Prioritized Technology:
Technologies to Sample Plumes of Ocean Worlds from Orbit/Flyby

Technical Goal

- Collect **>10 µL (**scalable**)** sample of 1- 10 µm ice particles from Enceladus plume travelling up from the moon at up to **600 m/s**.
- Collect >10 µL sample of 1- 10 µm ice particles from Europa plume travelling up from the moon at up to 300 m/s.
- Process ice particles into designed state for life detection measurements (melt, vaporize, dilute, desalinate, etc.) and transfer to instruments

Mission Applications

- Plumes erupting from the surface of Europa and Enceladus are thought to originate in their sub-surface oceans. Similar plumes were seen by Voyager as it flew past Triton, another candidate Ocean World. Retrieving material from the plumes would be a relatively simple way to access material from the sub-surface oceans and to assess their habitability/inhabitance.
- Key challenge is that density of plumes are fairly low – limiting sample size collected on a single flyby

Technical Status

Sampling/Analysis Systems:

- Cone/Funnel Ice Collector:
  - Plume Sampling System for Enceladus;
- Impact Ionization:
  - Cassini Cosmic Dust Analyzer
  - Europa Clipper SUDA
- Neutral Gases and Positive Ions:
  - Cassini INMS samples Enceladus plume – not optimized for aqueous sample collection
  - Europa Clipper MASPEX (not optimized to sample biogenic materials)
- Capture Cells/Aerogel Collection:
  - Stardust – Collected gas and particulates - not optimized for aqueous sample collection or in-situ analysis
  - Enrichment cell exosphere gas collector

Processing and Transfer systems:

- Microfluidic devices similar to those funded via PICASSO/MatISSE/ICEE2/ColdTech Programs