

TOPTICA LASER COMMISSIONING AT GEMINI NORTH

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L4AO 13 - Québec City - 7 June 2019

- Gemini North laser operation history
- Laser Upgrade summary
- On-sky commissioning:
 - Laser Optimization
 - Laser spot verification
 - AO system performance in LGS mode
- Back to science - 1st semester
- Summary and Future Plans

GEMINI North - Laser Operation history

AO system	R_{lim}	FOV ["]	Strehl [H-band]	Sky Coverage [%]
ALTAIR (NGS)	12-15	20	35	<1
ALTAIR (LGS)	15-18	20	20	~30
ALTAIR (LGS+P1)	14	50	8	~100

GEMINI North Laser Operation history

LGS Science
Observation time
[hours on sky]

Year \ Semester	A	B
2010	83	68
2011	60	68
2012	80	91
2013	116	48
2014	12	14
2015	10	2
2016	12	

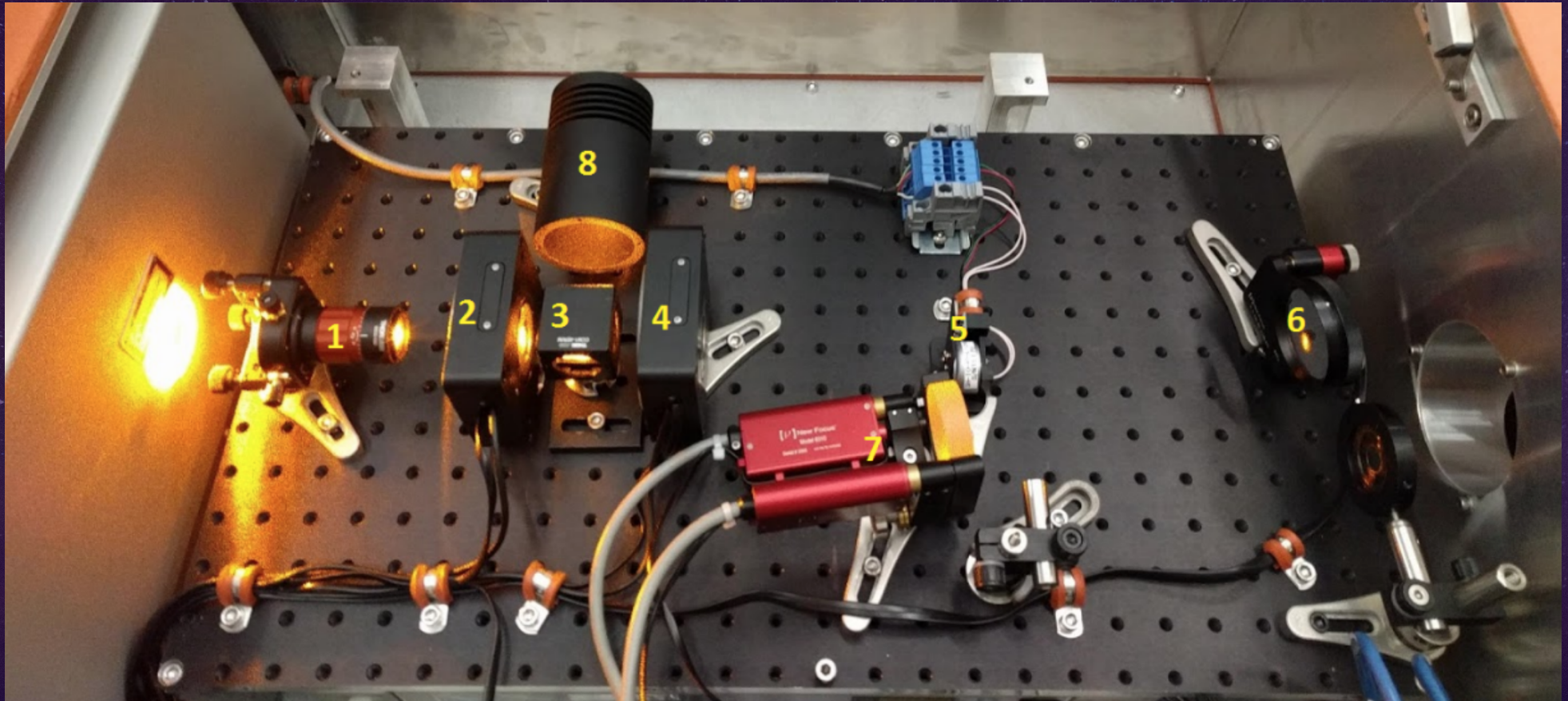
LASER UPGRADE SUMMARY

- LMCT laser operations stopped in 2016.
- Toptica laser factory acceptance test in October 2017.
- January - August 2018 installation of the Toptica laser on the telescope.
- October 2018 on-sky commissioning.



