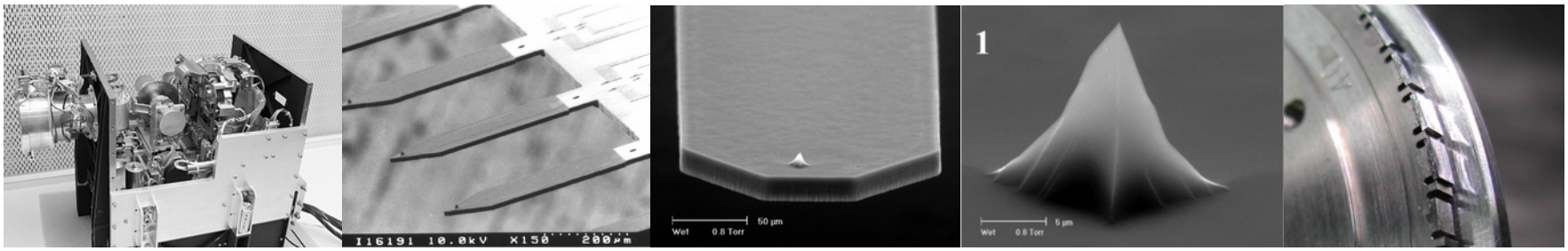
ÖAW IWF

Micro-Imaging Dust Analysis System

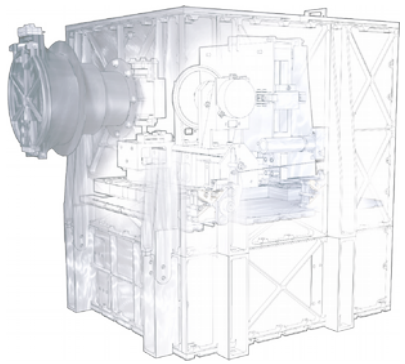


MIDAS team and archiving status

SWT #48, ESAC, Madrid

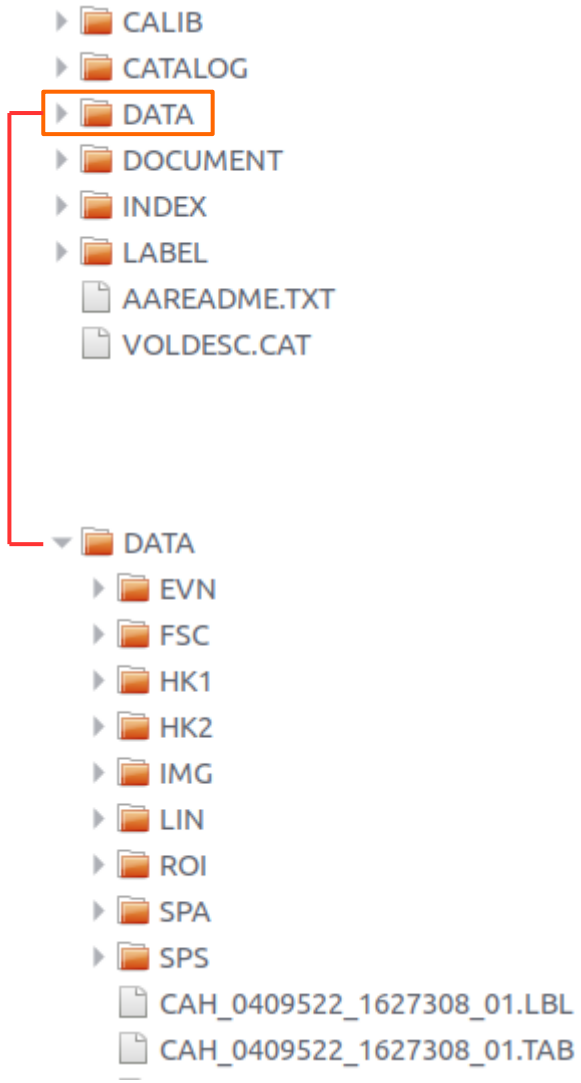
Mark S. Bentley

on behalf of the MIDAS team



@msbentley
@RosettaMIDAS

MIDAS archive products

