ULTIMATE-START:
Subaru Tomography Adaptive optics Research experimenT

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and ULTIMATE-START team

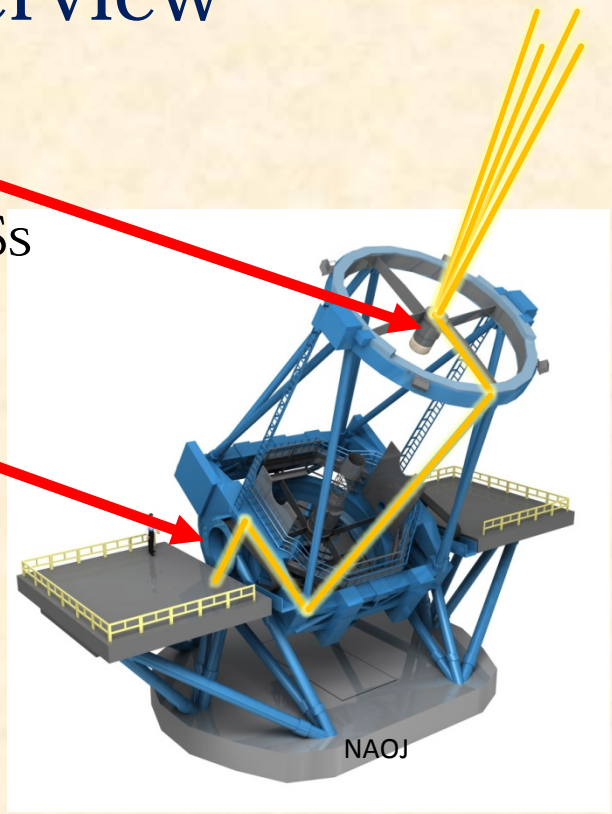
ULTIMATE-START overview

4 LGSs

- 20W laser from TOPTICA divided into 4 LGSs

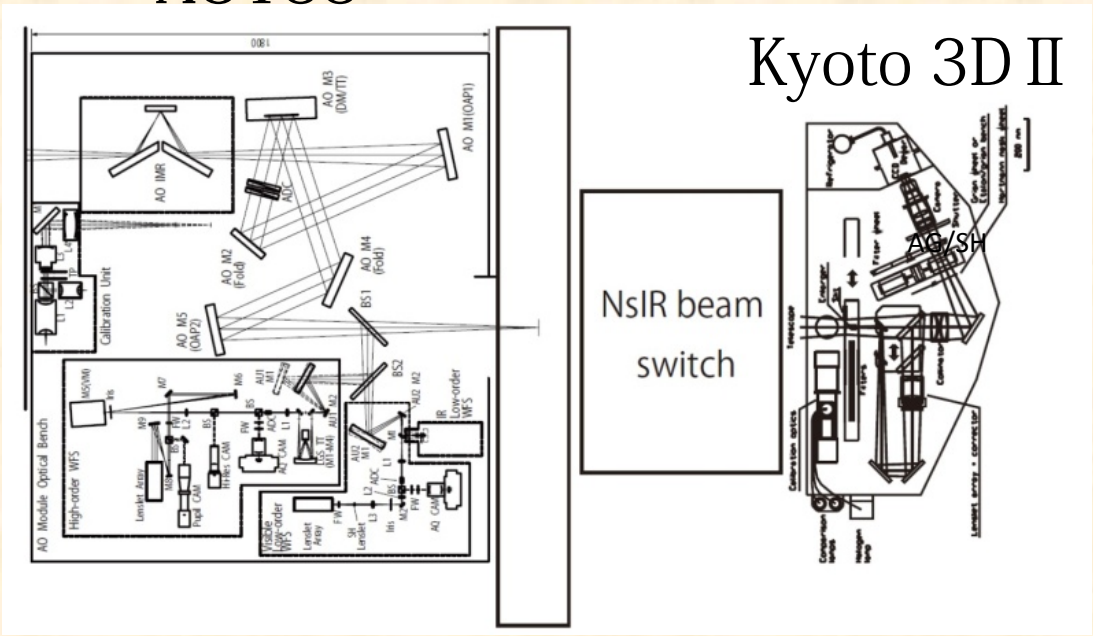
4 WFSs

- 25x25 Shack Hartmann WFSs



AO188

WFS unit



Kyoto 3D II

Wide-field AO development path

- We kicked-off laser tomography AO experiments with a JSPS funding as the first step of the ULTIMATE-Subaru.

✓ 1. Tomography AO correction with 3 NGSs : RAVEN

● 2. Laser Tomography AO experiment with 4 LGSs :
  - ➢ Install 4 LGSs + WFSunit

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3. Laser Tomography AO correction
  - ➢ Installing high-order DM

