RoSetta at Steins and toward Lutetia

Marcello Fulchignoni

Paris, May 19, 2009

Steins Fly-by Overview

4 August 2008 to 3 October 2008

Closest approach:

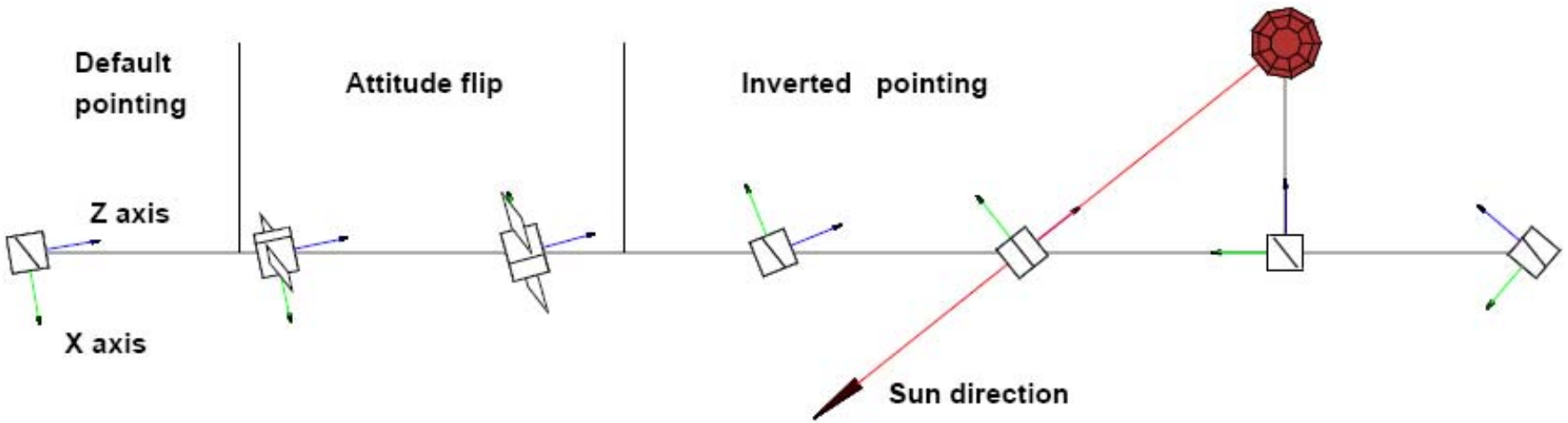
5 Sept. 2008 18:58

r_H = 2.14 AU, Δ = 2.41 AU

Relative velocity: 8.62 km/s

Targeted minimum flyby distance: 800 km

Final fly-by scenario: a complex matter



S/C flip started 40 min before closest approach
20 minutes duration

Phase angle coverage: 0-140°
Phase angle at approach: 38.5 deg
Phase angle zero at 1280 km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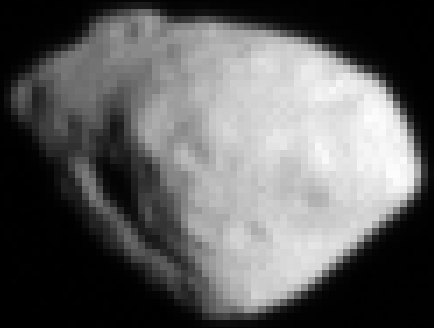
NAC best res. Image (100m/px)

5Sept UT: 18:28, dist:5200 km, phase=30°



WAC res. 100 m/px

5Sept UT: 18:36:45, dist=1029 km,phase=12°

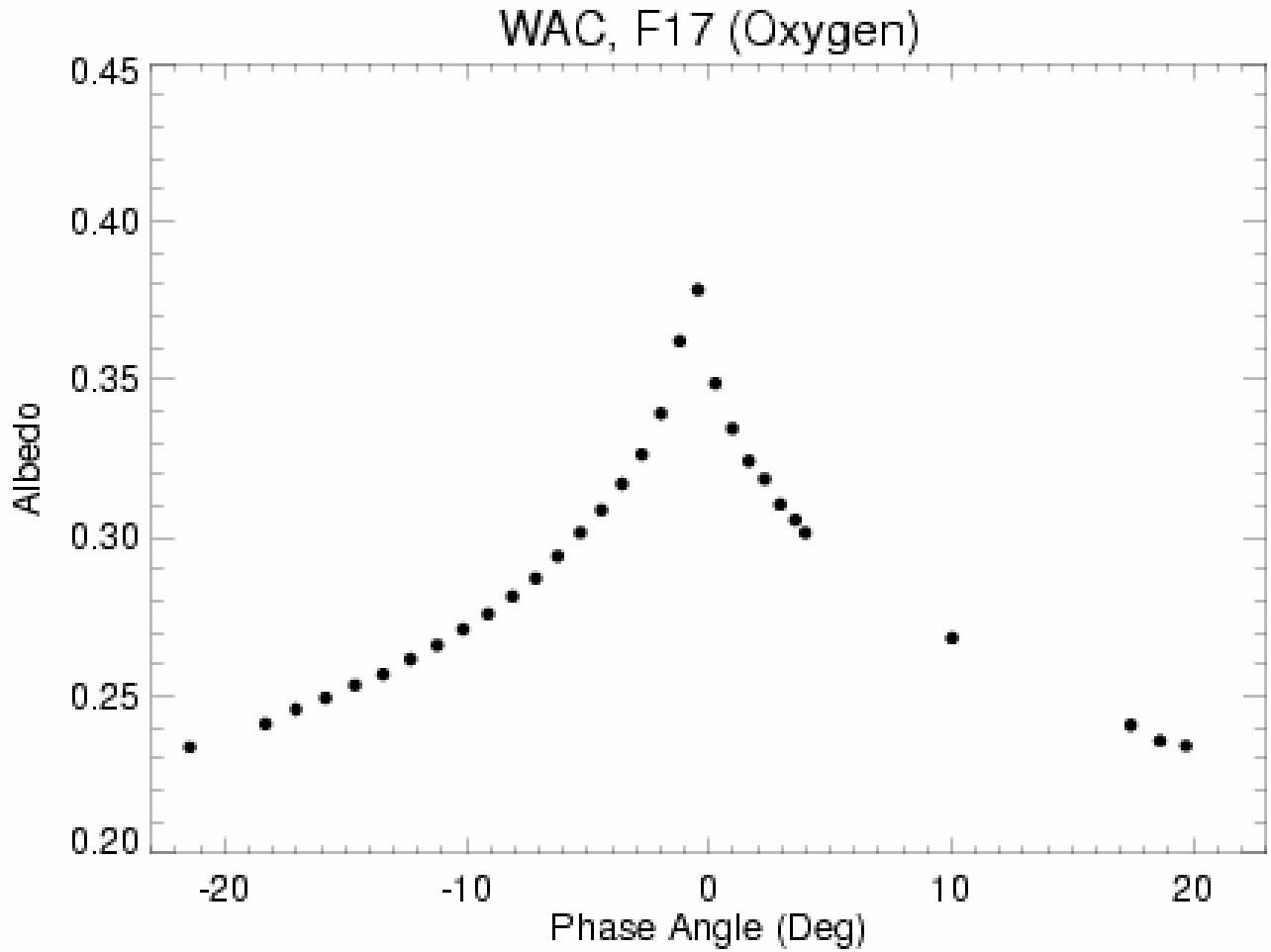
WAC best res. Image (80m/px)

