# Updates on adaptive optics systems

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Parameter	Tel-AO	Lab-AO
DM actuators	ALPAO 60	OKO MMDM 37
Size	18 cm	15 mm
Dynamic range	16 μm	9 μm
Inter-actuator stroke	4 µm	0.5 μm
Frame Rate	500 Hz	100 Hz
Mirror best flat	< 30 nm	400 nm
WFS Camera	Andor 897 EMCCD	USB CCD
Lenslet	7x7	6x6

Updates on AO

- 1 system

per scope

- fast WFS



NOIR

l'Observatoire LESIA



of Stellar Parameters







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## CHARA AO improvements

1. Most of the improvements are from an operational point of view, eg:

- the ability to isolate, remove, and follow each actuator. Allows us to make a functional if not best performing ao system for the night.
- 2. Due to the improved "spot location" algorithm we can go much fainter more reliably.
- 3. More parameters to experiment with to improve the faint limit further
- 4. Many online diagnostic tools in the new system to evaluate the performance of AO, to diagnose, analyze and adjust the AO systems
- 5. There is a true calibration of the Noll Zernike terms throughout allowing us to compare performance between systems.
- 6 The code runs much faster than the old code so the bandwidth of the servo is better.
- 7. Simulations to help with qualitative comparison on the go.









### **Engineering GUIs TELAO**

wfs.51	wfs_S1	wfs_51
MAIN ANDORSETUP AO ADJUST DM SERVO SIM MAIN ANDORSETUP AO ADJUST DM SERVO SIM	MAIN ANDORSETUP AO ADJUST DM SERVO SIM	AIN ANDORSETUP AO ADJUST DM SERVO SIM
Running: NO Shutter: CLOSED Read Mode: IMAGE Temp Status: STABLE GET	Actuator: 0 Amplitude: 0.10 C #Smp: 50 C #Mn: 1 Delay: 5 STEP TEST	Edge 217.8+-11.4 Edge Rge: 189.0/246.0   Box Flux  : 348.4 R0: 25.03+-24.81 TT OFF CENTROIDS ONLY
		214/967/1714 us Ref. 0  DM  :-0.0000 FPS: 0 IGNORE TILT RM PISTON
Full Frame: 512x512 Current Frame: 90x90 Num Pixels: 8100 Prea	Preq Min: 0.00 Preq Max: 0.00 Provint: 0.00	BOXES COG ACTS MEAS 1.0 WFS ABER DM ABER TOG REF 1 #FRAMES
	Actuator: 0 C Smoothing: 1 C WFSDM DATA	TOG EDGE 1000 + MKDARK 0-DARK -1000.0 + THRESH 3.0 + MIN FLUX 6.0 + DM STOP
Set Temp: -50 C Exposure: 0.00100 PreAmp Gain:	All O Single O Servo ON O Servo OFF O Both O CLTF O OLTF PLOT WFSDM	ZERO REF LAST REF DEF REF SAVE REF USE SUBAP 500 C NUM MEAN
Amplifier O EMCCD CCD Link Gin: O DES C ON EM Gin: 100	Freq Min: 0.00 + Freq Max: 0.00 + PS Min: 0.00 + PS Max: 0.00 + CLEAR DISP	TT ON TT OFF TT ZERO -1.000 C TT GAIN 0.0000 C TT DAMP 3.0 C TT STOP
	Pos X 47.9 * Pos Y 48.6 * Pitch 10.0 * Angle 0 * Set Boxes	D TT NAVGE Samp: 100 C Amp: 0.100 TT IMPULSE RM DM TILT ZERN TOG TT DIS
VSpeed: 0.50 uS 2 CCD HS: 10.00 MHz 2 CCD HS: 0.00 MHz		
	10.0 • ALIGN BOXES STOP ALIGN 1000 • TELEMETRY 9 • BOX SIZE 0 ZERN LOOP	
Hbin: 1 b Vbin: 1 Hstart: 1 Hend: 90 Vstart: 1	1.0 C Up Down Left Right 0 C Rotate 1.000 C Scale	MEAS RECON #Loops: 0 * #Waits: 1 * #Mean: 10 * #Cycles: 2 * Poke: 0.0200 *
	X 0.000 \$ Y 0.000 \$ Fc 0.000 \$ A1 0.000 \$ A2 0.000 \$ C1 0.000 \$ C2 0.000 \$ WFSAB ZWFSAB	CALC REC LAST RECON DEF RECON SAVE RECON 500 C DM MEAN
TOG DISP FAN OFF FAN LOW		AO ON AO OFF IGNORE TILT REMOVE PISTON APPLY RECON
WFS V X:+0.035 V Y:-0.20 V FC:+0.0 WFS V X:+0.035 V Y:-0.20 V FC:+0.017 V A1::-0.014 V A2:+0.012 V C1:+0.001 V C2:+0.014 V A2:+0.012 V C1:+0.001 V C2:+0.001 V C2:	WFS 🗹 X: +0.035 🗹 Y: -0.020 🗹 Fc: +0.017 🗹 A1: -0.014 🗹 A2: +0.012 🗹 C1: +0.001 🗹 C2: -0.009 RMS: +0.004	WFS ♥ X:+0.035 ♥ Y:-0.020 ♥ Fc:+0.017 ♥ A1:-0.014 ♥ A2:+0.012 ♥ C1:+0.001 ♥ C2:-0.009 RMS:+0.004 DM X:-0.066 Y:+0.001 Fc:-0.221 A1:+0.156 A2:-0.148 C1:+0.057 C2:+0.039 RMS:+0.093
DM X:-0.066 Y:+0.001 F:-0.2 M A CONTRACT OF CONTRACT O	DM X:-0.066 Y:+0.001 F:-0.221 A1:+0.156 A2:-0.148 C1:+0.057 C2:+0.039 RMS:+0.093 wfs 51 Rumning. A0-OFF TT-OFF	wfs_S1 Running. AO-OFF TT-OFF
CAM ON CAM OFF CLON CLOFF COOL CAM ON CAM OFF CLON CLOFF COOLON ON/-50.0C COOLOFF ALLOFF SAUTO SC	CAM ON CAM OFF CL ON CL OFF COOL ON ON/-50.0C COOL OFF ALL OFF SAUTO SOPEN SCLOSE	CAM ON CAM OFF CL ON CL OFF COOL ON ON/-50.0C COOL OFF ALL OFF SAUTO SOPEN SCLOSE
AO ON AO OFF FLATTEN SET FLAT LAST AO ON AO OFF FLATTEN SET FLAT LAST FLAT DEF FLAT TTON TT OFF TT ZERO LIN	AO ON AO OFF FLATTEN SET FLAT LAST FLAT DEF FLAT TT ON TT OFF TT ZERO LIN/LOG PixMult 5	AO ON AO OFF FLATTEN SET FLAT LAST FLAT DEF FLAT TT ON TT OFF TT ZERO LIN/LOG PixMult 5
MOVIE WFS WFS/PH WFS/MPH DM/ MOVIE WFS WFS/PH WFS/MPH DM/PH DM/PH IMAGE RESCALE REOPEN F	MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT	MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT
TELAO_W1	wfs_S1	wfs_E1
		ADULT DM STRUC SIM

