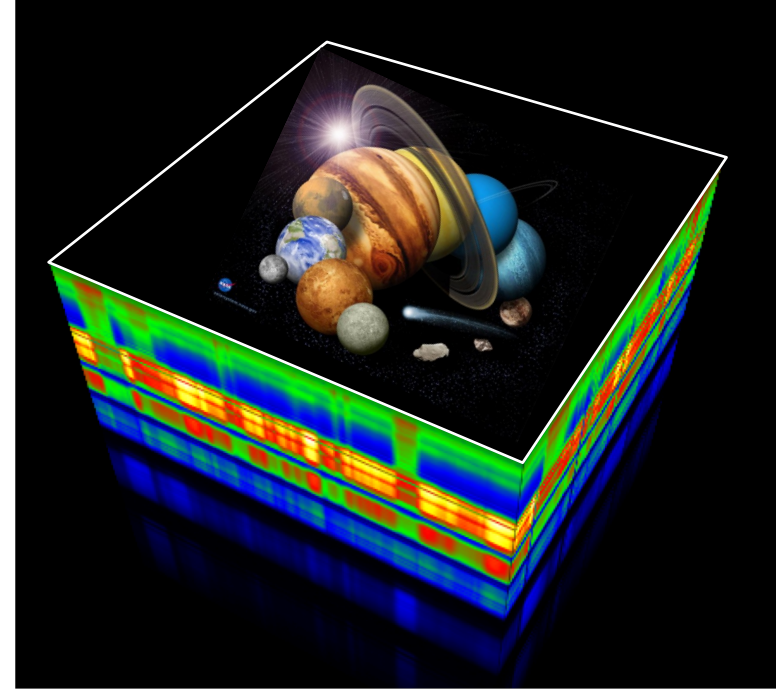


# The solar system with Harmoni



LAM : Olivier Groussin, T. Fusco, B. Neichel, O. Mousis

IPAG : A. Carlotti, S. Douté

IAS : J. Carter

Oxford Univ. : N. Thatte (PI), A. Hidalgo Valadez, F. Clarke

Open Univ. : N. Ligier

Leicester Univ. : L. Fletcher

# Today's questions in planetary science

From the NASA Planetary Science Decadal 2013 – 2022

- **Building new worlds**  
Understanding solar system beginnings
- **Planetary habitats**  
Searching for the requirements for life
- **Workings of solar systems**  
Revealing planetary processes through time

