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Critical comments on publications by S. Hoffmann and N. Vogt on historical novae/supernovae and their candidates

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Abstract

We critically discuss recent articles by S. Hoffmann and N. Vogt on historical novae and supernovae (SNe) as well as their list of "24 most promising events" "with rather high probability to be a nova" (Hoffmann et al., *AN*, 2020, 341, 79 (P3)). Their alleged positional accuracy of previously suggested historical nova/SN records is based on inhomogeneous datasets (Vogt et al.), but then used for the nova search in Hoffmann et al., *AN*, 2020, 341, 79 (P3). Their claim that previously only "point coordinates" for nova/SN candidates were published, is fabricated. Their estimate of expected nova detection rates is off by a factor of 10 due to mis-calculation. They accept counterparts down to 4–7 mag at peak, which is against the consensus for the typical limit of naked-eye discovery. When they discuss previously suggested identifications of historical novae, which they all doubt, they do not present new facts (Hoffmann, *MNRAS*, 2019, 490, 4194 (P2)). Their catalog of "24 most promising events" for novae (Hoffmann et al., *AN*, 2020, 341, 79 (P3)) neglects important recent literature (e.g. Pankenier et al., *Archeoastronomy in East Asia*, New York, Cambria, 2008 and Stephenson and Green, *JHA*, 2009, 40, 31), the claimed methods are not followed, etc. At least half of their short-list candidates were and are to be considered comets. For many of the others, duration of more than one night and/or a precise position is missing and/or the sources were treated mistakenly. Two "highlights," a fabricated SN AD 667–8 and a presumable recurrent nova in AD 891, are already rejected in detail in Neuhäuser et al., MNRAS, 2021a, 501, L1—in both cases, all evidence speaks in favor of comets. There remains only one reliable case, where close to one (possible) historically reported position, a nova shell was already found (AD 1437, Shara et al., *Nature*, 2017b, 548, 558). Since the proposed positional search areas are not justified due to unfounded textual interpretations (e.g. in fact comets), misunderstandings of historical Chinese astronomy (e.g. incorrect asterism), follow-up observations cannot be recommended.

KEYWORDS

novae, supernovae, comets

1 | INTRODUCTION: HISTORICAL NOVAE AND SUPERNOVAE

Within a few kpc around the Sun, there are several apparently young supernova (SN) remnants (SNR), some associated with pulsars, which should have formed in historical (pre-telescopic) time. And there is also a large text corpus on historical observations of transients, which should include SNe. Indeed, there are at least four more or less credible cases of historical SN observations with known nearby Galactic SNRs, namely in AD 1006, 1054, 1572, and 1604 (see Stephenson & Green 2002). In addition, for novae a few pairs (nova shells connected to historical records) were suggested (e.g. Shara et al. 2017b). Plausible connections of historical records with astronomical objects (remnants, shells) can be useful for astrophysical purposes; a precise time of explosion is the best age estimate for the nova or SN remnant (and a neutron star, if existing). Astrophysical age estimate and historical record can then support each other. Double evidence for a past event, each independently derived, supports both astrophysics and the interpretation of the transmitted records (e.g. really observed events).

Novae: Cataclysmic variables (CVs) are binary stars, where a low-mass star transfers material to a White Dwarf via an accretion disk; instabilities can lead to episodic accretion onto the White Dwarf yielding up to $\sim$100-fold brightenings for weeks to months (e.g. Chomiuk et al. 2021; Della Valle & Izzo 2020; Warner 1995) by conversion of gravitational to thermal energy—called "Dwarf Novae." It was suggested that White Dwarfs in all dwarf novae eventually accrete enough matter to experience a classical nova eruption (Shara et al. 1986). Hence, classical nova outbursts of dwarf novae could have happened in historical time—possibly seen by East-Asian court astronomers, who recorded many transients.

SNe: In addition to thermonuclear SNe of White Dwarfs (e.g. Type Ia), there are core-collapse SNe of massive stars—both types of SNe were seen by the naked eye as bright new stars for several months to more than a year. Reviews of historical SNe are found in Clark and Stephenson (1977) and Stephenson and Green (2002).

Connections of historical transients with SNe or novae are problematic in particular due to difficulties in the understanding of historical texts, which could be improved by transdisciplinary collaboration between astrophysicists, philologists, and historians—such a project is undertaken by us since 2012 under the name of *Terra-Astronomy* (see Neuhäuser et al. 2020). We have already studied various phenomena, for example, historical SNe (new Arabic records of SN 1006 in Rada & Neuhäuser 2015 and Neuhäuser et al. 2017a, 2017b as well as of SNe 1572 and 1604 in R. Neuhäuser et al. 2016b), comets in the

late 8th century (e.g. Chapman et al. 2014, 2015), and reconstruction of solar activity around AD 775 from aurorae and radiocarbon (e.g. Neuhäuser & Neuhäuser 2015). For a better understanding of historically given locations on sky, it can be useful to compare comet orbits derived from historical data alone with orbits extrapolated backward from telescopic observations, for example, for comet 1P/Halley (e.g. Neuhäuser et al. 2021b). In this article, we deal with suggested historical novae and SNe (Hoffmann et al. 2020; Hoffmann & Vogt 2020a, 2020b)—however, many of their candidates are not star-like, but obviously comets.

We discuss here records from East Asian court astronomers, using their nomenclature and system to specify locations on sky (mostly relative to Chinese asterisms and/or within lunar mansions); background is provided in Needham and Wang (1959) or Sun and Kistemaker (1997, henceforth SK97). Already in early drawings, stars in Chinese asterisms were connected by skeleton lines—reconstructions may vary in detail, see, for example, maps in Ho (1962) and SK97. Lunar mansions are right ascension ranges from one determinative star to the next, side by side, without the southern circumpolar region (invisible from China). The north polar region was called "Ziwei/Zigong yuan," one of three large enclosures. The identification of the determinative star of some asterisms is disputed or could have changed with time (e.g. SK97); the system of numbering the stars is not well understood.

Criteria are important to distinguish between different phenomena; they should be defined and selected such that fulfillment can be checked in historical records, that is, that pre-modern observers mentioned such properties: time, position, color/form/brightness, motion/dynamics, and duration. For the different physical phenomena (e.g. aurorae, comets, SNe, meteors), certain typical properties are to be used (Neuhäuser & Neuhäuser 2015 for aurorae and Neuhäuser et al. 2018b for meteors). Criteria are helpful to identify the physical nature of the observed event and to estimate its probability.

Stephenson and Green (2005) listed the following criteria for SNe in the context of discussing dubious cases of historical SNe (see also Stephenson & Green 2002):

  i. "long duration … (preferably more than three months),"
 ii. "fixed location" relative to stars,
iii. "low Galactic latitude (usually less than 10°),"
 iv. "no evidence of significant angular extent (… no indication of a tail),"
  v. "unusual brilliance (e.g. daylight visibility or brightness comparable to one of the brighter planets)," and
 vi. "several independent records."

The values on duration and Galactic latitude are approximate, exceptions are possible. Novae would fulfill similar criteria, but in particular somewhat shorter duration of visibility (e.g. Stephenson & Green 2009); they are also less bright compared to SNe if at the same distance; historical novae could be distributed all over the sky, because they are nearby (seen by the naked eye), as argued by Clark and Stephenson (1977), but they happen preferentially closer to the Galactic plane.

In Neuhäuser et al. (2018b, 2021b), we have suggested the following criteria for comets; even if several or most criteria are fulfilled, one always has to consider whether the whole story (plus possibly a drawing) is consistent with the classification:

i. timing: observed at night-time or twilight,
ii. position of first and/or last sighting: often close to the Sun, in or near the ecliptic,
iii. color and form: extension, for example, tail (typically white) directed roughly away from the Sun,
iv. dynamics/motion: motion relative to the stars, and
v. duration: several nights to many weeks.

In this paper, we critically discuss recent publications (Hoffmann 2019; Hoffmann et al. 2020; Hoffmann & Vogt 2020a, 2020b and Vogt et al. 2019) on historical East Asian guest stars, where they mainly aimed at identifying nova candidates. However, as we will show, there are many strong shortcomings in their work.

While the authors of the papers discussed here by Vogt et al. (2019) and Hoffmann (2019) in their acknowledgments mention that one of us (RN) has participated (actually started, designed, assembled team and collaborations, etc.) in those studies, he is not a co-author of those publications, because he did not agree with the methods as applied, nor with the results and conclusions (as mentioned in the acknowledgments of the first two papers). The main editor of the journal of the first (and third) paper, therefore, invited us to write up our arguments. This is presented here. In Section 2, we discuss the first two papers on previous historical SNe and novae (Hoffmann 2019; Vogt et al. 2019), in Section 3 additional papers on their nova suggestions (Hoffmann et al. 2020; Hoffmann & Vogt 2020a, 2020b), and in Section 4 we finish with a summary and final remarks.[1]

Neuhäuser et al. (2021a) have shown in detail that the sources used for two of the highlights in Hoffmann and Vogt (2020b), namely a presumable new historical SN AD

667-8 and a recurrent nova in AD 891, both obviously pertain to known comets.

2 | PAPERS BY VOGT ET AL. 2019 AND HOFFMANN 2019 ON PREVIOUSLY SUGGESTED HISTORICAL (SUPER-)NOVAE, ETC.

We comment here only on major problems in Vogt et al. (2019, henceforth P1) and Hoffmann (2019, henceforth P2), but partly also on Hoffmann, Vogt, Protte (2020, P3), and Hoffmann and Vogt (2020a, P4): mainly on the positional uncertainties not considered (Section 2.1), the claim on *point coordinates* raised in P1 and P2 (Section 2.2), problems in their treatment of historical novae suggested so far (Section 2.3), erroneous assumptions regarding the limiting magnitude in naked-eye discoveries of new objects (Section 2.4), and significant errors in their arithmetic (factor 10) and arguments regarding the expected number of novae among historical archives (Section 2.5). The first paper (P1) is motivated by a question posed by one of us (RN) to N. Vogt in 2016: How many novae are to be expected in historical archives based on our knowledge on novae and CVs from the telescopic era? First results were presented in a poster paper (Vogt et al. 2018), partly included in a review on SNe and novae (Pagnotta et al. 2020), part of Focus Meeting no. 5 at the International Astronomical Union (IAU) General Assembly 2018 (see Neuhäuser et al. 2020 for a summary).

2.1 | Positional accuracy of modern and historical SN/nova positions

In P1, positions of historically observed guest stars (reference given as Stephenson 1976) are compared with "modern counterparts of old supernovae, their coordinates given in the SIMBAD data base were used" (P1 section 2)—similar as done before by Nickiforov (2010). Coordinates of SNR are often relatively rough with significant differences between the SN location on one hand and explosion center or pulsar path on the other hand—indicating significant asymmetries (e.g. Bailes et al. 1989 for Vela, Rest et al. 2011 for Cas A, Fesen et al. 2008 for G130.7 + 3.1, suggested for SN 1181)—exact references and the method of positional determination (geometric center? emission peak? light center? which wavelength?) for the SNRs are not given in P1; in any case, the modern SNR coordinates are very inhomogeneous, which is neglected in P1.

Positions of guest stars derived from the diverse historical transmissions have even larger uncertainties and vary

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[1]The papers by Vogt et al. (2019), Hoffmann (2019), Hoffmann et al. (2020), and Hoffmann and Vogt (2020a, 2020b) were submitted without the consent of RN and after the participation of SH in the project had been terminated in a mutual agreement between RN and SH in February 2019.

strongly from case to case. This applies to both novae and SNe.

