Cosmic Physics & Planetology Laboratory

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Projects related to DWG4

Observations of MBOSS from ground and space
GIADA
DUSTER
DARLING
LANDS
Laboratory analysis projects
Mission to NEOs

Observations of MBOSS from ground

Several observing campaign in past years (ESO, SAAO, TNG)
main aim: dust environment of **short period comets** around **perihelion** (mainly 46P/Wirtanen, in support to the Rosetta mission)

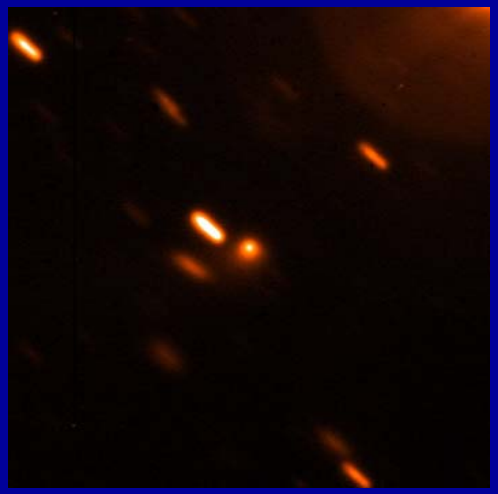
Last year was mainly devoted to a new project: **ADAM** (**A**nalysis of **D**istant **A**ctivity of **M**inor Bodies)

ADAM is a project aimed at analysing the activity of SPCs and Centaurs at heliocentric distances greater than 4 AU. Beyond 4 AU, the water sublimation rate is low and so the sublimation of other surface volatiles, such for example CO, could drive the presence of a coma and give rise to a dust environment expected to be different from that due to water. The activity far from the Sun has important implication both for the cometary population (the total lifetimes of nuclei could be overestimated) and for the replenishment of the zodiacal dust cloud. The aim is to observe a large number of targets, in order to compare activity levels and obtain hints about evolutionary differences for objects with different dynamical histories.

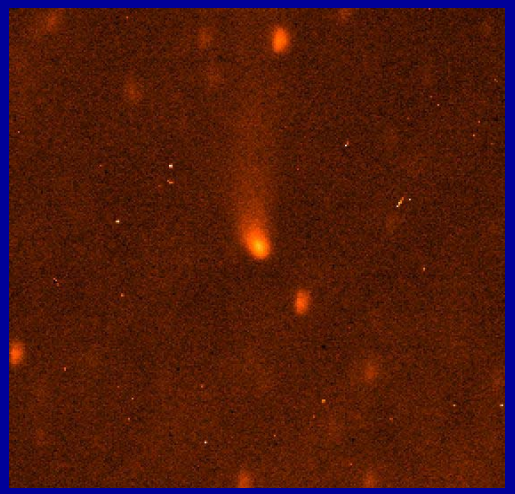
Observations of MBOSS from ground

Observing campaigns at European **large** telescopes performed (TNG, CalarAlto) and a **test** observing campaign has been proposed and accepted at the **medium** Italian telescope at ASIAGO (1.85 mt) (easier access to proposals with Italian PI)

Around 20 targets (comets and Centaurs) have been already imaged in the R filter at heliocentric distances between 3.5 and 7 AU



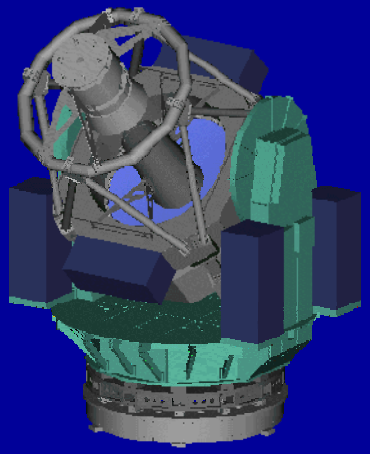
159P/LONEOS observed from TNG, @ 4.0 AU



C/2003 O1 (LINEAR) observed from 2.2 CalarAlto telescope, @ 7.4 AU

Observations of MBOSS from ground

Survey **STRANO** (**S**earch for **TRA**ns **N**eptunian **O**bjects) for the INAF-OAC guaranteed time with **VST** (**V**ery Large Telescope **S**urvey **T**elescope) *(to be completed in ESO - Paranal)*