picture credit: Jason Chu

Beam Injection Module



1. Beam expander

2. Half wave plate

3. Polarizing beam splitter cube

4. Quarter wave plate

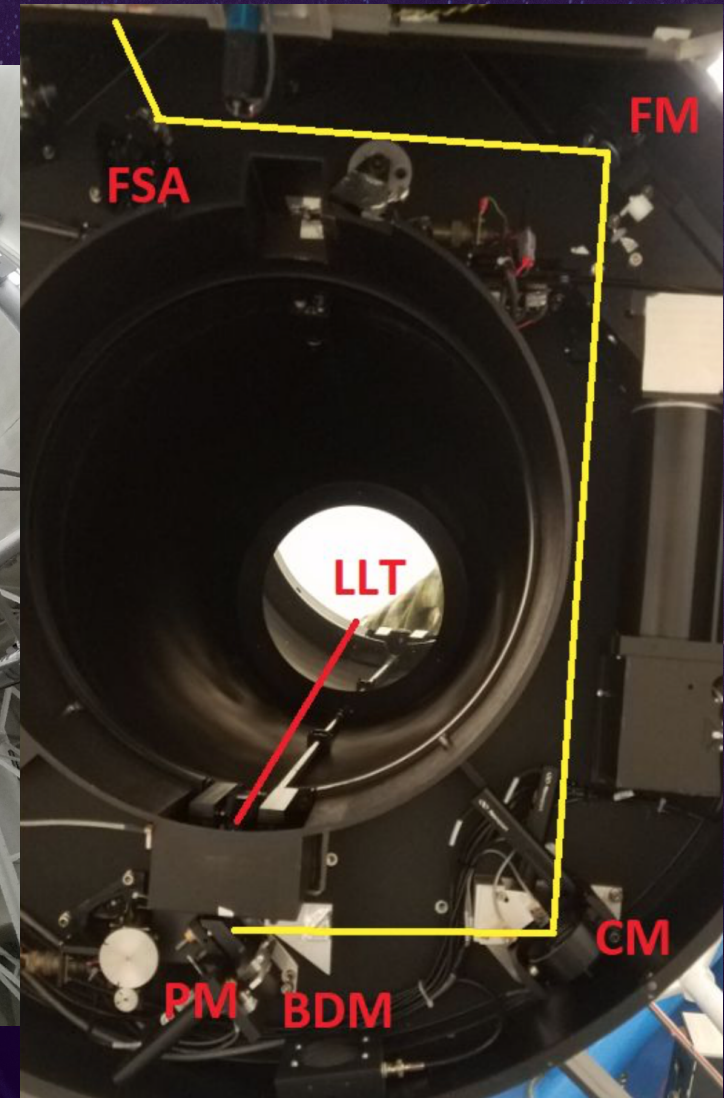