5Sept UT: 18:38:15

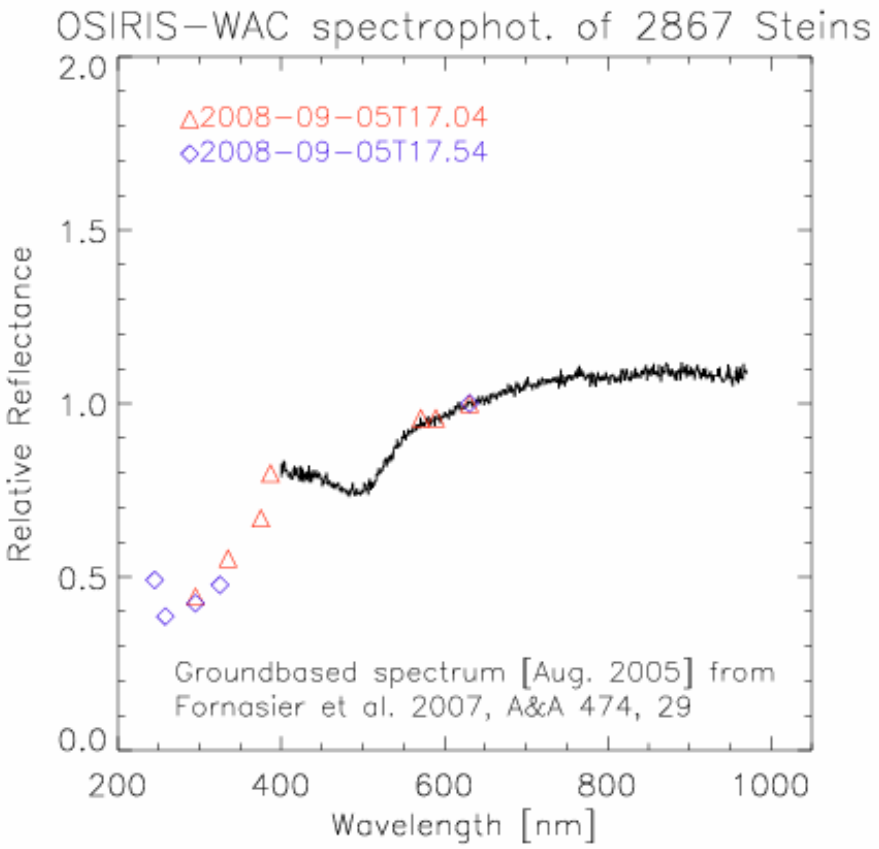
dist:806km,phase=50 °

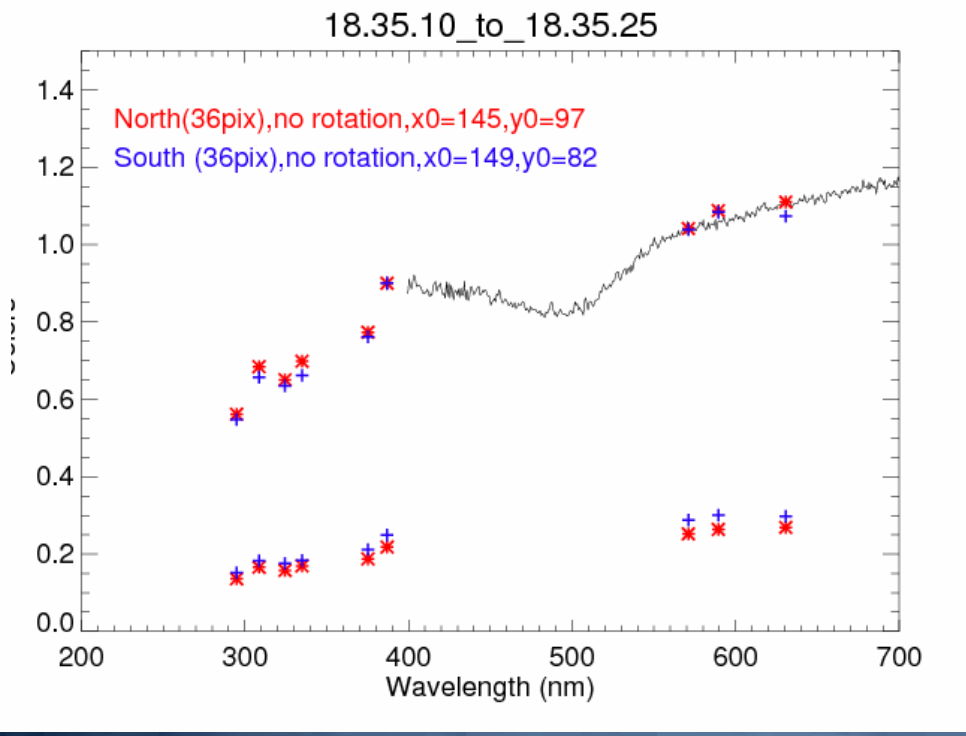
Colour images

Steins Albedo: 0.38 ± 0.05



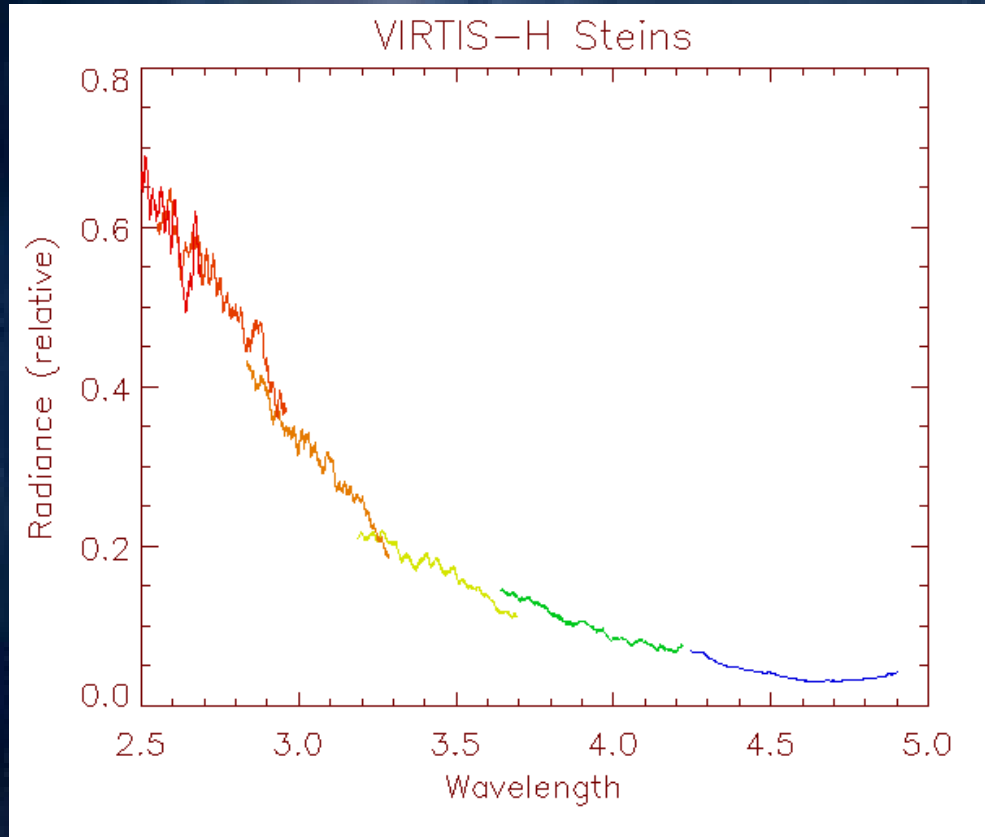
WAC Spectrophotometry



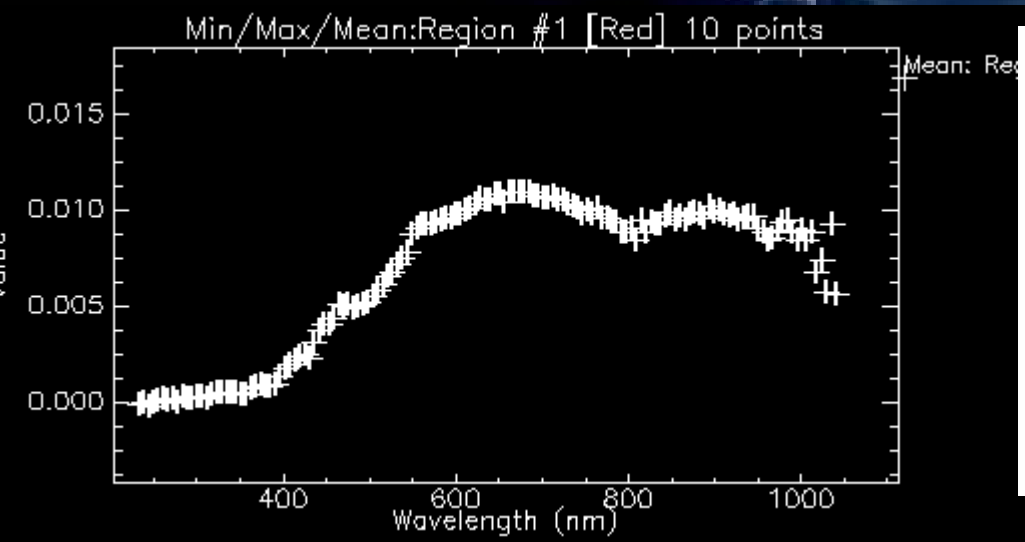


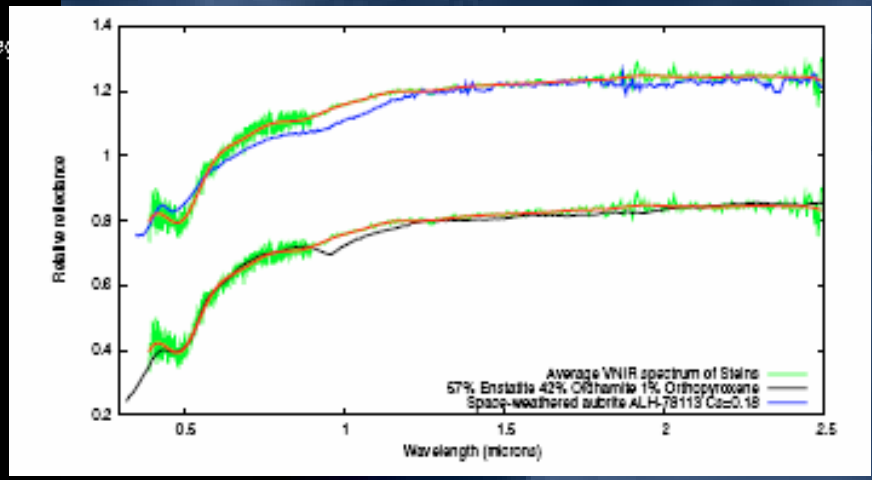
