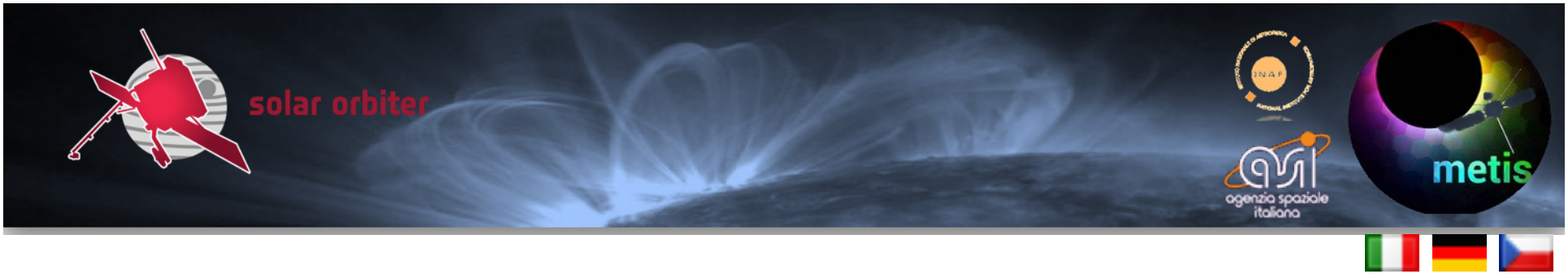
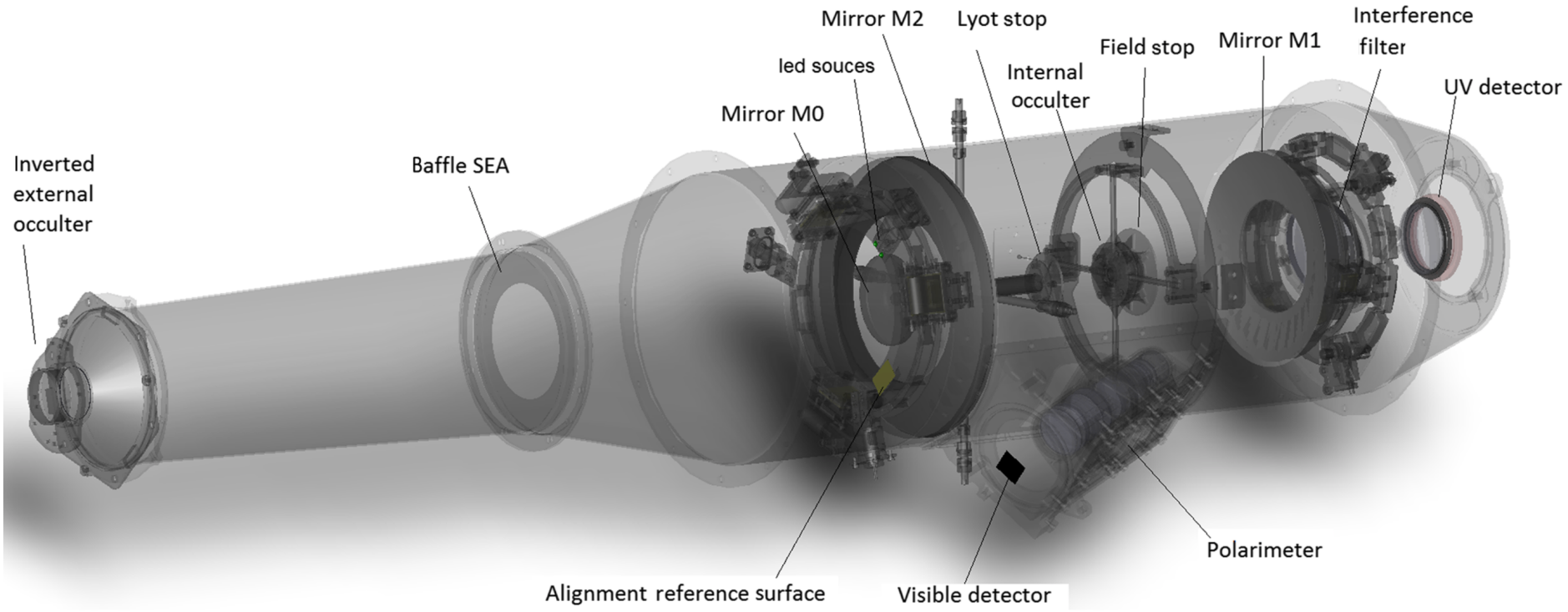


