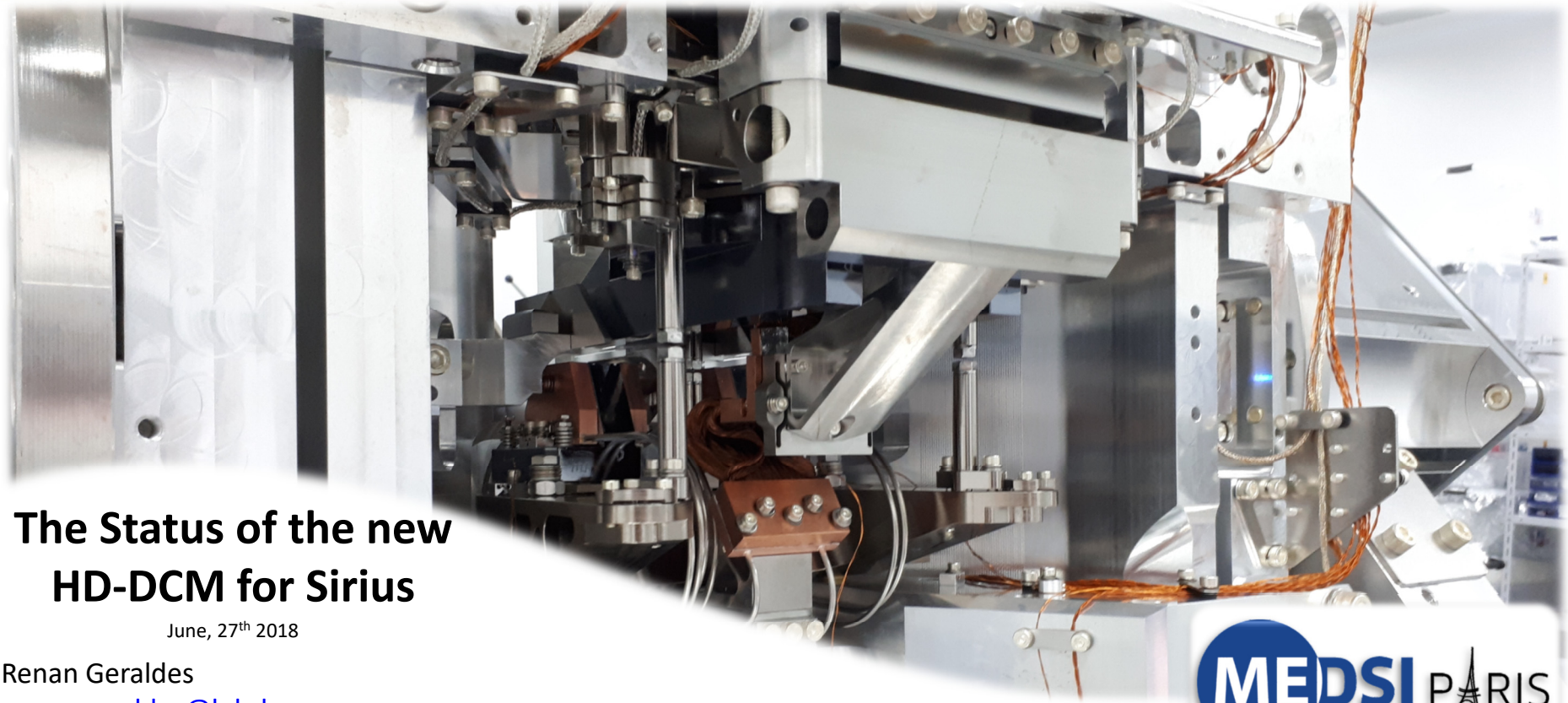
Brazilian Synchrotron Light Laboratory

MINISTRY OF SCIENCE, TECHNOLOGY INNOVATION AND COMMUNICATION

BRASIL BRAZILIAN GOVERNMENT

CNPEM Brazilian Center for Research in Energy and Materials



The Status of the new HD-DCM for Sirius

June, 27th 2018

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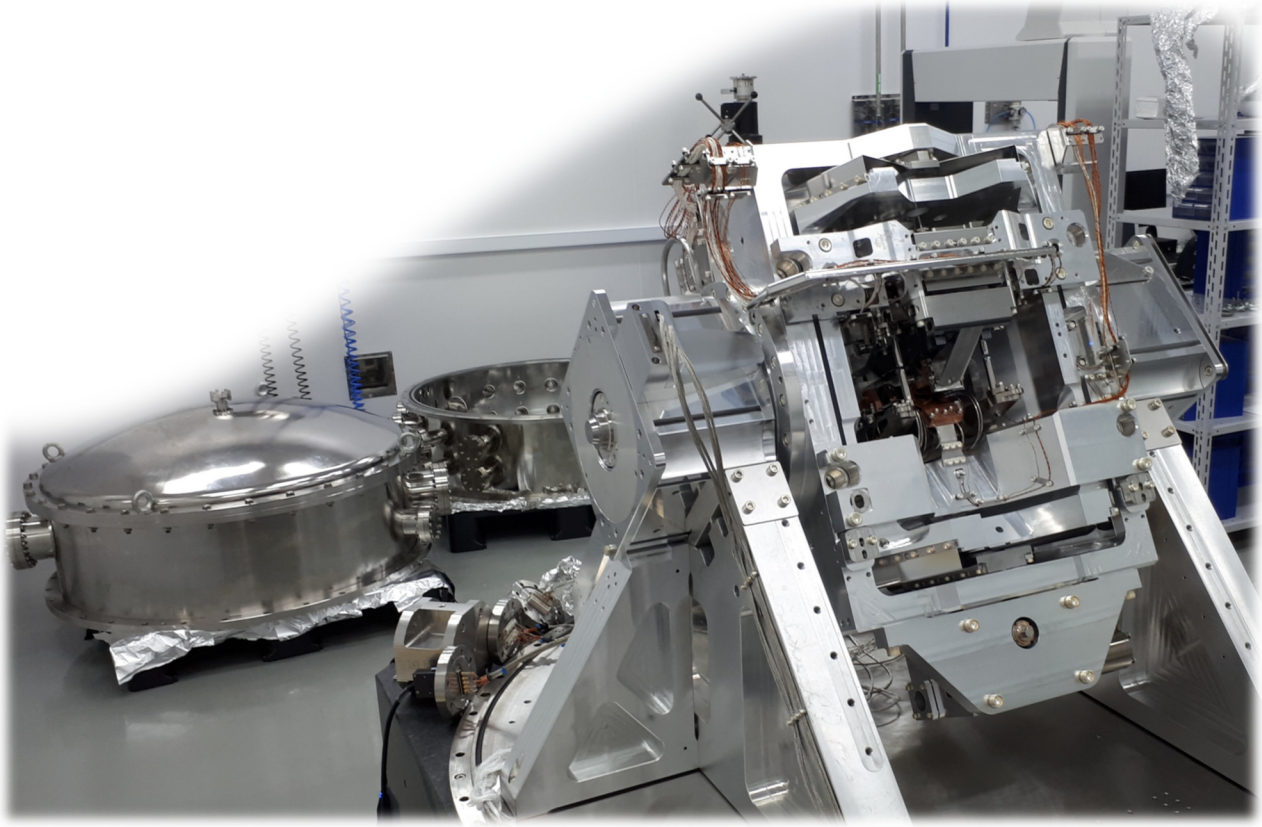
(On behalf of the Beamline Engineering Group of LNLS)

