New perspectives on the origin of Saturn irregular satellite system

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Questions

The questions we are trying to answer are:

- Is the present day structure of the irregular satellites of Saturn a faithful representation of the post-capture one?
- Is collisional capture a viable mechanism to create a system of irregular satellites?
- Is there any dynamical signature of the original nature of the satellites?
Dynamical modeling

Evaluation of the dynamical secular evolution of the satellites

Evaluation of the existence of collisional families

Determination of the plausible origins of the captured bodies

Evaluation of the impulse needed to change the orbit from heliocentric to planetocentric
Mean orbital elements

Dynamical model: Sun + Jupiter, Saturn, Neptune, Uranus + Titan, Iapetus
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**Dynamical model:** Sun + Jupiter, Saturn, Neptune, Uranus + Titan, Iapetus
Collisional families

We checked the existence of collisional families with the hcluster software by D. Nesvorny, based on the Hierarchical Clustering Method developed by Zappalà et al.

We found two small clusters of satellites with a velocity dispersion of 145 m/s: one for the prograde group (4 moons) and one for the retrograde group (6 moons).

All the other irregular satellites require values of velocity dispersion from about 300 m/s to about 500 m/s.
Orbital intersections

Black error bars: oscillations due to the \textit{mean eccentricities} and \textit{inclinations}

Red error bars: oscillations due to the \textit{mean eccentricity} when \textit{ignoring} the effects of \textit{Titan and Iapetus}
Orbital resonances

Red lines: orbital resonances with Jupiter
Primordial orbits

- **Green dots**: computed pre-capture orbits
- **Red dots**: the Saturn crossers (Morbidelli et al.)
- **Black dots**: the Centaurs which cross the orbit of Saturn
Conclusions

- First results indicate that the system of irregular satellites of Saturn is dynamically evolved and not primordial.

- Our results suggest that the dynamical features of irregular satellites may preserve some signature of their origin.

- We need to integrate dynamical and physical modeling in order to solve the problem of the origin of these bodies.
Merci !