

## MRD 142- Approach Dust Plume Survey

### Data Product Overview

One sentence executive description of product

The asteroid dust plume survey will be conducted during the Encounter phase and look for evidence of dust in vicinity and along the orbit plane of Bennu.

#### Overview

Data type (image, spectrum, data table, map format etc.)

two images and data tables

What does it measure at what scale

the existence of dust or gas released by Bennu over the past days, weeks or months within 100,000s of km of Bennu

What observations are required to provide the input data needed to make the data product?

OCAMS MapCam and PolyCam images

When in the DRM are the observations that make the data product scheduled to be taken?

September 12, 2018 (UTC) during the Approach Phase

How long does it take to produce the data product?

observations to be taken over a duration of hours, data products to be produced over a duration of 3 days

Is this product used of sample site selection, science value, or long-term science?

sample site selection

#### Data Product Structure and Organization

What is the structure of the data product (e.g. FITS file with 4 extensions)

ASCII and FITS file

How is the product organized (e.g. one data set per mission phase, one file per Earth Day, etc. )

four files

- one contains an image of the detected dust and shows its distribution relative to Bennu from PolyCam images
- one contains an image of the detected dust and shows its distribution relative to Bennu from MapCam images
- one contains measurements of the Full Width Half Maximum of Bennu and a number of stars in the field from PolyCam images
  - one contains measurements of the Full Width Half Maximum of Bennu and a number of stars in the field from MapCam images

## Data Format Descriptions

Header information (metadata) included with data product. For example:

Header for dust plume image map [kept in FITS image header]

date and mid-time of image (UT and modified julian date), plate scale (in arcseconds per pixel and km per pixel)

Header for dust plume model [table headers]

mid-point of observation (UT and modified julian date), Bennu FWHM (arc seconds), mean background star FWHM (arc seconds)

Detailed Description of data format. For example:

Table

Data Type

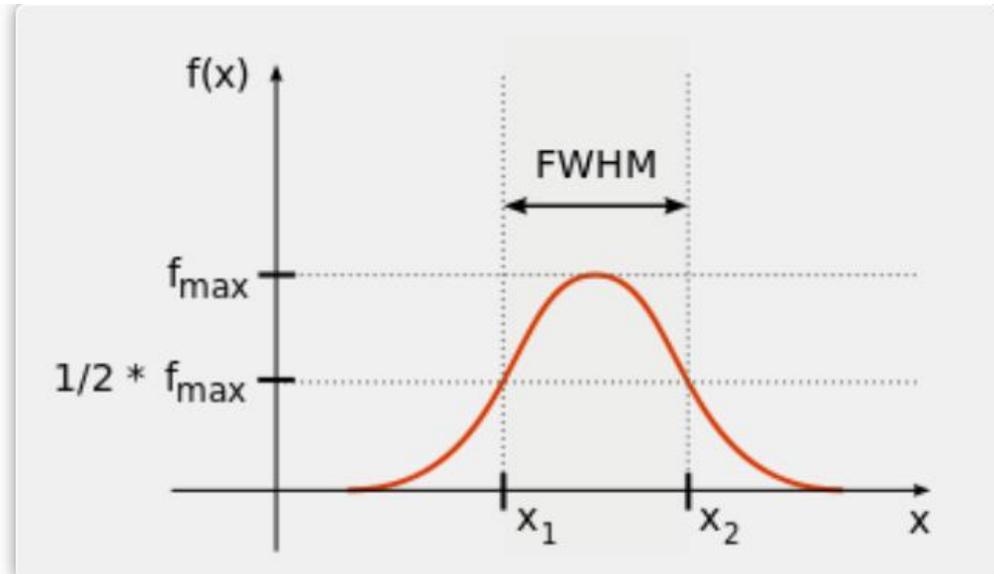
ASCII

Field name, Field Description, Field Length, Field Format

mid-point of observations - field will contain the date in UT calendar format (YYYY/MM/DD.DDDDD) and modified julian date (XXXXXXXX.XXXXX) for the middle point of the exposure time for image (or images) used to create the dust plume map

Bennu Full Width Half Maximum (FWHM) - the FWHM of Bennu measured off of an image co-added on the motion of Bennu. The image of a point source in an astronomical picture is modeled as a Gaussian curve. FWHM is a measure of the width of an astronomical object in an image. It is measured in arc seconds.

