

National Aeronautics and  
Space Administration

**Jet Propulsion Laboratory**  
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## Radio Occultation Instrument for Titan and the Outer Planets

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## General Objective:

Radio occultations (RO) between a small constellation of small sats at outer solar system bodies can provide atmospheric structure data of unprecedented detail (eg., pressure / temperature profiles) including rapid global coverage with frequent repeat measurements.

**RO small sats at the outer planets would produce unprecedented data volume of the atmospheres.**

Example: 2 weeks of traditional RO measurements (Mars orbiter to DSN station or Casini to DSN) is limited to narrow latitude bands, while 2 weeks of RO measurements between 2 smallsat orbiters produces global coverage. Greater coverage and repeat times are achieved with more than 2 satellites.

## Key Challenge (Power):

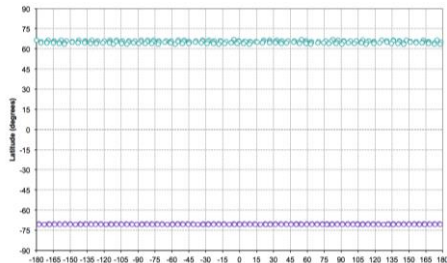
Solar powered smallsat experiments (including on Cubesats) in the outer solar system demand extremely low power usage, not achievable by the current JPL smallsat radio IRIS.

Radio Occultations offers an instrument that can provide refractivity profiles using only 1 Watt (or less transmitters) between satellites. The overall design is similar to JPL's Cion Earth-occultation receiver.

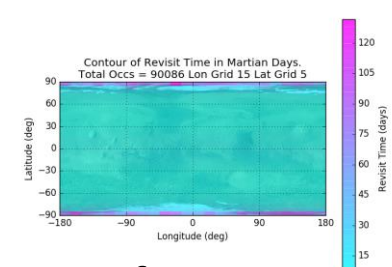
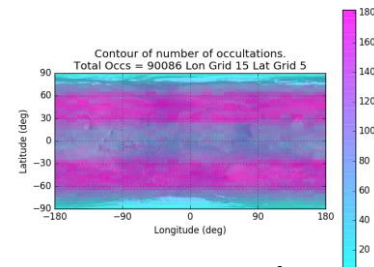
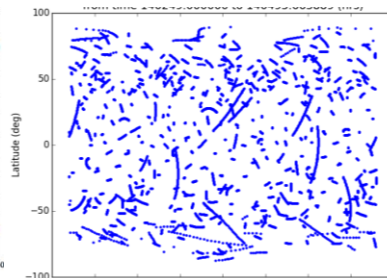
## Key Science Objectives:

- Refractivity to  $\leq 0.2e-8$ , with vertical resolutions 1 km (surface) to 10 km (top)
- Operate at two frequencies to measure charged atmosphere (TEC sensitivity  $< 10^{16}$  Electrons/m<sup>2</sup>)

### MRO DSN



### MRO-ODY



Coverage and repeat time of 4 sats at Mars