Regarding SNe, P1 uses the events in AD 185, 386, 393, 1006, 1054, 1181, 1572, and 1604. Stephenson (1976) and Stephenson and Green (2002) wrote that only SNe 1604, 1572, 1054, and 1006 would have secure identifications between historical observations and SNR positions—while SN 1181 and those from the first millennium would be far less certain. For example, for the guest star in AD 185, several different SNRs are still being discussed; for SN 386, an alternative SNR was suggested by Zhou et al. (2018). Hence, conclusions from all eight are misleading. Furthermore, the positions in Stephenson (1976) used in P1 were meant only approximate ($\pm$ several degrees, see Section 2.2).

Still, P1 conclude on a positional accuracy of $0.3 - 6.8°$ for SNe (P1 section 2, P1 table 1) and similar for novae: $0.5 - 11.1°$, or without one outlier, $0.5 - 5.2°$ (P1, table 2).

In P3 there is another comparison between modern SNR positions and presumable historical positions, now those derived by P3 (see critique on their method in Section 3), again eight historical SNe as in P1. Regarding the records on historical SNe, P3 uses the texts in Xu et al. (2000), "the most comprehensive" (P3, section 3.1)—however, for example, for SN 1006, Xu et al. list six records, while in Stephenson and Green (2002) we can find about 26 East-Asian records (many from Goldstein 1965 and Goldstein & Ho 1965). Again, it is not specified, which wavelength or reference is used in P3 for SNR positions (P3 Table 6 gives SNR G315.0-02.3 for SN 185, while Stephenson & Green (2002) discuss three SNRs and do prefer G315.4–2.3, whose Galactic coordinates for J2000.0 are 315.4168° and −2.3639°). In addition, when P3 compares SNR coordinates with historical positions by others (Table 4), they use positions from Stephenson (1976) (given by them as "Steph.+") and completely negate the extensive discussion and revision in Stephenson and Green (2002).

In their Tables 5 and 6 (P3) some coordinates, in particular, the declinations, are given unnecessarily to the fourth digit after the comma (in degrees), while the error circle radii are $1 - 6°$ (and the offsets to those radii being up to 6°). The offsets from their historical positions to the SNR positions listed in their Table 6 are not the difference between the center positions, but "the distance of the post-supernova object to the circumference" (section 3.1), that is, to the error circle, instead of the position. Then, the measured offsets are up to 6° (SN 1006); this value is then excluded as uncertain, and the maximum offset of 4.5° (SN 1572) is given in the abstract (P3). The offsets between their positions and the SNRs are in fact larger than the values listed in their Table 6; for example, in case of SN 185, they specified in section 2.4 (and in Table 5) that the error circle

has a radius of 6°, so that the offset between their position and (one of the suggested) SNR(s) is in total 8°, similar for SN 1181 in total 7°, for SN 1572 6.5°, etc. (P3 Tables 5 and 6). A value of up to 4.5° as given in section 4 and abstract (P3) is misleading—and used in P3 and later papers as argument for the size of the radii of their error circles of nova candidates (clearly underestimated).

In general, their (P1 and P3) treatment of historical SNe is very unsatisfactory, for example, the positions derived are not discussed, in particular, not under consideration of the state-of-the-art.

Finally, in Hoffmann and Vogt (2020b, henceforth P5), Table 2, they acknowledge that only for four historical SNe the identification of an SNR is considered "certain," namely SN 1006, 1054, 1572, and 1604—however, neither in the associated section 2.5 nor elsewhere in that paper, there is a redetermination of the presumable typical or maximal offset, which would then be based only on three SNe, since SN 1006 was excluded. To apply such offsets to their nova searches (P3–P5) is unjustified.

2.2 | Point coordinates?

In all papers by Vogt and Hoffmann discussed here, the authors claim that "they give point coordinates (centers of circles)" (P3, Figure 2). With "they," they mean in particular Hsi (1957a), Xi and Po (1966), Pskovskii (1972), Stephenson (1976), and then also "e.g., Shara, Patterson Kemp, … " (P2 Figure 13). In P3 (abstract), they claim that their search areas "should replace the single coordinate values given by previous authors." That previous scholars would have given coordinates without error bars (i.e. point coordinates instead of search areas), is clearly incorrect. P2 presented as their "result" that the positions of historical guest stars, for example, those from Stephenson, should be seen as areas, not points (P2 abstract)—they were never meant as point-coordinates.

Stephenson (1976) explicitly gave "approximate RA and Dec for 1950.0" and all Galactic coordinates l and b given in their Table 1 are dividable by 5, that is, they are given to the next best 5° (also for declination), so that their positional precision cannot be better than typically $\pm 5°$ in one or $\pm$5-7° in two dimensions. Stephenson (1976) also pointed out that one of the new stars seen in AD 1592 might have been Mira, but the position was "no better than about 10°," and he remarked on "the poor positioning of such stars in general."

P1 uses the coordinates from Stephenson (1976)—for historical novae it cites only Stephenson (1976), but not Stephenson and Green (2009), the latter with an updated list of many historically observed transients considered nova candidates given by them with "approximate

celestial coordinates"; and for historical SNe, P1 cites only Clark and Stephenson (1977), but not Stephenson and Green (2002).

In the PhD dissertation of Yau (1988, pp. 92-94, 114), under the guidance of F.R. Stephenson, available online and mentioned in P2 (in their Figure 3, but not in their reference list), the individual positional measurement uncertainties are explicitly given for all their candidates for novae, etc., sometimes error bars ($\pm$), sometimes coordinates for search areas, or spherical polygons.

Some more counterexamples regarding the claim by P1–P3 on "point coordinates" by others: for the "guest star" of AD 70, Stephenson and Green (2009) give "RA from 9 h to 10 h 20 m and in dec from +10 deg to +40 deg … galactic latitude … about +40 to +55 deg." For the "guest star" of AD 722, Stephenson and Green (2009) give "RA is from 0 h 40 m to 3 h 30 m and in dec from about +50 to +70 deg. The galactic latitude covers the range from about +10 to −15 deg." From such examples, it becomes clear without doubt that they did mean search *areas* (often spherical polygons), not point coordinates.

That Stephenson never claimed to publish "point coordinates" becomes obvious also from the fact that positional search fields are plotted for guest star positions, for example, Figures 7.3 and 7.6 for SN 1006 and Figures 10.3 and 10.5 for SN 1572 in Clark and Stephenson (1977), also Figure 9.3 in Stephenson and Green (2002). See also the search areas plotted for three transients in Stephenson (1971).

In addition, Hsi (1957a, 1957b) and Xi and Po (1966) meant *areas* and not *point coordinates*, as becomes clear from, for example, the fact that they suggested radio sources as counterparts to 11 of their nova/SN candidates—most with several degrees offset (Xi & Po 1966, Table 2).

2.3 | Previous identifications of historical transients as novae

P1 studies the separation range between remnant positions and historically transmitted positions not only for SNe, but also for novae. P1 discusses the suggestions for BC 77, AD 101, 483, 1437, and 1645. From those five cases, P1 concludes that the separation range, that is, allegedly the positional accuracy in historical transmissions of (dwarf) nova outbursts, would be 0.5 to 11.1° (or up to 5.2° by omitting one outlier). However, P2 argues that those five historical nova suggestions would be highly dubious: "none of the cases of CVs suggested to have a historical counterpart can be (fully) supported. Because the identification of the historical record of observation with the CVs known today turns out to be always uncertain … " (P2, abstract).

Then, any conclusion regarding those nova candidates in P1 would be unjustified—but P1 and P2 were submitted within 1 week.

Furthermore, while P2 does discuss two published modern counterpart suggestions for the guest star of AD 101, P1 considers only one of these two.

Next, we discuss some problems in P2, which should have been a critical examination of the previously suggested identifications of historical novae. However, the whole paper does not contain any new results, but mainly repeats other publications (partly incorrectly presented, partly long verbatim quotations from other modern papers), and the presumably new considerations in P2 are unfounded speculations. We present here a few examples; the records in BC 48, AD 101, and 1437 are also discussed below in Sections 3.1 and 3.2, because they are among their 24 most promising nova candidates (P3).

BC 48: "a guest star as large as a melon with a bluish-white color about four chi east of the 2nd star of Nandou."

Göttgens et al. (2019) presented a nova shell in M22, connected it to the guest star of BC 48 (given without a duration), and estimated the peak magnitude of the historical nova from the distance toward M22 and the typical absolute magnitude of novae to be 5.5 ± 1.4 mag. However, such a faint star cannot be seen with color ("bluish-white"), and it would not be described with the rare phrase "as large as a melon." These arguments were not mentioned in P2 and also overseen in Göttgens et al. (2019). For further discussion of the position, see Section 3.1.

AD 101: the guest star of AD 101 is reported to be located "in the space of the 4th star of Xuanyuan" (Xu et al. 2000), also without a reported duration. Depending on whether one would count from the north-west end or from the main star (α Leo) of Xuanyuan, the fourth star is either α Lyn or ζ Leo. The latter was preferred in the dissertation by Yau (1988) under the guidance of F.R. Stephenson, but completely neglected in P1—even though Yau (1988) is mentioned in P2 (Figure 3). Hertzog (1986) and Patterson et al. (2013) suggested the CV BK Lyn near α Lyn as counterpart. While in P3 Table 3 (and Figure A.8 in P4), the two positions for the two alternative possible counting in Xuanyuan are given, P2 already excluded one of them (but unjustified, see Section 3.1 footnote 14).

In P2, the asterism Xuanyuan as displayed in the Suzhou map in Figure 2 shows 14 stars from α Leo to the north-west, while in P2 Figure 3, drawn by SH, Xuanyuan has here only 13 stars (one star is missing; this is also the case in Figure 9 in P3)—it is a consensus that there are 14 stars from α Leo to the north-west plus three more south of α Leo. The Suzhou map in Figure 2 also shows that the exact identification of some of those 17 stars in Xuanyuan

does not seem to be so clear: the representation in the right part of Figure 2 is different in several cases compared to the Suzhou map on the left, for example, for the 5th and 12th star when counting from the north-west. The positions called "my interpretation" (P2, caption to Figure 3) are the interpretation of Yau (1988) for "suggestion 1" around ζ Leo, and of Hsi (1957a, 1957b) for "suggestion 2" around α Lyn; Yau (1988) is missing in the reference list of P2, but "Yau" is written within P2 Figure 3. For further discussion of the position, see Section 3.1.

AD 483. "Guest star east of Shen as large as a peck measure and like a fuzzy star" (Xu et al. 2000).