4. Ground-layer AO system : ULTIMATE-Subaru
  - ➢ Installing adaptive 2ndry

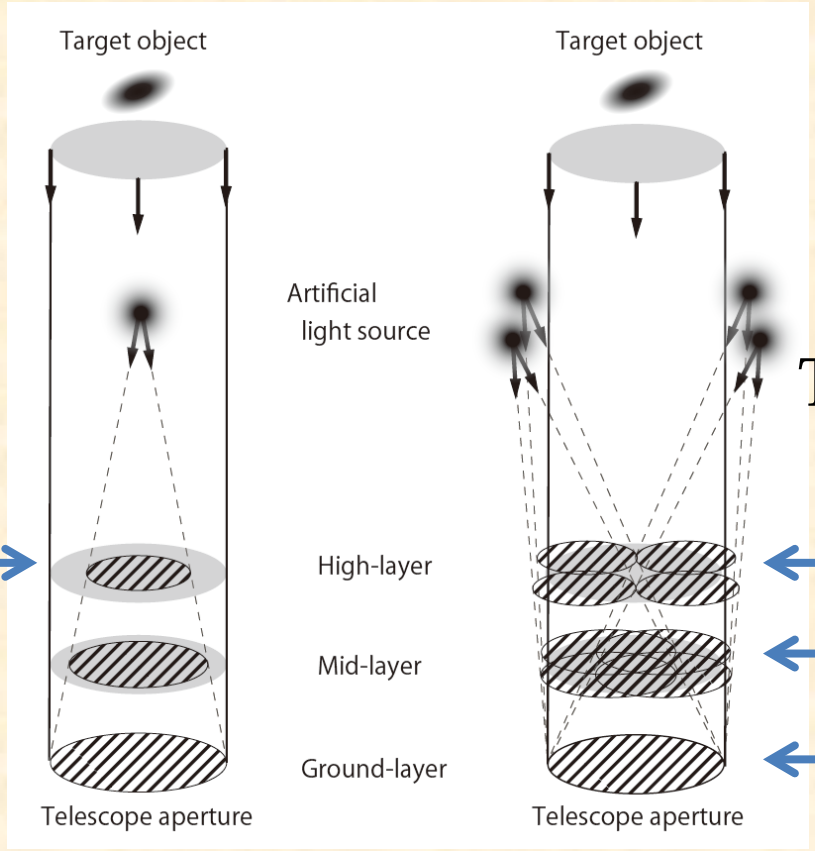
5. Wide-field multi-AO system on TMT

Tomographic AO system

- The “cone” effect associated with a single LGS system can be removed with multiple LGSs.

Infinity

90km



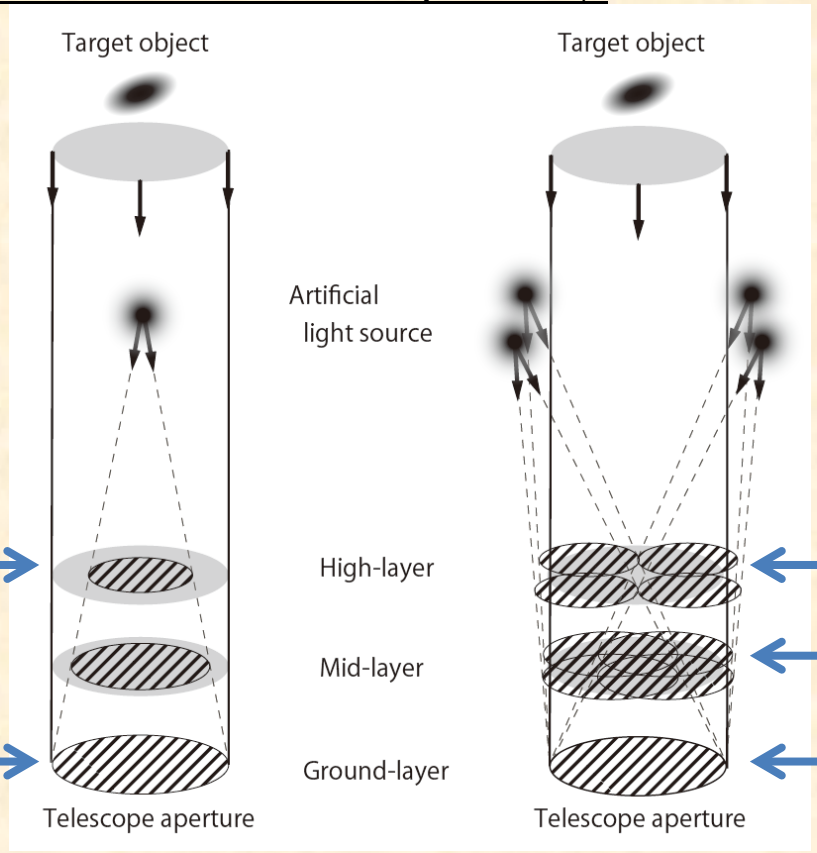
Outside areas of the “cone” are not covered

Turbulence layers up to 15km

All areas are covered

Tomographic AO system

- In the classical AO system, integrated wavefront distortion is measured with one light source, i.e. turbulence layers are degenerated.
- In the tomographic AO system, multiple light sources are used to estimate the turbulence layer at each altitude separately.