5. Safety shutter

6. BIM steering mirror 1

7. BIM steering mirror 2

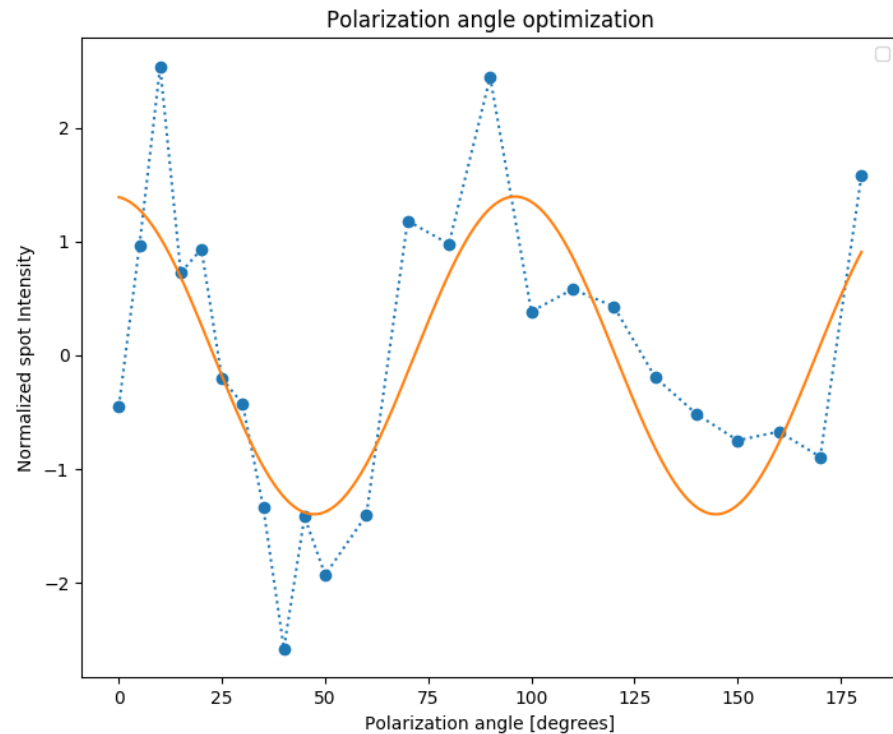
8. Beam dump

Beam Transfer Optics

