Objective:

Provide a testing environment which simulates the surface of Europa for sampling mechanism development and provides high throughput of surface simulants without breaking vacuum.

Key features include:

- Cryogenic Surface Temperatures: 70–130 K
- High-vacuum (Pressure <10^{-4} Torr)
- Unknown ice composition

Motivation:

Earth-Ambient Testing Will Give Fundamentally Different Results than on Europa

Cutting/Excavation:

- Hardness and fracture toughness of ice is expected to increase as temperature decreases, increasing the energy required to excavate a trench

Ice Chip/Shaving Dynamics:

- Chips/shavings will be launched from the cutting blades differently due to lack of air drag (ballistically), impacting tailings pile-up.
- Chips/shavings will likely not melt and refreeze, but stay loose instead, impacting debris pile-up and tool function
- No free moisture (from low pressure and low temperature) could change clumping behavior

Sample Integrity:

- Mission requirement to keep samples under 150 K because of highly nonlinear sublimation rates in vacuum and potential reaction of volatiles. It is necessary to test in a realistic environment to actually assess this.

The impact of these phenomenon must be understood to design effective sample acquisition and handling tools.

Major Design Features:

A. Cold Plate & Cold Heads - Compressed helium cold heads thermally strapped to cold plate
B. Cold Shroud - Conducts radiation from chamber walls to cold plate
C. Load Lock Chambers w/ Gate Valve – Allows for cycling of surface simulants with breaking vacuum
D. SLED & Ice Buckets - Allows surface simulants to enter/exit without breaking main chamber
E. Robotic Arm - 2 DoF manipulator for collection tool operation (Not flight-like, enables early testing)
F. Inspection & Reset Station (not shown) – Enables observation and measurement of collected samples and collection tool reset for further testing

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Pre-Decisional Information – For Planning and Discussion Purposes Only

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