CheMin

Group-2

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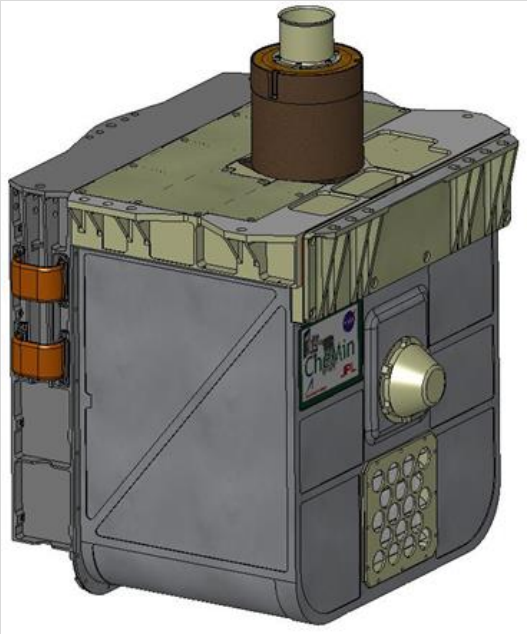
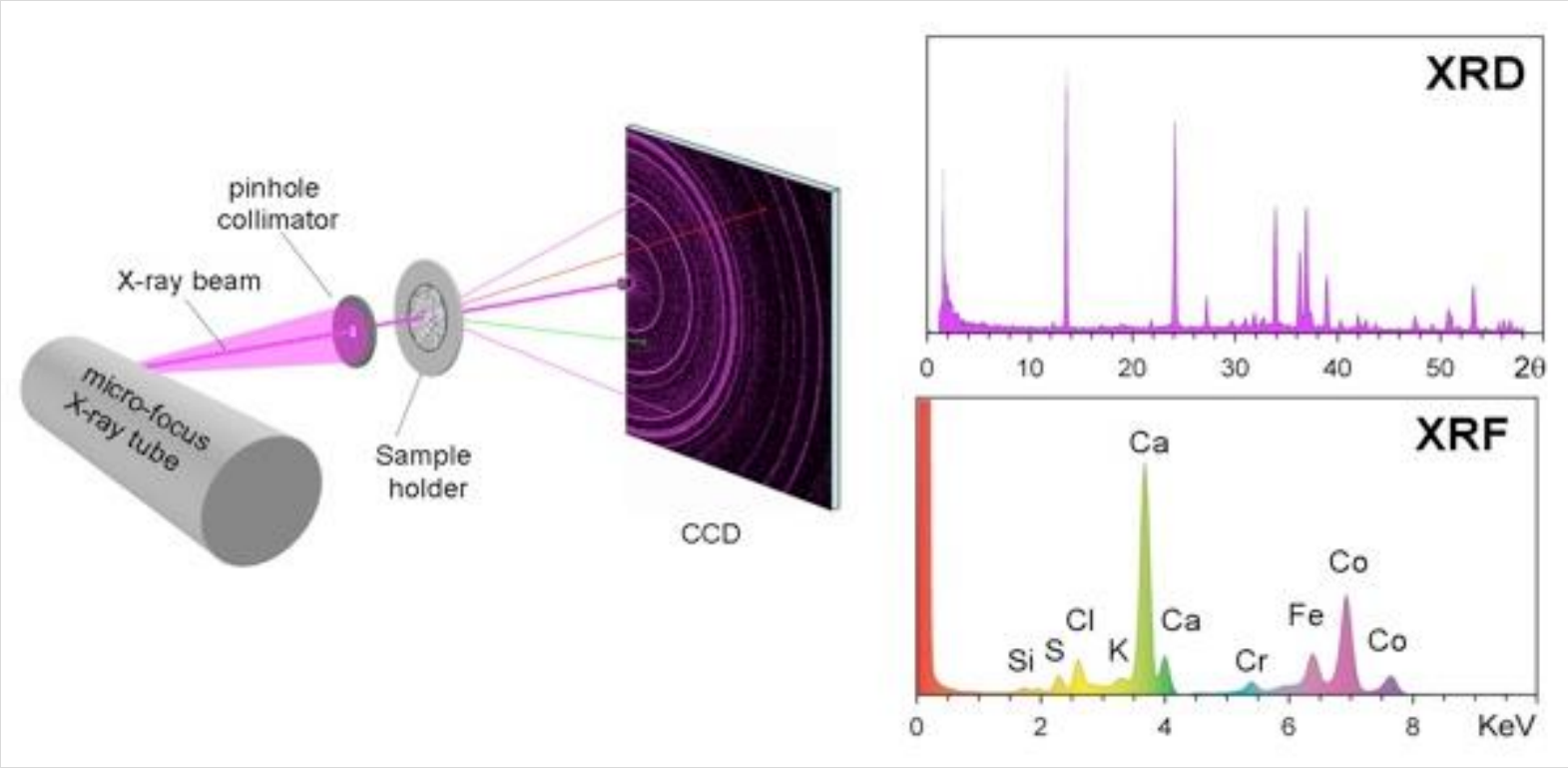
Introduction

