

# Pick-off Arm Module

CAB contribution to HARMONI-ELT LOWFS

Alberto Estrada, System Engineer



CENTRO DE ASTROBIOLOGÍA  
ASOCIADO AL NASA ASTROBIOLOGY INSTITUTE



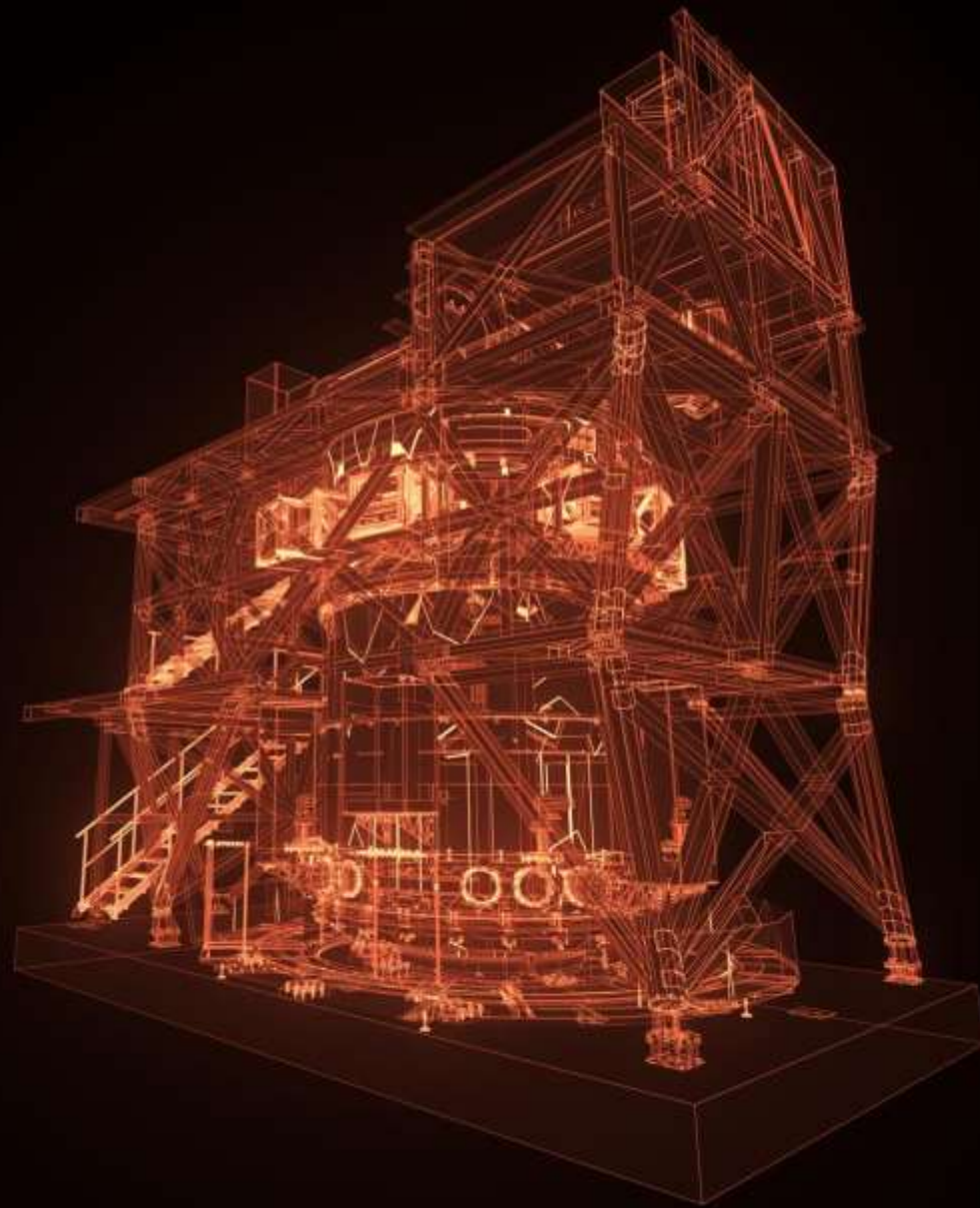
EXCELENCIA  
MARIA DE MAEZTU



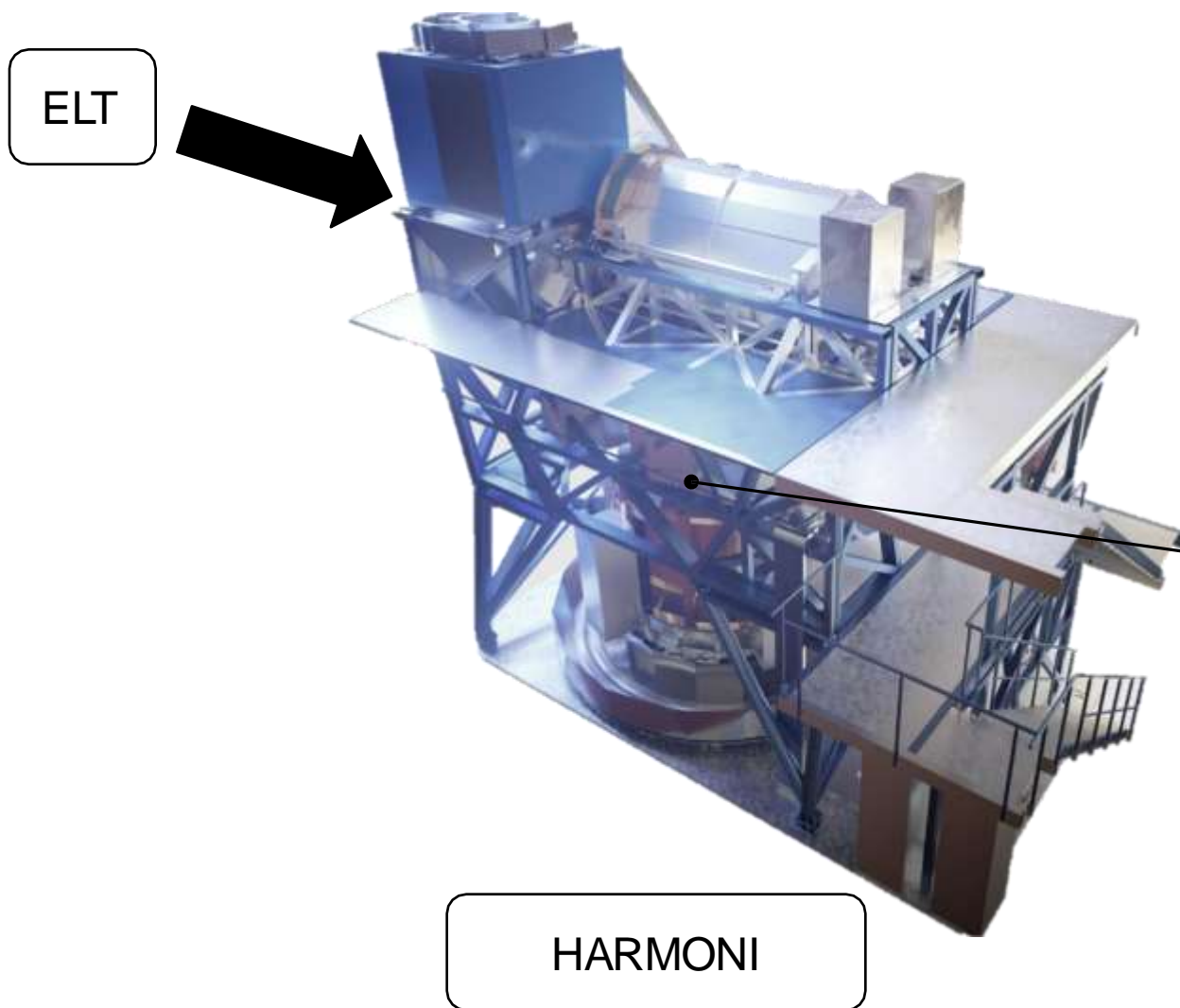
# Summary

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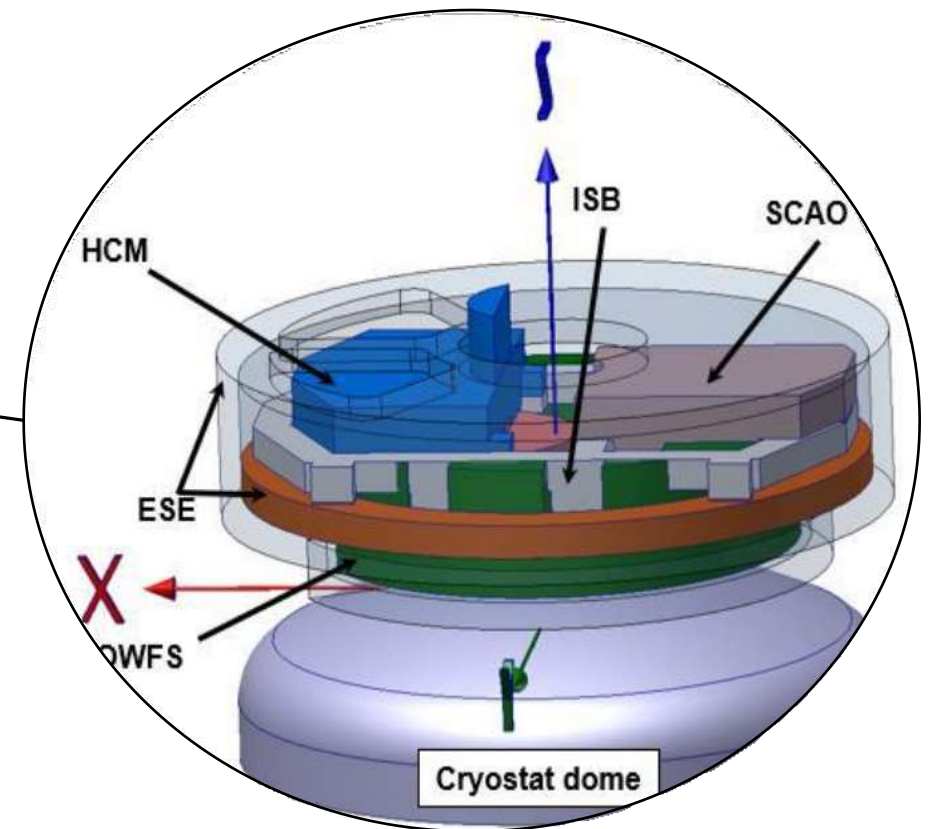
- 1 Introduction
- 2 Requirements
- 3 LOW FS Architecture
- 4 Flow-down
- 5 Technology Development
- 6 Integration & Tests



