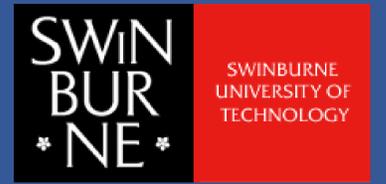




Cladistical Analysis of the Jovian Satellites.

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Take Home Message

An analysis of Jovian Satellite classification using a multivariate method: cladistics.

- ▶ More complex relationships from multivariate analysis.
- ▶ Each family composed of a large, type satellite.
- ▶ Prograde families, different origin mechanism to Retrograde Irregulars.
- ▶ Future work to compare with other Solar system bodies to resolve origins.

Introduction

There are 67 known satellites surrounding Jupiter. The most recent classification system^{1,2} is based on orbital characteristics.

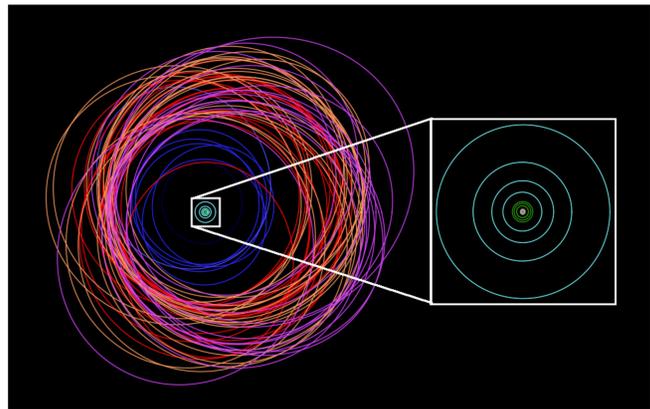


Figure 1: Orbits of the Jovian Satellites, from above.

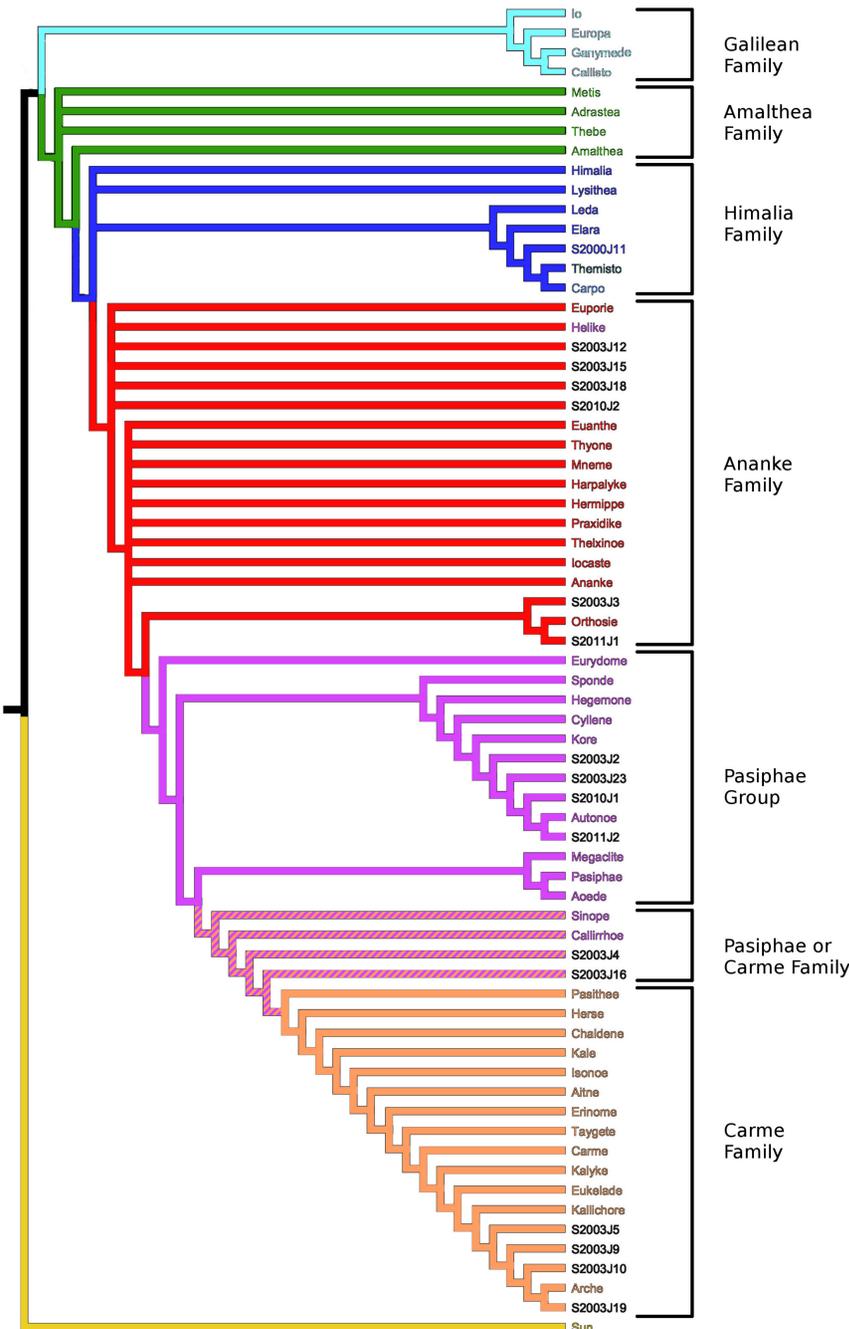
The closest group to Jupiter is the prograde Amalthea group, 4 small satellites embedded in a ring system. Moving outwards there are the Galilean moons, Io, Europa, Ganymede and Callisto, whose mass is similar to terrestrial planets. The largest group

