

Updates on adaptive optics systems

Karolina Kubiak

E. Rob Ligon

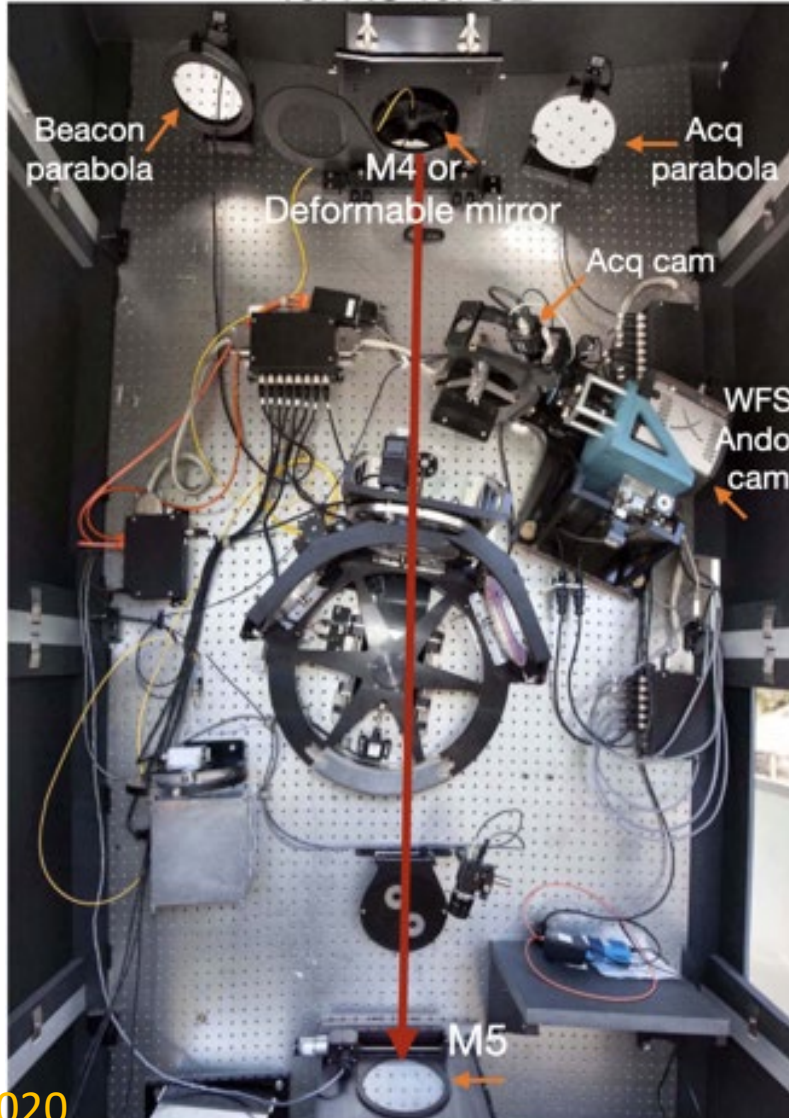
Theo ten Brummelaar

Overview

Overview

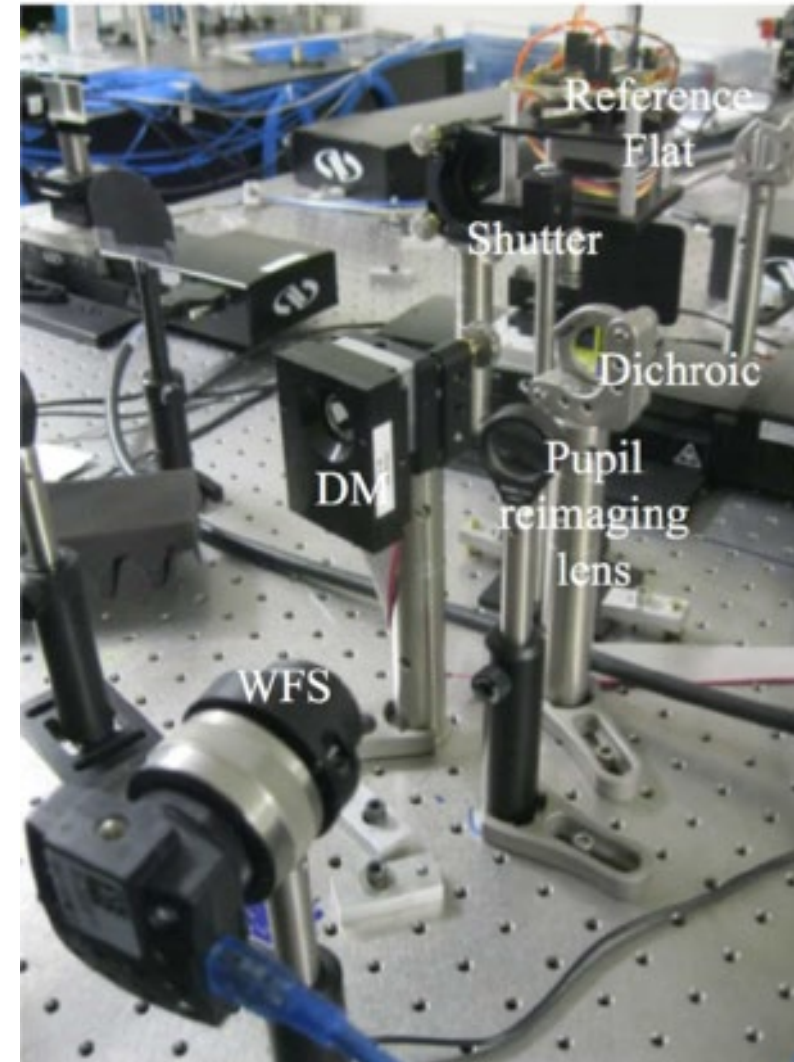
- 1 system per scope
- fast WFS
- locks on star
- M2 as fast TT

