THE DAVINCI+ MISSION TO REVEAL THE MYSTERIES OF VENUS: DEEP ATMOSPHERE VENUS INVESTIGATION OF NOBLE GASES, CHEMISTRY, AND IMAGING *PLUS*

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Brief Presenter Biography: Stephanie Getty is Deputy Principal Investigator of the DAVINCI+ mission. She also serves the Goddard Space Flight Center's Solar System Exploration Division as Deputy Director, and she is an active member of the science team for the Mars Organic Molecule Analyzer on the ExoMars rover. Her research interests include the evolution of habitability in the solar system, including molecular signatures of prebiotic chemistry and the potential for life beyond Earth.

Introduction: The Deep Atmosphere Venus Investigation of Noble Gases, Chemistry, and Imaging Plus (DAVINCI+) mission is one of four finalists now in Phase A study as part of the ongoing Discovery Program competition [1-5]. If selected for flight, DAVINCI+ will be the first mission to Venus to incorporate flybys, a descent probe, and an orbital phase into one unified architecture – at the cost of a Discovery mission. The result will be a transformative new understanding of the atmosphere, surface, and evolutionary path of Venus as a once-habitable planet [6] (and model exoplanet) that is now host to a certainly unhabitable surface environment.

Mission Science Goals: DAVINCI+ responds to major lingering questions about Venus, consistently prioritized by VEXAG goals documents [7] and the 2012 Planetary Decadal Survey [8]. DAVINCI+ will target answers to the still-shrouded mysteries of our neighboring planet:

1. What is the origin of Venus' atmosphere, and how has it evolved? How and why is Venus different (or similar) to Earth, Mars, and exo-Venuses?
2. Was there an early ocean on Venus, and if so, when and where did it go? What is the rate of volcanic activity?
3. What are the tesserae, including origin and history? How do they compare with major highlands, such as Ishtar Terra?

Mission Design: The primary design for DAVINCI+ features a launch in 2026 and two flybys by the end of 2027. The descent phase follows to deliver definitive bulk chemistry of the Venus atmosphere during a short but efficient (and scientifically sufficient) transect. This in situ investigation is then connected to remote observations of the dynamic atmosphere, cloud deck, and surface properties during the subsequent orbital phase.

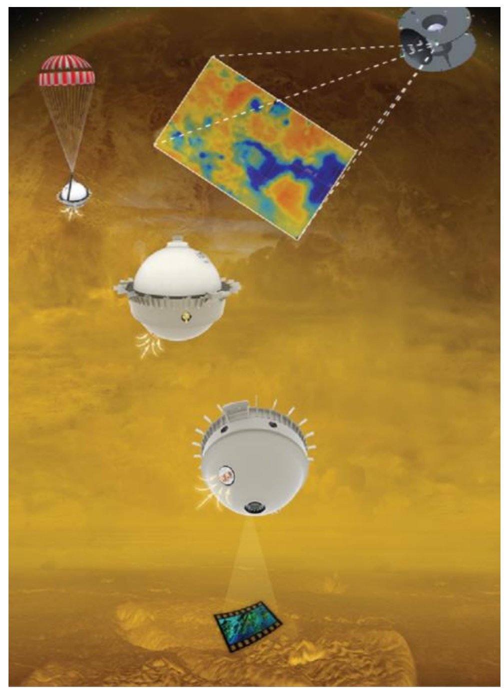

Fig 1. DAVINCI+ will provide long-awaited insights about the Venus atmosphere, surface features, and watery history through a combined flyby-descent-orbiter mission.

DAVINCI+ will capture definitive mass spectrometry, key atmospheric isotope ratios, descent imaging, and orbital imaging at UV and IR wavelengths to establish new knowledge about the vertically resolved atmosphere and currently poorly understood regions of the surface. The scientific payload is derived from highly capable instrumentation that has transformed our understanding of Mars and is now poised to answer longstanding questions about the origin and evolution of Venus' complex, stratified atmosphere, geophysical origin and evolution of its surface features, including present-day activity, driven at least in part by volcanism, and details of Venus' watery past.

Conclusions: DAVINCI+ builds upon the flyby, landed, and orbital mapping missions of the past to take the next critical step in Venus exploration: a sophisticated probe-orbiter combination. DAVINCI+ will deliver a chemical laboratory capable of revealing the atmospheric chemistry, a descent imager surpassing previous similar instruments on Mars, an environmental package to establish context, and an orbital imaging (and communications) asset to connect remote sensing to *in situ* exploration. The discoveries to be made by DAVINCI+ will close long-standing gaps in models of atmospheric evolution, Venus' water loss, and surface-atmosphere interactions. The resulting model inputs and constraints promise to benefit a broad community of next-generation scientists to understand how planetary habitability evolves and to pave the way for exoplanetary modeling, observations, and exploration of Venus-like worlds beyond our solar system [9].

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