Chaotic capture of (dark) matter by binary systems

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Résumé

Binaries are everywhere: binary stars at the heart of many exoplanetary systems, SMBH binaries at the center of galaxies, binary asteroids among small bodies, even the Solar System in a rough approximation can be viewed as the Sun+Jupiter couple. Here, using a symplectic map description, we study the capture of a galactic flow of (dark matter) particles by binaries and even n-aries. This approach allows to model the scattering of 10^16 particles during 10^9 orbital periods of the binary system. It is shown that the capture cross-section is much larger than the area of the binary being inversely diverging at small particle energy. We show that the dynamics of captured (dark matter) particles is chaotic and is well described by a simple symplectic map. We obtain the (dark matter) particle density distribution inside such systems and determine in the vicinity of the binary the enhancement factor of their density compared to its galactic value as a function of the mass ratio of the bodies and of the ratio of the body velocity to the velocity of the galactic particle wind. We find that the enhancement factor can be on the order of tens of thousands. References:

J. Lages, D. Shepelyansky, I. Shevchenko, *Kepler map*, Scholarpedia, 13(2):33238 (2018)

G. Rollin, J. Lages, D. L. Shepelyansky, *Chaotic enhancement of dark matter density in binary systems*, A&A 576, A40 (2015)

J. Lages, D. L. Shepelyansky, *Dark matter chaos in the Solar System*, Monthly Notices of the Royal Astronomical Society : Letters 430, L25-L29 (2013)

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