



A high Resolution Imaging Camera concept for the Marco Polo mission

L. Colangeli ⁽¹⁾, M.A. Barucci ⁽²⁾, J.R. Brucato ⁽³⁾, F. Capaccioni ⁽⁴⁾, F. Cortecchia ⁽¹⁾, S. Debei ⁽⁵⁾, E. Dotto ⁽⁶⁾, P. Eng ⁽⁷⁾, J.L. Josset ⁽⁸⁾, Y. Langevin ⁽⁹⁾, L. Marinangeli ⁽¹⁰⁾, G. Marra ⁽¹⁾, E. Mazzotta Epifani ⁽¹⁾, P. Palumbo ⁽¹¹⁾, M. Zusi ^(1,12)

⁽¹⁾ INAF – Osservatorio Astronomico di Capodimonte – Napoli (Italy)

⁽²⁾ LESIA-Observatoire de Paris (France)

⁽³⁾ INAF – Osservatorio Astrofisico di Arcetri – Firenze ((Italy)

⁽⁴⁾ INAF - IASF - Rome (Italy)

⁽⁵⁾ CISAS - Università di Padova (Italy)

⁽⁶⁾ INAF – Osservatorio Astronomico di Roma (Italy)

⁽⁷⁾ Institut d'Astrophysique Spatiale - Orsay (France)

⁽⁸⁾ SPACE-X, Neuchâtel (Switzerland)

⁽⁹⁾ Institut d'Astrophysique Spatiale - CNRS / Univ. Paris Sud XI - Orsay (France)

⁽¹⁰⁾ IRSPS, Università d'Annunzio – Pescara (Italy)

⁽¹¹⁾ Università Parthenope – Napoli (Italy)

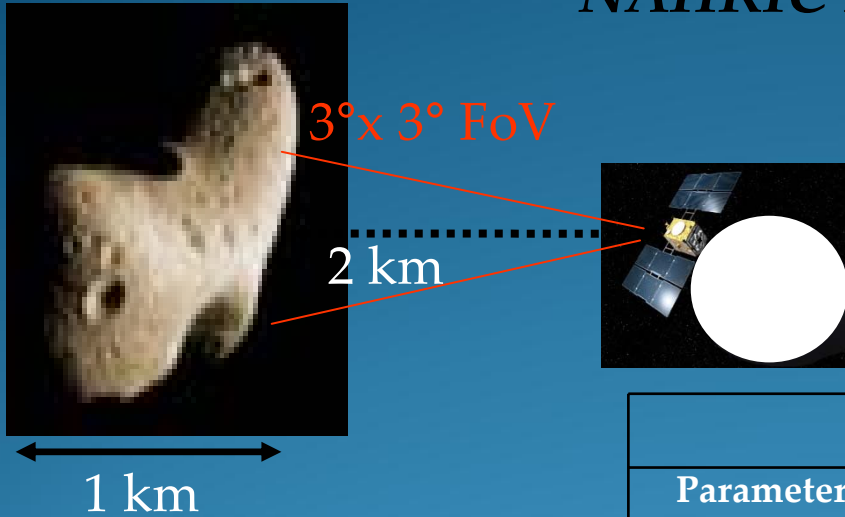
⁽¹²⁾ Università “Federico II” – Napoli (Italy)

Scientific and operational objectives

- To carefully analyse the morphology and topography of the NEO target surface;
- To identify landing site opportunities which are suitable for samples acquisition;
- To help (by broad-band filter images) exploration of mineralogical and chemical compositions.



NAHRIC Requirements



Geometric and Radiometric req.

Pointing req.