Virtis H Steins

- Spectrum in radiance units (still relative – absolute calibration waiting for filling factor accurate estimates from final pointing)



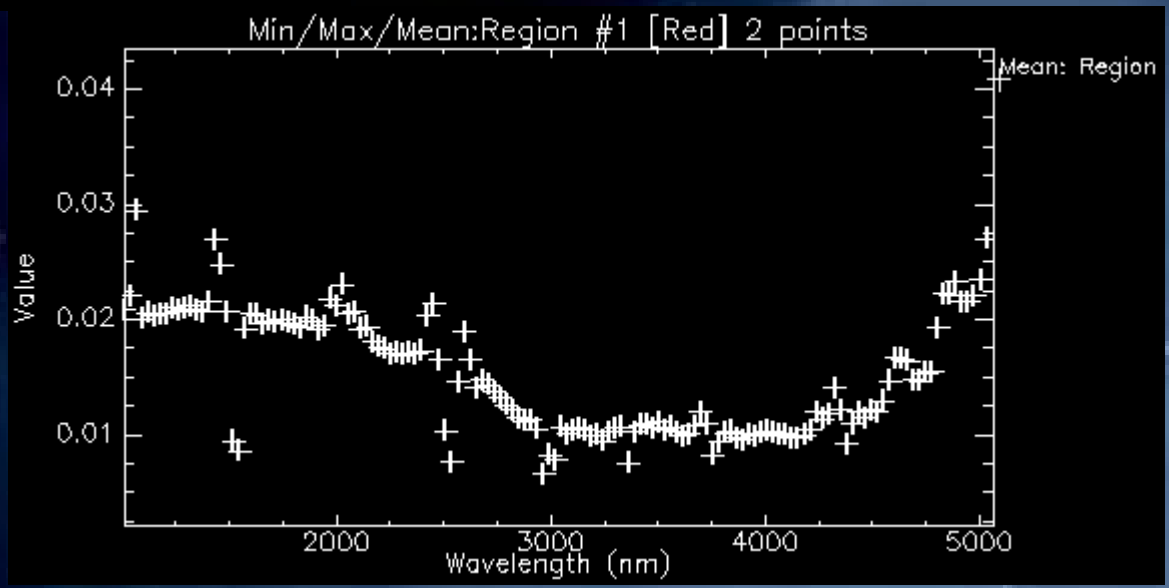
VIRTIS-M



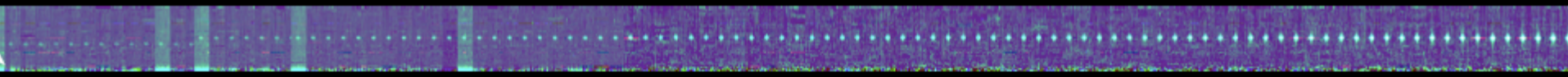


288 spectral bands (0.25-5 micron)