# Today's questions in planetary science

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- **Building new worlds**

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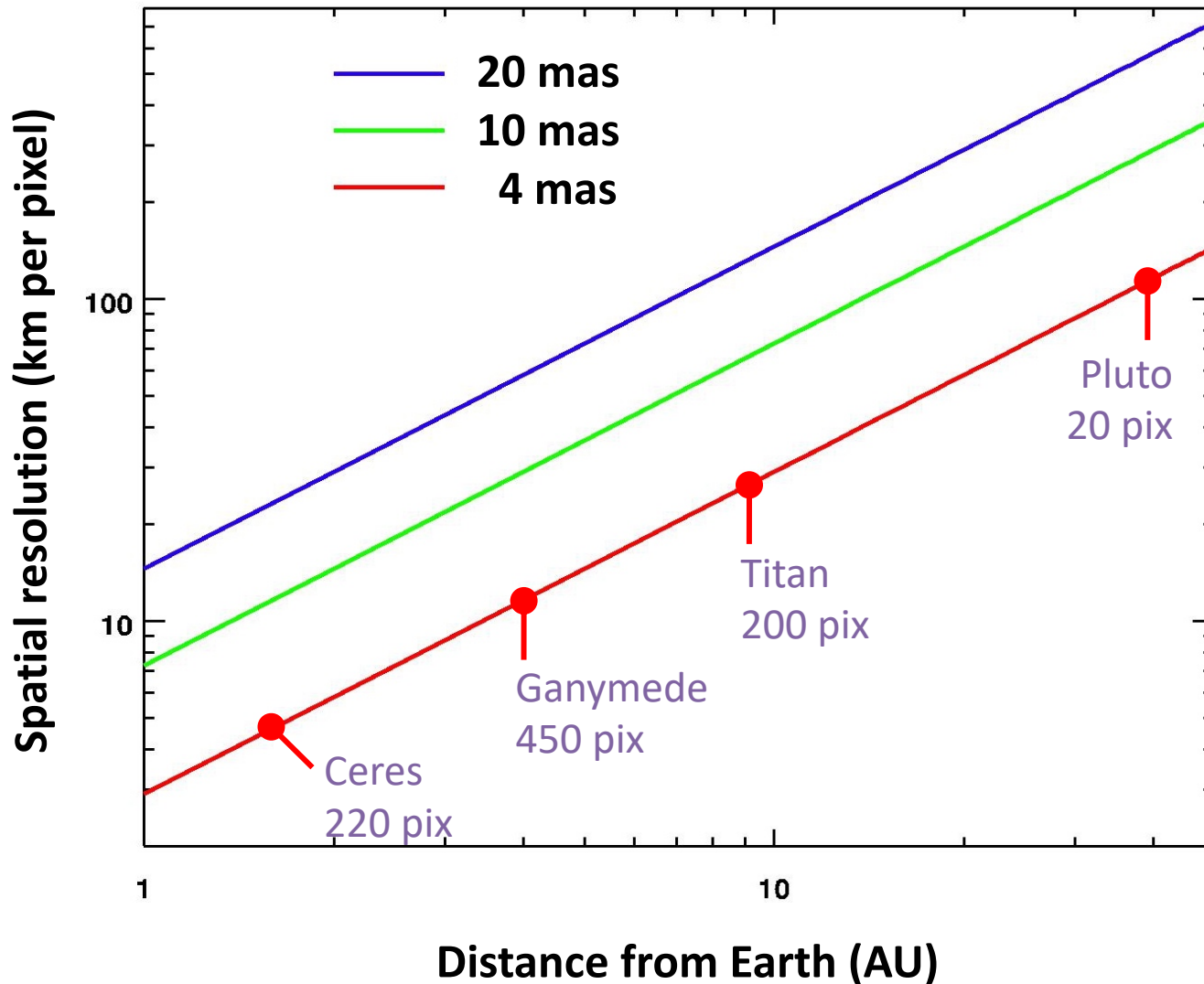
Searching for the requirements for life