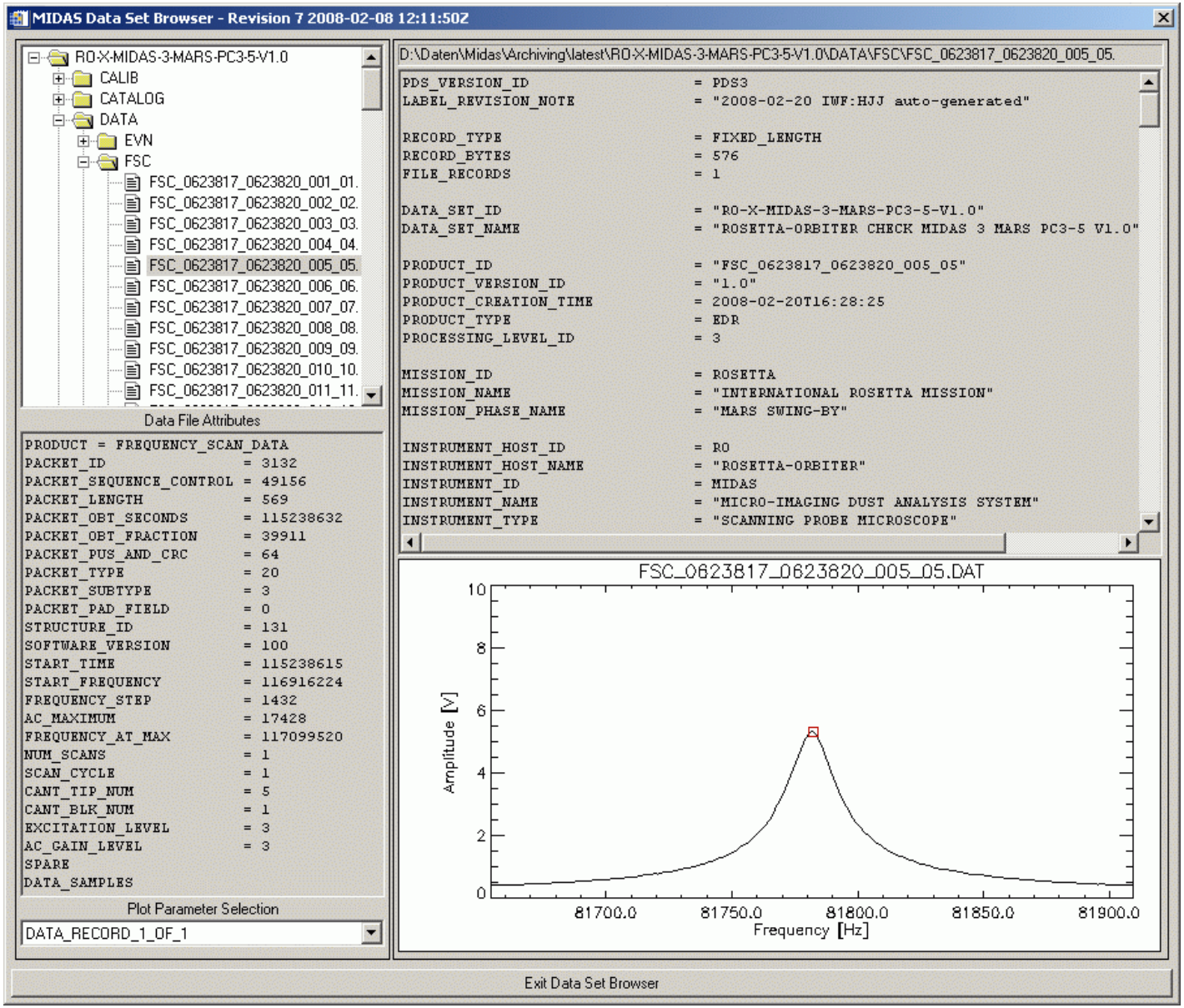


- EVN – instrument events
- FSC – frequency scans
- HK1 – engineering HK
- HK2 – science HK
- **IMG – AFM scans/images**
- LIN – line scans (topography)
- ROI – feature detected onboard
- SPA – approach/retraction curve
- SPS – vibration monitoring
- CAH – cantilever history
- **TGH – target history**