This transient was connected to Te-11, first classified as Planetary Nebula, then considered an unusual nova shell (Miszalski et al. 2016). Stephenson and Green (2009): "A position to the east of Shen would have a galactic latitude of between about 0 and −10°. However, the uncertainties in position would be much too large to identify a remnant, even if we could be sure that the guest star represented a stellar outburst. The fact that the guest star had a significant angular extent and *it was like a bushy (star)* strongly suggests that it was a comet." P1 and P2 do not even cite Stephenson and Green (2009). Miszalski et al. (2016): "The reference to a *fuzzy star* might be thought to indicate a comet, but Nickiforov (2010) finds that many of the fuzzy star descriptions cannot refer to comets and must be novae or supernovae." However, the conclusion by Nickiforov (2010) based on just four objects is clearly unfounded: He argued that the "fuzzy star" (in Zhen) observed sometime in the lunar month 275 Jan 14 to Feb 12 would have an elongation of $135 - 160°$ from the sun by assuming that "Zhen" would point to the asterism of that name (roughly Corvus), but it could also be the lunar mansion of that name (which is usually meant in the Jin shu source). Then, he argued that the "fuzzy stars" in BC 204, AD 158, and AD 269 are all at a relatively high ecliptic latitude, so that it would be statistically unlikely that they are comets, but no statistics nor details are given (the AD 158 event is only in the Korean Samguk Sagi of AD 1145, often uncertain according to Kronk 1999). However, a lot of comets have appeared at high ecliptic latitude (see, e.g., Kronk 1999 with comets in Boo, Dra, UMa). Furthermore, Pankenier et al. (2008) wrote that the term translated as "fuzzy star" (actually "star became fuzzy") is "entirely consistent with cometary records where it is generally used to describe the appearance of tail-less comets or the changed aspect of a comet that has grown a tail." As in Nickiforov (2010), P3 also uncritically accepts "fuzzy stars" as nova candidate, see our Section 3 for methods.[2]

AD 1437: "A guest star first appeared between the 2nd and 3rd stars of Wei (LM 6). It was nearer to the 3rd star and separated from it by about half a chi. It lasted 14 days in all" (Xu et al. 2000 for AD 1437).[3] Shara et al. (2017b) found a nova shell nearby, and the ground-based proper motion of its central star would be consistent with it being near the center of the shell by AD 1437.

P2 gives and compares the Gaia proper motion of the CV with the ground-based values: "The parallax measured by Gaia is 0.9602 ± 0.0483 mas, leading to a distance of the CV of 1.041 ± 0.0523 kpc. This means that the nova shell with a radius of about 50 arcsec or 0.82 light-years … "; here, the parallax π was converted naively to distance in pc by $1,000/\pi$[mas], even though the proper estimation under consideration of the prior had been published already by Bailer-Jones et al. (2018), who gave $1,014^{+54}_{-49}$ pc for this star, so that the prior is relevant. (With the Gaia EDR3 data, the photogeocentric distance is now 988^{+37}_{-36} pc, see Bailer-Jones et al. 2021.) Then, P2 continues: "the proper motion of the CV measured by Gaia DR2 is only a third of the proper motion μ measured by Pagnotta in Shara et al.," that is, from the ground (P2, section 3 before 3.1), then: "for reasons of the variability of a CV and the nebulosity around this particular star, it is very possible that the Gaia data in this case are erroneous." Such statements leave the reader completely perplexed: why should variability and a nebulosity affect the Gaia data, but not the ground-based data? One should consider the measurement uncertainties: the Gaia PM is several σ different from the ground-based values. Why are the Gaia flags and the goodness of the fits not considered? This treatment of the proper motion is extremely unsatisfactory. The effect of the Gaia data on the connection between the CV and the shell was previously considered by Bond and Miszalski (2018), who noticed that the Gaia proper motion is still "in a direction approximately consistent with their (Shara et al.)

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[2]We comment here briefly on the guest-star work of Nickiforov (2010), because it has also been used for unjustified conclusions: While it is a useful approach to study the credibility of the transient records from

East Asia by their Galactic distribution, the paper by Nickiforov (2010) is unsatisfactory, because some basic standards are missing by classifying the transmissions as novae: (i) no source and text critique, no consideration that the texts are (late) compilations, (ii) mis-understanding of lunar mansions as asterisms (and localization of all transients at the determinative star of that asterism), (iii) incorrect claim that "fuzzy stars" would often not be comets, and also incorrect interpretation of all "guest stars" as novae, and (iv) overinterpretation of records without duration. With a proper treatment of those ~100 records (his appendix), there would have been no contradiction regarding the distribution of novae around the Galactic plane. His conclusion that the East Asian records would not be reliable is not justified, see, for example, many reliable reports about comet 1P/Halley, historical SNe, planetary conjunctions, etc.

[3]When Xu et al. add "(LM 6)," they point out that the mentioned asterism name "Wei" (in what we consider the tail of Sco) is also the name of a lunar mansion, namely that of LM 6.

scenario, especially if the nebula itself has a smaller proper motion in the same direction as the star," not cited in P2.

The suggestion in P2 that the 14-night duration would be a combination of first the appearance of a "guest star" in Sco for maybe only one night, and then 14 nights later a conjunction of Jupiter and the moon, is completely unsubstantiated, no examples for such misleading concatenations are known.

The identification of the "guest star" depends on the counting of stars in the asterism Wei; P2 rejects the suggestion by Shara et al. (2017b) and Stephenson and Green (2009), but the arguments in P2 are not justified—see our detailed discussion in Section 3.1 under AD 1437 (1437 being one of the "24 most promising events" of nova candidates in P3).

AD 1645: "a large star entered [ru] Yugui," no duration is mentioned (Xu et al. 2000).

Yugui could be meant as asterism or lunar mansion (LM 23). There is a nova shell (AT Cnc) detected within the lunar mansion Yugui, but not in or close to the asterism Yugui, suggested by Shara et al. (2017a) to be connected with the object detected in AD 1645; they prefer the interpretation as asterism, because "xiu" (lodge) as indicator for lunar mansions is not given—but there are many instances, where clearly the lunar mention is meant, even though "xiu" is not given (e.g. Pankenier et al. 2008 on comets). They also mention that the source for this text, the Chungbo Munhon Pigo, "is not a very reliable source," but has dating errors in the 17th century. P2 does not discuss these problems nor the term "entered." P2 on AT Cnc: "… a 3-arcsec shell around the object (Shara et al. 2012)" (section 4), but the shell has a diameter of 3 arc min (Shara et al. 2017a section 1). Stephenson and Green (2009) argue that, because first appearance of transients is usually given with Chinese terms like "jian" (was seen/appeared) or "chu" (emerged), the term "ru" for "entered" would indicate a movement; the wording "large star" could also point to a comet.

In sum, given that P2 state that all five previous identifications of historical guest stars with modern novae, CVs, etc. would be dubious, any conclusions on novae in P1 based on these five cases would be unjustified.

2.4 | Limiting magnitude of "guest stars"

P1 claims that Chinese astronomers could discover guest stars down to fourth or even fifth magnitude. It is clear that a guest star, once noticed, can be followed and observed until it reaches the naked-eye limit of about 6th mag, but it is different for the discovery.

Previously, Clark and Stephenson (1977, p. 51) gave 1–2 mag, Hertzog (1986) found 2 mag as limit, Strom (1994) 1.5 mag for SNe, and Stephenson and Green (2009) "significantly brighter than +2." None of the historical SNe (or novae) discussed so far in the literature, for example, Stephenson and Green (2002, 2009), are known to have been fainter than 2 mag at discovery or at peak (e.g. Stephenson & Green 2002, 2009). (Exceptions may be possible in very systematic monitoring and at prominent celestial positions, for example, near stars regularly observed or in dark areas.) No examples of confirmed SNe or novae with peak fainter than 2 mag are known.

From the fact that Mira might possibly have been detected in AD 1070 and/or 1592 (maximum 2–4 mag), P1 (section 4) claims that "there is no reason to believe that they (Chinese astronomers) were unable to detect new guest stars down to the fifth magnitude … " (section 6).

Clark and Stephenson (1977) gave the opposite conclusion: from the fact that at most one or two possible Mira records by pre-telescopic East-Asian astronomers were found, that is, detections at maximum light (2nd mag, then the brightest star in its area, but every ~11 months, i.e. many maxima in the 2222 yr studied by P1), they consider the limit for naked-eye discovery to lie at 1–2 mag (Clark & Stephenson 1977, p. 51). In addition, Strom (1994) concluded from the absence of Mira maxima in historical archives that the detection limit is around 1.5 mag. (In P5, we are then surprised to read "the nature of an event [guest star] remains always uncertain. We already excluded the currently known Mira stars because of their faintness"—now, Mira star maxima are considered too faint for naked-eye detection?)

It is also not certain whether the records from AD 1070 and 1592 pertain to Mira—whether (or when) Chinese court astronomers were interested in (semi-)periodic variability of stars like Mira is not clear.

In their section 4, P1 mentioned "Nova Vulpeculae 1670 … identified with CK Vul" with a peak magnitude of 2.5–3 mag for 10 days in 1671 as observed in Europe by, for example, Hevelius (July 1671) and Cassini (1671), that is, after the invention of the telescope. CK Vul is now considered a merger of a White Dwarf and a Brown Dwarf (Kaminski et al. 2015) instead of a nova. P1 did not mention that this guest star was not detected by the professional Chinese court astronomers, neither in 1670 nor 1671, it is not listed in, for example, Xu et al. (2000) nor Hsi (1957a, 1957b), which both end in AD 1690. The non-detection by Chinese astronomers appears to be a contradiction to the claim in P1 that the typical limit for naked-eye discoveries of guest stars could lie at 4 or 5 mag—in particular given the fact that CK Vul lies between the important Tianshi enclosure and the Tianjin

asterism (our Cygnus), in the middle of the summer triangle (Deneb, Altair, Vega).

P1 mentioned in section 4 the Mira-like variable χ Cyg to be located 4.8° off the position of a transient observed on AD 1404 Nov 14 as given in Stephenson (1976).[4] P1 did not mention the observation dated AD 1408 Oct 24, which is listed in Xu et al. (2000)—with the same position (both "SE of Niandao"), brightness (both "shiny bright"), color (both "yellow"), and dates (both "10th month, day 17"). (P1 did not cite the guest star catalog of Xu et al. (2000) at all.) P1 also mention that χ Cyg would reach a maximum at 4 mag (~3.5 mag at AAVSO). Already Nickiforov (2010) pointed to the fact that a transient has a certain minimum brightness, when a color is mentioned—a "yellow" color cannot be detected at 3.5–4 mag. P1 do not consider the pulsation period of χ Cyg (405–409 days, Sterken et al. 1999), which would not be consistent with two detections almost 4 years apart. The identification of the object of AD 1404/08 with χ Cyg is not convincing.[5]

P1 does not mention the extensive discussion of this object in Stephenson and Yau (1986) with positional error box polygon and Stephenson and Green (2002, pp. 208–213), who discuss further sources, also from Japan, and show that the AD 1404 record is a misdated erroneous copy of the AD 1408 observation, and come to the conclusion that the observed object was probably a meteor or bolide ("did not move," i.e. head-on); one of the arguments being that the records do not mention any duration, so that it could be all within just one night. The fact that the object is called "like an oil-cup of a lamp" shows that it was extended, that is, very bright; "Zhou Bo" also means that it was very bright and yellow, as given explicitly.

There is no evidence that Chinese astronomers regularly could discover new stars at 4–5 mag. Even trying to restrict this limit to areas of asterisms (P1) does not work, because, for example, χ Cyg is very close to the southernmost (17 Cyg) of five stars of the Chinese asterism Niandao.

The fact that records on CK Vul, Mira, and Mira-like variables like χ Cyg (but also β Per 2.1–3.4 mag, δ Ceph 3.3–4.4 mag, β Lyr 3.0–4.4 mag, ranges from American Association of Variable Star Observers (AAVSO)) from the

many pre-telescopic maxima are obviously missing, would be consistent with a discovery limit around 2 mag.

In the paper by Strom (1994), cited otherwise by P1, we find: "to be detected an object had to reach at least V = 1.5 mag. This is consistent with, and to some extend supported by, the fact that not one of the 12 novae with V < 5 mag observed in Europe between 1600 and 1900 (Payne-Gaposchkin 1957) were recorded in the Chinese chronicles (Ho & Ang 1970), even though they include objects as bright as V = 2.0 (T CrB 1866) and 2.6 (CK Vul 1670)." The only comment by P1 on this argument by Strom (1994) is the claim "that the time overlap between ancient Far Eastern and modern European observations was too short to allow statistically significant results in their comparison" (P1 section 4)—apart from the fact that observations from AD 1600 to 1911 are not "ancient," ~300 years of overlap (until 1911) is definitely statistically more significant than the 100 years of telescopic nova studies by Duerbeck (1990) used in P1 to derive the nova rate down to certain magnitude limits (their Table 3).