spatial resolution is ~ 300 m/pix



STEINS lightcurve sequence

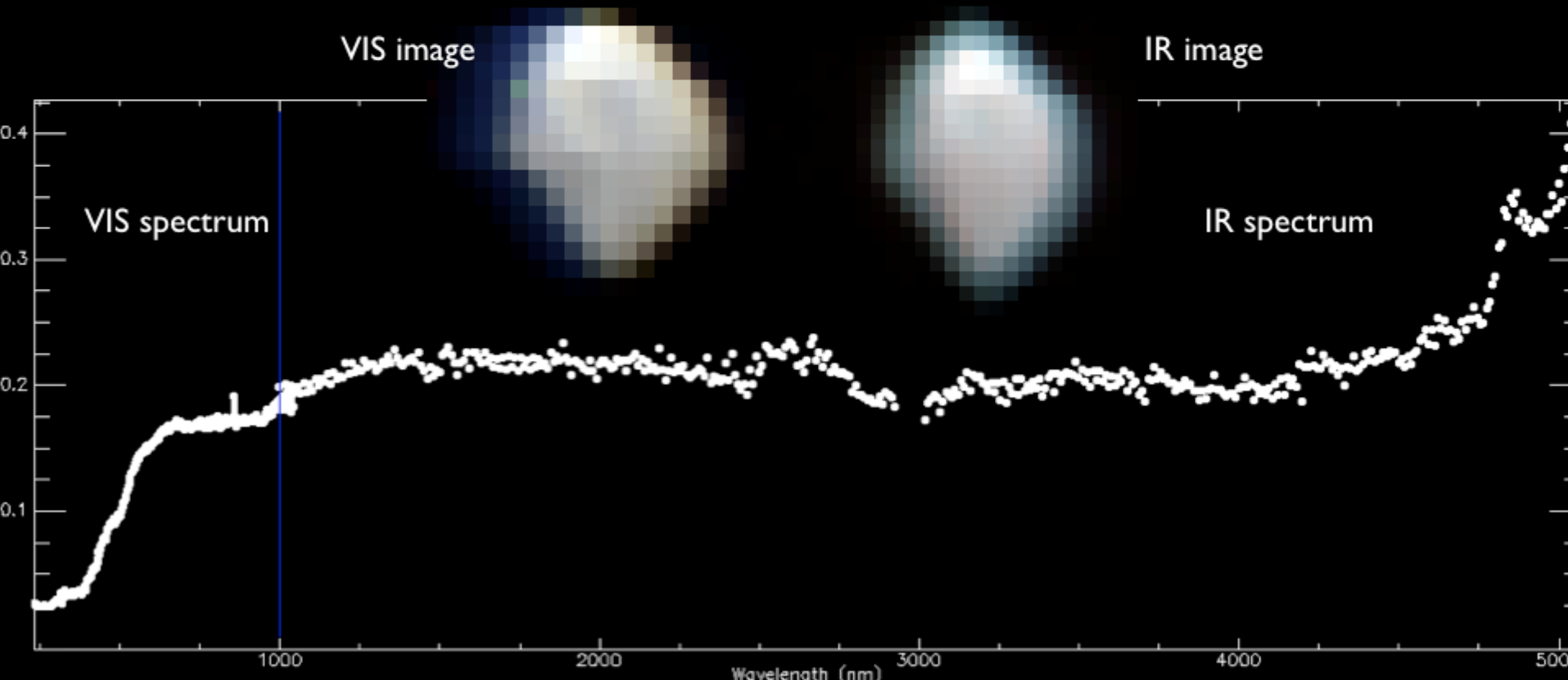


B 1.26µm - G 2.37µm - R 3.25µm

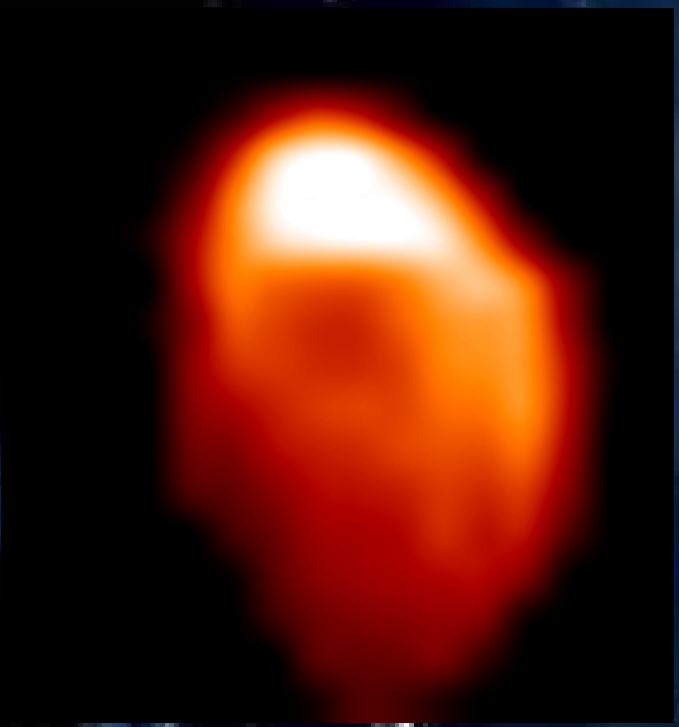
2008-09-05T11:30:08.284

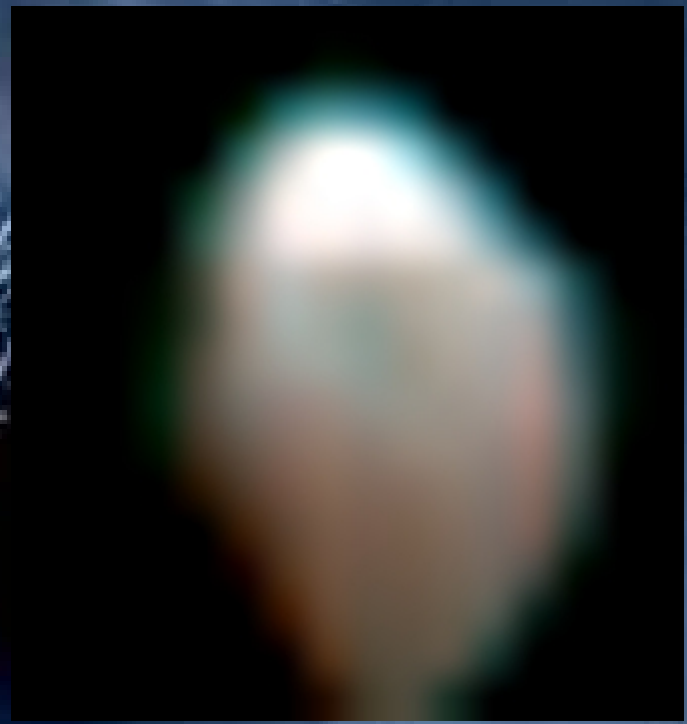
2008-09-05T17:58:14.763

STEINS high res observation

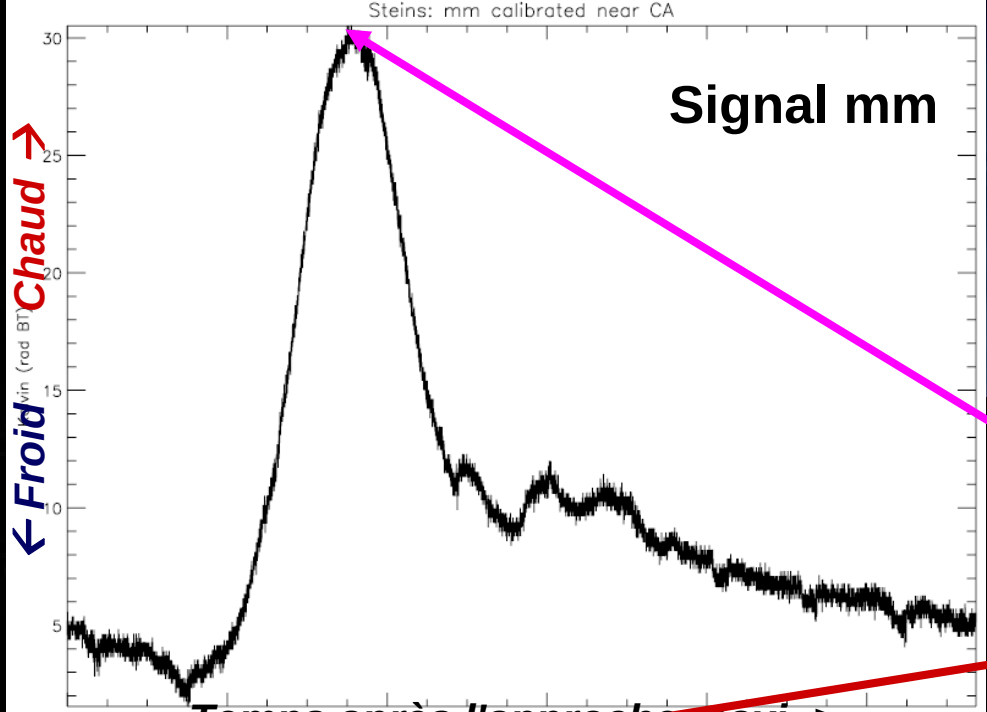


Temperature (left)and emissivity(right) Maps for ε =1

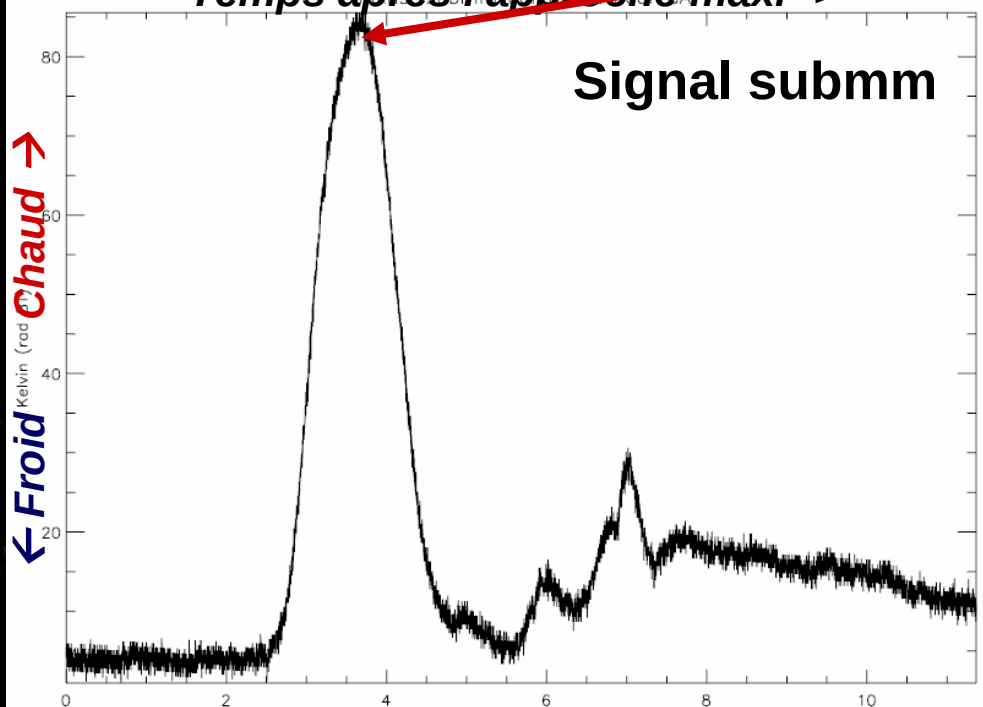