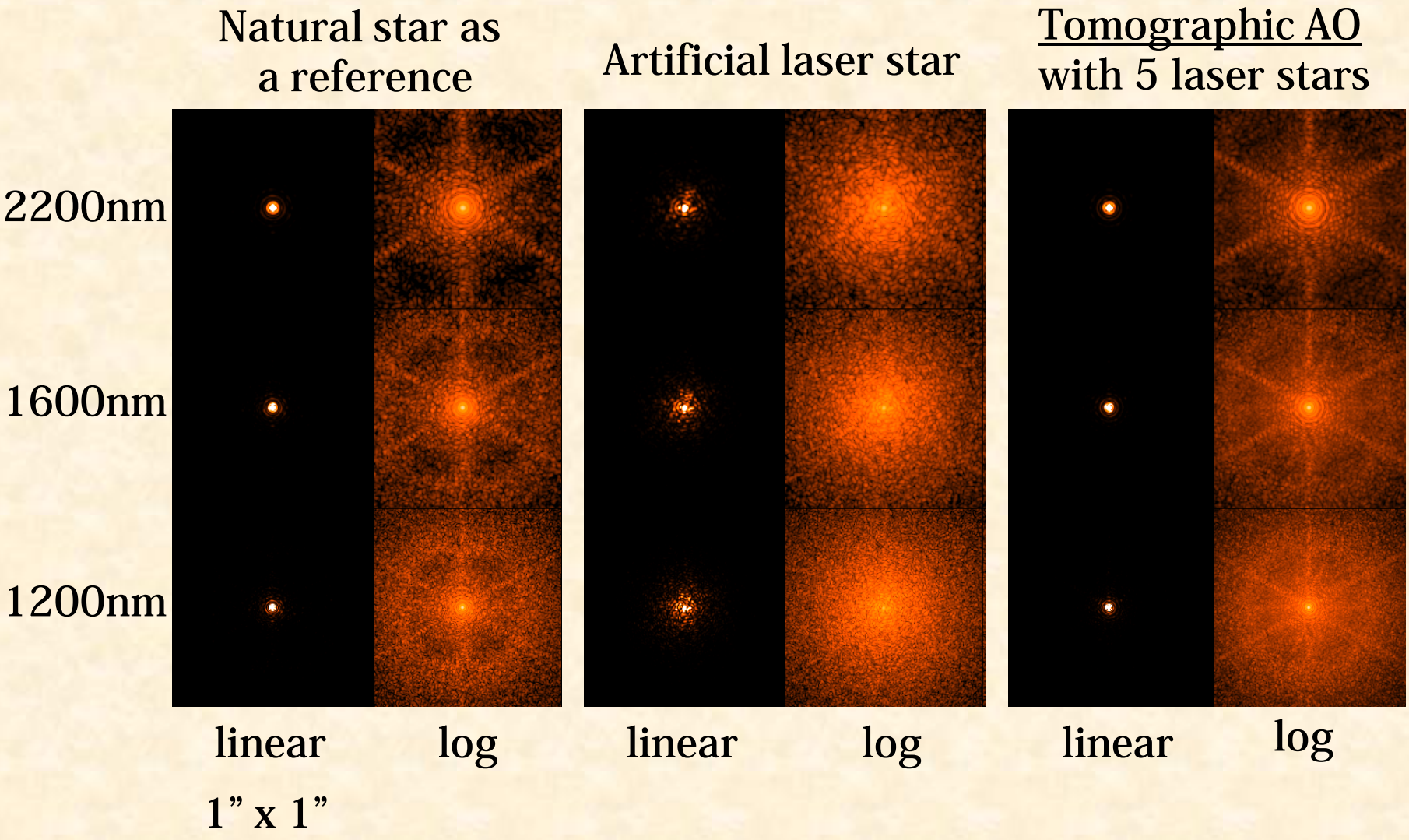


Integrated/
Degenerated

Separated
"3D" estimates

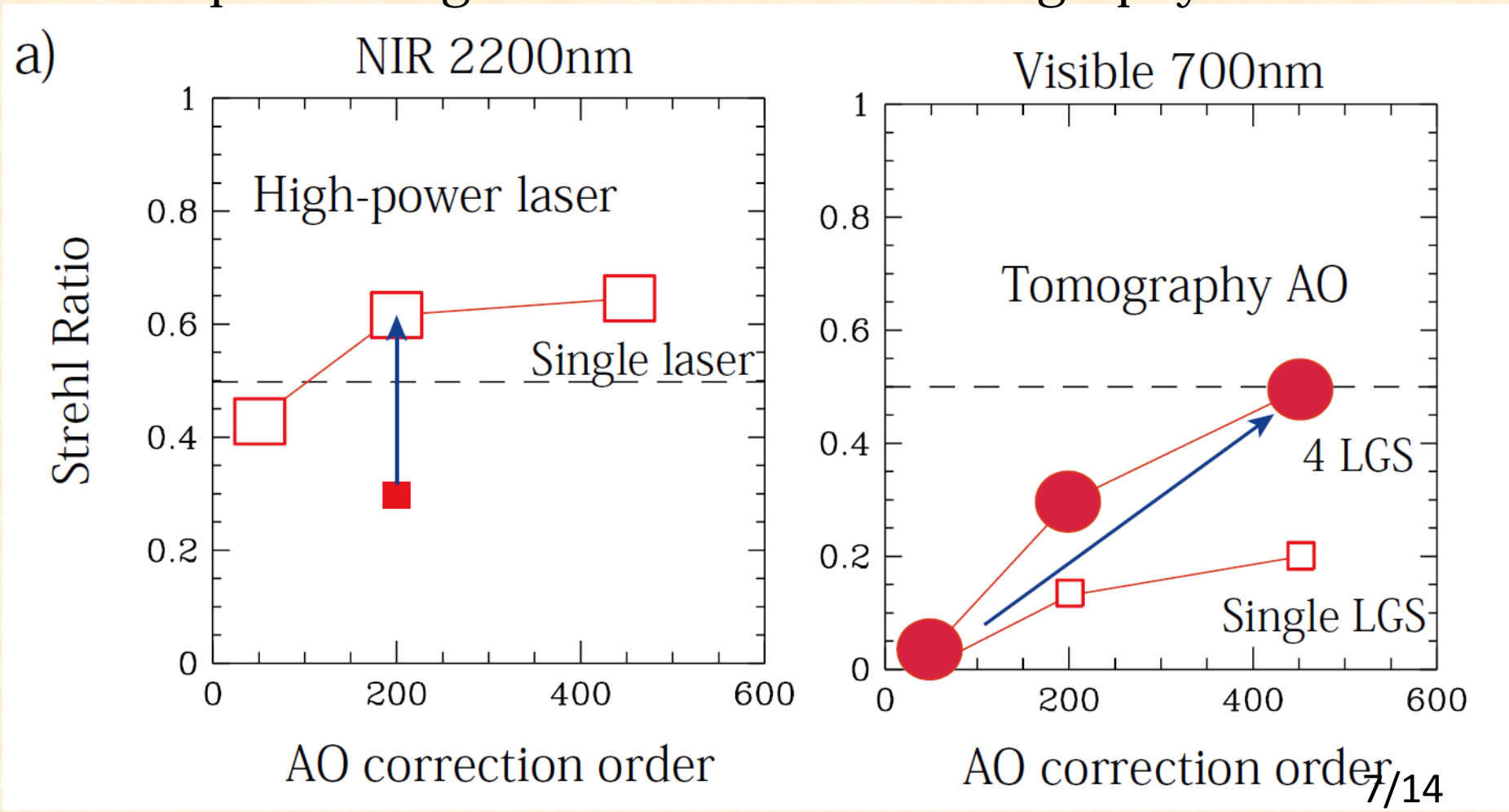
Point Spread Function with a tomographic AO

- PSF calculated for an AO system on 30m aperture TMT.

