

ULTIMATE-START: Subaru Tomography Adaptive optics Research experiment

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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

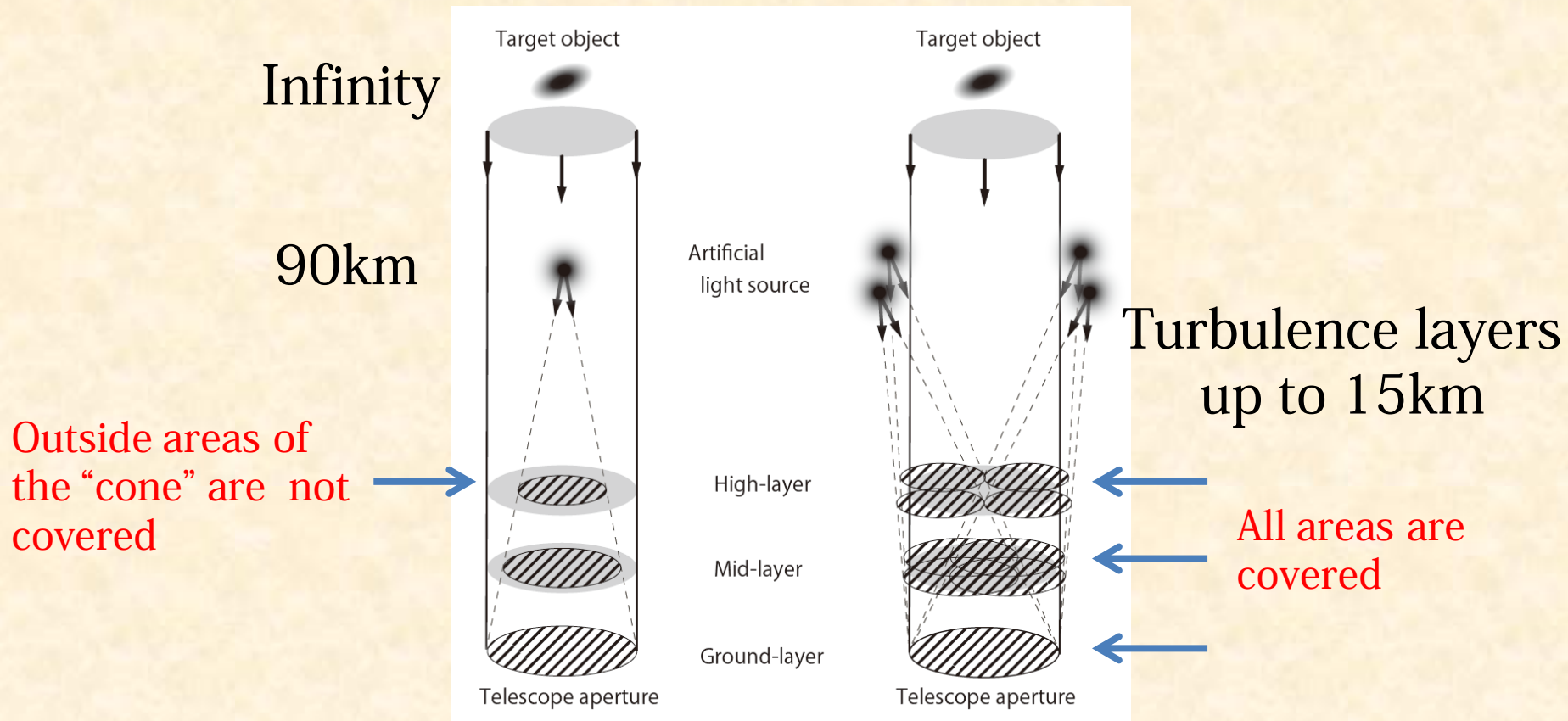
4. Ground-layer AO system : ULTIMATE-Subaru