MEDSI PARIS 2018
MECHANICAL ENGINEERING DESIGN OF SYNCHROTRON RADIATION EQUIPMENT AND INSTRUMENTATION

Outline

- Introduction
- Design
- Results
- Conclusions
- Next steps



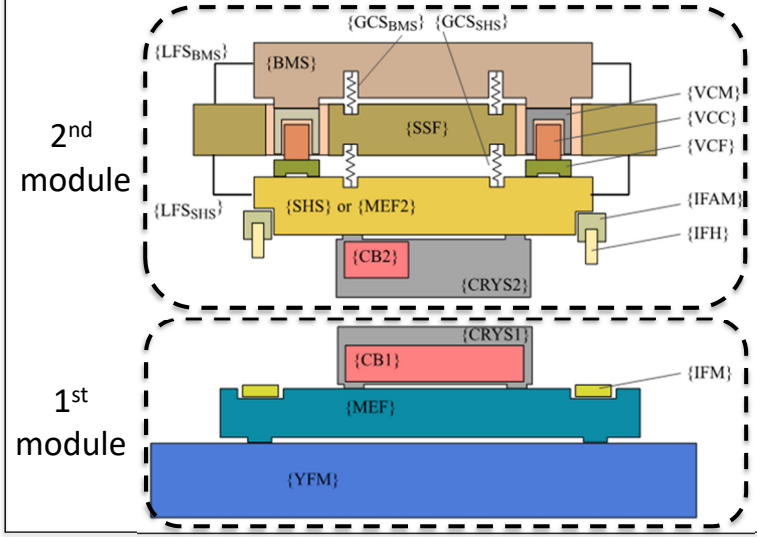
Introduction

Parameter	Original Specs (2015)
Type:	Vertical DCM
Beam offset:	18 mm
Angular range:	3 to 60°
Angular resolution:	0.2 µrad
Pitch/roll stability:	in-position: **< 10 nrad** (±3σ) flyscan: **< 200 nrad** (±3σ)
Crystal sets:	Si(111): 2.3 to 38 keV Si(311): 4.4 to 72 keV
Crystal sizes (W x L):	1st crystal: 15 x 35 mm^2 2nd crystal: 15 x 190 mm^2
Crystal cooling:	1st crystal: Indirect LN_2 (80 K) 2nd crystal: Copper straps (155 K)
Crystal DoF:	1st crystal: fixed at rotation center 2nd crystal: gap, pitch, roll
Beam size:	1.7 x 1.7 mm^2
Input Power:	150 W
Base pressure:	< 5 x 10^{-8} mbar

Design guidelines:

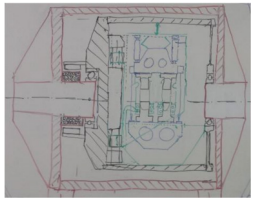
- Minimum degrees of freedom
- Low-stiffness actuator with balance mass
- Taylored and balanced cooling channels
- Embedded interferometric metrology

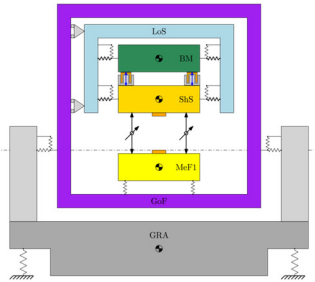
High-dynamic core:

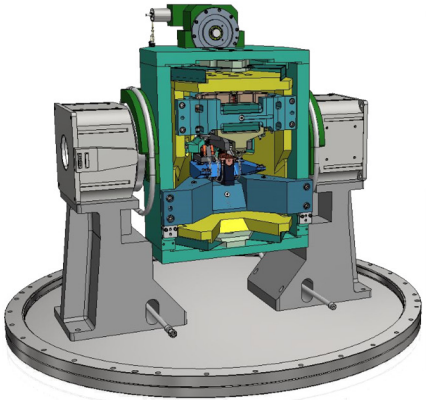


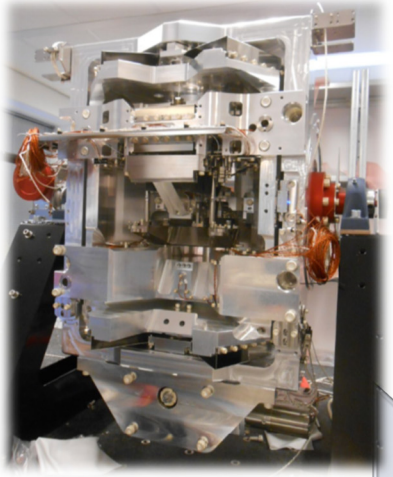
[Ref. TUCA05 MEDSI 2016]