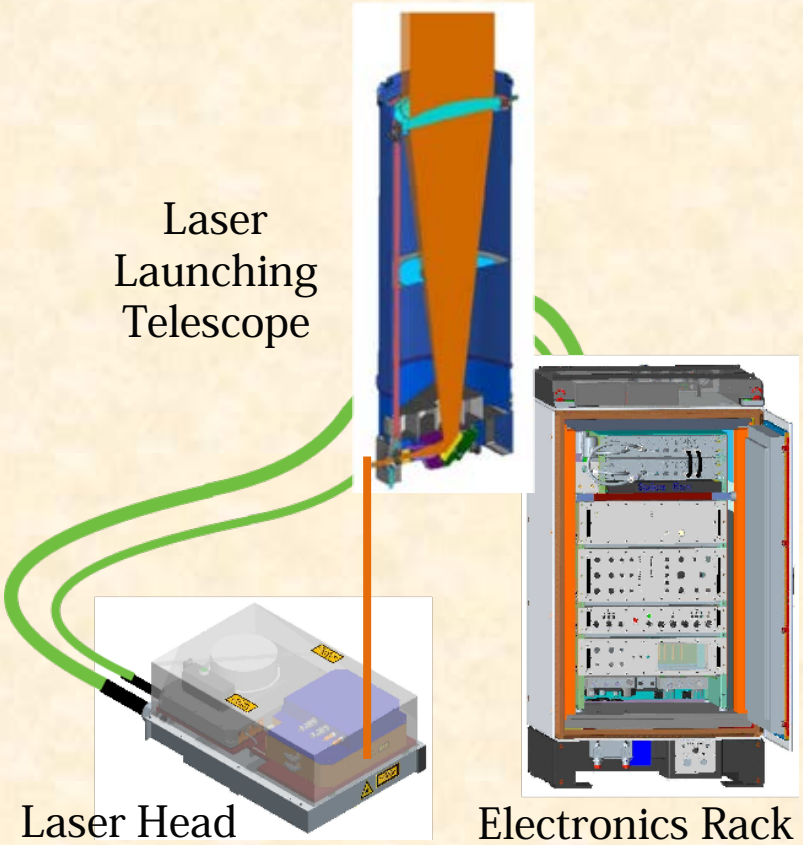


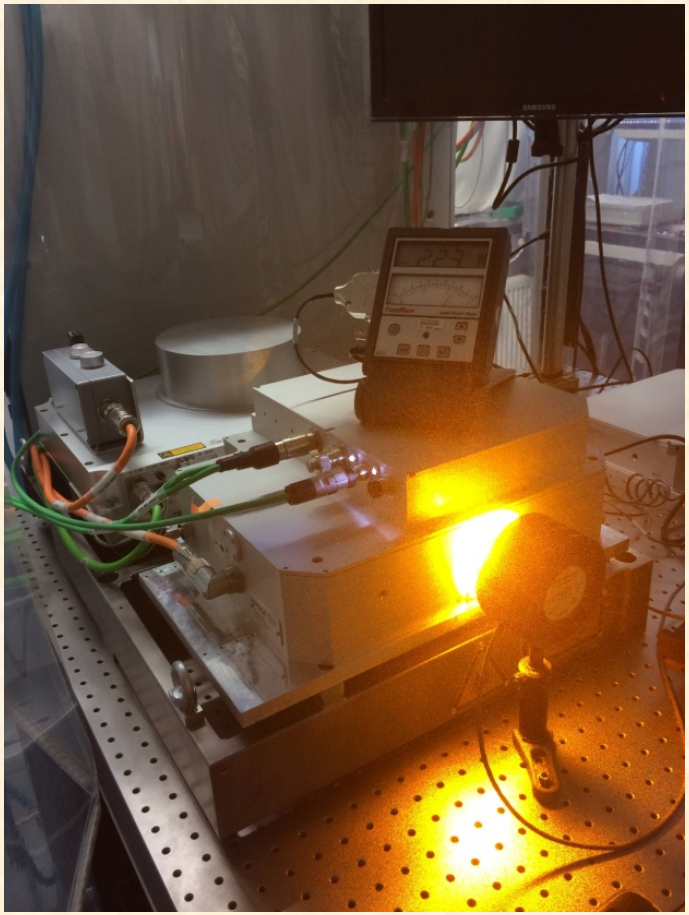
Laser tomography AO
for high spatial resolution observations in the visible light

Simulation for the 8m Subaru telescope
Square : Single LGS AO, Circle : Tomography AO



