



Contribution ID: 69 Contribution code: TUO05

Type: Contributed Oral Presentation

## The design of SIBIPIRUNA, a cryogenic soft X-ray tomography beamline with BSL2, BSL3 and BSL4 compatibility for Sirius and Orion at CNPEM

*Tuesday 16 September 2025 14:20 (20 minutes)*

Recent outbreaks of emerging infectious diseases have highlighted the need for enhanced biosafety measures and research capabilities. Addressing this, the Brazilian Center for Research in Energy and Materials (CNPEM) is spearheading the development of Orion, Latin America's first facility to host a Biosafety Level 4 (BSL4) laboratory\*. More ambitiously, Orion will pioneer a groundbreaking global achievement: the integration between BSL4 areas and synchrotron beamlines. A connection between Orion and the 4th-generation storage ring Sirius/LNLS\*\* will enable unprecedented X-ray bioimaging opportunities in soft, tender and hard X-rays, with a program covering cells, tissues up to entire organisms. At the lower energy range, the SIBIPIRUNA beamline will allow for 3D imaging of infected single cells using cryogenic soft X-ray tomography. With a resolution target of 30nm, rapid full tomography time around 5 to 10 minutes, and whole unstained samples, unmatched detailed studies of viral infection mechanisms will be unlocked. This work describes the design of the beamline and its end-stations, highlighting their compatibility and compliance with biocontainment and decontamination needs.

### Footnotes

\* M. Rodrigues, 2024, Nature 632.8027

\*\* L. Liu et al., 2023, Proc. 14th Int. Particle Acc. Conf., pages 2586–2589

### Funding Agency

Brazilian Ministry of Science, Technology and Innovation (MCTI)

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**Session Classification:** Beamlines Session 1

**Track Classification:** BEAMLINES: Beamlines and Instruments