200 230



Temps après l'approche maxi ->



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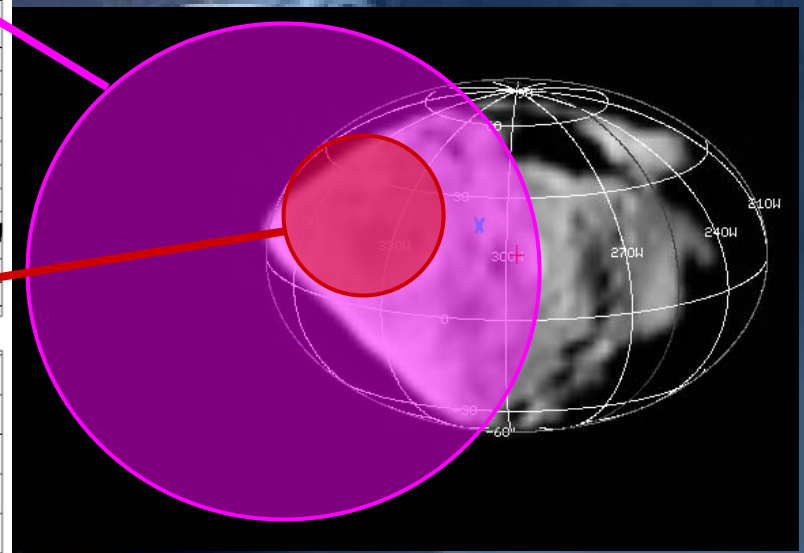
Signal continuum détecté par MIRO peu après l'approche maximale à Steins le 5.78 Septembre 2008



Morphological overview/1

Highly non-spherical body

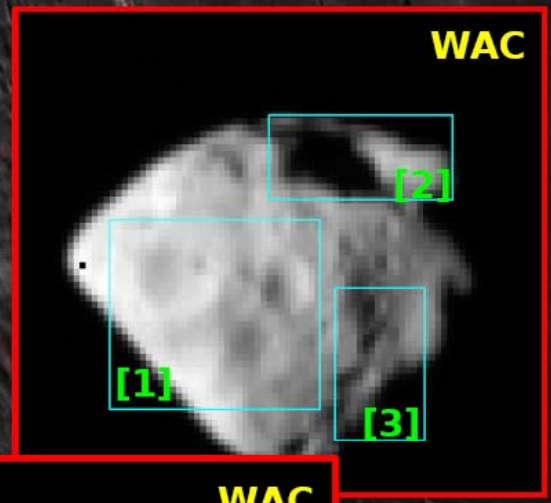
A number of sub-km craters[1]

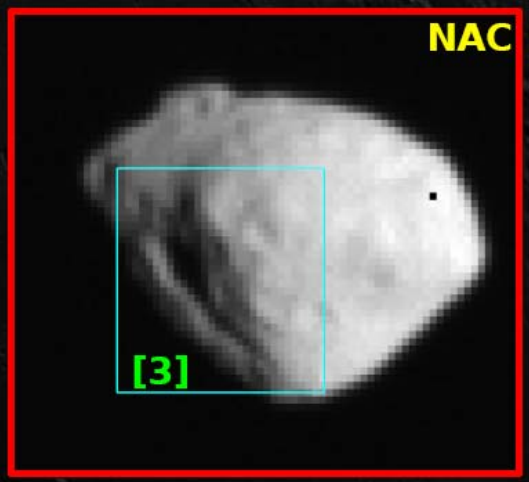
One large crater (D~2km)[2]