											_								0 10										
MAIN ANI	DORSETUP	AO ADJU	JST DM	SERVO S	IM							MAIN AND	ORSETUP A	ADJUST	DM SERVO	SIM			MAIN AND	DORSETUP AO	ADJUST D	M SERVO	SIM						
DM Curre	ent: 5.8081 /	A DM	Temp: 25.	8125 C	Elect Temp: 42.1	250 C	POWER OFF	Р	OWER ON	REOF	PEN TT	Trys: 10	0 F	FOCUS WFS	ALIGN BEACO	ON ALIGN	BOXES	FOCUS SCOPE	x 0.000	D I Y	0.000 🗘 I	-c 0.000	1 A1 0.000	‡ A2	0.000 ‡ C1	0.000	C2 0.000	C TELAB	ZTELAB
FLATTEN	N DM	LAST FL	AT	DEF FLAT	ZER	O FLAT	31: +0.163	LIN/LOG	SAVE FLAT	S	ET FLAT																		
1.10 🗘	RM DM TI	LT LIN			40: -0.236	5		21: +0.045		RM DI	M TILT ZERN	WFS Fo	ocus	Delay:	5 L	.imit: 0.050	S	Step: 1000.0											
		55: +0.395		48: -0.373	39: -1.00	x 00	30: +1.000	20: -1.000	12: +1	1.000		Scope F	Focus	Delay:	5 L	.imit: 0.050	S	Step: 5.0	10.0	R0cm	7.0	MAG	SOPEN SC	LOSE	AR ON STAR OF	F ATM O	N ATM OFF	WFE ON	WFE OFF
		54: -1.000	х	47: -0.747	X 38:-1.00	x 00	29: -0.318	X 19: -1.000	11:+1 ) X	1.000	4: -0.231	Beaco	on	Delay:	5 L	.imit: 0.150	S	Step: 50.0	1.0	\$	DM U	p	DM Down		DM Left		DM Right	Re	set DM
59: +1.000	X X	53: +0.645	x	46: -0.577	X 37:+1.0	x 00	28: +1.000	X 18:+1.00 X	10:+1 ) X 9:+1	000 X	3: +1.000	Calsour	rce X	Delay:	5 L	.imit: 0.050	S	Step: 50.0											
57: +0.339	x	52: -0.370	х	44: +0.152	36: +1.0 X	00	26: -1.000	17: -1.000 X	) X 8:+1	.000 X	2: -1.000	Calsour	irce Y	Delay:	5 L	.imit: 0.050	s	Step: 50.0	1.0	*	BEAM	Up	BEAM Down	n	BEAM Left	E	BEAM Right	Rese	et BEAM
56: -0.133	x	51: +1.000	x	43: -1.000	35: +0.99 X	92 X	25: -1.000	16: +1.00 X	D X 7:+0	.414 X	1: -1.000	Calsource	e Focus	Delay:	5 L	.imit: 0.050	S	Step: 4000.0	0.632		OBS Lamb	da (um)						ME	
		49:-0.029	х	42: -0.208	34:-0.14 X	-/ X	24: -1.000	X 14:+0.81	6:+0	.316	0: +1.000		G	Delay:	2	imit: 2000		Step: 01	0.035		OBS Lambo		ABER RECO				LC DIVI POS	IVIE/	ISF03
		45. 0.025		41: -0.096	32: -1.00	00	23: -1.000	13: +1.00	5: -1. D	.000		DM Tilt O	Offload	Servo:	• OFF	) on		Deadzone: 0.50	DM GA	AUSSIAN	DM LIN	EAR	DM ZERNIK	E	CALC DM/ZERN		SIM ON	SII	M OFF
Num: 31	🗘 Val	l: 0.0	Act:	SET	INC DEC	ALL	+ALL *ALL	USE Zer	n: SET IN	NC DEC	ZERO	WFS	X:+	0.035 🗸	Y: -0.020 🗸	Fc: +0.017	A1:-0.0	014 🗹 A2:+0	WFS	✓ X: +0	.011 🗹 🕐	Y: +0.142 🗹	Fc: +0.016	A1: +0.0	004 🗹 A2: +0.0	02 ✓ C'	1: +0.003 🗹	C2: +0.019	RMS: +0.010
WFS	Solution	X: +0.417	✓ Y:	+0.353 🗹	Fc: -0.010	A1: -0.00	06 🗹 A2: +0	0.026 🗹 C1	+0.027 🗹 C2	: +0.020 I	RMS: +0.013	DM	X: -0	0.066	Y: +0.001	Fc: -0.221	A1: +0.1	156 A2: -0	D. DM	X: +0	.000 '	Y: +0.000 wfs_E1	Fc: +0.000 1 Running.	A1: +0.0	100 A2: +0.00	JO C1	.: +0.000 AO-OF	C2: +0.000 F TT-OFF R0=6.	RMS: +0.010 67+-1.43
DM		X: -2.008	Y:	-0.665 DM Se	Fc: -4.017 Prvo OFF	A1: +3.00	04 A2: +9	9.964 C1	:-1.917 C2: AO-OFF T	: +0.381 l T-OFF R0=nar	RMS: +2.957 n+-nan	CAM ON	CAM OFF	CL ON	CL OFF	COOL ON	ON/-50.00	C COOL OFF	CAM ON	CAM OFF	CLON	CL OFF	COOL ON	OFF/17.00	COOL OFF	ALL OFF	SAUTO	SOPEN	SCLOSE
CAM ON	CAM	OFF C	LON	CL OFF	COOL ON	ON/-50.7C	COOL OFF	ALL OFF	SAUTO	SOPEN	SCLOSE	AO ON	AO OFF	FLATTEN	N SET FLAT	LAST FLAT	DEF FLAT	T TT ON	AO ON	AO OFF	FLATTEN	SET FLAT	LAST FLAT	DEF FLAT	TT ON	TT OFF	TT ZERO	LIN/LOG	PixMult 5
MOVIE	WF	s wi	S/PH	WFS/MPH	DM/PH	DM/MPH	IMAGE	RESCALE	REOPEN	PING	QUIT	MOVIE	WFS	WFS/PH	WFS/MPH	DM/PH	DM/MPH	H IMAGE	MOVIE	WFS	WFS/PH	WFS/MPH	DM/PH	DM/MPH	IMAGE	RESCALE	REOPEN	PING	QUIT