Tel-AO for S2



Anugu et al. 2020

Lab-AO for S2

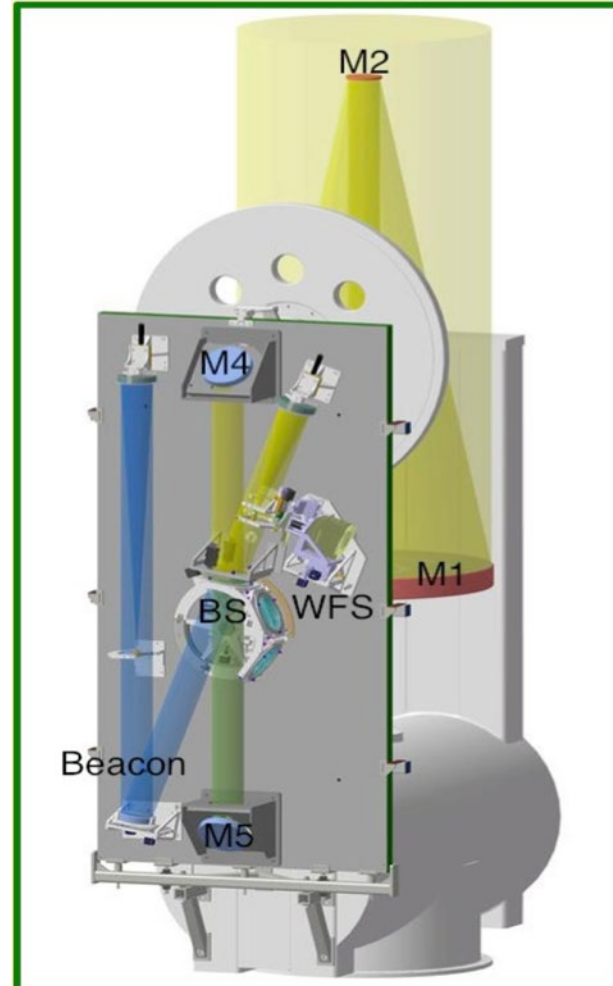


- 1 system per scope
- slow WFS
- locks on blue beacon
- responsible for guiding

Anugu et al. 2020

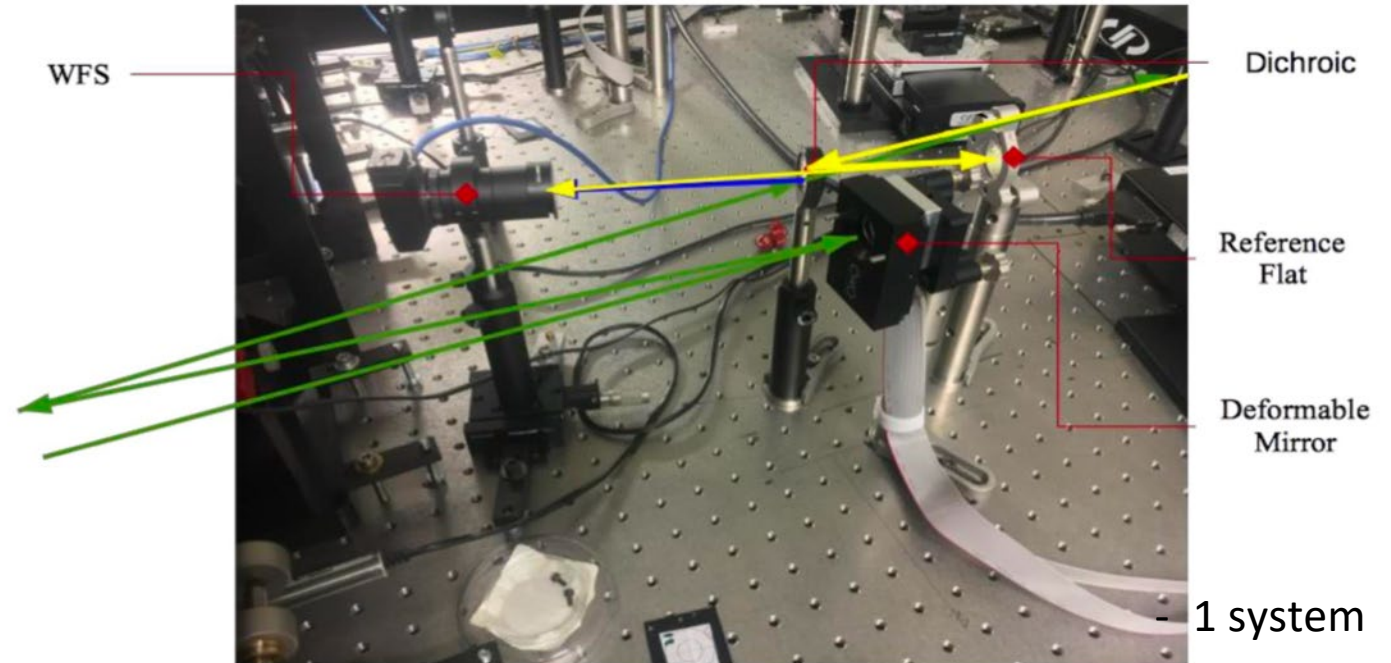
Overview

Telescope



- 1 system per scope
- fast WFS
- locks on star
- M2 as fast TT

Optical Lab

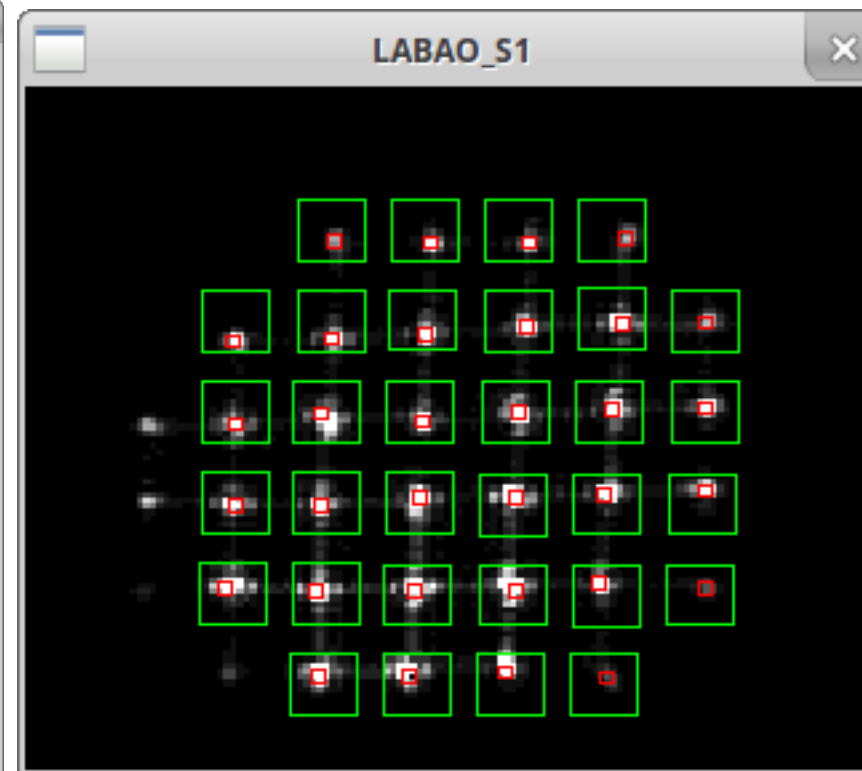
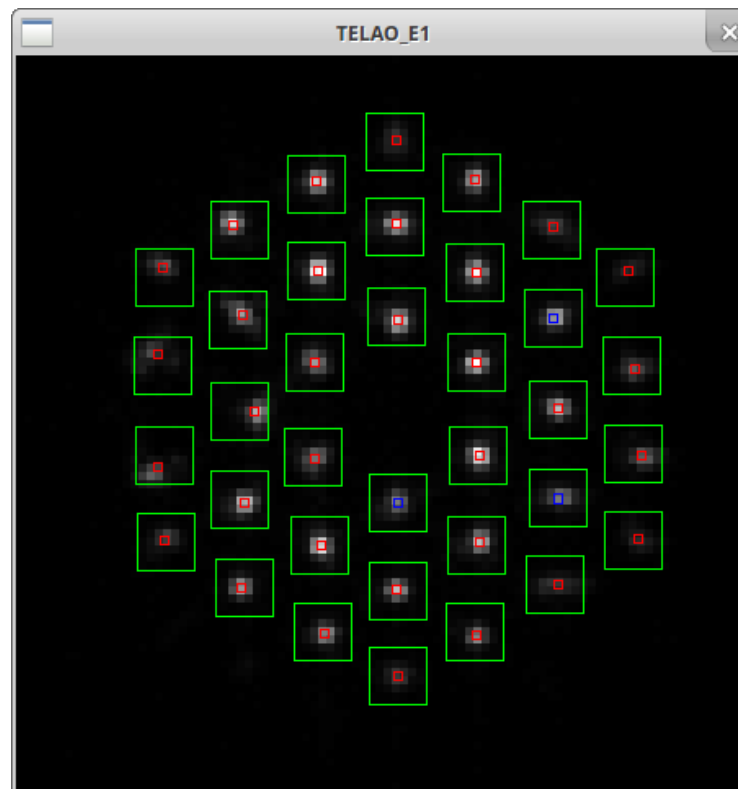


Slow WFS, locks on blue beacon

- 1 system per scope
- slow WFS
- locks on blue beacon
- responsible for guiding



- 1 system per scope
- fast WFS
- locks on star
- M2 as fast TT



- 1 system per scope
- slow WFS
- locks on blue beacon
- responsible for guiding

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



New SOFTWARE for TELAO and LABAO

September 2024

14 April 2025

Developed
Theo

Engineering

Bug reporting & wish list

CHARA AO

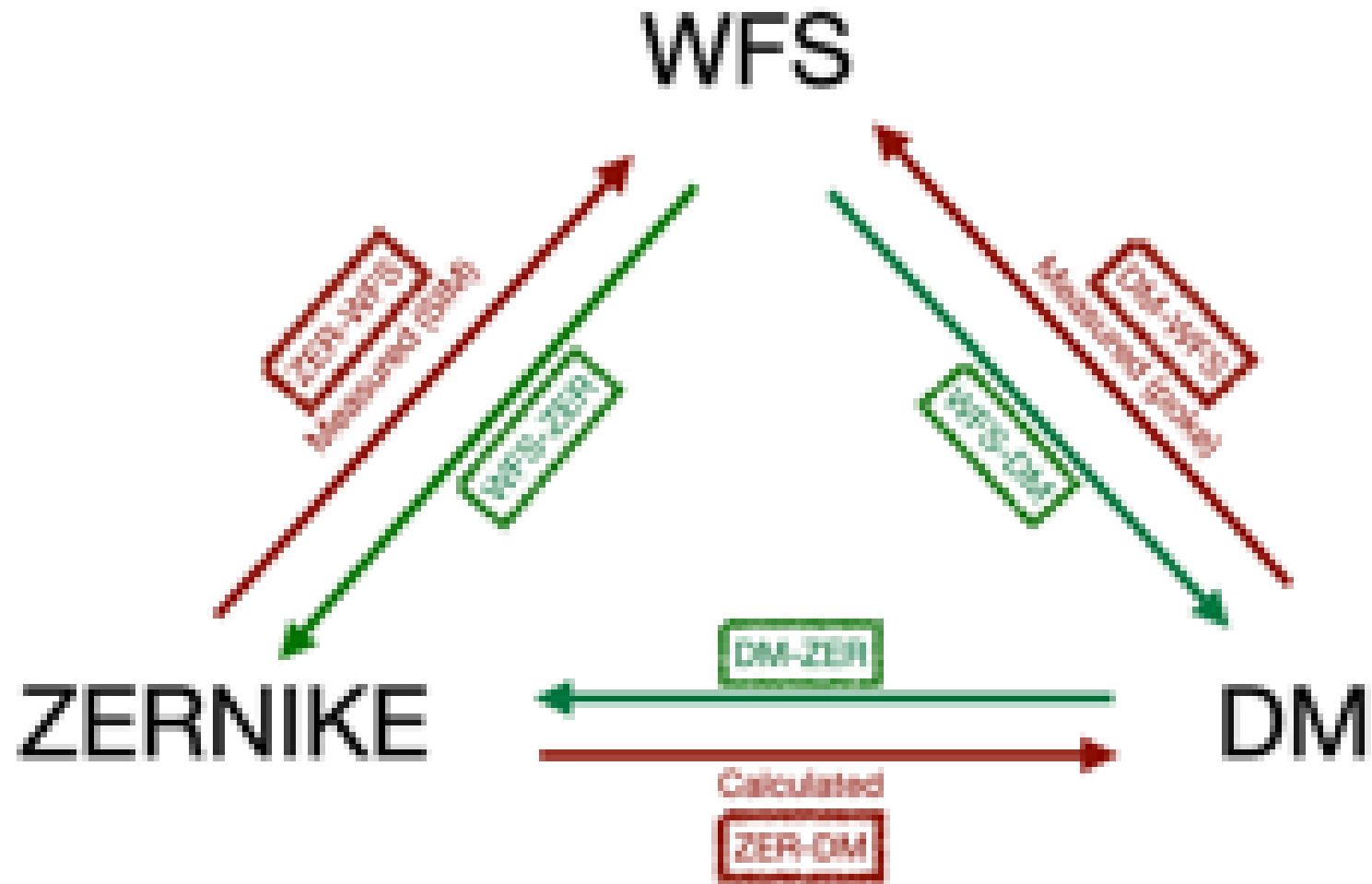
Reviewed
Rob

Testing

“Crashed”
Karolina

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

MAIN ANDORSETUP AO ADJUST DM SERVO SIM

Running: NO Shutter: CLOSED Read Mode: IMAGE Temp Status: STABLE GET

Full Frame: 512x512 Current Frame: 90x90 Num Pixels: 8100

Set Temp: -50 Exposure: 0.00100 PreAmp Gain:

Amplifier: EMCCD CCD High Gain: OFF ON EM Gain: 100

VSpeed: 0.50 uS 2 EMCCD HS: 10.00 MHz 2 CCD HS: 0.00 MHz

Hbin: 1 Vbin: 1 Hstart: 1 Hend: 90 Vstart: 1

TOG DISP FAN OFF FAN LOW

WFS DM 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 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

WFS S1 Running.

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 FLAT DEF FLAT TT ON TT OFF TT ZERO LIN/LOG PixMult 5

MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT

MAIN ANDORSETUP AO ADJUST DM SERVO SIM

Actuator: 0 Amplitude: 0.10 #5mp: 50 #Mn: 1 Delay: 5 STEP TEST

Freq Min: 0.00 Freq Max: 0.00 PS Min: 0.00 PS Max: 0.00 PLOT IMP PS

Actuator: 0 Smoothing: 1 Num: 1000 WFS DM DATA

Freq Min: 0.00 Freq Max: 0.00 PS Min: 0.00 PS Max: 0.00 PLOT WFS DM

Pos X: 47.9 Pos Y: 48.6 Pitch: 10.0 Angle: 0 Set Boxes

10.0 ALIGN BOXES STOP ALIGN 1000 TELEMETRY 9 BOX SIZE 0 ZERN LOOP

1.0 Up Down Left Right 0 Rotate 1.000 Scale

X: 0.000 Y: 0.000 Fc: 0.000 A1: 0.000 A2: 0.000 C1: 0.000 C2: 0.000 WFSAB ZWFSAB

Mx sum: 0.01 Memory: 0.99 Gain: 0.20 Damp: 0.05 Int: 0.00 Clamp: 9.0 Denom: -2.0 SEND

WFS DM 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 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

WFS S1 Running.

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 FLAT DEF FLAT TT ON TT OFF TT ZERO LIN/LOG PixMult 5

MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT

MAIN ANDORSETUP AO ADJUST DM SERVO SIM

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

BOXES COG ACTS MEAS 1.0 WFS ABER DM ABER TOG REF 1 #FRAMES

TOG EDGE 1000 MKDARK 0-DARK -1000.0 THRESH 3.0 MIN FLUX 6.0 DM STOP

ZERO REF LAST REF DEF REF SAVE REF USE SUBAP 500 NUM MEAN

TT ON TT OFF TT ZERO -1.000 TT GAIN 0.000 TT DAMP 3.0 TT STOP

TT NAVGE Samp: 100 Amp: 0.100 TT IMPULSE RM DM TILT ZERN TOG TT DIS

FLATTEN_DM LAST FLAT DEF FLAT SAVE FLAT SET FLAT OLD FLAT

MEAS RECON #Loops: 0 #Waits: 1 #Mean: 10 #Cycles: 2 Poke: 0.0200

CALC REC LAST RECON DEF RECON SAVE RECON 500 DM MEAN

AO ON AO OFF IGNORE TILT REMOVE PISTON APPLY RECON

WFS DM 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 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

WFS S1 Running.