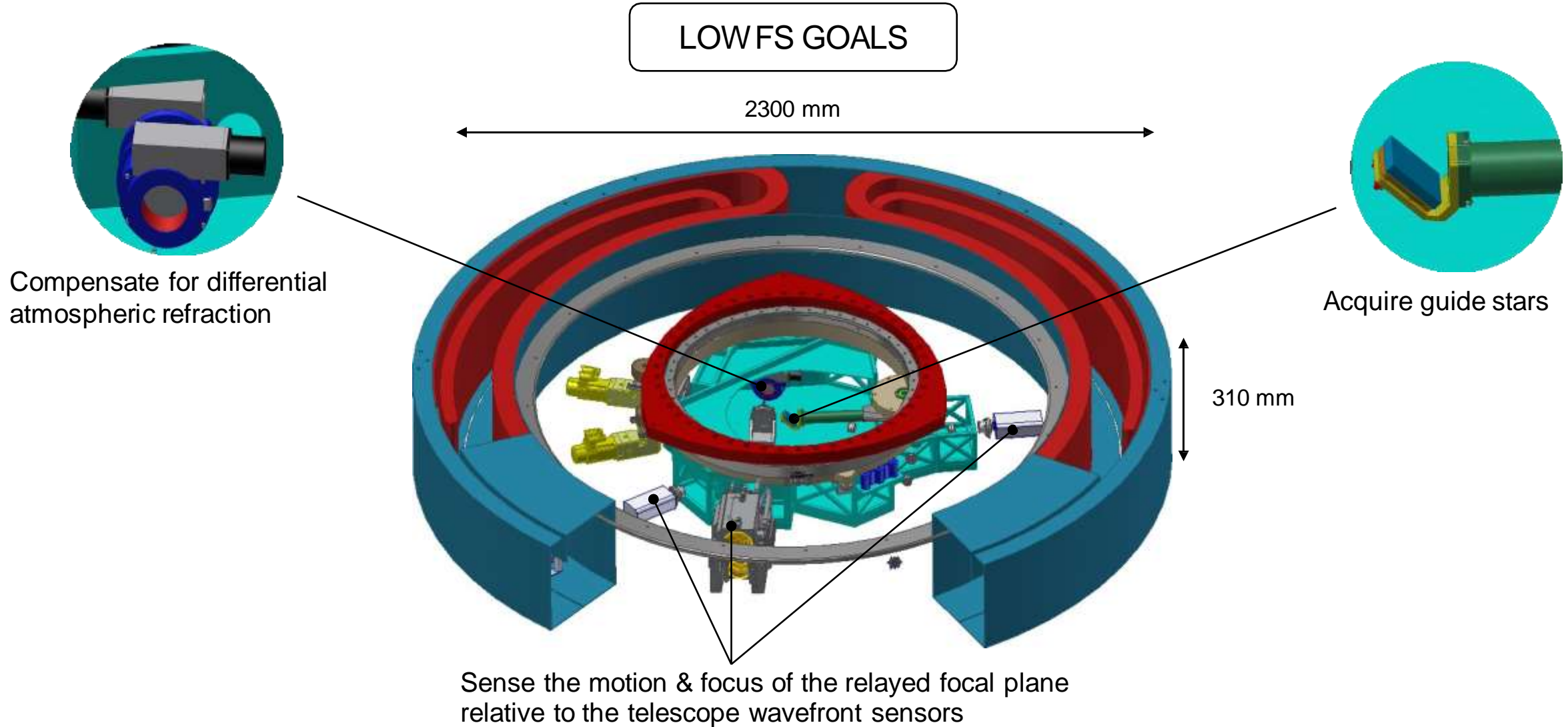
# 1. INTRODUCTION



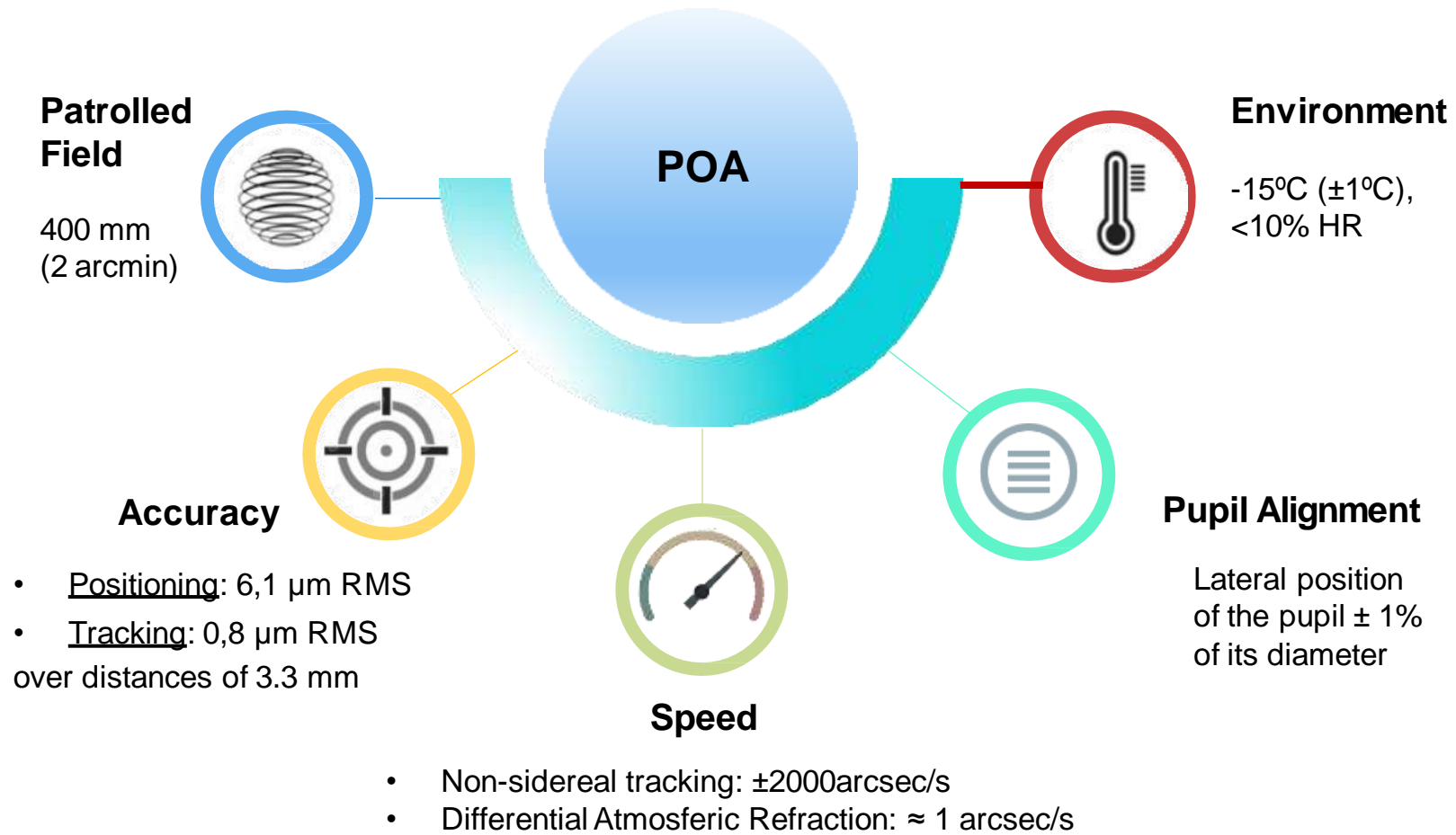
Natural Guide Star  
Sensor System



# 1. INTRODUCTION