➤ Installing adaptive 2ndry

5. Wide-field multi-AO system on TMT

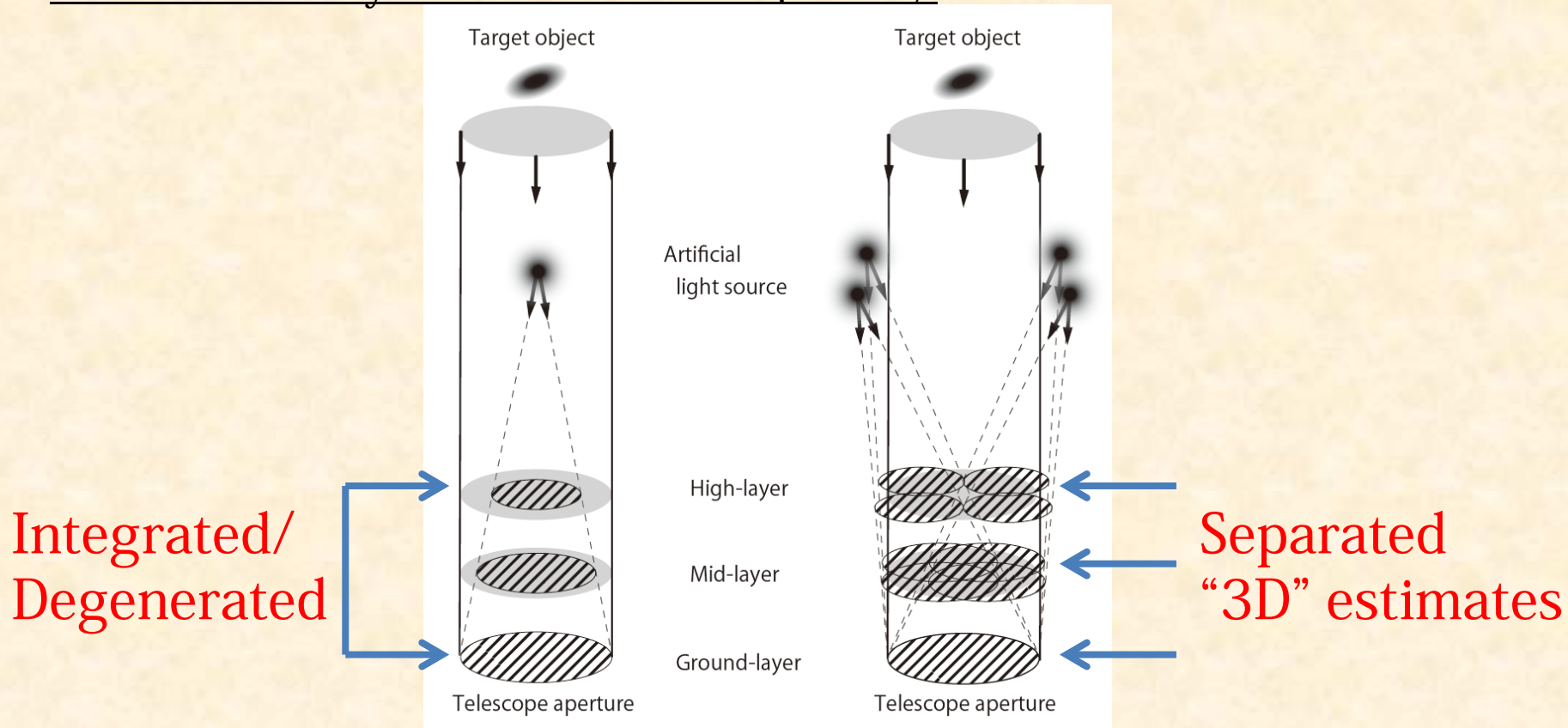
Tomographic AO system

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



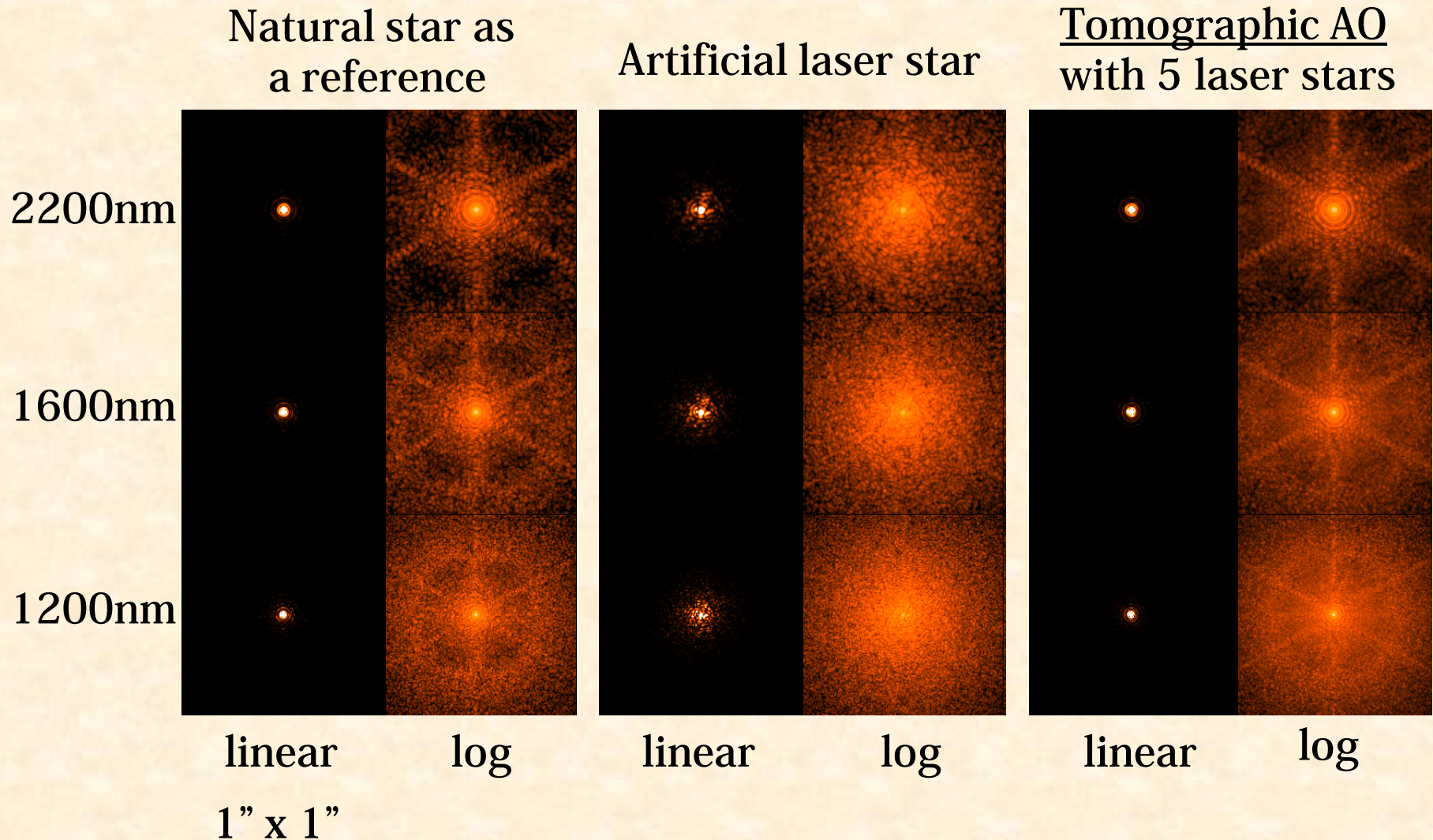
Tomographic AO system

- 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.