- **Workings of solar systems**

Revealing planetary processes through time

**Harmoni will mainly contribute to two of them**

# Spatial resolution with Harmoni

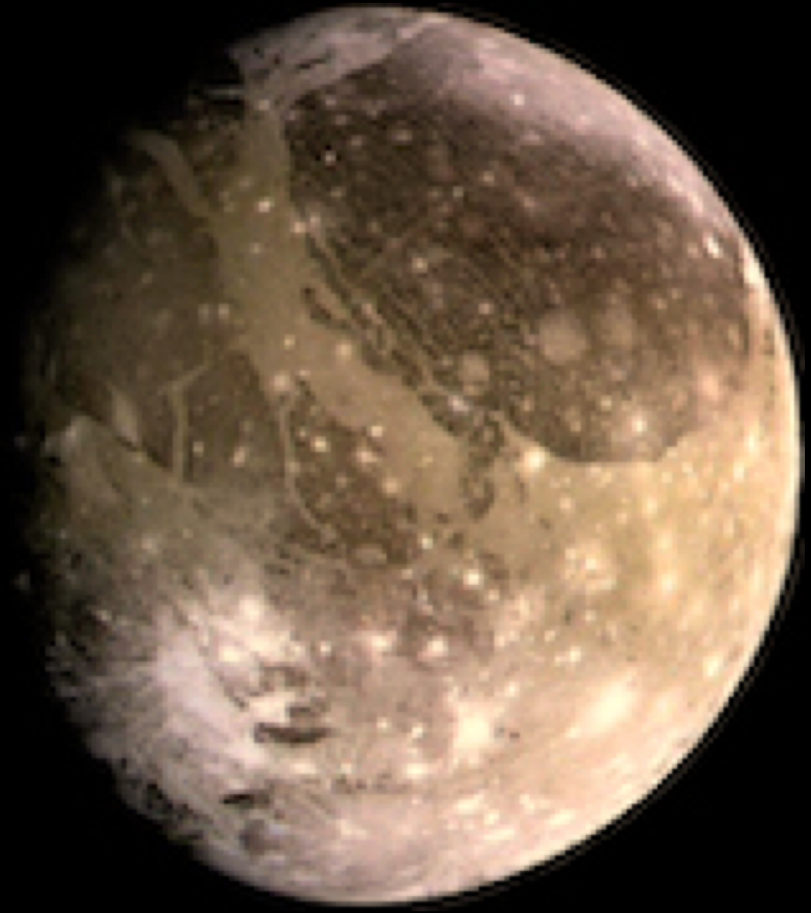




# Ganymede (5270 km)



**HST @50 mas**



**Harmoni @10 mas**

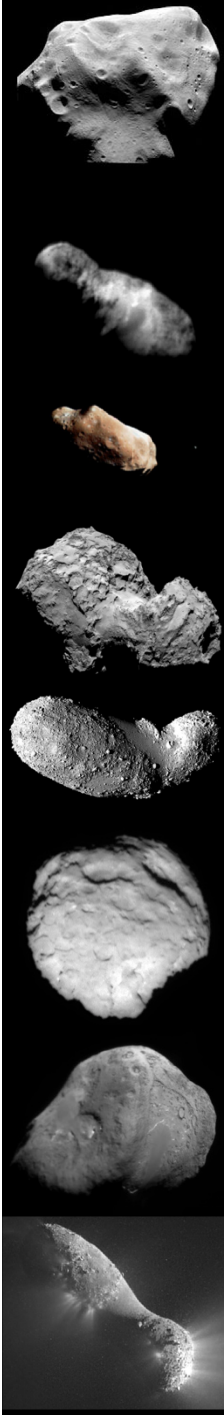
# Asteroids, Comets, TNOs, ...

## Building new worlds

They are the residuals of planetary formation and hold clues on how planets formed

- Spatially unresolved observations (size <100 km)
  - Detection and characterization (**density**) of **multiple systems**
  - Surface **composition**
- Spatially resolved observations (size >100 km)
  - **Shape** models (and **density** determinations)
  - **Geological** & **compositional** heterogeneities
  - **Atmosphere** of Pluto

*See talks P. Vernazza and P. Rousselot*

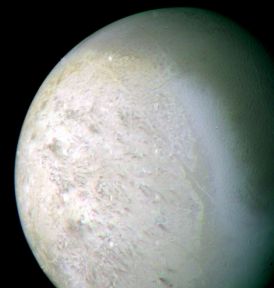
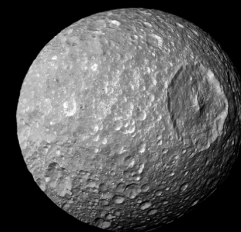
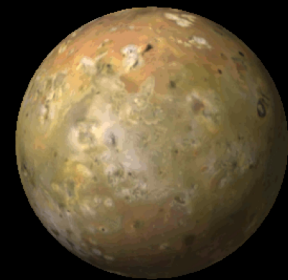


# Satellite of giant planets

## Workings of solar systems

### In-situ formation or capture ?

- Spatially unresolved observations (size <100 km)
  - Surface composition
- Spatially resolved observations (size >100 km)
  - Shape models (and density determinations)
  - Geological & compositional heterogeneities:
    - Io volcanoes
    - Europa and Enceladus plumes
    - Europa and Ganymede non icy components
    - Triton icy components
  - Exosphere and atmosphere



# Atmosphere of giant planets

## Workings of solar systems

A laboratory to investigate large-scale fluid dynamics and physicochemical phenomena

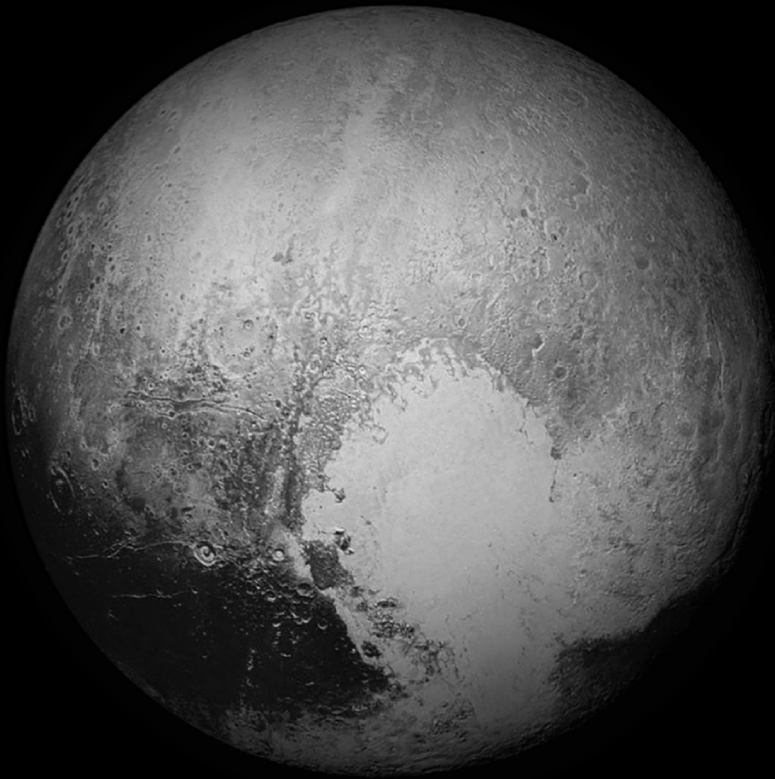
Atmospheric dynamics and global circulation

