

PT410 Cold Head dynamic characterization

Modal and microvibration tests

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SPACE PAYLOADS DEPARTMENT &
MATERIALS AND STRUCTURES DEPARTMENT

I. WHAT IS INTA?

II. BACKGROUND

III. OBJECTIVES

IV. MODAL TEST

V. TEST BENCH MODAL TEST

VI. MICROVIBRATION TEST

VII. RESULTS

VIII. CONCLUSIONS & QUESTIONS

I. WHAT IS INTA?



II. BACKGROUND

Old background



Present project



2K GROUND-BASED CRYOSTAT



3 cryocoolers + Joule Thomson cooler



CHARACTERIZATION OF THE COLD HEAD

MICROVIBRATIONS

CHARACTERIZATION OF THE COLD HEAD

Non-operational

COLD HEAD
MODAL TEST

TEST BENCH
MODAL TEST

- Natural frequencies
- Bending moments
- Damping effect



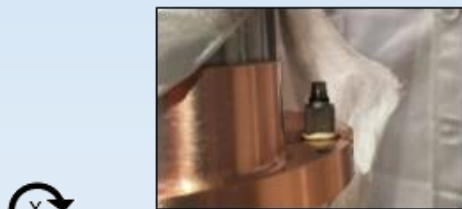
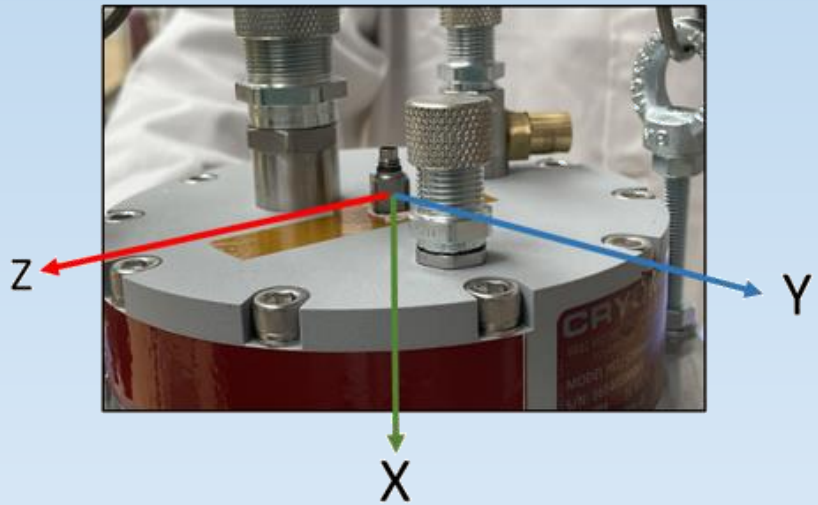
In operation

