Re: Tethys' Lagrangian Points and Telesto/Calypso

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- *From*: Bill Owen <wmo@xxxxxxxxxxxx>
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Ricky Romaya wrote:

> Hi,
>
> On Wikipedia, it is said that several moons have companion moons in their Lagrangian points, such as Tethys http://en.wikipedia.org/wiki/Natural_satellite). After looking the data on Tethys, such moons are Telesto and Calypso, residing in L4 and L5 of Tethys. What I expect is the three moons will have the same semi−major axis, orbital period and inclination around Saturn and Saturn's Equatorial plane, respectively. While the semi−major axis and orbital period is confirmed, the inclinations are different, with
>
> Tethys : 1.12
> Telesto: 1.19
> Calypso: 1.56
>
> I'm under the impression that the Lagrangian points are all on the plane in which the satellite orbits the main body. If that is true, considering Saturn is the main body, and Tethys is the satellite, then why Telesto and Calypso have different inclinations?
>
> If the lagrangian points doesn't have to be on such plane, then, considering the plane on which the satellite is orbiting the main body as the XZ plane in Cartesian system, what are the constraints of the points' location on the Y axis?
>
> TIA

The L4 and L5 points are indeed in the orbital plane of the two massive bodies (Saturn and Tethys, in this example). However, the third body need not be *exactly* at the libration point. If it's a little bit off, it will oscillate about the point −− this is what "stable equilibrium" is all about. The vertical component of that oscillation will show up as an inclination relative to the Saturn−Tethys orbital plane, or (as Tethys itself is inclined to Saturn's equator) a *difference* in the inclination of Telesto and Calypso compared to that of Tethys.

See, for instance,

http://www.cdeagle.com/ommatlab/crtbp.pdf

http://www.iop.org/EJ/article/0143−0807/17/2/005/ej6204.pdf

for more information about the circular restricted three−body problem,
its zero−velocity curves (these define the allowable volume of space
for a given energy) and some nice figures.

−− Bill Owen
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