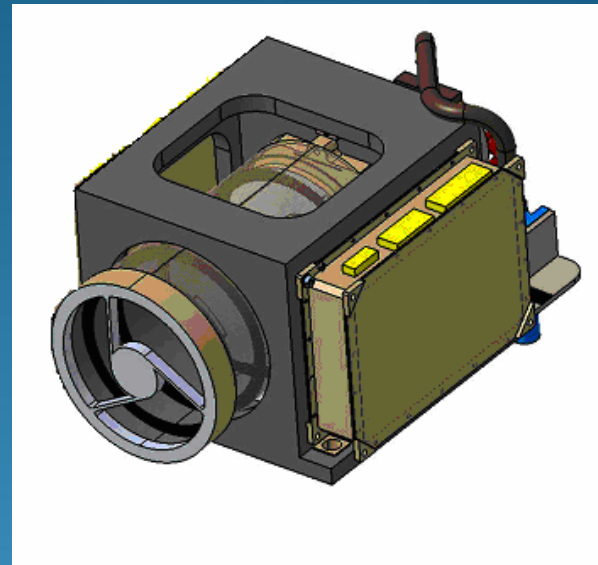
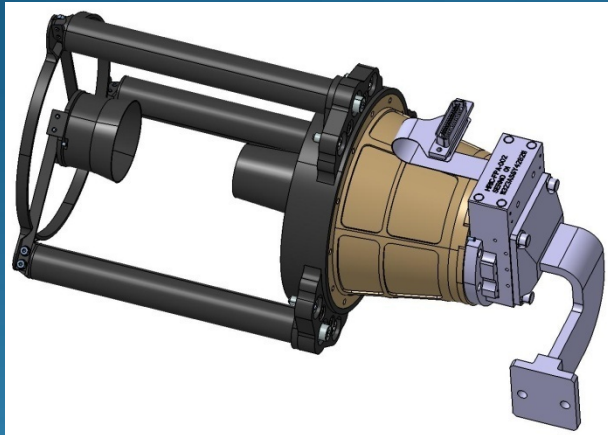
Main Scientific requirements	
Parameter	Value
Pixel scale	0.05 m pixel ⁻¹ at 2 km from NEO
Pixel IFOV	5.2"/pixel
Spectral range	400 ÷ 900 nm
Image quality	Diffraction limited at 400 nm
Field of view	3 deg
Filters	1 panchromatic (central λ = 650 nm; 500 nm bandwidth) 3 band-pass (λ = TBD nm; 40 nm bandwidth - TBC)
AME	5.2 arcsec (absolute accuracy)
RPE	1.5 arcsec/s (stability)

Optical design - Trade-off Analysis

- Optical design optimised wrt the stringent requirement on spatial resolution and considering mechanical and compactness constraints
- The optical design is integrated with filters, detector and mechanics
- Analysis of on-axis (heritage from HRIC SIMBIO-SYS) vs. off-axis solution

Main optical characteristics	
Parameter	Value
Optical configuration	Catadioptric: Ritchey-Chretien with dedicated corrector
Aperture size	50 mm
Obscuration	30%
F-number	8
Focal length	400 mm
Spectral range	400 ÷ 900 nm (diffraction limited at 400 nm)
Field of view	3 deg
Pixel IFOV	5.2"/pixel
Detector	Si-PIN 2048x2048
Pixel size	10 μm