- **Spatially resolved observations**
  - Atmospheric structures (clouds, hazes)
  - Giant storms, vortex
  - Winds and weather
  - Aurora



# Pluto with Harmoni (HSIM)

1.8  $\mu\text{m}$ , 900 sec



New Horizon (in situ)

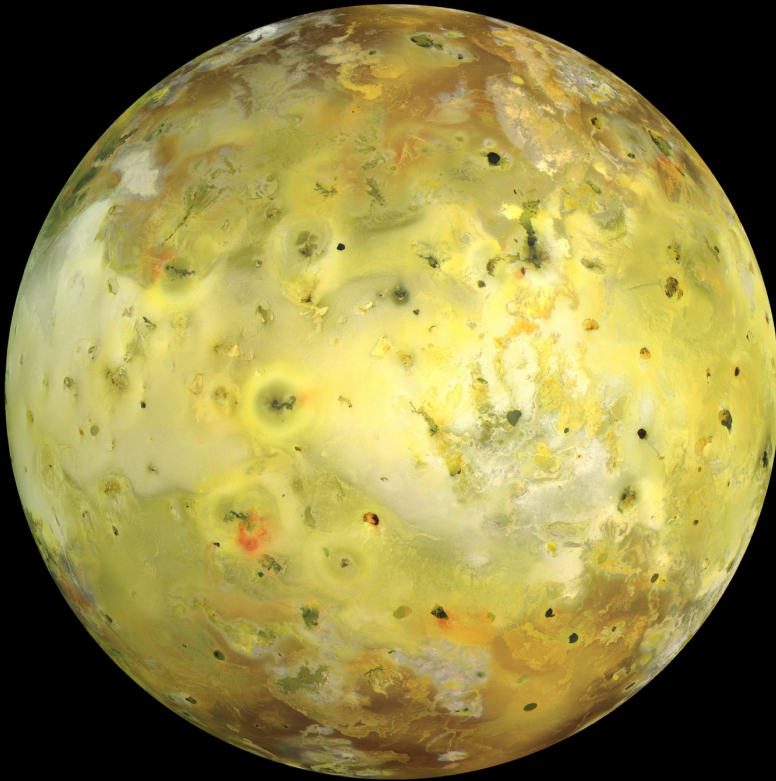


HSIM LTAO 4 mas (w/o deconvol.)