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 FLAT DEF FLAT TT ON TT OFF TT ZERO LIN/LOG PixMult 5

MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT

MAIN ANDORSETUP AO ADJUST DM SERVO SIM

DM Current: 5.8081 A DM Temp: 25.8125 C Elect Temp: 42.1250 C POWER OFF POWER ON REOPEN TT

FLATTEN DM LAST FLAT DEF FLAT ZERO FLAT 31: +0.163 LIN/LOG SAVE FLAT SET FLAT

1.10 RM DM TILT LIN 40: -0.236 21: +0.045 RM DM TILT ZERN

55: +0.395 48: -0.373 39: -1.000 X 30: +1.000 20: -1.000 12: +1.000

59: +1.000 X 54: -1.000 X 47: -0.747 X 29: -0.318 X 19: -1.000 X 11: +1.000

58: +1.000 X 53: +0.645 X 46: -0.577 X 38: -1.000 X 28: +1.000 X 18: +1.000 X 3: +1.000

57: +0.339 X 52: -0.370 X 45: +1.000 X 37: +1.000 X 27: -0.382 X 17: -1.000 X 9: +1.000 X 2: -1.000

56: -0.133 X 51: +1.000 X 44: +0.152 X 36: +1.000 X 26: -1.000 X 16: +1.000 X 8: +1.000 X 1: -1.000

50: -1.000 X 43: -1.000 X 35: +0.992 X 25: -1.000 X 15: -0.199 X 7: +0.414 X 0: +1.000

49: -0.029 42: -0.208 X 34: -0.147 X 24: -1.000 X 14: +0.813 6: +0.316

41: -0.096 33: -0.248 X 23: -1.000 13: +1.000 5: -1.000

32: -1.000 22: -0.418

Num: 31 Val: 0.0 Act: SET INC DEC ALL +ALL *ALL USE Zern: SET INC DEC ZERO

WFS DM X: +0.417 Y: +0.353 Fc: -0.010 A1: -0.006 A2: +0.026 C1: +0.027 C2: +0.020 RMS: +0.013

WFS DM X: -2.008 Y: -0.665 Fc: -0.017 A1: +3.004 A2: +9.964 C1: -1.917 C2: -0.381 RMS: +2.957

DM Servo OFF AO-OFF TT-OFF R0=nan+nan

CAM ON CAM OFF CL ON CL OFF COOL ON ON/-50.7C COOL OFF ALL OFF SAUTO SOPEN SCLOSE

MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT

MAIN ANDORSETUP AO ADJUST DM SERVO SIM

Trys: 10 FOCUS WFS ALIGN BEACON ALIGN BOXES FOCUS SCOPE

WFS Focus Delay: 5 Limit: 0.050 Step: 1000.0

Scope Focus Delay: 5 Limit: 0.050 Step: 5.0

Beacon Delay: 5 Limit: 0.150 Step: 50.0

Calsource X Delay: 5 Limit: 0.050 Step: 50.0

Calsource Y Delay: 5 Limit: 0.050 Step: 50.0

Calsource Focus Delay: 5 Limit: 0.050 Step: 4000.0

COG Delay: 2 Limit: 2.000 Step: 0.1

DM Tilt Offload Servo: OFF ON Deadzone: 0.50

WFS DM 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 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

WFS S1 Running.

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 FLAT DEF FLAT TT ON TT OFF TT ZERO LIN/LOG PixMult 5

MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT

MAIN ANDORSETUP AO ADJUST DM SERVO SIM

X: 0.000 Y: 0.000 Fc: 0.000 A1: 0.000 A2: 0.000 C1: 0.000 C2: 0.000 TELAB ZTELAB

10.0 R0cm 7.0 MAG SOPEN SCLOSE STAR ON STAR OFF ATM ON ATM OFF WFE ON WFE OFF

1.0 DM Up DM Down DM Left DM Right Reset DM

1.0 BEAM Up BEAM Down BEAM Left BEAM Right Reset BEAM

0.633 OBS Lambda (um) ABER RECON CALC DM POS MEAS->POS

DM GAUSSIAN DM LINEAR DM ZERNIKE CALC DM/ZERN SIM ON SIM OFF

WFS DM X: +0.011 Y: +0.142 Fc: +0.016 A1: +0.004 A2: +0.002 C1: +0.003 C2: +0.019 RMS: +0.010

WFS DM X: -0.000 Y: +0.000 Fc: +0.000 A1: +0.000 A2: +0.000 C1: +0.000 C2: +0.000 RMS: +0.010

WFS E1 Running.

CAM ON CAM OFF CL ON CL OFF COOL ON OFF/17.0C COOL OFF ALL OFF SAUTO SOPEN SCLOSE

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/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT



Engineering GUIs LABAO

LABAO_S2

MAIN AO ADJUST DM SERVO SIM

Server is stopping.
You will have to REOPEN the connection
once it is running again.

Edge 1.9+1.2
202/1353/25036 us

Box Flux | 107.9
DM | 0.8164
R0: 15.58+2.47
FPS: 40

TT OFF

SERVO ON

BOXES COG ACTS MEAS 1.0 TOG ABER TOG REF 1 #FRAMES

TOG EDGE 1000 MKDARK 0-DARK -1000.0 THRESH 3.0 MIN FLUX 18.0 DM STOP

ZERO REF LAST REF DEF REF SAVE REF USE SUBAP 40 NUM MEAN

TT ON TT OFF TT ZERO -4.000 TT GAIN 0.000 TT DAMP 0.0 TT STOP

1 TT NAVGE Samp: 100 Amp: 0.100 TT IMPULSE RM DM TILT ZERN TOG TT DIS

FLATTEN_DM LAST FLAT DEF FLAT SAVE FLAT SET FLAT OLD FLAT

MEAS RECON #Loops: 0 #Waits: 1 #Mean: 10 #Cycles: 2 Poke: 0.2500

34 CALC REC LAST RECON DEF RECON SAVE RECON 500 DM MEAN

AO ON AO OFF IGNORE TILT REMOVE PISTON APPLY RECON

WFS DM X: -0.044 Y: +0.169 Fc: -0.025 A1: -0.002 A2: +0.030 C1: -0.006 C2: -0.011 RMS: +0.013
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

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

MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT

LABAO_S2

MAIN AO ADJUST DM SERVO SIM

Edge 1.9+1.2
202/1353/25036 us

Box Flux | 107.9
DM | 0.8164
R0: 15.58+2.47
FPS: 40

TT OFF

SERVO ON

BOXES COG ACTS MEAS 1.0 TOG ABER TOG REF 1 #FRAMES

TOG EDGE 1000 MKDARK 0-DARK -1000.0 THRESH 3.0 MIN FLUX 18.0 DM STOP

ZERO REF LAST REF DEF REF SAVE REF USE SUBAP 40 NUM MEAN

TT ON TT OFF TT ZERO -4.000 TT GAIN 0.000 TT DAMP 0.0 TT STOP

1 TT NAVGE Samp: 100 Amp: 0.100 TT IMPULSE RM DM TILT ZERN TOG TT DIS

FLATTEN_DM LAST FLAT DEF FLAT SAVE FLAT SET FLAT OLD FLAT

MEAS RECON #Loops: 0 #Waits: 1 #Mean: 10 #Cycles: 2 Poke: 0.2500

34 CALC REC LAST RECON DEF RECON SAVE RECON 500 DM MEAN

AO ON AO OFF IGNORE TILT REMOVE PISTON APPLY RECON

WFS DM X: -0.044 Y: +0.169 Fc: -0.025 A1: -0.002 A2: +0.030 C1: -0.006 C2: -0.011 RMS: +0.013
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

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

MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT

LABAO_S2

MAIN AO ADJUST DM SERVO SIM

Actuator: 1 Amplitude: 0.10 #Smp: 50 #Mn: 1 Delay: 5 STEP TEST

Freq Min: 0.00 Freq Max: 0.00 PS Min: 0.00 PS Max: 0.00 PLOT IMP PS

Actuator: 0 Smoothing: 1 Num: 1000 WFSDM DATA

• All • Single • Servo ON • Servo OFF • Both • CLTF • OLTf PLOT WFSDM

Freq Min: 0.00 Freq Max: 0.00 PS Min: 0.00 PS Max: 0.00 CLEAR DISP

Pos X: 66.2 Pos Y: 56.7 Pitch: 15.0 Angle: 0 Set Boxes

10.0 ALIGN BOXES STOP ALIGN 1000 TELEMETRY 11 BOX SIZE 0 ZERN LOOP

1.0 Up Down Left Right 0 Rotate 1.000 Scale

X 0.000 Y 0.000 Fc 0.000 A1 0.000 A2 0.000 C1 0.000 C2 0.000 WFSAB ZWFSAB

Mx sum: 0.01 Memory: 0.99 Gain: 0.50 Damp: 0.05 Int: 0.00 Clamp: 9.0 Denom: -2.0 SEND

WFS DM X: -0.044 Y: +0.169 Fc: -0.025 A1: -0.002 A2: +0.030 C1: -0.006 C2: -0.011 RMS: +0.013
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

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

MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT

LABAO_S2

MAIN AO ADJUST DM SERVO SIM

FLATTEN_DM LAST FLAT DEF FLAT ZERO FLAT LIN/LOG SAVE FLAT SET FLAT

1.10 RM DM TILT LIN 25: +1.000 24: +0.886 23: +0.926 22: +0.612 RM DM TILT ZERN

X 26: +0.685 11: +0.517 X 10: +0.442 X 9: +0.620 21: +0.670

X 27: +0.680 X 12: +0.344 X 3: +0.752 X 2: +0.698 X 8: +0.473 X 20: +0.831

X 28: +0.000 X 13: +0.678 X 4: +0.626 X 0: +0.000 X 1: +0.820 X 7: +0.381 X 19: +0.000

X 29: +0.557 X 14: +0.651 X 5: +0.691 X 6: +0.704 X 18: +0.544 X 36: +1.000

X 30: +0.910 X 15: +0.643 X 16: +0.000 X 17: +0.735 X 35: +0.601

X 31: +0.000 X 32: +1.000 X 33: +0.345 X 34: +1.000

Num: 0 Val: 0.0 Act: SET INC DEC ALL +ALL *ALL USE Zern: SET INC DEC ZERO

WFS DM X: -0.044 Y: +0.169 Fc: -0.025 A1: -0.002 A2: +0.030 C1: -0.006 C2: -0.011 RMS: +0.013
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

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

MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT

LABAO_S2

MAIN AO ADJUST DM SERVO SIM

Number of Trys: 10 LAB DICH M7 DM SCP DICH BC FOCUS ALIGN BOXES STOP ALIGN

Limit Trigger: 1.0 AUTO M7 AUTO DM AUTO SCP

Scope Dich Delay: 3 Limit: 0.500 Step: 20.0 Gain: 100.0 GET SEND

Beacon Focus Delay: 3 Limit: 0.100 Step: 100.0 Gain: 22050.0 GET SEND

M7 Delay: 3 Limit: 0.500 Step: 3000.0 Gain: 10000.0 GET SEND

DM Tilt/M7 Delay: 3 Limit: 0.100 Step: 3000.0 Gain: 30000.0 GET SEND

WFS DM X: -0.044 Y: +0.169 Fc: -0.025 A1: -0.002 A2: +0.030 C1: -0.006 C2: -0.011 RMS: +0.013
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