Introduction









03/2015 Kick-off

12/2015 Conceptual Sketch

08/2016 Conceptual Design

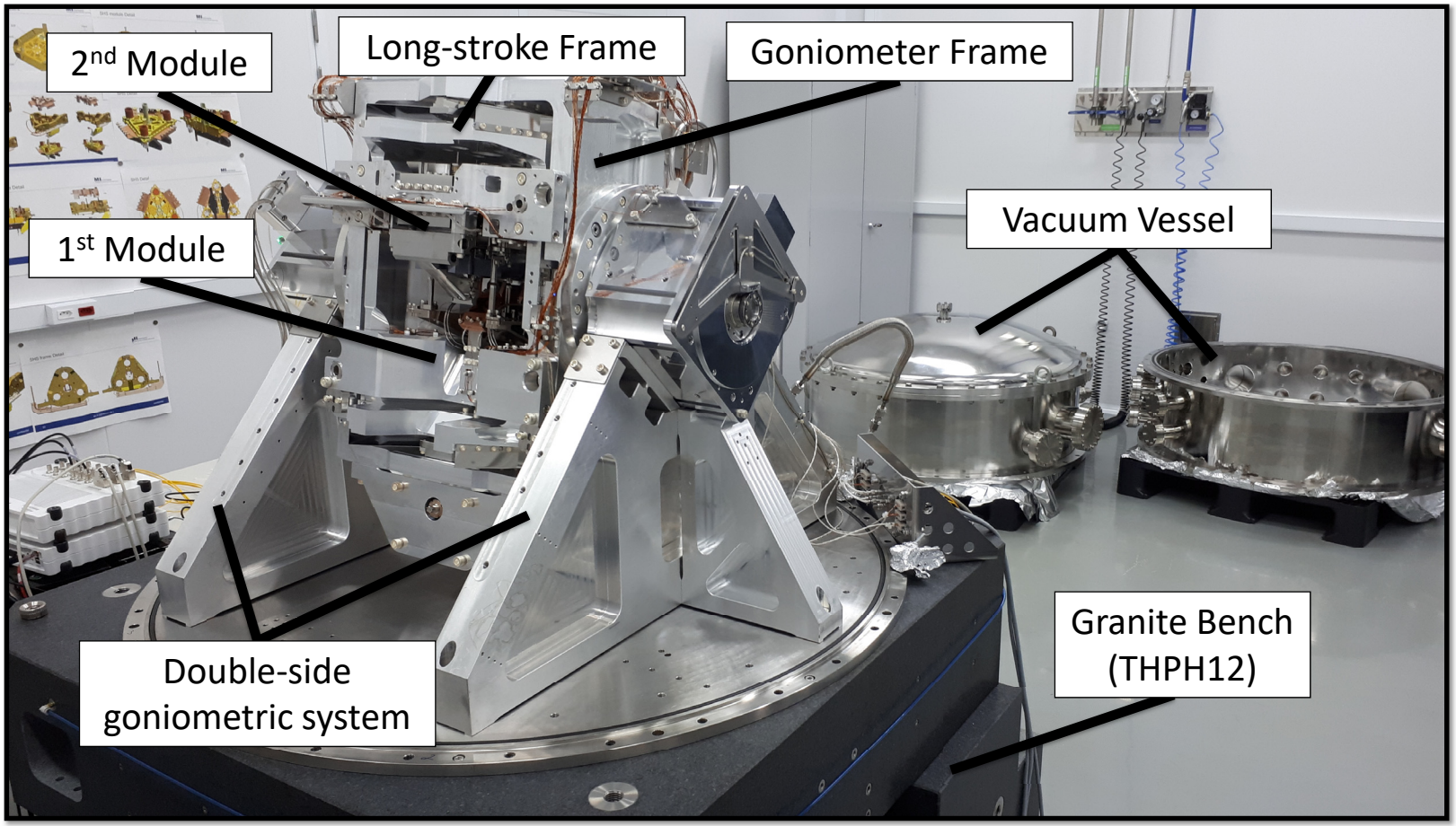
12/2016 Global Design

02/2017 Detailed Design

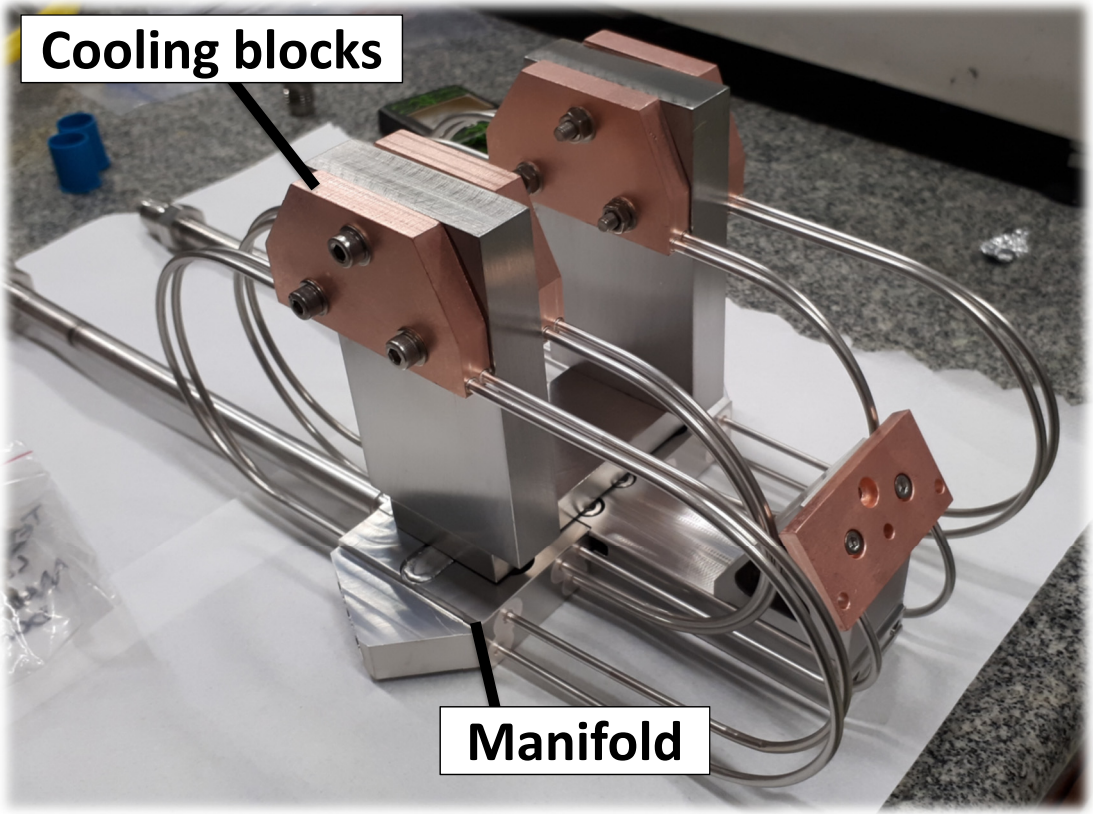
05/2017 Core Validation