Updates on AO



NOIR Lab











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#### Engineering GUIs LABAO

LABAO_52	LABAO_52	LABAO_52
MAIN AO ADJUST DM SERVO SIM	MAIN AO ADJUST DM SERVO SIM	MAIN AO ADJUST DM SERVO SIM
Server is stopping.	Edge 1.9+-1.2 Edge Rge: -0.9/5.7   Box Flux  : 107.9 R0: 15.58+-2.47 TT OFF SERVO ON	Actuator: Actuat
once it is running again.	BOXES COG ACTS MEAS 1.0 C TOG ABER TOG REF 1 #FRAMES	Freq Min: 0.00 🗘 Freq Max: 0.00 🗘 PS Min: 0.00 🇘 PS Max: 0.00 🗘 PLOT IMP PS
	TOG EDGE 1000 C MKDARK 0-DARK -1000.0 C THRESH 3.0 C MIN FLUX 18.0 C DM STOP	Actuator: 0 C Smoothing: 1 C WFSDM DATA
	ZERO REF LAST REF DEF REF SAVE REF USE SUBAP 40 \$ NUM MEA	All O Single O Servo ON O Servo OFF O Both O CLTF O OLTF PLOT WFSDM
	TT ON TT OFF TT ZERO 4.000 C TT GAIN 0.0000 T TT DAMP 0.0 C TT STOP	Freq Min:         0.00         CLEAR DISP
	1 TT NAVGE Samp: 100 C Amp: 0.100 TT IMPULSE RM DM TILT ZERN TOG TT DIS	Pos X 66.2   Pos Y 56.7   Pitch 15.0   Angle 0   Set Boxes
	FLATTEN_DM LAST FLAT DEF FLAT SAVE FLAT SET FLAT OLD FLAT	10.0 C ALIGN BOXES STOP ALIGN 1000 C TELEMETRY 11 C BOX SIZE 0 C ZERN LOOP
	MEAS RECON #Loops: 0 0 #Waits: 1 0 #Mean: 10 0 #Cycles: 2 0 Poke: 0.2500	1.0 C Up Down Left Right 0 C Rotate 1.000 C Scale
	34 CALC REC LAST RECON DEF RECON SAVE RECON 500 C DM MEAN	X 0.000 \$ Y 0.000 \$ Fc 0.000 \$ A1 0.000 \$ A2 0.000 \$ C1 0.000 \$ C2 0.000 \$ WFSAB ZWFSAB
	AO ON AO OFF IGNORE TILT REMOVE PISTON APPLY RECON	Mx sum: 0.01 Camp: 0.99 Gain: 0.50 Damp: 0.05 Int: 0.00 Camp: 9.0 Denom: -2.0 SEND
WFS 🗹 X:-0.044 🗹 Y:+0.169 🗹 Fc:-0.025 🗹 A1:-0.002 🗹 A2:+0.030 🗹 C1:-0.006 🗹 C2:-0.011 RMS:+0.013	WFS & X:-0.044 & Y:+0.169 & Fc:-0.025 & A1:-0.002 & A2:+0.030 & C1:-0.006 & C2:-0.011 RMS:+0.013	WFS ♂ X:-0.044 ♂ Y:+0.169 ♂ Fc:-0.025 ♂ A1:-0.002 ♂ A2:+0.030 ♂ C1:-0.006 ♂ C2:-0.011 RMS:+0.013
DM X:-0.005 Y:-0.048 Fc:-0.080 A1:+0.067 A2:-0.041 C1:+0.047 C2:+0.035 RMS:+0.060 dm tilt autoalignment is complete	dm_tilt Autoalignment is complete. AO-ON TT-OFF	DW A-0005 1:-0046 PC-0060 A1:-0067 A2:-0041 C1:+0047 C2:+0040 dm_till Autoalignment is complete. AC-001 TC-FF
CAM ON CAM OFF 40 C FPS X: 580 Y: 476 C dX: 128 dY: 112 C ROI ALLOFF	CAM ON CAM OFF 40 \$ FPS X: 580 \$ Y: 476 \$ dX: 128 \$ dY: 112 \$ ROI ALL OFF	CAM ON CAM OFF 40 \$ FPS X: 580 \$ Y: 476 \$ dX: 128 \$ dY: 112 \$ ROI ALL OFF
AO ON AO OFF FLATTEN SET FLAT LAST FLAT DEF FLAT TT ON TT OFF TT ZERO LIN/LOG PixMult 3	AO ON AO OFF FLATTEN SET FLAT LAST FLAT DEF FLAT TT ON TT OFF TT ZERO LIN/LOG PixMult 3	AO ON AO OFF FLATTEN SET FLAT LAST FLAT DEF FLAT TT ON TT OFF TT ZERO LIN/LOG PixMult 3
MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT	MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT	MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT