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

MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT

LABAO_S2

MAIN AO ADJUST DM SERVO SIM

X 0.000 Y 0.000 Fc 0.000 A1 0.000 A2 0.000 C1 0.000 C2 0.000 TELAB ZTELAB

10.0 R0cm 7.0 MAG SOPEN SCLOSE STAR ON STAR OFF ATM ON ATM OFF WFE ON WFE OFF

1.0 DM Up DM Down DM Left DM Right Reset DM

1.0 BEAM Up BEAM Down BEAM Left BEAM Right Reset BEAM

0.450 OBS Lambda (um) ABER RECON CALC DM POS MEAS-POS

DM GAUSSIAN DM LINEAR DM ZERNIKE CALC DM/ZERN SIM ON SIM OFF

WFS DM X: -0.044 Y: +0.169 Fc: -0.025 A1: -0.002 A2: +0.030 C1: -0.006 C2: -0.011 RMS: +0.013
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

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

MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT

Some details

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)

mean flux of the all boxes

state of FSM

aberrations

TT & AO status

wfs_S1

MAIN ANDORSETUP AO ADJUST DM

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

BOXES COG ACTS MEAS 1.0 WFS ABER DM ABER TOG REF 1 #FRAMES

TOG EDGE 1000 MKDARK 0-DARK -1000.0 THRESH 3.0 MIN FLUX 6.0 DM STOP

ZERO REF LAST REF DEF REF SAVE REF USE SUBAP 500 NUM MEAN

TT ON TT OFF TT ZERO -1.000 TT GAIN 0.0000 TT DAMP 3.0 TT STOP

10 TT NAVGE Samp: 100 Amp: 0.100 TT IMPULSE RM DM TILT ZERN TOG TT DIS

FLATTEN_DM LAST FLAT DEF FLAT SAVE FLAT SET FLAT OLD FLAT

MEAS RECON #Loops: 0 #Waits: 1 #Mean: 10 #Cycles: 2 Poke: 0.0200

45 CALC REC LAST RECON DEF RECON SAVE RECON 500 DM MEAN

AO ON AO OFF IGNORE TILT REMOVE PISTON APPLY RECON

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

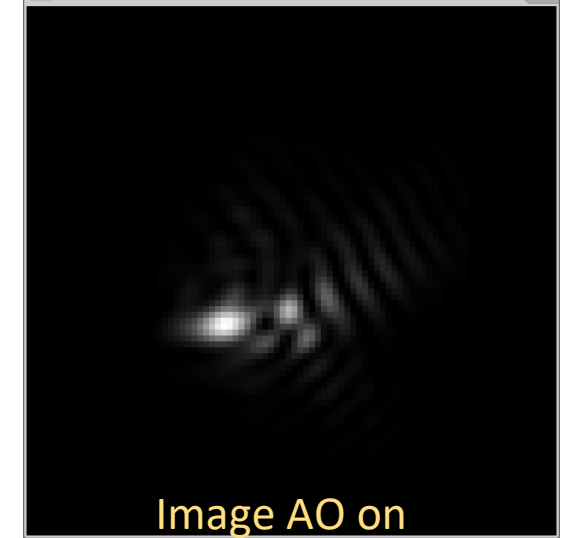
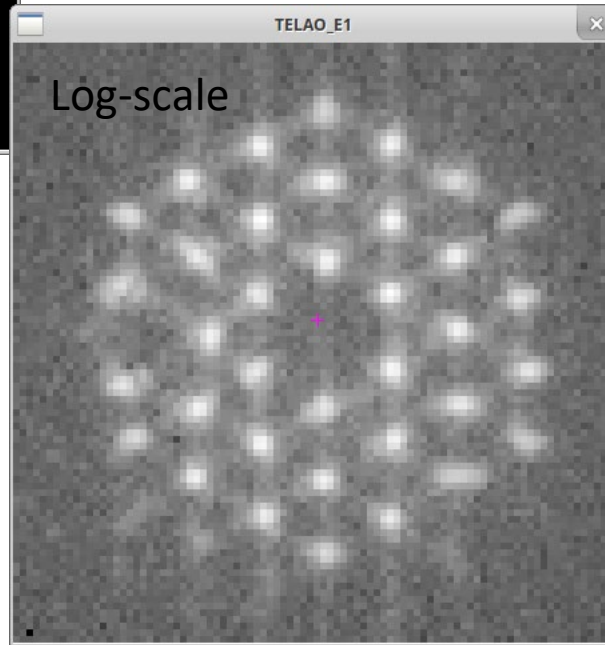
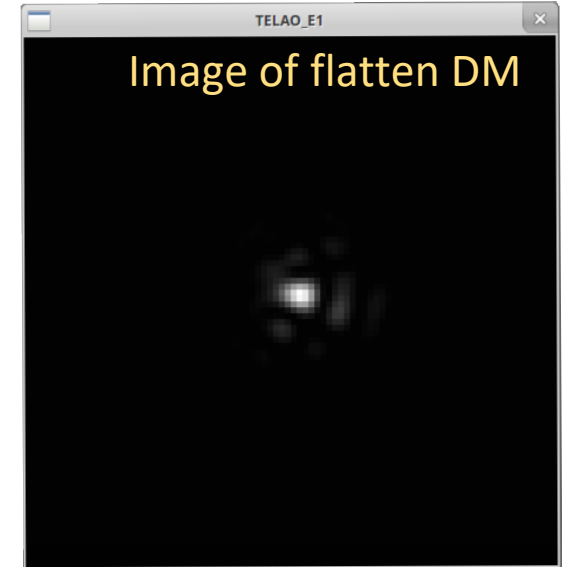
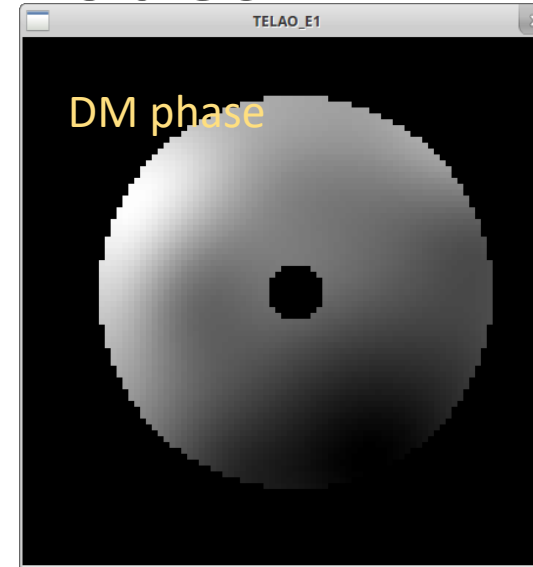
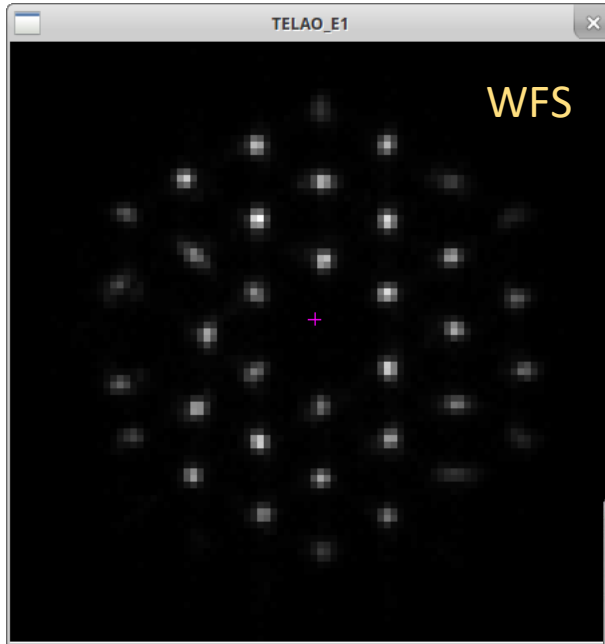
wfs_S1 Running. AO-OFF TT-OFF

CAM ON CAM OFF CL ON CL OFF COOL ON ON/-50.0C COOL OFF ALL OFF SAUTO SOPEN SCLOSE

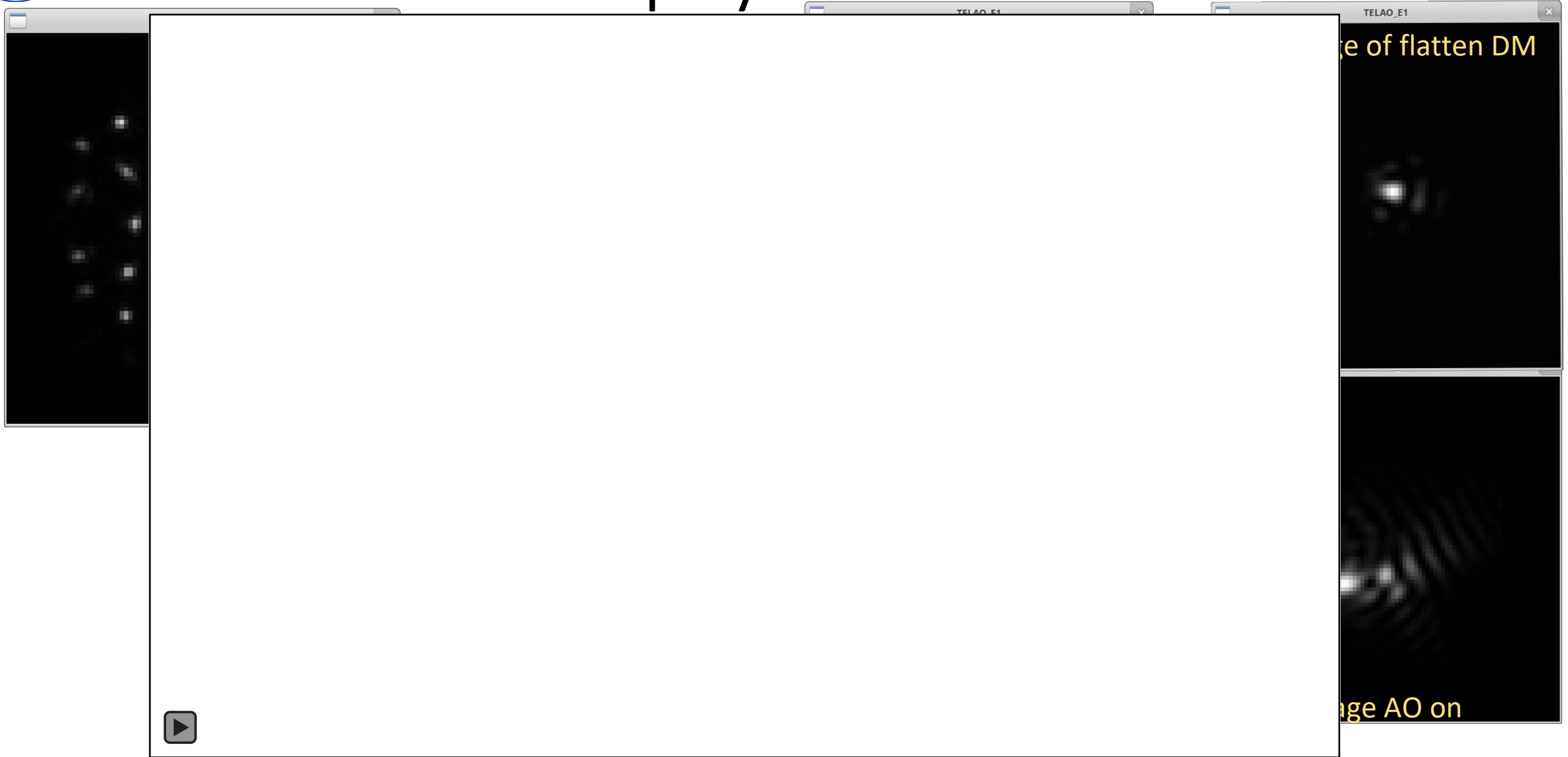
AO ON AO OFF FLATTEN SET FLAT LAST FLAT DEF FLAT TT ON TT OFF TT ZERO LIN/LOG PixMult 5