Stray light reduction and Metis off-pointing

Federico Landini

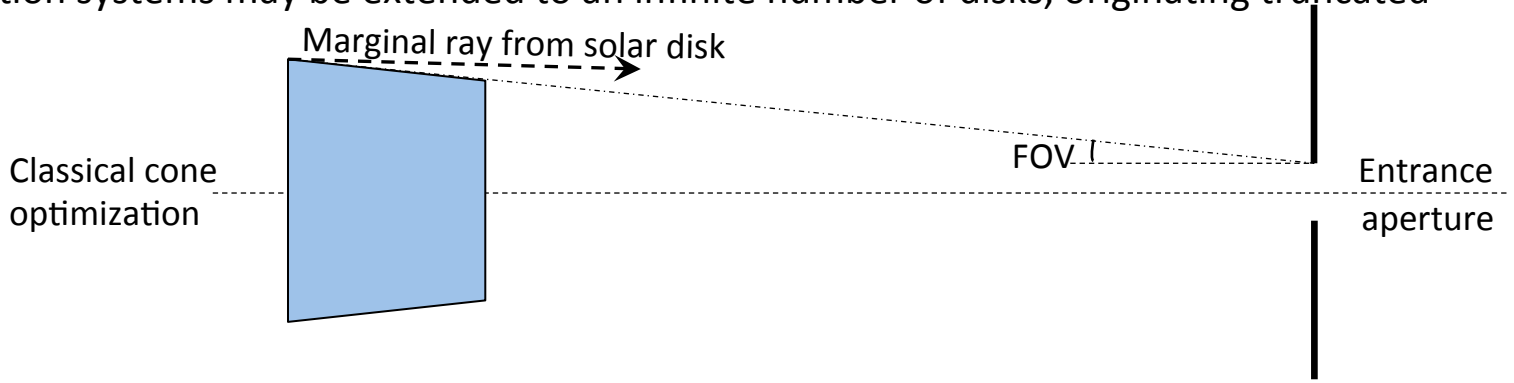
Outline

- Stray light reduction:
  - Optimization of the occulter
    - The Inverted External Occulter
    - Optimization concept
    - BOA, the occulting system prototype
  - IO position fine tuning
- Stray light and off-pointing

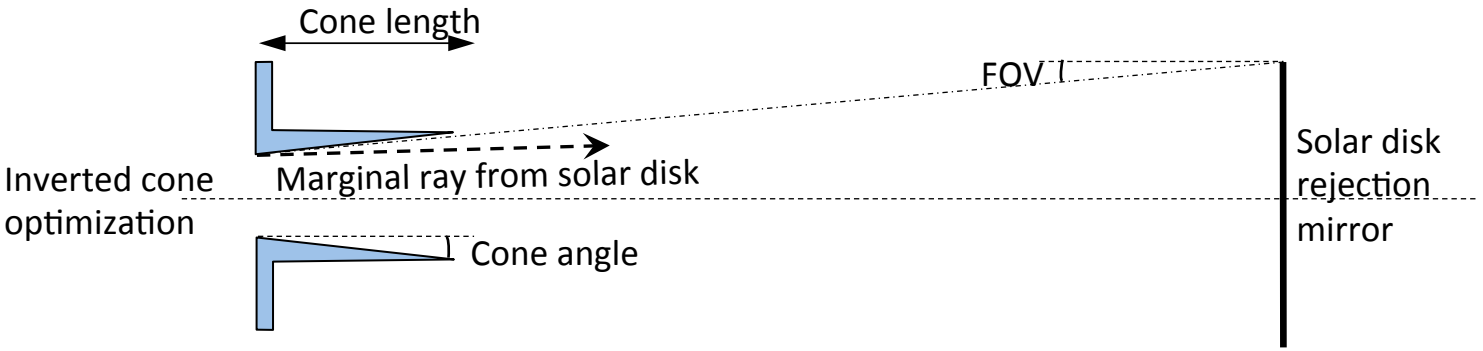

Mirror M2
Lyot stop
Interference filter
led souces
Field stop
Mirror M1
Internal occulter
UV detector
Mirror M0
Inverted external occulter
Baffle SEA
Polarimeter
Alignment reference surface
Visible detector

IEO optimization concept

Multiple disk occultation systems may be extended to an infinite number of disks, originating truncated cones.