Point Spread Function with a tomographic AO

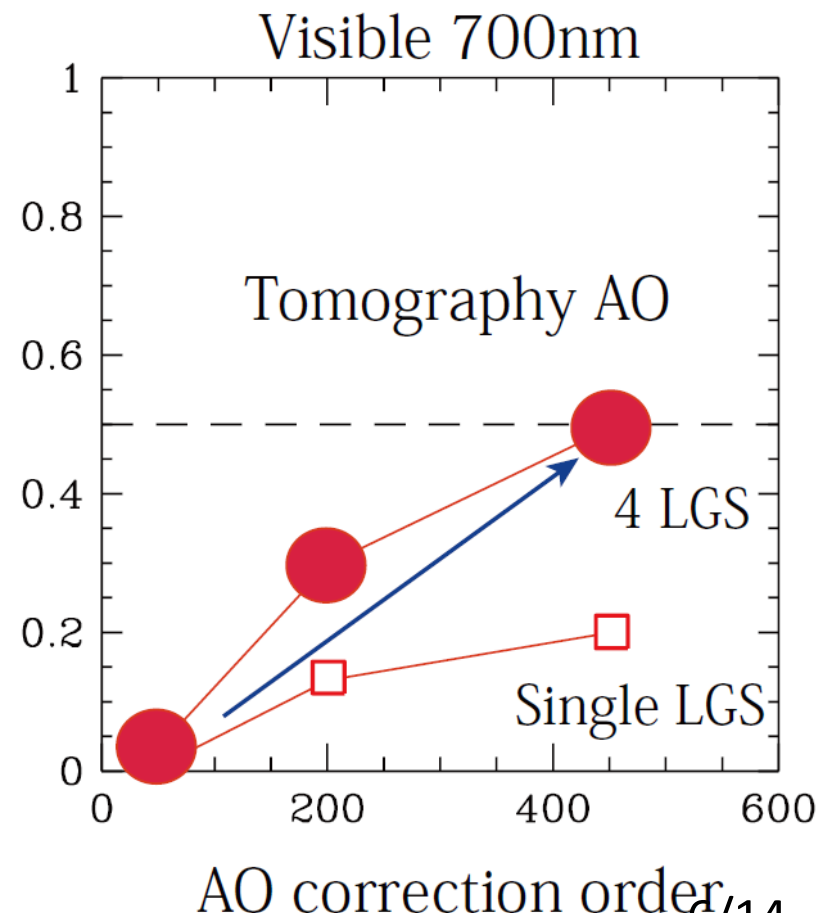
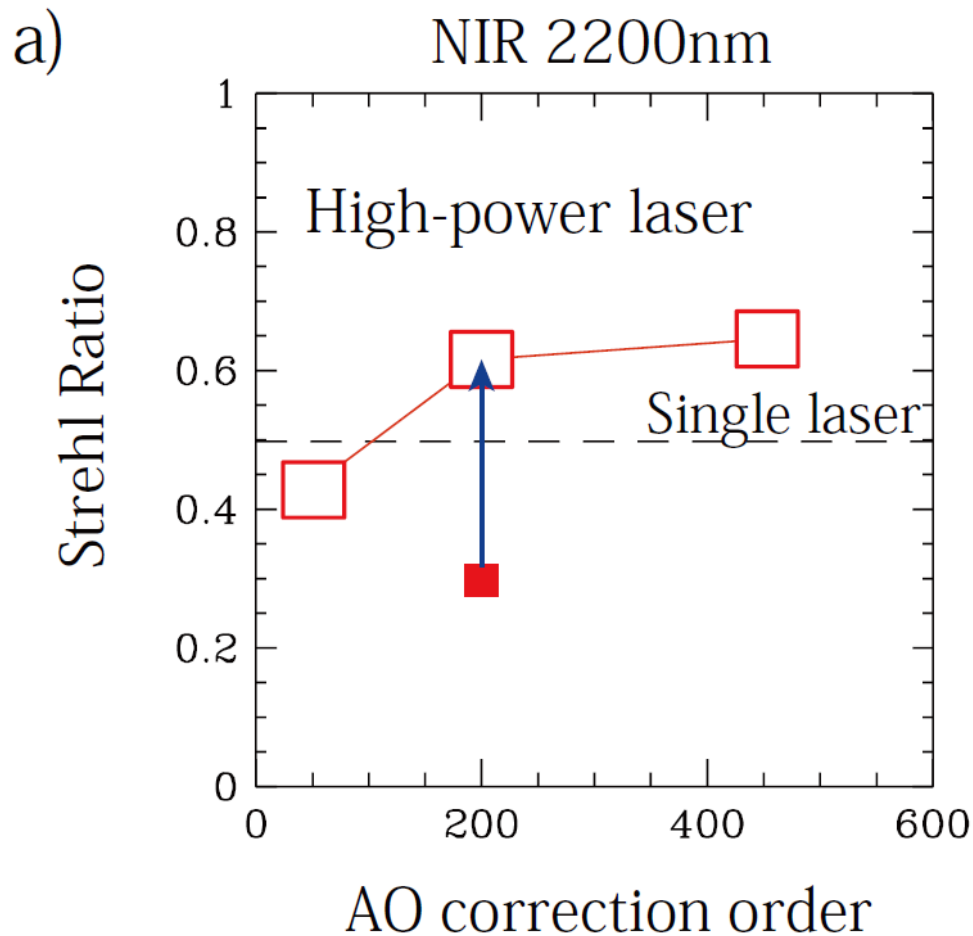
- PSF calculated for an AO system on 30m aperture TMT.