MOVIE WFS WFS/PH WFS/MPH DM/PH DM/MPH IMAGE RESCALE REOPEN PING QUIT

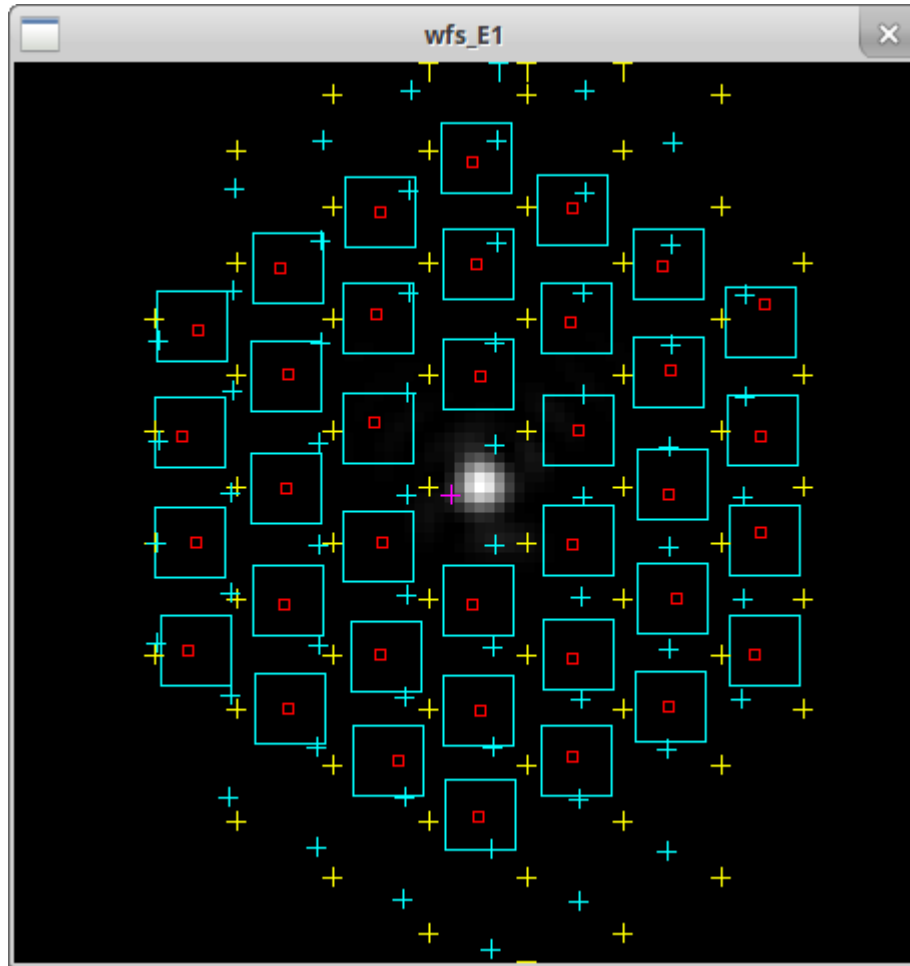
Display modes



Display modes



Visualization tools

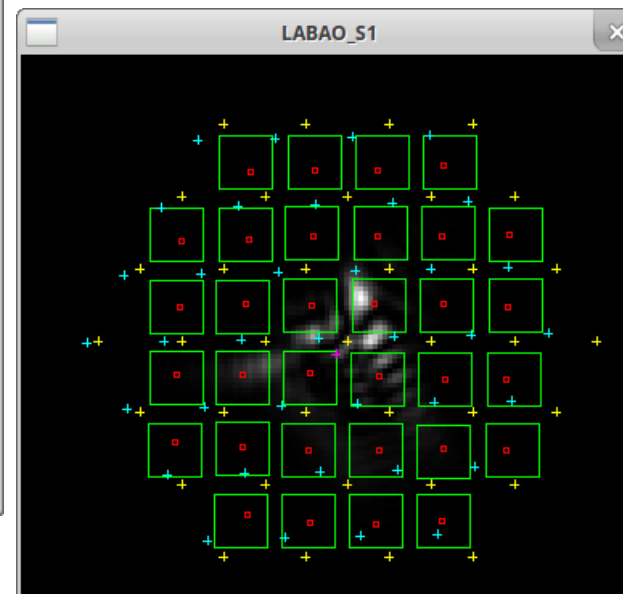


Theoretical actuators grid (yellow)

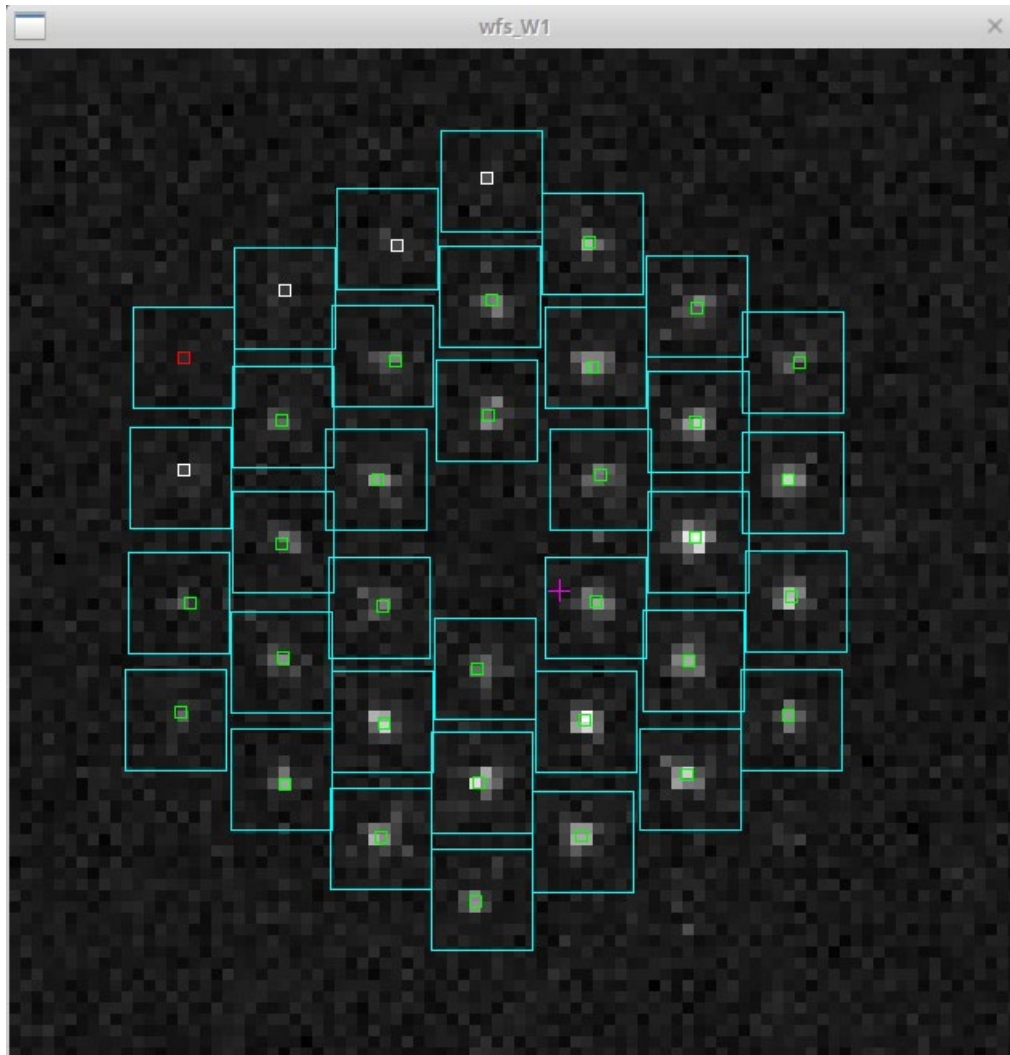
Measured actuators grid (turquoise)