LABAO_52	LABAO_52	LABAO 52
MAIN AO ADJUST DM SERVO SIM	MAIN AO ADJUST DM SERVO SIM	MAIN AO ADJUST DM SERVO SIM
FLATTEN_DM         LAST FLAT         DEF FLAT         ZERO FLAT         LIN/LOG         SAVE FLAT         SET FLAT	Number of Trys: 0 LAB DICH M7 DM SCP DICH BC FOCU	US ALIGN BOXES STOP ALIGN X 0.000 C Y 0.000 C Fc 0.000 A1 0.000 A2 0.000 C C1 0.000 C C2 0.000 C TELAB ZTELAB
1.10 CRM DM TILT LIN 25: +1.000 24: +0.886 23: +0.926 22: +0.612 RM DM TILT ZERN		
X X X X	Limit Trigger: 1.0 AUTO M7 AUTO DM AUTO SCP	10.0 C ROCM 7.0 C MAG SOPEN SCLOSE STAR ON STAR OFF ATM ON ATM OFF WEE ON WEE OFF
20:+0.685 11:+0.517 10:+0.442 9:+0.620 21:+0.670 X X X X X X X X X X X X X X X X X X X		
27:+0.680 12:+0.344 3:+0.752 2:+0.698 8:+0.473 20:+0.831	Scope Dich Delay: 3 Limit: 0.500 Step: 20.0 Gain:	100.0 GET SEND 1.0 DM Up DM Down DM Left DM Right Reset DM
X X X X X X X		
28:+0.000 1:13:+0.678 4:+0.626 0:+0.000 1:+0.820 7:+0.381 19:+0.000 x x x x x x x x x x x x x x x	Beacon Focus Delay: 3 Limit: 0.100 Step: 100.0 Gain:	22050.0 GET SEND 1.0 BEAM Up BEAM Down BEAM Left BEAM Right Reset BEAM
29:+0.557 14:+0.651 5:+0.691 6:+0.704 18:+0.544 36:+1.000		
X X X X X X	M7 Delay: 3 Limit: 0.500 Sten: 3000.0 Gain:	100000 GFT SEND 0.450 * ORS Lambdo (um) AREP RECON
30:+0.910 15:+0.643 16:+0.000 17:+0.735 35:+0.601 x x x x x		CALC DW FOS WERS-FOS
31: +0.000 32: +1.000 33: +0.345 34: +1.000	DM Tilt/M7 Dolar 2 Limit 0100 Story 2000. Cain	
Num: 0 2 Val: 0.0 Act: SET INC DEC ALL +ALL *ALL USE Zern: SET INC DEC ZERO	Divi fill/w// Delay. S Linfit. 0.100 Step. S00.0 Gain.	SUDDUD DM GAUSSIAN DM LINEAR DM ZENNIKE CALC DM/ZERN SIM ON SIM OFF
WF5 V X:-0.044 V Y:+0.169 V Fc:-0.025 V A1:-0.002 V A2:+0.030 V C1:-0.006 V C2:-0.011 RMS:+0.013	WFS 🗹 X:-0.044 🗹 Y:+0.169 🗹 Fc:-0.025 🗹 A1:-0.002 🗹 A2:+0.030 🗹 C1:-0	0.006 𝒴 (22-0.011 RMS:+0.013 WFS 𝒴 X:-0.044 𝒴 Y:+0.169 𝒴 Fc:-0.025 𝒴 A1:-0.002 𝒴 A2:+0.030 𝒴 (1:-0.006 𝒴 (22:-0.011 RMS:+0.013
DM X:-0.005 Y:-0.048 Fc:-0.080 A1:+0.067 A2:-0.041 C1:+0.047 C2:+0.035 RMS:+0.060	DM X: -0.005 Y: -0.048 Fc: -0.080 A1: +0.067 A2: -0.041 C1: +0	40.047         C2: +0.035         RMS: +0.060         DM         X: -0.005         Y: -0.048         Fc: -0.080         A1: +0.067         A2: -0.041         C1: +0.047         C2: +0.035         RMS: +0.060