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



ULTIMATE-START overview

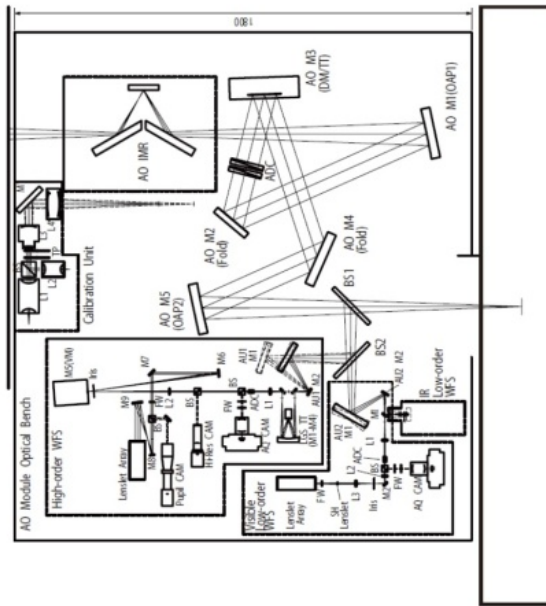
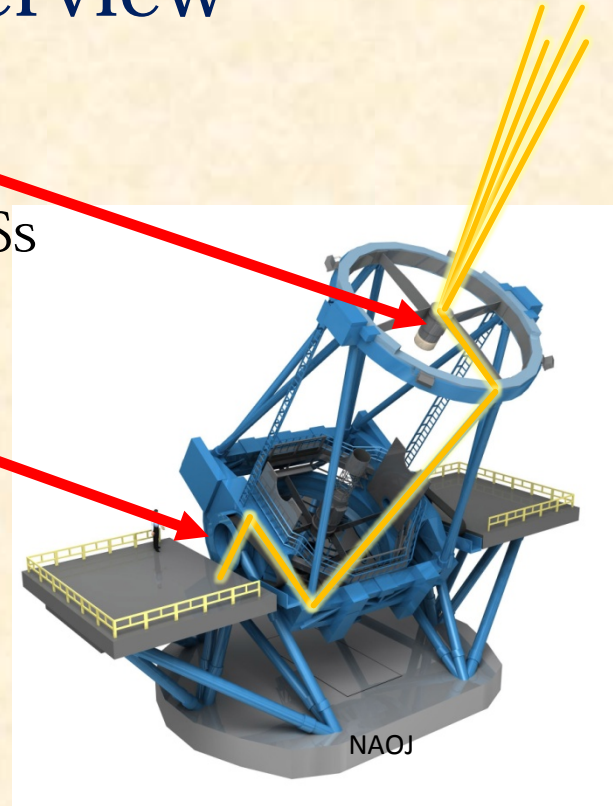
4 LGSs