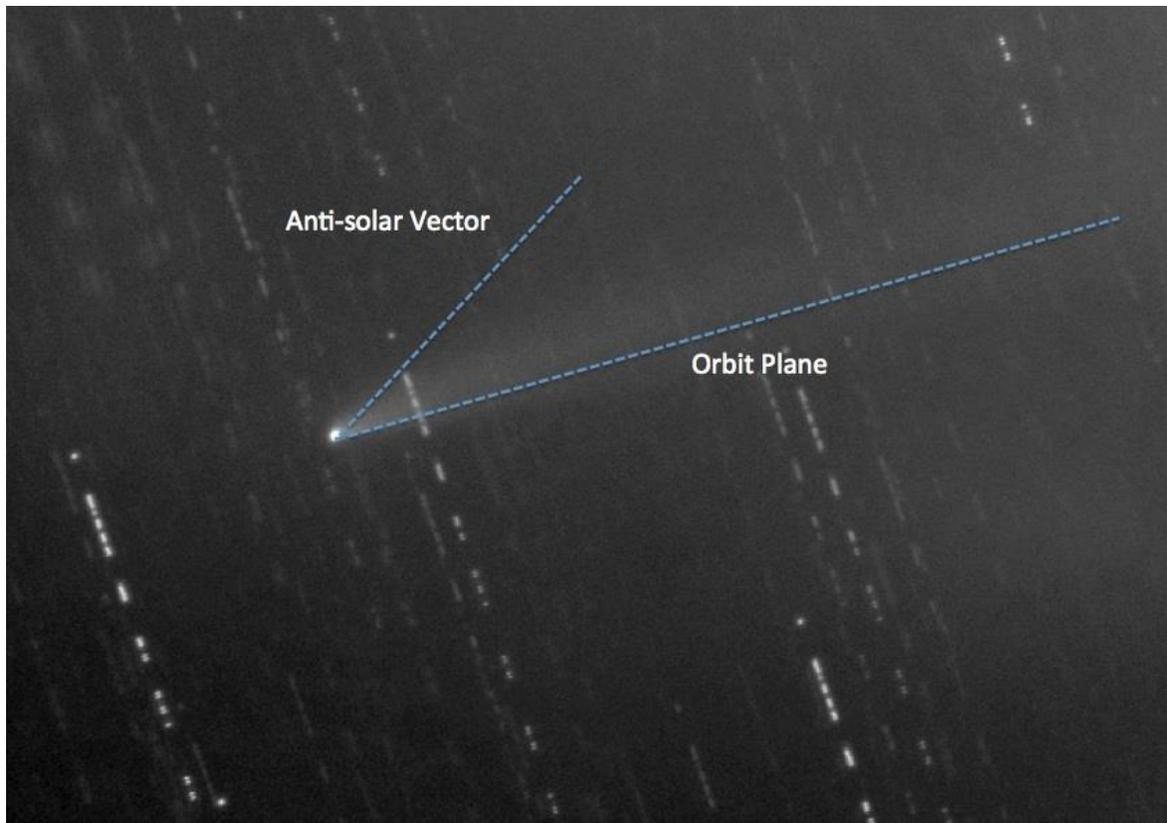
Mean Background Stars Full Width Half Maximum (FWHM) - the mean FWHM of 4 or more stars in the Dust Plume Search field. The FWHM is measured off of an imaged co-added on the position of the stars.



example of dust plume table format:

2018 09 12.123456 12.34 11.23

Dust map: example of an Approach phase dust map (example image is a ground-based image of the low-activity comet 49P/Arend-Rigaux, plate scale image size and limiting magnitude are different than for PolyCam)



## Data Product Generation

How and by whom is the product generated?

What are the input products needed to produce the product?

MapCam/PolyCam L2 images of Bennu, Bennu ephemeris position, MapCam/PolyCam image exposure time, MapCam/PolyCam image exposure duration

Are there format expectations for the input products?

