Contribution ID: **86** Type: **Poster (preferred)**

Diagnostic beam dump design for the EuPRAXIA@SPARC_LAB project

Wednesday, 29 May 2024 19:08 (6 minutes)

EuPRAXIA is the first European and world-wide project that develops a dedicated particle accelerator research infrastructure based on novel plasma acceleration concepts and laser technology. The project EuPRAXIA@SPARC_LAB, which will be built at the Frascati National Laboratories, aims at constructing a FEL radiation source based on RF linear accelerator combined with a plasma module. The linear accelerator consists of two fundamental components: a 3 m long accelerating cavity in S-band located at the beginning of the line, which accelerates electrons up to 300 MeV, and a subsequent series of 8 X-Band accelerating structures that allow accelerating the primary beam up to 800 MeV, in an intermediate section of the line, and up to 1.2 GeV at the FEL entrance. According to the design parameters, the EuPRAXIA@SPARC_LAB FEL will provide more than 1011 photons/pulse with a pulse duration of less than 50 femtoseconds. A wide class of experiments will benefit from these brilliant, soft X-ray FEL pulses using X-ray absorption and emission spectroscopies and X-ray resonant Raman scattering. The energy range of this FEL beam will allow performing spectroscopic experiments looking at the K-edges of "light"atoms, such as carbon and nitrogen, and at the L-edges of "heavy"atoms, including some 3d transition metals.
In this work, some of the radiation protection studies conducted for the realization of the authorization procedure are reported, focusing particularly on the diagnostic beam dumps design placed along the LINAC, which are used in alignment operations and primary beam studies.
Part of these studies, performed by the Monte Carlo code FLUKA, involves the analysis of three different cases corresponding to the different energies that can be reached during acceleration (300, 800, and 1200 MeV). The spatial distributions of the photon and neutron ambient dose equivalent were estimated through Monte Carlo simulations, assuming scenarios of interaction between the primary electron beam and the diagnostic beam dumps. The structure of the proposed dumps was designed to achieve ambient dose equivalent values below 1 μSv/h in areas near the bunker, thus enabling their classification as freely accessible areas or, at most, as supervised areas, according to the provisions of the current national regulations (Legislative Decree 101/2020).

Scientific Topic 1

Source terms, new accelerator facilities and related topics

Scientific Topic 2

Scientific Topic 3

Scientific Topic 4

Scientific Topic 5

Scientific Topic 6

Scientific Topic 7

Scientific Topic 8

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Session Classification: Poster Session