MICROVIBRATION
TEST

- Microvibration response
- Forces and moments

IV. MODAL TEST

SET-UP

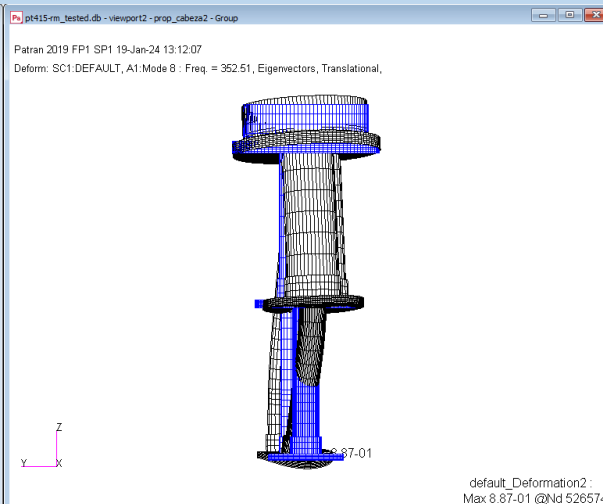
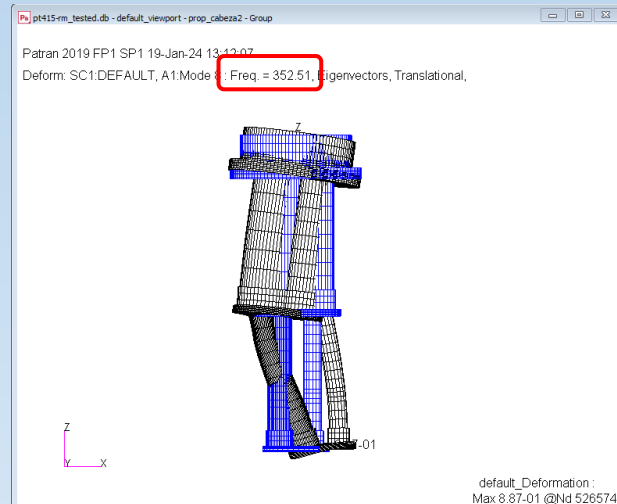
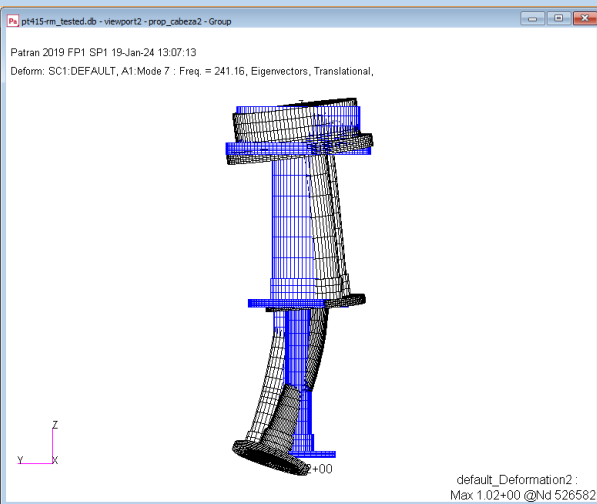
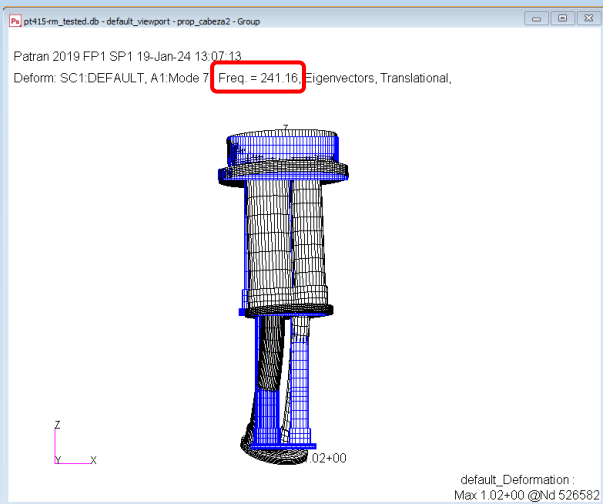