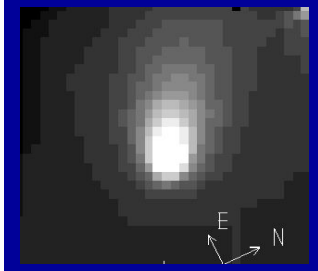


2.6 m aperture
1.47° FOV
16k × 16k CCD mosaics

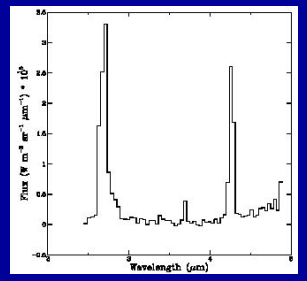
Presently:
- definition of the fields
- definition of technical characteristics

- organising a collaboration with Brett Gladman (University of British Columbia) - CFHTLS

Observations of MBOSS from space



Past: programs CONTRAST and EXTRACT for ISO (ISOCAM and ISOPHOT) to analyse in the IR range the dust and gas environment of SPCs



Present and **future**: to analyse in the IR range the dust and gas environment of SPCs and Centaurs with:
- ASTRO-F (proposal sent last week for observing period Oct.2006-Aug.2007)
- SPITZER (proposal for the Cycle-3 (Jun.2006-Jun2007) due 16 February 2006)

It should be necessary and **could be useful** to co-ordinate European projects in order to prepare huge and scientifically sounding proposal to be presented at non-European space facilities

Observations of MBOSS - inventory of resources

Ground and space observations (mainly imaging in BVRI filters, spectroscopy) of comets and Centaurs

Standard reduction of images; several have been used to derive activity parameters and as input for coma dynamics modelling

Observation programs are ongoing or have been submitted; new data on distant objects are expected in the next months

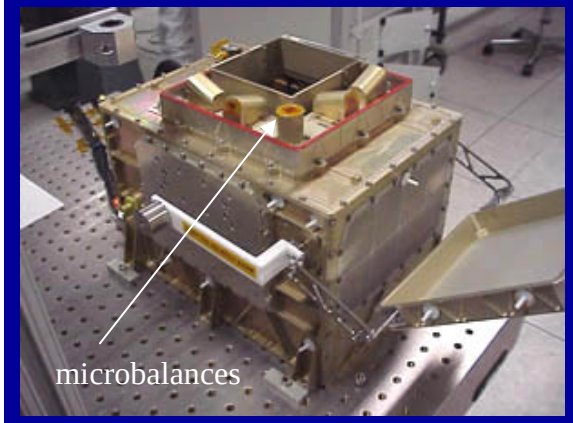
About 1500 frames

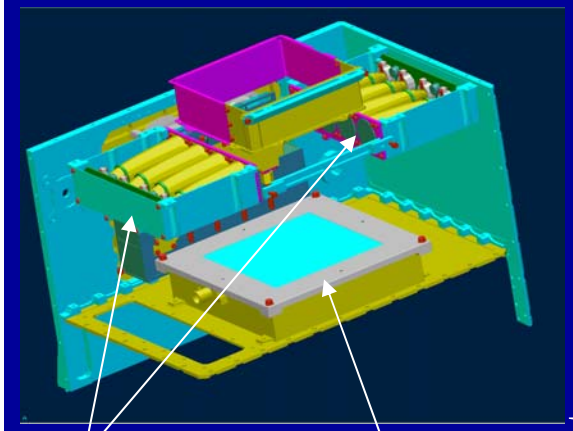
FITS formats

Several instruments(observatories, satellites) have been used. The data set is original, even if usually observatories keep copy of data for archive

No public access foreseen

GIADA - Grain Impact Analyser and Dust Accumulator





- On board the Rosetta mission towards 67P/Churyumov-Gerasimenko
- PI Luigi Colangeli
- International Consortium (I, E, UK, F, D)
- Industrial Partner: **Galileo Avionica** - Campi Bisenzio - Italy
  Sener - Madrid - Spain