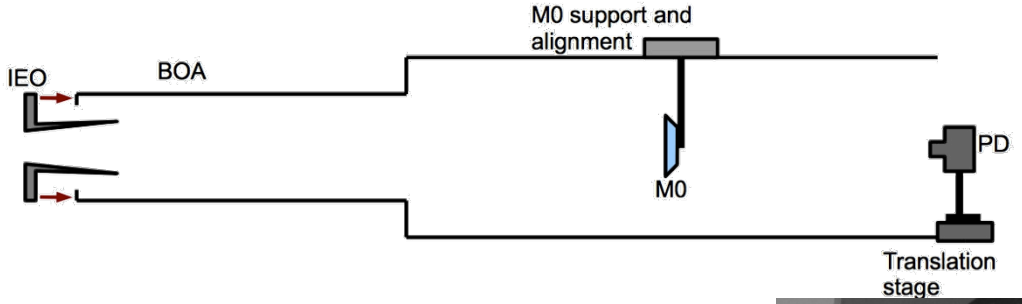


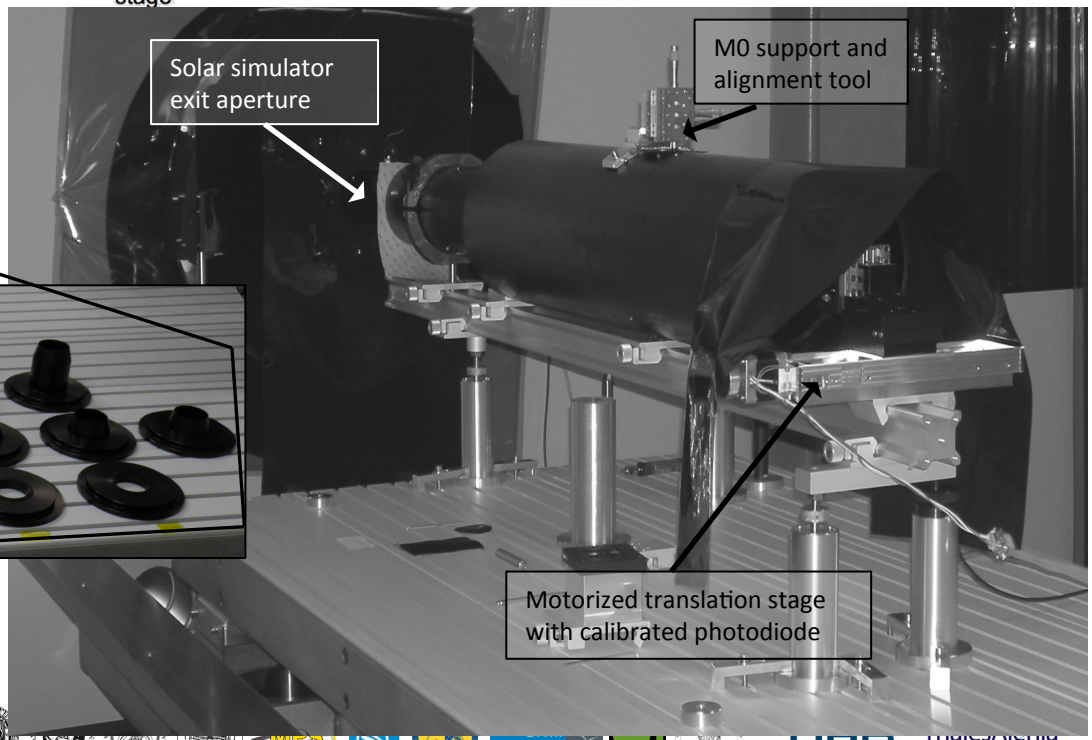
METIS innovative occultation system required a dedicated study to determine the most suitable occulter optimization technique.