21.8 kg

Free-free condition

- 3 triaxle accelerometers
- Impact hammer
- SCADAS III recorder
- X60 adhesive

IV. MODAL TEST



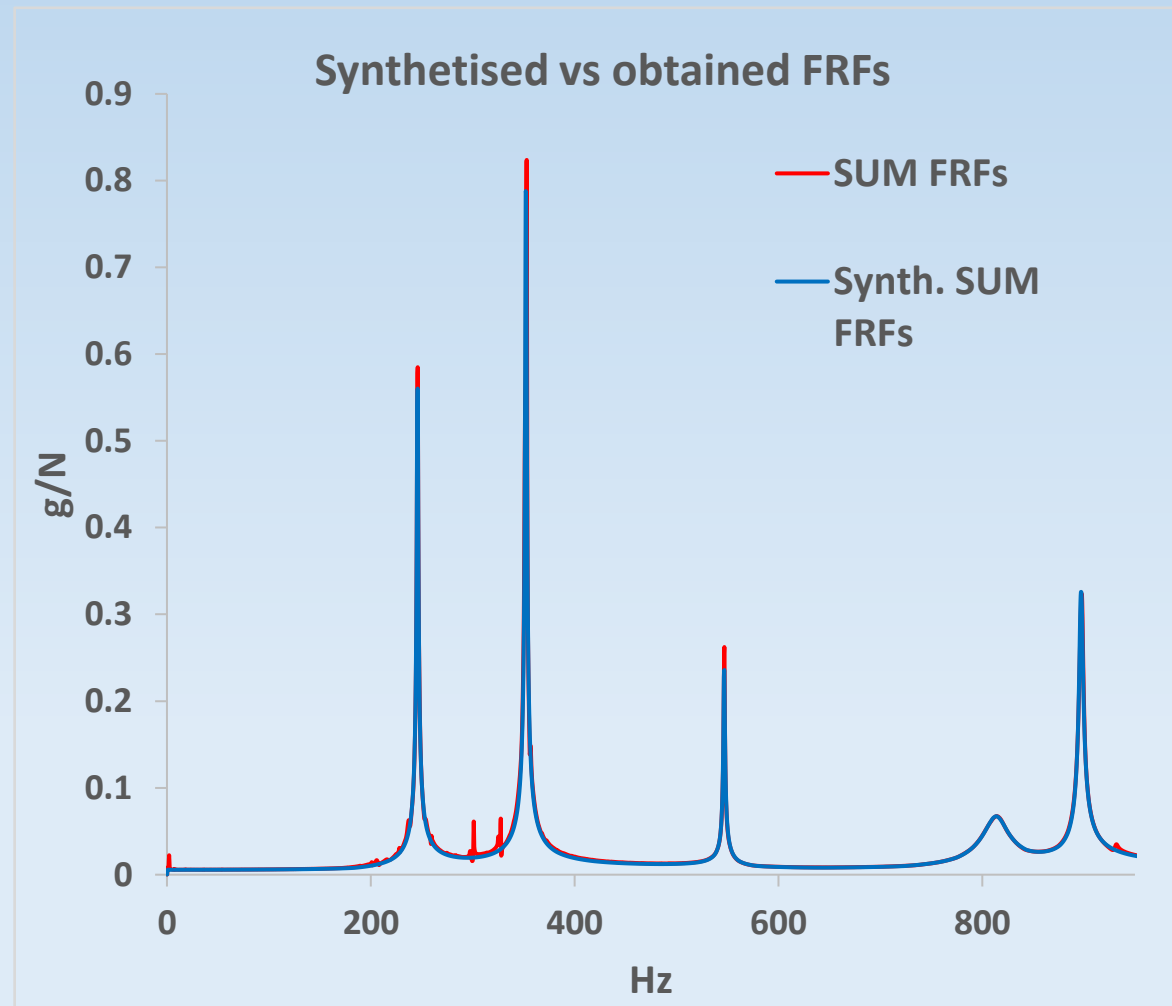
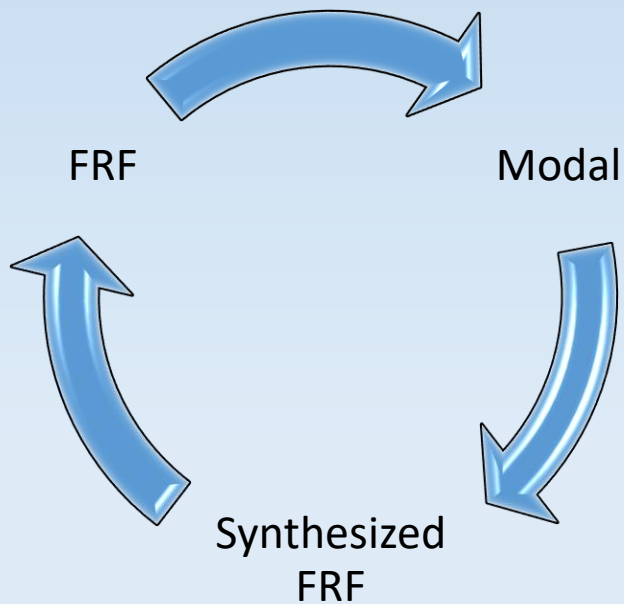
IN ACCORDANCE WITH THE SIMULATION