NB: In P4, we can read "a new star up to 4 mag would have been realized by the ancient naked-eye astronomers with considerable likelihood" (section 2) plus footnote 2: "This hypothesis derived from historical catalogues is confirmed by the observational experience of one of us (SH)"—to be able to see normal stars down to 4 mag or even fainter cannot be a serious argument. In P4, we can even find "we consider only novae with peak brightness $m < 7$ mag as possible counterparts" (section 2)—now 7 mag!

We consider the typical magnitude limit for discovery of a new star to lie at ~2 mag as consensus.

2.5 | Expected nova detection rate in historical archives

P1 claim that "more than 100 guest star observations have been obtained by Chinese, Korean, Japanese, and Vietnamese astronomers between ~600 BCE and ~1,690 CE" (abstract); neither in the abstract nor in the remaining text, they give a reference for this number; it should probably pertain to novae, possible including also SNe. Given the time range, it might be based on 90 entries in Hsi (1957a, 1957b) and 75 entries in Clark and Stephenson (1977, pp. 46–49), both for nova and SN candidates, but that would both be less than 100; Xu et al. (2000, pp. 328–338) list 106 Chinese records, compiled as possibly star-like, stationary transients, but that catalog is not cited in P1. All these catalogs certainly include some comets. P3 (Figure 3 caption): "Coordinates of historical novae according to Hsi, Xi and Po, Pskovskii and Stephenson+ ... A higher abundance of records even

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[4]"Emperor Chengzu of Ming, 6th year of the Yongle reign period, 10th month, day gengshen (17). In the night, at the zenith, southeast of Niandao, there was a star like an oil-cup of a lamp. It was yellow and shiny bright. It emerged but did not move. It was said to probably be a Zhou Bo, a star of virtue" (Xu et al. 2000, p. 142).

[5]Li Qi-bin (1978, 1979) found two more records of this event in six different local gazettes misdated by 2 months, concluded that "all records refer to the same event," but then suggested that it is related to the nearby high-mass X-ray binary Cyg X-1—Imeda and Kiang (1980) followed suit—not justified given the discussion in Stephenson and Green (2002, pp. 208–213).

outside the Milky Way, that is, in areas of few stars, occurs along the ecliptic."

In Tables 3 and 4, P1 tries to estimate the number of naked-eye novae within the studied time range (2,222 years) by first estimating the number of novae with a maximum brighter than some limit (2, 4, 5 mag) from CV astrophysics (table 3) and then comparing with naked-eye novae in the last few centuries (table 4). Apart from the fact that the uncertainties in table 3 are all several orders of magnitude each, so that conclusions with better precision are not possible, there are also clear errors in the arithmetic in P1 by going from table 3 to table 4: in table 3 (last line), there are supposedly 300 novae down to 2 mag, 1,860 to 4 mag, and 4,760 to 5 mag—all for a time range from BC 532 to AD 1690, that is, a total of 2,222 years. Then, in table 4 (2nd line), there is the "rate of novae per century from CV density (Table 3)": 1.4 novae down to 2 mag, 8.4 down to 4 mag, and 21.4 down to 5 mag—obviously too small by a factor of 10, for example, 300 in 2,222 years from Table 3 are 13.51 per century, not 1.4. In P3, yet different numbers are given: "we expect a few ($\sim$5) to a few 100 ($\sim$430) novae per century … (Vogt et al. 2019)"—without precise justification (but again partly for too faint magnitudes like 4 or 5 mag, P3 Table 1).

Then, also in section 4, P1 lists a few incompleteness factors for historical archives and write that it would be "hardly possible to estimate the influence of all these factors exactly"; next, they assume an incompleteness factor of 10 and write that they would then "expect $\sim$30 to $\sim$480 sightings of classical novae during the 2,222 years covered," obviously by dividing the numbers in the last line of table 3 by 10, that is, $\sim$30 novae in 2,222 years brighter than 2 mag and $\sim$480 brighter than 5 mag. This is to be compared to the number found in historical archives: $\sim$100 potential nova guest stars.

Regarding the incompleteness, P1 also claim in footnote 3 that the completeness estimate of Strom (1994) would not be applicable here—but that is not justified: Strom (1994) estimated the incompleteness of historical SNe by comparing the numbers of historical naked-eye (i.e. volume-limited) SNe so far (8) with the number of young SNRs within the same distance (10), seven of which are in common, which immediately yields a completeness of $\sim$70% (Strom 1994). And by comparing the numbers of guest stars recorded independently in Japan and China, and their overlap, Strom (1994) obtained a completeness of "67% of naked-eye novae, SNe, and comets"—footnote 3 in P1 is misleading.

We come back to the original question posed by one of us (RN) to the first author in P1 (NV), as to how many novae are to be expected in historical archives based on our current knowledge on novae and CVs from the telescopic era: (a) if three novae (plus one SN, namely 1604)

not fainter than 2.0 mag happened in $\sim$300 years up to 1911 (V841 Oph, 1848, V = 2.0 mag; T CrB, 1866, 2 mag; GK Per, 1901, 0.2 mag; see also Payne-Gaposchkin 1957), then we expect a total number of $\sim$22 novae within 2,222 years—of which 67% are expected in historical archives from East Asia (Strom 1994), that is, about 15 novae (+ 5 SNe); or (b) with 7 novae not fainter than 2.0 mag in 100 years up to 1990 (GK Per 1901, V603 Aql 1918, V476 Cyg 1920, RR Pic 1925, DQ Her 1934, CP Pup 1942, and V1500 Cyg 1975; see Duerbeck 1990), of which 67% should have been noticed by the naked eye (Strom 1994), we expect $\sim$104 nova records within 2,222 years. Since the former estimate (300 years) is statistically more significant than the latter (100 years), and since it gives the correct order-of-magnitude for SNe, the real number of naked-eye novae in the archives will probably be closer to $\sim$15 than to $\sim$104. This is to be compared to the number of candidates: Stephenson and Green (2009) have $\sim$50, while Hsi (1957a, 1957b), Ho (1962), Stephenson (1976), Clark and Stephenson (1977), and Xu et al. (2000) list up to $\sim$100 for about the same time span—and they all include some comets and other non-novae (see e.g. AD 891, Neuhäuser et al. 2021a).

In their Figure 2, P1 displayed magnitudes of stars presumably seen by the naked eye in China (1385–1450 stars in 283 asterisms, 45 at 7th and 8th mag) and in the ancient West (1,025 stars in 48 constellations, just 1 fainter than 6th mag)—but they give neither references for these data (probably Ptolemy's Almagest for the West) nor do they mention problems with the identifications, in particular, of the fainter stars (strong differences in the identifications between, e.g., Ho 1962 and SK97).[6] For example, Pliny the Elder (AD 23–79) mentioned "1,600 stars being remarkable."[7] The comparison in P1 is anyway misleading: while Ptolemy listed measured ecliptic longitudes and latitudes, as well as magnitudes together with descriptions of which stars he meant, the Chinese astronomers listed asterisms and published positional measurements only for a small subset of stars.

3 | PAPERS BY HOFFMANN ET AL. (2020) AND HOFFMANN AND VOGT (2020A,B) ON SUGGESTED HISTORICAL (SUPER-)NOVAE, ETC.

The paper by Hoffmann, Vogt, Protte (P3) presents a catalog of "24 most promising events" of historical transients

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[6]According to the identification of Ptolemy's stars in Verbunt and van Gent (2012), two stars are fainter than 6.0 mag, namely k Psc with V = 6.1 mag and 46 Vir A with V = 6.07 mag (Simbad).

[7]Nat. Hist. I, 101: "the heavens, divided as they are into 72 constellations … In these they have announced 1600 stars, as being remarkable either for their effects or their appearance," citing cumulatively among others Hipparchos and Eudoxos, English Bostock and Riley (1855).

suggested as nova candidates and similar (P3), possible counterparts are discussed in P4 and P5. We comment on their method and all their individual cases, but not on all problems.[8] P3 section 4 summarizes their results with the following statement: "we selected a list of 25 events (in 24 years …) with a rather high probability to be a nova." We will show that many of their suggested candidates are something else, not novae, often obviously comets.

3.1 | SN/nova candidates in Hoffmann et al.

In P4 (section 1), we find as follows: "we applied three selection criteria as stated in HVP2020 [P3]:

i. Transients with a given duration … or
ii. transients with a well-defined position given, that is, next to a single star … and
iii. not already suggested as SN or comet."

In P3, we find in the abstract: "we selected those without movement and without a tail (to exclude comets) and which was not only visible within a certain hour (to exclude meteors)."[9]

We will consider the "24 most promising events" of historical transients (actually 25 events in 24 different years) as listed in P3 tables 2 and 3 (table 2 does not include AD 101 and 369, which are listed in table 3). Table 2 in P3 has 23 entries for 23 years and table 3 in P3 has 26 events in 25 years. We consider the events listed in P3 table 2 plus AD 101 (as in P3 table 3 and P4 tables 1 and 3),[10] they are based only on Ho (1962) and Xu et al. (2000). See our Table 1.

Ho (1962) listed events, which could in principle be comets or (super-)novae from the Chinese text corpus (until AD 1600). Xu et al. (2000) revised this compilation

TABLE 1 The 24 presumably best events for historical novae in Hoffmann et al. (2020) and Hoffmann and Vogt (2020a, 2020b) and some of the problems

Year	Comment (for details, see text)
BC 204	"xing bo" = "star became fuzzy"
BC 104–1	"xing bo" = "star became fuzzy"
BC 48	No duration given, position uncertain
BC 5	"hui xing" = "broom star"
AD 64	"bright vapor 2 chi … long"
AD 70	Very rough position
AD 101	No duration given, position uncertain
AD 329	"xing bo" = "star became fuzzy"
AD 641	"xing bo" = "star became fuzzy"
AD 667	"hui xing" = "broom star" AD 668 (1)
AD 668	"hui xing" = "broom star" (1)
AD 683	"hui xing" = "broom star"
AD 722	Very rough position
AD 840	"hui xing" = "broom star"
AD 891	Last sighting of a known comet (1)
AD 1175	"xing bo" = "star became fuzzy"
AD 1430	Maybe 2 positions or events (?)
AD 1431	"hui xing" = "broom star" (2), "Hanyu star"
AD 1437	(Nova shell nearby, Shara et al. 2017b)
AD 1461	"star … turned into white vapor" 4 nights
AD 1497	Wrong asterism in P3–P5 (3)
AD 1592	See, for example, Stephenson and Yau (1987)
AD 1661	Uncertain position, could be LM
AD 1690	"anomalous star" 2 nights

Note: (1) Detailed discussion in Neuhäuser et al. (2021a). (2) This "broom star" record in Xu et al. (2000) is missing in P3. (3) The record used in P3 says that the object was seen only "at dusk," so that it should have been excluded by their own (P3) criteria.

and concentrated on probably stationary stellar events (until AD 1690). Pankenier et al. (2008), the same team as Xu et al. (2000), revised and extended the Ho (1962) compilation on apparently non-stationary objects ("comets" and "meteors"). There are still overlaps between those from Xu et al. and Pankenier et al., and the latter also partly revised Xu et al. These authors compiled the texts, studied them philologically, and pointed to obvious misdatings—contexts on weather and astrological interpretations are mostly omitted. P1–P5 clearly does not consider the original Chinese texts. Stephenson and Green (2009) presented a list of "guest stars" ("ke xing"), namely those, which have the highest probability of being novae—most also in Xu et al., plus some additional ones.