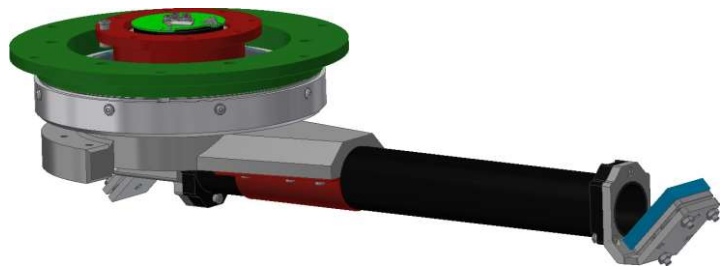


# 2. REQUIREMENTS

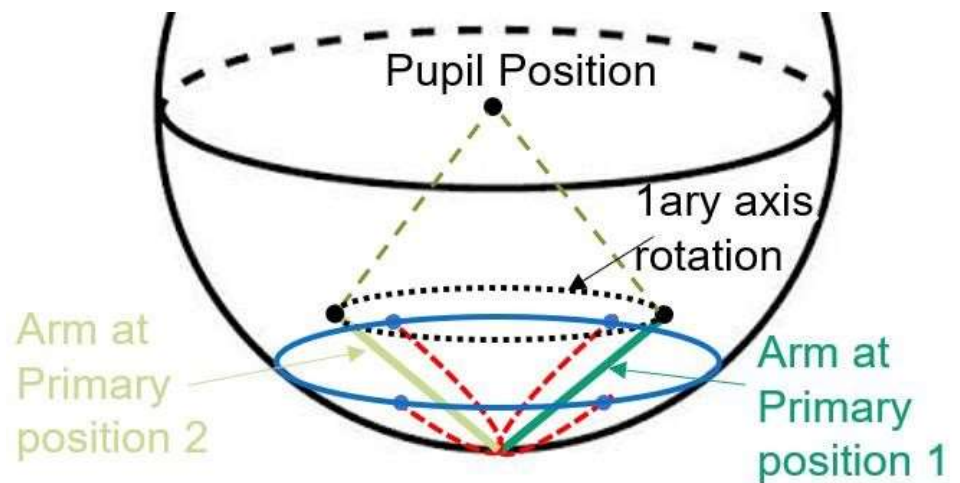
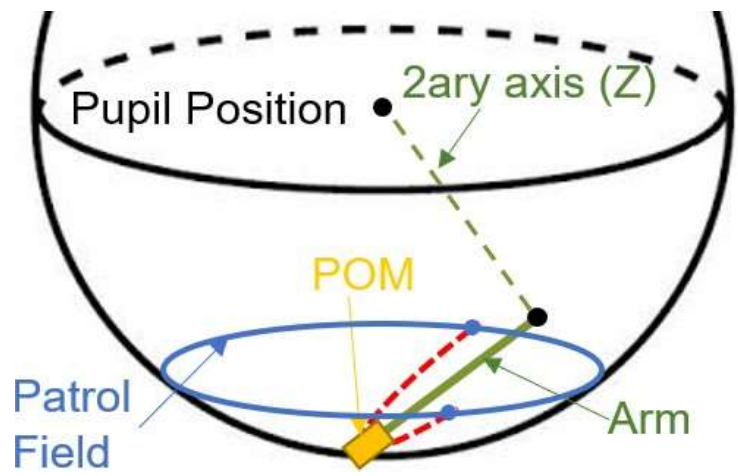
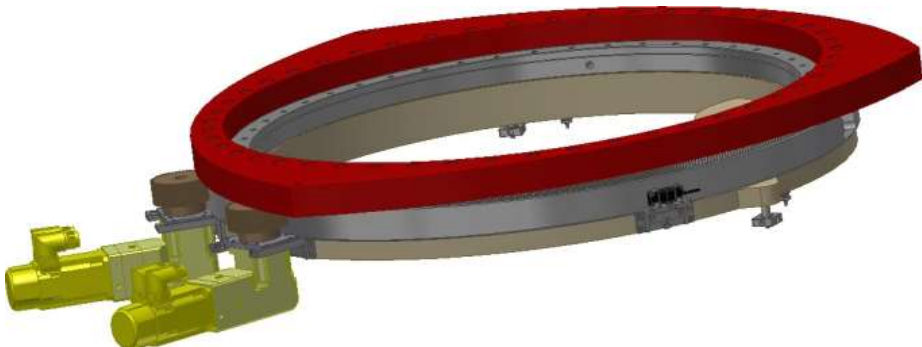


