Introduction of RAVEN

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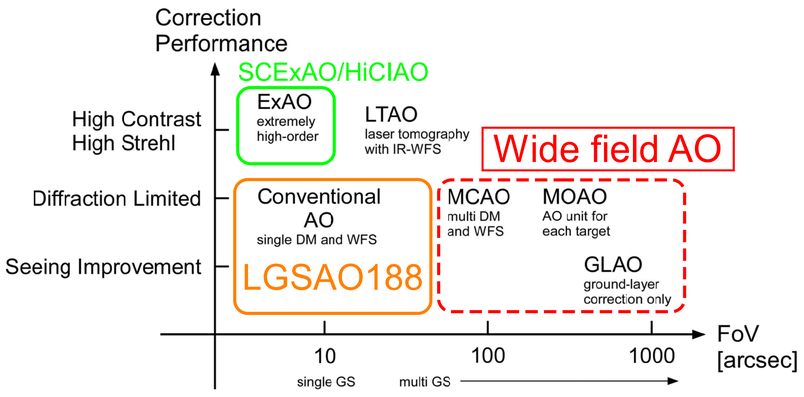
RAVEN is a demonstrator of Multi-Object Adaptive Optics (MOAO) and will be attached to Subaru Telescope as a carry-in instrument. An observation run in combination with IRCS is expected in the year of 2013. Not only the demonstration of the performance of the new type of AO, but also scientific verification is the goal of the project. A Canadian group: University of Victoria and NRC-HIA, leads the project and a Japanese group: Subaru Telescope and Tohouku University supports the project to obtain technology related the next generation adaptive optics. MOAO is a type of wide-filed AO and realizes simultaneous observation picking-up objects from the field-of-regard (FoR) of a few arcminutes. The method will be advantageous for 30m-class telescopes because FoR increases. Experiences at 8m-class telescope will be helpful for the development of MOAO on 30m-class telescope.

1. Overview of RAVEN Project

- MOAO demonstrator (targeting 1st on 8m class)
  - Validation in laboratory room
  - On-sky science verification
- Canadian group project
  - University of Victoria (UVic)
  - Herzberg Institute for Astronomy (HIA)
- Supported by Japanese group
  - Subaru Telescope (infra/manpower, researcher exchg)
  - Tohoku Univ. (basic experiment in laboratory)
- Already funded
  - 6M CAD by BCKDF/CFI Leading Edge Fund
  - In kind contribution from HIA & Subaru (> 400K CAD)?
- Schedule
  - 2013～(2015) Hilo/summit

2. Meaning to Subaru

(1) Good chance to obtain wide-field AO technigue
- no wide-field AO plan of Subaru is funded yet
  (⇔ seeing limited powerful instrument.: Suprim cam, MOIRCS)
- tomographic wavefront reconstruction is a common technique for all types of wide-field AO

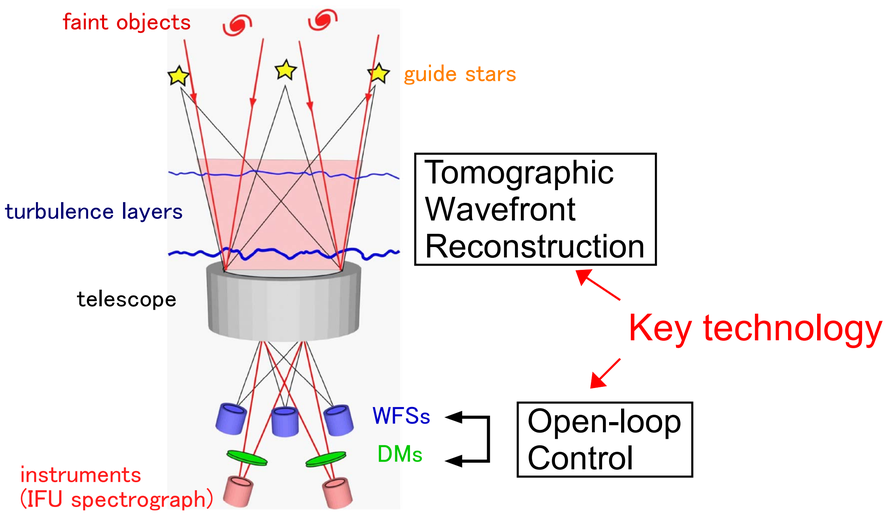


(2) Expansion to TMT
- MOAO is advantageous for a larger telescope
- on-sky verification by 8m-class is an important experience for the future development

3. Multi-Object Adaptive Optics (MOAO)

FoR: 3 arcmin
FoV: a few arcsec

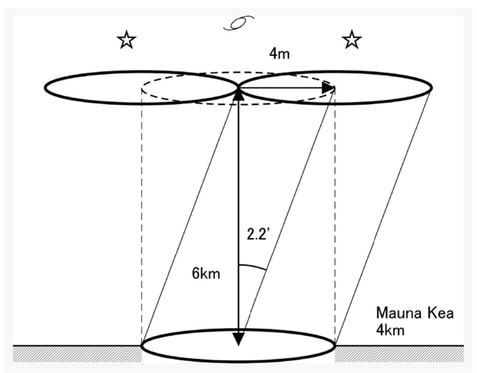
- diffraction-limited
- targeted only



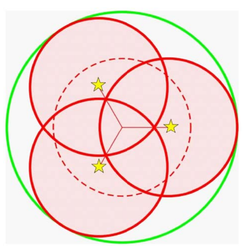
3.1 Merit of MOAO

(1) High Strehl ratio for the target
⇒ the same type adopted for Keck NGAO

(2) Field-of-Regard expands with the telescope aperture
⇒ a candidate of TMT 2nd generation instrument



beam overlap at 6km (top view)



