

## Critical Role of Entry Probes in Giant Planet Exploration

\*Sushil K Atreya<sup>1</sup>, Olivier Mousis<sup>2</sup>

1. University of Michigan Ann Arbor, 2. Laboratoire d'Astrophysique de Marseille

Flyby and orbiting spacecraft have explored the giant planets since the early 1970's. In situ measurements in the troposphere are essential, however, for constraining the models of formation, evolution and interior processes of the giant planets. The models employ abundances and isotopic ratios of key elements, in particular C, N, S, O, He, Ne, Ar, Kr, Xe and D/H, derived from the measurement of their (bulk) reservoir species. That was the scientific rationale for the 1995 Galileo Probe at Jupiter and a Saturn Probe in NASA's New Frontiers list of candidate missions. Considering that the icy giant planets are distinct from the gas giants, they represent the missing pieces of the puzzle of the formation of the outer solar system, besides being the closest analog for nearly half of the confirmed exoplanets. Thus, their comprehensive exploration with an orbiter-probe spacecraft is essential. The principal focus of this talk is the science, feasibility and implementation strategy of in situ measurements with entry probes at the icy giant planets, Uranus and Neptune, guided by thermochemical models and lessons learned from the Galileo Probe and the ongoing Juno Orbiter. [[www.umich.edu/~atreya](http://www.umich.edu/~atreya)]

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