dm_tilt Autoalignment is complete. AO-ON TT-OFF	dm_tilt Autoalignment is complete.	AO-ON TT-OFF dm_tilt Autoalignment is complete. AO-ON TT-OFF
CAM ON CAM OFF 40 \$ FPS X: 580 \$ Y: 476 \$ dX: 128 \$ dY: 112 \$ ROI ALL OFF	CAM ON CAM OFF 40 C FPS X: 580 Y: 476 C dX: 128 C dY:	112 C ROI ALLOFF CAM ON CAM OFF 40 C FPS X: 580 V Y: 476 C dX: 128 C dY: 112 C ROI ALLOFF
AO ON AO OFF FLATTEN SET FLAT LAST FLAT DEF FLAT TT ON TT OFF TT ZERO LIN/LOG PixMult 3	AO ON AO OFF FLATTEN SET FLAT LAST FLAT DEF FLAT TT ON TT OFF	TT ZERO LINVLOG PixMult 3 C AO ON AO OFF FLATTEN SET FLAT LAST FLAT DEF FLAT TT ON TT OFF TT ZERO LINVLOG PixMult 3 C
MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT	MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE	REOPEN PING QUIT MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT

Interferometric Survey

of Stellar Parameters

ISSP

THE UNIVERSITY OF SYDNEY

Australian National University

**XETER** 

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KYOTO SANGYO UNIVERSITY





#### Some details

ſ		7			W	fs_S1					×	
	MAIN AND	DRSETUP A	AO ADJUST	DM mean	n flux of the	all boxe	S					
	Edge 217	.8+-11.4	Edge Rge: 1	89.0/246.0	Box Flux  : 348.4	R0: 25.0	3+-24.81	Π	OFF	CENTR	ROIDS ONLY	state of FSM
	214/967/	1714 us	Ref	:0	DM :-0.0000	FPS	5:0	IGNO	RETILT	RM	PISTON	
	BOXES		COG	ACTS	MEAS	1.0	WFS ABER	DM ABER	TOG REF	1	#FRAMES	
	TOG E	DGE	1000 ‡	MKDARK	0-DARK	-1000.0	THRESH	3.0 ‡	MIN FLUX	6.0	DM STOP	
n FSM	ZERO	REF	LAST	REF	DEF REF	SAVE	REF	USE	SUBAP	500	NUM MEAN	
	πα	DN	Π	DFF	TT ZERO	-1.000	TT GAIN	0.0000		3.0	TT STOP	
oop,	10	TT NAVGE	Samp:	100	Amp: 0.100		PULSE	RM DM	TILT ZERN	то	G TT DIS	
	FLATTE	N_DM	LAST	FLAT	DEF FLAT	SAVE	FLAT	SET	FLAT		LD FLAT	
	MEAS R	ECON	#Loops:	0	#Waits: 1	#Mean:	10	#Cycles:	2	Poke:	0.0200	
	45	CALC RE	c	LAST RECON	DEF	RECON		SAVE RECON	500	÷	DM MEAN	
	A	D ON		AO OFF	IGNC	ORE TILT	RE	MOVE PISTO	4	APPLY	RECON	
	WFS	✓ X:+ X:-	-0.035 🗹 0.066	Y: -0.020 🗹 Y: +0.001	Fc: +0.017 A	1: -0.014 🗹 : +0.156	A2: +0.012 A2: -0.148	C1: +0.0	001 🗹 C	2: -0.009 2: +0.039	RMS: +0.004 RMS: +0.093	aberrations
			10	wfs	_S1 Running.	0	10			AO-OFF TT-	OFF	TT & AO status
	CAM ON	CAM OFF	CLON	CL OFF	COOL ON ON/	-50.0C COO	L OFF AI	LL OFF	SAUTO	SOPEN	SCLOSE	
	AO ON	AO OFF	FLATTEN	SET FLAT	LAST FLAT DEF	FLAT TT	ONT	T OFF	TZERO	LIN/LOG	PixMult 5	
	MOVIE	WFS	WFS/PH	WFS/MPH	DM/PH DM/	MPH IM	AGE RE	SCALE F	REOPEN	PING	QUIT	