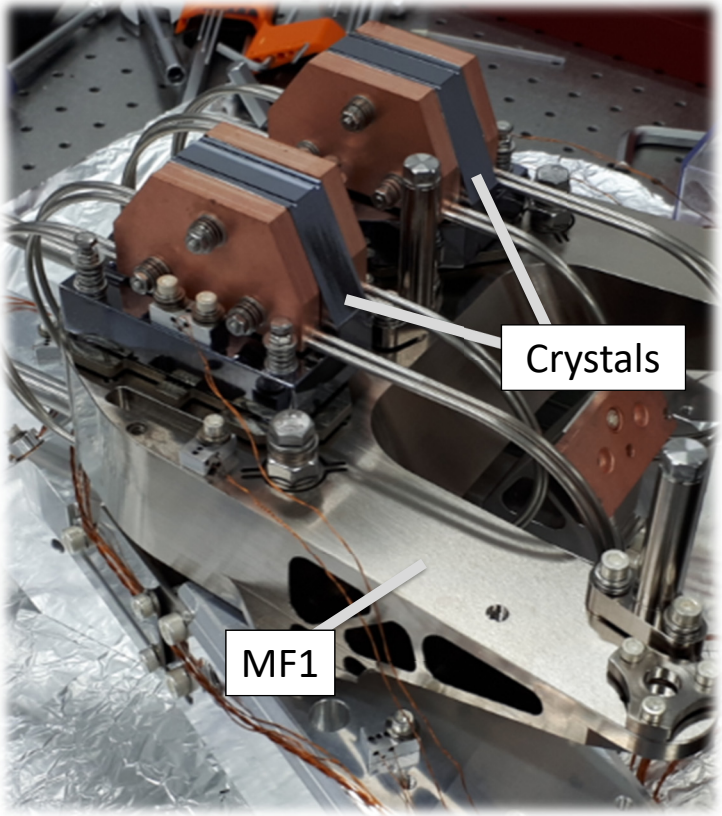
05/2018 Offline Validation

Design: Overview



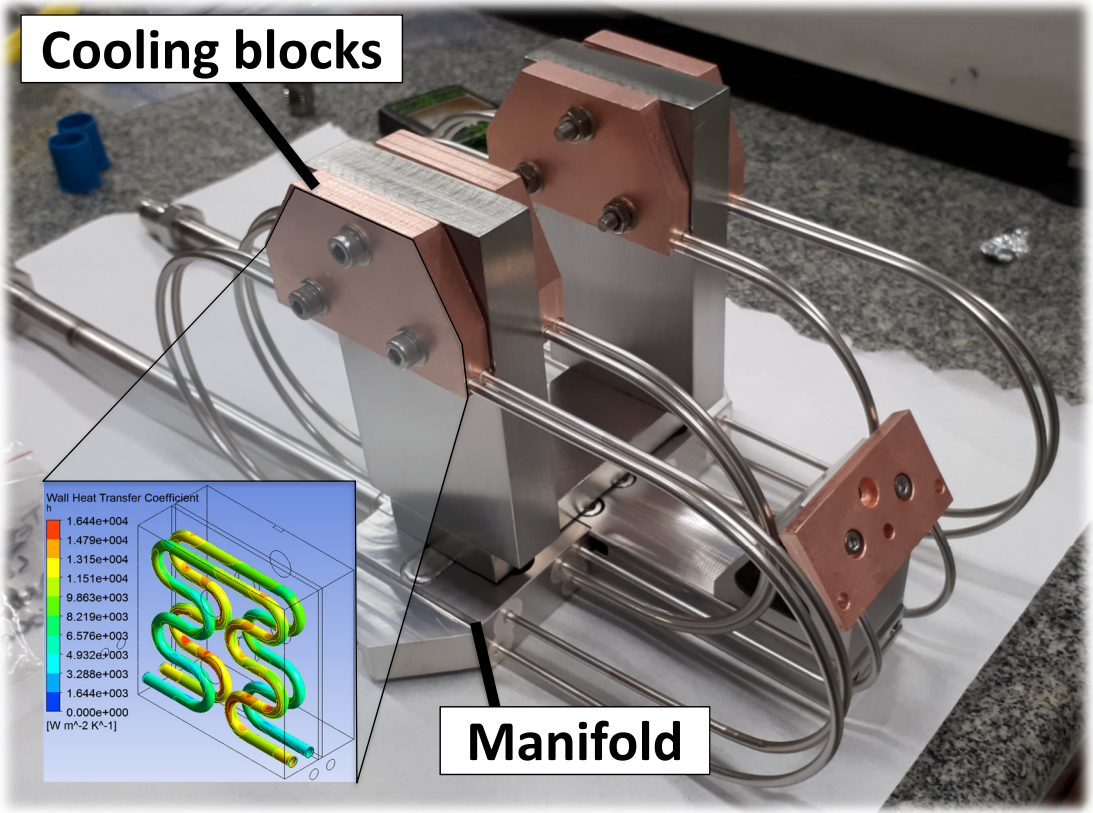
Design: Manifold

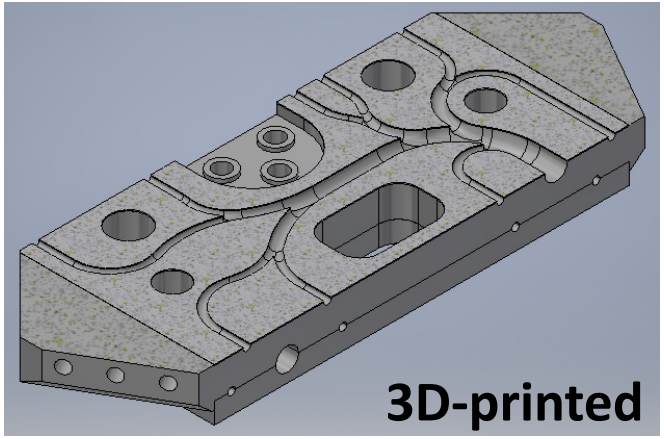


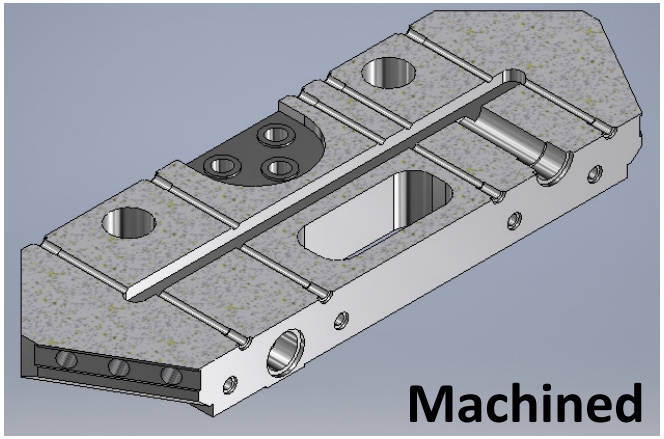


*Manifold assembly mounted to brazing tooling.