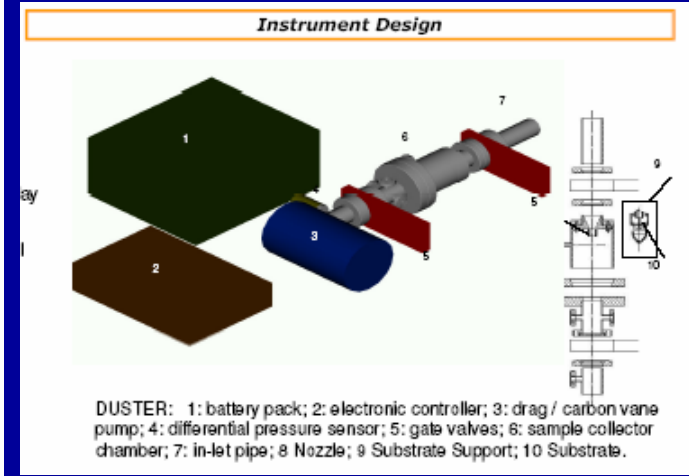
Science objectives

- Dust **flux** and **fluence** (different directions)
- Dynamics of cometary dust
  - Single grain **momentum**
  - Single grain **velocity**
  - Dust velocity distribution
- Grain **mass**
- Evolution of dust environment with time
- Infer optical/chemical properties

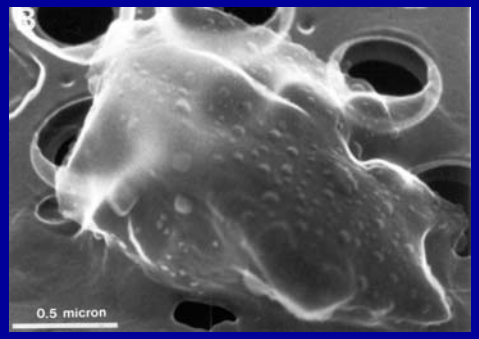
Science Operations Planning:

Long term programming scenarios (dust jet activity, surface characterisation…)

DUSTER - Dust in the Upper Stratosphere Tracking Experiment and Return



DUSTER: 1: battery pack; 2: electronic controller; 3: drag / carbon vane pump; 4: differential pressure sensor; 5: gate valves; 6: sample collector chamber; 7: in-let pipe; 8 Nozzle; 9 Substrate Support; 10 Substrate.

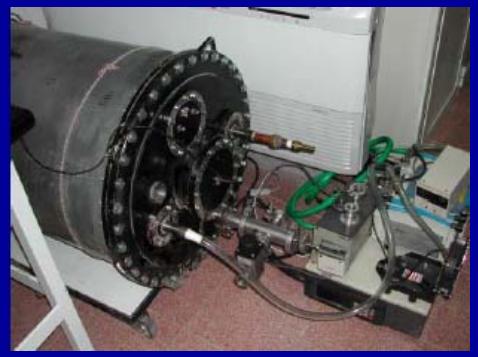


- PI **Pasquale Palumbo**

- Non-European collaborators: Univ. Of New Mexico
  Los Alamos Nat. Laboratory
  NY State University

Collection, retrieval and laboratory analysis of stratospheric dust:

- design and realisation of a dedicated instrument;
- flight on a balloon-borne platform in the stratosphere;
- sample retrieval and laboratory analysis;
- laboratory / modelling studies to determine the impact of our findings on climate studies



Thermal vacuum chamber where single components of DUSTER have been tested at p = 3÷10 mbar and T = -60°C.

N2 Discipline Working Group Meeting
Northeim, 21-23 November 2005

DARLING - Direct Analysis and Retrivial in Low earth orbit of INterplanetary Grains

Dust Monitoring Experiment for the ISS

PI: **Pasquale Palumbo**

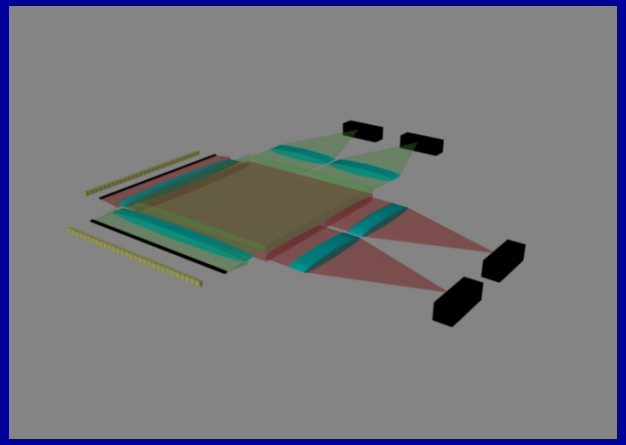
Comet-99 on MIR

Science objectives:

- quantitative determination of the flux of circum-terrestrial dust
- quantitative analysis of mass, size, velocity, density distribution and composition
- determination of the relative contribution to interplanetary population of cometary, asteroidal and interstellar components
- identification and discrimination of natural particles and debris
- identification of the sources of natural dust in the SS
- detection of organic matter in interplanetary and interstellar dust

Combination of passive

and active (GIADA) techniques

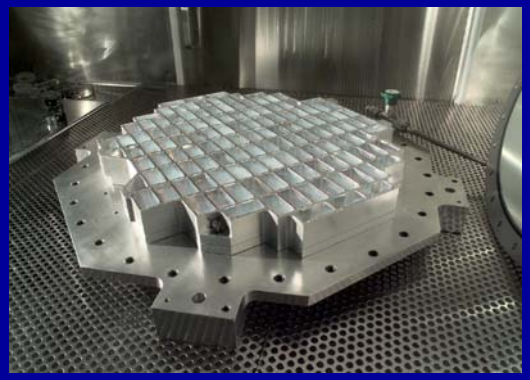


Preliminary estimated sensitivity ranges for the instruments:

$v < 10$ km s^{-1}

$d > 5$ μm

LANDS - Laboratory ANalyses of Dust from Space

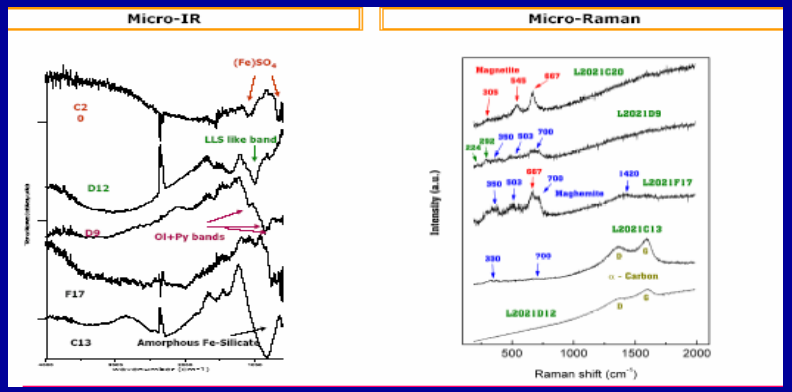


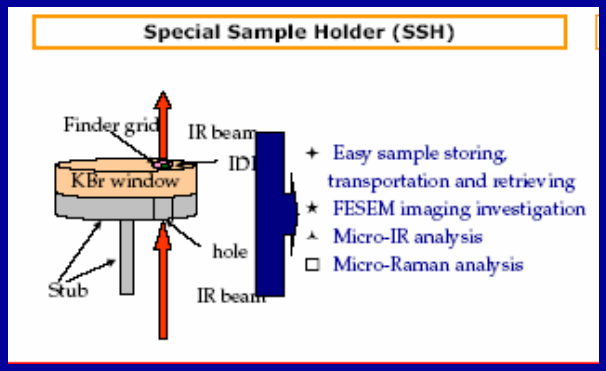
PI: **Alessandra Rotundi**

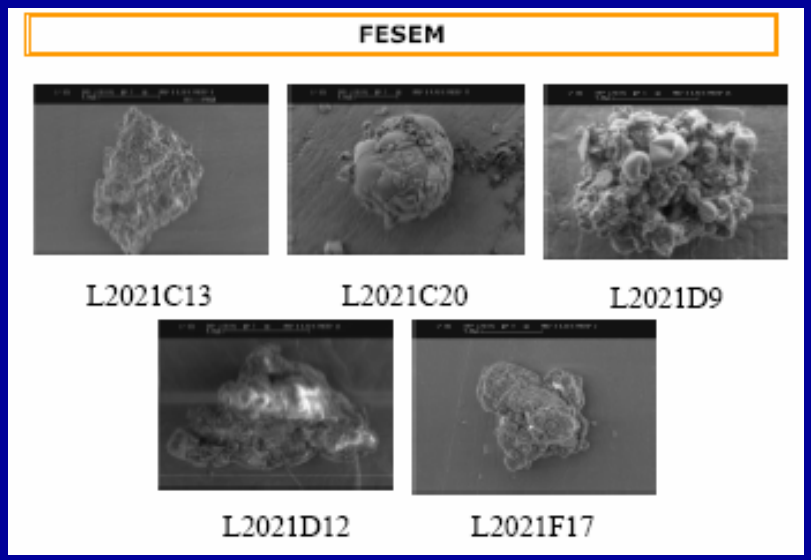
- Stardust space mission (NASA) collected interstellar and cometary dust in aerogel during a fly-by of comet 81P/Wild-2
- Samples will return to Earth in Jan. 2006;
- Our laboratory has been selected by NASA to be part of the Preliminary Examination Team;
- Samples will be analyzed in our laboratory by micro-IR, micro Raman, Field Emission Scanning Electron Micoscopy, Energy Dispersive X-ray Analysis.