Interferometric Survey

ISSP

 $\underset{SYDNEY}{^{\text{THE UNIVERSITY OF}}}$ 

214 - time needed to close the AO loop;
967 - time needed to run all the calculations in FSM
1714 -time needed to run everything (close the AO loop, run the calculation, get data from a camera)

Georgia<u>State</u> University l'Observatoire LESIA

NOIR



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KYOTO SANGYO UNIVERSITY

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Australian

National University







#### Visualization tools



Theoretical actuators grid (yellow)

Measured actuators grid (turquoise)

Boxes - size, auto aligned, up to 10 grids

Center of gravity for light (purple) - auto alignment



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#### Low flux - flexible centroid estimation



flux in the box > 9 std of flux - gaussian centroid

3 std < flux in box < 9 std - max pixel position

flux in box < 3 std - ignore the sub aperture













#### DM visualization and control

TELAO_W1 ×																
MAIN AND	ORSET	UP AO	ADJUS	T DI	M SERVO	SIM										
DM Curren	nt: 5.808	81 A	DM Te	mp: 25	5.8125 C	Elect	Temp: 42.12	50 C	PO	WER OF	F	PC	OWER ON		REOP	EN TT
FLATTEN	DM	LA	ST FLAT		DEF F	LAT	ZERC	D FLAT	31:+	0.163	LIN	/LOG	SAVE	E FLAT	SE	T FLAT
1.10 ‡ F	RM DM	TILT LIN	]				40: -0.236					21: +0.045			RM DN	I TILT ZERN
			-		48: -0.373		20. 4 00	• v	30: +	1.000				12: +1.000		
		55: +0.3	95		47: -0.747	х	39: -1.00	U X	29: -	0.318	х	20: -1.000		11: +1.000		
50.04.000		54: -1.0	00	Х	45. 0.577		38: -1.00	0 X			v	19: -1.000	Х			4: -0.231
59: +1.000	x	53: +0.6	45	х	46: -0.577	х	37: +1.00	0 X	28:+	1.000	X	18: +1.000	x	10: +1.000	х	3: +1.000
58: +1.000	х	52.02	70	v	45: +1.000	Х	25.14.00	~	27: -	0.382	Х	47. 4 000	v	9: +1.000	Х	2. 1.000
57: +0.339	х	52: -0.3	/0	Х	44: +0.152	х	36: +1.00	U	26: -	1.000	х	17:-1.000	X	8: +1.000	х	2: -1.000
56.0422	v	51: +1.0	00	Х	42: 1.000	~	35: +0.99	2 X	25.	1 000	v	16: +1.000	X	7 0.444	v	1: -1.000
50:-0.133	X	50: -1.0	00	х	43: -1.000	X	34: -0.14	7 X	25:-	1.000	X	15: -0.199	х	7: +0.414	х	0: +1.000
		40: 0.0	20		42: -0.208	Х	22. 0.24	• v	24: -	1.000	Х	14.0012		6: +0.316		
		49:-0.0	29		41: -0.096		33: -0.24	8 X	23: -	1.000		14: +0.813		5: -1.000		
							32: -1.00	0	22.4			13: +1.000	1			
Num: 31	<b>_</b>	Val· 00		Act:	SET	INC	DEC	ALL		).418   *Δ11		F Zerr	y SET	INC	DEC	ZERO
WES	-	V: +0.0	17	/	(:+0.252	X Ec	. 0.010			χ Δ2·						MS: +0.012
DM		X: +0.4 X: -2.0	+17 💌 108	1	Y: -0.665	E FC	: -0.010 🕑 : -4.017	A1:+	3.004	A2:	+9.964	C1:	-1.917	C2: +0.0	81 R	MS: +2.957
					DN	/ Servo (	OFF						AO	OFF TT-OF	F R0=nan	+-nan
CAM ON	CAI	MOFF	CL C	N	CL OF		OOL ON	ON/-50	.7C C	OOL OF	FAL	LLOFF	SAUTO	SOP	EN	SCLOSE
MOVIE	1	NFS	WFS/	PH	WFS/MF	РН	DM/PH	DM/M	РН	IMAGE	RE	SCALE	REOPEN	PIN	IG	QUIT

REGULAR range 50% - 90% range >90% range

#### **BLOCKED**

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Australian National University

