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The Nautilus mission

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The Nautilus mission proposal has recently been submitted to ESA in response to the ESA call for the M4 mission. The overarching science goal of the Nautilus mission, proposed by a team of European scientists with a strong participation of US scientists, is to explore a volatile-rich asteroid not represented in our meteorite collections (C- or D-type), and ultimately cast light on the early history of the solar system.
This goal translates into a number of specific science objectives, which can only be reached by a rendezvous mission:

- Characterize the bulk composition (volatiles, organics, silicates) and variegation across the surface
- Identify active regions and the source of activity
- Characterize the chemical and isotopic composition of the volatiles
- Characterize the surface mineralogy and composition
- Characterize the thickness and structure of the regolith
- Characterize the astrobiological potential for future human and/or robotic exploration

We emphasize that targeting an active object very much helps in simplifying the mission. The emitted species can be characterized from an orbiter, hence without the need of a landing module (or a penetrator) as it would be the case for an inactive body.

The proposed strategy consists in a direct trajectory to the rendezvous target. During the cruise phase, one or two main belt asteroid(s) will be visited (fly-bys), with a priority given to the reconnaissance of new worlds (e.g., a metallic asteroid). The choice of the rendezvous target will be investigated during the definition phase and will result from a trade-off between launch window opportunities, available spacecraft resources and the discovery during the forthcoming years of additional active main belt asteroids. For now, our baseline scenario has the dwarf planet Ceres as rendezvous target. The possible presence of a subsurface ocean on Ceres implies that it must be considered as an astrobiological target and potential habitable world at the same level as Mars and the icy satellites such as Europa, Ganymede and Enceladus. A total mission duration of typically 7.5 years is anticipated.

The specific science objectives of the mission will be best achieved with a payload that will perform high-resolution imaging, ultra-violet, visible, near-infrared, mid-infrared and microwave spectroscopy, mass spectrometry of the gas phase, magnetic field measurements, and radio science.

The spacecraft design will be similar to DAWN. It will have a dry mass of 863 kg (including payload), a total mass at launch of 1599 kg (including margins), an electrical propulsion ΔV capability of 10.7 km/s and can be launched by a Soyuz rocket.

Because it benefits from an important heritage for both the spacecraft and the instruments, the proposed Nautilus mission does not require any significant technology development and does not present any significant risks. All in all, Nautilus has all the ingredients to become to JUICE what Mars Express has been to Rosetta.

Nautilus is supported by a team of ~170 scientists that includes prominent, world-class experts of primitive solar system bodies and of space instrumentation.