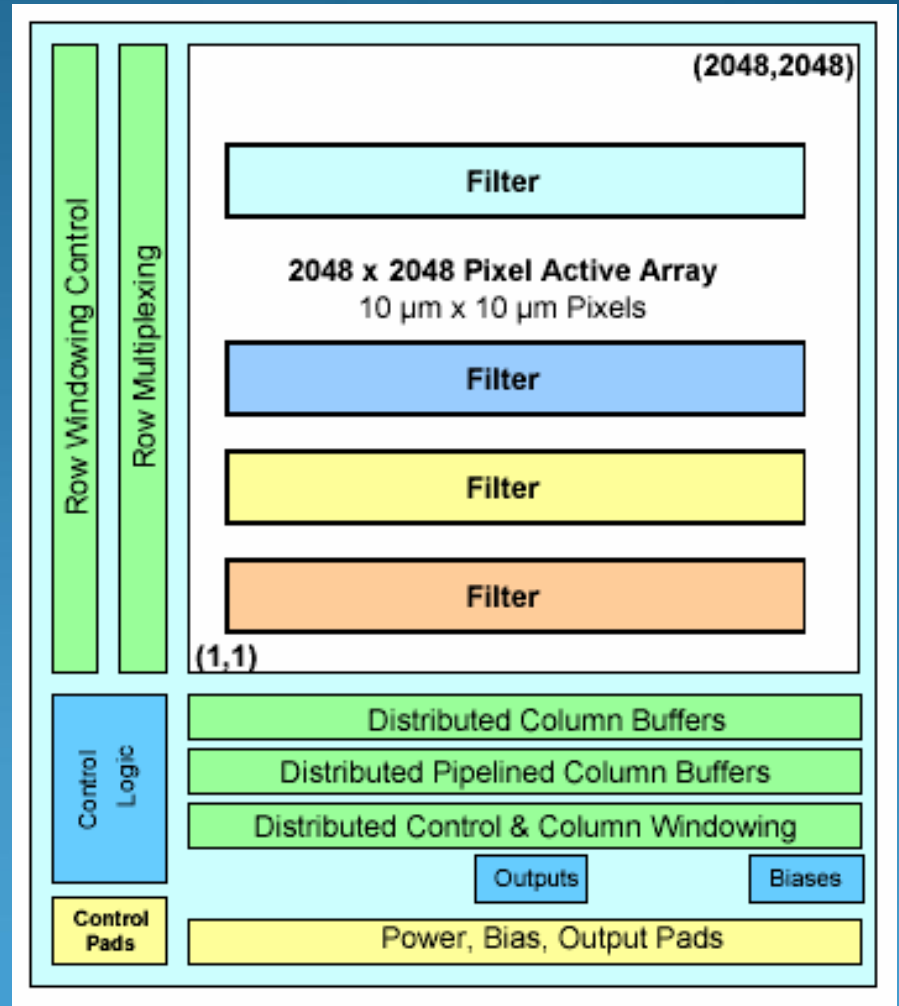
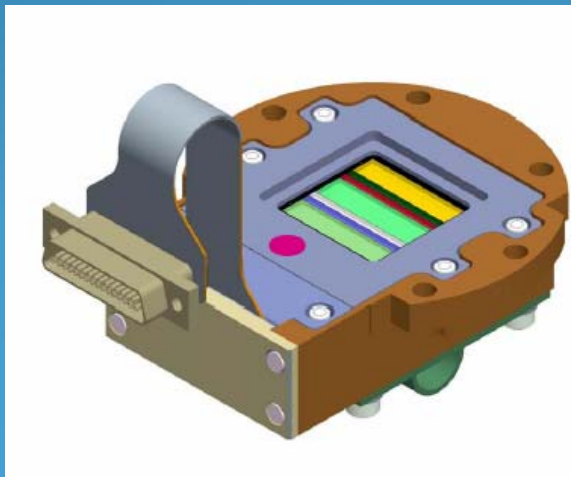
Budgets