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[8]For example, the reference in P3 and P5 to Neuhäuser et al. (2018c) is just a summary in German, but should be R. Neuhäuser et al. (2016a), the original English publication.

[9]P3 (section 2.1) present the following selection steps: "1. … no explicit tail and no explicit movement" resulted in 183 entries; the above criteria (i) and (ii) resulted then in a subset of 34 entries; then, "out of this selection where the textual description does not suggest a comet … 27 remaining". This last selection step from 34 to 27 by excluding comets is surprising, because it was written that the first step already should have excluded comets (P3 section 2.1.1); then, the events in AD 369, 393, and 396 are excluded to arrive at "24 most promising events" (P3), actually 25 events in 24 years.

[10]but without AD 369, which is only in P3 table 3, but excluded in P3 section 2.1.2, because it was suggested as SN candidate. The durations given in P3 table 3 are missing in P4 table 3 for BC 5, AD 667, 668, 683, and 840; for AD 1175, the duration given in P3 table 3 and P4 table 3 should be 6 days (Xu et al. 2000, Aug 10–15 according to Song shi Tianwen zhi ch. 56), instead of only 5 days.

Stephenson and Green (2009) and Pankenier et al. (2008) were not considered in P1–P5. Furthermore, listings of historical meteors were not consulted in P1–P5 (e.g. Ahn 2005; Pankenier et al. 2008).

We will use below the quotations in P3 Table 2 (and 3), they contain four different terms for presumable nova candidates: "broom star," "fuzzy star," "(anomalous) star," and "guest star" (to include broom and so-called fuzzy stars as nova candidates are not the state-of-the-art, see below). We will now consider their "24 most promising events" described with those four terms in turn by discussing, in particular, the following issues:

- whether the state-of-the-art and relevant (recent) literature was studied,
- whether translations were checked with critical editions of the original Chinese texts,
- whether the derived positions are credible (partly in Section 3.2),
- whether there are contradictions to their own selection criteria, and
- whether there are comets among their candidates (see their criterion (iii) above).

We first consider the "broom stars" (found by P3 in Ho 1962 and Xu et al. 2000).

BC 5, AD 667, 668, 683, 840, and 1431. These objects were recorded as "hui xing," literal "broom star", that is, a star with a tail; those objects were considered since long ago as comets, for example, Pingré (1783), but see also Ho (1962) and Stephenson (1976). For AD 1431, P3 quotes just "Hanyu star," while the text in their source, Xu et al. (2000), gives also "broom star" (more below). All of these are listed in the *Cometography* of Kronk (1999), and none of them is considered nova candidate in Stephenson and Green (2009), both references not considered in P3–P5.

In the record of BC 5, the given Qianniu could be either the asterism or the lunar mansion of the same name, which is not discussed in P3; if the latter, the search area would be the whole lunar mansion. While Stephenson (1976) listed this event as possible SN/nova (one of two "hui xing" exceptions), Stephenson and Green (2009) revised this consideration (no SN/nova candidate any more).

The record of AD 667 is a misdated doublet of AD 668; the classification as a comet with tail and motion is given in Neuhäuser et al. (2021a); the Ho (1962) translation of the AD 668 record—as used in P3—includes a mistake; P5 ignored several historical sources, re-interpreted duration and position against the textual transmission, and fabricated a new historical SN (AD 667 to 668) as one of their highlights.

In the case of AD 683, the state-of-the-art is also not considered, for example, Xi and Po (1966) discussed this event (misdated to AD 684).

For AD 840, P3 misinterprets the text "between Ying-Shih and Tung-pi" (Ho 1962) as to mean *in between*, that is, the huge error circle (radius 9°) is centered in the middle of the two asterisms of that names, but the Chinese "jian" includes the spaces of both "Ying-Shih and Tung-pi," most likely here the two lunar mansions of those names, through which the comet passed.

"Hui" clearly indicates a tail; the lack of explicit information regarding motion does not qualify a transient as stellar object. If one would want to consider a "hui xing" as nova, where the observed extension due to excessive brightness was mistaken for something like a tail, one would need to proof stationarity with clear evidence, etc.[11]

Second, we consider their "fuzzy stars."

BC 204, BC 104–101 (P3: −103),[12] **AD 329, 641, and 1175.** All these "fuzzy stars" are suggested by P3 as nova candidates or similar. The work by Xu et al. (2000) on probably stationary guest star candidates was partly modified by Pankenier et al. (2008) on comets; for example, the "fuzzy stars" of BC 204, BC 104–101, AD 329, and 641 from Xu et al. (2000) are given in Pankenier et al. (2008) as "star became fuzzy," which is a more precise rendering. This wording indicates most likely comets. The texts do not give any evidence for star-like appearance or stationarity. None of the above listed "fuzzy stars" are considered nova candidates in Stephenson and Green (2009).

For so-called "fuzzy star," Pankenier et al. (2008, p. 6) wrote: "In the past, some scholars have been perplexed by the compound *xingbo*, which appears to defy Chinese grammatical conventions by having *xing* "star/celestial body" modify *bo* "be fuzzy/bristle." However, *bo* has a verbal sense here, meaning "to become fuzzy or bushy.""

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[11]P4 (section 6) claim that the phrase "it passed through the east of Kulou" for SN 1006 (cited from Xu et al. 2000) would imply motion and disqualify this guest star as SN. They do not mention the discussion of this phrase in Clark and Stephenson (1977) and Stephenson and Green (2002, pp. 156-157): "The term translated as *passes through* (*li*) need not necessarily imply motion. For instance, the compound *li shi*, in speaking of a person's life, means *to pass through the world*. Perhaps an alternative meaning of *li* would be *spent its time in*. Whatever the interpretation, there is ample evidence – both here and elsewhere – that the star remained fixed."

[12]dated BC 104–101 by Xu et al. (2000), but no duration is given. It was dated just BC 102 in Ho (1962), P3 gave the year −103, but citing Xu et al. (2000). If they followed Ho (1962), they probably got confused by converting from the AD/BC or CE/BCE scale to astronomical counting (correct: BC 102 = −101), even though they unnecessarily provided a color figure (P3 figure 4) to display the difference between the two scales. Also Pankenier et al. (2008) gave BC 102.

This is entirely consistent with cometary records where it is generally used to describe the appearance of tail-less comets or the changed aspect of a comet that has grown a tail … Rendering *xing bo* as "bushy star" by analogy with *hui xing* ("broom" plus "star"), which is quite properly translated "broom star," is misleading in that it obscures the possibility that *bo* may imply a change of appearance."

Pankenier et al. (2008) give the comet of AD 595 as example, where this interpretation of the Chinese record is consistent with observations from Europe. It is similar for the comet of AD 668, first "broom," then "fuzzy" (Neuhäuser et al. 2021a).

While P2 wrote that "the fact that something is described as *bo xing = po hsing* or fuzzy does not exclude it from being a comet" (section 6.1), P2 then accepts several "fuzzy stars" as nova candidates—this ignores the state-of-the art: a very bright star (or SN) can appear extended due to large scintillation—but for considering an alternative to comet for "xing bo," one would need strong evidence for the excessive brightness (or always low altitude) and also for the stellar nature like explicit stationarity, as is reported for bright SNe like SN 1006, etc.[13]

With two fuzzy star examples (AD 329, 1,175), we will show how P3–P5 treats the transmission regarding textual and positional interpretation.

AD 329. For the "fuzzy star in the NW" of AD 329, "trespassing against Dou" is reported (Xu et al. 2000), that is, it was near some star or the skeleton line of the asterism Dou (in our UMa). The term "trespass" [fan] means an "approach within 7 cun," ~0.7° (e.g. Pankenier et al. 2008, p. 467); and Stephenson and Green (2009) point out that "trespass" [fan] often indicates motion. However, in P4 there are five large error circles with a total area of 263 square degree (table 3) with nine counterparts plotted (figure A.9), mostly more than ~0.7° off the stars and

the skeleton, partly in an asterism other than Dou, and their presumable best candidate, a Planetary Nebula, is not plotted in their Figure A.9. (Their statement in this context, that "script was invented only in the -3rd millennium" [i.e. BC 3000–2001], is incorrect, as Sumerian and Egyptian proto-literate symbol systems were invented around BC 3400–3100). Nevertheless, P5 conclude that "one object precisely fits the position described in the text" and that "due to the perfect match of the positions of M97 and the guest star, we considered PN re-burst scenarios" (section 5.3, similar in table 9)—strongly overstated for the "fuzzy star" of AD 329.

AD 1175. In the case of AD 1175 (Xu et al. 2000: "xing bo"), the uncertainty in the position given just as "above Qigong" and "outside the wall of Ziwei" (P3 Table 2) is clearly larger than the error circle drawn in P4 (Figure A.17), and the position is not discussed at all; in other cases, "above" was considered by P3 to pertain to a horizontal system (P3, AD 668, where their "above" is a translation error by Ho 1962, but correct in Pankenier et al. 2008, see also Neuhäuser et al. 2021a). P4 incorrectly apply typical expansion velocities of nova shells to a Planetary Nebula to claim that it might have erupted in historical time.

In sum, the terms "hui xing" and "xing bo" are not qualified to indicate star-like objects. In P4, we can read "we neglect wording and consider only reports of long tails with a clear direction as definitely indicating comets" (section 1)—there are not many comet records, where both tail length and tail direction were mentioned, but there are much more records of "hui xing" and "xing bo" objects, which clearly indicate comets (not only 1P/Halley), see, for example, the comet of AD 891 (Neuhäuser et al. 2021a).

P3 wrote in their abstract: "we selected those without movement and without a tail (to exclude comets)"—obviously not done that way. It is not argued convincingly why those "broom" and "fuzzy stars" should be credible nova candidates. P3 also leave out several more records from Ho (1962), Xu et al. (2000), and Pankenier et al. (2008), namely "broom" or "fuzzy stars" with similarly few information as those which got selected in P3, for example:

BC 204, Aug 14—Sep 12: "a fuzzy star appeared in Dajiao for over 10 days …," single-star asterism α Boo—got selected in P3, and

BC 104–101: "A fuzzy star appeared at Zhaoyao," single-star asterism γ Boo—got selected in P3, but

AD 575 Apr 27: "there was a fuzzy star in Dajiao" (Xu et al. 2000)—did not get selected in P3 even though Hsi (1957a, 1957b) considered it as reappearance of the possible nova of BC 204 (also in Xi & Po 1966).

While P3 did suggest some counterparts for the BC 204 observation at the single-star asterism Dajiao, that is,

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[13]When trying to justify their interpretation of transients reported as "fuzzy star" to indicate extension, P3 write that "in some cases, the supernovae are described with long rays and horns implying a fuzzy or extended appearance", with references to two records on SN 1054: "Song huiyao jigao ch. 52" (P3 footnote 5) and "Ichidai yoki" (P3 footnote 6), without text quotations in P3. For these two records, we find in Xu et al. (2000): "with horned rays radiating in all directions" (Song huiyao jigao ch. 52) and "a guest star emerged … It appeared fuzzy in the east at the Tianguan star" (Ichidai yoki); and we have indeed quoted all parts here relating to extension or size – 'long rays' are fabricated by P3. When the SN 1054 text says "pointed rays to all sides", this is just scintillation due to excessive brightness (similar in SN 1006); in the Japanese source Mei getsu ki (ch. 23), SN 1054 is phenotypically described to have 'appeared fuzzy'. In P2, Hoffmann also argues that a report from 'China of SN 1572, Xu et al. 2000, p. 143' would report the SN as 'fuzzy' (P2 section 6.1), but the term 'fuzzy' appears only in the astro-omenological interpretation, the observational report itself gives details on the brightness evolution.