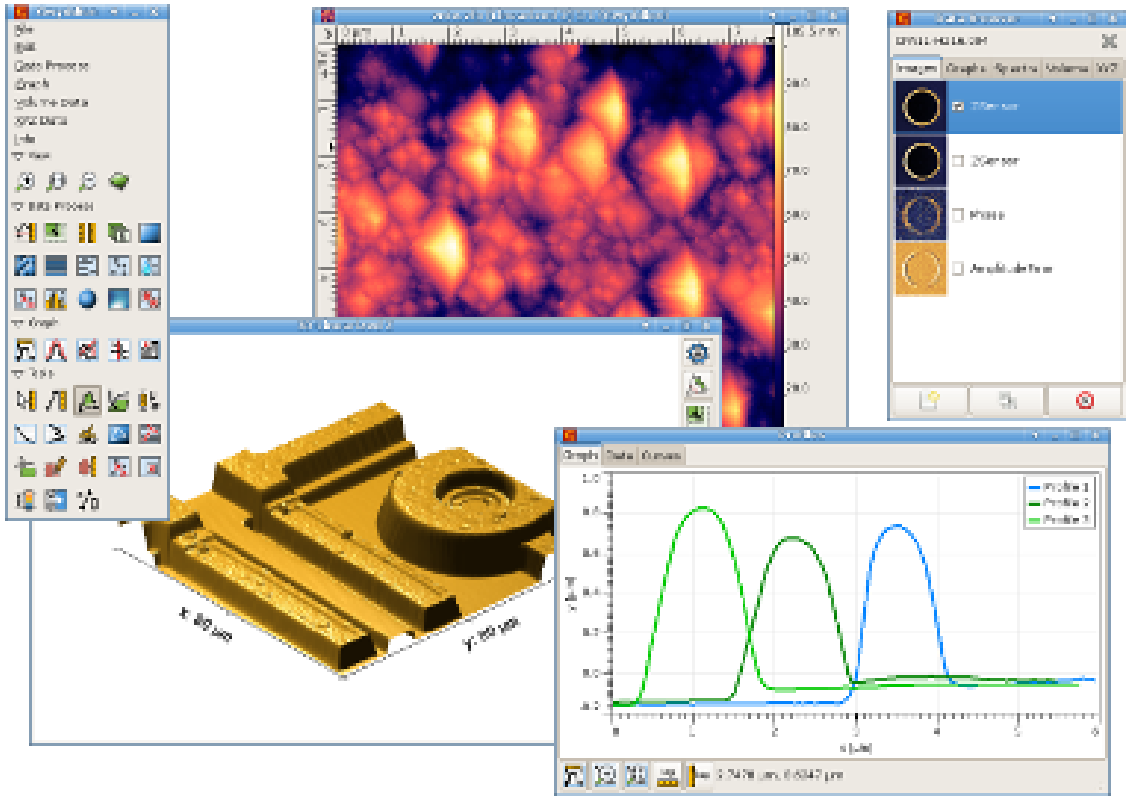
MIDAS archive products

- Key data product:
  - `DATA/IMG/IMG*ZS.[`*`LBL/IMG`*`]`
    - ZS = Z Set-point (topography)
  - IMG file = BCR (standard AFM format)
    - can be opened with free/open source tools
    - data are rectangular height fields
  - 2D plots with any PDS3 viewer (e.g. NASAView)
- Archive browser tool
  - source code in `DOCUMENT/CODE` folder
  - browses science products and instrument HK
  - IDL (and license!) required

Archive browser



- Gwyddion – open-source AFM toolkit
  - http://gwyddion.net/
  - cross-platform, python shell for scripting