- 20W laser from TOPTICA divided into 4 LGSs

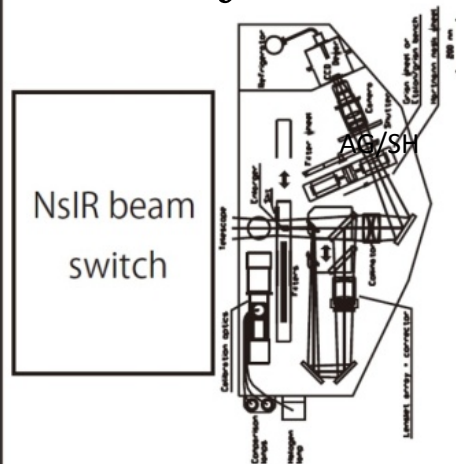
4 WFSs

- 25x25 Shack Hartmann WFSs

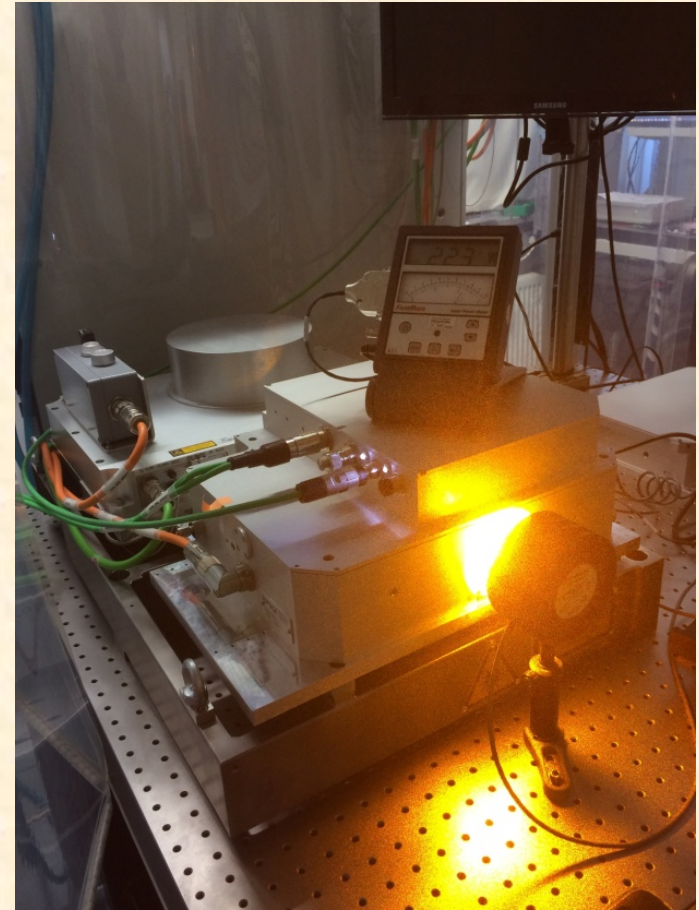
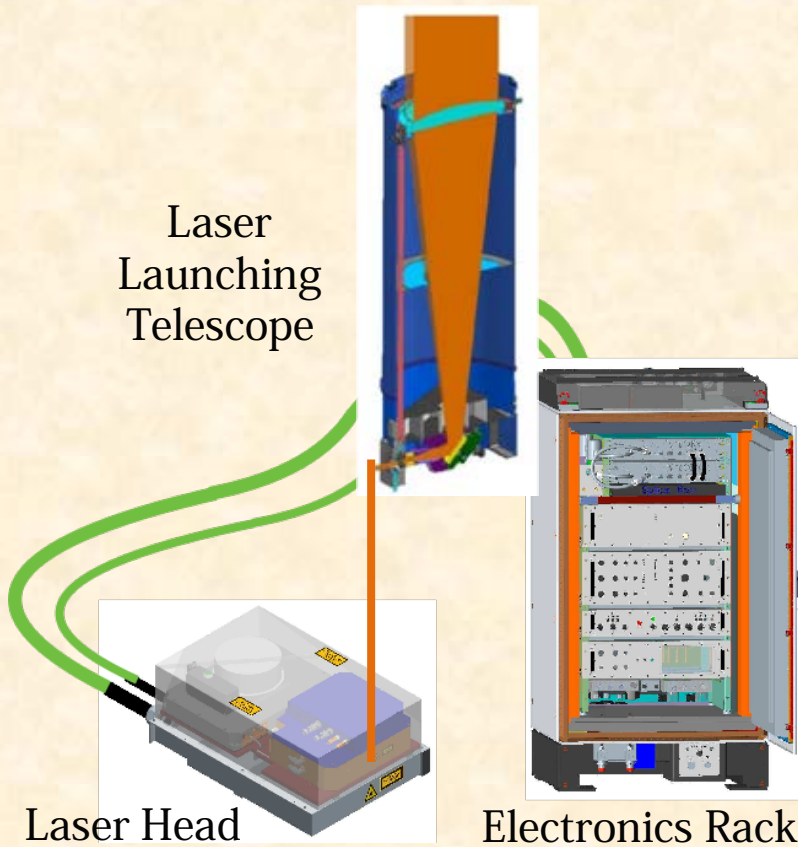
AO188 WFS unit



