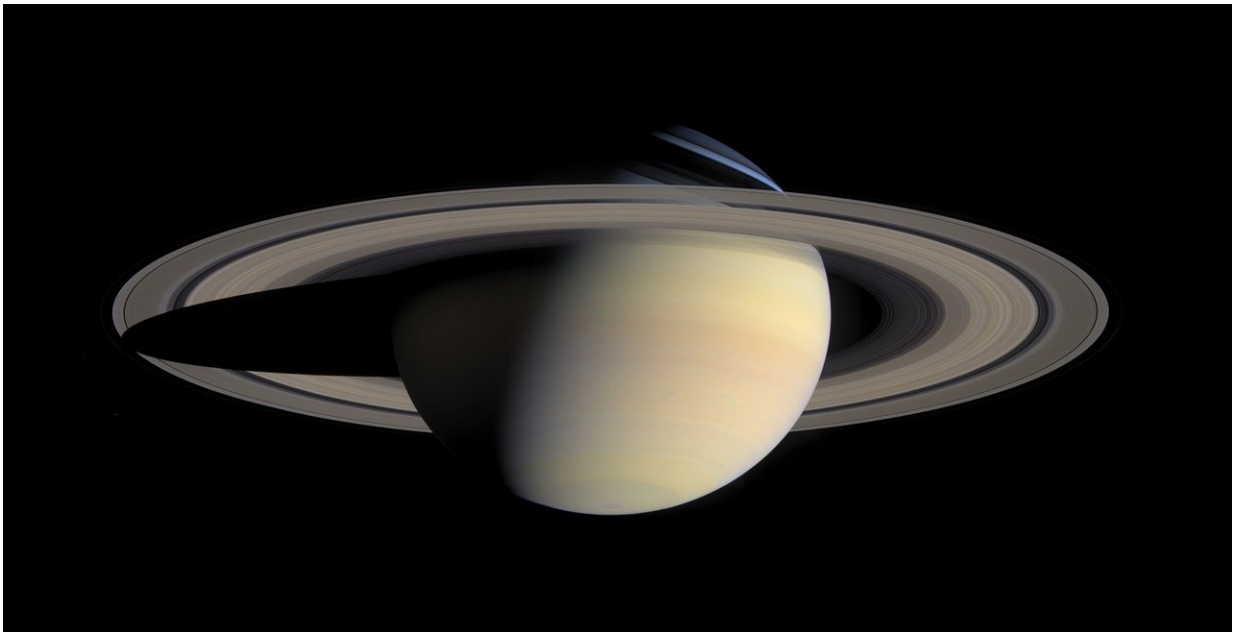
Simulations suggest Saturn may have helped create Jupiter's big moons

April 20 2018, by Bob Yirka



Credit: CC0 Public Domain

A team of researchers from France and the U.S. has created a computer simulation of the development of the solar system focusing on Jupiter and the origins of its moons. In their paper uploaded to the *arXiv* preprint server, the group describes the simulation showing that Saturn may have played a role in the creation of Jupiter's largest moons.

Most space scientists agree that most, if not all, of Jupiter's smallest

moons came to our solar system from elsewhere—on the other hand, the four largest moons, Ganymede, Io, Callisto and Europa are believed to have originated near the planet itself—but, as the researchers with new effort note, there is a problem with this theory. How could they have formed from nearby material if Jupiter cleared a track around the sun, as theory also suggests, via gravitationally attracting everything in its path as Jupiter formed? To learn more and possibly solve that problem, the researchers built a computer simulation to show what might have happened as Jupiter and other nearby planets formed.

The simulation showed, the team reports, that Saturn may have played a role in the creation of Jupiter's moons by moving close enough to Jupiter to disrupt material orbiting the sun at the edges of the path cleared by the larger planet—causing some of the material to enter that cleared space. That material, the simulation further showed, could have coalesced to form the four large moons that we see today.

If further study backs up the simulation, the group suggests, their findings may have an impact on the study of other solar systems—those that have many planets, they note, might have undergone a similar process. In such cases, scientists might want to take a closer look at the larger planets to see if they also have large moons that could be harboring life.

The simulation suggests a plausible scenario surrounding the development of Jupiter's larger moons, the researchers note, but it still does not explain why those four moons are made of different kinds of materials—it would seem logical to assume that they would be very similar in makeup if they all coalesced from roughly the same pool of rocks, dust and gas.

More information: Saturn's formation and early evolution at the origin of Jupiter's massive moons, arXiv:1804.02892 [astro-ph.EP]

arxiv.org/abs/1804.02892

Abstract

The four massive Galilean satellites are believed to have formed within a circumplanetary disk during the last stages of Jupiter's formation. While the existence of a circum-jovian disk is supported by hydrodynamic simulations, no consensus exists regarding the origin and delivery mechanisms of the building blocks of the forming satellites. The opening of a gap in the circumsolar disk would have efficiently isolated Jupiter from the main sources of solid material. However, a reservoir of planetesimals should have existed at the outer edge of Jupiter's gap, where solids were trapped and accumulated over time. Here we show that the formation of Saturn's core within this reservoir, or its prompt inward migration, allows planetesimals to be redistributed from this reservoir towards Jupiter and the inner Solar System, thereby providing enough material to form the Galilean satellites and to populate the Main Belt with primitive asteroids. We find that the orbit of planetesimals captured within the circumjovian disk are circularized through friction with gas in a compact system comparable to the current radial extent of the Galilean satellites. The decisive role of Saturn in the delivery mechanism has strong implications for the occurrence of massive moons around extrasolar giant planets as they would preferentially form around planets within multiple planet systems.