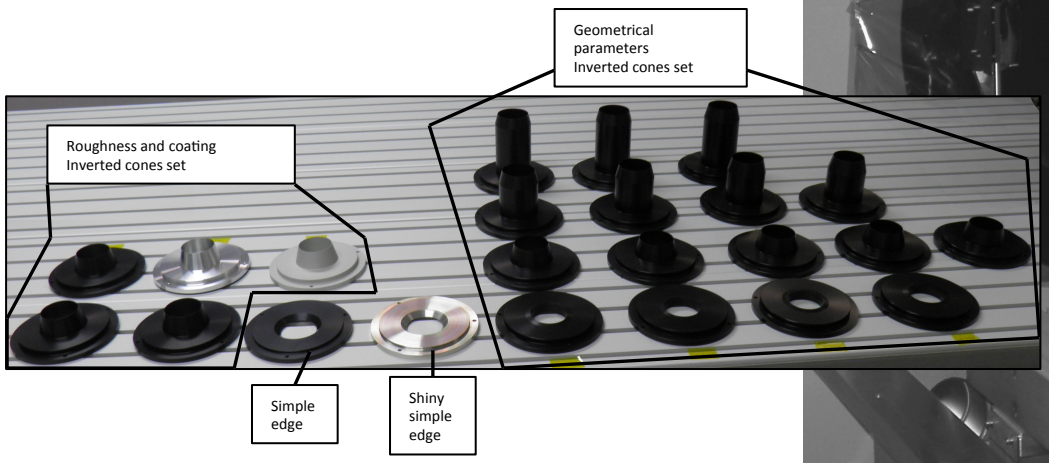


BOA

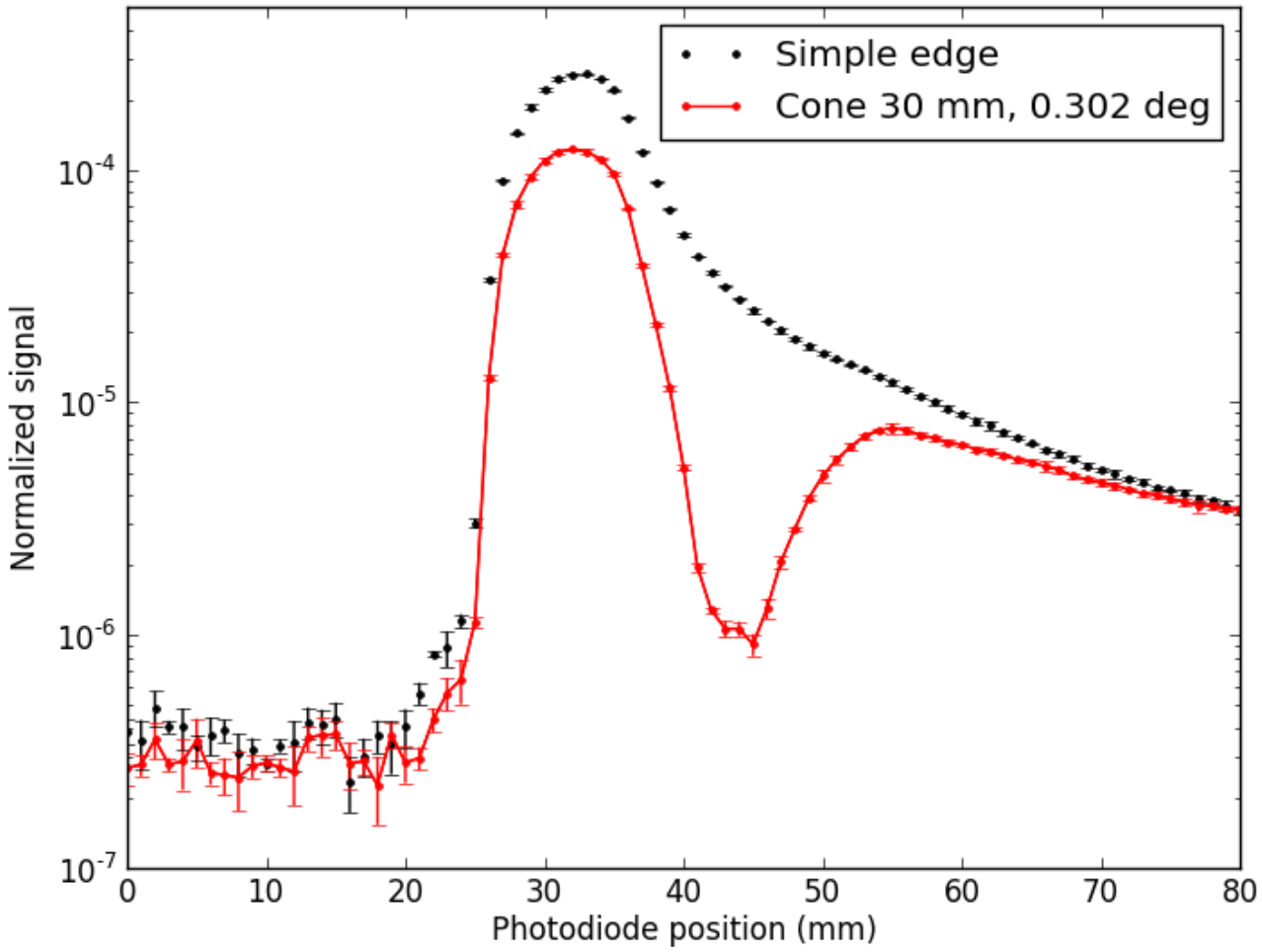
- Breadboard of the Occulting Assembly





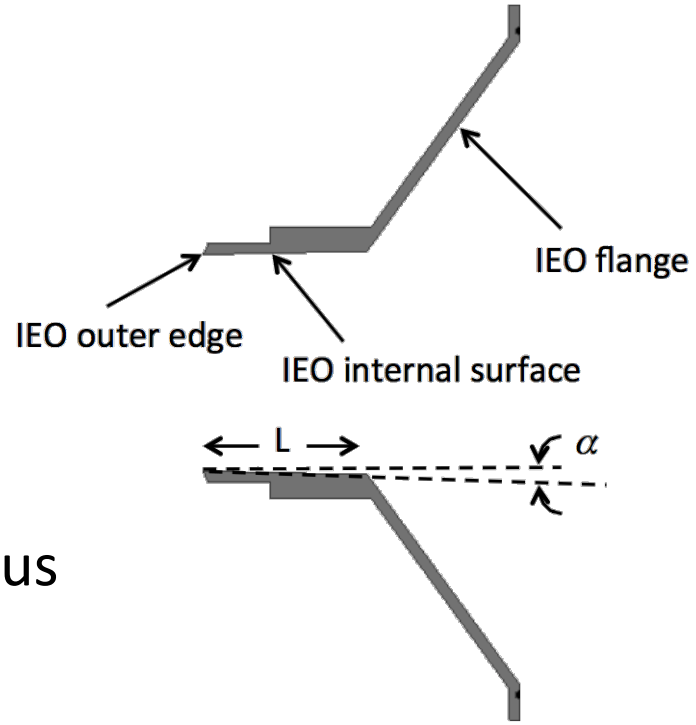


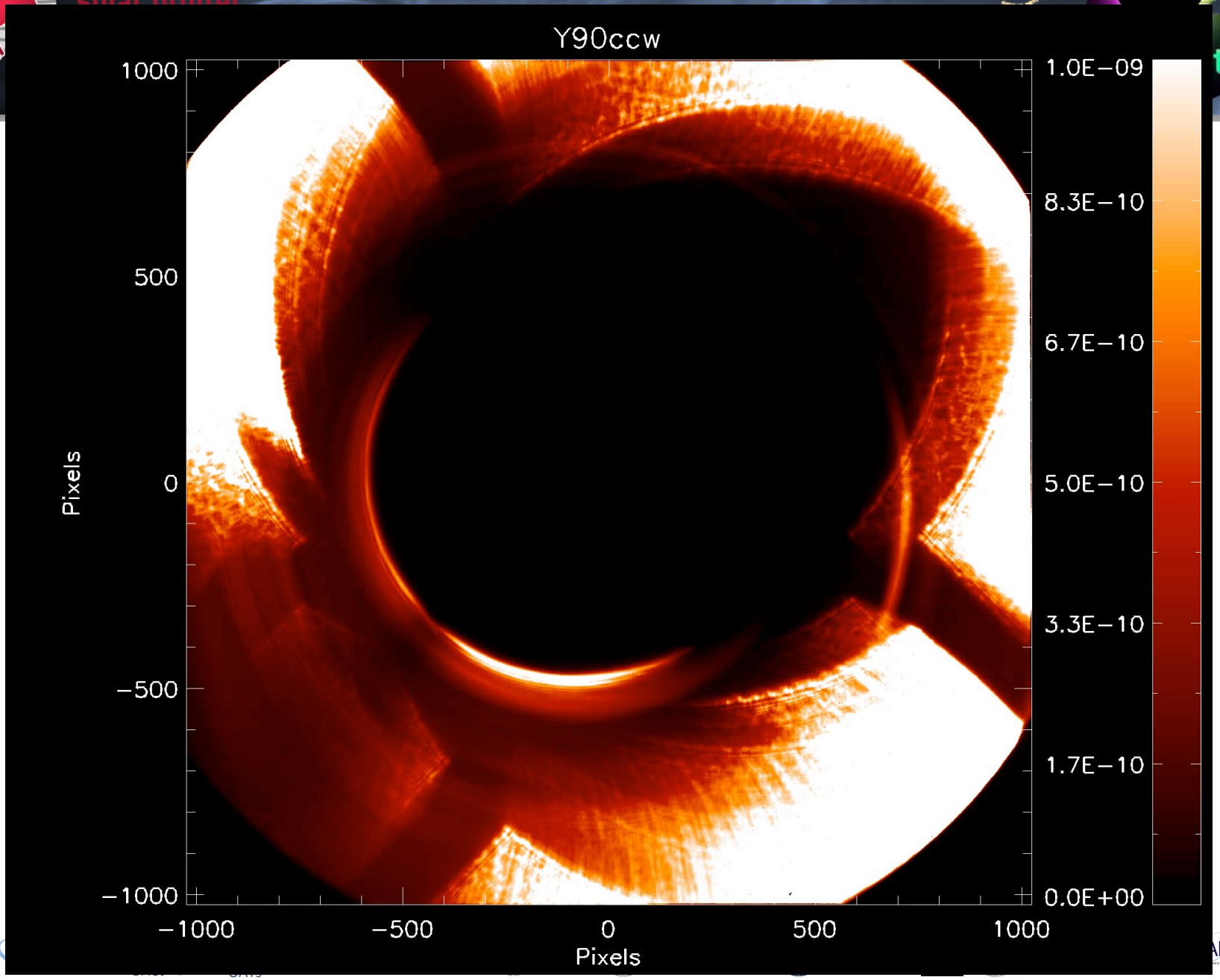
BOA results


Simple edge
Cone 30 mm, 0.302 deg
Normalized signal
10^{-4}
10^{-5}
10^{-6}
10^{-7}
0
10
20
30
40
50
60
70
80
Photodiode position (mm)

BOA results

- Concept: inverted cone
  [Landini et al, Proc. SPIE 2012]
- Length: 30 mm
  [Landini et al, Proc. SPIE 2013]
- Cone semi-aperture angle: 1.07 deg
  [Landini et al, Proc. SPIE 2013]
- Coating: Acktar magic Black
  [Landini et al, Proc. SPIE 2014]
- Outer edge finishing shape: circular, radius
  [Landini et al, Proc. SPIE 2014]