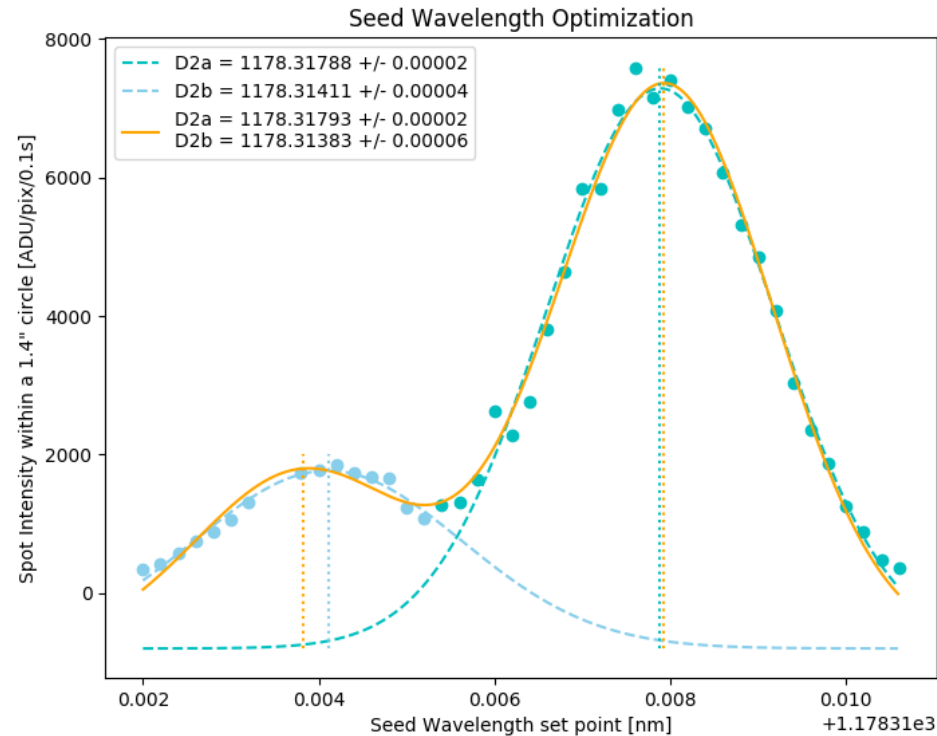


LASER OPTIMIZATION

- Polarization



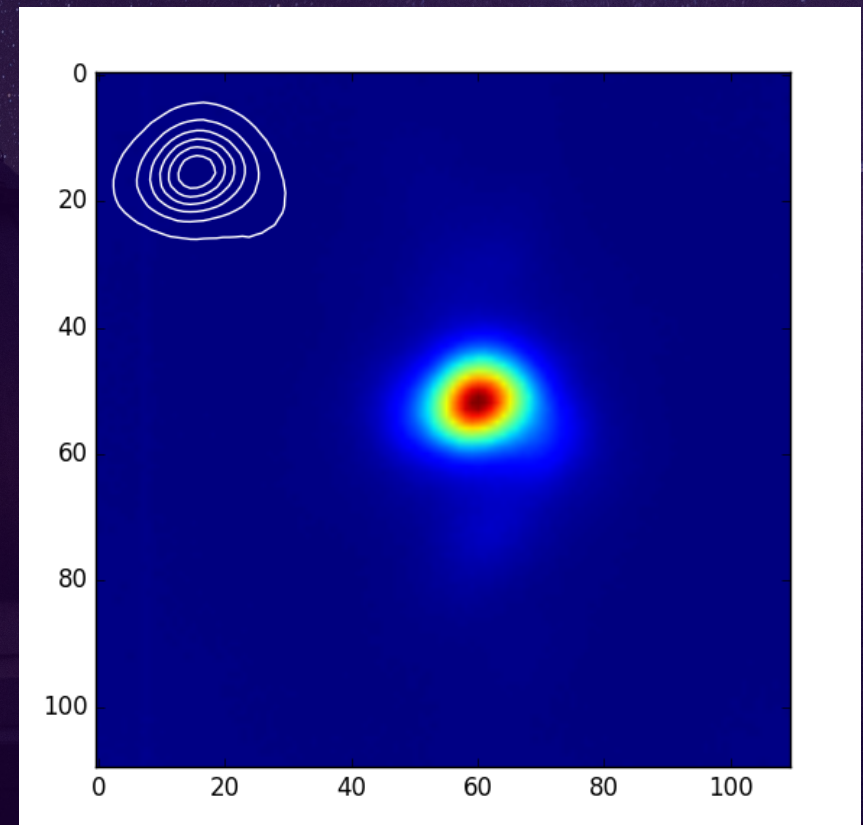
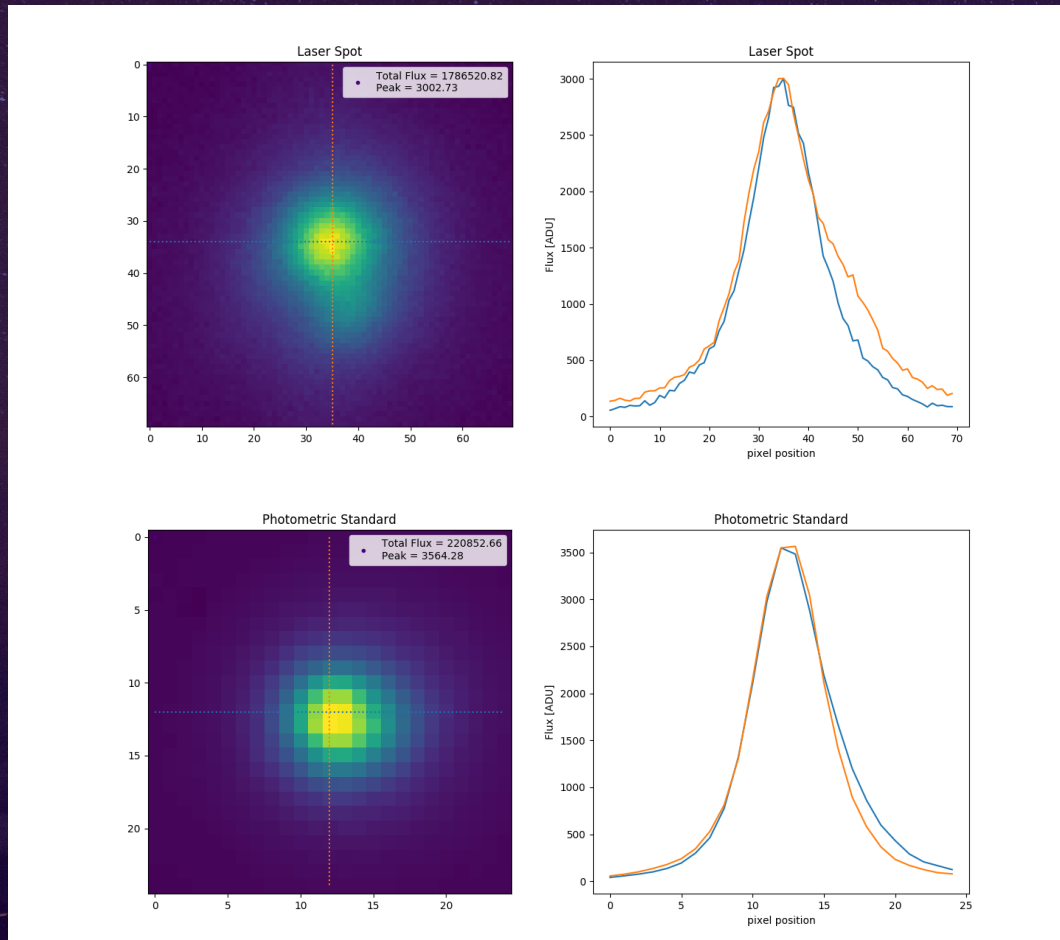
- Seed Wavelength