# 3. LOWFS ARCHITECTURE

Secondary Axis

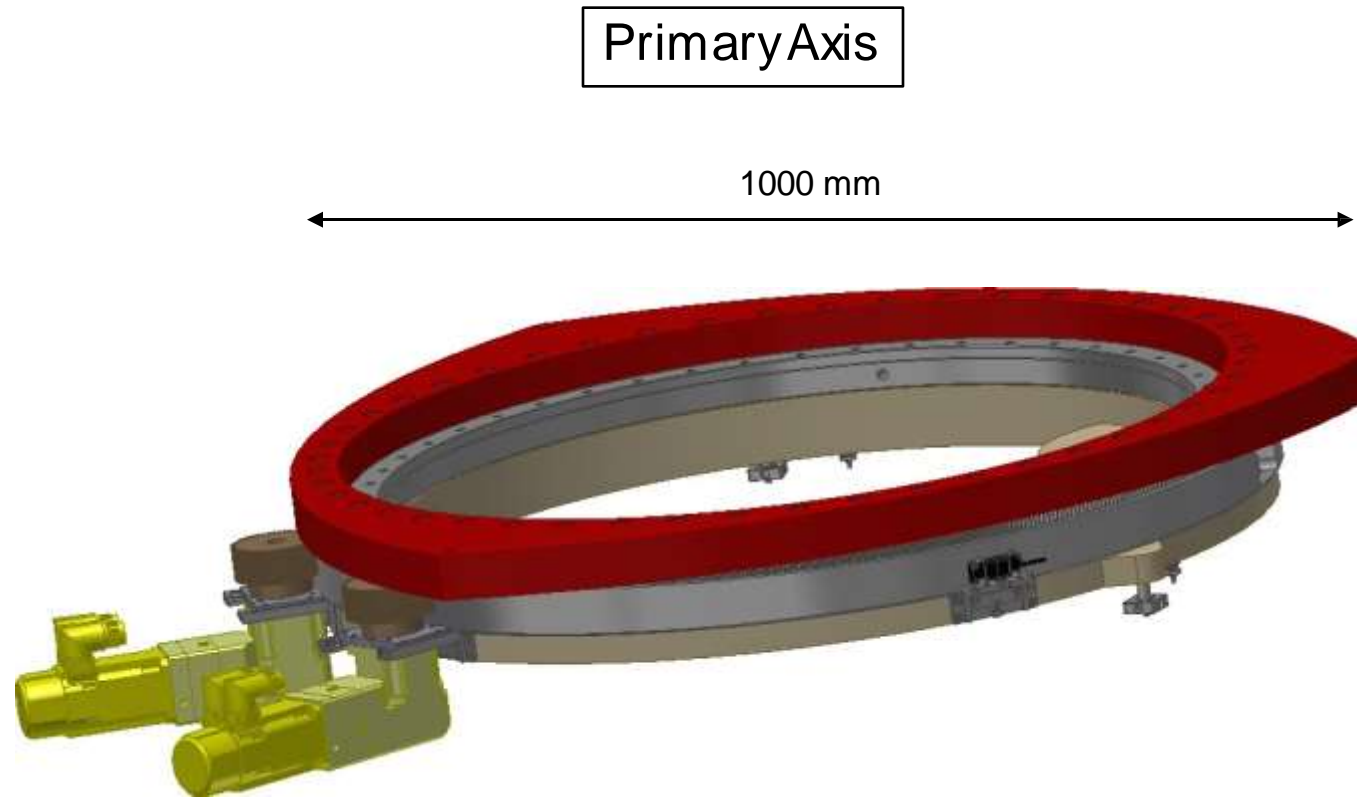


Primary Axis



# 3. LOWFS ARCHITECTURE

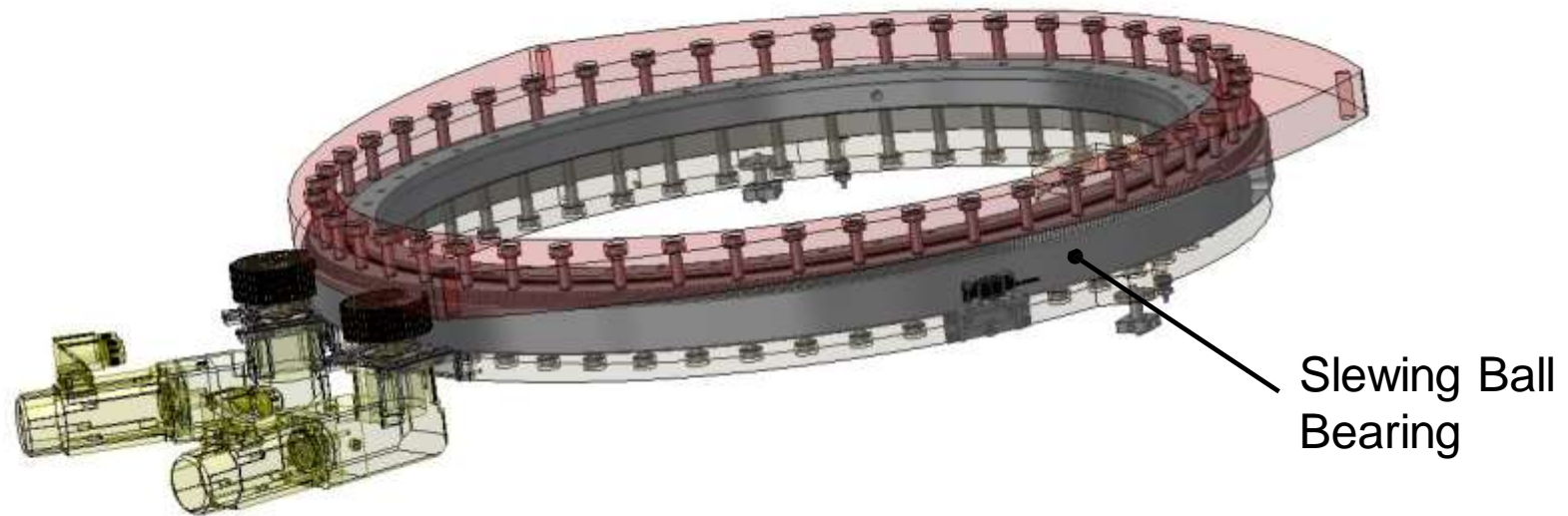
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# 3. LOWFS ARCHITECTURE

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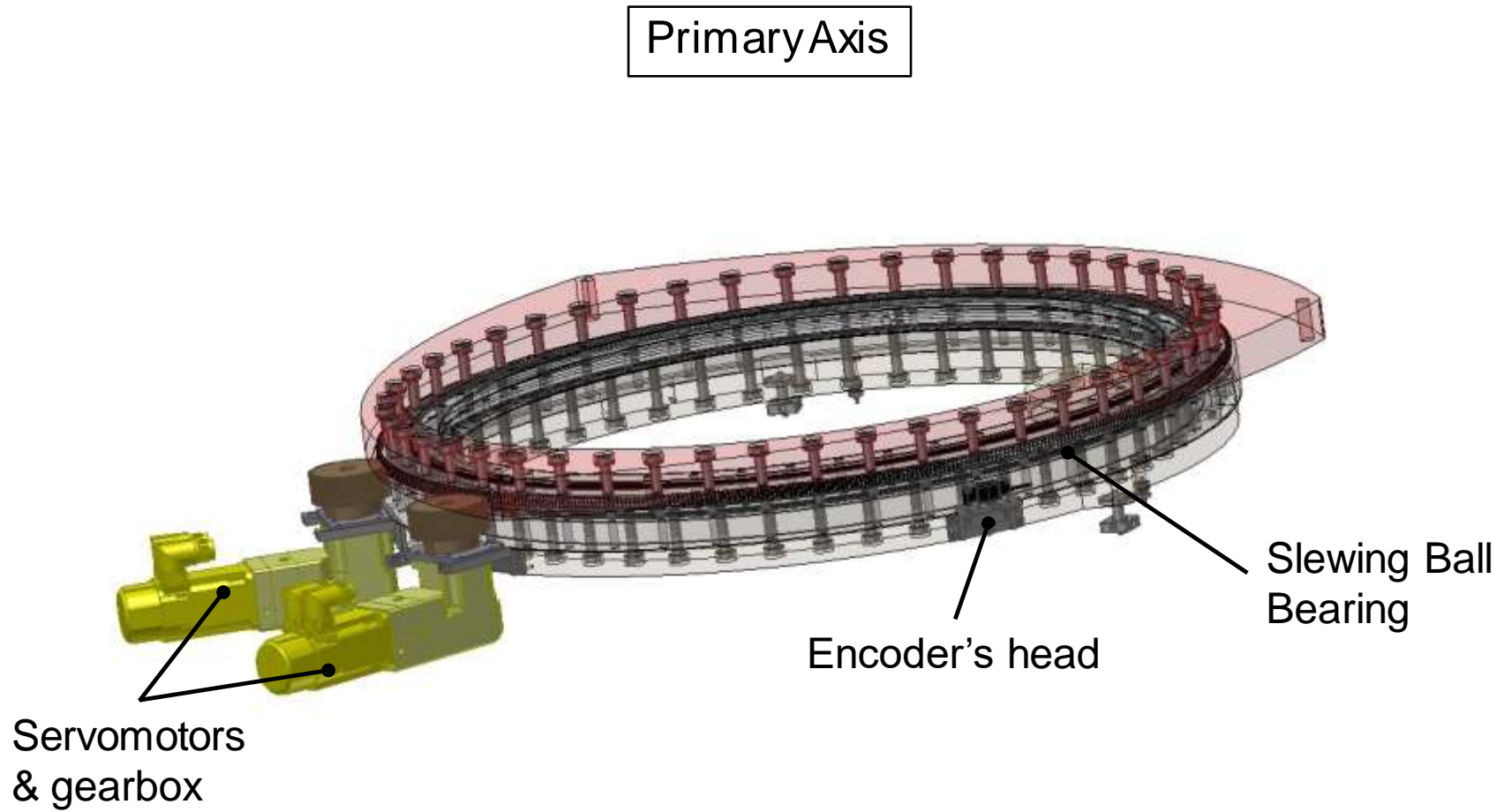
Primary Axis