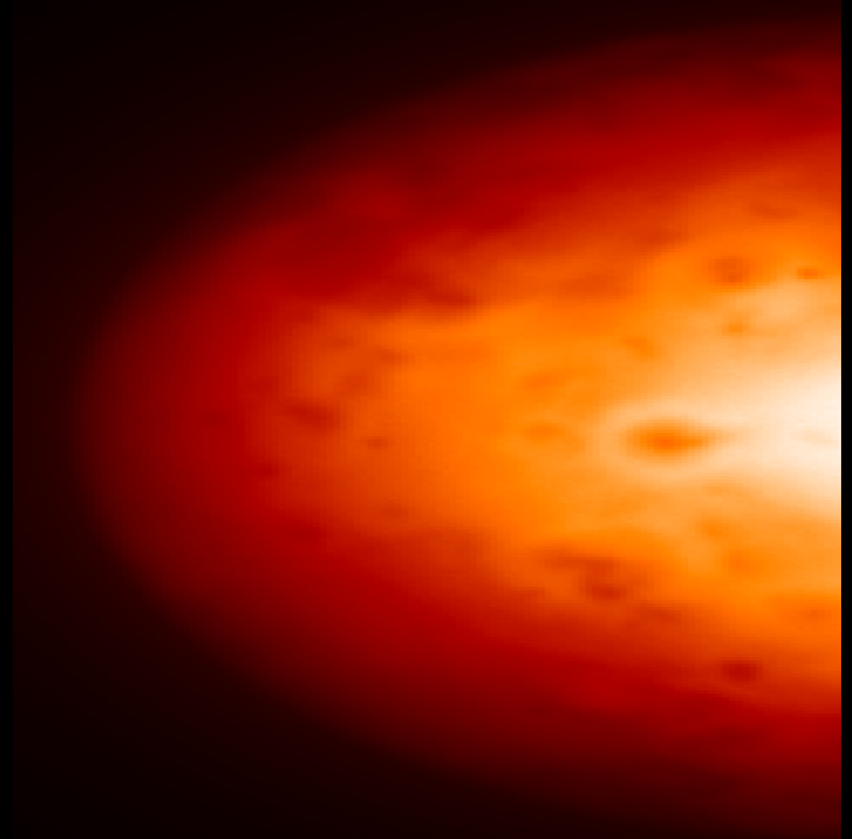


# Io with Harmoni (HSIM)

1.8  $\mu\text{m}$ , 900 sec

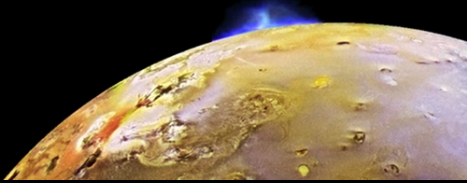


Galileo (in situ)

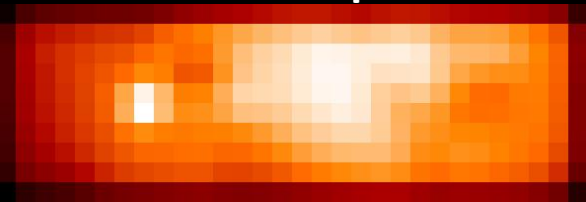


HSIM LTAO 4 mas (w/o deconvol.)

# Io volcanoes with Harmoni (HSIM)



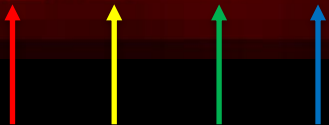
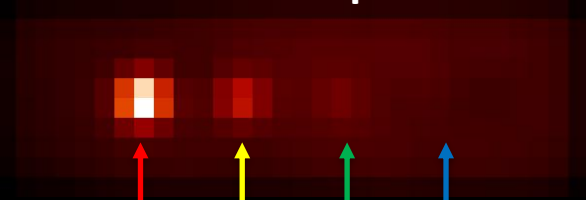
1.45  $\mu\text{m}$