Working with IMG/BCR files

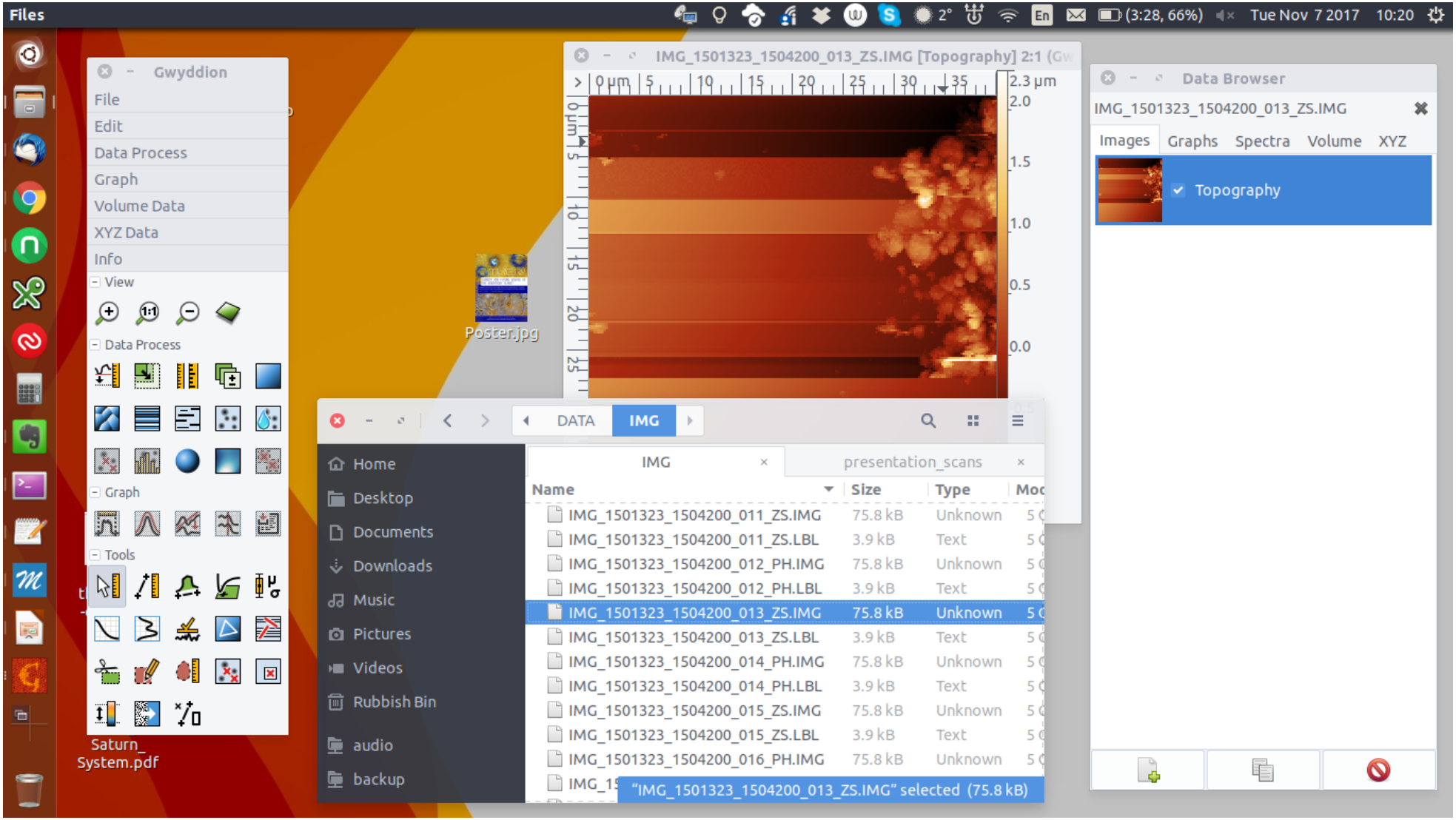
- Example data
  - Figure 3 from Bentley *et al.* (2016)