- CheMin is a mineralogy instrument that will identify and quantify the minerals present in rocks and soil powder samples delivered by the rover's robotic arm



Description

- CheMin Instrument is located inside the main body of the rover
- CheMin Uses
  - A technique called X-ray diffraction (XRD) for mineralogy characterization
  - X-ray fluorescence (XRF) for elemental characterization
  - A single detector for both measurements
  - One moving part (Sample wheel)



(CheMin XRD/XRF instrument)

What CheMin does?

- CheMin analyze the sample delivered to it by SA/SPaH
- It identifies the minerals present in Mars soil & rocks
- Mineralogy helps CheMin to assess the involvement of water in their formation, position and alteration
- CheMin data is useful in the search for potential mineral energy sources for life or indicators for past habitable environments

CheMin Requirements

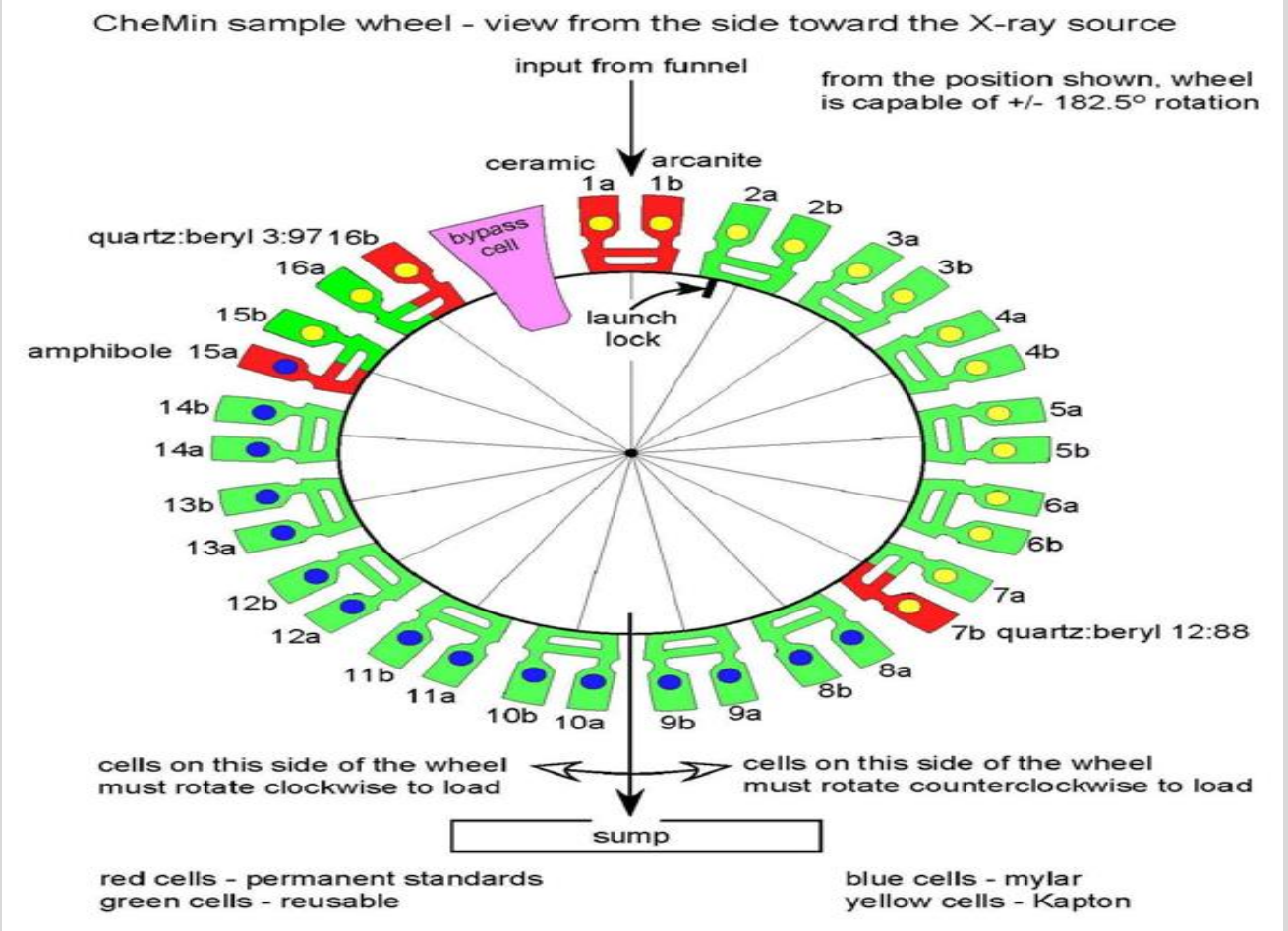
- Power Requirements
  - Chemin require 250W-hr power per evening for processing.
  - CheMin is limited to approximately 4 hours of analysis per evening of operation, with the remaining energy allocated for pre-analysis warm-up of the X-ray source, and post-analysis data processing and transfer.
  - The complete analysis of any one sample can take up to 10 hours, thus requiring multiple evenings to analyze a sample.

CheMin components

- Funnel
  - Receives drill powders or scoop samples from the SA/SPaH system
  - Maximum of 65 mm^3 of sample material is delivered