ALMOST NO DAMPING - RIGID SOLID

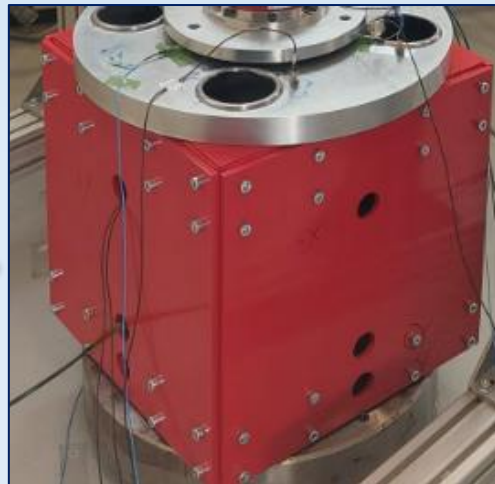
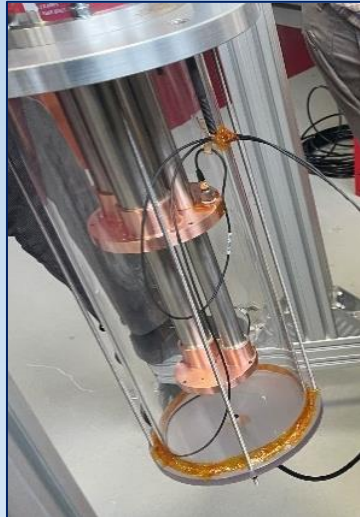
Mode	Modal type	Freq. measured (Hz)	Freq. simulated (Hz)	Error (%)	Damping (%)
1	1 st Bending XY	245.8	241.2	1.91	0.30
2	1 st Bending XZ	352.2	352.5	0.09	0.21

Validation of results

Frequency Response Functions (FRFs)



V. TEST BENCH MODAL TEST



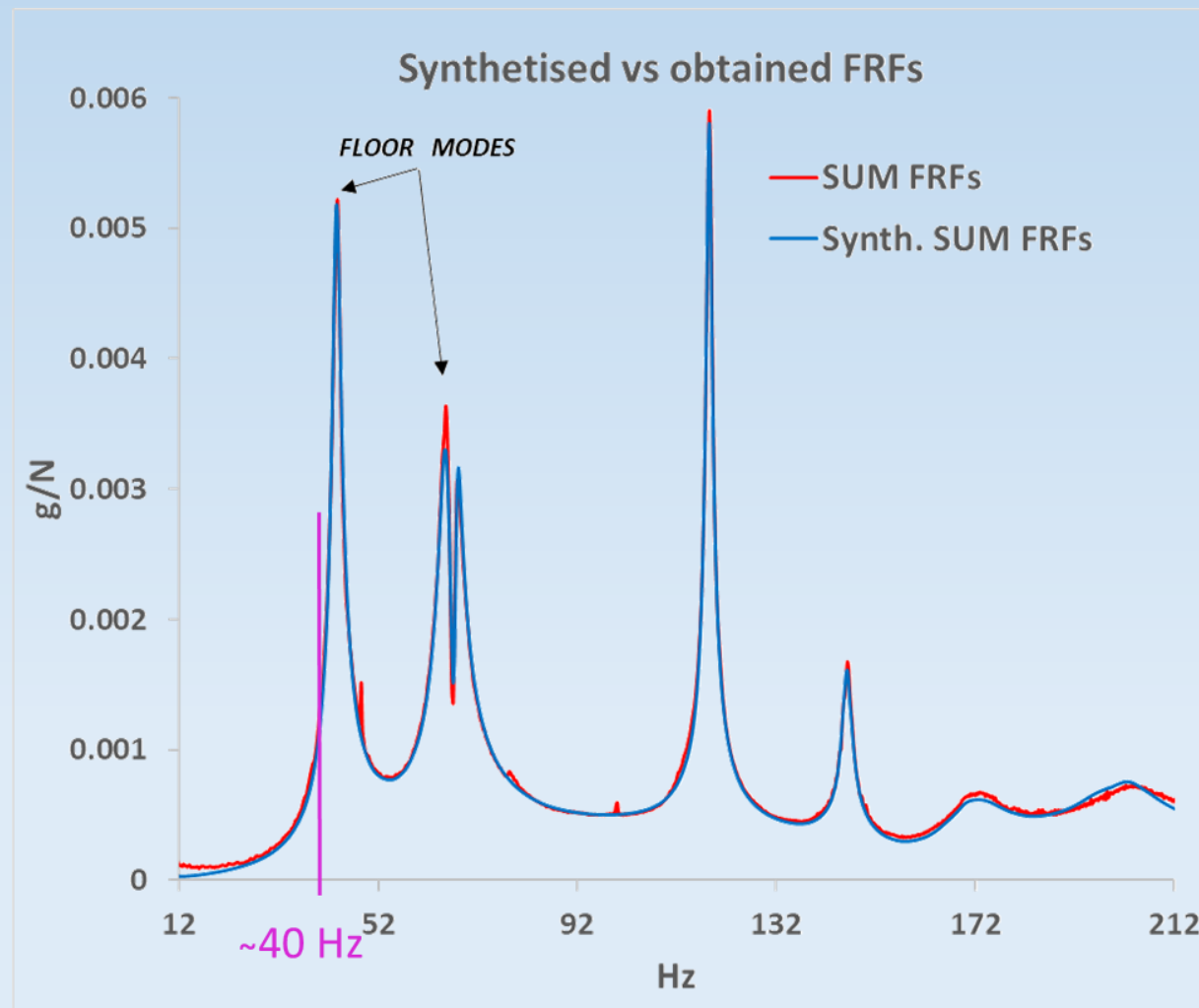
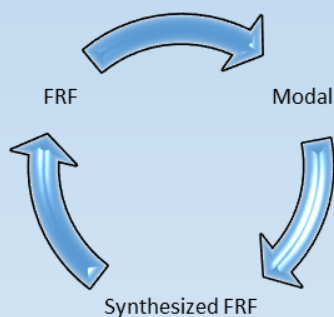
Results obtained