Kyoto 3D II

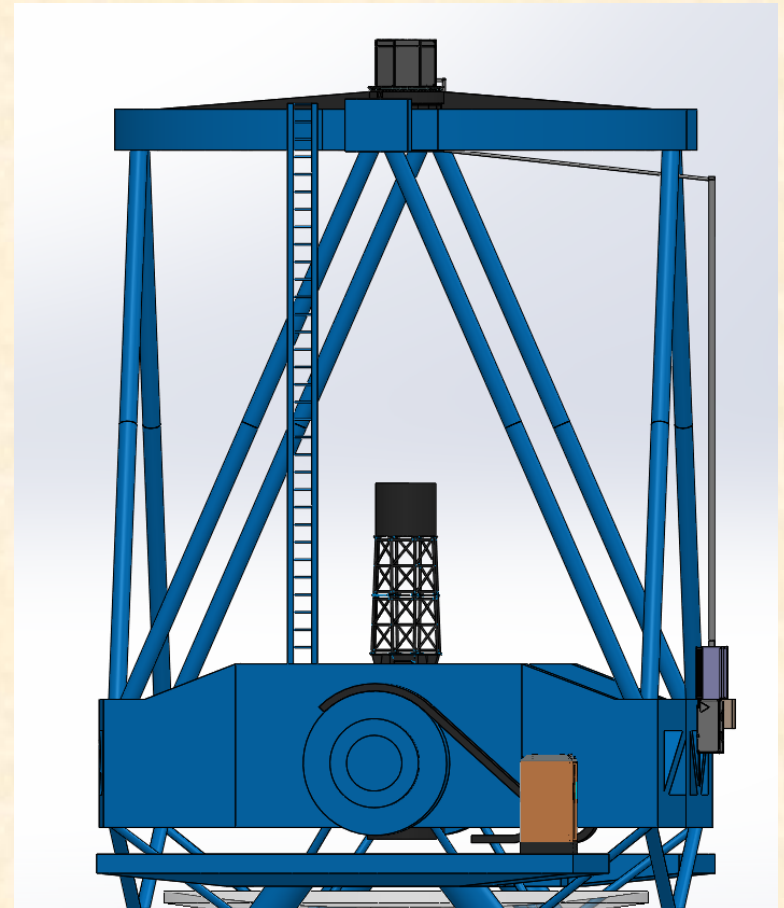
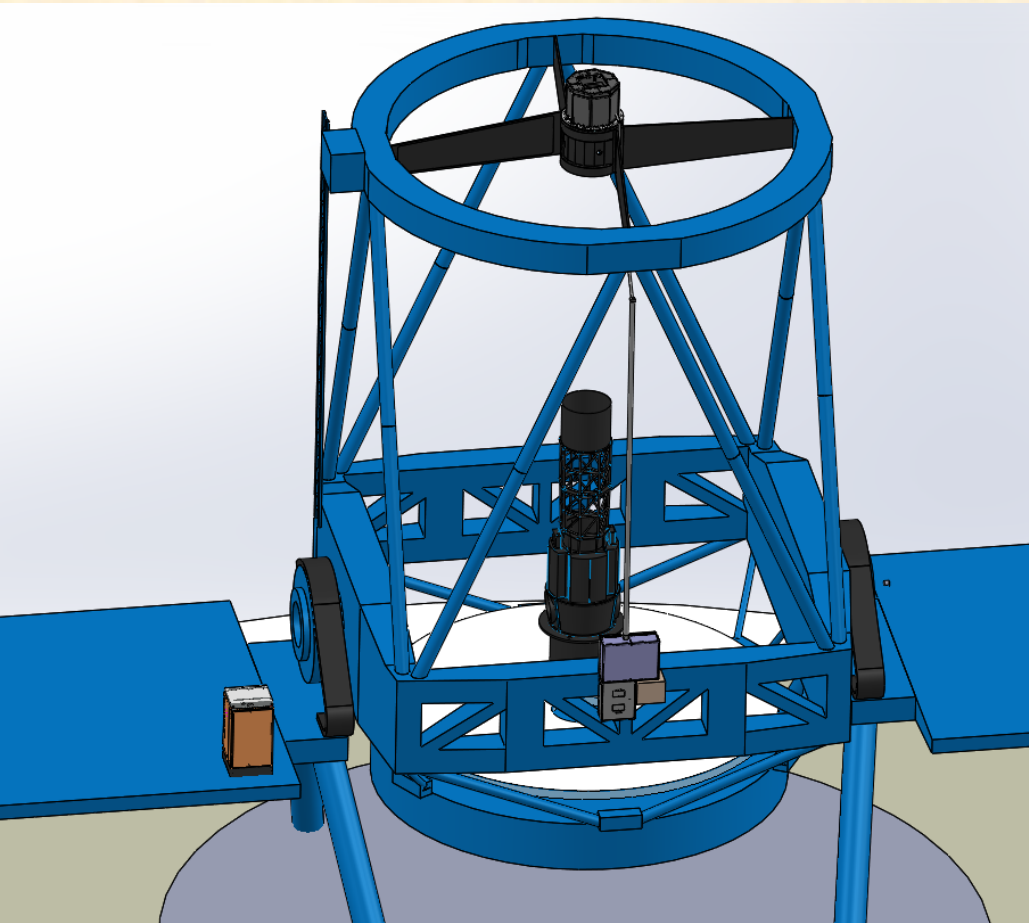