Boxes - size, auto aligned, up to 10 grids

Center of gravity for light (purple) - auto alignment



Low flux - flexible centroid estimation

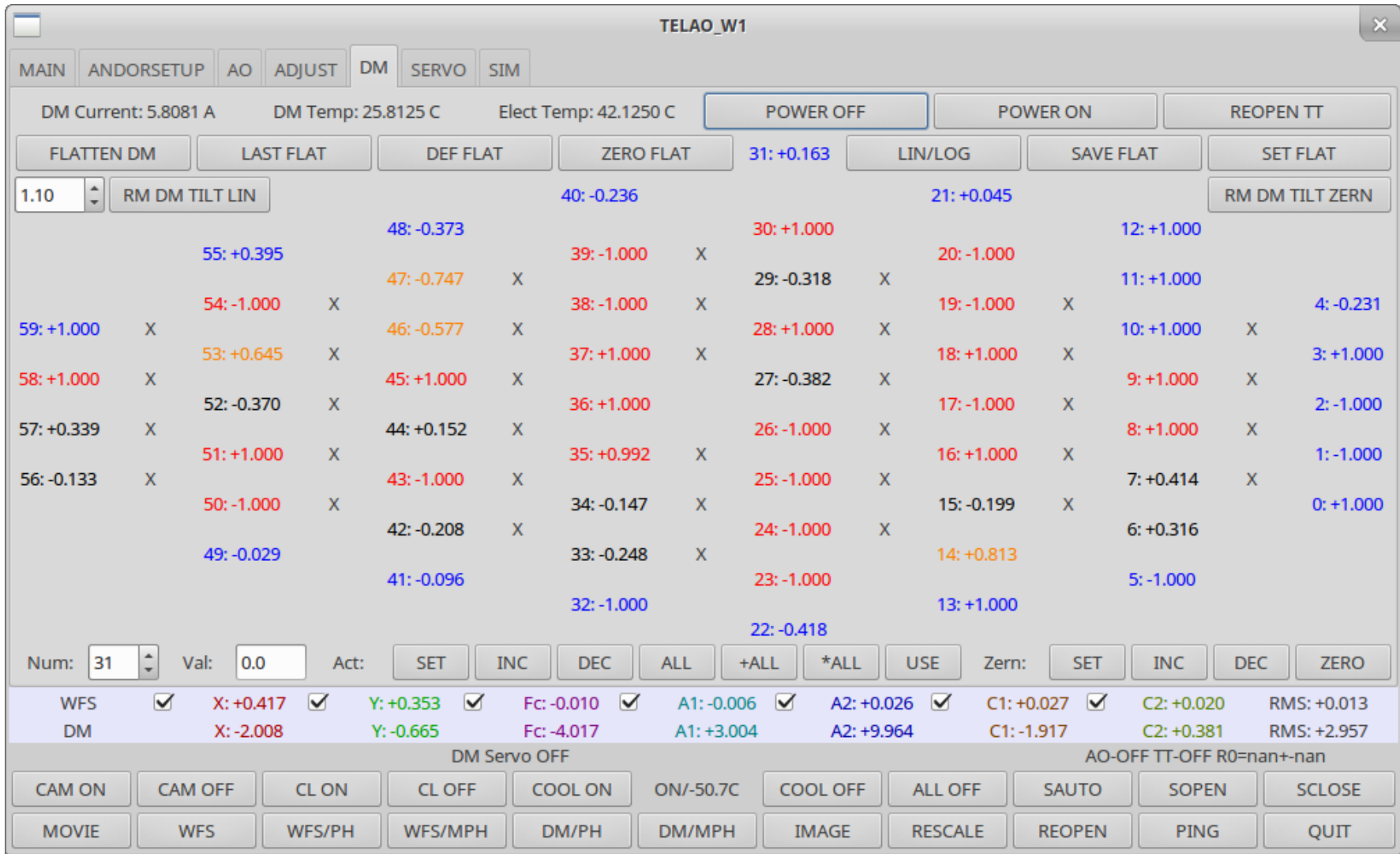


flux in the box > 9 std of flux - gaussian centroid

$3 \text{ std} < \text{flux in box} < 9 \text{ std}$ - max pixel position

flux in box $< 3 \text{ std}$ - ignore the sub aperture

DM visualization and control



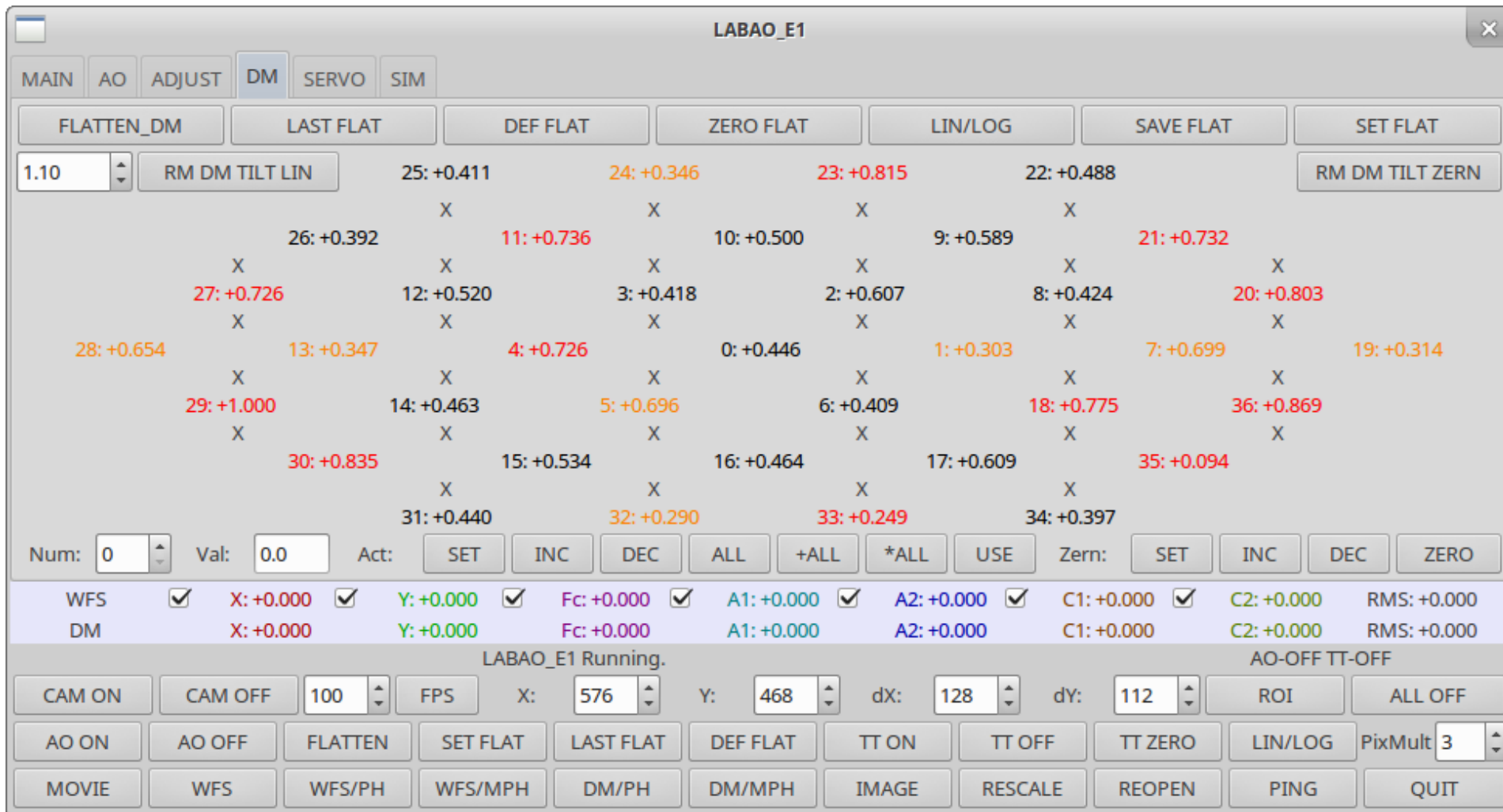
REGULAR range

50% - 90% range

>90% range

BLOCKED

DM visualization and control



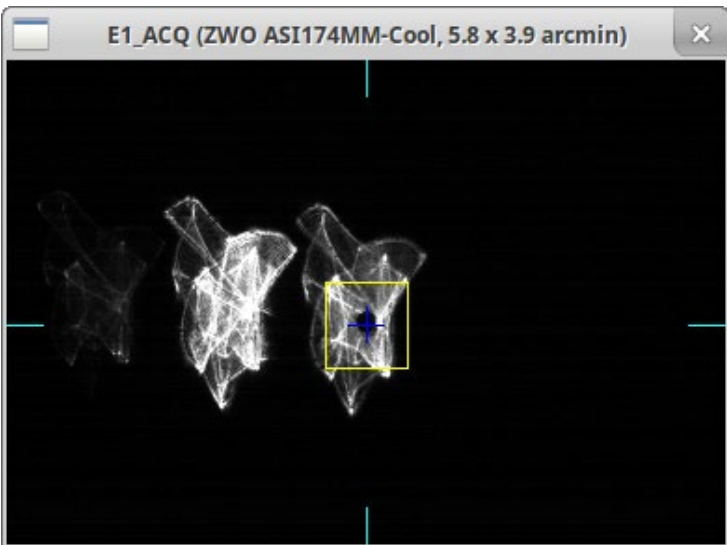
REGULAR range

50% - 90% range

>90% range

BLOCKED

DM flaring



MAIN

ANDORSETUP

AO

ADJUST

DM

SERVO

SIM

DM Current: 7.3950 A

DM Temp: 0.0000 C

Elect Temp: 31.0938 C

POWER OFF

POWER ON

REOPEN TT

FLATTEN DM

LAST FLAT

DEF FLAT

ZERO FLAT

31: -1.000

LIN/LOG

SAVE FLAT

SET FLAT

1.10

RM DM TILT LIN

40: -1.000

21: +1.000

RM DM TILT ZERN

59: +1.000	X	54: -1.000	X	48: +1.000	47: -1.000	X	39: +1.000	X	30: +0.806	20: +1.000	12: -1.000	4: +1.000
58: +1.000	X	53: +0.431	X	46: +1.000	X	X	38: -0.626	X	29: -1.000	X	19: -1.000	X
57: -1.000	X	52: +1.000	X	45: -0.620	X	X	37: +1.000	X	28: -0.306	X	18: +0.524	X
56: -1.000	X	51: +0.633	X	44: +0.063	X	X	36: +1.000	X	27: +1.000	X	17: -1.000	X
		50: -1.000	X	43: +1.000	X	X	35: -0.838	X	26: -1.000	X	16: -0.311	X
		49: -1.000		42: -1.000	X	X	34: +1.000	X	25: +1.000	X	15: +1.000	X
				41: -1.000			33: -1.000	X	24: -1.000	X	14: -0.109	6: +1.000
							32: +1.000		23: +1.000		13: -1.000	5: +1.000
									22: +0.607			