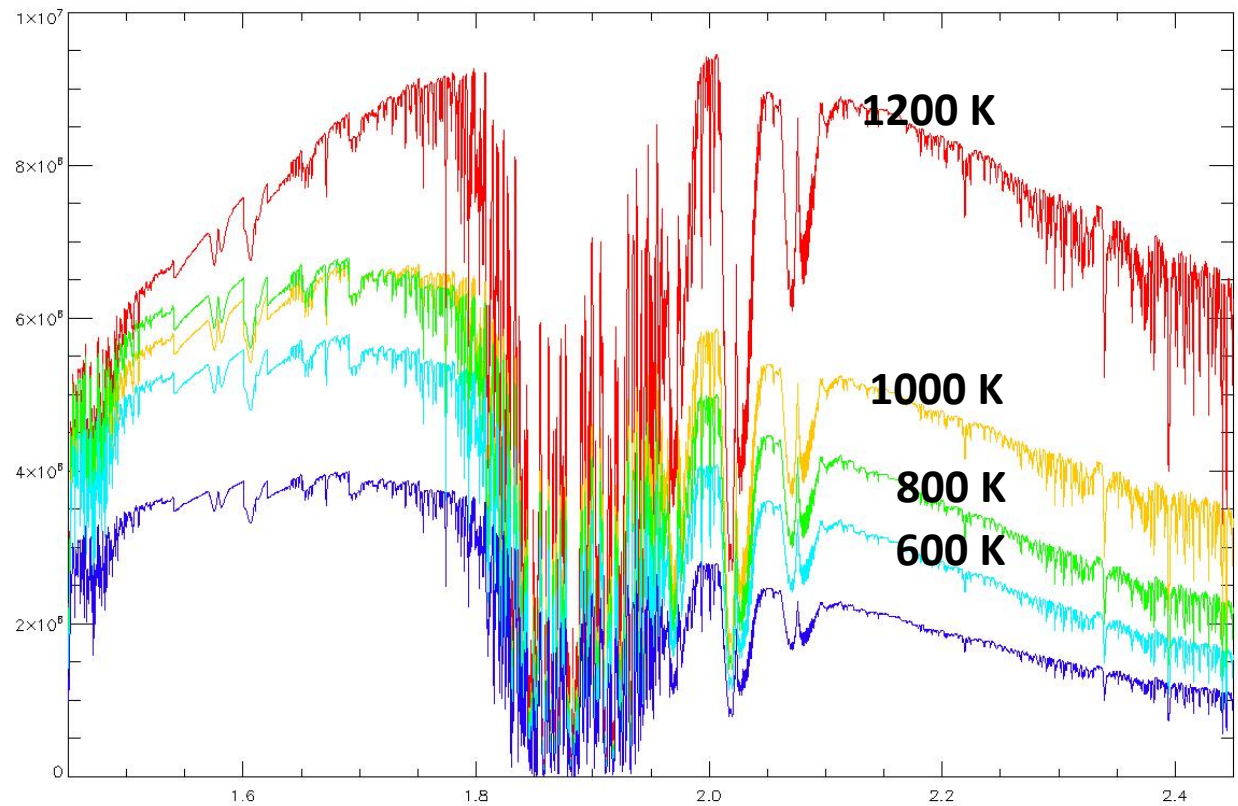
1.95  $\mu\text{m}$



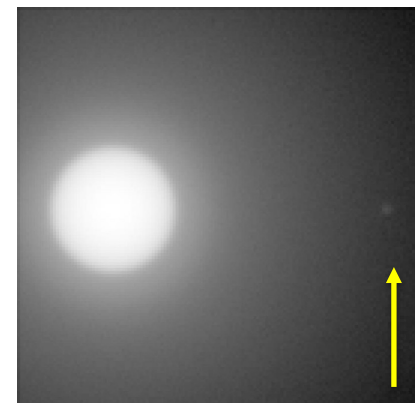
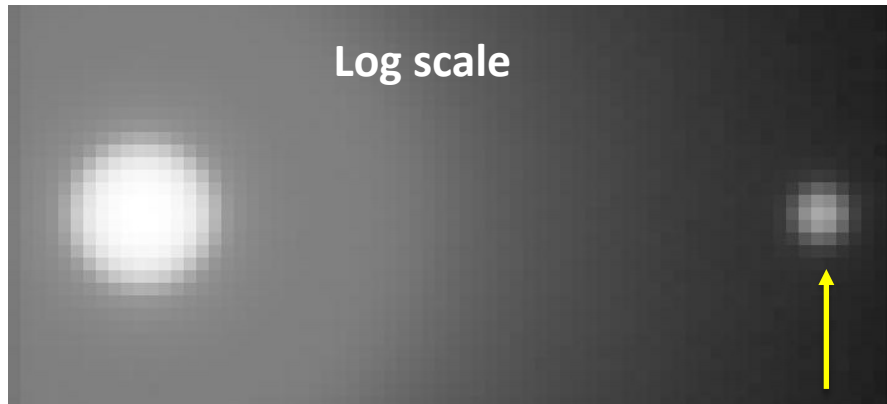
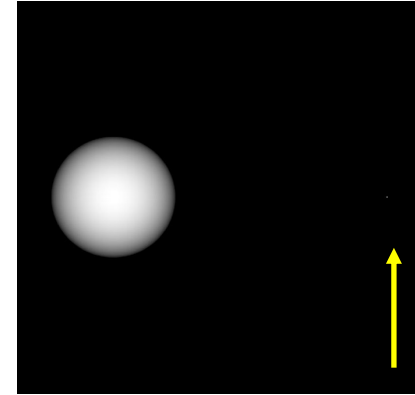
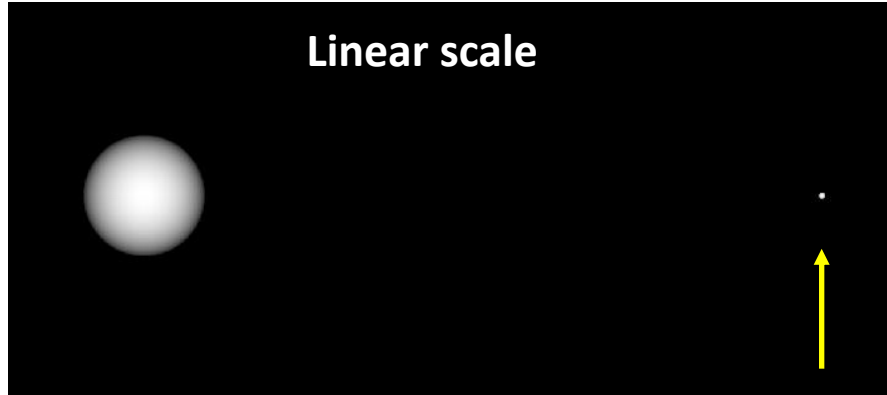
2.45  $\mu\text{m}$