TOPTICA new laser



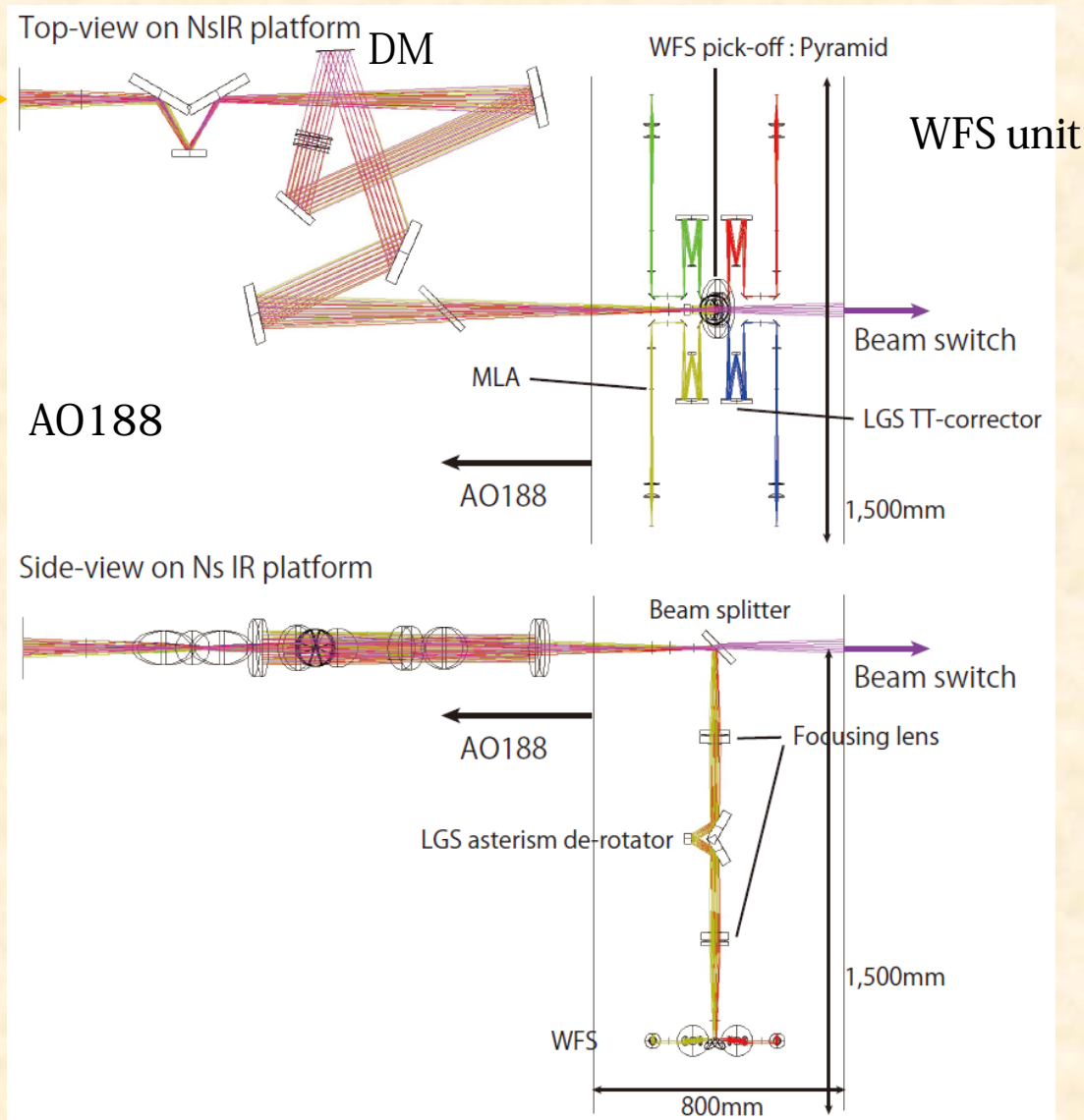
- 20W TOPTICA laser will be more than 10 times brighter than the current Subaru LGS.

