

Notes on Second Meeting NGKAO Solar System group, Feb. 14 2006 (Valentine day)

Attendees: M. Adamkovics (MA), J. Emery (JE), K. Noll (KN), F. Marchis (FM)

Absent: A. Bouchez (AB)

We reviewed the two main science cases and assigned tasks for each area. Below a brief summary.

Next meeting is scheduled in two weeks (Tuesday Feb. 28 at 11am).

We expect to have part of the simulation ready if the PSF can be provided to us soon. I have the feeling that we can request less simulated PSFs. For instance I don't expect to see a large difference between on-axis PSF with a reference of 5th to a 10th magnitude. I put in green ink the inputs for the Technical team.

Thank you for your comments.

It is time to work on Spitzer proposals now.

Regards

F.

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Science cases

A. ----- Multiple Asteroidal Systems -----

* A.1 Simulation of 87 Sylvia and its 2 moons (assigned to **Franck**)

- Characteristic of the asteroidal system

This is a main-belt asteroid with $m_v \sim 12$, two moons are known and were detected with Keck AO (2001) & VLT-NACO (2005). The primary is resolved (~ 0.12)

- For this simulation a third faint moon will be added closer to the primary and also a fourth one between the new moons

- detection profile will be calculated (algorithm already developed **FM**)

- Positions of centroid and relative photometry will be measured. Precision on the estimate of the orbital parameters will be discussed (possibility of detecting very small precessions, and gravitational effects between moons (forced eccentricity)?)

- Comparison with TinyTIM HRC/ACS (HST) & VLT-NACO (**KN**)

Inputs from Technical team: Simulated short exposure On-Axis PSFs ($\sim 2-5s$) (x10) at various wavelength (0.5, 0.7, 1.2, 1.6, 2.2 microns) at median seeing conditions for a bright reference ($m_v=12$)

Main Goals: Stability of the PSF (very high SR) and its influence for the orbit determination of multiple systems + gain for observations in visible

* A.2 Observations of 2003EL61 and its two moons (assigned to Antonin - **PLEASE CHECK & COMMENT (& Keith?)**)

- Characteristic of the asteroidal system

This is a TNO asteroid with $m_v \sim 17.4$, two moons are known and were detected with Keck LGS AO (2005). Will the primary be resolved in visible?

- detection profile will be calculated (algorithm already developed FM)

- Positions of centroid and relative photometry will be measured.

- Comparison with TinyTIM HRC/ACS (HST) & Keck LGS AO (KN)

- Shall we expect a gain in the case of coronagraphic observations?

Inputs from Technical team: Simulated long exposure On-Axis PSFs ($\sim 60s$) (x3) at various wavelength (0.5, 0.7, 1.2 microns) in good seeing conditions for a faint reference ($m_v = 17.4$)

Main Goals: Quality of the PSF and comparison with HST (quantify)

* A.3 Size and Shape of Asteroids (assigned to Josh & Keith?)

This work is mostly a statistical study. Tables will be prepared for this project.

- We want to know:

How many asteroids can be observed with a NGAO with a limit of magnitude of 15,16,17,17.5, 18 in all populations (MB, Trojan, Centaurs, TNOs)

How many asteroids could be resolved with a NGAO working at 0.5, 0.7, 1.2 microns

- Illustrate the size estimate and variety of shape using resolved images of asteroids from spacecrafts (Itokawa, Ida, Matilde,)

- Scientific justification. Why is it important? (formation process, collisions, ...)

Inputs from Technical team: Angular resolution at 0.5, 0.7, 1.2 microns for $m_v < 15$ and $m_v \sim 17.5$ at median seeing conditions

Main goals: Gain in angular resolution because of the visible wavelength range

* A.4 Spectroscopy of moonlets (assigned to Josh & Keith?)

Because the halo around primary asteroid will be reduced, spectroscopy capability will be enhanced

- Using the image simulations from A.1 and A.2, quantify the S/N gain (comparing with Keck AO NGS/LGS)

- Scientific justification: What kind of absorption features can we expect for asteroid surfaces (C,S, M, V taxonomic types) in the NIR, and in visible. Do we need the short wavelength visible range (< 0.7 microns). What is the most adequate spectral resolution?

Inputs from Technical team: inputs about IFU and relation with spectral resolution (do we need this?)

Main goals: Do we really need the short wavelength range in visible? what kind of R for the instrument?

