Drilling on Mars: Overcoming the Complexity

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HARDWARE OVERVIEW
• Cleans rock surfaces with a brush
• Places and holds the APXS and MAHLI instruments
• Acquires samples of rock or soil with a powdering drill or scoop
• Sieves the samples (to 150 μm or 1 mm) and delivers them to instruments or an observation tray
• Exchanges spare drill bits
Curiosity’s & its cousins – human scale
Curiosity’s Sampling System
Turret Mounted Tools & Instruments

Drill
Acquires powder from rocks

APXS
Alpha Particle X-Ray Spectrometer

CHIMRA
Collection and Handling for Interior Martian Rock Analysis
Scoops regolith, sieves and portions

MAHLI
Mars Hand Lens Imager

DRT
Dust Removal Tool
The Drill – Heart of the system
CHIMRA: Drill Sample Path
CHIMRA: Scooping and Processing
Rover Body Mounted Sampling System Hardware
The SAM suite

**SAM suite instruments and major subsystems**
- Quadrupole Mass Spectrometer (QMS)
- 6-column Gas Chromatograph (GC)
- 2-channel Tunable Laser Spectrometer (TLS)
- Sample Manipulation System (SMS)
- Gas Processing System

Inside the rover chassis

Sample Analysis at Mars (SAM)
Chemistry and Mineralogy (CheMin) – 1st planetary in-situ X-ray diffraction
DEVELOPMENT & TESTING
The Last Time the US Drilled Off Earth…
Flight Rover Testing – Arm Calibration While Level
Flight Rover Testing – Arm Calibration at Tilt
Engineering Model Rover Arm Calibration
First Drill Test Using Integrated Arm/Drill
OPS HIGHLIGHTS
First Drill Hole on Mars! By Anyone!
Windblown “sand shadow” at the Rocknest site
Wheel scuff to confirm depth of sand, for safe scooping
MAHLI view of coarse (0.5 to 1.5 mm) sand from the ripple's surface, and fine (< 0.25 mm) sand on wall and floor of trench
Curiosity self-portrait at Rocknest

Assembled from 55 MAHLI images

Shows four scoop trenches and wheel scuff
Curiosity’s 1.6-cm drill bit, drill and test holes, and scoop full of acquired sample
CREDITS

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