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Brazilian synchrotron light laboratory. history and scientific challenges for crystallographers

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In 1982 a group of scientists of the Brazilian Center for Physical Research, Rio de Janeiro, started a viability study and promoted an open discussion involving all scientific community about the construction of a synchrotron light source in Brazil [1]. Later on, the Brazilian National Science Council (CNPq) created the National Synchrotron Light Laboratory (LNLS). After an open bidding for hosting this new national laboratory, the CNPq privilegiated the proposal from Campinas - Sao Paulo State, where LNLS began its activities in 1987. Starting from scratch, the LNLS staff designed, produced most of the components and built up a second-generation synchrotron source, a 1.37 GeV electron storage ring named UVX. The UVX photon source was commissioned and open to users together with the first set of seven beam lines in July 1997 [2]. At that time, the UVX ring was the only synchrotron source in operation in the southern hemisphere. Because of the rather low electron energy of the UVX storage ring, the critical photon energy associated with its emission spectrum is also low (Ec=2.08 KeV); thus the maximum flux lies within the soft X-ray energy range. In spite of this drawback for hard X-ray users, it should be pointed out that among 17 beam lines currently in operation at LNLS, 13 of them are X-ray beam lines while only 4 provide users with VUV and IR photons; this reflects the preference of the scientific community for the use of X-rays. Particularly, a high number of crystallographers from Brazil and abroad have conducted, during the last 20 years, many research projects at LNLS using XRD, SAXS and EXAFS beam lines. After open discussions with the community of users, the LNLS staff started a few years ago the design and construction of a new 3.0 GeV electron storage ring named Sirius [3], which will be in operation by 2019 and will replace the current 1.37 GeV UVX source. Sirius - a modern fourth-generation photon source - will allow for a number of novel and interesting experiments which are not now possible using the UVX source. Since the electron energy of Sirius is higher than that of UVX, the new synchrotron source will provide to users with a much higher flux of high energy photons. Additionally, its extremely low emittance (0.25 nmrad instead of 100 nmrad of the UVX source) will make it possible to install X-ray undulators, apply coherence properties of the photon beams and analyze very small (nanometric) sample volumes. Certainly, the forthcoming availability of Sirius will open bright perspectives and challenging opportunities to crystallographers. However, in order to achieve efficient use of fourth-generation photon sources for novel experiments, crystallographers will need to know and understand the new pertinent theories and methods for data analysis, be aware of required procedures for big data processing and be prepared for proper use of new extremely stable optical components and modern X-ray detectors with very high spatial and time resolutions.

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