Prediction of space distribution of young neutron stars as sources of gravitational waves

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For gravitational wave (GW) projects it is necessary to constrain regions in the sky, were sources of GW can be expected and in which amount. We estimated the supernova rate of the solar vicinity within 3kpc and for the Gould Belt in particular, depending on different models and based on the most recent star catalogues. We suggest strategies to search for young isolated radio quite NS.

We used the Simbad catalogue to determine all stars within 3kpc, which are supposed to end in a super nova, i.e. have masses about 8 solar masses or more. From HIPPARCOS and CCDM and 2MASS we derived BVJHK magnitudes to calculate extinctions from multi colour photometry or we used extinctions from Posselt (2007), together with intrinsic colours predicted from models.

Together with luminosities and temperatures it is possible to estimate masses and ages by putting the stars into the HR – Diagram. With known age and mass it is in principle possible to estimate the residual life time, i.e. the time until the star ends in a SN. From this data we derived a SN rate. Stars with masses between 8 and 30 solar masses turned into NS in our simulation. Every NS gets a certain mass (distribution from Woosley et al., 2002), a certain kick velocity (Hobbes et al. 2005) and cools after birth. We used the cooling models from Kaminker et al. (2005) and Popov et al. (2006).

We estimated the SN rate of the Gould Belt for the next few million years. This should be similar to the actual SN rate, if we assume that the SN rate stays constant over some million years. From radial velocity and proper motions we identified ~100 runaway stars with masses more than 8 solar masses. Tracing back every runaway star may lead us to the non optical component, which is supposed to be a NS or BH now (see Prokhorov & Popov, 2005). If we compare the regions containing clusters of stars with low residual life time to possible origins of runaway stars and furthermore to regions with a relative large amount of rare isotopes like Al26 or Fe60 (formed during a SN event), we have three evidences to constrain areas in the sky which may host more NS and BH than on average.

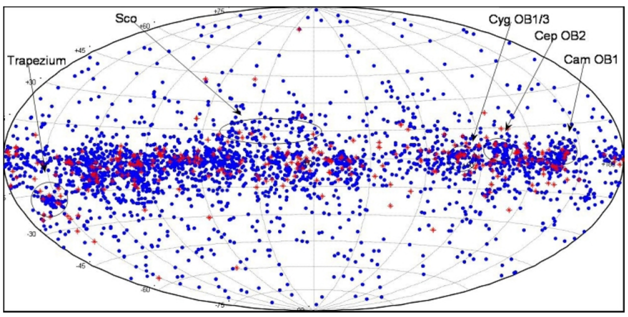

Figure 1. Spatial distribution of SN pro-genitors with low residual life times (red dots) within 3kpc. Blue dots show other massive stars from our sample. In this plot ~3000 stars with reliable data, such as colours, distance, spectral type and luminosity class, are shown.

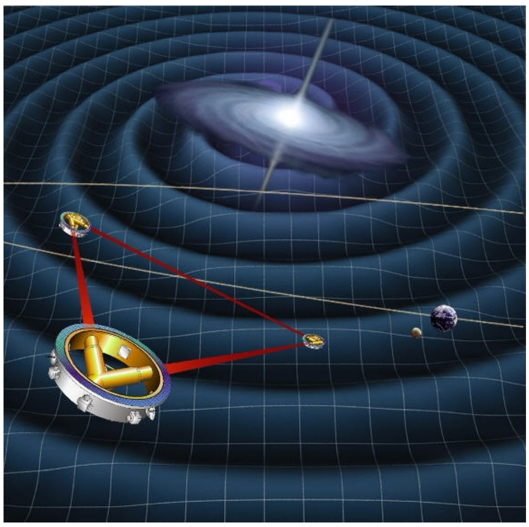

Figure 2. The LISA interferometer (launch in 2017) detects gravitational waves with low frequency.