B. ----- Titan and other Giant Planet satellites -----

B.1. Titan surface and atmosphere (assigned to Mate, Antonin & Franck)

We will create a fake Titan observations considering also the haze component in visible and NIR and using global map (with $R = 30-200$ km) of Cassini spacecraft. We will focus on atmospheric windows for which the surface can be seen (tools are ready MA & FM). Wavelength not defined yet.

- Deconvolution with AIDA may be included (algorithm 95% ready FM)

- Comparison with Keck NGS AO, VLT AO, and Cassini will be included
- Good temporal coverage from the ground vs spacecraft will be discussed and illustrated by surface changes due to a cryo-volcano (and/or clouds in the troposphere?)
- Spectroscopy to detect N₂⁺ species in the atmosphere (high R) and measure winds in Titan atmosphere at various altitudes (extremely high R).

For wind on Titan

see http://astron.berkeley.edu/~fmarchis/document/KNGAO/Documents/Kostiuk_TitanWind.pdf

Inputs from Technical team: Simulated short exposure On-Axis PSFs (~2-4s) (x10) at various wavelength (**NOT YET DEFINED**) in good seeing conditions for a bright reference (mv=8.5). Should we expect a degradation due to the angular size of Titan (D=0.8")

Main Goals: Observations of an extended object - imaging and spectroscopy of its atmosphere. Comparison with previous NGS AO systems. Illustration of the variability of solar system phenomena (volcanism, clouds)

B. 2 Io volcanism (assigned to **Franck**)

We will create two set of fake Io images with various active eruptive centers using Galileo/Voyager global map (R~35 km). One in sunlit (on axis reference) and the second one in eclipse (off axis reference at 25"). Observations at 0.7, 0.9, 1.2, 1.6, 2.2 microns will be considered not finalized yet)

- Deconvolution with AIDA may be included (algorithm 95% ready **FM**)
- Comparison with Keck NGS AO & Gemini PlanetFinder will be included
- Photometric precision on the eruptive centers will be estimated

Inputs from technical team:

- Simulated short exposure On-Axis PSFs (~1s) (x10) at various wavelength (0.7, 0.9, 1.2, 1.6, 2.2 microns) under good seeing conditions for a bright reference (mv=5.5).
- Simulated short exposure Off-Axis PSFs (~1s) (x10) at various wavelength (0.7, 0.9, 1.2, 1.6, 2.2 microns) under good seeing conditions for a bright reference (mv=6) located at 25" (or more...).
- possibility to discuss NIR WFS (to close the loop on Io itself in eclipse?)

Main Goals: Observations of an extended object - imaging of its surface. Comparison with previous NGS AO systems. Illustration of the variability of solar system phenomena (volcanism). Comparison with Keck NGS AO anisoplanetic and KPAO (wider-field AO systems such as MCAO & MOAO).

B.3 Observations of smaller Giant Planet satellites (assigned to **Josh (& Antonin?)**)

With this work we expect to be able to tell if a KNGAO system will be useful to study other Giant planet satellites. A table summarizing those which can be observed (on-axis) and the best spatial resolution (in km + number of element on the disk), plus a brief summary of their scientific interest (spectroscopy, activity, work previously done).

Example: For NIR spectroscopy of four of Saturn's satellites (including Enceladus), you can have a look on <http://astron.berkeley.edu/~fmarchis/document/KNGAO/Documents/SaturnSatellites/>

Inputs from technical team:

- Problem of halo due to the disk of the Giant planets (how can we quantify/simulate this?)
- Angular resolution at 0.5, 0.7, 1.2 microns for mv<15 and mv~17.5 in median seeing conditions
- Proper motion (non sidereal tracking)

Main Goals: Make sure that this instruments will be useful for various targets in the solar system

C. ----- Atmosphere of Giant Planets ----- We decided to drop this science case for the moment

A difficult problem. The committee has the feeling that the design of a AO system aiming to observe only Jupiter/Saturn is not appropriate. Low priority science case

* If cross-correlation is chosen. what should be the wavelength of observations (comparing the contrast of features of the atmosphere of Jupiter/Saturn with those on the photosphere of Sun)

* If we want to use the satellites to close the tip-tilt loop. Several problems 1. their intensity vs the glare of the Planet 2. Motion of the satellites 3. anisoplanetic effect must be simulated.

* Spectroscopy? need science inputs

* Atmosphere and environment of Uranus & Neptune

Quality of KPAO PSF on such extended objects?