	Figure 1	Figure 2	Figure 3
target	14	12	12
cantilever	9	9	7
image resolution	256 x 256	256 x 256	192 x 192
image size	80 x 80 µm²	20 x 20 µm²	40 x 40 µm²
pixel resolution	312 nm	80 nm	210 nm
z step size	0.7 nm	0.7 nm	0.7 nm
retraction height	1095 nm	977 nm	734 nm
duration	1 day, 05:05:33	08:14:15	11:16:30
start time	2015-04-29T05:21:40Z	2015-03-13T08:44:38Z	2015-01-18T20:59:28Z
filename	IMG_1509813_1512600_054_ZS	IMG_1507001_1508813_005_ZS	IMG_1501323_1504200_013_ZS

ESC2 ESC2 ESC1

https://www.nature.com/nature/journal/v537/n7618/fig_tab/nature19091_ST1.html

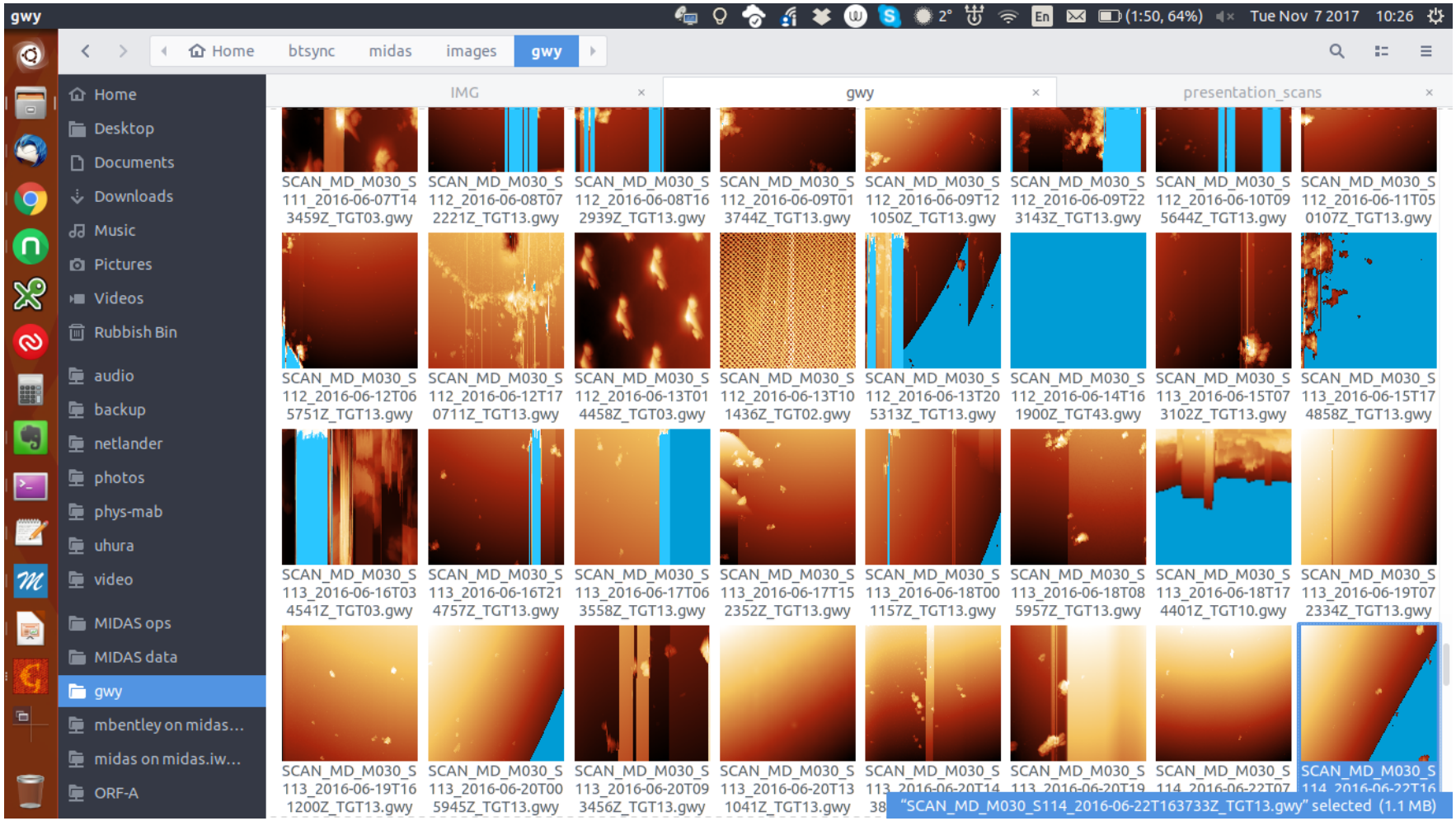
Working with IMG/BCR files



Just double-click the .IMG file!

Browsing images

- Gwyddion will automagically provide a thumbnail



Cantilever & target histories

- Two types of histories are tabulated
  - TGH: timestamped target SCAN vs EXPOSURE modes
  - CAH: timestamped cantilever (frequency scan/scan)
- To determine when dust was collected:
  - check the start/stop time of the image with dust
  - find the previous image showing *no* dust
  - check the CAH for exposures in between
    - can be more than one…
- Will be easier when the enhanced archiving is done
  - dust particle catalogue will be complete

Typical scan sequence

- To *fully* understand an image, the entire sequence of instrument operations can be important…
  - Rotate wheel
    - select target, coarse Y
  - Translate wheel