Num: 0

Val: 0.0

Act: SET INC DEC ALL +ALL *ALL USE

Zern: SET INC DEC ZERO

WFS ☒

X: +0.312

☒

Y: +0.173

☒

Fc: -0.182

☒

A1: -0.149

☒

A2: +0.339

☒

C1: -0.057

☒

C2: -0.090

RMS: +0.137

DM ☒

X: -0.062

☒

Y: +2.304

☒

Fc: +0.620

☒

A1: +0.330

☒

A2: +1.679

☒

C1: +1.033

☒

C2: +1.096

RMS: +0.446

DM Servo OFF

AO-OFF TT-OFF R0=5.33+6.06

CAM ON

CAM OFF

CL ON

CL OFF

COOL ON

ON/-50.0C

COOL OFF

ALL OFF

SAUTO

SOPEN

SCLOSE

MOVIE

WFS

WFS/PH

WFS/MPH

DM/PH

SHUTTER

IMAGER

TELESCOPE

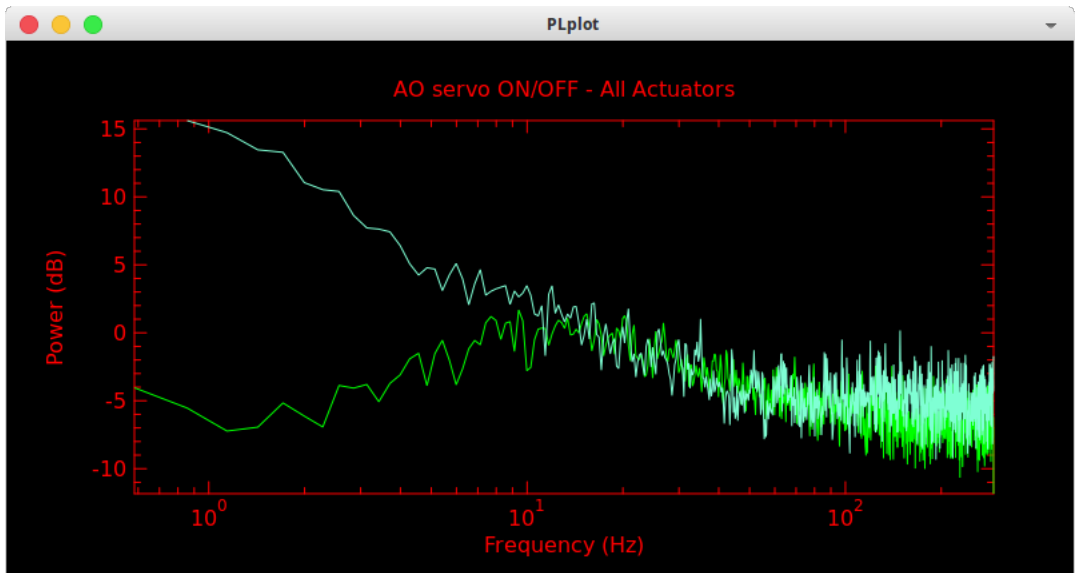
WINDSHIELD

WIND

WINDSTOPPER

CHARA AO GTK early stages of developments

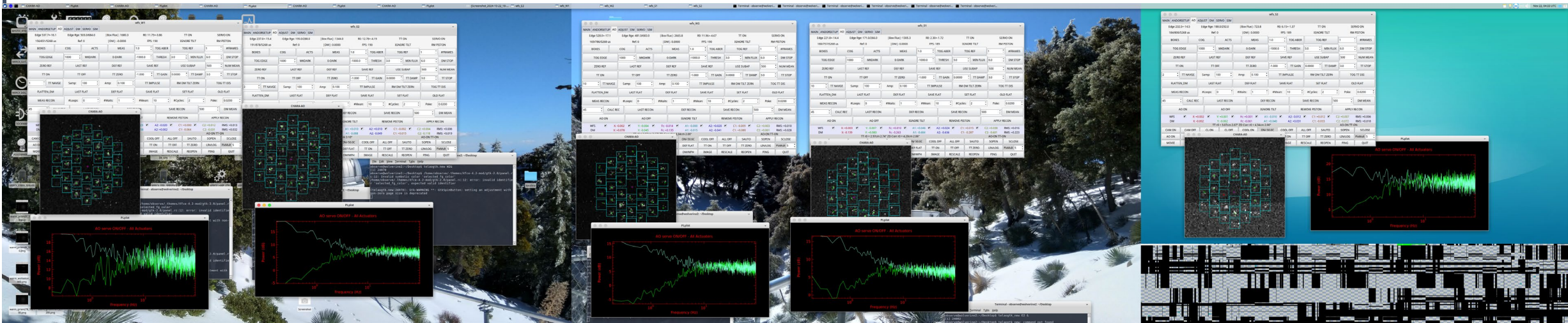
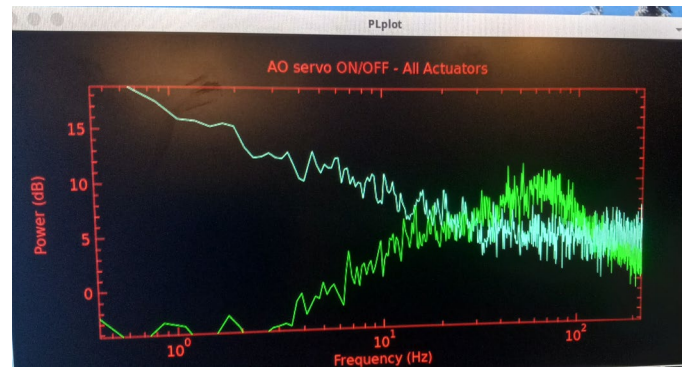
Optimizing TELAo performance - power spectrum



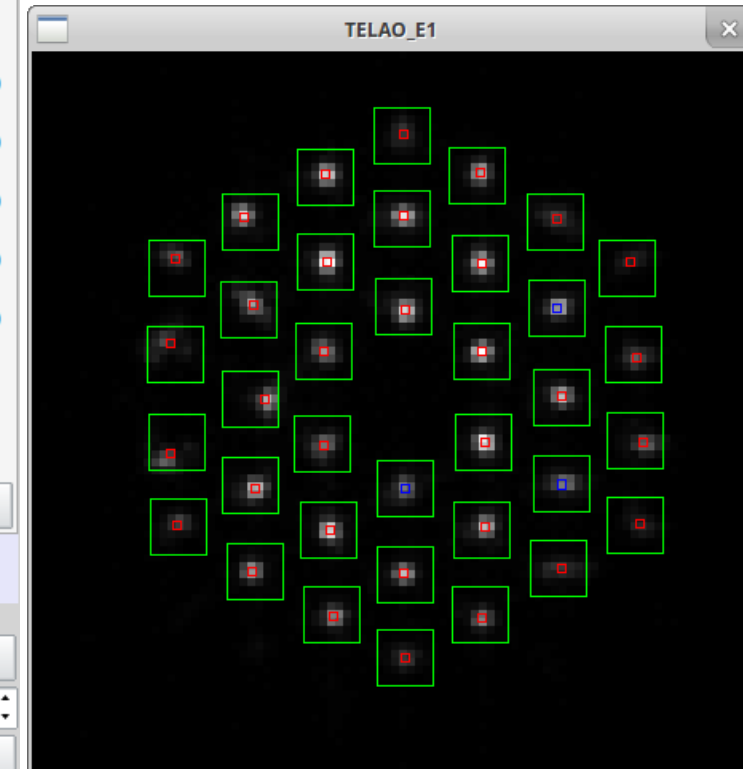
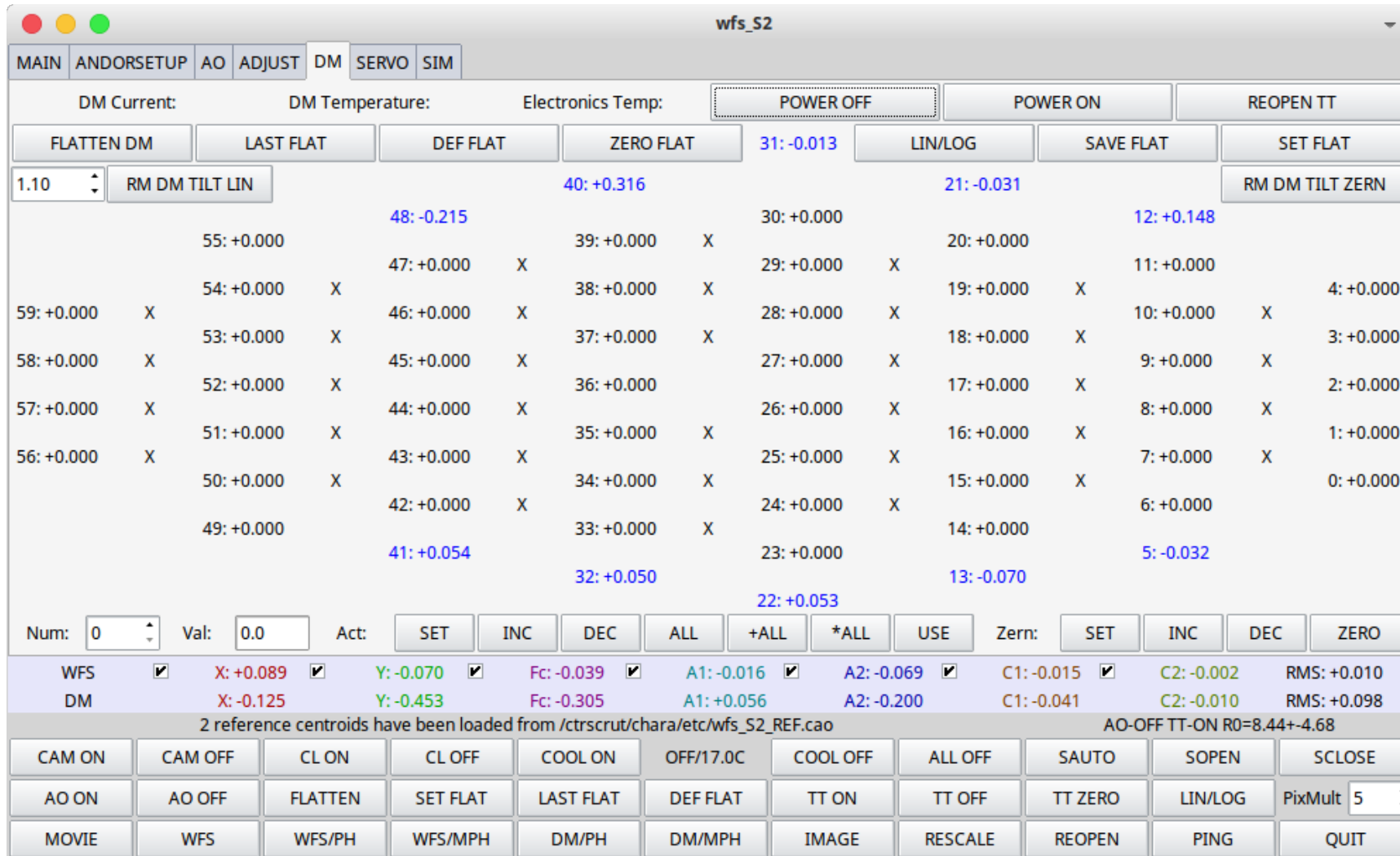
SERVO OFF - no DM loop, just TT