# 3. LOWFS ARCHITECTURE

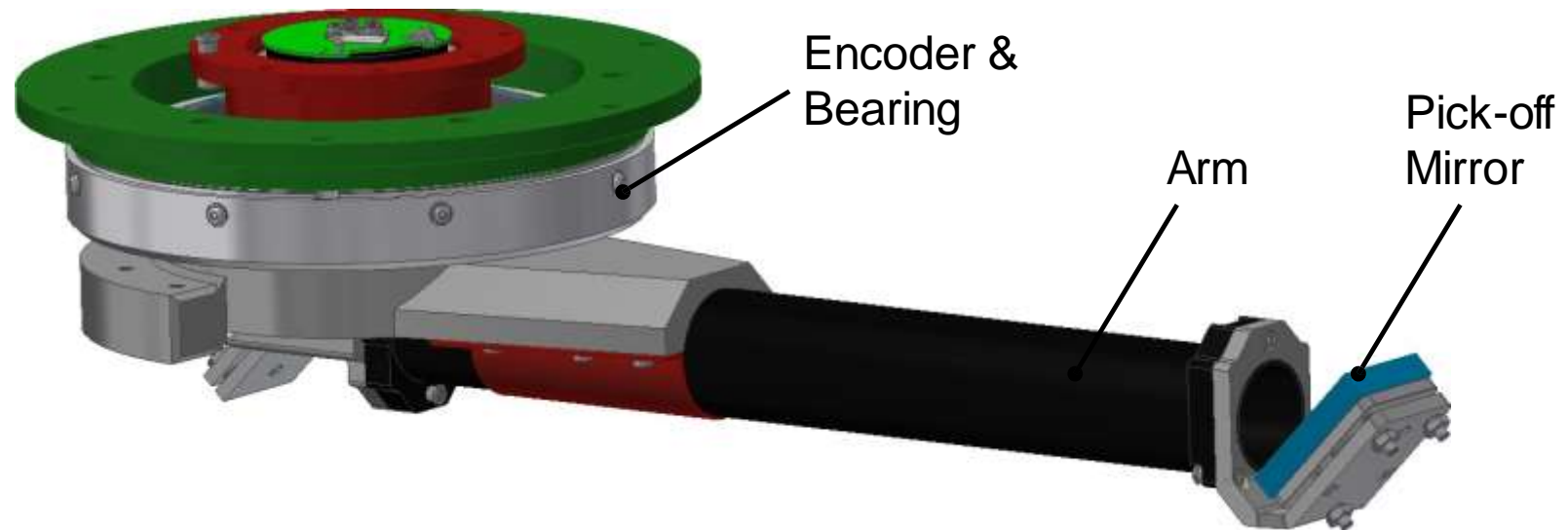
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# 3. LOWFS ARCHITECTURE

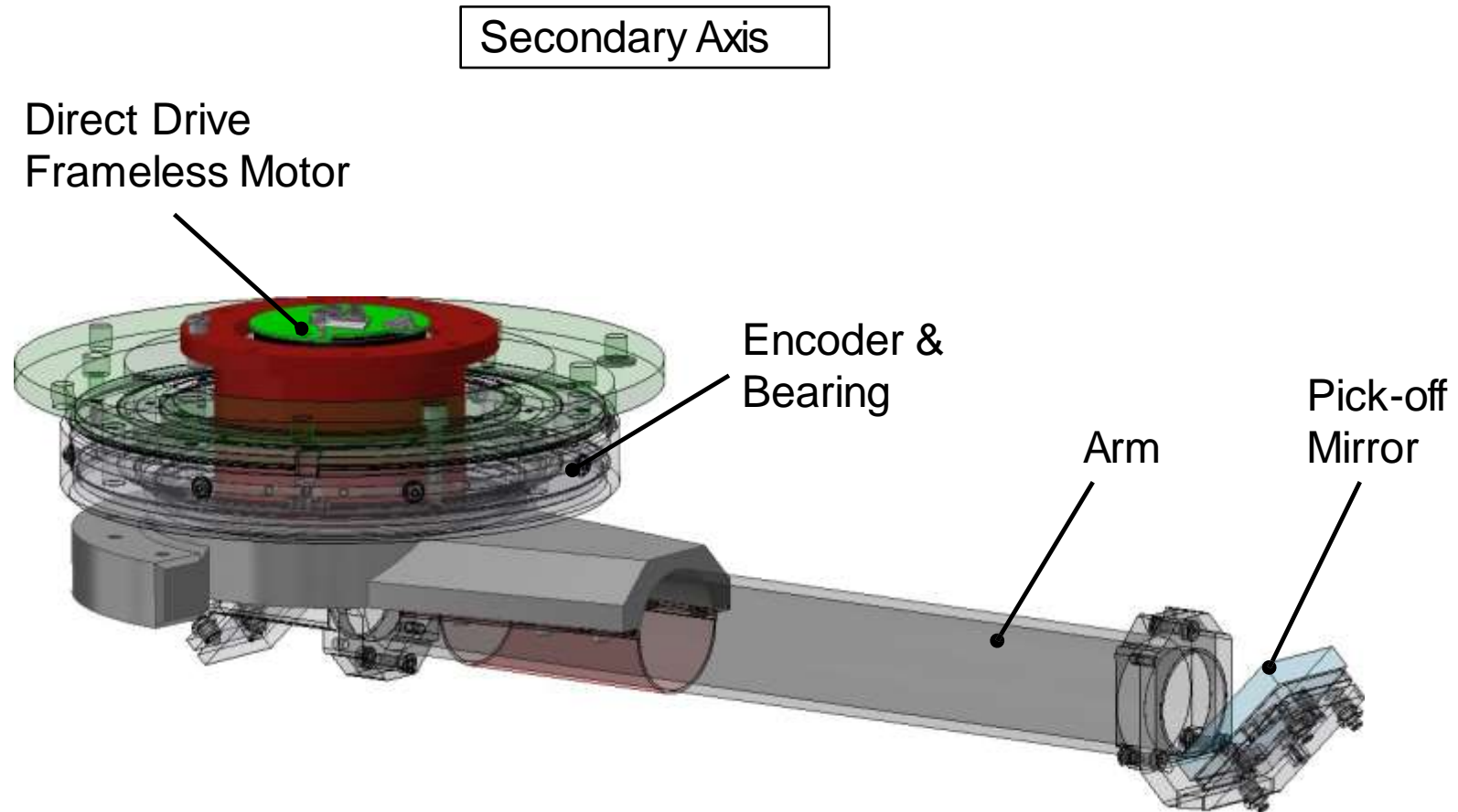
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Secondary Axis



# 3. LOWFS ARCHITECTURE

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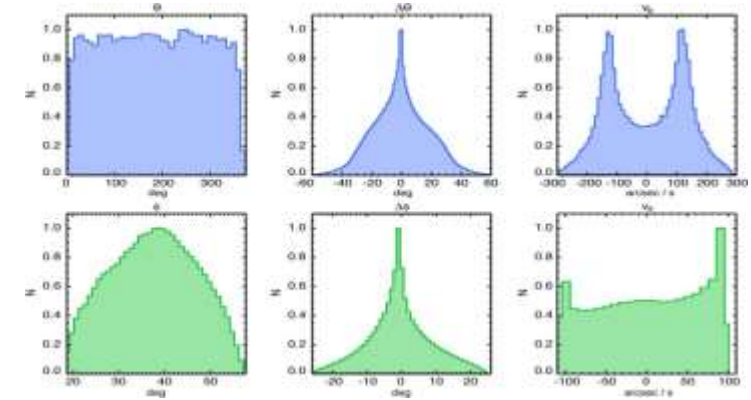


# 4. FLOW-DOWN

## Subsystem Budgets

- Tracking speed: Kinematic model

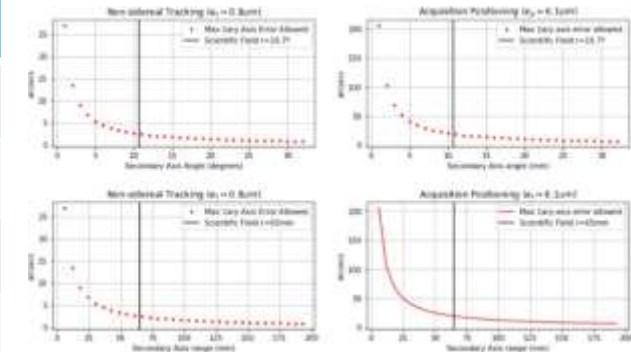
Parameter	Primary Axis	Secondary Axis
Range	0-360°	±35°
Angular speed (non-sidereal)	±300 as/s	±100 as/s
Angular speed (sidereal)	< 1 as/s	< 1 as/s



- Accuracy: Monte Carlo simulations and geometrical analysis

Contributor	Accuracy
Primary Rotation in Z	1.6 as
Secondary Rotation in Z	0.5 as
Primary Wobble	5 as
Secondary Wobble	0.5 as

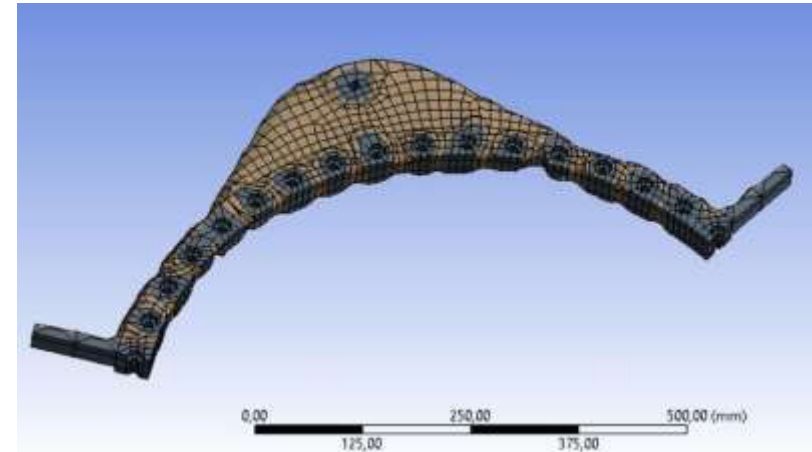
Contributor	Pupil Alignment
Primary Wobble	5 as
POM tip-tilt resolution	26 as
Structural deformations	21.5 as
Secondary Axis Tilt adjustment	32 as



