

Venus Atmospheric Structure Investigation (VASI) on the Proposed DAVINCI+ Probe

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Only a single near-surface profile exists of the atmosphere of our twin planet, that obtained in 1985 by the VEGA-2 lander. The handful of other probe missions have very limited vertical resolution, or sensor failures. Unlike altitudes above 40km, which have been relatively well-surveyed by radio occultation profiles from orbiter missions, the fine temperature structure of lowest part of the Venus atmosphere must be interrogated by direct measurement. This structure is important in several respects. First, the structure and composition reflects the interactions between surface and atmosphere of an ‘exoplanet in our back yard’ which may be much more typical than are those of Earth. Secondly, there are indications that particularly interesting phenomena may occur on Venus, not seen in the atmospheres of Earth, Mars or Titan (but analogous to aspects of ocean stratification on Earth) : the VEGA-2 profile is impossible to reconcile with a profile that is both convectively stable and compositionally uniform. A favored hypothesis is that the lowest few kilometers are compositionally denser (lower N₂). The supercritical thermodynamics of carbon dioxide add to the rich possibilities in this region.

The exchange of angular momentum between the retrograde, slowly-rotating Venus and its dense atmosphere is reflected in the wind profile, which can now be interpreted by global circulation models. Again, while cloud-top (60-70km) winds are now well-known from Akatsuki and preceding missions, very little data exist on winds in the hidden lowest 40km. Doppler tracking, turbulence measurements, and trajectory reconstruction from descent imaging will shed unprecedented light on the lower atmospheric dynamics.

DAVINCI+ is presently concluding a Phase A study in NASA’ s Discovery program, with possible selection in summer 2021 for flight in the latter half of this decade. This presentation will review how the VASI’ s measurements of pressure, temperature and wind, far superior in resolution and/or quantity to those of previous missions, may improve our understanding of Venus and complement DAVINCI+’ s composition measurements and imaging.

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