LASER SPOT and PHOTON RETURN

- Equivalent magnitude
 $V_{\text{mag}} = 7.3$

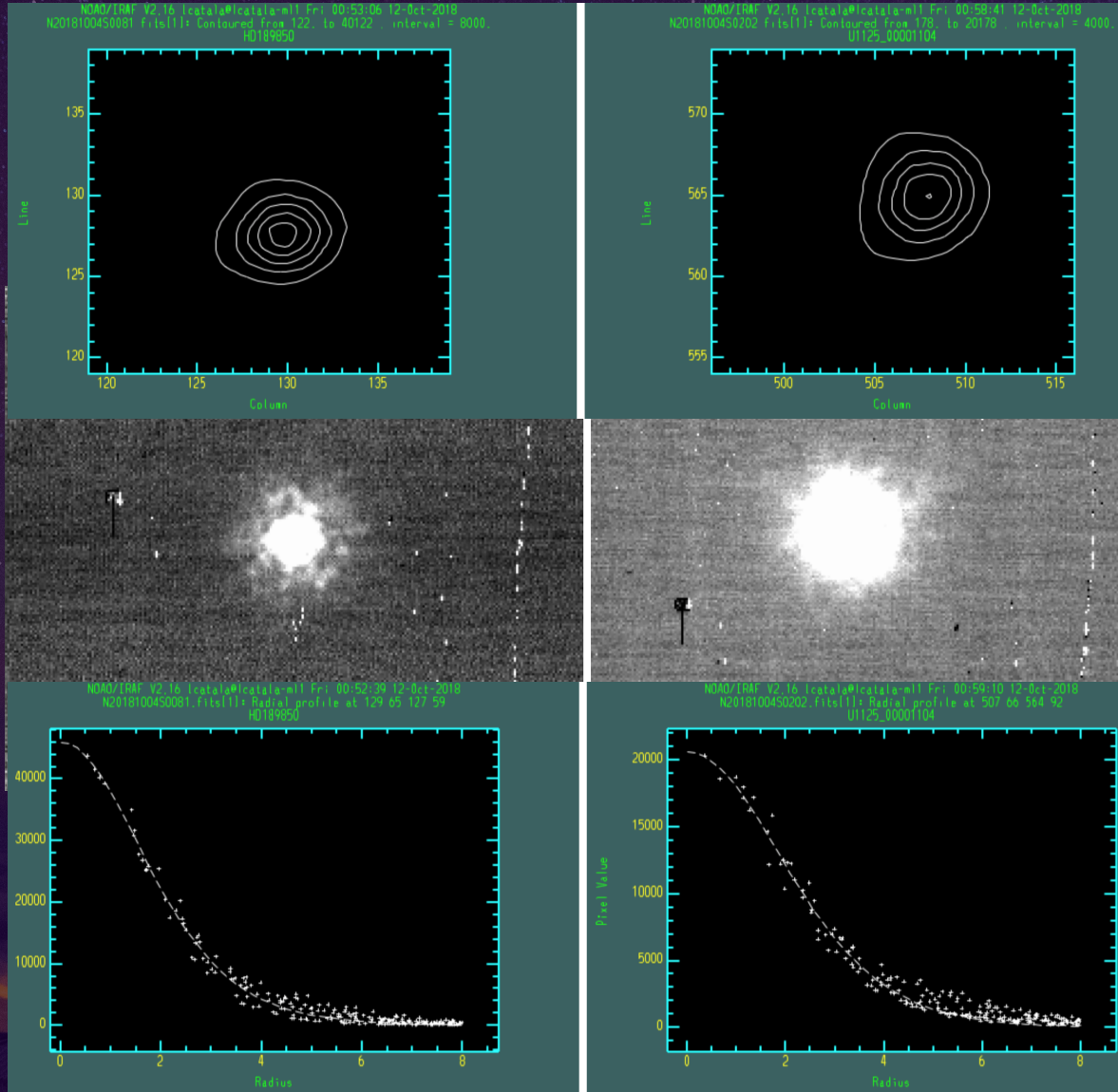
- Spot size
 $\text{FWHM} = 1.49'' / 1.34''$