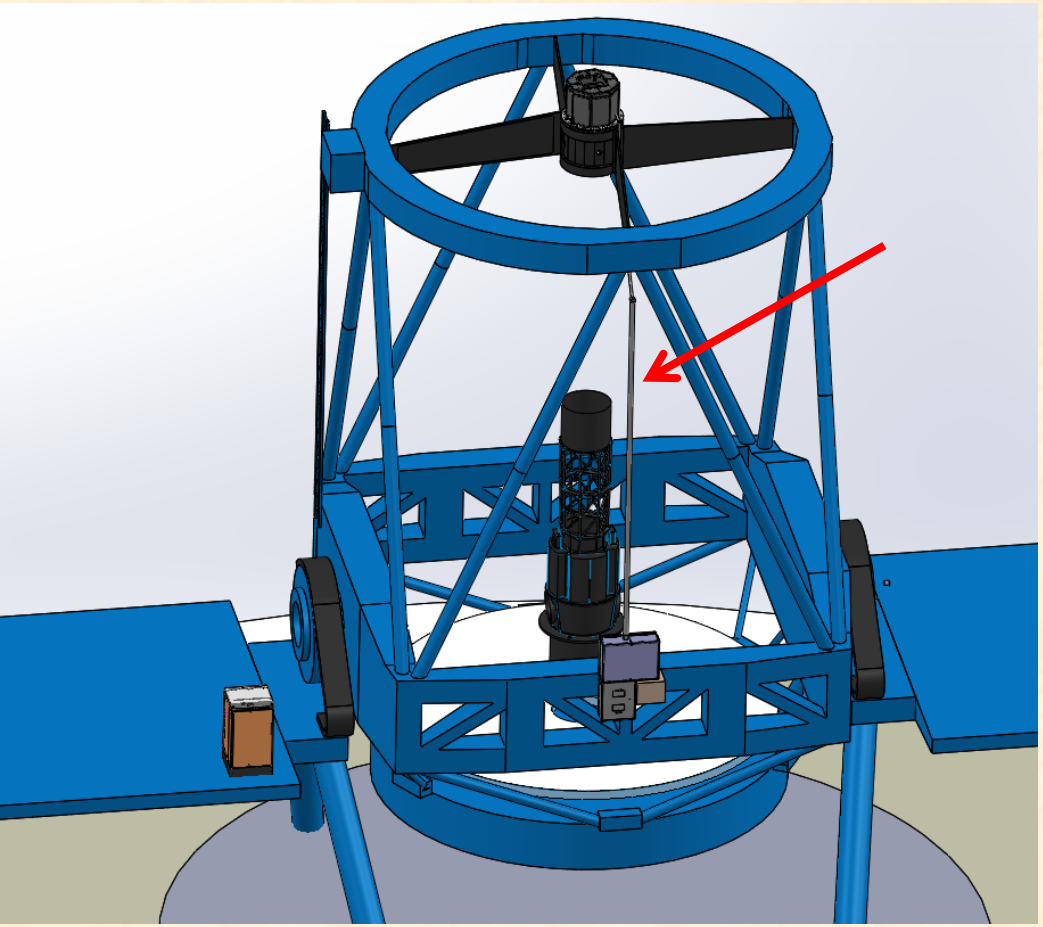
TOPTICA new laser

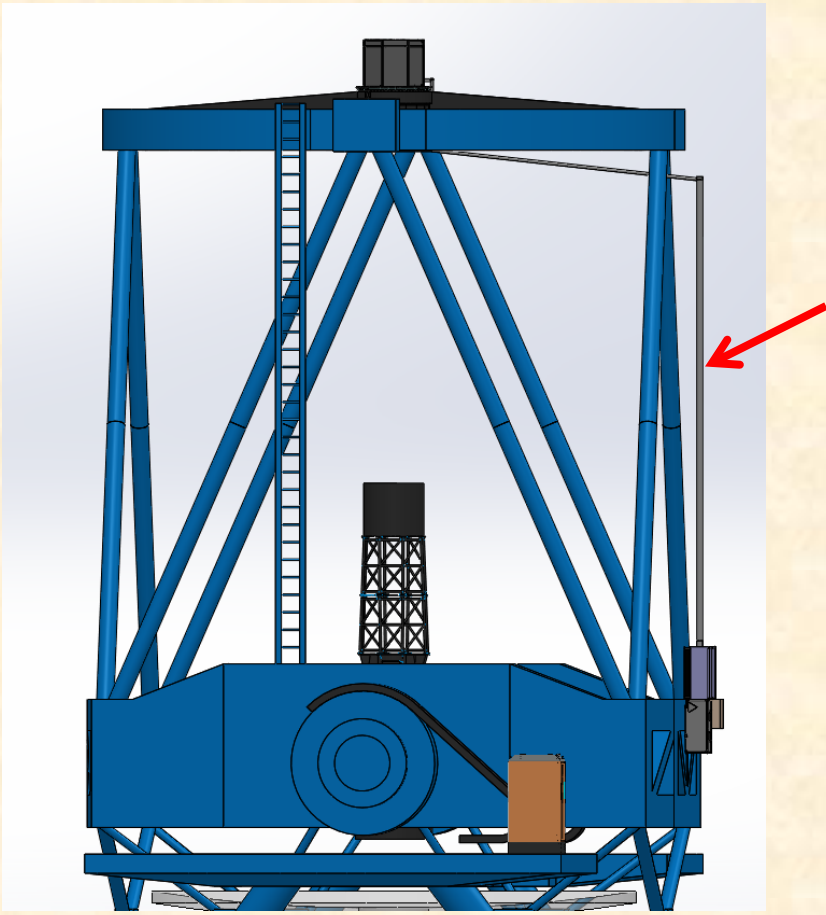




- 20W TOPTICA laser will be more than 10 times