α Boo (P4 Figure A-2), they did not notice nor mention that the observation in AD 575, again at Dajiao, should then also be possible for those presumable counterparts. Such considerations of alternative observations are generally missing in P3–P5. Their selection is not repeatable nor reproducible. The state-of-the-art is not reflected, evidence for many of their claims is not given, published counter-evidence is missing.

Third, we will consider their somewhat anomalous stars.

AD 1431, 1461, 1690. For the "Hanyu star" of AD 1431 in Jiuyou, also called "broom star" ("beside Jiuyou," Xu et al. 2000), see also above under "broom stars." The reconstruction of the asterism Jiuyou ("Jiuliu" in SK97) differs in SK97 compared to P3–P5. P5 presents the AD 1431 event as outburst of the symbiotic binary KT Eri—one of their three highlights. Even if the reconstruction of Jiuliu/Jiuyou in P3–P5 (as in Stellarium) would be correct, the star KT Eri is closer to 55 Eri, a star in the Chinese asterism Jiuzhoushukou, than to any star in Jiuyou (so that the record should have given Jiuzhoushukou, if KT Eri would be correct). From the fact that the alleged "guest star" (P5 section 5.3) is reported as "shiny bright," P5 conclude that it would have been "rather bright," but "shiny bright" is typical for a comet. P5: "All this opens the fascinating perspective of having perhaps identified a recurrent nova with a cycle of ~600 years" (section 5.3)—but the text points to a comet, reported as "broom star" for 15 days. KT Eri has V = 15 mag at quiescence and had an outburst to V = 5.4 mag in 2009 (given in P5)—then, since the amplitude of nova eruptions are up to 12 mag (P1), it would have had $\geq 3-5$ mag at maximum, so that it would hardly be noticed as new star by the naked eye, and certainly not reported as "shiny bright."

For AD 1461, P3 table 2 omits that the "star as white as powder" (Jul 30 to Aug 2, i.e. 4 nights, P3: "3 days") then "turned into a white vapor and went out of sight" on Aug 2 (Ho 1962 no. 522, similar in Pankenier et al. 2008 among their comets); then, Ho (1962) continued (no. 523): 1461 Aug 5 "a (hui) comet appeared at the East," etc.—whether these two sources could pertain to one comet, is not discussed in P3.

In AD 1690, there was also an "anomalous star" for 2 days; P3 table 3 claims that the sighting would be close to ε Eri, identified as "third star Ji" (incorrectly called "single-star-asterism" in P3 table 2), but according to P4 section 4, the specifications about the positions, etc. within the historical record would be intrinsically inconsistent.

In P3–P5, a thorough discussion of the terms "anomalous stars" or "Hanyu star" as used by Chinese court astronomers is missing. The objects of AD 1431 and 1461 are not listed as nova candidates in Stephenson and Green (2009), while AD 1690 is beyond their time range.

Fourth, we will now consider the objects listed in P3 Table 2 as "guest star"; according to the state-of-the-art, one might expect the best nova candidates among those "ke xing," lit. "guest star" (see Stephenson & Green 2009), in particular if a duration of more than one night is mentioned; P3 section 2.1.1 gives "ko xing," which does not exist—in the old Wades-Gilles transliteration it is "k'o hsing," in the new Pinyin "ke xing." The criterion "duration" of more than just one night (their criterion (i) in P3 and P4) can be useful to exclude, for example, bolides, meteors, and mock moons. The criterion "single star" (their criterion (ii) in P3 and P4) of a relatively precise position is not helpful to select novae as long as there is no evidence for stationarity and other nova criteria. Records with a precise position could have become separated from the remaining transmissions, see, for example, AD 891 (Neuhäuser et al. 2021a). Among their "24 most promising events," there are some cases, for which P3 neither lists "single-star-asterism" (or similar) in table 2, nor a duration in table 3, that is, objects that fulfill neither of their two main criteria, so that their selection procedure is intransparent.

Now, we will consider the four objects listed in P3 as "guest stars" without duration of more than one night.

AD 891 and AD 1497. The records used in P3 for these two objects among their "24 most promising events" mention only for a short part of the night. This contradicts their criterion to exclude those "only visible within a certain hour (to exclude meteors)" (P3 abstract).

For AD 891, the only record considered in P3 says "at the hour of *hai* [LT=21-23h]" (Xu et al. 2000), not quoted in P3 Table 2, but their Table 3 says "this could allude to short visibility (meteor?)." For AD 1497, Xu et al. (2000) have: "at dusk a guest star … " (not quoted in P3 Tables 2 and 3). Both may be listed among their "24 most promising events" because of presumably small search areas. The Japanese record of AD 891 used in P3 is most likely the last sighting of Alfred's comet also seen in China, Arabia, and Europe (Neuhäuser et al. 2021a); Pankenier et al. (2008): "broom star over 100° long," etc. (not cited in P3).

For AD 1497, P3 table 3 gives only a small circle around β UMi as position (in Beiji), but this is the wrong asterism (true: Tianjiu).[14]

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[14]"Tianji" is in the translation of Xu et al. (2000), a typo for "Tianjiu", see Chinese text on their pp. 336/337 (and Stephenson and Green 2009). 'Tianjiu' is an asterism of 10 stars with 22 And (SK97, p. 191) and/or θ And (Pankenier et al. 2008, p. 462), ancient maps confirm the number (Stephenson and Green 2009: "Tianjiu consists of the three stars θ, ρ, σ And", which is incomplete). Three asterisms with different Chinese characters are all transcribed 'Tianji', none of them with β UMi, which is one of the five stars of Beiji (picked in P3) – a prominent asterism near the North Pole (SK97, pp. 217ff); see Neuhäuser, Neuhäuser, Chapman (2021).

Both the records for AD 891 and 1497 specify an asterism, but do not specify, which star, so that the assumption in P3 that the records would point to the determinative star of the asterism is not justified (Neuhäuser et al. 2021a; Stephenson & Green 2009); the constituents of the asterism Tianjiu are not finally established (SK97), see footnote 13.

BC 48 and AD 101. Note that AD 101 is not listed in P3 table 2, but in P3 table 3; we discussed it briefly in Section 2.3. The records for BC 48 and AD 101 specify just one date, no duration. Both records point to a seemingly precise position (BC 48: "4 chi East of 2nd star of Nandou," AD 101: "in the space of the 4th star of Xuanyuan," both Xu et al. 2000). The counting in both Nandou and Xuanyuan is not certain, but disputed (see Liu 1986 and Yau 1988 for Xuanyuan, and Stephenson and Green 2009 for BC 48 in Nandou).[15] P3 does not present any new evidence for the counting within Nandou or Xuanyuan. Stephenson and Green (2009) for BC 48 said that the "stellar nature is unclear" (because reported as "as large as a melon," not discussed in P3).[16] See also discussion for AD 1437 below. While for AD 101 in Xuanyuan, P2 (section 7) prefers the counting from north to south (instead of starting from the

determinative star as given in the historical precedent), in the case of BC 48, P2 agrees with starting the counting from the determinative star (ϕ Sgr), first toward the north and then continuing further south. We do not list all mistakes and inconsistencies.[17]

For all these last four cases (BC 48, AD 101, 891, 1497), the lack of a duration of more than one night weakens the case for outburst, as mentioned explicitly by Stephenson and Green (2009) for the example AD 101.

Now, we will discuss the "guest stars" with explicit duration of more than one night: AD 64, 70, 722, 1430, 1437, 1592, and 1661.

AD 64. The record on AD 64 does mention a certain duration (75 nights) plus a relatively precise position ("near Zouzhifa," η Vir). *Zuozhifa* is hardly a *single-star-asterism* (P3 table 2), but the most western star of the Eastern Wall of the enclosure *Taiwei*, where all stars have names (SK97). However, in P3 table 2, the text "with bright vapour 2 chi … long" (Xu et al. 2000) is missing. In P4, we also find for the "guest star" of AD 64: "as two Chinese chi are almost 2° this appearance could only be have been caused by the atmosphere" (section 4)—no, such an extension can also be a comet tail; there is no evidence for excessive brightness or stationarity (and it is also not only seen at low altitude, as η Vir culminates high up from China in spring). Hsi (1957a, 1957b), Kronk (1999), and Stephenson and Green (2009) considered it as comet.

Sightings of "guest stars" can be part of "broom star" records, see AD 891. In Pankenier et al. (2008) many such conversions are attested, but already in Ho (1962) the problem was well-known (e.g., Ho no. 228, which was regarded as nova by others): "we shall come across several cases where guest stars turned into (*hui*) comets and vice versa" (p. 137). Comets can be observed as small, large, or so-called fuzzy (guest) stars, in particular during the first and last sighting—these phenotypical descriptions do not contradict their physical nature.

AD 70 and 722. These two events were listed in Stephenson (1976) as nova candidates, and most recently

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[15]The discussion in P2 section 2.4 suggesting that the position of the AD 101 "guest star" around α Lyn, that is, fourth star counted from the north-west, would be more likely than the alternative counting from α Leo (4th star from α Leo is ζ Leo) is misleading: Liu (1986) compared reported conjunctions between planets (and the moon) with certain stars whose numbers were given, in order to identify those numbered stars and to understand the numbering system – and found that the "second star of Xuanyuan" is η Leo, just north of α Leo, that is, second if counted from α Leo; then, the fourth star would be ζ Leo. P2 tries to argue that the way of "counting depends on the astronomical purpose", for example, that planetary astronomers would only be interested in stars near the ecliptic, that is, that they would count from α Leo (a star very close to the ecliptic), while others would count differently. There is absolutely no evidence at all for such a claim, for example, for a division between "ecliptical" and "non-zodiacal" astronomers – this is fabricated by P2. Note that the observation implying that the 2nd star of Xuanyuan is η Leo is from AD 404 (Liu 1986), so that it is more likely that this counting was already applied by AD 101 (ζ Leo as 4th star), that is, during the Han dynasty (BC 206 - AD 220), when the system of asterisms, etc. was fixed.

[16]In figure 11 in P2, the asterism "Nandou" is translated as "Dipper," but it actually means "Southern Dipper" ("nan" = "south"). The skeleton of Nandou contains six stars (μ, λ, ϕ, σ, τ, ζ Sgr), but in P2 (section 7), there is an additional star mentioned for Nandou (ρ Sgr), which, however, belongs to a different Chinese asterism, namely "Jian" (called "Establishment" in P2). The determinative star of Nandou is ϕ Sgr (SK97, p. 52); P2 starts the counting with this star, then the next to the NW, namely λ Sgr as 2nd star, then further north to $3rd = \mu$, but then continuing south of ϕ with $4th = \sigma$, then $5th = \tau$, and then $6th = \zeta$ Sgr. Stephenson and Green (2009) on BC 48 in Nandou: "allowing for precession, a location approximately 4 deg to the east of this star [λ Sgr] would be only about 2.5 deg from ϕ Sgr (towards the north)", so that the latter should have been specified – not considered in P2 nor P3. This further weakens the identification in Göttgens et al. (2019).