AO LGS mode Performance Verifications

NGS On-axis
 $V_{\text{mag}} = 8.75$
Seeing = $0.37''$
EI = 78
K' (2.12 microns)

FWHM = 91 mas



LGS On-axis
 $V_{\text{mag}} = 12.17$
Seeing = $0.36''$
EI = 73
K' (2.12 microns)

FWHM = 105 mas

AO LGS mode Performance Verifications

Using NIRI (0.214"/pix - FOV:21.9x21.9") with the K' filter (2.12 microns)

NGS vs. LGS

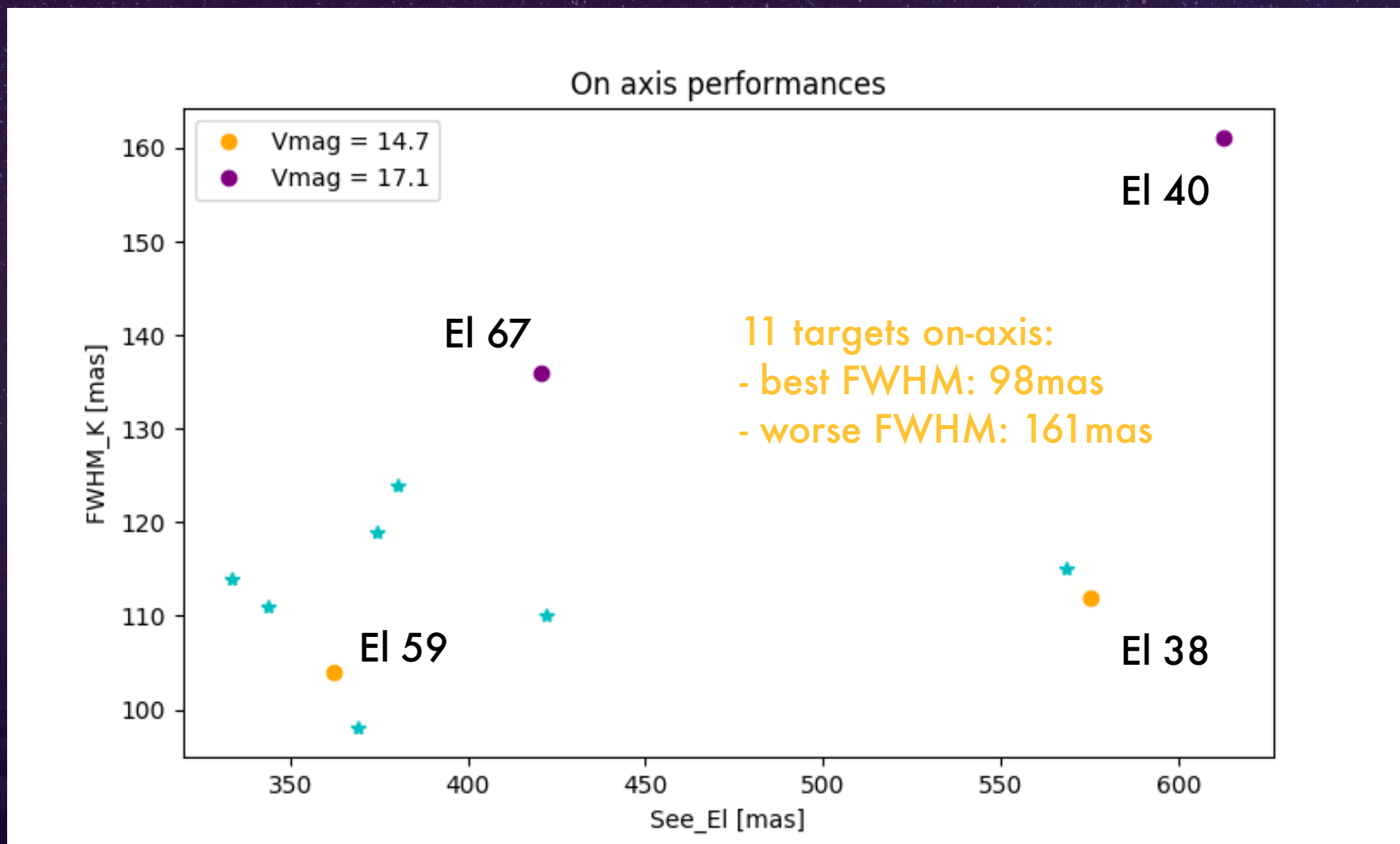
On-axis:

- range of TTGS mag ($V_{\text{mag}} = 11.5 - 17.1$)
- range of elevation (38 - 79 deg)

On-axis vs. Off-axis vs. LGS+P1

Non-sidereal target

AO LGS mode Performance Verifications



AO LGS mode Performance Verifications

AO mode	NGS or TTGS V mag / separation	Seeing (@zenith)	Elevation [deg] (seeing @ El)	NIRI imaging in K' FWHM
NGS vs LGS comparison (on-axis)				
NGS	8.75 / on-axis	0.37"	78 (0.40")	91 mas
LGS	12.17 / on-axis	0.36"	73 (0.40")	105 mas
Faint TTGS and Elevation dependance (on-axis)				
LGS	17.1 / on-axis	0.42"	67 (0.44")	136 mas
LGS	17.1 / on-axis	0.45"	40 (0.59")	161 mas
Performance off-axis				
LGS	11.53 / on-axis	0.48"	49 (0.57")	115 mas
LGS	11.53 / 22" off-axis	0.47"	47 (0.57")	120 mas
LGS+P1	10.96	0.37"	51 (0.45")	209 mas

First Science observation with NIFS

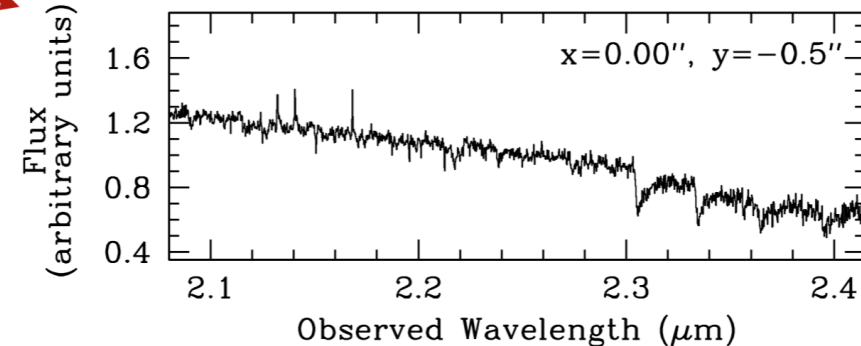
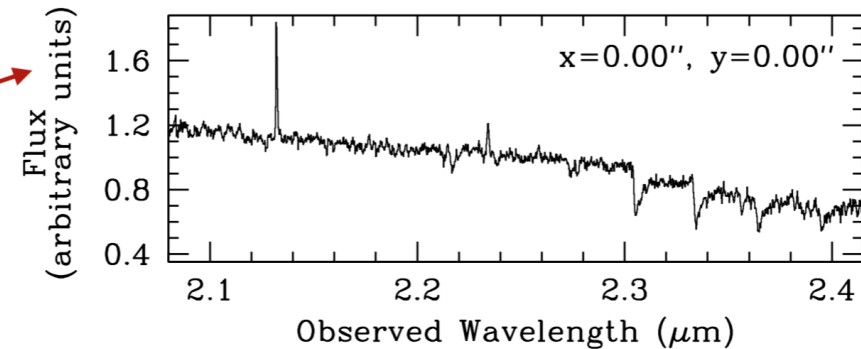
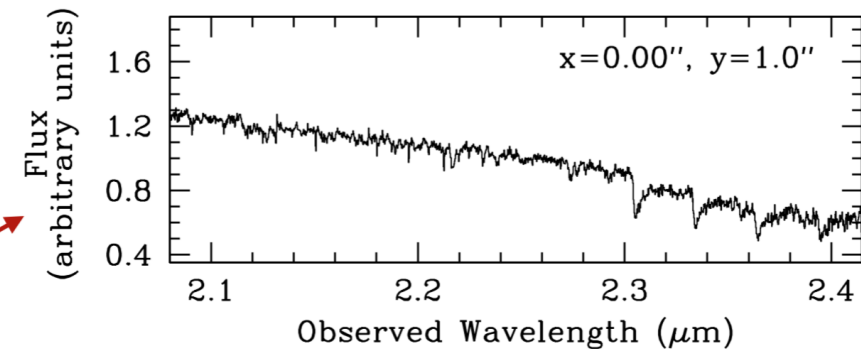
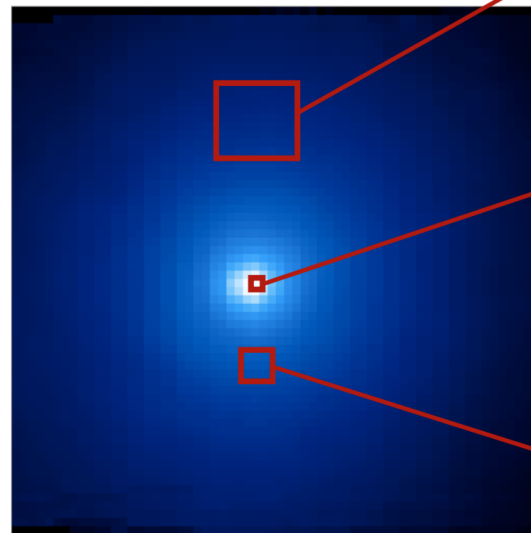
BH mass



Galaxy bulge
properties

Using
NIFS + LGS AO
to address the
bias of galaxy sizes
and luminosities in
current data
samples.

courtesy of Jonelle Walsh



2019A – Summary of 1st Semester of Science

4 NIFS + LGS programs
37.2 observing hours (science + calibrations) \leftrightarrow 6.8%

- Proposals for 2019B:
- Overall 1.3% of total time (2460 hours)
 - NIFS: 31.2 hours (10%)
 - NIRI: 0.8 hours (0.7%)

WFS counts per
subaperture
[ADU]

Scaled to 1kHz

2019-A
290

Year \ Semester	A	B
2010	139	120
2011	120	118
2012	139	148
2013	103	125
2014	106	105
2015	98	93
2016	86	

Toptica “plug & play” system and stability allow to move from block operation to queue >>> 2019A was a transition semester

16 years old system
RTC limitation >>> upgrade plan in discussion.
Signs of hardware failure >>> Dead actuator found on the DM.

MCAO system for GEMINI North founded
Project officially started in October 2018

See Eduardo Marin talk on Saturday (Session 6 @ 12:00)
For the GNAO LGS facility current design

THANK YOU !

Background picture* credit:
Jason Chu

*original does not have the purple overlay

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