BENCH MODES	
Bending	~ 180 Hz
Orthogonal	~ 200 Hz

COLD HEAD MODES	
Bending	~ 115 Hz
Orthogonal	~ 150 Hz

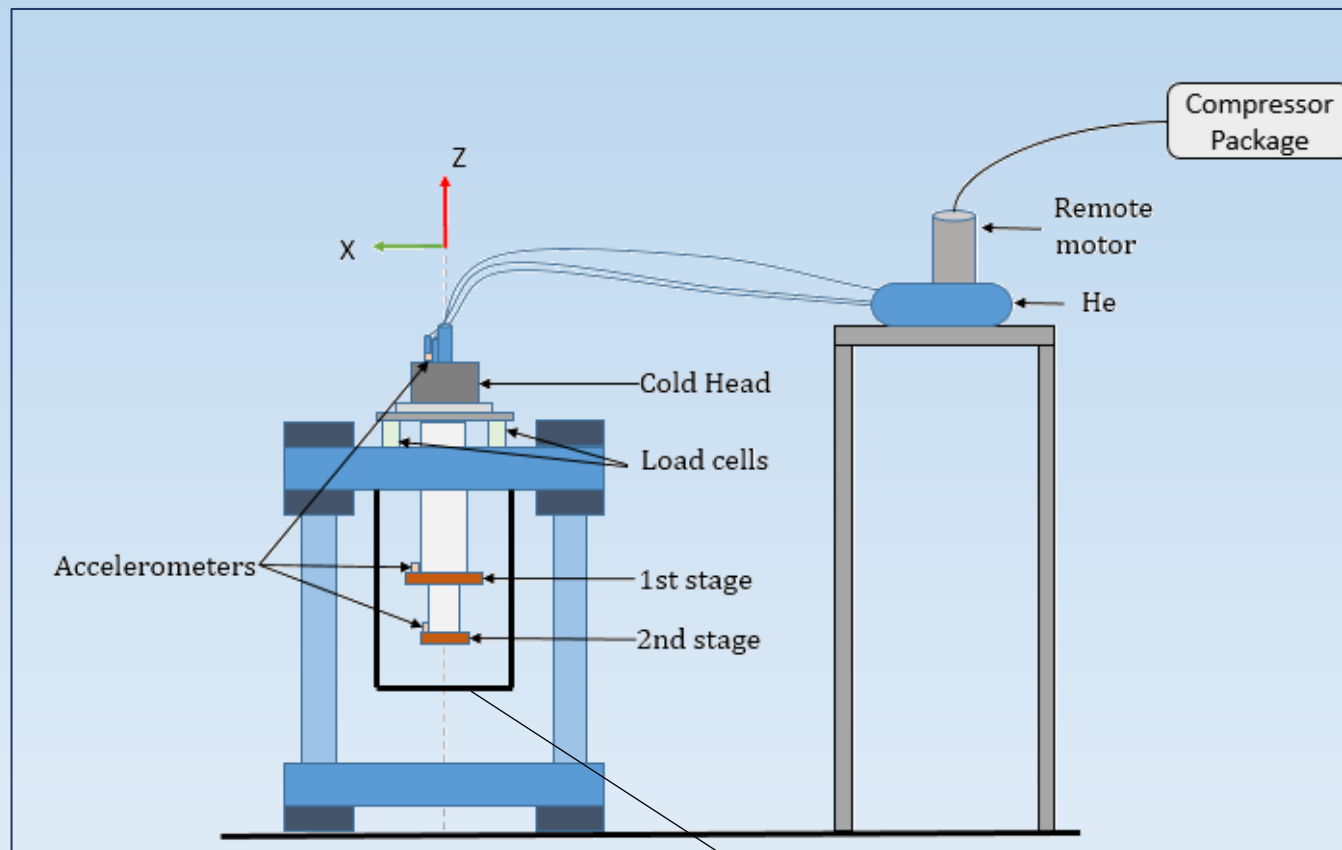
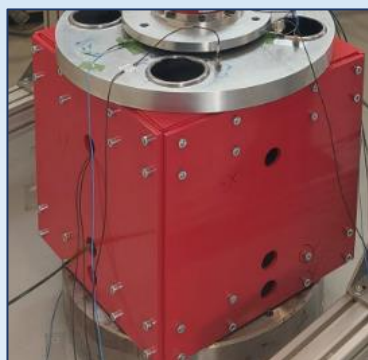
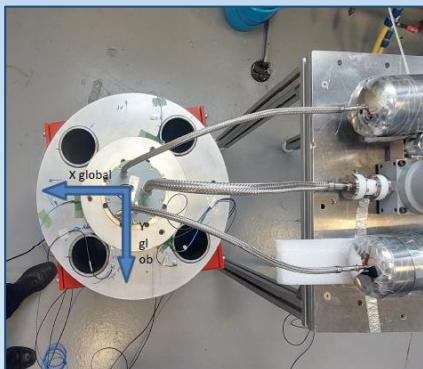
V. TEST BENCH MODAL TEST