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[17]For AD 101, in P2 table 4, "star 6" and lozenge 'b' are both said to be "objects in the northern half" of the search circle in figure 6, but object 'b' is in fact in the southern half. In P2 figure 6, it is announced that, as search area, "a rectangle … will be analyzed in a forthcoming paper. Hoffmann and Vogt" (P3), but in P3, only a circle with 2° radius around HIP 82729 is given as search field (P3 table 3); in P4, figure A-20, this circle includes positions that would not be consistent with the historical text. Furthermore, in figure A-20 (P4) a second, larger circle is drawn around μ Sco, which includes ϵ Sco – again inconsistent. In this large circle, P4 "found only one possible candidate, V1101 Sco, an interesting low-mass X-ray binary", but then: "However, looking at the map (Fig. A20) this valid candidate from the physical point of view must be dropped because it does not fit the described position" – another intrinsic contradiction: Why was it in the search circle?

also in Stephenson and Green (2009), AD 70 as "stellar outburst" and AD 722 as possible "fast nova." In both these cases, the positions are not constrained well by the historical records, for example, for AD 70: "the probability of identifying a nova remnant in this huge area is negligible" (Stephenson & Green 2009), similar for AD 722. Any candidate counterpart found or suggested in such large search areas has a-priori a very low probability, in particular without a nova shell or other concrete evidence for an outburst in historical time. Kronk (1999, pp. 516–517) has a comet candidate in AD 70.

AD 1430. P3 rely on Xu et al. (2000, p. 142), who give: "at dusk, a guest star more than one chi northeast of Nanhe" (without indications for omissions), reported for Sep 3, Nanhe is made up of α, β, γ CMi (SK97); hence, due to short visibility, it should have been excluded by P3 according to their own criteria. The words "at dusk" were omitted in P3—possibly, because CMi is not visible at dusk in Sep, but not discussed by P3. In the Chinese in Xu et al. (2000, p. 336), there is an omission between "dusk" and "guest star." It was a meteor that was observed at dusk (Stephenson and Green 2009). Xu et al. (2000) give a second transmission for Sep 9 for a position "beside Nanhe." Both records give the same color "bluish-black" (Xu et al.), so that both could pertain to the same object—however, due to the different phrases for different dates ("more than 1 chi NE" and "beside"), the position could have changed (maybe a comet?). Only in the record for Sep 9, a duration of 26 days is given. Maybe, we even deal with two different objects. P3 do not consider those aspects.

AD 1437 is discussed here together with **BC 48** and **AD 101**, which were listed before, because we consider here critically the numbering of stars within an asterism. The record giving "between the 2nd and 3rd stars of Wei … nearer to the 3rd star and separated from it by about half a chi" (14 days) points to the tail of Sco. This observation is also discussed in P2, given that a nova shell was found nearby (Shara et al. 2017b). P2 and P3 do not consider the—possibly correct—counting of stars suggested by Stephenson and Green (2009) and Shara et al. (2017b). Likewise, in BC 48 and AD 101, rather precise positions are given, BC 48: "about 4 chi E of 2nd star of Nandou," AD 101: "in the space of the 4th star of Xuanyuan," all texts from Xu et al. (2000). Even if assuming that the asterisms Nandou and Wei were meant (and not the lunar mansions with the same names), it is not clear which star is meant, also in AD 101.

Analyses of star charts (see Stephenson & Green 2009 and references in note 10 therein) show that the "2nd star of Nandou" (BC 48) is λ Sgr, the "4th star of Xuanyuan" (AD 101) may be α Lyn, and the "2nd and 3rd stars of Wei" (AD 1437) are ε and ζ Sco, respectively, or alternatively μ

and ζ Sco. Only the latter variant is possible here, because in the former case, ε and ζ Sco would not be neighboring stars.[18] Those Chinese star charts, however, are late (13th/14th cent.), so that they may not be valid for BC 48 and AD 101, and the observation of AD 1437 is from Korea; they do not show clear systematics in numbering the stars along the skeleton. For AD 101, there is clear evidence for a different counting starting from the determinative star α Leo (see Yau 1988 based on Liu 1986, and our Section 2.3), so that this alternative systematics could also be valid for other cases; e.g. Shara et al. (2017b) do consider an alternative for AD 1437 in Sco: counting clockwise from the determinative star μ Sco, the 2nd star would be ζ, the 3rd η Sco. When P2 (section 8) write, for example, "At the given position of the event in 1437" and "the historical position of a guest star in −47" (BC 48), it is suggested that it would be clear which star and, hence, which position would be meant; P2 ignores critical remarks by, for example, Stephenson and Green (2009).

On the one hand, P2 claims that "multiple ways of counting the stars had been in use" (section 2, on AD 101), but on the other hand, a "common counting" (P2 section 2) is assumed (see also our footnote 14). While P2 claims that Stephenson would make interpretations "without any historical base" (section 3.2), claims in P2 are without any historical base.

A conclusion that certain objects would "fit" a position, is not justified, because it remains unclear which stars were meant in the historical text; no efforts were made in P3–P5 to clarify this situation.

AD 1592. We do not need to discuss the records of AD 1592 here, as they were studied in great detail in Stephenson and Yau (1987) and Stephenson and Green (2002, pp. 203–208), all not taken into account by P3–P5. P3 Table 2 identifies the 3rd star of Tiancang as θ Cet (3rd from west), while in P4 section 4, ζ Cet is preferred (3rd from east); P5 ends the discussion with the unjustified statement "we give priority to the interpretation as writing errors."

AD 1661. The "guest star … appeared in Nü" (Xu et al. 2000, pp. 145–146), but P3 does not consider, whether the asterism or lunar mansion Nü (LM 10) is meant. The Korean record gives "Nü xiu" (Xu et al. 2000, p. 338), which could imply "Nü lunar-mansion." A Korean record

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[18]Stephenson & Green (2009): if the counting in Wei would be μ, ε, ζ Sco, then "ε and ζ Sco are not adjacent members of Wei: μ Sco lies between them", so that the specification in the historical report "guest star … between the 2nd and 3rd star" would not make sense, as the determinative star μ Sco would be located between the 2nd and 3rd star and, hence, should have been mentioned in relation to the position of the 'guest star'. It is possible that a different counting system was applied in Korea compared to China, even though the Korean astronomers adopted the astronomical system in general from China.

for SN 1604 (Xu et al. 2000 text 3, p. 338), that is, close in time, also has "xiu," which clearly means the lunar mansion with a "du" measurement. Although in the case of the Korean record for a "large star" in AD 1645 in Yugui, P2 followed Shara et al. (2017a) that the term "Yugui" cannot pertain to the lunar mansion Yugui, because the term "xiu" would be missing, P3 here for AD 1661 does not use this argument ("xiu" is given, so that the lunar mansion should be meant), but assumes that the asterism Nü would be meant. Again, against their claims, the original Chinese text was not consulted, so that "xiu" was overseen.

P3 section 4 summarizes their results with the following statement: "we selected a list of 25 events (in 24 years …) with a rather high probability to be a nova because it is reported as star-like (no tail, no movement reported) and lasted for more than one night"—obviously in large parts wrong and fabricated.

In sum, among their 24–25 events, among those with a duration of more than one night, there remains only one reliable nova candidate with a relatively small search area, namely AD 1437 (about half a chi separated from the 3rd star of Wei, our Sco)—however, here, the counting of stars in still uncertain. The location of the nova shell (Shara et al. 2017b) is not fully consistent with the suggested interpretation of the historical position statement, but nearby. This event was suggested as nova candidate before by Hsi (1957a, 1957b), Stephenson (1976), and Stephenson and Green (2009). For other "guest stars," the missing duration weakens the case for a stellar outburst. More than half of the candidates in P3 (at least 13 of 24) are most certainly comets including the many "broom" and "fuzzy stars."

How could it happen that there are so many comets and so few credible nova candidates in the presumably non-cometary guest star list (of nova candidates) of P3?

P3 pretends to have applied new methods, which, however, is not the case. Before selecting counterpart candidates, one should have performed a full text-critical analysis of the historical sources as follows:

- compile and consider all sources (but P3 neglected, for example, Kronk 1999, Pankenier et al. 2008, Stephenson and Green 2009),

- use or generate literal, technical translations (but P3 overlooked, for example, that it is Tianjiu, not Tianji, AD 1497),

- discuss inconsistencies or corruptness among sources, for example, doublets, dating errors, and scribal errors (but P3 did not consider, for example, that the

AD 667 record was a misdated doublet from AD 668),

- clarify meaning and usage of words and technical terms (e.g. *jian* or *xingbo*, but not done in P3),

- close reading of the texts by considering that they are (sometimes late) concatenated compilations (but not done, see e.g. AD 668 and 891 in Neuhäuser et al. 2021a),[19]

- consider the context, for example, other historical events (politics, weather, etc.) and possibly the astro-omenological interpretation (but not done in P3), for examples, see the comets of AD 668 and 891 (Neuhäuser et al. 2021a),

- consider carefully, whether there are additional records on the relevant phenomenon in the Chinese text corpus, which got separated to different chapters or years (e.g. the comet of AD 891 also in 893),

- check, whether there are additional observations recorded by other cultures, then to be studied with same procedure as above (not done in P3, e.g. the comet of 891 seen also in China, Arabia, and Europe, for which P3 mentioned only one Japanese observation).

All this is missing in P3–P5. Their work, therefore, did not advance the state-of-the-art.

Only after such a solid source and text critique has been performed, one can try to determine the nature of the phenomenon by applying clear selection criteria; this means to classify the transmitted events recorded with phenotypical descriptions with today's object classes defined by physics (e.g. comets, novae/SNe, meteors). Clear criteria are useful, see, for example, criteria for SNe and comets in Section 1. If information on certain properties is missing (e.g. stationarity or duration) and/or if the given properties are not typical for a certain phenomenon (like e.g. novae), then caution is needed. Such an objective operation may also help to avoid misclassifications and biases. For each astrophysical application, one needs only reliable candidates and well-constrained positions—just as "white rainbows" are not useful as aurora candidates for solar activity studies, because they are real fog-bows or night-time rainbows (see Neuhäuser et al. 2018a), objects with extension and/or movement across the sky, like those among their list of "24 most promising events" (P3 Table 2), are obviously comets, not nova candidates.

All transients listed in P3 were suggested as SN/nova candidates before. While this is also stated in P4 Table 1, some of those previous suggestions were revised in later

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[19] As text structure, P3 gives in section 2.1: *"A () star appeared at"* name of asterism – the text is almost never that simple.

publications, for example, Xi & Po (1966) and Stephenson and Green (2009). At least half of them were found to be comets in more recent literature (e.g. Kronk 1999; Pankenier et al. 2008). In addition, P3–P5 omit several promising SN/nova candidates (see e.g. Stephenson & Green 2002, 2009), again showing that the selection criteria in P3 failed.

P3 did not apply a "new method": all previous selections of SN/nova candidates among historical transients tried to remove comets, meteors, etc., to pick out the best events, and to constrain their positions (search areas)—and many also listed the most promising counterparts.

3.2 | Their positional error circles

As shown above, the selection of candidates in P3–P5 and their interpretation of the historical texts have strong shortcomings, so that one should not rely on them. We will now briefly discuss how P3 derived coordinates and search areas, which were defined in their next step (sections 2.2–2.4): however, it is wrong to always use circles as search areas—one should in most cases define spherical polygons,[20] see our Section 2.2 on point coordinates.

The error circle radius "is chosen either to cover the given distance [meaning a given angular separation to a certain star] or … as roughly half the distance to the neighboring asterism" (P3, section 2.2), both obviously resulting in unnecessarily coarse approximations.[21] Proper spherical polygons would be more useful.