# 5. TECHNOLOGY DEVELOPMENT

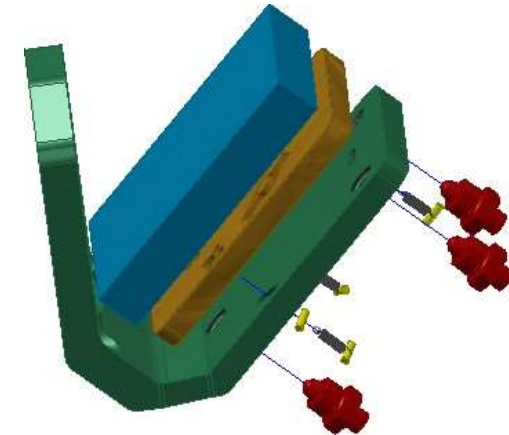
Primary Axis

- FEA Topological Optimization
- FEA Structural & Modal
- Encoder's head analysis



Arm

- Custom Mount
- FEA Thermal Transient



# 5. TECHNOLOGY DEVELOPMENT

## Secondary Axis: Technology Trade-off



**Piezo Stages COTS**

✗ Carried load



**Air Bearing Stages COTS**

✗ Air supply

✗ Height



**Mechanical Bearing Stages COTS**

✗ Height

✗ Operating temperature



**Slewing Bearing (custom)**

✗ Height, mass, oversized

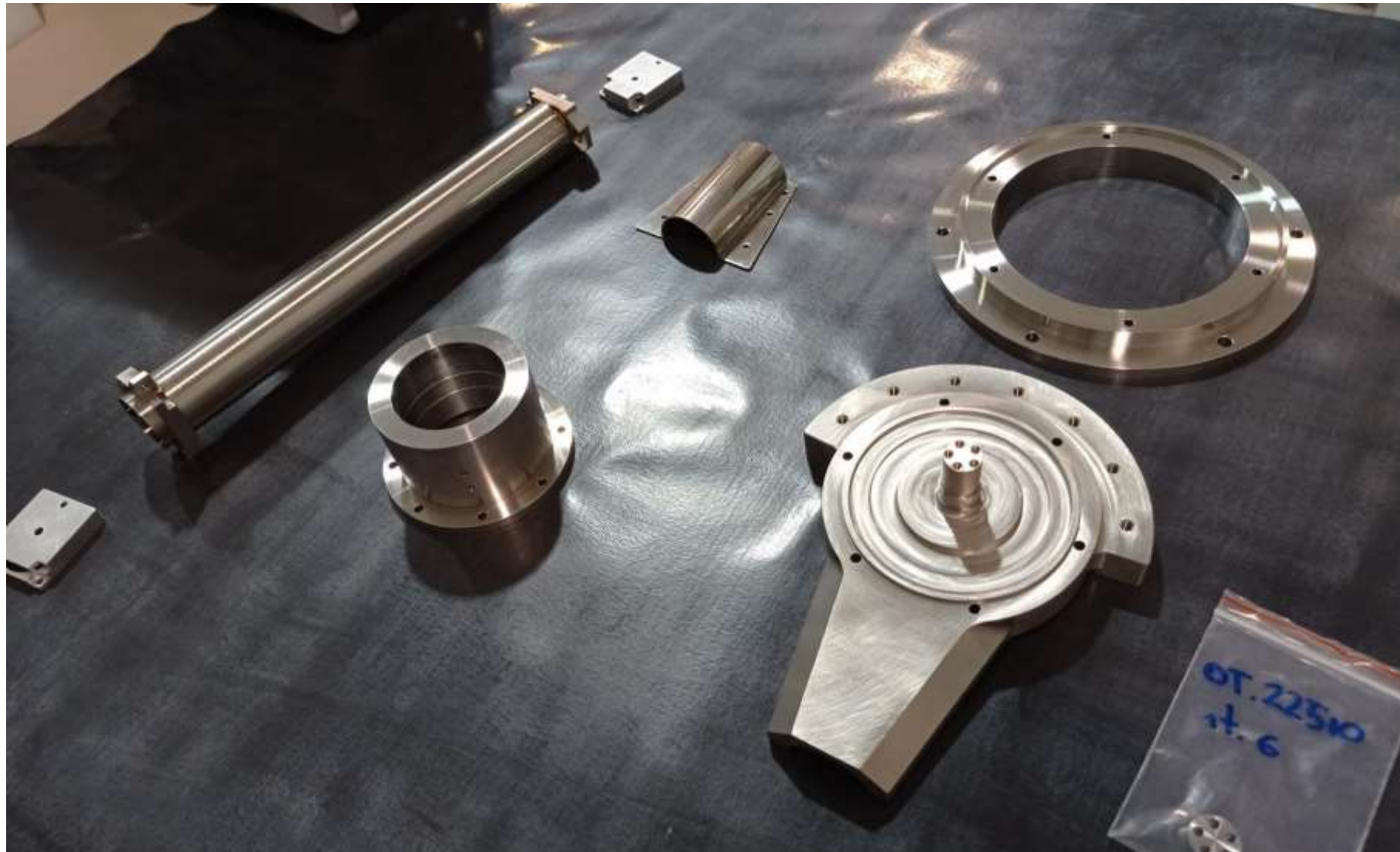
✗ Accuracy



