

# Progress in the Development of CheMin-V, a Definitive Mineralogy Instrument for Landed Science on Venus

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**Mineralogical Analysis using X-ray Diffraction and X-ray Fluorescence (XRD/XRF):** XRD is the only *in-situ* technique able to identify, quantify and determine the elemental composition of minerals present in planetary regolith. When combined with XRF, the composition of X-ray amorphous components can be determined.

**The CheMin-V XRD/XRF instrument:** CheMin-V can return quantitative mineralogical results in as little as 15 minutes and can analyze up to four separate samples, leaving margin for sample delivery and data transmission. XRD/XRF analyses of drilled and powdered samples on Venus by CheMin-V will yield:

- *Identification of all minerals*
- *Quantification of all minerals, including structure states and cation occupancies.*
- *Abundance of all major elements present in each mineral (H and above) from their refined lattice parameters*
- *Valence states of all major elements, including speciation of multivalent species*
- *The quantity and elemental composition of X-ray amorphous material, if present.*

*There are no other spacecraft instruments in NASA's planetary science inventory that can claim even one of these capabilities.*

**Development of CheMin-V to TRL-6:** A next-generation CheMin-V instrument called "XTRA," coupled with a PlanetVac Sample Handling System (SHS) is being developed to TRL-6 as part of a NASA grant for a lunar application. The entire system will be tested to TRL-6 in early 2022. Figure 1 shows a 3-D model of the instrument and Figure 2 shows a conceptual design of the SHS.

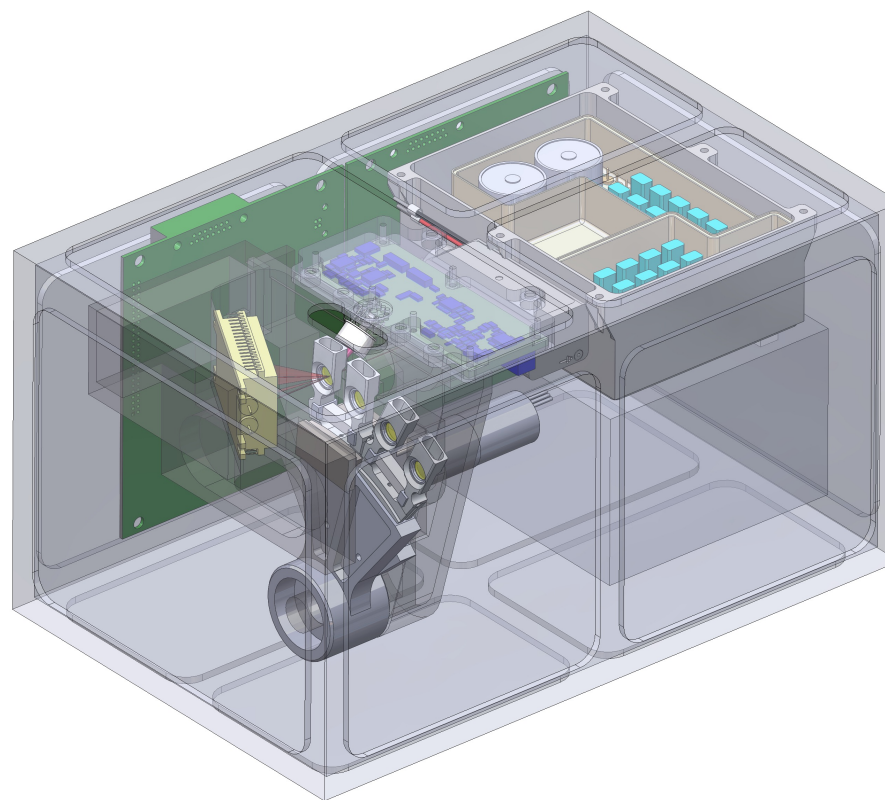


Fig. 1: 3D model of the XTRA instrument showing the refined design of the geometry and sample handling system. Dimensions: 29 X 19 X 16 cm.

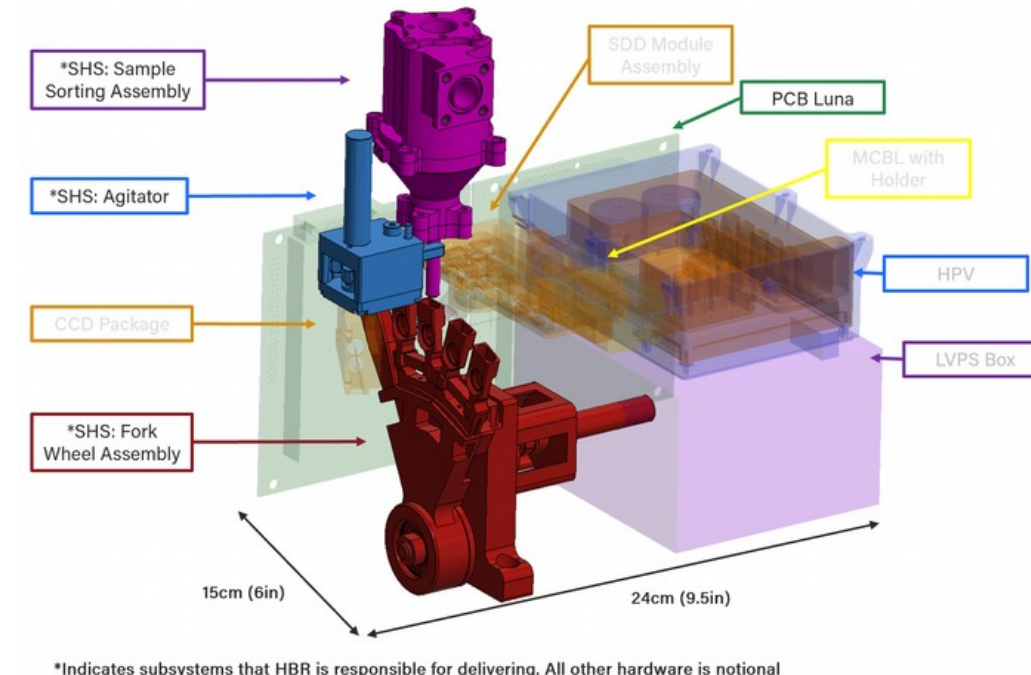


Fig. 2: Development of a TRL-6 sample handling system (SHS). HoneyBee Robotics is developing PlanetVac and the mechanical components of CheMin-V as part of a funded DALI proposal.

The CheMin-V instrument is included in the baseline payload of the proposed Venus Flagship mission, and the Venera-D mission.

Understanding Venus' surface mineralogy and evolution through direct measurements will inform comparative Terrestrial Planetology in our own solar system and provide a basis for the interpretation of remote observations of "Venus-like" exoplanets circling sun-like stars.