  - It contains a 1-mm mesh screen to keep larger than expected grains from entering the CheMin sample handling system
  - Grains that pass through the screen will pass into the upper reservoir portion of the sample cell
  - CheMin may reduce contamination by sample dilution

CheMin components

- Sample cell and sample wheel
  - Carries 27 reusable sample cells and 5 permanent reference standards
  - Only 10 mm^3 material is required to fill the sample cell
  - Remaining sample goes to reservoir (which is above cell)
  - During filling, analysis, and dumping, the sample cell is shaken by piezoelectric actuators (piezos)



(Sample Wheel And Sample cell)

CheMin components

- X-Ray Beam
  - X-ray beam from the X-ray tube is directed through a transmission sample cell containing sample
  - X-ray sensitive CCD imager is positioned on the opposite side of the sample from the source
  - X-ray diffraction occurs with the crystal material and form the rings i.e. a two-dimensional image that constitutes the diffraction pattern

CheMin Process

- CONFIG PHASE
  - Position the X-ray sensitive CDD imager
  - Receive drilled powder through the drill, scoop and CHIMRA sorting assembly

CheMin Process

- FILLING PHASE
  - Open chemin inlet protection cover
  - 16 dual cells on the sample wheel -> 1piezzo for each dual cell
  - piezzo is active during filling analysis and dumping
  - Turn on piezzoelectric actuators number X
  - put sample in the funnel
  - Close inlet protection cover