    - via linear stage – select cantilever and coarse X
  - Perform resonance sweep of selected cantilever
    - (dynamic mode only)
  - Approach target + fine-tuning
  - Repeated resonance sweep
  - Start line-by-line scan
- Event history can be used to follow this (per image)

Events and housekeeping

- EVN (instrument events)
  - Simple ASCII table of event time, ID and name

OBT	UTC	count	ID	name
394343624.644	2015-07-01 03:55:01.316000	15060	42552	EV_SHUT_CLOS_STARTED
394343638.356	2015-07-01 03:55:15.028000	15061	42554	EV_SHUT_CLOSED
394343924.616	2015-07-01 04:00:01.288000	15069	42674	EV_ABS_APPR_STARTED
394343941.839	2015-07-01 04:00:18.511000	15071	42624	EV_ABS_APP_POS_REACHED
394344104.658	2015-07-01 04:03:01.330000	15075	42661	EV_BACK_APP_STARTED
394344121.796	2015-07-01 04:03:18.468000	15076	42768	EV_APP_LVDT_ON_MIN_POS
394344164.669	2015-07-01 04:04:01.341000	15079	42652	EV_LIN_TO_ABS_STARTED
394344195.213	2015-07-01 04:04:31.885000	15080	42631	EV_LIN_POS_REACHED
394344346.461	2015-07-01 04:07:03.133000	15085	42591	EV_SEARCH_FOR_REF_PULSE
394344362.788	2015-07-01 04:07:19.460000	15086	42587	EV_SAVING_TABLE
394344363.014	2015-07-01 04:07:19.686000	15087	42592	EV_SEGMENT_FOUND
394344523.742	2015-07-01 04:10:00.414000	15091	42641	EV_F_SCAN_STARTED
394344524.77	2015-07-01 04:10:01.442000	15092	42642	EV_F_SCAN_CYCLE_STARTED
394344542.532	2015-07-01 04:10:19.204000	15094	42643	EV_F_SCAN_CYCLE_FINSHED