**Direct Drive & Encoder + integrated bearing (custom)**

✗ Operating Temperature

# 6. INTEGRATION & TESTS

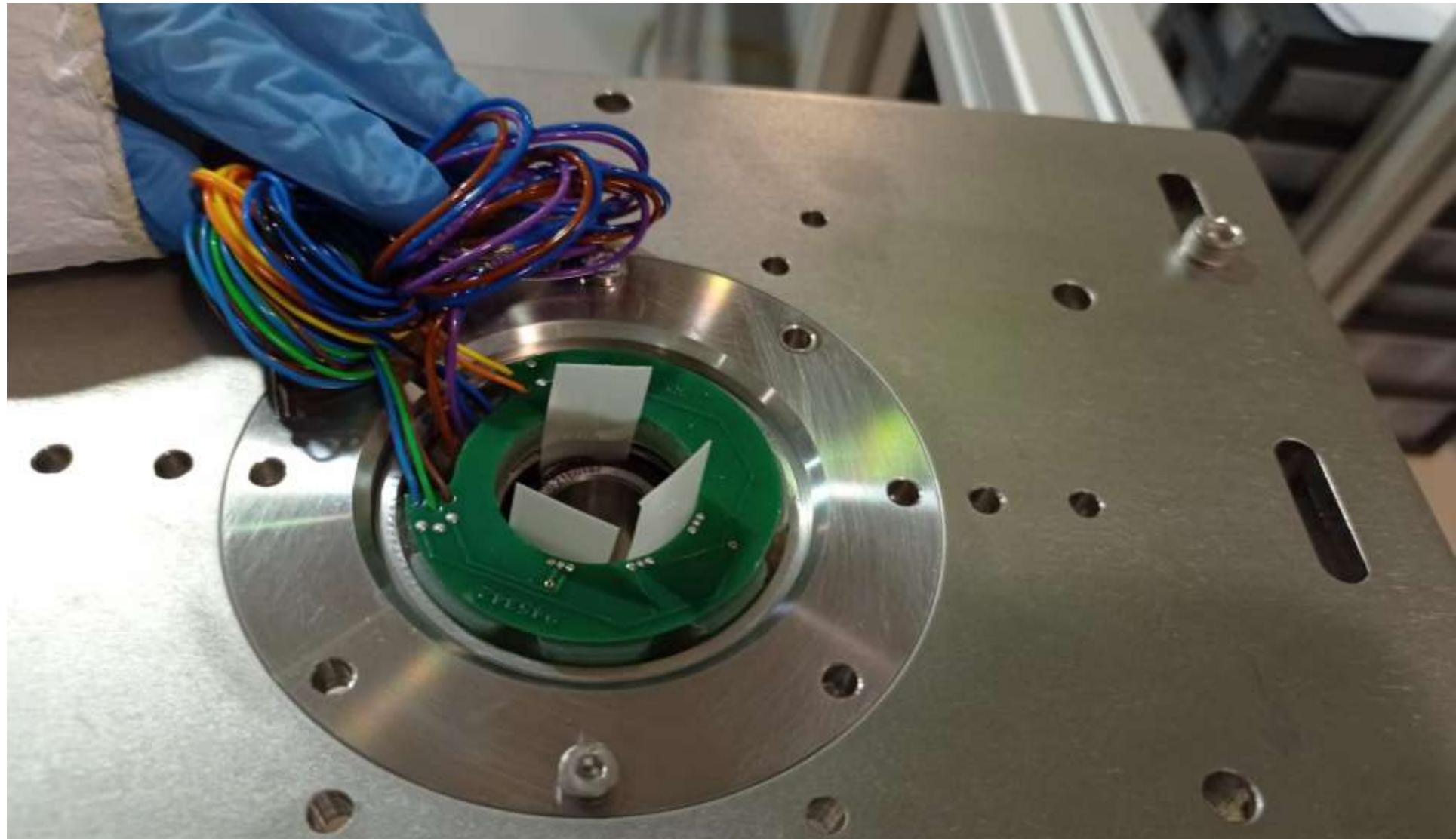


# 6. INTEGRATION & TESTS

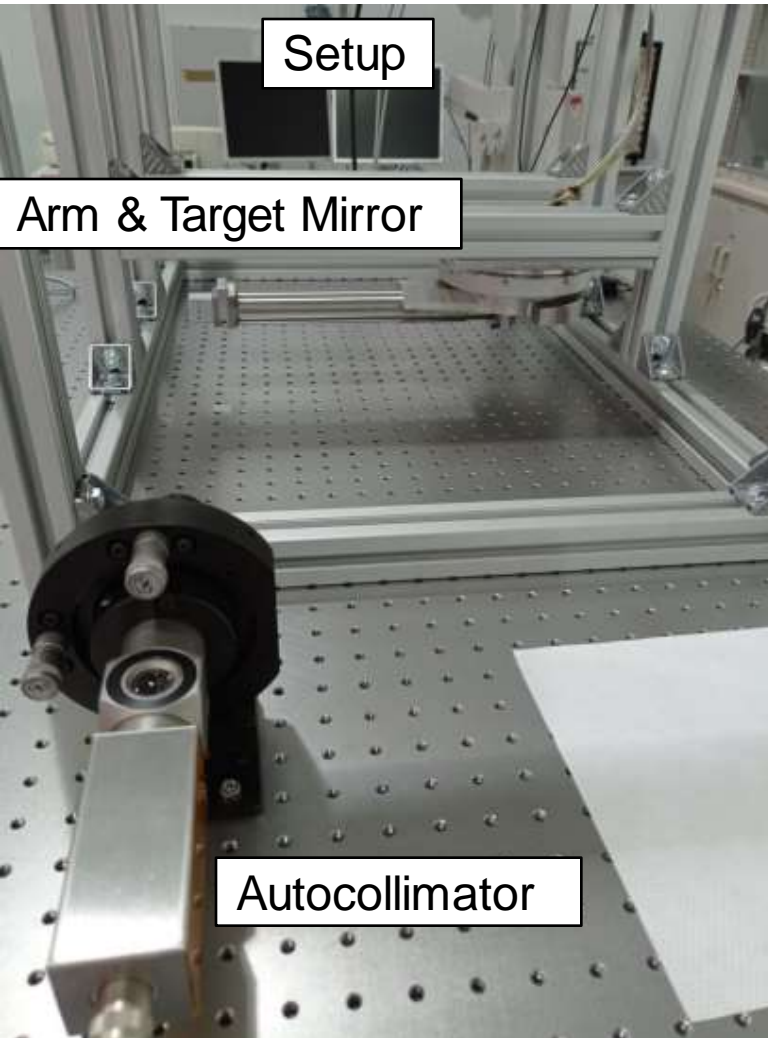




# 6. INTEGRATION & TESTS

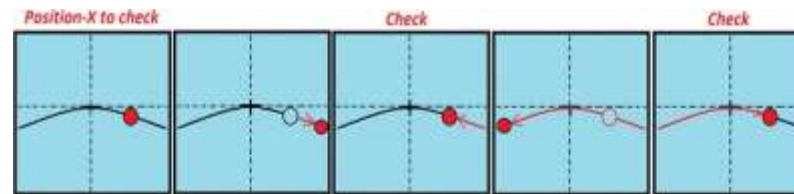


# 6. INTEGRATION & TESTS

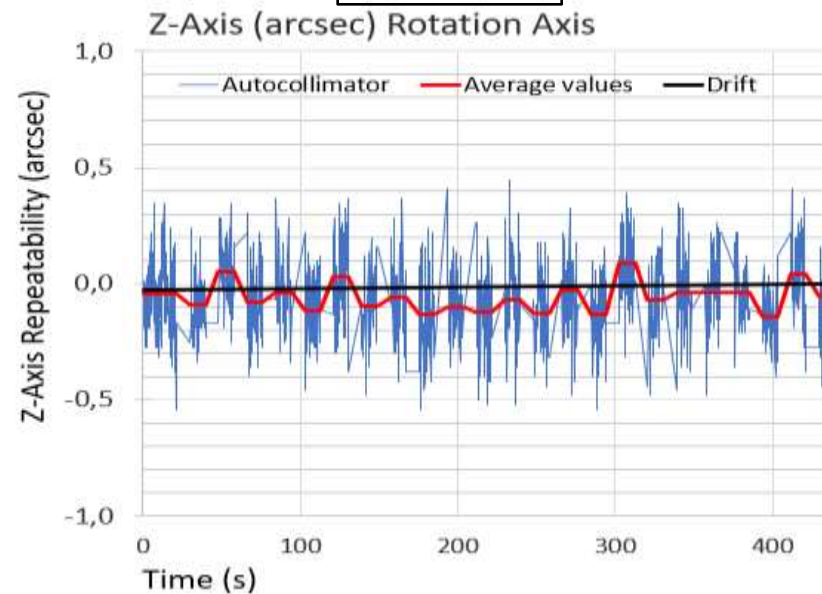


## Repeatability Test

### Method



### Results

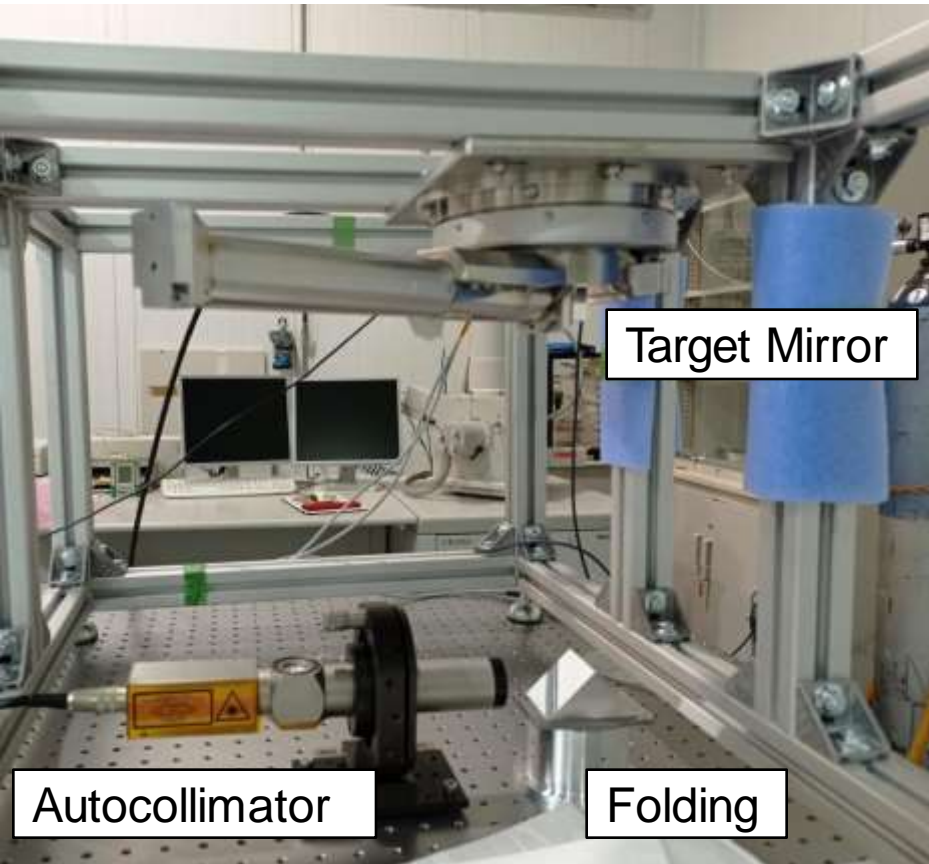


### Conclusions

	Acceptance Criteria	Result
Bidirectional Repeatability	$\pm 0.5$ as	$\pm 0.36$ as
Noise		$\pm 0.25$ as