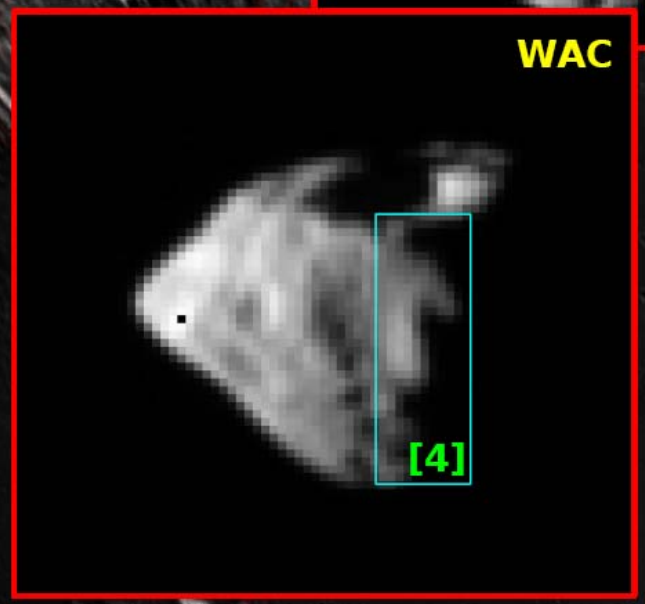
Possible chain of craters and/or cracks[3]

Overlapping craters[3]

Ridges[4]

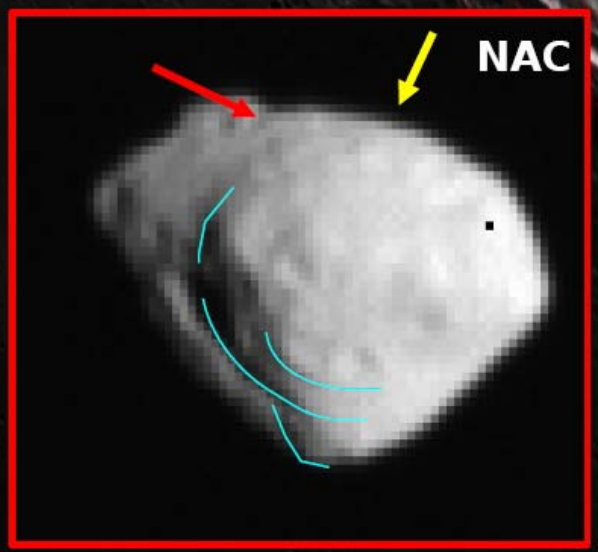


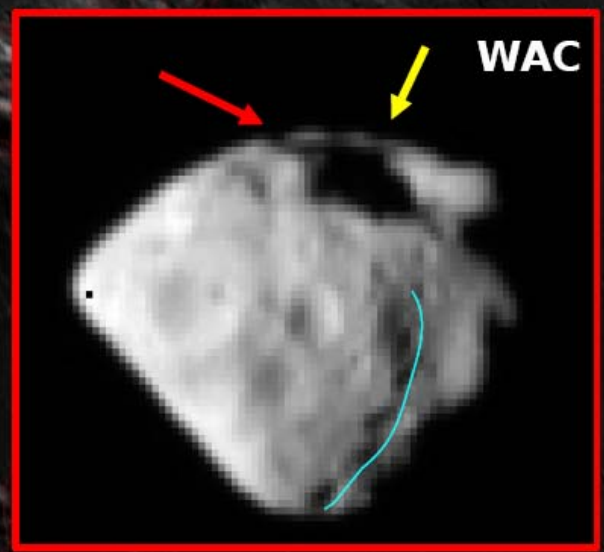




Morphological overview/2

- The 2km-sized crater has well defined rim: relatively young?
- The 2km-sized crater: possibly two big craters on top?
- Other large craters are shallow: old and/or regolith jolting?
- The large depression in the NAC image seems to be connected to the 'chain' in the WAC images: a possible large fracture, maybe triggered by the 2km-sized crater?





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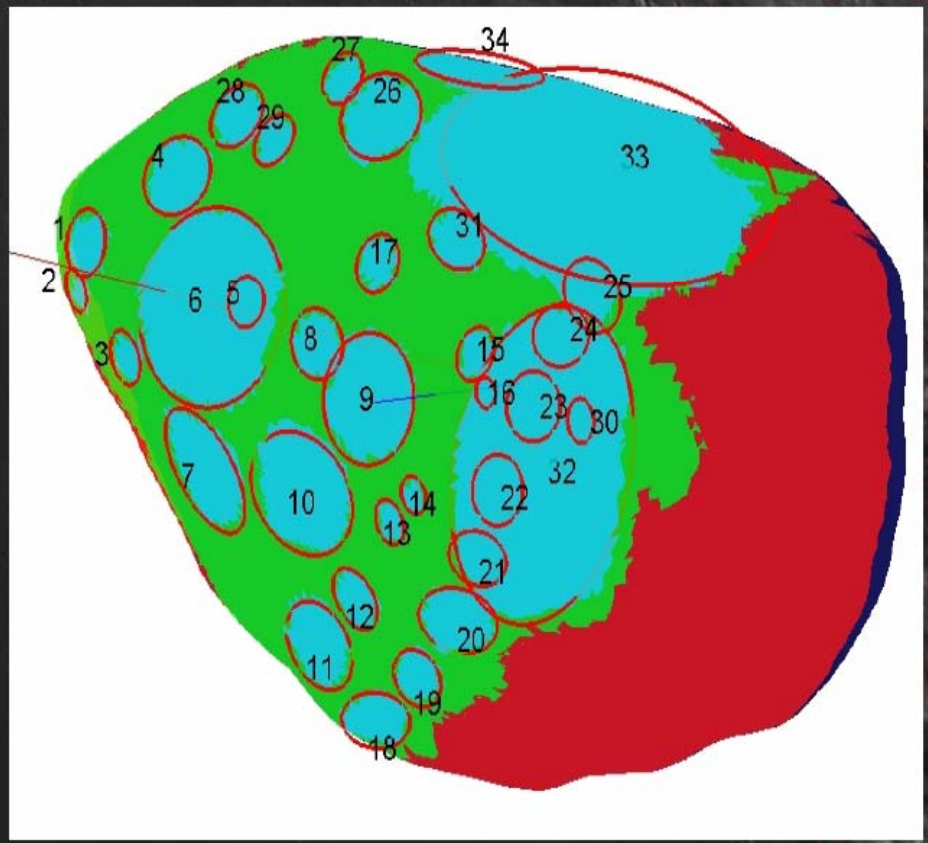
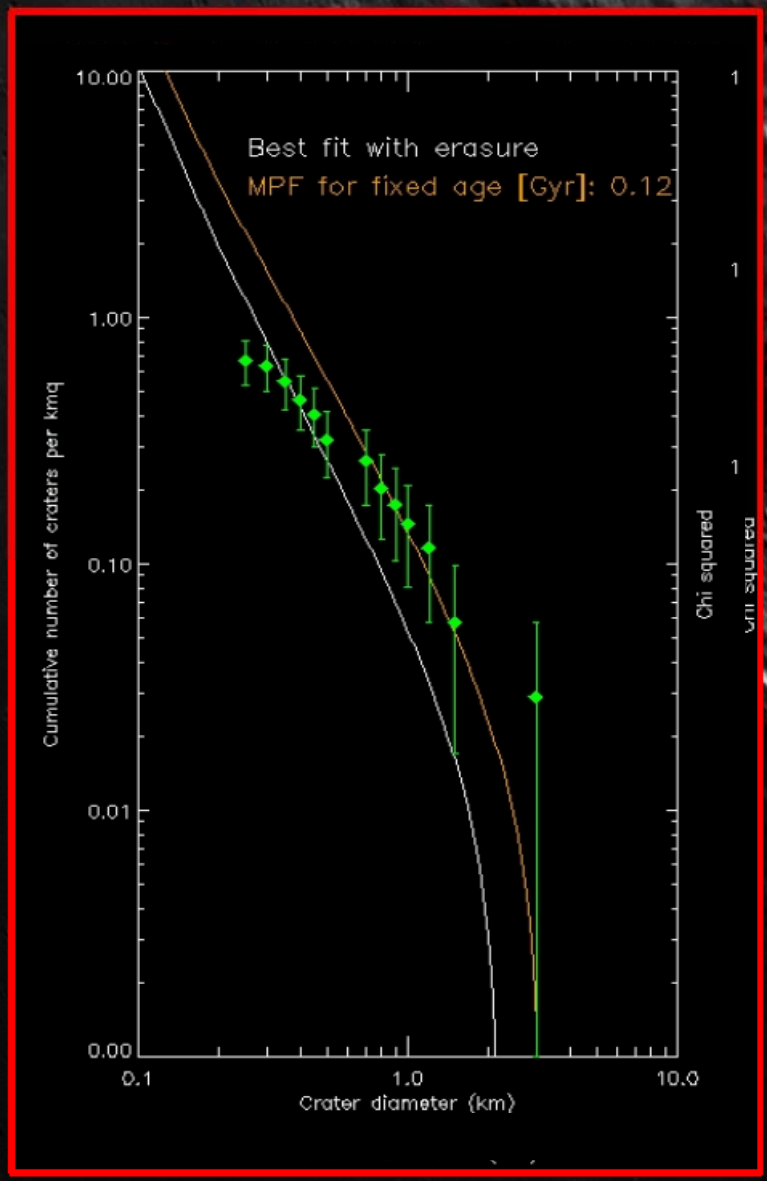
Shape corrected cumulative distribution:

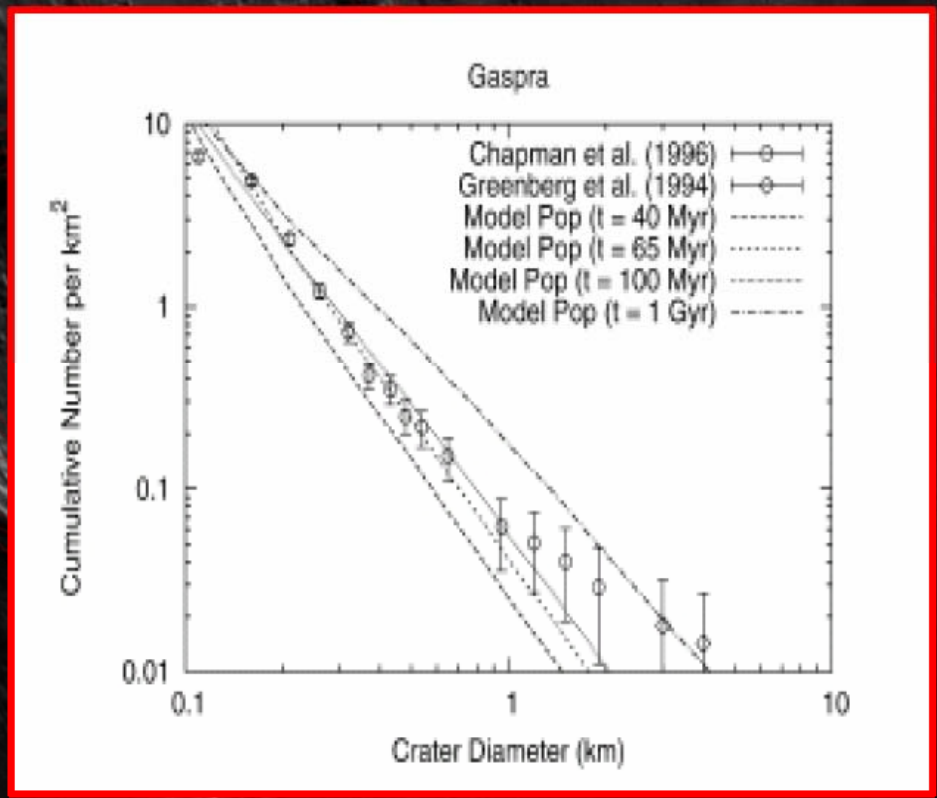
Taking into account the 3D shape model, we corrected the raw crater diameters and compute the final crater cumulative distribution.



Age estimate: comparison with Gaspra



Gaspra best fit:



O'Brien etal 2006

Asteroid (Type)	Gaspra (S)	Mathilde (C)	Ida (S)	Eros (S)	Itokawa (S)	Steins (E)
						
Diameter	12 km	53 km	31 km	17 km	0.35 km	6.7 x 5.9 x 4.3 km
Period	7.09 hr	17.406 d	4.634 hr	5.267 hr	12.132 hr	6.047 hr
Age	200 My	2-4.5 Gy	1 Gy	2 Gy	1-100 My	100-150 My
Density	2.7g/cm^3 (b)	1.3 g/cm^3 (a)	2.6 g/cm^3 (b)	2.67 g/cm^3 (b)	1.95 g/cm^3 (b)	? (c)
Porosity	?	55 – 63 %	18 – 24 %	16 – 21 %	39 – 43 %	?
Meteorite	ordinary chondrite	carbonaceous chondrite	ordinary chondrite	ordinary chondrite	ordinary chondrite	aubrite
Objective	Fly-By Galileo (1991) Res=54m/px	Fly-by NEAR (1997) Res=180m/px	Fly-by Galileo (1993) Res=25m/px	1 year-RD NEAR (2000) Res=cm/px	Hovering Hayabusa (2005) Res<1cm/px	Fly-by Rosetta (2008) Res<80 m/px
Science return	-First asteroid with young age (200 Myr) -Absence of large craters	-First asteroid with low density - Large craters (5 with D> 5 km) suggest porous bodies have much higher impact strength than expected	- First discovery of a satellite (Dactyl) - Age estimate (1 Byr) - First estimate of density of S-type - First constraints on mechanical properties	- Larger amount of boulders than expected - Lack of very small craters - First evidence of thick regolith	- First evidence of rubble-pile structure - First S-type with low bulk density - Amount of large boulders - Lack of small craters (<10 m) requires unknown process	-- First chunk of e highly differentiated object --First visit to a body shaped by the YORP effect?