Installation of the new laser system to the Subaru telescope

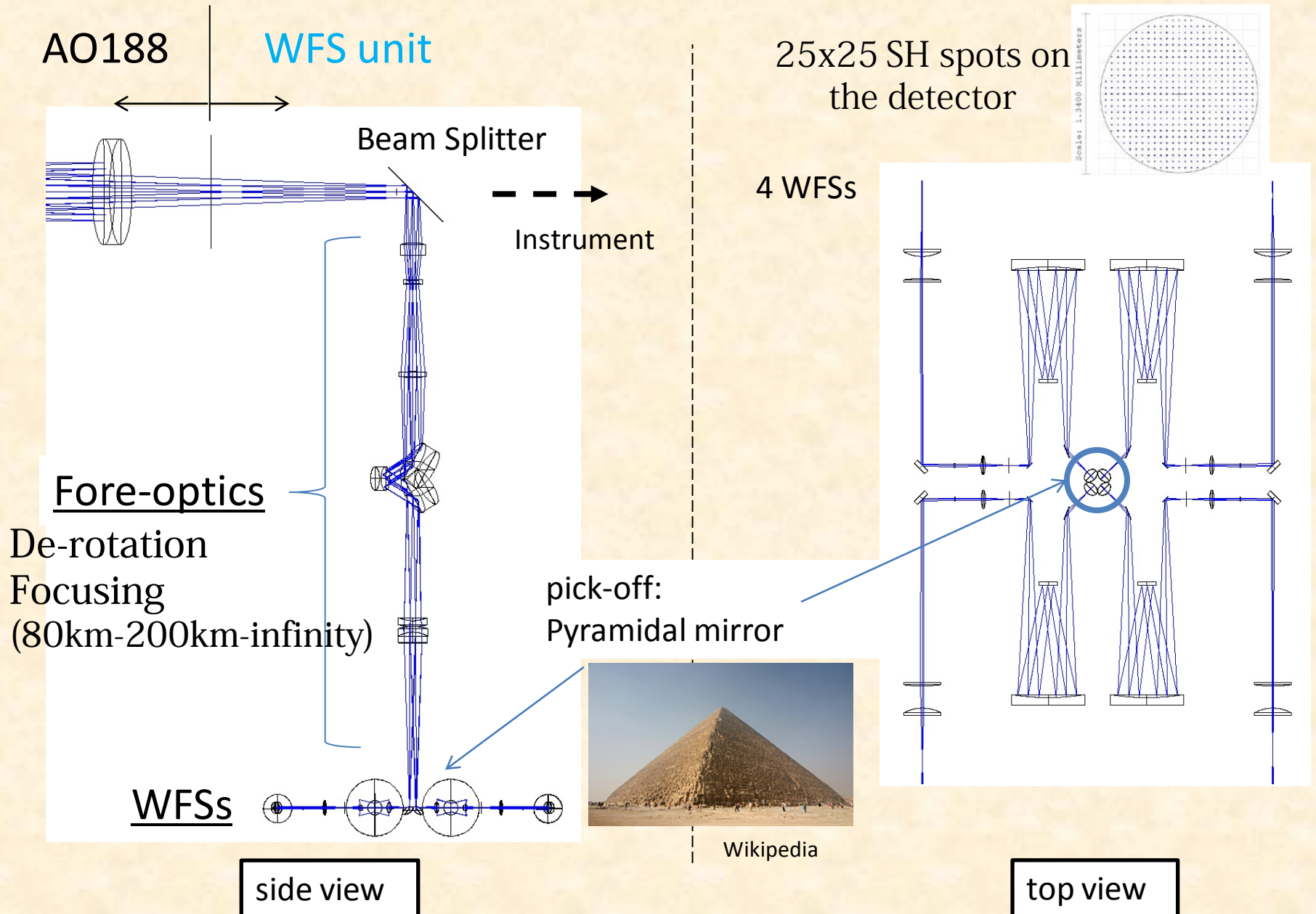


Tomography WFS unit controls the DM in AO188 system

Light from the telescope

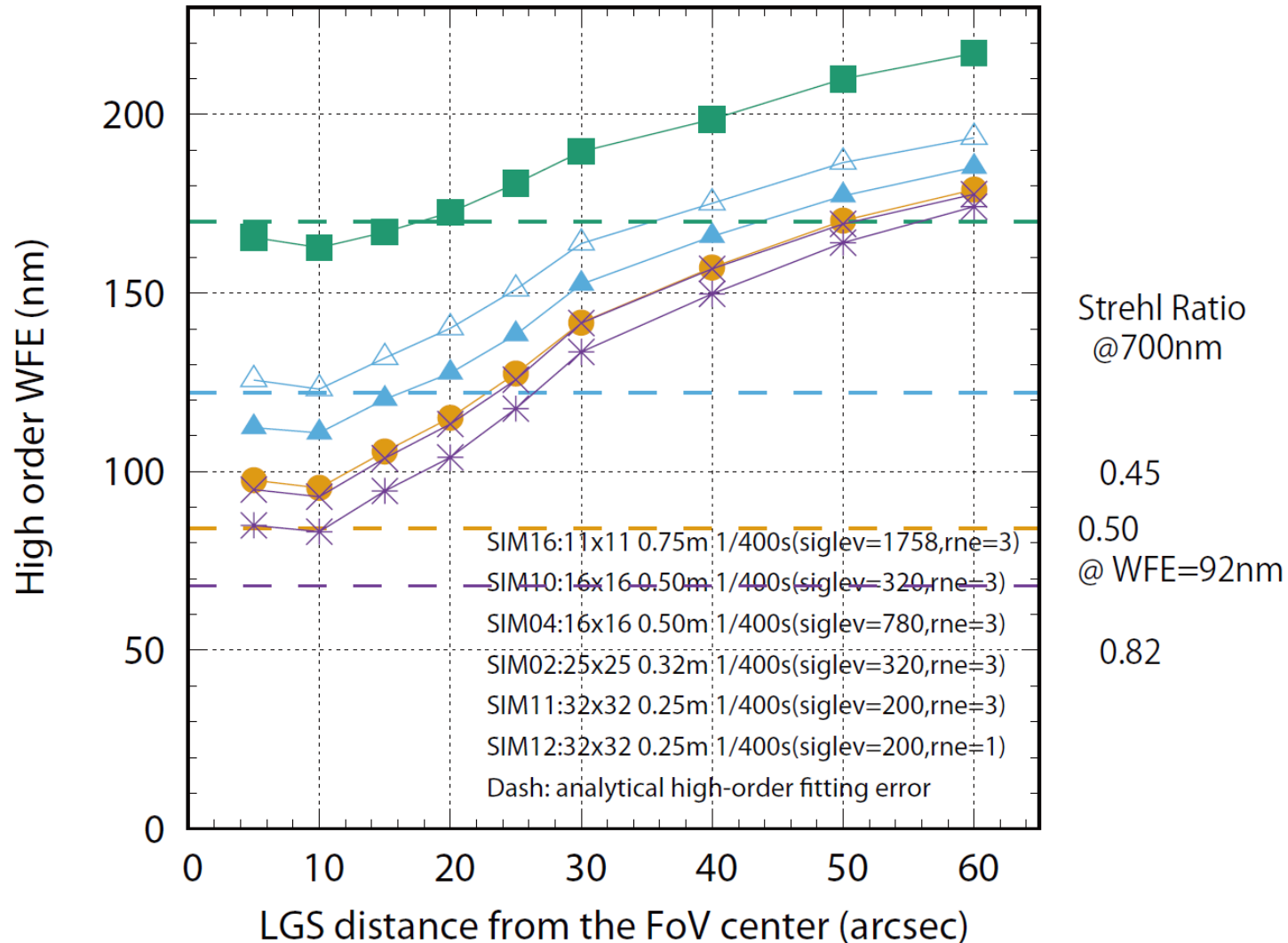


SH WFSs for tomography AO



Specify parameters with simulations

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



Time-line of the project

	FY2017	FY2018	FY2019	FY2020	FY2021
Install the first TOPTICA laser	Purchase/Assembling				
1 LGS launching optics with the current LLT		Purchase/Assembling			
4 LGS launching optics		Design	Purchase	Assembling/Testing	
LGS SH WFS prototyping and on-sky testing	Assembling/Testing				
AO188 DM upgrade		Purchase/Install			
4 LGS SH WFSs construction	Design	Purchase	Assembling/Testing		Install
RTS for tomographic estimation	Design	Purchase	Assembling/Testing		
High-resolution NIR imaging tests with IRCS					
High-resolution visible imaging tests with 3DII					

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

You are welcome to join the ULTIMATE-START project.

- ANU collaboration for LLT/laser.

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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