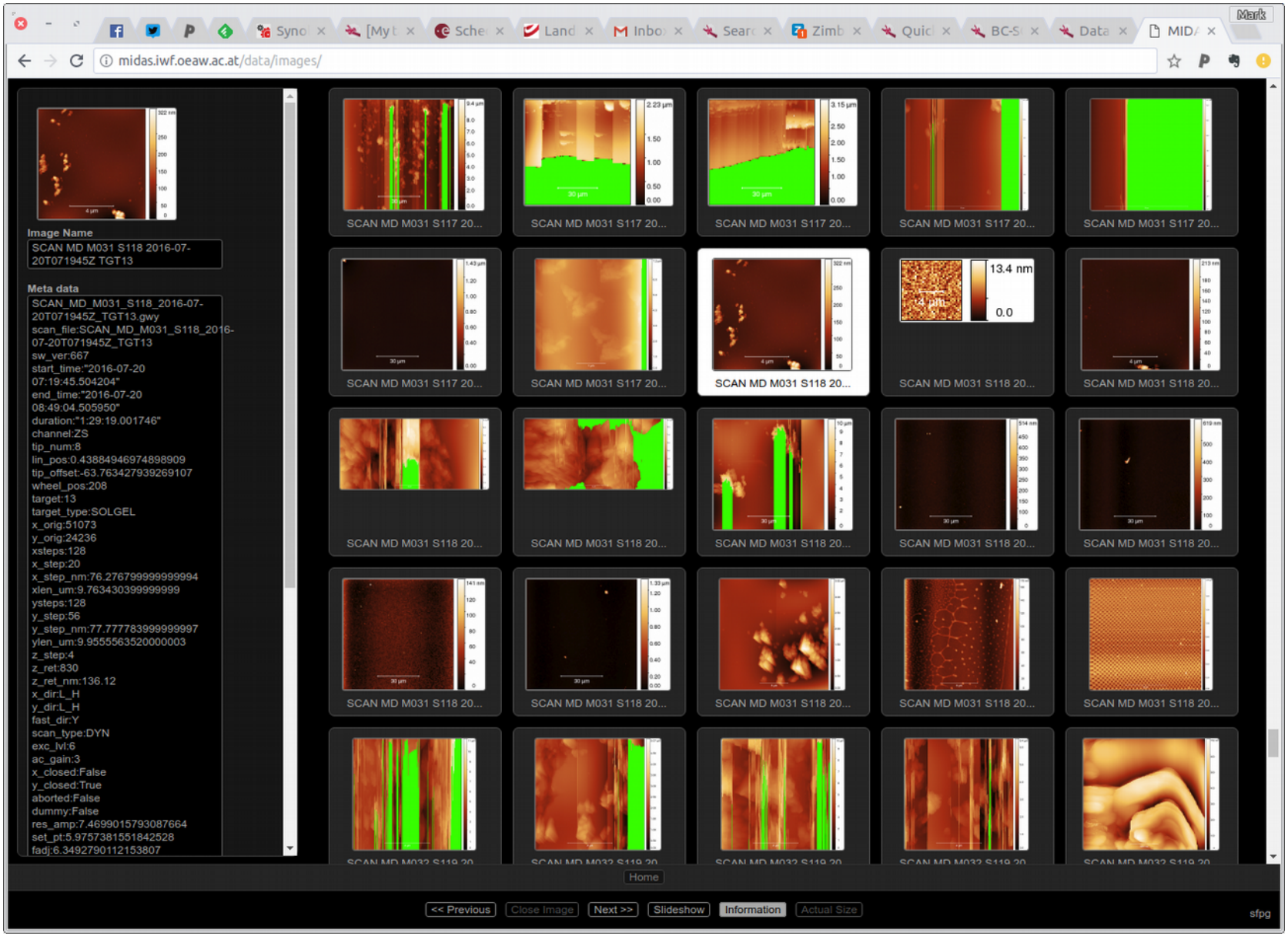
Events and housekeeping

- Two types of HK packet
  - HK1 – basic engineering parameters
  - HK2 – extended parameters
- Binary TLM packets in archive
  - use PDS3 tools to read ENG data
- Any parameter can be plotted by archive tool
  - internally we have an HDF5 file with ENG HK
    - this could also be made available

Beyond the PSA

- How else can we help you?
- Additional file formats?
  - internally MIDAS uses Gwyddion files
    - native format, multiple channels and types, meta-data
    - may try to provide access to these (not via PSA)
  - pipeline also produces PNG thumbnails
  - recently produced FITS files for a collaborator
- Image browser available
  - link to PSA products could be added

Beyond the PSA



So long!


SO LONG
AND
THANKS
FOR ALL
THE FISH
TELECONS
DISCUSSIONS
DATA
FUN!