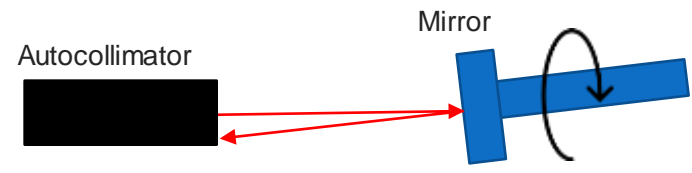
# 6. INTEGRATION & TESTS

Setup



## Wobble Test

### Method

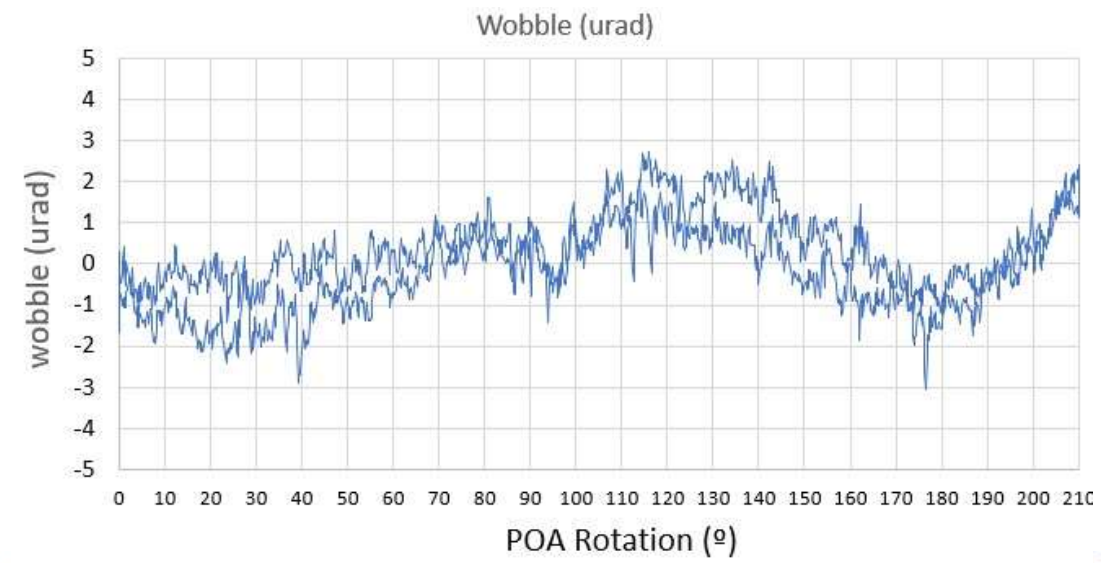


### Conclusions

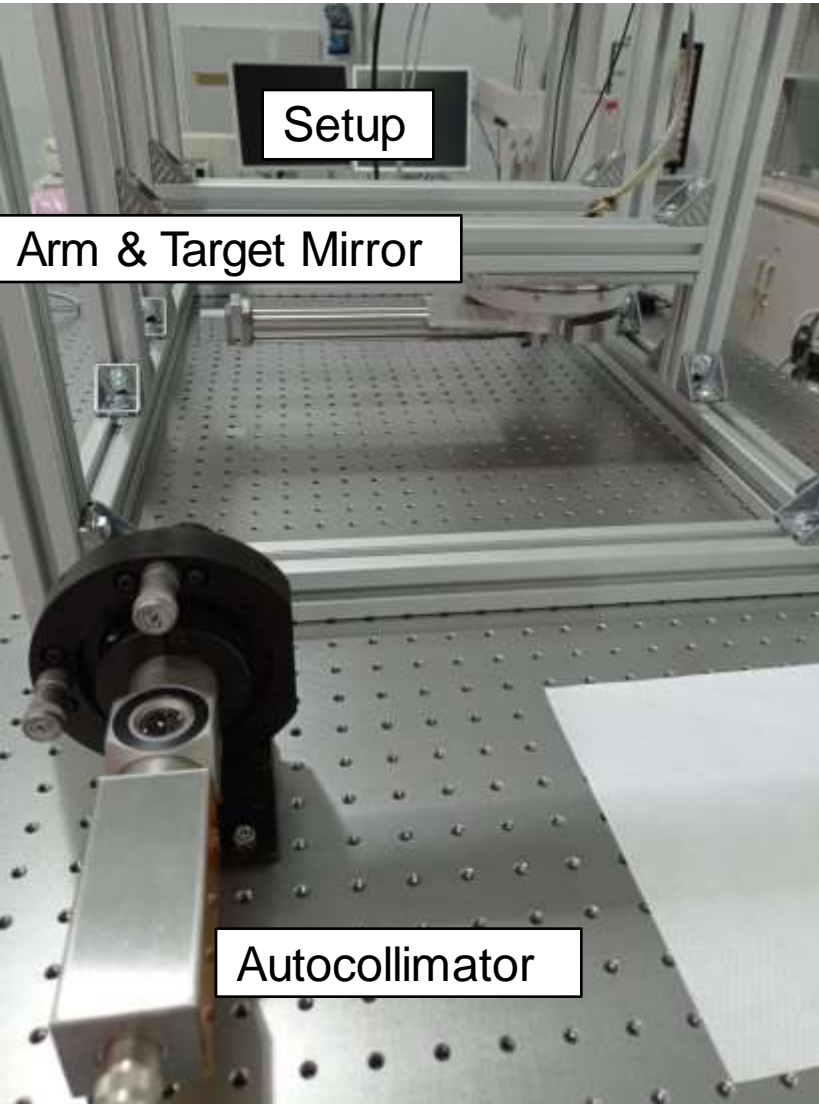
Acceptance Criteria      Result

Wobble	$\pm 0.5$ as	$\pm 0.45$ as
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### Results

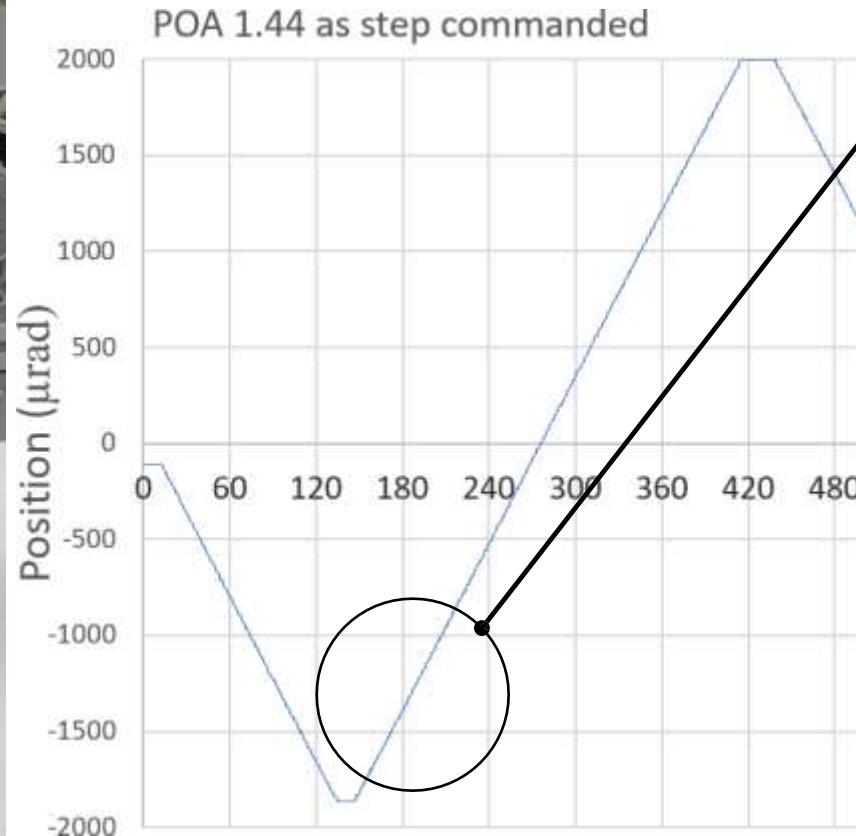


# 6. INTEGRATION & TESTS



Step by step Test

Results



Conclusions

Acceptance Criteria

Result

Step Resolution

±1.6 as

±1.45 as

“Don't just accept the world you inherit today  
No big challenge has ever been solved, unless  
people dare to think different.”

Tim Cook