Updates on AO

vniversity of **XETER** 

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Interferometric Survey

of Stellar Parameter

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NOIR Lab



#### DM visualization and control



Observatoire LESIA



Georgia<u>State</u> University KYOTO SANGYO

UNIVERSITY

Australian

Universitv

National

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**SYDNEY** 

Interferometric Survey

#### DM flaring

								TELAO_E	E1						3
	MAIN AND	ORSETUP	AO AI	DJUST	DM SERVO S	SIM									
	DM Curre	nt: 7.3950	A D	M Temp:	0.0000 C	Elect T	emp: 31.0938	BC	POWER	DFF	F	POWER ON		REOPE	EN TT
E1_ACQ (ZWO ASI174MM-Cool, 5.8 x 3.9 arcmin)	FLATTEN	DM	LAST F	FLAT	DEF FLA	Т	ZERO F	FLAT	31: -1.000	L	IN/LOG	SAVE	FLAT	SE	T FLAT
	1.10 🗘	RM DM TI	LT LIN				40: -1.000				21: +1.00	0		RM DM	I TILT ZERN
					48: +1.000				30: +0.806				12: -1.000		
1 1			55: +1.000		47: -1.000	х	39: +1.000	х	29: -1.000	х	20: +1.00	00	11: -1.000		
	50.14.000	v	54: -1.000	Х	45.14.000	~	38: -0.626	Х	20. 0.205		19: -1.00	0 X	404.000		4: +1.000
	59: +1.000	X	53: +0.431	х	46: +1.000	x	37: +1.000	х	28: -0.306	X	18: +0.52	24 X	10: +1.000	х	3: +0.272
	58: +1.000	Х	52. 1 000	v	45: -0.620	х	26. 1 000		27: +1.000	Х	17. 1.00		9: +1.000	Х	2. 1 000
	57: -1.000	X	52: +1.000	X	44: +0.063	х	36: +1.000		26: -1.000	х	17:-1.00	U X	8: -1.000	х	2: +1.00
• •	56. 1.000		51: +0.633	Х	42: 1 000	v	35: -0.838	Х	25. 1 000	v	16: -0.31	1 X	7: 1.000	v	1: +1.00
	50:-1.000	X	50: -1.000	х	43: +1.000	~	34: +1.000	х	25: +1.000	X	15: +1.00	x 00	7:-1.000	X	0: -1.00
			40: 1.000		42: -1.000	х	22: 1.000	~	24: -1.000	Х	14:010	0	6: +1.000		
			491.000		41: -1.000		551.000	^	23: +1.000		140.10	6	5: +1.000		
							32: +1.000		22: +0.607		13: -1.00	0			
	Num: 0	🗘 Va	l: 0.0	Act:	SET	INC	DEC	ALL	+ALL */		USE Ze	rn: SET	INC	DEC	ZERO
	WFS		X: +0.312		Y: +0.173 🗹	Fc:	-0.182 🗹	A1: -0.	149 🗹 🖌	2: +0.33	• 🗹 C	1: -0.057 🗹	C2: -0.09	90 R	MS: +0.137
	DM		X: -0.062		Y: +2.304	Fc: •	+0.620	A1: +0.	330 A	2: +1.679	e Cr	1:+1.033	C2: +1.0	96 R	MS: +0.446
	CAMON	CAM	OFF	CL ON		ervo		ON/-50.0	c [ cool (				SOPI	- RU=5.33-	+-0.00
								GHA	RA AQ	GTK	early	stages	of dev	elon	ments
	WOVIE	JU VVF	3	WF5/PH	WESTWIPH		NVI/PH	SWI/WIN	IN INAC		RESUALLY	LABEN		e op	



