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IFIN-HH/ELI-NP Training and Conference Center  
Sydney Benjamin Galès / main conference hall

# Extreme Light Sources at CERN: From Compact X-ray Sources to the Gamma Factory

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The unique combination of ultra-relativistic particle beams and laser technology at CERN opens new frontiers in the generation of extreme light, spanning photon energies from the extreme ultraviolet to the  $\gamma$ -ray regime. This seminar presents recent progress and future prospects for laser-beam interaction experiments within the CERN accelerator complex, focusing on two flagship initiatives: the Gamma Factory proof-of-principle experiment at the Super Proton Synchrotron and a compact inverse Compton scattering (ICS) X-ray source under construction at the CLEAR facility.

The Gamma Factory concept exploits resonant laser excitation of ultra-relativistic partially stripped ions to produce unprecedented fluxes of narrowband high-energy  $\gamma$ -rays, with potential extensions to secondary particle sources such as positrons, muons, and neutrinos. Achieving this requires the development of ultra-low-noise, high-average-power ultrafast laser systems capable of operating in harsh radiation environments. In parallel, the ICS program leverages compact X-band electron linacs and cavity-enhanced burst-mode lasers to deliver high-brightness X-ray beams with energies up to the MeV scale, targeting applications ranging from medical therapy to fundamental nuclear physics.