RETROGRADE PLANETS ARE MORE STABLE THAN PROGRADE PLANETS

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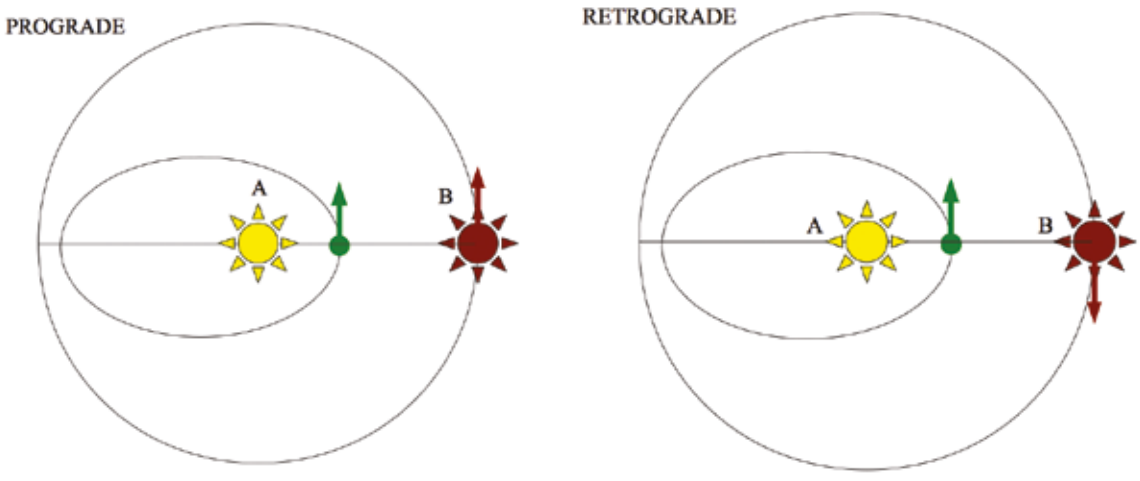

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Currently over 800 exo-planets have been detected mostly by indirect methods. Of these, the most successful are the radial velocity method and the transit method. Recently, transit data allowed to identify planets on retrograde orbits with respect to the star's spin. We now also know several planets which belong to binary systems. These planets can orbit one of the stars or both of them, and could have formed in circumstellar or circumbinary disks, or could have been captured from a passing star. In the latter scenario, the orientation of the planet's orbit is not necessarily aligned with the binary and it could either be prograde or retrograde.

We considered two stars A and B at distance 1AU from each other1. We investigated the stability of planets around A, which included computing a chaos indicator. A planet close to A is always stable and follows approximately a 2-body Keplerian orbit. As we move the planet further away from A it will be subject to increasing gravitational force from B until it is no longer stable. The stability limit depends on the binary's mass ratio and is different for prograde or retrograde planets. When B has 50% of A's mass, prograde planets are stable up to 0.4 AU while retrograde planets are stable up to 0.65 AU. When B has 5% of A's mass, prograde planets are stable up to 0.5 AU while retrograde planets are stable up to 0.9 AU. We showed that instability was due to resonances between the binary's and planet's orbital frequencies, and their eventual overlap which causes Chirikov chaotic diffusion. We used a perturbative analysis to model the effect of B on the planet's orbit around A, and showed that retrograde resonances are weaker than prograde resonances. This explains why retrograde planets are more stable than prograde planets.

FIGURE 1
The results scale with the distance between A and B.