Validation of results



VI. MICROVIBRATION TEST

SET-UP



STANDARD 1
- Horizontal

STANDARD 2
- Horizontal
- Flexlines right angles

- Non-vacuum condition
- 15 min operation
- Down to 147 Kelvin



Other configurations studied:

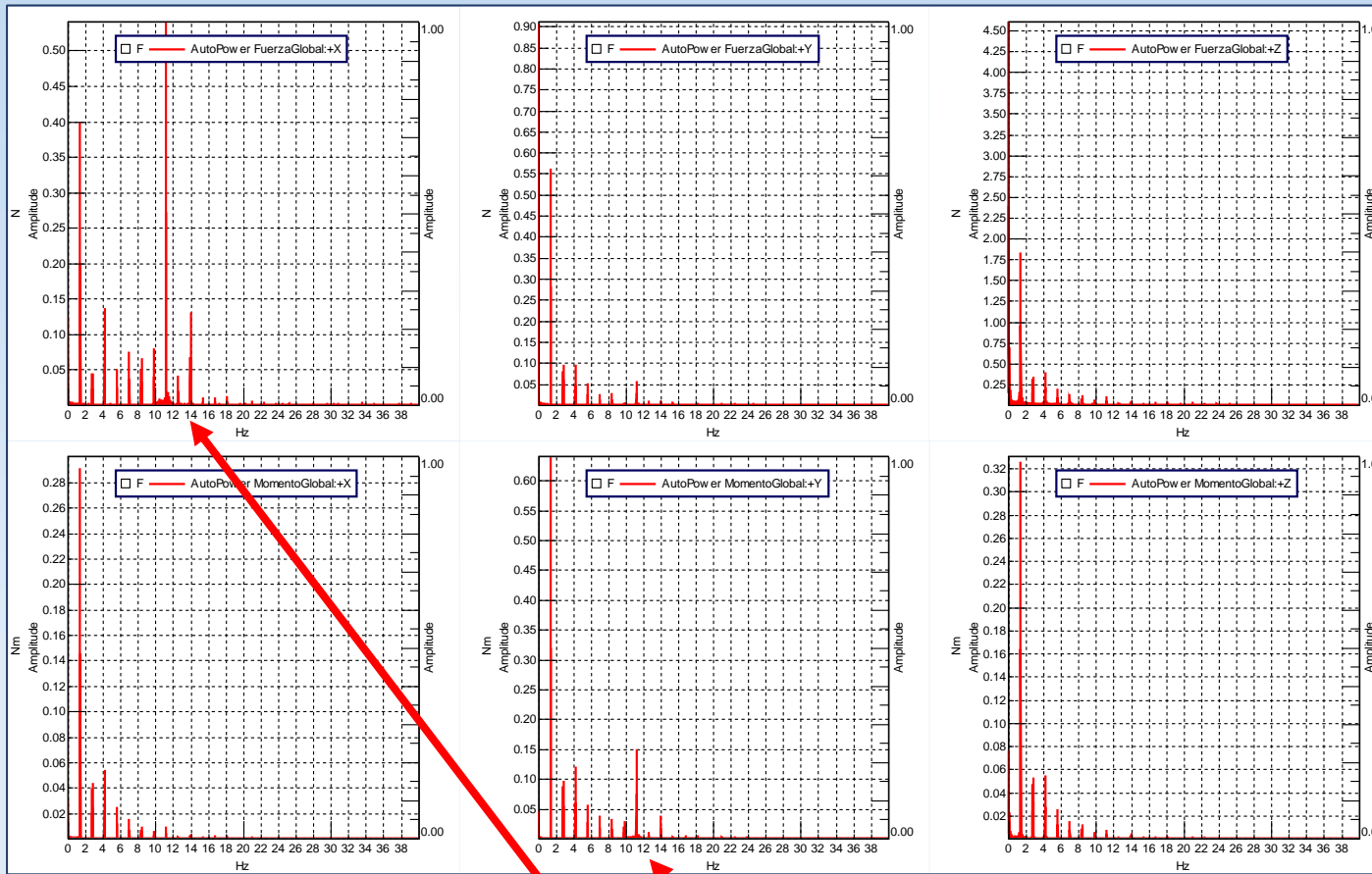
- Vertical
- Standard 2 with bellows



STANDARD 2

FORCES AND MOMENTS

Up to 30 Hz threshold



Coupling at 12 Hz



- Forces and moments induced of the cold head are obtained



HARD TO FIND IN MANUFACTURERS INFO!

