Brief History of CRISM
Observing Modes

Nov 2015
**Observing Schematic & Gimbal Range of Motion**

Original range of gimbal motion
+60° to -60°

MRO orbit track direction

Each dashed line represents an EPF scan, originally 5 on each incoming and outgoing side of the central scan, with 2 scans later added near +/- 20 deg for EPF observing mode.

Central scan

Gimbal Angle

+60° to +30° to nadir (since 2012_275) +30° to -60°(2010_280 to 2012_146)

-60°
Timeline of Observing Modes

- Obs. mode: FRT, HRL, HRS, EPF, ATO, FRS, ATU, MSW, MSP, HSV, HSP, MSV, LMB, TOD, FFC
- Green bars: gimbaled
- Blue bars: pushbroom

Space Exploration
Timeline of Observing Modes: **Gimbaled** *(Surface Science)*

First Generation (“Classic”)
- Gimbal range +/-60°
  - 5 incoming EPFs
  - Central scan
  - 5 outgoing EPFs
- 2 segments added to EPF mode

Second Generation
- Restricted gimbal range (-30° to nadir)
  - no EPFs
  - half central scan

PSP mission phase → obs. mode ↓
FRT
HRL
HRS
EPF
ATO
FRS
ATU

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<th>ESP</th>
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**Classic Targeted Observing Modes: FRT, EPF**

- **Full Resolution Targeted (FRT)**
  - central scan only

- **Emission Phase Function (EPF) mode**
  - consists of 5 (or 6) incoming and outgoing scans plus a 10x-binned, ~200 m/pix central scan
  - Each FRT/HRL/HRS also has 5 EPF segments but the central scan is ~20 or ~40 m/pix.

~20 m/pix

FRT central scan + EPF sequence
Classic Targeted Observing Modes: HRL, HRS

Half Resolution Long (HRL)

Half Resolution Short (HRS)

40 m/pix
Second Generation Targeted Observing Modes

- **Full Resolution Short (FRS)** (~20 m/pix)
- **Along Track Oversampled (ATO)** (variant of FRT before 2012_142) (highest spatial resolution in center)
- **Along Track Undersampled (ATU)** (~40 m/pix downtrack)
- **ATO** (after 2012_142) (up to ~8 m/pix downtrack, but requires special processing for increased resolution)

~20 m/pix (cross-track)
Timeline of Observing Modes: **Mapping**

- **MSW, MSV** = 5x binned = 100 m/pix
- **MSP, HSV, HSP** = 10x binned = 200 m/pix

Began VNIR-only observing modes (both mapping and targeted types)

Hyperspectral mapping modes
Mapping Modes

100 m/pix

MultiSpectral Window (MSW)

MultiSpectral VNIR (MSV)

200 m/pix

MultiSPectral Mapping (MSP)

HyperSPectral Mapping (HSP)

HyperSPECTral VNIR (HSV)

All mapping mode observations can vary in length:
~45, 180, or 540 km
Timeline of Observing Modes: Atmospheric Modes and Calibrations

- **Emission Phase Function (EPFs)**: Acquired throughout the mission (see also slide 5)

- **Tracking Optical Depth (TODs)**: Hyperspectral, 10x binned snapshots to help fill spatial and temporal gaps between targeted observations, generally for atmospheric characterization.

- **LiMB Scans (LMBs)**: Requires spacecraft pitch maneuver to view limb of planet, low-angle gimbal scan.

Timeline:

- **PSP**: 2007-2008
- **ESP**: 2009-2010
- **EM1**: 2011
- **EM2**: 2012
- **EM3**: 2013-2015

Mission Phases:
- **Mission Phase**: Obs. mode
- **Function** (EPFs)

**Flat Field Calibrations (FFCs)**: Acquired throughout the mission.
LMB

space

atmosphere

surface

TOD

- 4 hyperspectral snapshots of surface
- Pixels are non-square and elongated downtrack – similar to flat fields

EPF not shown (see slide 5)
Summary: Current Suite of Observing Modes

- FRS
- ATU
- ATO
- MSV
- MSP, HSP, HSV
- TOD
- LMB
Summary: Current Observing Mode Spectral Sampling

- **VNIR IR**
  - FRT, HRL, HRS, EPF
  - FRS, ATU, ATO, LMB, TOD

- **VNIR-only modes:**
  - HSV/FRS/ATO/ATU

- **MSV**

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