Design: Manifold







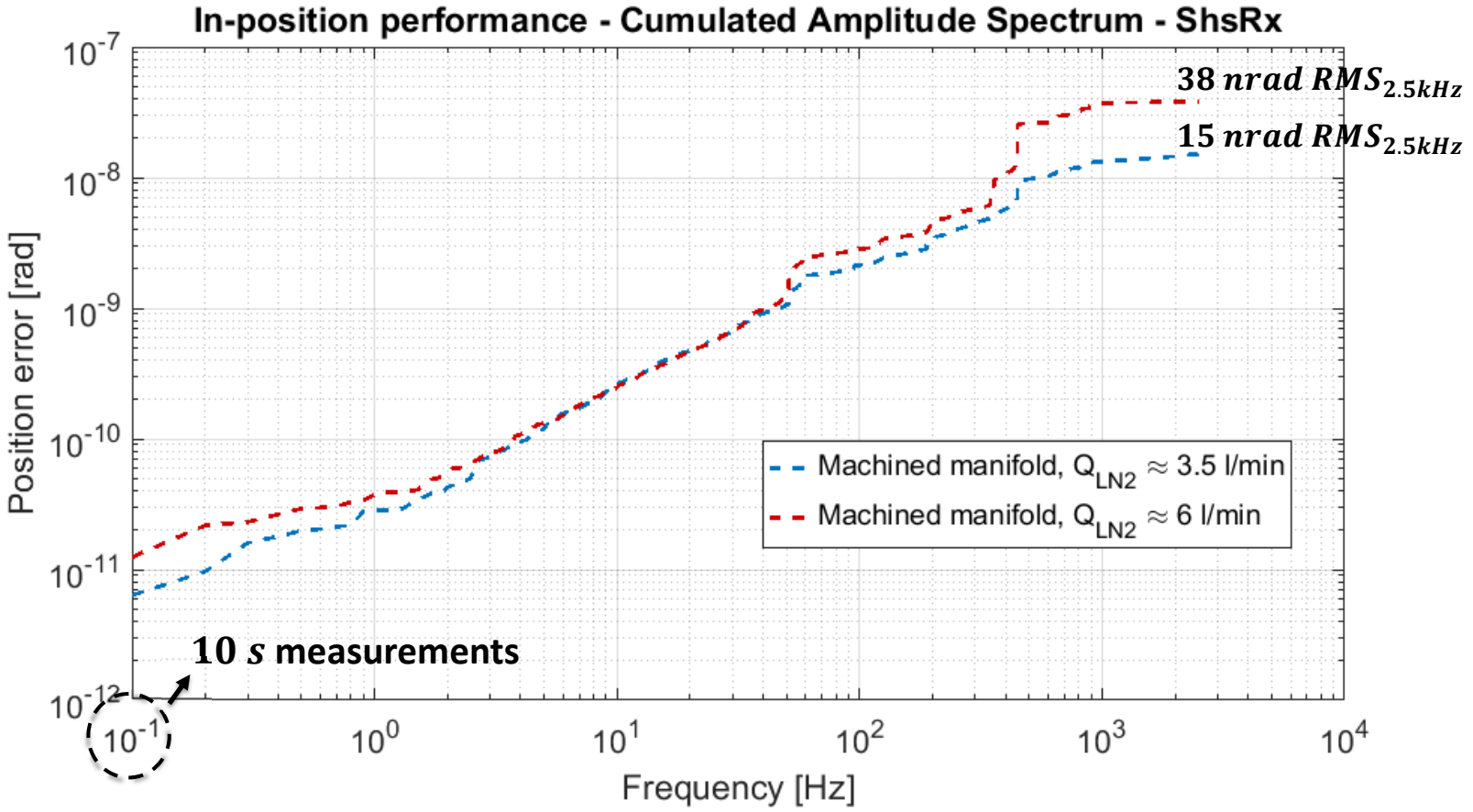
*Manifold assembly mounted to brazing tooling.

Results

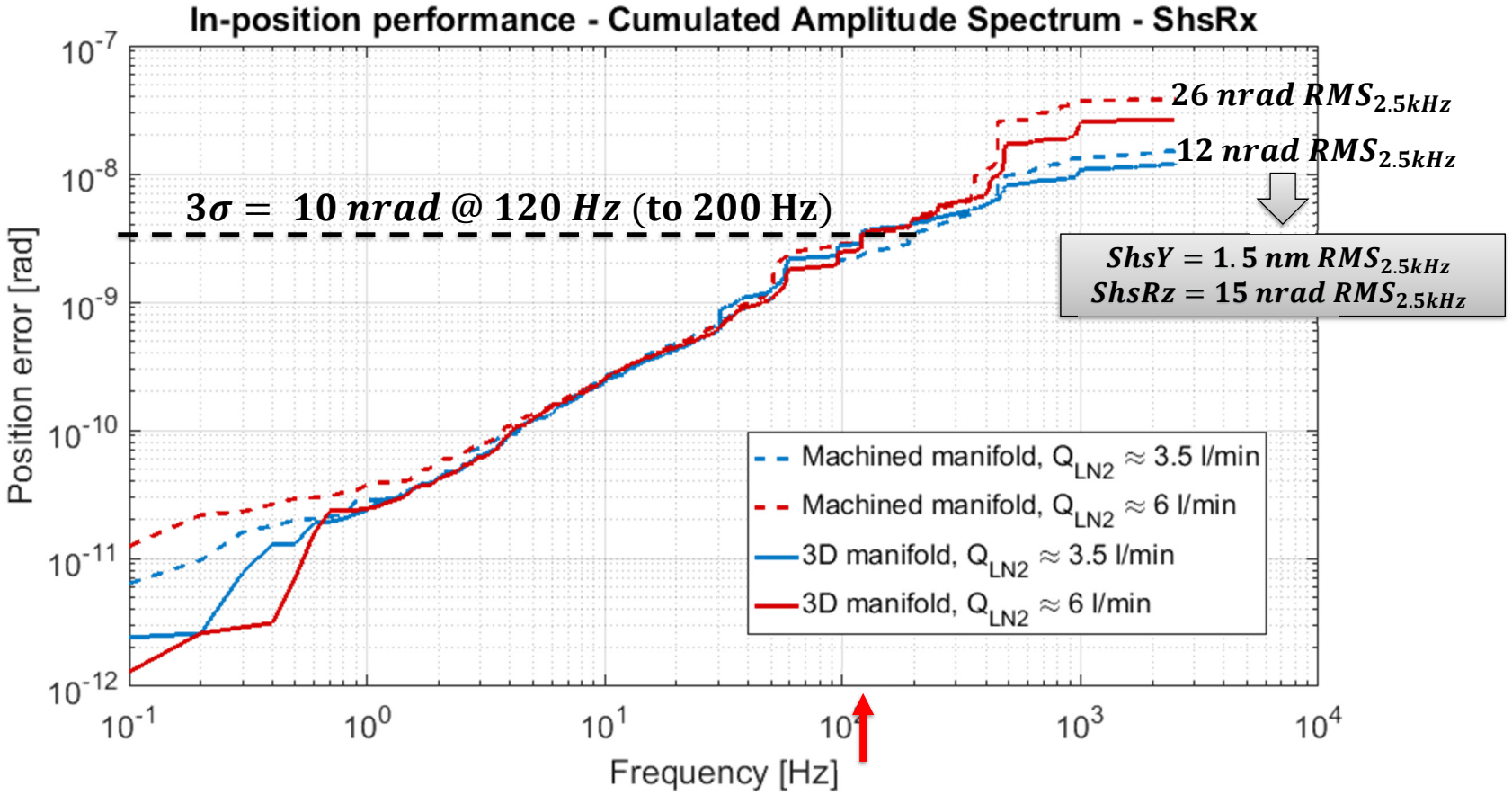
- **In-position performance:**
  - Machined manifold
  - Printed manifold
- **Scanning performance:**
  - *Standard mode:* goniometer + long stroke + short stroke
  - *High-performance mode:* goniometer + short stroke
- **Source degradation**

In-Vacuum
Cryocooled
Metrology lab floor

In-Position Performance (1)

