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Commissioning Results of the SAPOTI Cryogenic Nanoprobe at the CARNAÚBA Beamline at Sirius/LNLS

Wednesday 28 August 2024 11:20 (20 minutes)

SAPOTI will be the second nanoprobe to be installed at the CARNAUBA (Coherent X-Ray Nanoprobe Beamline) beamline at the 4th-generation light source Sirius at the Brazilian Synchrotron Light Laboratory (LNLS) [1]. Working in the energy range from 2.05 to 15 keV, it has been designed for simultaneous multi-analytical X-ray techniques, including absorption, diffraction, spectroscopy, fluorescence and luminescence, and imaging in 2D and 3D. Highly-stable fully-coherent beam sizes between 30 and 120 nm, with monochromatic flux up to 1e11ph/s/100-mA/0.01%BW, are expected with an achromatic KB (Kirkpatrick-Baez) focusing optics, whereas a new in-vacuum high-dynamic cryogenic sample stage has been developed aiming at single-nanometer resolution images via high-performance 2D mapping and tomography [2].
A Loading Chamber (Figure 1) was designed to: i) preserve the vacuum level and cleanliness of the Main Chamber, with the KB system and a cryogenic nanopositioning sample stage, and ii) store up to six samples in cryogenic condition (around 100 K), using a Pulse Tube Cryocooler, in a carousel with an angular range of about 75°. The samples are preliminarily loaded in the Loading Chamber using a load-lock system (VCT500 Leica Microsystems) and a customized sample cartridge, which can carry up to three samples and gets engaged in the carousel. Then, for sample loading, a linear stage with a custom cryogenic gripper based on thermal inertial, gets a sample and goes toward the sample stage in the Main Chamber through an embedded gate valve, designed to separate the environments and with a 40mm diameter opening for the gripper tip. The key advantages with this cryogenic design are: i) the independence of complex liquid nitrogen circuits and infrastructure, ii) the avoidance of long conductive straps, which might be prone to fatigue and wear, including the release of particle debris on the sample and mirrors; and iii) compliance with high-throughput possibilities, given a loading-time target of a few tens of seconds, and robust and redundant automation. The overall alignment budget and the temperature-related limited amount of time required for this procedure were the biggest technical challenges for this project. This work presents the mechanical design, thermal models, alignment requirements, automation and operational procedures, including the assembly and offline commissioning results.
[1] Tolentino, H.C.N. et al., (2023). J. Electron Spectrosc. Relat. Phenom. 226 (147340).
[2] Geraldes, R.R. et al., (2023). AIP Conf. Proc. 2990 (040017).

I plan to submit also conference proceedings

No

Primary authors: LENA, Francesco (BRAZILIAN SYNCHROTRON LIGHT LAB - LNLS/CNPEM); GERALDES, Renan Ramalho (BRAZILIAN SYNCHROTRON LIGHT LAB - LNLS/CNPEM)

Co-authors: Mr PEREIRA, Erik (BRAZILIAN SYNCHROTRON LIGHT LAB - LNLS/CNPEM); Mr DEL NERO, Filipi (BRAZILIAN SYNCHROTRON LIGHT LAB - LNLS/CNPEM); Mr BASILIO, Gabriel (BRAZILIAN SYNCHROTRON

LIGHT LAB - LNLS/CNPEM); Mr BRUNHEIRA, Gabriel (BRAZILIAN SYNCHROTRON LIGHT LAB - LNLS/CNPEM); TOLENTINO, HÉLIO (BRAZILIAN SYNCHROTRON LIGHT LAB - LNLS/CNPEM); Mr BITTELI FRANÇA, Joao Vitor (BRAZILIAN SYNCHROTRON LIGHT LAB - LNLS/CNPEM); Mr PERISSINOTTO, Lucas (BRAZILIAN SYNCHROTRON LIGHT LAB - LNLS/CNPEM); Mr SIQUEIRA DA SILVA, Matheus Henrique (BRAZILIAN SYNCHROTRON LIGHT LAB - LNLS/CNPEM); Mr MACHADO, Michel (BRAZILIAN SYNCHROTRON LIGHT LAB - LNLS/CNPEM); Mr PROENÇA, Pedro (BRAZILIAN SYNCHROTRON LIGHT LAB - LNLS/CNPEM); Mr GOMES, Rodrigo (BRAZILIAN SYNCHROTRON LIGHT LAB - LNLS/CNPEM); Mr FALCHETTO, Vinicius (BRAZILIAN SYNCHROTRON LIGHT LAB - LNLS/CNPEM); Mr MARINO, Yago (BRAZILIAN SYNCHROTRON LIGHT LAB - LNLS/CNPEM)

Presenter: GERALDES, Renan Ramalho (BRAZILIAN SYNCHROTRON LIGHT LAB - LNLS/CNPEM)

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