In P4, we can then read: "working with point coordinates (even after attaching error bars) will lead to wrong results concerning the identification of counterparts" (section 1)—and, yes, this is what is done in P3: working with point coordinates of a nearby Hipparcos star and attaching an error circle around it. P3: "We have chosen stars from the Hipparcos catalogue as centers of the circles because coordinates are shifted by precession even within the few decades between our predecessors … and us. By anchoring our suggestions with stars, we hope to

ease the comparison for later colleagues" (section 3.2)—as if only positions of real stars could be precessed and not pure coordinates.[22]

In section 2.5 it is said that the search area radius is "normally assumed to be 3°"—this value may possibly come from a presumably typical offset of modern SNR positions to historical SNe. In the abstract this separation was given to be "between 0 and 4.5°" (from their section 3)—while in P1, it was $0.3 - 7'$ for SNe and 0.5 to 5.2°′ or 11.1° for novae; see our Section 2.1.[23]

It is clear that their simplified circles (instead of proper polygons) in most cases either exclude important areas on sky (possibly meant by the Chinese) or include areas clearly not meant (or even both)—this makes astronomical follow-up observations based on P3 inefficient or fruitless.

P3 claims to have "developed a method which reconsiders in detail positions and sizes of ancient asterisms" (P3 abstract). In P2, where maps from Korea and China are compared, it is claimed regarding Figure 5 that "their chain of stars shows the same pattern," but in fact the two skeletons for Wei plotted there are different at the Scorpius tail end. Mostly, they apparently use Stellarium (appendix P4). P2–P5 also do not reflect on differences in the asterism reconstructions like, for example, Ho (1962) and SK97. For their alleged reconstructions of asterisms, P2–P5 also did not use the Dunhuang map from the 7th century with more than 1,300 stars in 257 asterisms (see Bonnet-Bidaud et al. 2009).

P3 often give only English names of asterisms, but such translations are ambiguous—proper names should not be translated, it would be best to give the Chinese terms. The *IAU working group on star names* working to *"preserve intangible astronomical heritage (cultural celestial names)"* recommends for Chinese names that *"Pinyin spelling is preferred, following* Sun and Kistemaker (1997)," that is, using Chinese names (maybe together with an English translation). Regarding proper star names from other languages, we would continue and prefer to use, for example,

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[20] For comet 1P/Halley in AD 760, the positions given by the Chinese astronomers partly result in error circles (e.g. "Youzhifa 7 cun position," that is, within ~1° of β Vir) and partly in spherical polygons (e.g. "it was located/situated in Lou, in Wei for-a-while/space," also said to be in the "east direction"), see figure 8 in Neuhäuser et al. (2021b).

[21] For example,, for BC 204, one of their "24 most promising events" (P3), it is said that this Chinese single-star asterism (Dajiao = α Boo) has different separations to surrounding asterisms, but a circle is defined, where a polygon reflecting the different separations should have been chosen. (This example is said to be displayed in figure 7, but it is actually in figure 6.) In figure A.2 in P4, it becomes clear that the 5° radius circle around α Boo is too large (namely including neighboring asterisms like, e.g., Zousheti).

[22] For example, BC 48, see P4 figure A.4: the 'guest star' is reported to be *"4 chi"* east of the 2nd star of Nandou assumed here to be λ Sgr, but it is clearly evident from figure A.4 that the error circle is not exactly and just east of λ Sgr, but a bit too far north, namely around HIP 91974 (2° north of λ Sgr). Furthermore, the circle radius of 4° is too large as it includes σ Sgr – but if the 'guest star' would have been closer to σ Sgr (4th star?) than to λ Sgr (2nd star?), the closer one would have been given in the record from China. Hence, in this case, both the center and size of the search area are unjustified.

[23] For example, for BC 104–101 (P3: −103), a "fuzzy star" near a single-star asterism (γ Boo) is reported; in P4 figure A.3, the 3° radius circle is (here) too small, because the neighboring asterisms are more distant. This example BC 104–101 shows that their own claim to have used "roughly half the distance to the neighboring asterism" (P3, section 2.2) was not followed.

"Betelgeuze" instead of its English translation being "the hand of the female one having something about her related to the middle" (Kunitzsch & Smart 2006).

The coordinates in Table 6 (P3) are said to be given "in equinox 20000." The caption for the x-axes in all their plots (P2–P5) has −RA/h (i.e. negative), while all the numbers given on those axes are positive, so that the plotted RA would be negative (e.g. P3 Figures 6–9 and A.1–A.7); this is not justified by the fact that the (absolute) values of the right ascensions in their plots increase from right to left, RA values must always be positive. In Table 4 (P3) 30 of 32 right ascension values are given incorrectly as negative numbers (two are zero), positive in Tables 5 and 6. This cannot be explained by giving RA east of 0 h as negative numbers.

It is no surprise to read in P4, where they searched for CVs in the error circles that "for 9 out of 24 events in our short-list … we have not yet identified any hint that they are records of classical novae" (section 5.1). However, if the average separation between any two CVs on sky would be just a few degrees (according to P1), then one should find CVs in most of their large error circles.

3.3 | Hoffmann and Vogt (2020a, 2020b) on objects in their error circles

Given that the selection of nova candidates in P3 suffers from many mistakes (e.g. several well-known and/or almost certain comets), there is no point in searching for other objects in their (ill-defined) search areas such as CVs, planetary nebulae (PNe), SNRs, pulsars, symbiotic stars, etc. Such searches were done in P4 and P5 without any useful results. In several of their search areas, no counterparts were found (e.g. P5 Table 9). There is, therefore, no much need to comment on further errors and mistakes in those papers (P4 and P5).[24]

We comment on one more feature in P3–P5, the many figures presumably needed to identify counterparts within the error circles, which is explained in P5 as follows: "This process of plotting all known nebulae into the charts with our search circles also allows us to see and judge quickly if the object in the circle really fulfils further conditions where applicable. [Footnote 2: In papers [P]3 and [P]4 on the CV search, we needed to check this in an additional step of evaluation after the catalog query.] Additionally,

it allows us to see … if there is an object slightly outside our search circle which could possibly also be taken into account—by turning a blind eye to the limits of our intended search fields" (section 4).

Why would one need a figure to check whether an object (CV, PN, PSR, SNR, etc.) is located within the error circle around the presumably best position? Such an information is readily available from a simple algorithm by comparing the two coordinates (it is just the separation). And also for proper polygons, it is straightforward to check, which objects of certain types like CVs, etc. are inside, there are ready-to-use tools at, for example, Simbad and VizieR, figures are not needed for such simple issues. Figures can sometimes display certain complex results better than text or tables, for example, complex search fields like polygons (derived from close reading and text analyses), but here in P3–P5 we got almost 20 versions of figures with Xuanyuan (some with the wrong number of stars). It is of course also inconsistent to first define a certain error radius and then to check whether there is an acceptable "object slightly outside our search circle." With checking "further conditions where applicable," maybe a comment like "consider only stars in the eastern half" of the circle (P3, Table 3, AD 891) is meant—but also for checking such a condition, one does not need a figure (it is also a simple algorithm); in the case of AD 891, it went wrong anyway, because the recurrent nova U Sco, their presumable counterpart of this comet (P5), is west of Dongxian, not in the "eastern half."

In P4, we read "we consider only novae with peak brightness $m < 7$ mag as possible counterparts" (section 2). To accept CVs, etc. as possible counterparts down to 4–5 mag or even 7 mag at peak or discovery, means that they considered too many unrealistic counterparts. As discussed in Section 2.5, this is against the consensus for the typical limit of naked-eye discovery, which was suggested to lie at around 2 mag.

4 | SUMMARY AND FINAL REMARKS

The papers by Hoffmann and Vogt (P1–P5) on historical (super-)novae contain a number of shortcomings, for example:

- In Vogt et al. (2019, P1), a presumably typical offset between historically reported positions and current locations of supernovae and novae is obtained from inhomogeneous datasets and uncertain identifications.
- In their study of previous identifications of novae with historical records, Hoffmann (2019, P2) does not present any new results, but quite a number of misunderstandings.

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[24]Note that separations between identical objects are given to be below 1 arc sec to seven digits after the comma (in arc sec) in P5 table 3 (e.g. PN V*CP Pup compared to CV CP Pup); that separations are said to be given in the *inverse* of arc min in table 7 (which is not true); or note the following statement: "For our study it is not important how far away a CV is. The only criterion is the ability to reach naked eye visibility by a classical nova eruption" (section 5.2)—but apparent brightness depends on distance.

- The calculations of expected novae in historical archives (P1) includes mistakes in the arithmetics (by a factor of 10 in P1).

- Their claim that previous studies would have always presented "point coordinates" is clearly incorrect, but fabricated (P1–P3).

- The limiting magnitude applied by these papers (P1–P5) for naked-eye discovery of a new star of 3–7 mag is not reasonable and against the state-of-the-art (∼2 mag).

- The presentation of a list of "24 most promising objects" for novae, etc. in Hoffmann et al. (2020, P3) does not apply any new methods, but is full of many shortcomings: the original Chinese texts were not studied, source and text critique as well as close reading were not applied, obvious (previously known) comets ("hui xing" and "xing bo") are presented as nova candidates, the positions are not justified (instead of well-defined spherical polygons, they persent only circles), etc.

- At least half of the objects in their final list of "24 most promising objects" are obviously comets.

- Their alleged new historical SN of AD 667–8 (one of the three "highlights" in P3–P5) was a comet observed in AD 668 for 19 nights according to Ho (1962), Xu et al. (2000), and Pankenier et al. (2008), see Neuhäuser et al. (2021a)—the AD 667 record is just a misdated copy.

- The single Japanese record of AD 891 misinterpreted as recurrent nova U Sco in AD 891 in P3–P5 (another "highlight") obviously belongs to several reports of a comet seen also in China, Arabia, and Europe (Kronk 1999; Neuhäuser et al. 2021a).

- As their 3rd highlight, P3–P5 present the "Hanyu star" of AD 1431 in the asterism Jiuyou, misinterpreted as outburst of the symbiotic binary KT Eri, but that star is closer to a different asterism (Jiuzhoushukou), and it was also called "broom star," that is, a comet.

- P1–P5 neglect important recent literature and sources, for example, Kronk (1999) and Pankenier et al. (2008) on comets as well as Stephenson and Green (2009) on historical novae, and they often omit evidence against their claims.

- Among their "24 most promising events," apart the many comets, most of the remaining objects are reported for only one night and/or the position is not constrained well, so that follow-up observations would be fruitless. In a case like AD 1437 (see Shara et al. 2017b for the nova shell), there are still unsolved problems like counting the stars.

Final remarks: P2 write that "a potential historical observation alone cannot be relied on to draw conclusions on the evolution of binaries" (like CVs, in P2 abstract), "Little concrete information can be derived from historical observations of guest stars" (P2, section 2.3), and the use of "historical reports for the astrophysics is doubtful" (section 3.5), so that we ask about the sense of their lengthy publications (P1–P5). Their papers show how it should not be done. It does not make sense to search for CVs, PNe, SNRs, etc., for example, in incorrect search fields of temporary cometary positions.

P3 themselves wrote in their section 4 regarding their nova list: "it is not worth to print any list of objects" and "this resulting list … is … not the final answer"; then in section 5, they "leave it to further research to decide whether the historical transient had been a classical nova, a supernova, or maybe none of this but a comet, a meteor, a flare star, or some other phenomena … all objects found in catalogues of nova and supernova remnants might lead to wrong conclusions." Here, the reader is again completely lost: wasn't a correct identification the very goal of P3–P5? Maybe, the whole exercise was not meant serious? But we can agree with one of the conclusions as just cited: their lists should not be *printed* or used—with their list, one is lost.

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