- 8m aperture
- 3' FoV
- 3 Guide Star

4. At Subaru Telescope

(1) Configuration
- handled as a carry-in instrument
- installed on NsIR; science instrument is IRCS
- feasibility study is going on to use LGS

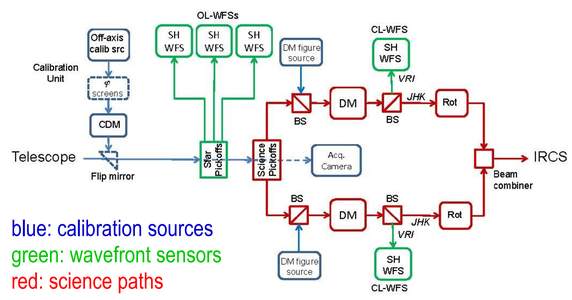
(2) To be done
- on-source open-loop experiment in Canda was successful.: 2.5”→ 0.5”
- validation of on-sky tomography by multi-GS has not been done yet
- necessary to establish the calibration method

5. System

specifications

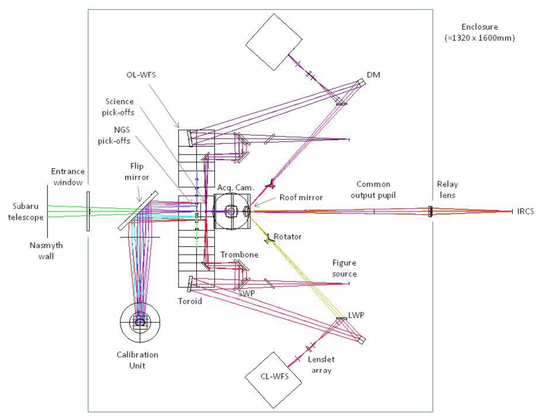
Number of science channel	2 (= # of DM)
WFS	3 NGSs (1 LGS) / 10x10 SH
Field size	FoR: 2' (3.5' goal); FoV: 4" each CH
Wavelength range	Sci: 0.9-2.5um; WFS: 0.6-0.9um
Science instrument	IRCS (Imaging, Grism, Echelle)
Ensquared Energy	>30% on 140mas slit (0.75" seeing)
System Throughput	>32%

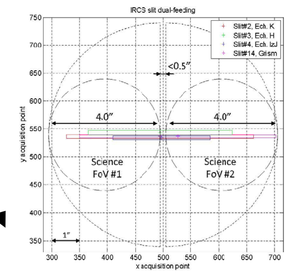
block diagram



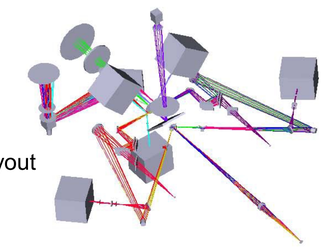
6.Optical Layout

top view (1320mm x 1600mm)





FoV of the 2 CH on IRCS slit

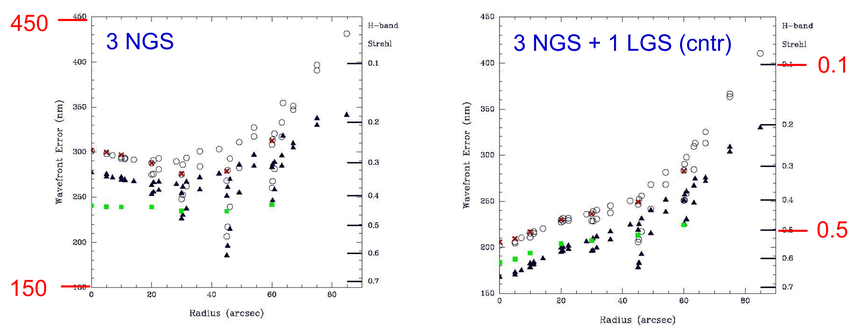


3D picture of the optical layout

7.Performance

Conditions:
- 0.75" seeing
- 3 NGSs @ r=45"
  (bright enough: <8mag?)
- H-band

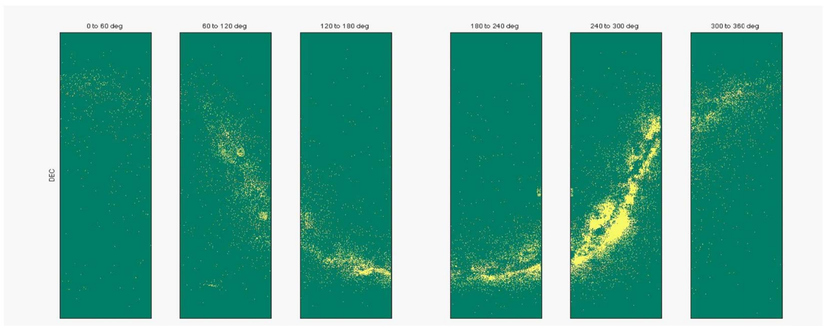
WFE[nm] (left axis) SR (right axis)



X-axis: separation from the center of FoV in arcec
Y-axis left: WFE in nm: ○ allmodes; ▲TT removed
right: × Strehl Ratio; ■ Ensquared Energy

8. Sky Coverage

Conditions:
- 3 NGSs in 2' ϕ
- R<13mag



RA [deg]	0 -60	60 - 120	120 -180	180 -240	240 - 300	300 - 360
Sky Cov [%]	0.54	2.77	3.06	3.64	12.53	2.39

9. Science

Examples:
- Metal poor stars
- Kinematic asymmetries in high-z disk galaxies
- Quasar pairs

If you are interested, please contact H. Terada, M. Akiyama, S. Oya. Especially, ideas on intra-galactic science are welcome because the sky coverage is almost limited to the Galactic plane.

10. Schedule