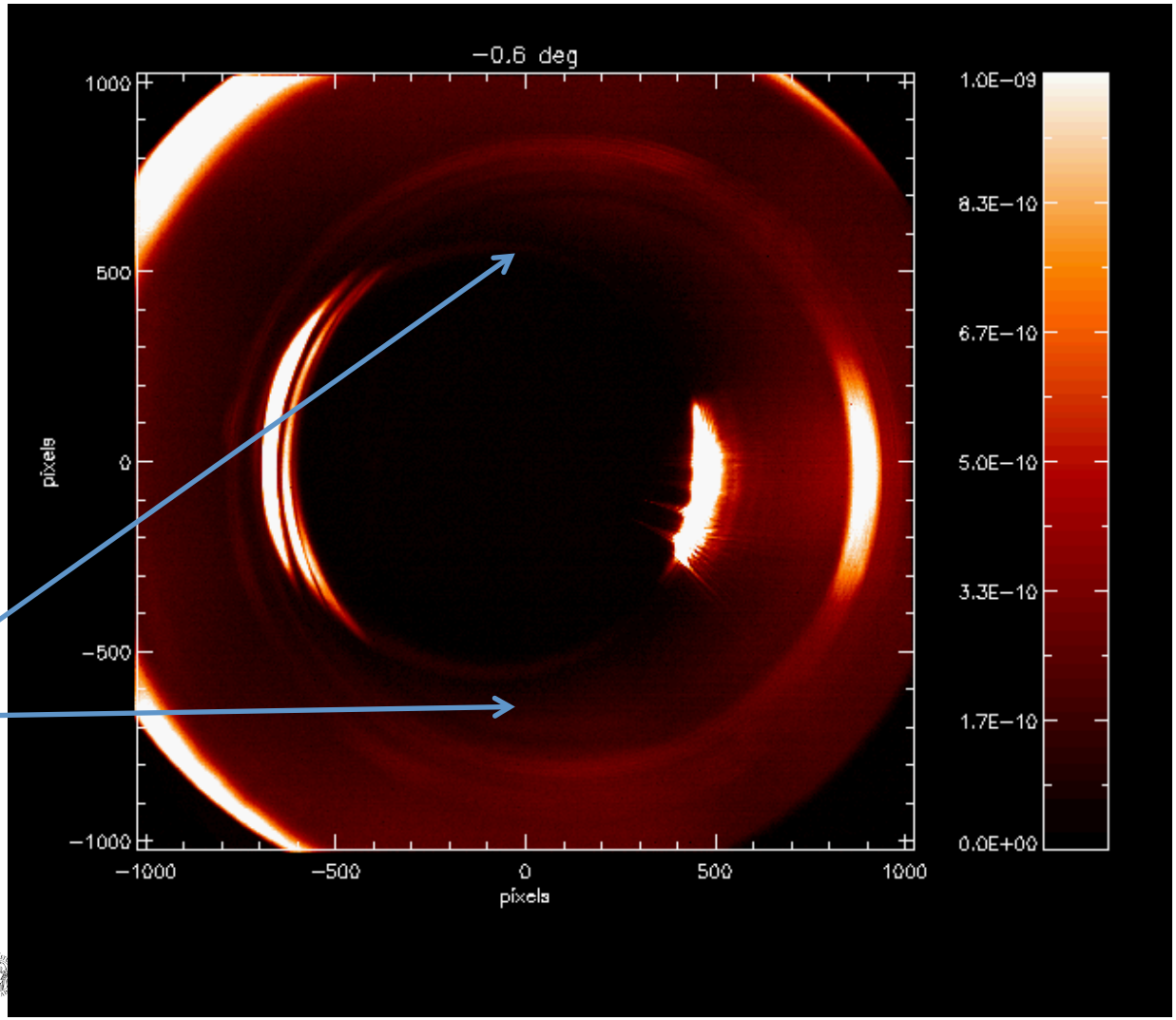



Y90ccw
1000
500
0
−500
−1000
Pixels
−1000
−500
0
500
1000
Pixels
1.0E−09
8.3E−10
6.7E−10
5.0E−10
3.3E−10
1.7E−10
0.0E+00

Off pointing

Metis may experience off-pointings, due