Laboratory analysis projects

IDPs from the NASA stratospheric collection: Laboratory characterisation







L2021-	Texture	Size (μm)	IR-class	Raman
D9	aggregate very porous	12	Ol+Py	Maghemite[1] (+Hematite[2])
D12	aggregate very porous	10x8	LLS	α-Carbon
C13	aggregate low porosity	12x10	FeO	α-Carbon (+Maghemite)
C20	spherical compact	14	FeO - FeS	Magnetite[3]
F17	cluster compact	10	N.C.	Maghemite (+ Magnetite)

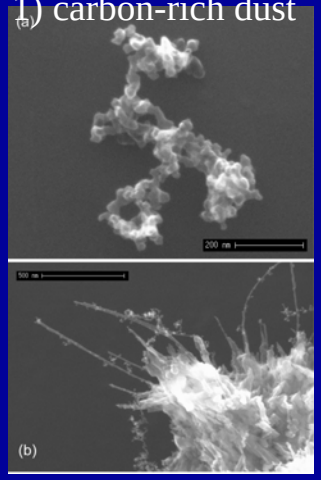
Table 1: IR-class* (Ol = Olivine, Py = Pyroxene, LLS = Layer Lattice Silicates) and other mineral phases (FeO = Fe- oxide-rich; FeS = Fe-sulfide-rich) – N.C. Not Classified; Raman spectroscopy (mineral phases. (1)= γ-Fe_2O_3 [maghemite] (2)= α-Fe_2O_3 [hematite](3) = Fe_3O_4[magnetite]. *The IDP IR classification is from [7]

Laboratory analysis projects

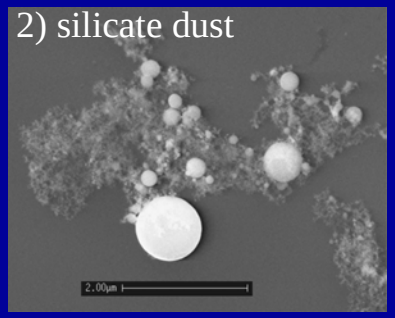
Cometary Dust Analogues (production and processing) for Rosetta

Cometary dust can be completely amorphous, partially ordered and crystalline; these components may coexist at small scales with variable composition.

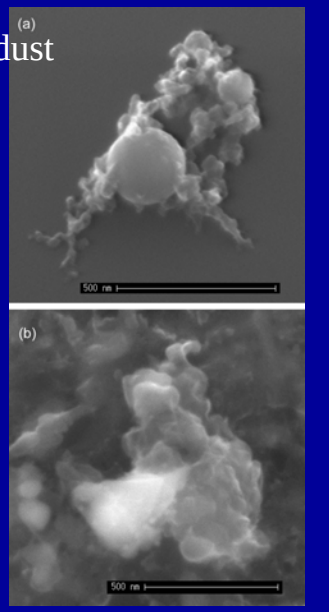
1) carbon-rich dust



2) silicate dust



3) silicate dust



We simulate the condensation and various post-condensation processes active in space.

Production:
laser ablation in Ar/O_2
arc discharge in Ar/H_2
grind, sieve materials

Processing:
thermal annealing
UV irradiation
H_2 bombardment

Laboratory analysis projects

Cometary Dust Analogues (production and processing) for Rosetta

Rosetta Payload:
Results Obtained on CDA

- VIRTIS: Well purified materials, with calibrated granulometry, were used for the calibration of VIRTIS-H in Meudon, to test the instrument capabilities on mineral samples.
- MIDAS: Several sets of samples to analyse instrument capabilities to discern various types of textures, morphologies and composition and to perform laboratory calibration of the instrument.
- COSIMA and OSIRIS: samples were used to perform laboratory measurements in support to the payload development.

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