brighter than the current Subaru LGS.

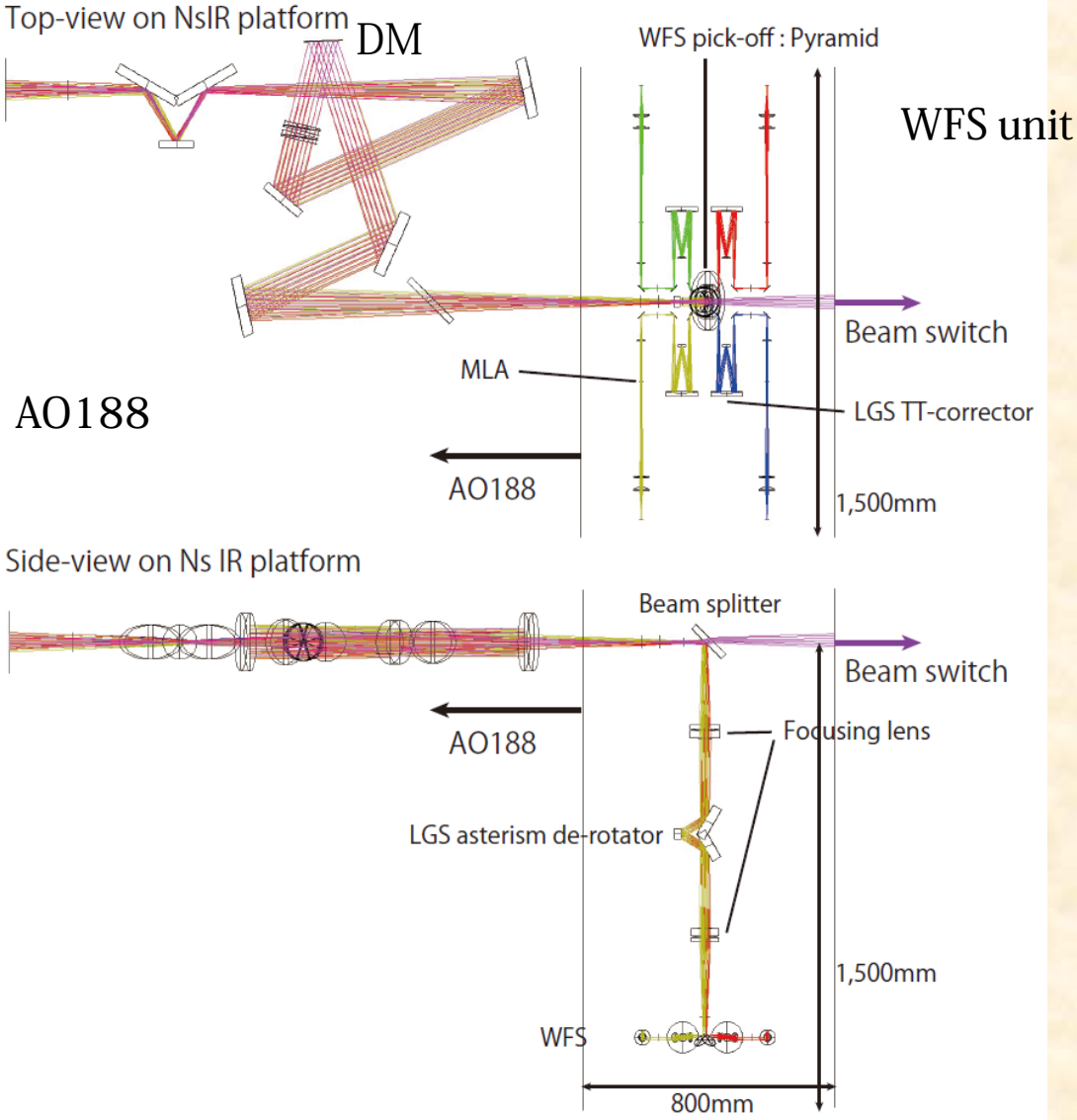
Installation of the new laser system to the Subaru telescope (Minowa)