#### Optimizing TELAO performance - power spectrum



SERVO OFF - no DM loop, just TT SERVO ON - both TT and DM

Gain and dumping





#### Tuning AO on-sky doing science time

							١	wfs_S2								-
MAIN ANDO	RSETUP	AO ADJU	JST DM SE	RVO SIM												
DM Cu	urrent:		DM Tempe	rature:	Elec	tronics Ter	np:		POWER	OFF		PC	OWER ON		REOF	'EN TT
FLATTEN I	DM	LAS	T FLAT	DEF FL	AT	ZER	O FLAT	31	I:-0.013		LIN/LOG	i	SAV	E FLAT	S	ET FLAT
1.10 🗘	RM DM T	TILT LIN				40: +0.31	6				21:	-0.031			RM D	M TILT ZERN
		55: +0.00	0	48: -0.215	v	39: +0.0	00 X	30	0: +0.000		20:	+0.000		12: +0.148	3	
59: +0.000	x	54: +0.00	0 X	46: +0.000	x	38: +0.0	00 X	28	3: +0.000	x	19: K	+0.000	X	10: +0.000	, ) X	4: +0.000
58: +0.000	x	53: +0.00 52: +0.00	o x	45: +0.000	x	37: +0.0 36: +0.0	00 X 00	27	7: +0.000	>	18: ( 17:	+0.000	x x	9: +0.000	x	3: +0.000
57: +0.000	x	51: +0.00	0 X	44: +0.000	x	35: +0.0	00 X	26	5: +0.000	×	( 16:	+0.000	x	8: +0.000	x	1:+0.000
50.10.000	~	50: +0.00	0 X	42: +0.000	x	34: +0.0	00 X	24	4: +0.000	x	) (	+0.000	х	6: +0.000	~	0: +0.000
		49: +0.00	0	41: +0.054		33: +0.0 32: +0.0	00 X	23	3: +0.000		14:	+0.000		5: -0.032		
								22	: +0.053							
Num: 0	‡ V	al: 0.0	Act:	SET	INC	DEC	ALL	+AL	L *	ALL	USE	Zern	n: SET	INC	DEC	ZERO
WFS DM	r	X: +0.08 X: -0.12	39 🗹 🕚	Y: -0.070 🛛 🗹 Y: -0.453	Fc: Fc:	-0.039 🗹 -0.305	A1: -	-0.016 +0.056	۲	A2: -0. A2: -0.	069 💌 200	C1: C1:	-0.015 💌 -0.041	C2: -0. C2: -0.	002 010	RMS: +0.010 RMS: +0.098
		2 referen	ce centroids l	nave been loa	ded from	/ctrscrut/c	hara/etc/w	vfs_S2_I	REF.cao				A	O-OFF TT-O	NR0=8.44	+-4.68
CAM ON	CAN	1 OFF	CL ON	CL OFF	C	OOL ON	OFF/17	.0C	COOL	OFF	ALL O	FF	SAUTO	SO	PEN	SCLOSE
AO ON	AO	OFF	FLATTEN	SET FLAT		ST FLAT	DEF FL	AT	TT O	N	TT O	FF	TT ZERC	LIN	LOG	PixMult 5
MOVIE	W	/FS	WFS/PH	WFS/MPI	+ [	DM/PH	DM/M	РН	IMAG	δE	RESCA	ALE	REOPEN	I PI	NG	QUIT



Your Talk Title Here



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# Some of next steps

- obsgtk update, optimization, wish list
- labaogtk wish list
- using DM as TT system
- on sky reconstructors
- AO performance diagnostics
- regular meeting with operators
- beaconmon logs, logs in general
- documentation
- aomon
- lurkgtk









## AO performance - STST & AOMON





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Updates on AO

## AO performance - STST



Georgia State University & Conservatoire LESIA Conservatoire LESIA Conservatoire LESIA Conservatoire LESIA

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## AO performance - STST



Georgia State University OF University OF University OF University OF University OF University OF SYDNEY OF SYDNEY OF SYDNEY



## AO performance - aberration plot

						wfs_S1					×
	MAIN AND	ORSETUP AC	ADJUST D	M SERVO S	SIM						
	Edge 217	8+_11/	Edge Rae 189	0/246.0	LBax Flux  : 34	8.4 F	10: 25.03+-24.81		TT OFF	CENT	ROIDS ONLY
TELAO E	1			8	3 11:-0.000	0	FPS: 0	I	GNORE TILT	RN	PISTON
		<b>1</b>			MEAS	1.0	\$ WFS AE	BER DM AB	ER TOG RE	F 1	#FRAMES
والمعطو	her of the	Annel Vr	ly <sup>ren b</sup> '''y	┙┛┙┛	0-DARK	-1000	.0 ‡ THRE	SH 3.0	MIN FLU	JX 6.0	DM STOP
					DEF REF		SAVE REF		USE SUBAP	500	NUM MEAN
بمنها والاحتياب أبني					TT ZERO	-1.00	р 🗘 та	AIN 0.0000	TT DAM	P 3.0	<b>ТТ STOP</b>
J. A. C. A.	1.1		_	M.	0.100	\$	TT IMPULSE	RM	DM TILT ZERN	тс	IG TT DIS
محجمكي ويستعاده والتبين فيلتلين المتنا والمتلف والمتلف	مهمهمه	Weger Au	مري <b>ماي</b> ا (مايا	/ 4 mar	EF FLAT		SAVE FLAT		SET FLAT	0	LD FLAT
					. 1		aan: 10			A Poko:	
						#11		* #Cych	es. [2	FORE.	0.0200
						DEF RECON		SAVE REC	ON	\$00	DM MEAN
						IGNORE TILT		REMOVE PI	STON	APPLY	RECON
					0.017 🗹	A1: -0.014	A2: +0.	012 🗹 C1	:+0.001 🗹	C2: -0.009	RMS: +0.004
					0.221 ning.	A1: +0.156	A2: -0.7	148 C1	: +0.057	C2: +0.039 AO-OFF TT	RMS: +0.093 OFF
	CAWLON	CAINTOFF	CLON	CLOFF	COOLON	ON/-50.0C	COOL OFF	ALL OFF	SAUTO	SOPEN	SCLOSE
	AO ON	AO OFF	FLATTEN	SET FLAT	LAST FLAT	DEF FLAT	TTON	TT OFF	TT ZERO	LIN/LOG	PixMult 5
	MOVIE	WFS	WFS/PH	WFS/MPH	DM/PH	DM/MPH	IMAGE	RESCALE	REOPEN	PING	QUIT



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