Yes. MapCam image headers need to use the standard FITS header format. A list of FITS keywords and their meanings is required for reading these values into the photometry software.

What algorithms and/or calibration data is used to generate products?

Bennu Dust Plume Search algorithm (ALG-AP-[TBD]), OCAMS MapCam/PolyCam flat field calibrations

Are there format expectations for the inputs?

No.

Has a specific Science Team Member been assigned to produce this product?

Carl Hergenrother

Will multiple versions of the product be generated?

Nominally no. If dust is detected from Bennu, contingency observations will be made during the following weeks. These data products would then be produced after every Approach phase dust plume search to characterize the temporal behavior of dust production and dust dynamics.

How will they differ?

They will be the same.

On what cadence will they be delivered?

On the cadence determined by the dust plume contingency plan.

## Data Product Validation

How will the product be vetted to ensure contents and format are correct?

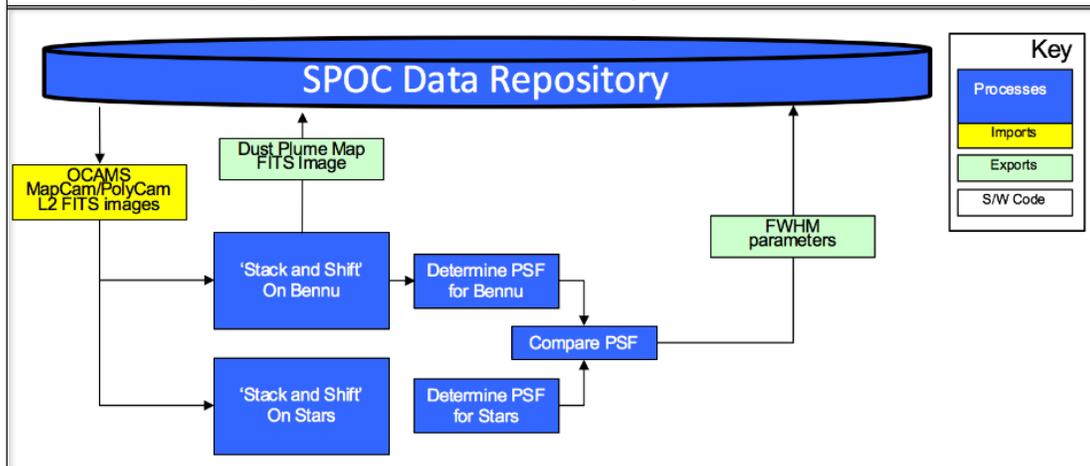
Software to be tested on real ground-based images of comets with low levels of activity and on synthetic dust plume data created with the SkyMaker software.



## Dust Plume Map and Properties

List functions of Dust Plume Map and Properties Generation:

1. Read MapCam/PolyCam L2 images from SPOC Data Repository
2. 'Stack and Shift' PolyCam images on the background stars to produce co-added 'stars' image
3. 'Stack and Shift' PolyCam images on the motion of Bennu to produce co-added 'Bennu' image
4. Determine point spread function (PSF) of Bennu from co-added 'Bennu' image
5. Save Dust Plume Search image data product to data repository
6. Determine point spread function (PSF) of background stars from co-added 'stars' image
7. Determine PSFs of Bennu and background stars
8. Save FWHM parameters data product to data repository



Describe the sources, destinations, and transfer procedures for data products.

State the size of an individual data product and the total size of all the data products generated over the course of each mission phase. Size estimate by Baseline?

State the time span covered by a product, if applicable, and the rate at which products are generated and delivered.

Both Dust Plume data products will be produced during the Approach phase. The ASCII product is very small ( $\ll 1$  MB) while the image will be the size of a single OCAMS FITS image (2 MB).

Standards used to generate data product  
Time (e.g. times are all converted to UTC)

UTC

Coordinate System

J2000 Right Ascension and Declination coordinates

Data Storage Conventions (i.e. byte order, compression, machine dependence)

Dust plume map and dust plume models to be saved to SPOC repository  
Product to be retrieved via WebQuery based on data product type (name)

Relevant ICD Data Products:

- Dust Plume Image (AP-18)