Celestial Mechanics – Exercises

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Unit 6

Problem 6.1

Consider the circular, restricted three body problem Sun–Jupiter–dust particle. If the dust particle is small enough, it will experience, besides solar gravity, the solar radiation pressure. Since the radiation pressure force, like gravity, is inversely proportional to the squared distance, it effectively reduces gravity by a constant factor β, the ratio of the radiation pressure to gravity. As a result, the gravitational potential GM_1/r_1 of the Sun is replaced by the "photogravitational potential" $GM_1(1-\beta)/r_1$. Compare this "photogravitational" problem to the purely gravitational problem. How would the quasi-spheres and the quasi-cylinder change and in which order will the Lagrangian points appear when the Jacobi constant diminishes? Can additional Lagrangian points appear in this problem and, when yes, under which conditions and where can they be located? Detailed quantitative analysis of the equations is not needed; qualitative answers are sufficient.
(**2 points**)

Problem 6.2

There is an asymmetry between the numbers of asteroids discovered around Jupiter's Lagrangian points L_4 and L_5. As of May 2019, about 2500 asteroids were known to reside at L_5 while roughly 4600 asteroids were observed around L_4.[2] What might be the reasons for that asymmetry? (*Supplementary Information: This is a currently unsolved problem.*)
(**up to 2 points, 1 for every reasonable hypothesis**)

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