Tomography WFS unit controls the DM in AO188 system

Light from the telescope



SH WFSs for tomography AO (Watanabe M2)

AO188

WFS unit

Beam Splitter

Instrument

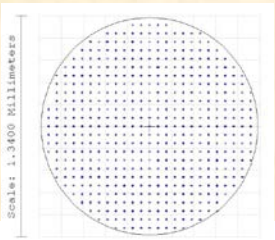
Fore-optics

De-rotation
Focusing
(80km-200km-infinity)

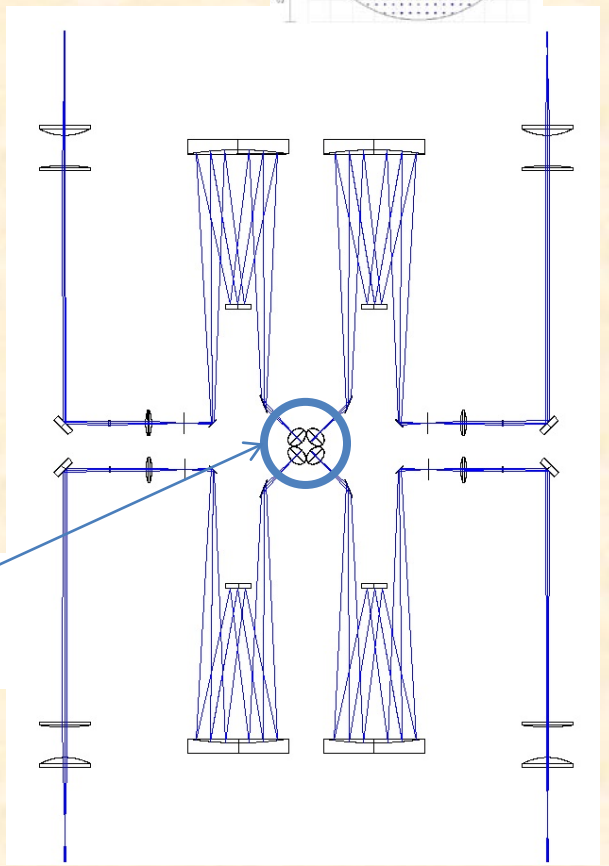
WFSs

side view

25x25 SH spots on the detector



4 WFSs



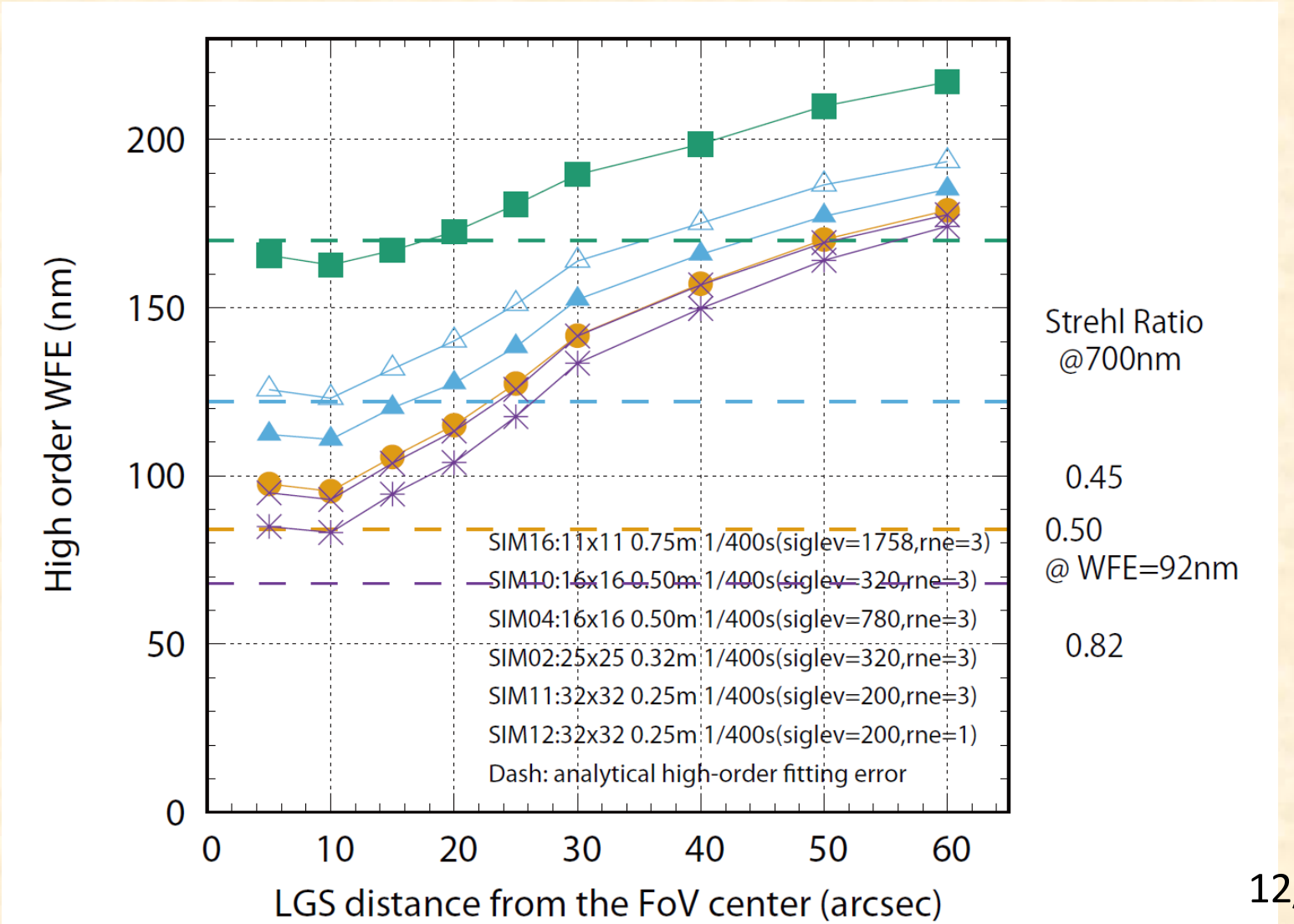
pick-off:
Pyramidal mirror

Wikipedia

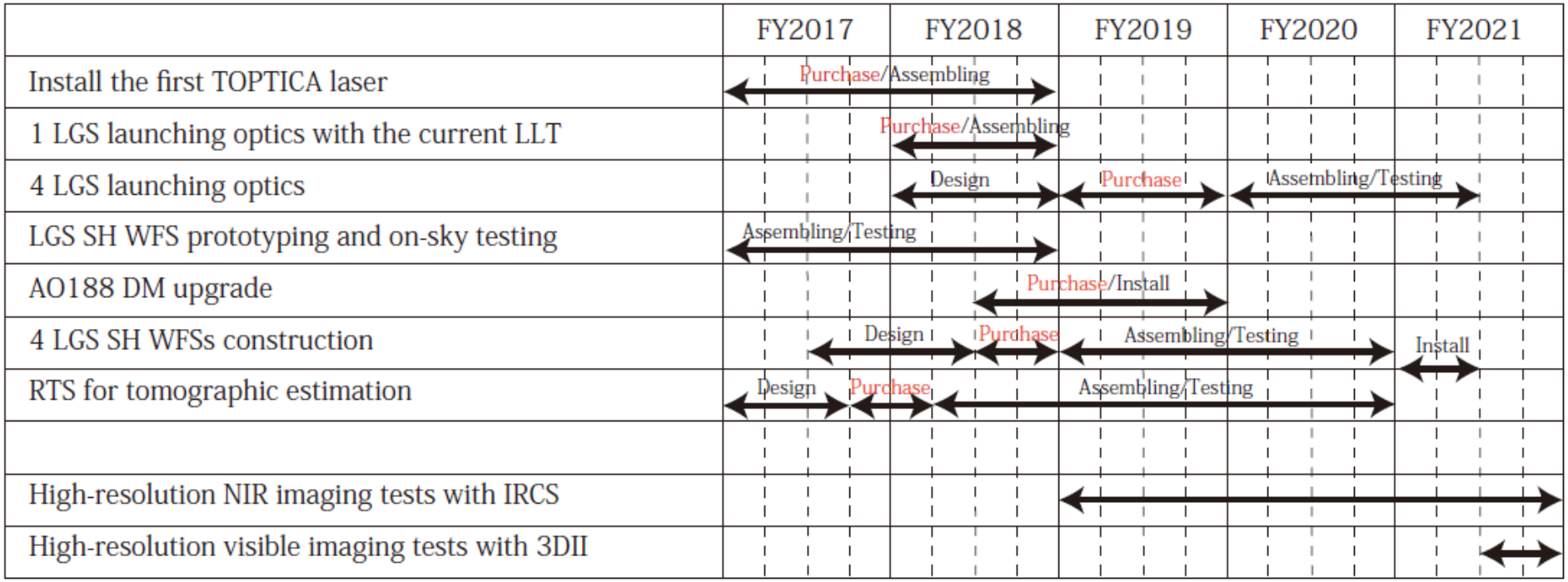
top view

Specify parameters with simulations

- Target for the residual high-order wave front error is RMS=100nm.



Time-line of the project



- 4 LGS system development is lead by Subaru telescope (Minowa)
- 4 WFS system development is lead by Tohoku Univ. (Akiyama)

- Single LGS upgrade will be available from FY2019. Increased SR in the NIR.
- Tomography AO system will be only available as a PI-type instrument.

You are welcome to join the ULTIMATE-START project.

- Australian National Univ. collaboration for LLT/laser development.

We are currently advertising a 4-year post-doc position for the development of the system (starting from ~2018/04).

If there is a person who is interested in joining the project, please let me know.

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