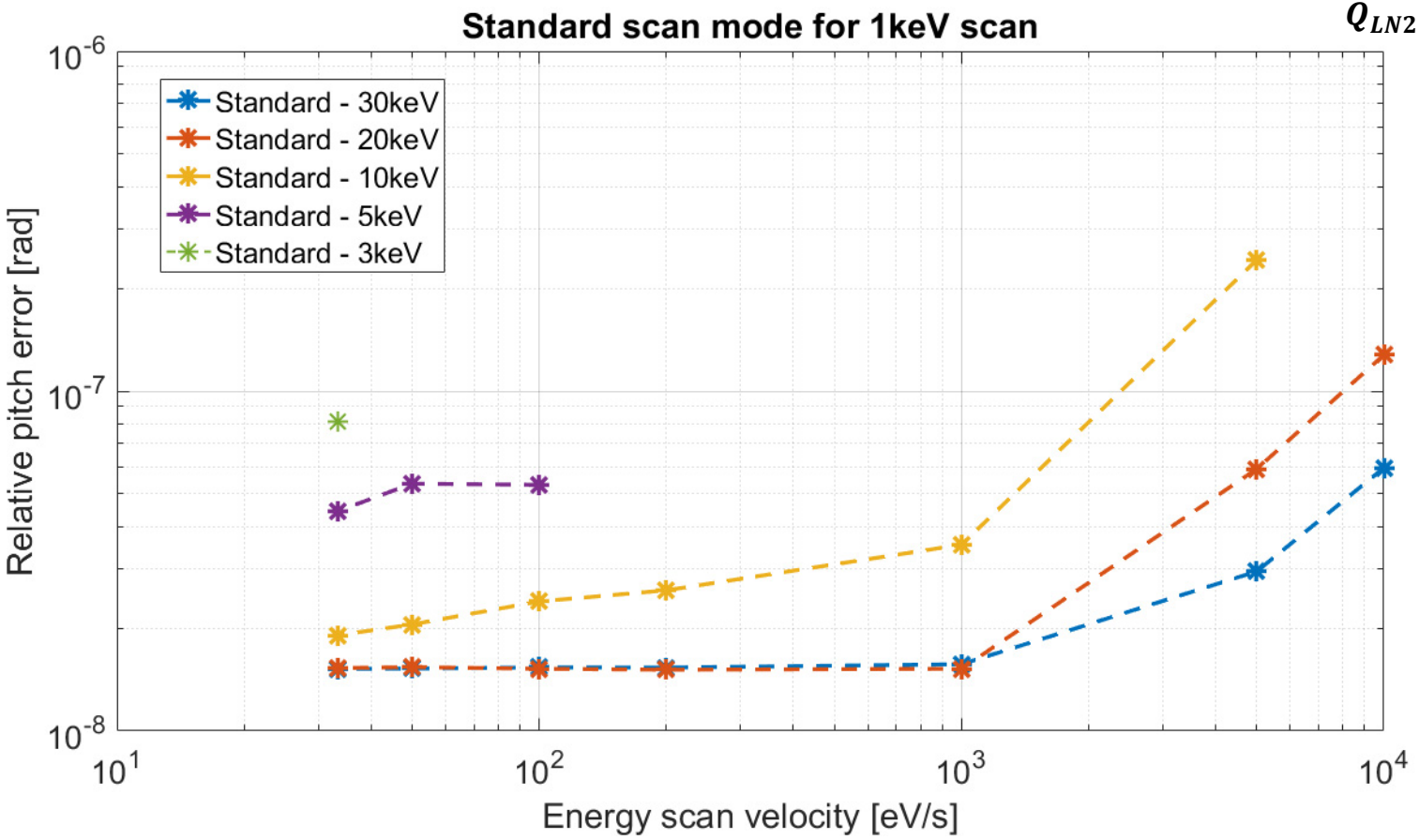


In-Position Performance (2)



