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Enceladus life finder: the search for life in a habitable moon.

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Is there life elsewhere in the solar system? Guided by the principle that we can most easily recognize life as we know it—life that requires liquid water—Enceladus is particularly attractive because liquid water from its deep interior is actively erupting into space, making sampling of the interior straightforward. The Cassini Saturn Orbiter has provided the motivation. In particular, at high resolution, spatial coincidences between individual geysers and small-scale hot spots revealed the liquid reservoir supplying the eruptions to be not in the near-surface but deeper within the moon [1], putting on a firm foundation the principle that sampling the plume allows us to know the composition of the ocean. Sensitive gravity and topography measurements established the location and dimensions of that reservoir: $\sim$ 35 km beneath the SPT ice shell and extending out to at least 50 degrees latitude, implying an interior ocean large enough to have been stable over geologic time [2]. The Cassini ion neutral mass spectrometer (INMS) discovered organic and nitrogen-bearing molecules in the plume vapour, and the Cosmic Dust Analyser (CDA) detected salts in the plume icy grains, arguing strongly for ocean water being in con-tact with a rocky core [3], [4]. As much as Cassini has done, it cannot provide detailed information on the ocean environment that allow for a quantitative assessment of the potential for life. Acquiring such knowledge represents the essential first step in characterizing the nature of the subsurface ocean and its biological potential.
Enceladus Life Finder, or ELF, is a solar-powered Saturn orbiter designed to fly multiple times through the plume of Enceladus.The goals of the mission are derived directly from the most recent decadal survey: first, to determine primordial sources of organics and the sites of organic synthesis today, and second, to determine if there are modern habitats in the solar system beyond Earth where the conditions for life exist today—and if life exists there now. Enceladus is the ideal outer solar object to address these issues because of Cassini's discovery of an organic- and salt-rich water ocean, and the accessibility of its interior through the plume.
ELF carries compositional instruments of far greater mass range, dynamic range, resolution and sensitivity than those on Cassini. The ELF payload consists of two time-of-flight instruments, the Mass Spectrometer for Planetary Exploration (MASPEX), and the Enceladus Icy Jet Analyser (ENIJA), optimized to analyse respectively the gas and grains.

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