- Cold head bending modes in free-free condition: 246 Hz in XY and 352 Hz in XZ

- Cold head bending modes in the test bench: 115 Hz and 150 Hz

- Forces of the cold head up to 30 Hz are meaningful

- The accelerometers were too cold to report measurements



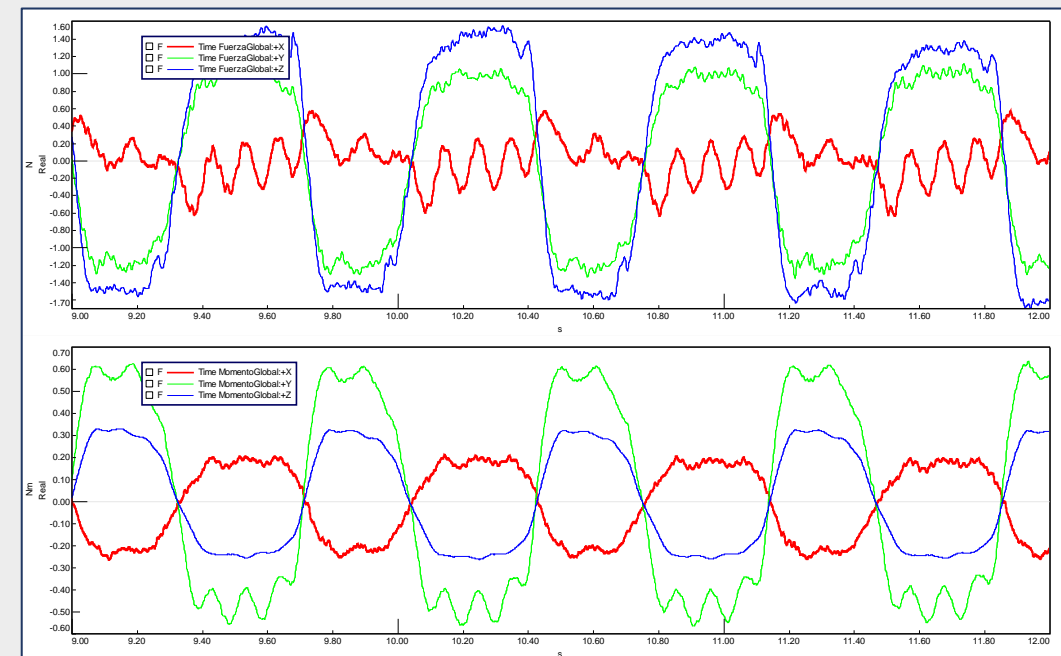
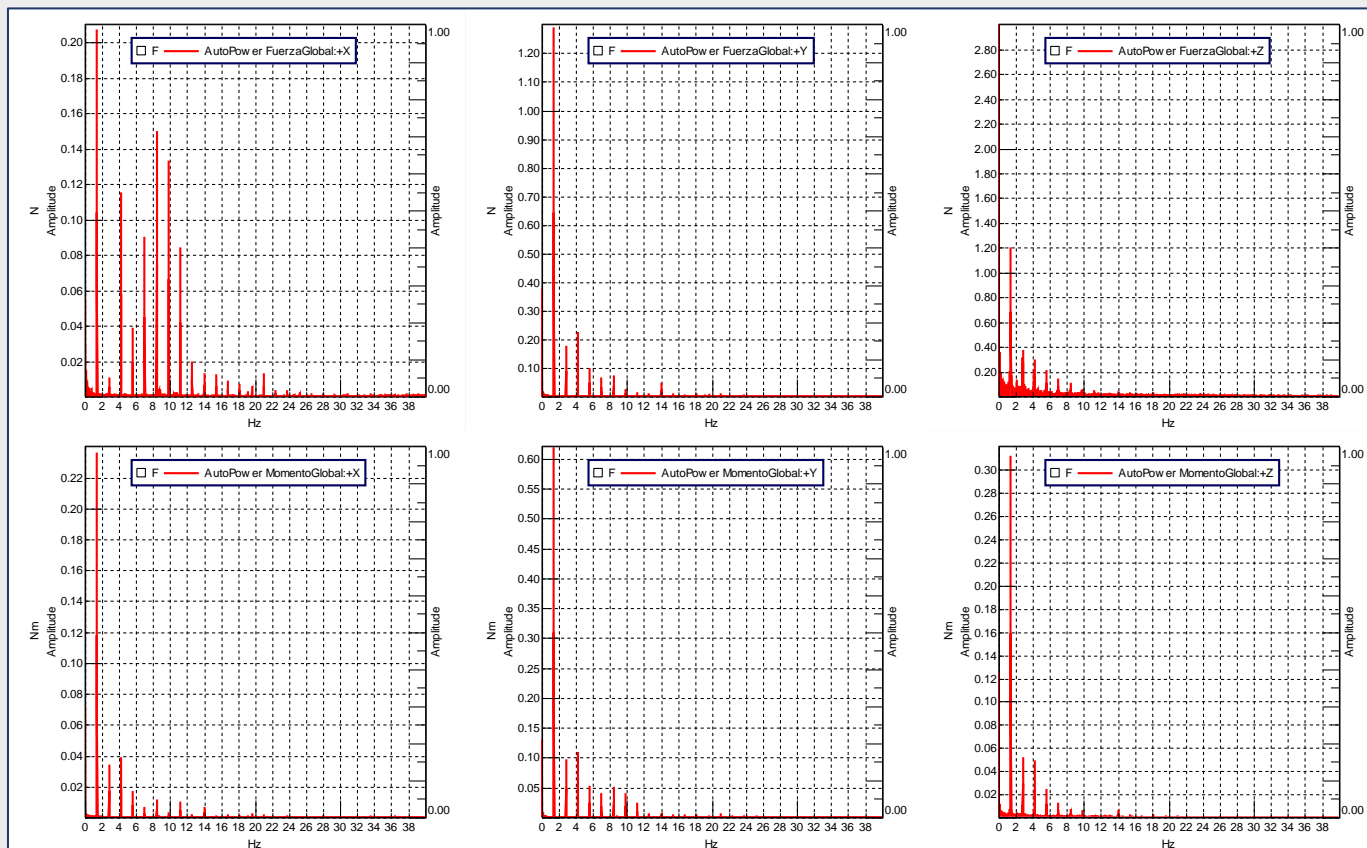
DYNAMIC CHARACTERIZATION



- Validated data for the cryostat final model
- Future tests in the cryostat

THANK YOU! ANY QUESTION?

STANDARD 1



STANDARD 2 + BELLOWS