is the outer Irregular retrograde satellites, with high eccentricities and inclinations. The aim of this project is to investigate the validity of the groupings and taxonomic relationships amongst these satellites, using a technique called cladistics.

Cladistics and Methods

Cladistics is mainly used to examine the relationships between biological groups, though it is also used to analyse Galaxies³. This work is the first usage of cladistics in a planetary science context. Cladistics uses a multivariate analysis to examine the relationships between groups. The advantage of this method over other, bivariate analysis systems is the inclusion of multiple characteristics, thus more detailed relationships can be inferred. To construct a taxonomic tree, a taxon-character matrix is required. A matrix is a table consisting of the individual satellites (taxa) in the rows, and the **orbital (5), physical (2) and compositional (29) characteristics** in each column. The matrix is analyzed using the Mesquite software package⁴. The resulting branching taxonomic tree is then a hypothesis for the relational groups.

Strict consensus Taxonomic Tree

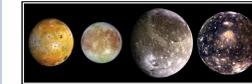


Colors of the groups used throughout the poster:

- Amalthea Inner Regular Family
- Themisto Prograde Irregular
- Carmo Prograde Irregular
- Carme Irregular Family
- Sun outgroup
- Galilean Family
- Himalia Prograde Irregular Family
- Ananke Irregular Family
- Pasiphae Irregular Group
- Uncategorised and yet to be named

Taxonomic Groups

Galilean Family



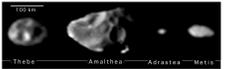
Sister group to all other satellites. Thought to have formed locally through disk accretion⁵ and survived planetary encounters of the jumping-Jupiter model⁶.

Amalthea Inner Regular family

Sister group

to irregular satellites, suggesting a common origin.

Similar mechanism of capture to Himalia family.



Himalia Prograde Irregular family:

Themisto and Carmo were proposed as their own groups², but this analysis supports a larger family with the type satellite being Himalia. Forms a distinct group to the other irregular satellite groups. This would suggest a common origin, but perhaps not a common mechanism of capture.

Ananke Irregular family

Heike is moved from the Pasiphae group. Some of the unclassified members can also be assigned: S2003J3/12/15/18, S2010J2 & S2011J1. The Ananke family form a super-family with the other irregular satellites.

Pasiphae Irregular group:

Pasiphae itself forms a small group with Megaclite and Aoede. 2nd group with Sponde, Hegemone, Cyllene, Kore, Autone, S2003J2/23, S2010J1 and S2011J2, but no large member. Possibly result of multiple interactions, with multiple originator objects.

Carme Irregular family

Expanded to confidently include S2003J5/9/10/19. Possible other members include Sinope, Callirrhoe and S2003J4/16. These satellites could be part of the Pasiphae or Carme families.

Future Work

This method could also be applied to the Saturnian and other gas giant satellite systems. The use of cladistics for comparison between type satellites and other orbital bodies could resolve their origins.

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