Asteroid 21 Lutetia

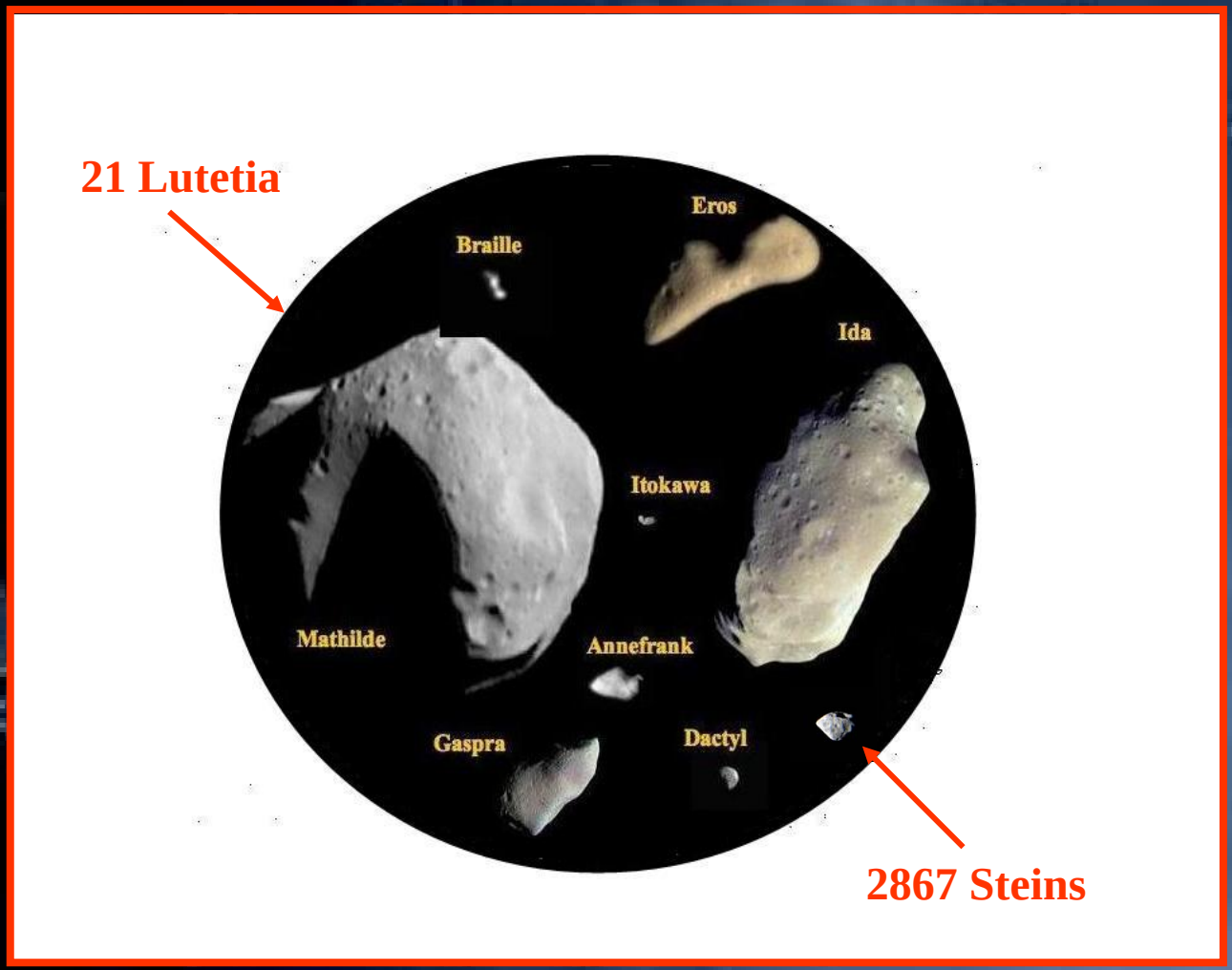
- **SEMIMAJOR AXIS = 2.435 AU**

- **ECCENTRICITY = 0.164, INCLINATION = 3.064**

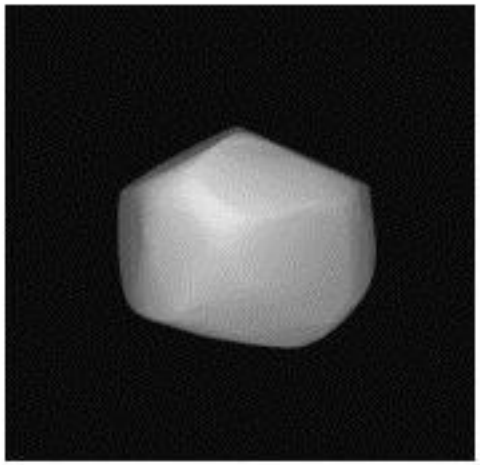
- **DIAMETER: 96 km 109 km 130 x 104 x 74 km**
- *(IRAS) (radiometry) (radar data)*
- ***It is large enough to allow the mass and bulk density determination***
- ***by the radio science experiment***

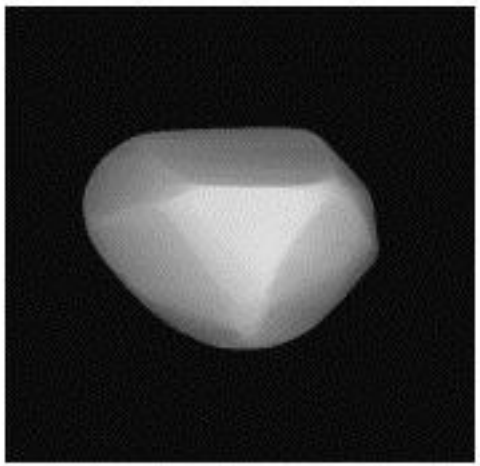
- **ALBEDO: 0.22±0.02 0.17±0.07 0.11 0.09**
- *(IRAS) (radar data) (radiometry) (polarimetry)*
- **D= 98.3 ± 5.9 km A=0.208 ± 0.025 (Mueller et al. 2006)**
- **PREVIOUS TAXONOMICAL CLASSIFICATION:**
- **M (Tholen), M0 (Barucci & Tholen) , W (Rivkin) , Xk (Bus)**

Asteroid comparative sizes



Asteroid 21 Lutetia





Rotational period = 8.17 ± 0.01h

Pole solution: RADAR OBS. (Magri et al, 1999)

prograde rotation, axis ratio: 1.26:1.15:1.0

pole: $\lambda_1 = 228^o \pm 11$, $\beta_1 = +13^o \pm 5$ or

$\lambda_2 = 48^o \pm 11$, $\beta_2 = +5^o \pm 5$

Shape and pole solution: LIGHTCURVES ANALYSIS (Torppa et al., 2003)

prograde rotation, axis ratio: 1.4:1.2:1.0

pole: $\lambda_1 = 220^o \pm 11$, $\beta_1 = +3^o \pm 10$ or

$\lambda_2 = 39^o \pm 10$, $\beta_2 = +3^o \pm 10$


THE END
RdV : 21 Lutetia
10 July 2010