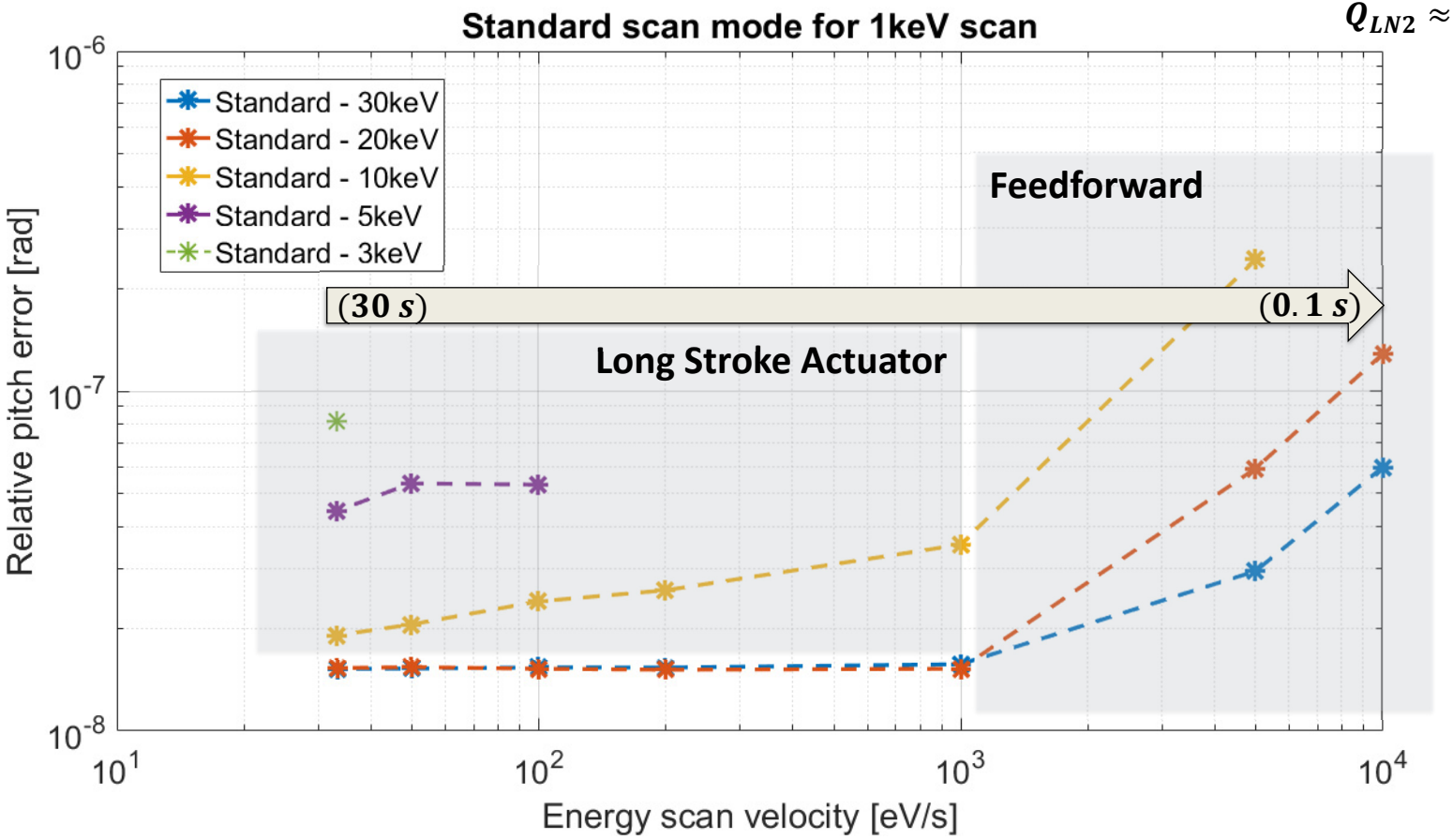
Standard Scanning

$Q_{LN2} \approx 4\ l/min$



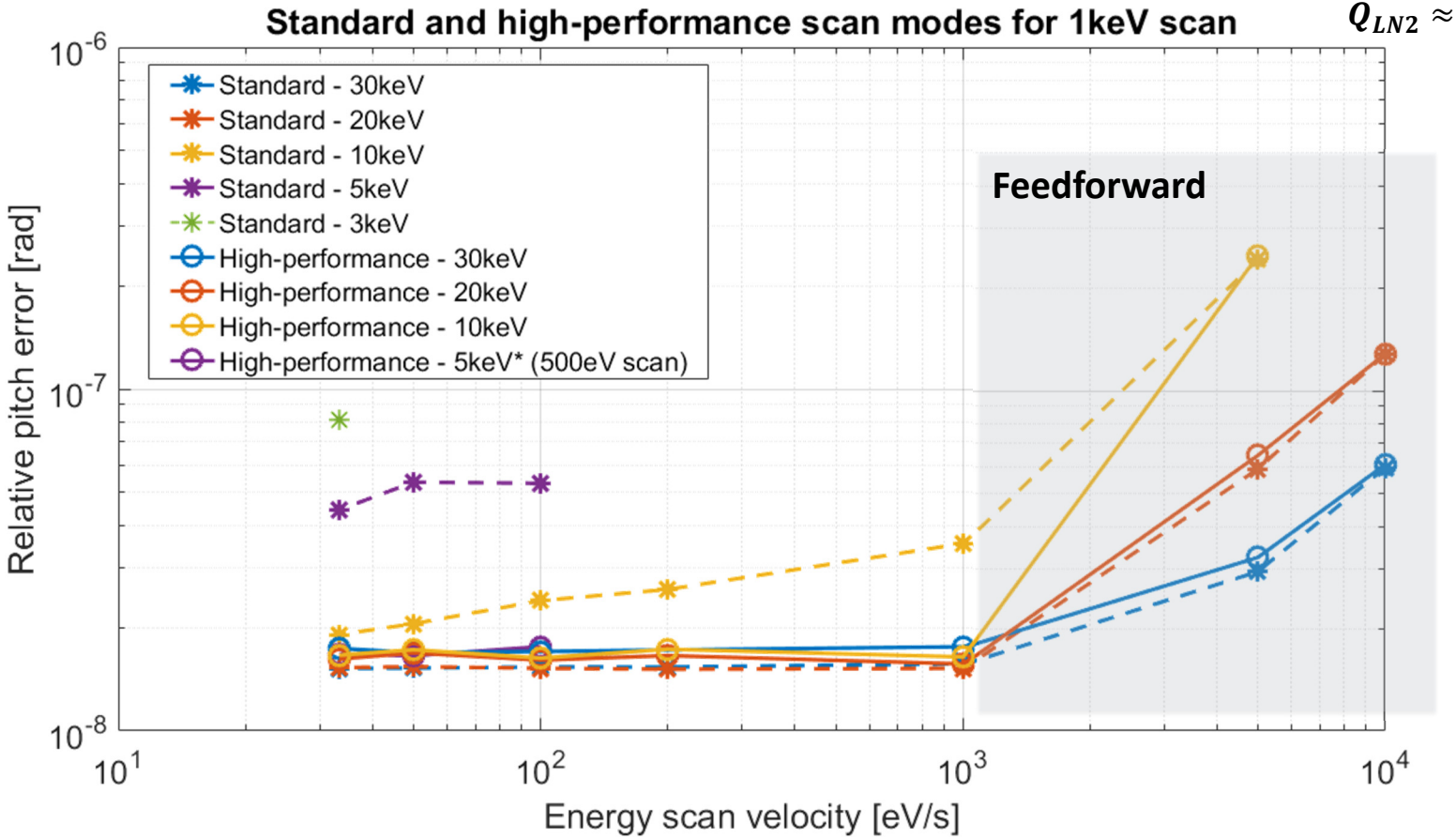
Standard Scanning

$Q_{LN2} \approx 4\ l/min$

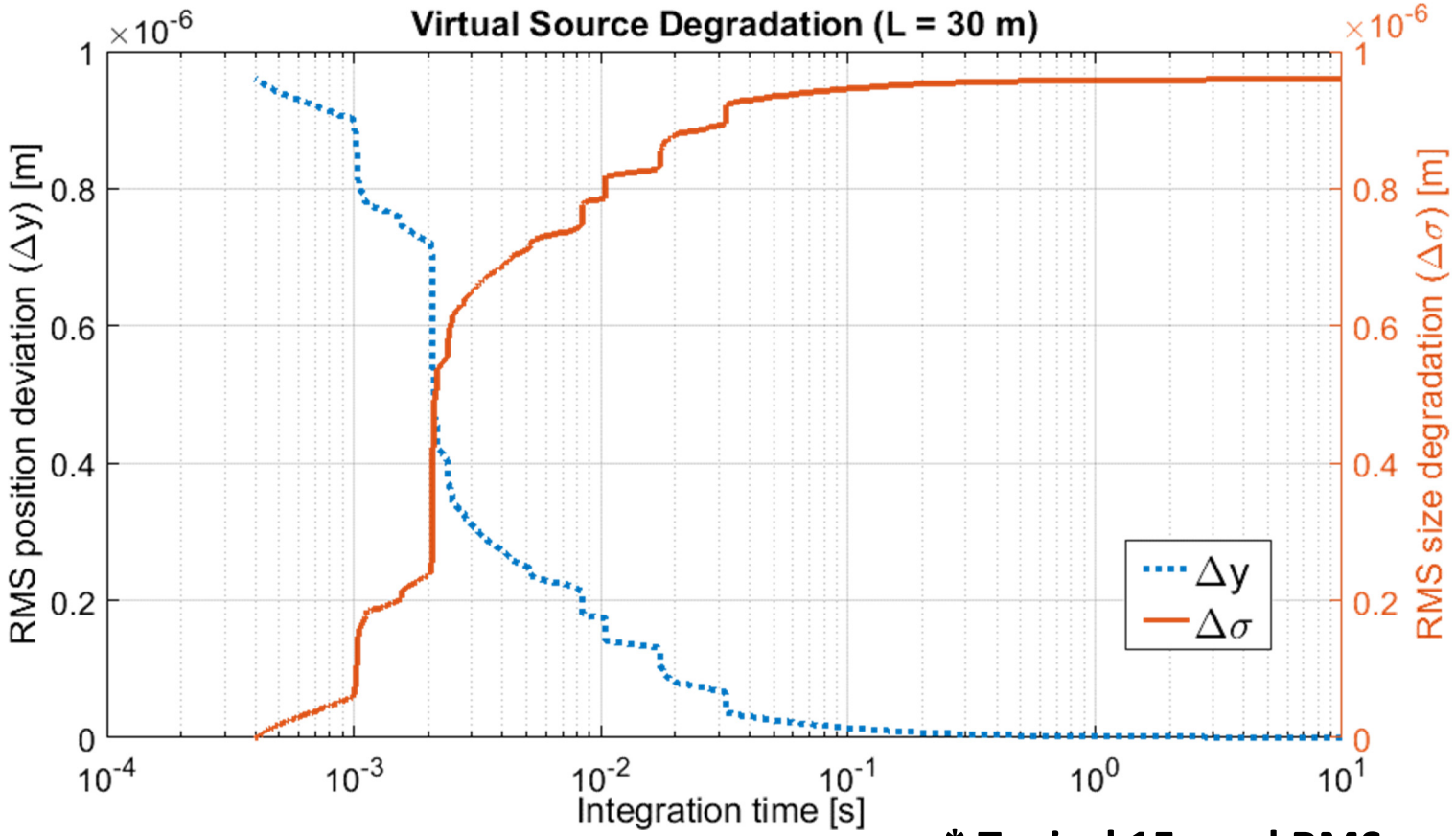


High-Performance Scanning

$Q_{LN2} \approx 4\ l/min$

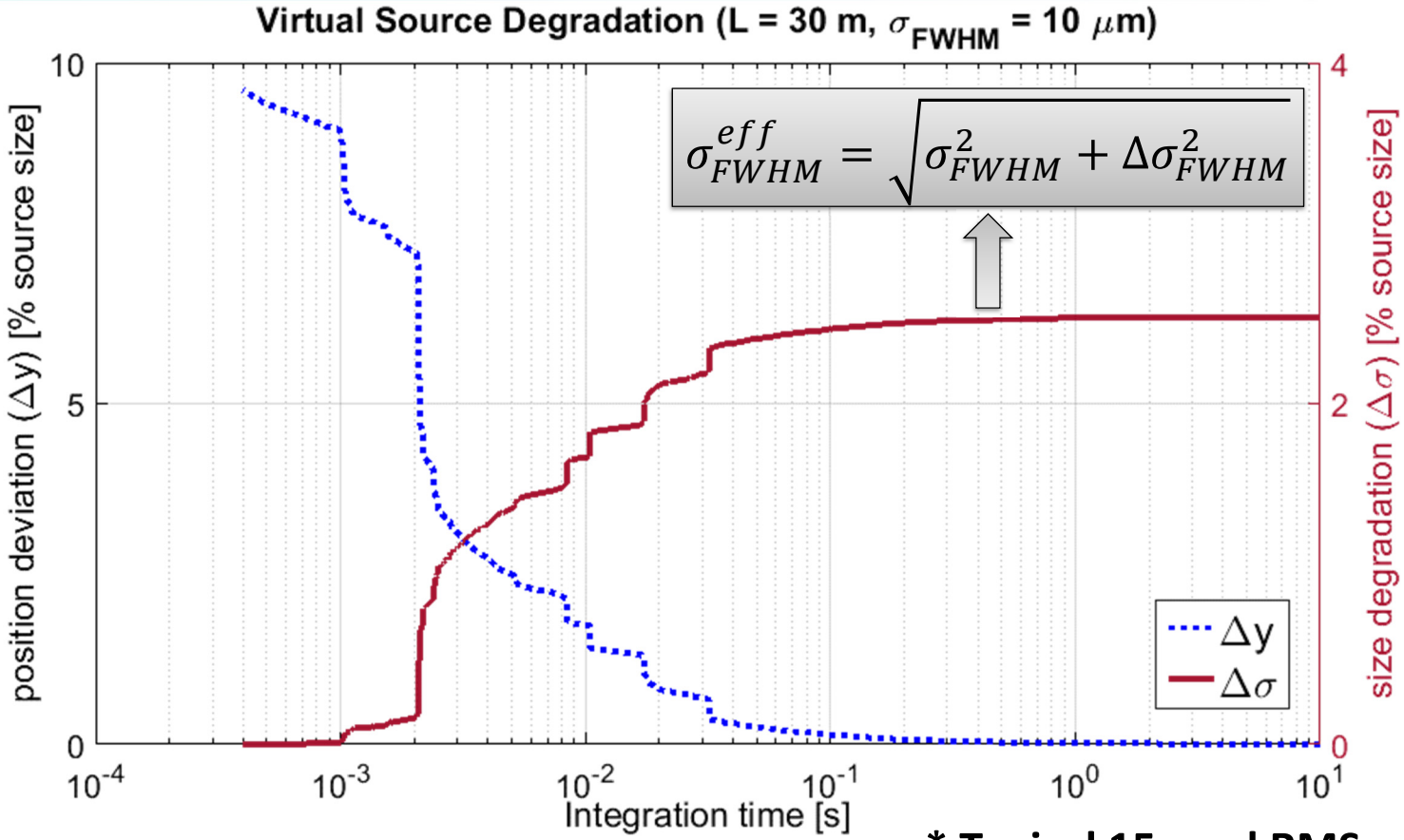


Source Degradation (1)



*** Typical 15 nrad $RMS_{2.5kHz}$ meas.**

Source Degradation (2)



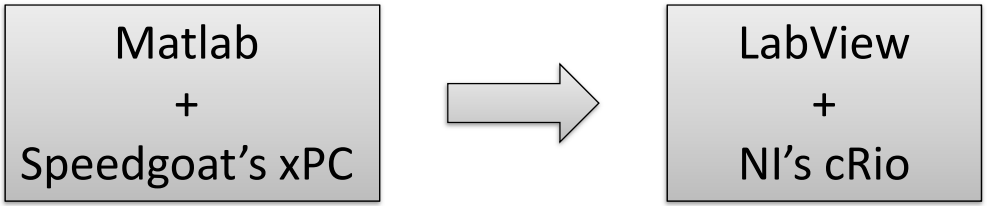
*** Typical 15 nrad $RMS_{2.5kHz}$ meas.**

Conclusions

- In-vacuum cryocooled performance with pitch in-position stability around 15 nrad $RMS_{2.5kHz}$ has been achieved for the HD-DCM;
- Thanks to the high-dynamic concept of the system, up to 1keV/s scans are possible with equivalent performance;
- Depending on the integration time of the experiments, source degradation can be estimated as a position variation of 10% of the beam size at the millisecond end, or a size degradation of 2.5% on the other end.
- Final performance to be proven at the beamlines;
- Limitations of an embedded interferometric system (cosine, Abbe, cyclic errors) are expected to be greatly reduced by calibration, thanks to high-repeatability design.
- The mechatronics system has been proven and may occasionally follow any other suitable feedback signal that may be provided by the beamline.

Next Steps

- Control hardware migration:



- Implementation of feedforward for improved performance at high speeds;
- Online commissioning at the MANACA beamline in the beginning of 2019;
- Second unit in production to be installed at the EMA beamline still in 2019;
- LOS actuator upgrade for full-range high-performance scanning.

Acknowledgements

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- The community;
- The organizers;
- The audience.