CheMin Process

- ANALYSIS PHASE
  - Turn on X-ray beam
  - CDD reads out and erase the X-ray flux multiple times (+1000times) for analysis
  - Data handling
  - Identify energy of X-rays strikes by the detector and produce 2D image of diffraction pattern
  - Sum all the X-ray detected by CDD into a histogram of number of

CheMin Process

- DUMPING PHASE
  - Rotate the sample wheel 180^0 (sample cell inversion)
  - Empty the cell after use by inverting and vibrating the sample cell over the sump
  - Rotate back to the next sample slot
  - Rotate the sample wheel 180^0-X (X corresponds to the distance between sample cells)
  - Turn off piezzo

CheMin Commands

- chemin on: start the chemin process
- xray_set_ position:set the xray position towards sample
- sample_receive:this message from telecommunication module
- cell _next:from the sample
- cell_clean_current:dump the sample
- inlet_open:open the
- inlet_close:

CheMin Commands

- xray_turn_on: turn on the x-ray beam
- analysis_start:start analysis on sample
- cdd_create_diffreaction_image:
- cdd_create_1d_2t_plot:
- send_result:send result to telecommunication server
- power_off:turn off the chemin and terminate the process.

Code Explanation

- SimulateRoverMain
  - Module creation
    - CheMinModuleMain
    - Power Server
    - Telecom Server
  - Module launching
    - CheMinModuleMain is launched
      - Threads for CheMin server and CheMin process are created & started
    - Server threads for Power and Telecom are created & started

Code Explanation

- CheMin server
  - If message is ‘chemin_on’
    - Set CCU to true and create CheminClient(9013->power) thread and start it
  - If message is ‘power on’
    - Launch chemin process create CheminClient(9002->Telecom) thread and start it
  - If message is ‘Power Off’
    - Then free Chemin threads

Code Explanation

- CheMin Client
  - If port is 9013
    - PowerRequirement is sent to PowerClient
  - If port is 9002
    - XrdDiffraction image is sent to TelecomClient

Code Explanation

- CheMin Process - can receive the text file which contains the commands to execute
  - f_xray_set_position()
    - set and configure x-ray beam position
  - f_sample_receive()
    - launch the powder sample receiving procedure
    - If inlet cover is opened, abort the operation

Code Explanation

- f_cell_go_to(5)
  - Choose the sample cell (depending on given sample cell number and current sample cell)
- f_cell_clean_current()
  - Start the cleaning procedure
- f_inlet_open()
  - Open inlet cover if not opened already

Code Explanation

- f_piezzo_tun_on(v_current_sample_cell/2)
  - Turn on the given piezzo if not on
- f_inlet_close()
  - Close inlet cover if not closed already
- f_piezzo_turn_off(v_current_sample_cell/2)
  - Turn off the given piezzo if not off
- f_xray_turn_on()

Code Explanation

- f_analysis_start()
  - Verify that every component is ready to start analysis phase
    - X-ray position
    - X-ray on
    - Inlet cover closed
    - Sample cell contamination checked
    - Sample not contaminated

Code Explanation

- f_analysis_start()
  - Starts analysis // not clear with this
    - play music ‘voice.mp3’
    - f_cdd_read_erase()

Code Explanation

- f_cdd_create_diffraction_image()
  - Create diffraction image
- f_cdd_create_1d_2t_plot()
  - Create 1D 2theta plot image
- f_send_results()
  - End of process, send results to telecom

Code Explanation

- Power Server
  - Waits for client message
  - If receive message, print it
    - then create power client(9008->CheminServer) thread and start it

Code Explanation

- Power Client
  - Print socket port
  - If socket port is 9008
    - then send "POWER ON" to port 9008 (to Chemin Server)

Code Explanation

- Telecom Server
  - Waits for client message
  - If receive message print it
    - then create telecom client(9008->CheminServer) thread and start it

Code Explanation

- Telecom Client
  - Print socket port
  - If socket port is 9008
    - then send "Chemin receives telecom acknowledge" to port 9008 (to Chemin Server)