to spacecraft misalignments or to commanded operations.

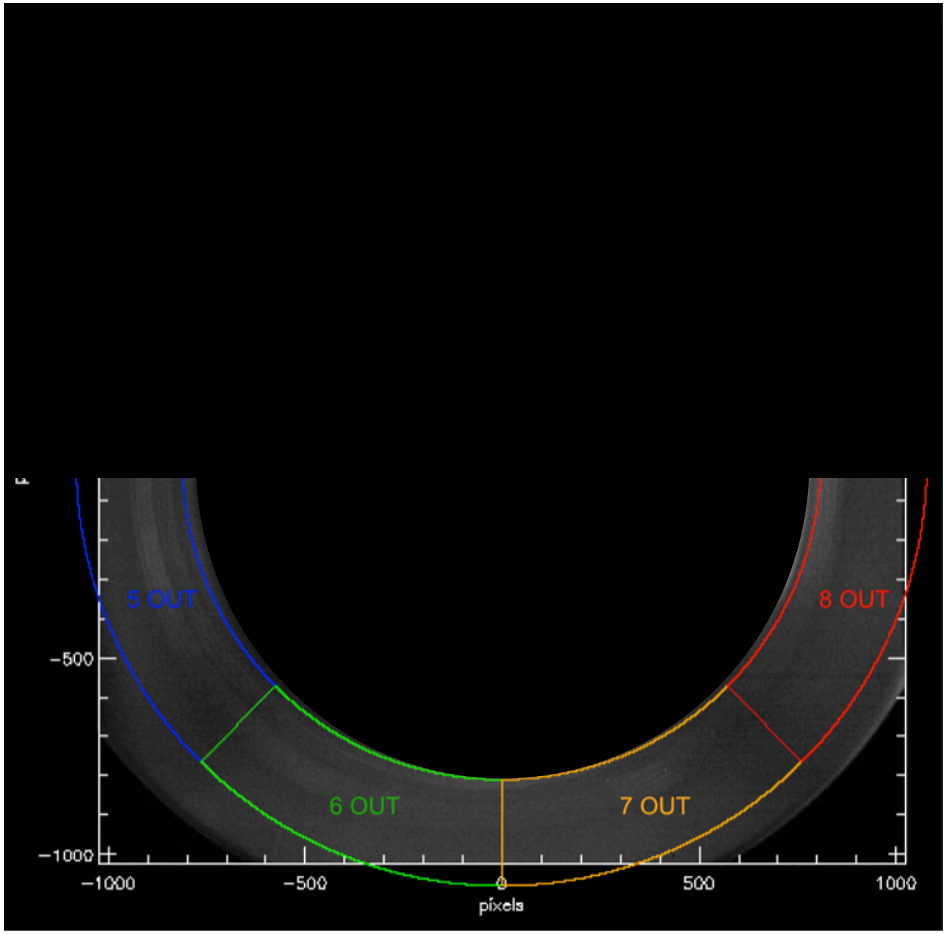
The calibration bench is motorized and was used to off-point Metis at –0.6°, –0.3°, 0.3°, 0.6° in yaw.