SERVO ON - both TT and DM

Gain and dumping



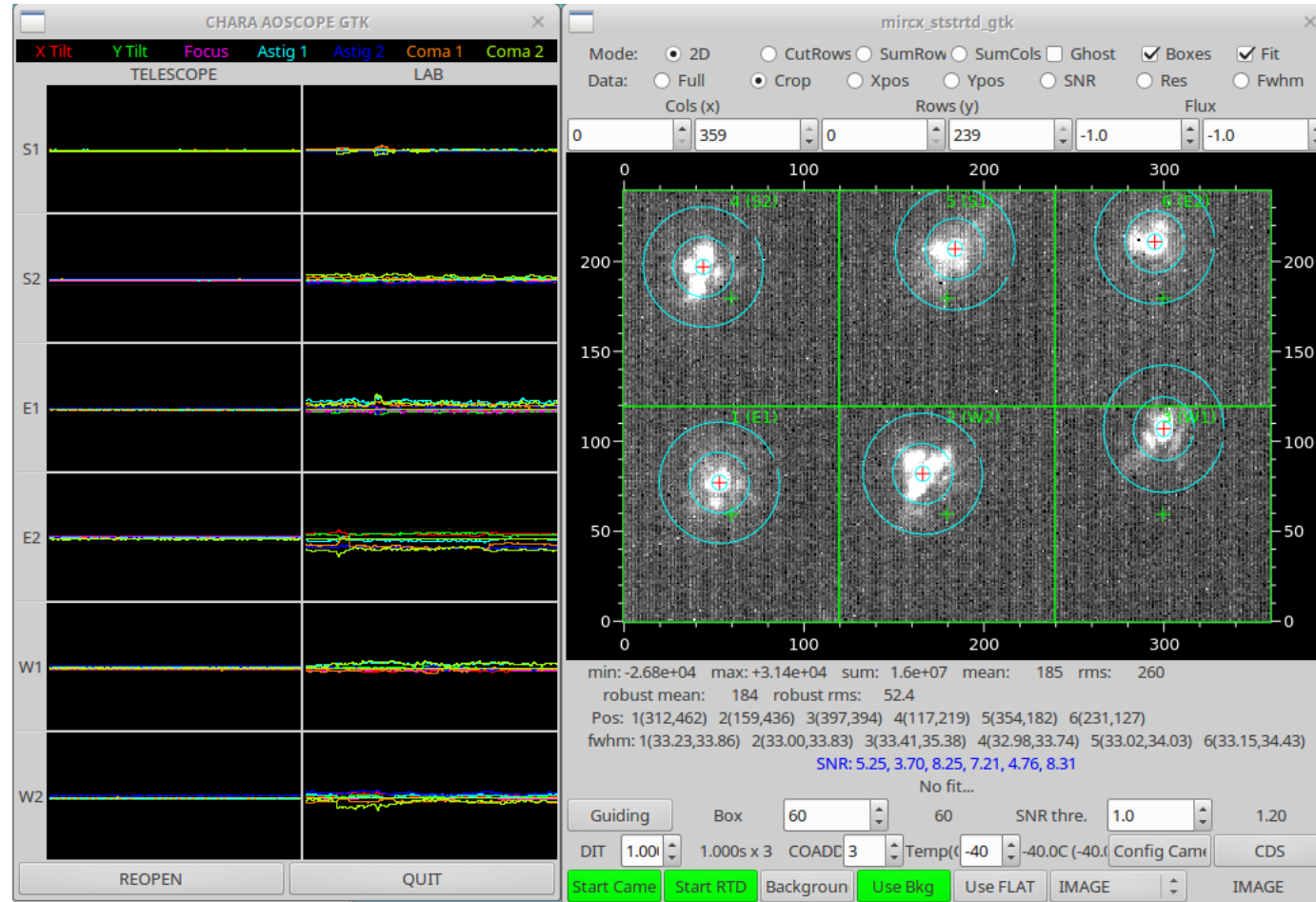
Tuning AO on-sky doing science time



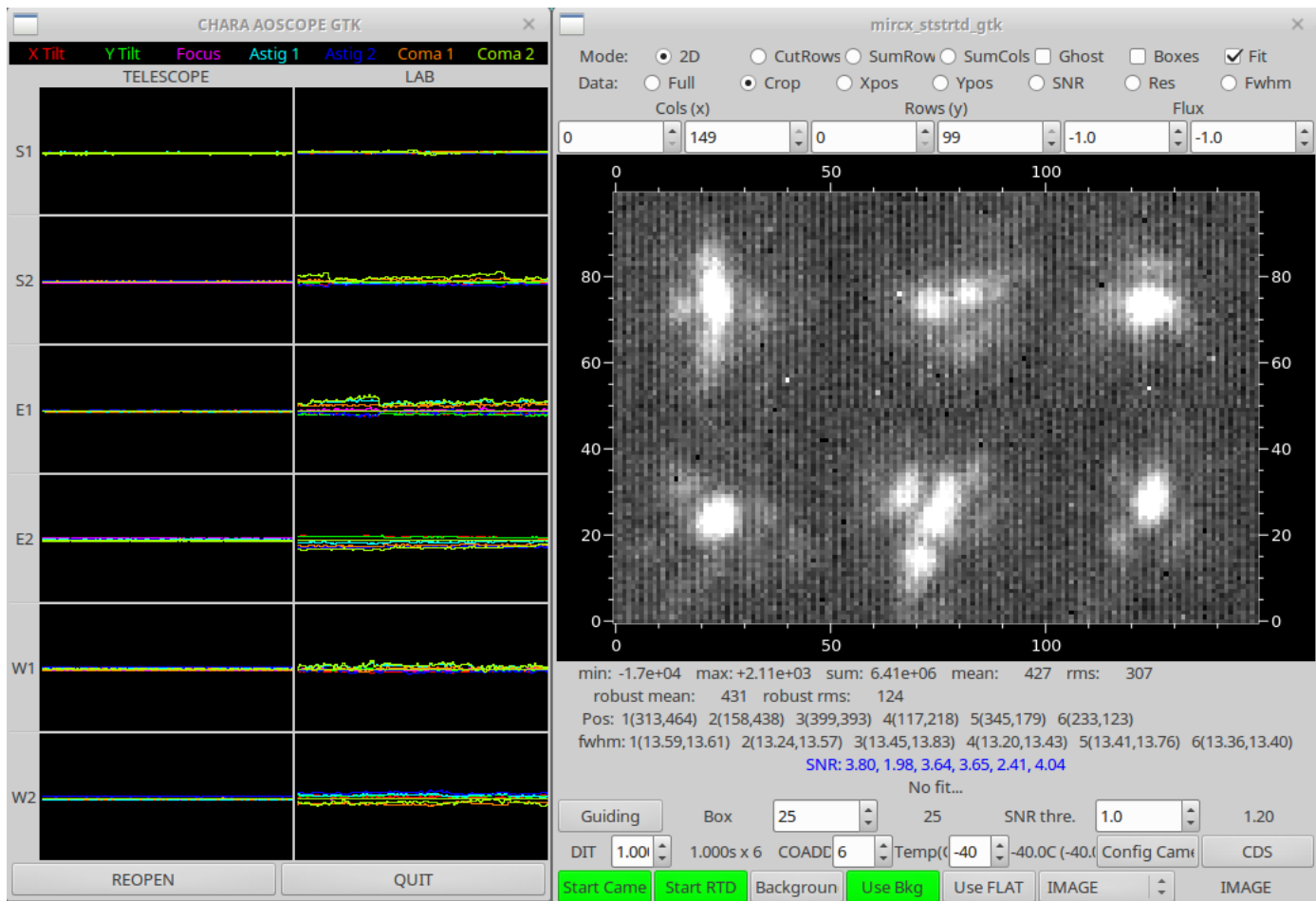
Some of next steps

- 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

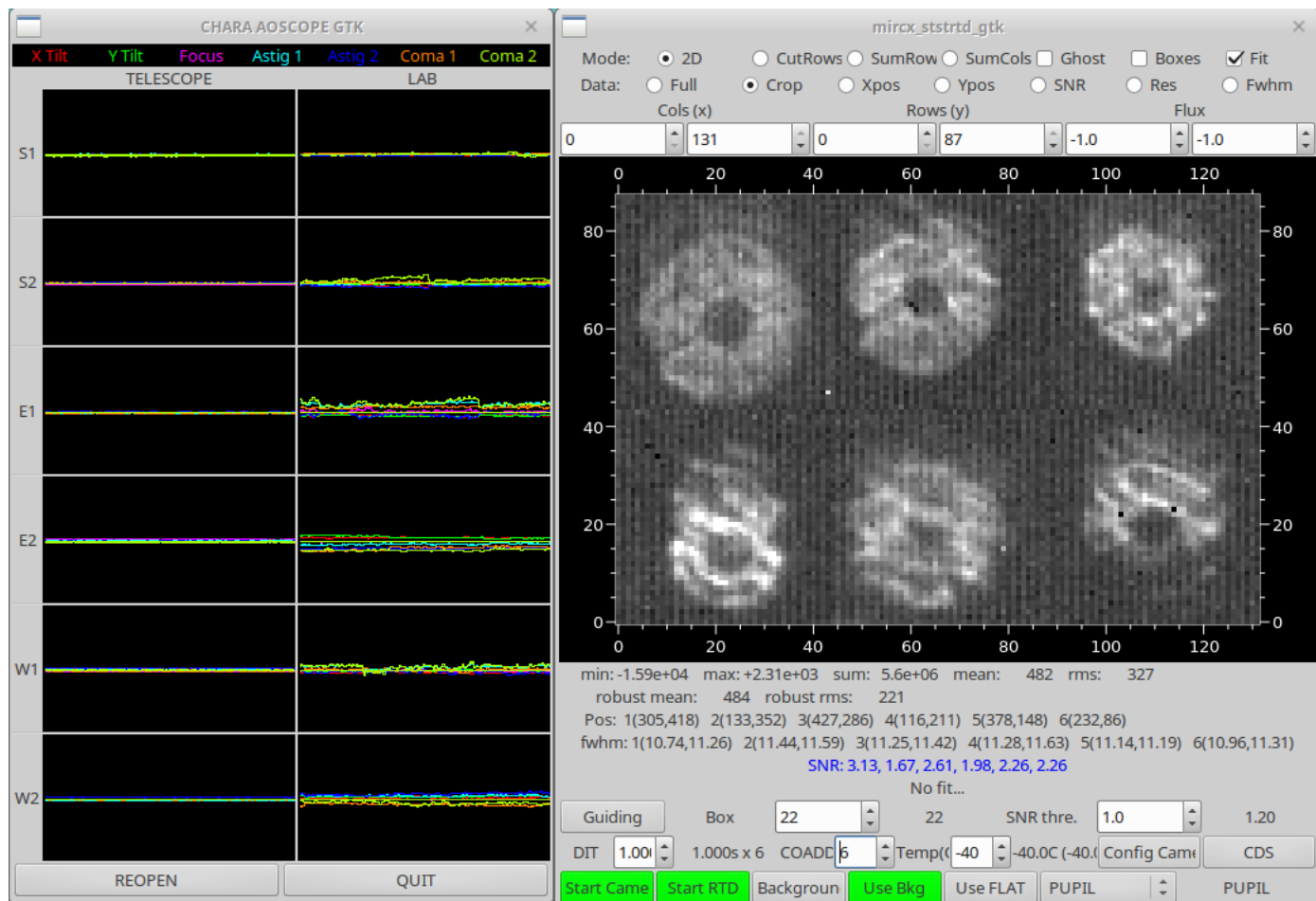
AO performance - STST & AOMON



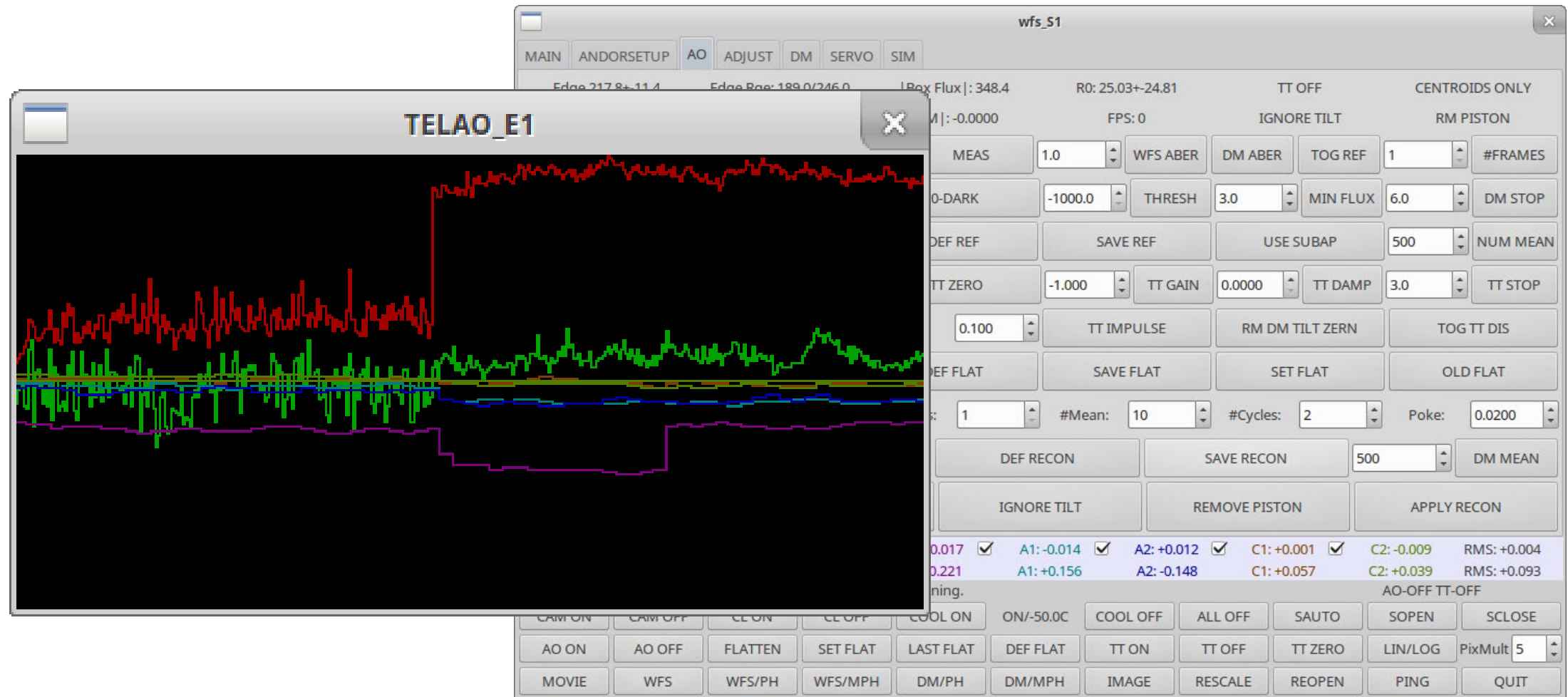
AO performance - STST



AO performance - STST



AO performance - aberration plot



lurkgtk

