FLYBY DELIVERS MULTIPLE DEEP JUPITER PROBES. T. R. Spilker[1], W. B. Hubbard[2], and A. P. Ingersoll[3], [1]Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109-8099, tspilker@mail1.jpl.nasa.gov, [2]Lunar & Planetary Laboratory, Univ. of Arizona, Tucson, AZ 85721, [3]California Inst. of Technology, Pasadena, CA 91125.

Introduction: *In situ* probes are the most reliable means for sampling composition and conditions deep in giant planet atmospheres. While exceeding its baseline mission, the *Galileo* probe entered a distinctly non-representative region of Jupiter (a "hot spot") and apparently did not measure the full deep abundances of such important species as H_2O and H_2S, whose measured abundances were still increasing at the deepest datum [1], [2]. Multiple deep (~100 bar) *in situ* probes minimize the hot spot risk, and address spatial variations and deep constituent abundances.

Science Objectives: The primary science goals are to understand:

1. Bulk composition & its gradients, especially as related to solar system formation & planetary evolution
2. Atmospheric chemistry
3. Atmospheric structure & dynamics
4. Spatial variability in the troposphere & deeper

These are supported by the mission's measurement objectives, in rough priority order:

1. Mixing ratios of the primary C, O, N, & S bearers, as a function of depth
2. Cloud composition, density, & particle size
3. Atmospheric temperature, pressure, & density as a function of depth
4. Bulk flow (wind) as a function of depth
5. Vertical radiant energy flux as a function of depth
6. Ortho- to para-H_2 ratio
7. Noble gas & disequilibrium species mixing ratios; isotopic ratios for selected elements

The objectives address all three major topics of the SSE Roadmap Quest, "To Explain the Formation and Evolution of the Solar System and Earth."

Payload: Candidate instruments: GCMS; net flux radiometer; nephelometer; atmospheric structure package with thermometers, pressure transducers, and accelerometers; sound speed instrument, for ortho-/para-H_2 ratios; USO for Doppler wind experiments.

Mission Design: Figure 1 illustrates the most important aspects of the mission design. About 6 months before arrival via a "standard" transfer to Jupiter the Carrier-Relay Spacecraft (CRSC), with up to 3 or 4 100-kg probes [3], is on the trajectory labeled "South Probe." The probe is released, and a maneuver of ~30-50 m/s places the CRSC and remaining probes on the "Equatorial Probe" trajectory, such that arrival is ~2-3 hours before the south probe arrives; that probe is then released. Another maneuver of 30-50 m/s places the CRSC and north probe on the "North Probe" trajectory such that arrival is 2-3 hours before the equatorial probe, and that probe is released. A final maneuver of ~70 m/s places the CRSC on the polar flyby trajectory indicated. Probes deployed in this manner can reach latitudes up to ~25° away from equatorial.

Data Relay. As the CRSC flies by Jupiter N-to-S, it receives the probes' transmissions in non-overlapping order, storing them for later playback from heliocentric orbit. Planetary rotation carries the probes toward the CRSC "ground track" for the deepest parts of their missions.

Radiation: A polar flyby yields less than 1/3 the dose of the Galileo orbiter's first perijove pass, less than 30 krad. The equatorial probe's radiation environment is similar to the Galileo probe's, while the N and S probes experience less than that.

History & Status: In 1997 JPL's Team X, under guidance from SSES' Astrophysical Analogs CSWG, conducted preliminary studies of this new mission design. At that time the AACSWG made it their top near-term priority. Delivery by other spacecraft, such as Solar Probe and Pluto-Kuiper Express, was examined and rejected. No more detailed studies have been conducted since that time.

Cost: The *INSIDE Jupiter* spacecraft, modified to substitute the probes and their deployment mechanism for IJ's substantial (>500 kg wet) primary propulsion module, could function as the CRSC, so the CRSC and mission could be implemented within a Discovery Program budget plus the cost of the probes. Probe development would require ~$15M for heat shield R&D before project start [3].

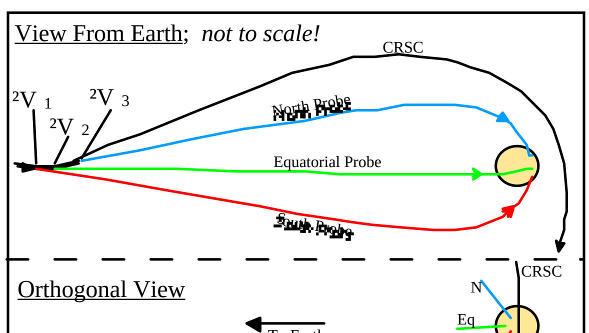

Figure 1

References: [1] Neimann H.B. et al. (1998) *JGR.*, *101*, E10, 22,857-89. [2] Hubbard W.B. et al. (1997) *Science Objectives For Jupiter Deep Probes*, AACSWG communication to JPL's Team X. [3] Rowley R. et al. (1997) Team X Study Report, *Jupiter Deep Multiprobes*.