Actual stray light

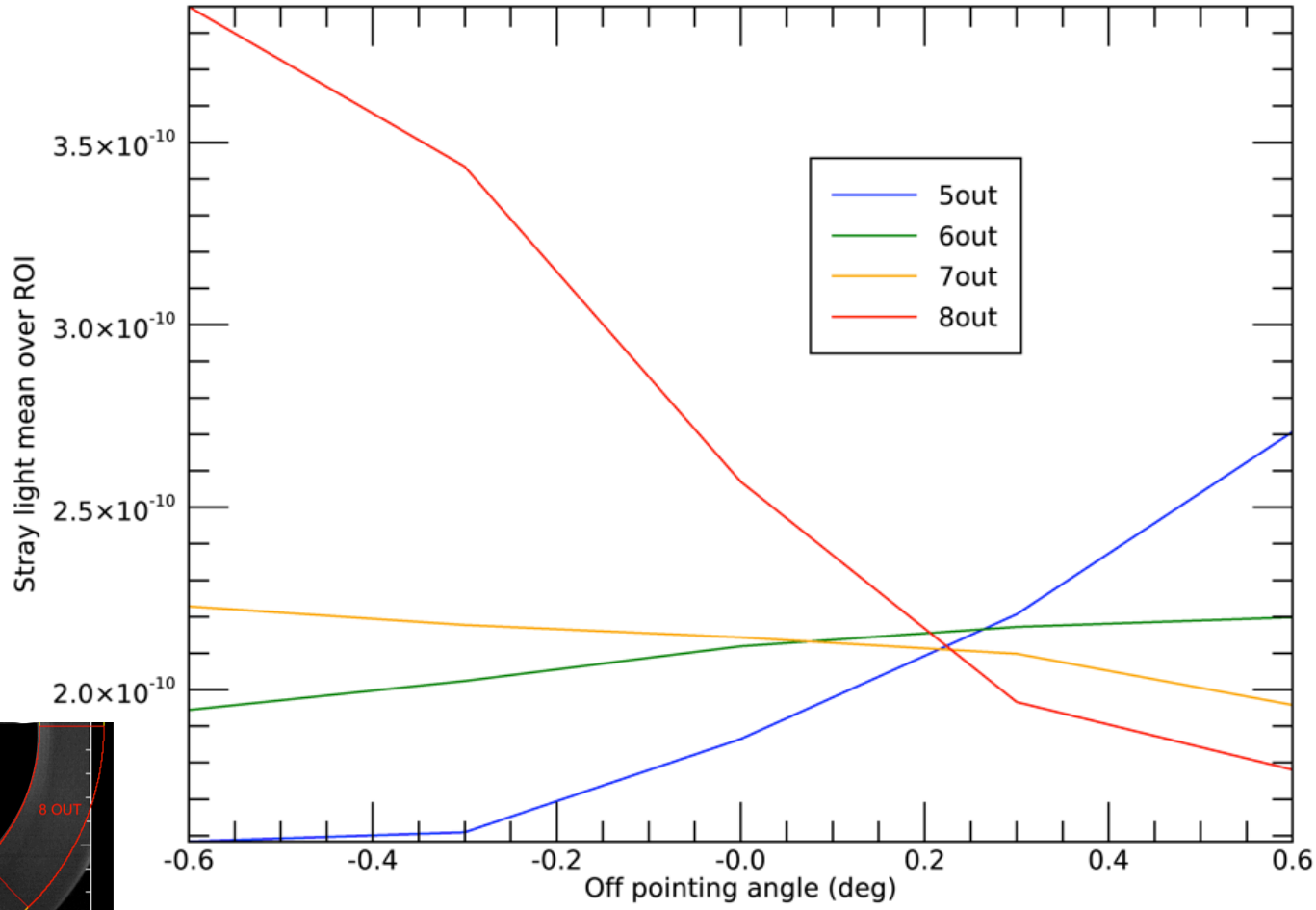
Off pointing

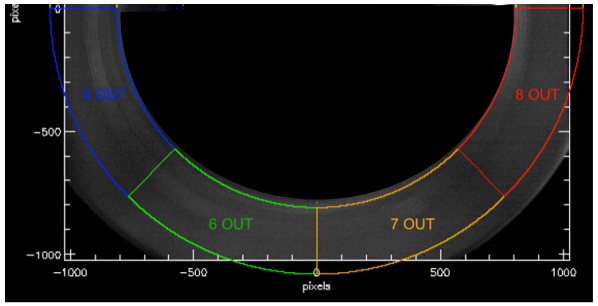
- The signal average was evaluated in some ROIs for each off-pointing.
- To avoid the influence of the setup, only 4 ROIs were actually selected.
- Not the ideal ROIs: far from the IO edge (all of them), far from the tilt direction (green and orange).



Off-pointing

- It is actually possible to use the method in flight to monitor the spacecraft off-pointing.
- Refinements are necessary!





Summary

- In order to reduce the stray light generated by the IEO, an optimization of its shape was needed.
- An experimental campaign was conducted with a prototype of the occulting system and the geometry of an inverted truncated cone was defined.
- The actual (flight model) occulting system had a huge stray light leak due to the IO misalignment.
- IO was fine-tuned: the Metis stray light is well below the requirement ($<10^{-9}$ in units of mean solar disk brightness).
- In flight stray light measurements may be used to infer the spacecraft pointing.