Contribution ID: **296** Type: **Contributed**

Intensity Tuning of X-Ray Laser Photon Pulses with Rarefied Gases: The SASE3 Beamline Gas Attenuator at the European XFEL Facility.

Thursday 21 June 2018 09:50 (20 minutes)

The European XFEL is a 3.4 km long branched underground facility that generates extremely intense X-ray flashes to be used by researchers from all over the world. Located in the Hamburg urban area, it officially began operation in September 2017, and the first experiments are running as scheduled since then. Located at the soft X-ray beamline (SASE3), a gas-based intensity modulation cell is currently being commissioned: the so-called "SASE3 Gas Attenuator" beamline sector comprises almost a 25 m long system that enables the tuning of the transferred photon intensity without compromising the outstanding coherence properties of the beam or collimating it.

This is achieved by a large static clear aperture (20 mm nominal diameter) and windowless transition between the active cell and the rest of the X-ray beam transport system. The complete sector has been qualified as UHV with a base pressure below 5 x 10-9 mbar when there is no gas injected. Also, the active cell can be brought up to 35 mbar, while two symmetrical four-stage differential pumping modules keep the interface pressure with the next vacuum sector below 5 x 10-8 mbar. It is designed to operate with up to 5 selectable gas species (N2, Ar, Kr, Ne, Xe).

To provide the highest pressure control precision, an in-house feedback control system has been developed. Since the device will be used for many and diverse types of experiments, it needs that the subsystems used for the precise pressure measurement and the regulation of the injected gas flow are flexible enough. In this case, two device arrays, one of capacitive vacuum gauges and another of mass flow controllers are working in coordination to extend their intrinsic precision to the required large dynamic range. At the same time, to limit the gas flow transferred from the active gas cell, an effective but easy variable aperture system has been implemented. The first experiments with beam are expected for the second half of 2018.

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Session Classification: Vacuum in Accelerators

Track Classification: Vacuum in Accelerators