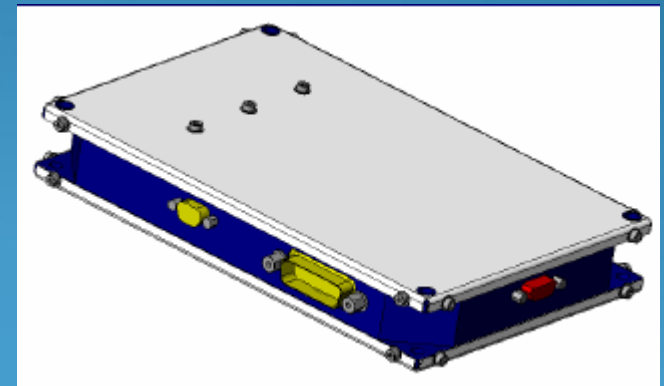
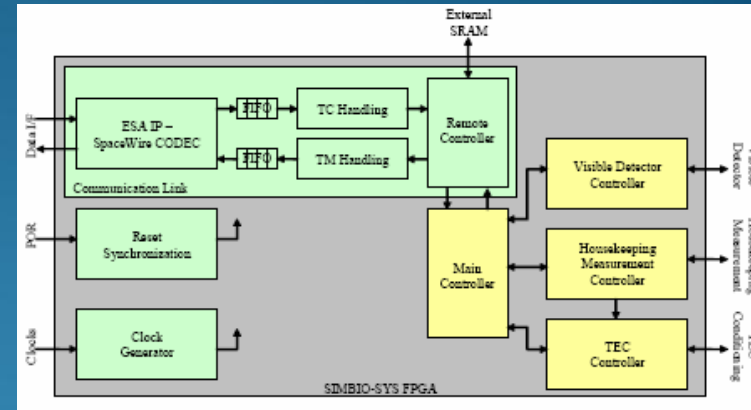
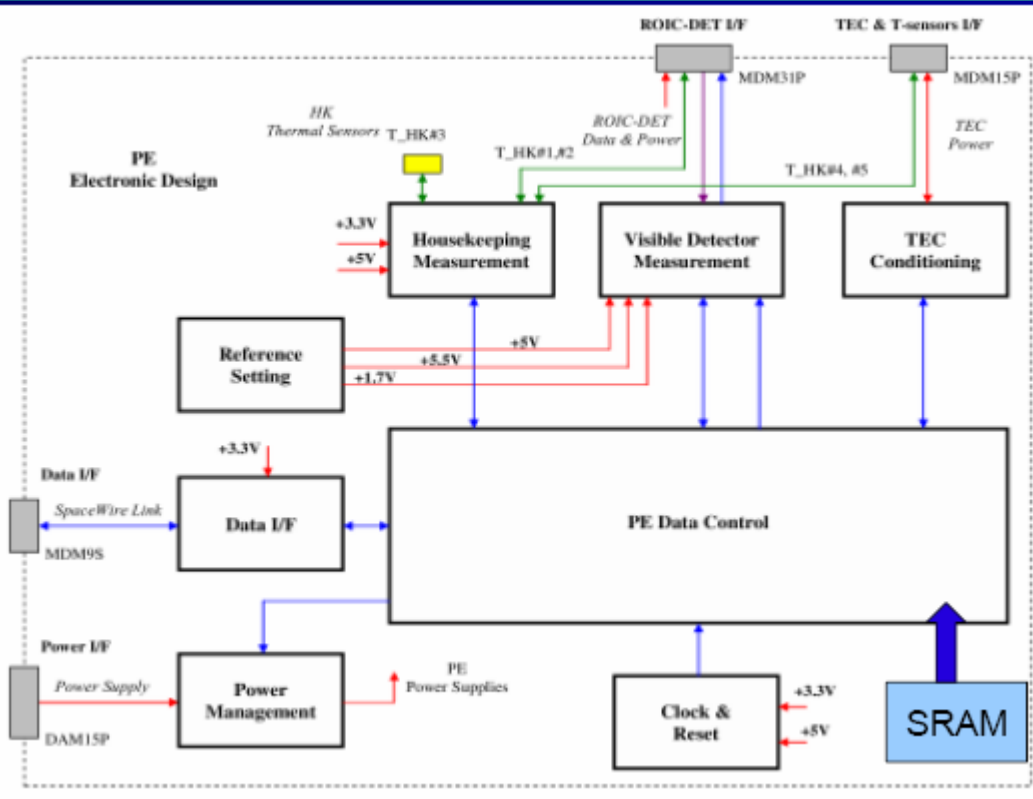
Parameter	Unit	Value	Note
Mass	kg	3.5 Kg	Including PE box, but except cabling between PE and Main Electronics
Dimensions	mm	H=120 mm W=80 mm L=280mm	Volume: $2.7 \cdot 10^6 \text{ mm}^3$
Total average power	W	7	Without ME and DC/DC converter which are assumed part of the S/C electronics



Sensor



Proximity Electronics



Conclusions

Optical design:

- simple, light and compact
- trade-off analysis

Operations:

- cover of the NEO surface
- high image quality (in terms of SNR)
- acceptable data rate

Management:

- Heritage from other on-going projects (sensor, PE, ME)
- Few dedicated (internal) resources