SCAO 20 mas



# Binary asteroids with Harmoni (HSIM)



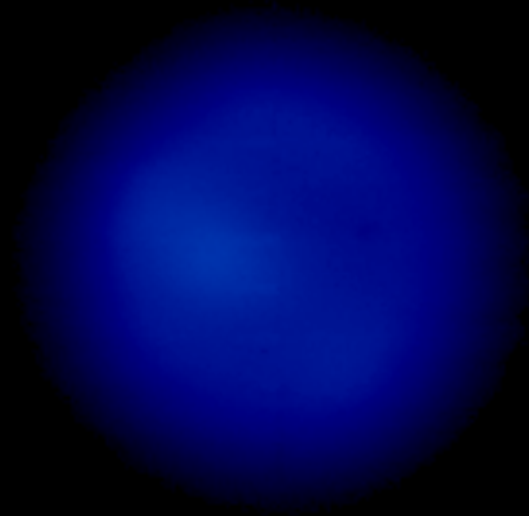
Primary = 100 km  
Secondary = 6 km  
Separation = 560 km

Primary = 100 km  
Secondary = 1 km  
Separation = 180 km

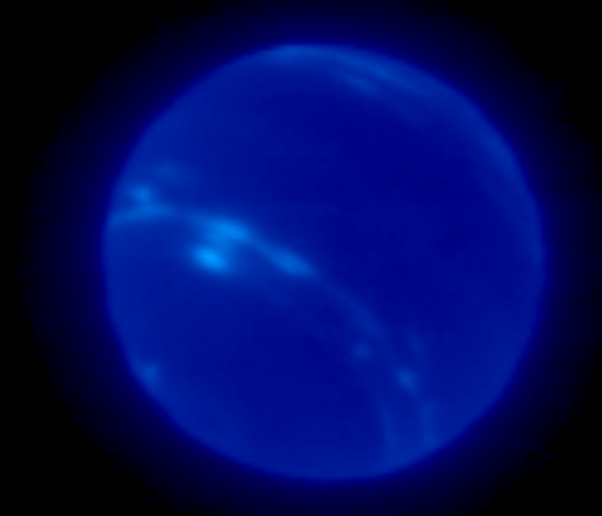


# Importance of the deconvolution

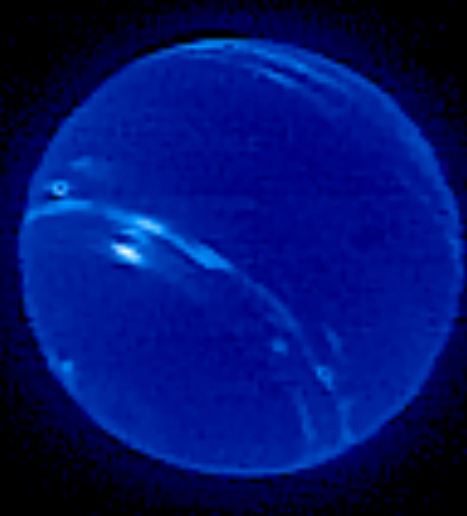
Seeing limited



MUSE/NFM



Deconvolution



Example of deconvolution of MUSE/NFM data  
Fusco et al.

# Conclusions

Harmoni is a powerful instrument to study the solar system

➤ Numerous science cases can be addressed

We will have (very) limited GTO nights

➤ optimization is mandatory

Do not hesitate to contact me if you are interested by this instrument for the solar system

