Shielding and Radiation Protection for a Compact Inverse Compton Backscattering X-rays Source, ThomX

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Abstract

ThomX [1] is a particle accelerator dedicated to the production of high flux and high-energy X-rays (flux up to 10^{13} photon.s^{-1} – energy up to 90 keV) using Inverse Compton backscattering effect between an electron beam and a highly amplified laser (with the help of a Fabry-Perot cavity [2]). Shielding has been designed to comply with many constraints regarding the surroundings and the technical specificities of the machine. This presentation shows how the multipurpose Monte-Carlo code FLUKA [4] [5] helps studying miscellaneous topics among those raised by the building of a particle accelerator, above all regarding radiation protection, safety and environmental protection. An overview of the validation campaign will be described too, as the Thomx commissioning will begin at the first semester of 2019.

ThomX will be used in the same room as another particle accelerator, Andromede [3], which is a Secondary Ion Mass Spectrometer (SIMS) using a Van der Graaf generator. Thus, hutches had been designed in order to use both plants independently ensuring an ambient dose rate inferior to 5 µSv.h^{-1} outside the hutches even if both accelerators are on. As the total weight of the shielding is limited by the maximum load of ground, the width of the walls of the ThomX hutch had been optimized, leading to the reduction of 350 tons of concrete compared to the first design [6]. In a same goal, local shielding was designed to reduce radiological impact on workers. Environmental issues were studied, for instance the radiological impact of air release coming from the hutch when the accelerator is used had been assessed, or the radioactive waste production.

References

[1] A. Variola, J. Haissinski, A. Loulergue et F. Zomer, ThomX : Technical design report, Orsay: LAL, 2013.

[2] J. Bonis, R. Chiche, R. Cizeron, M. Cohen, E. Cormier, P. Cornebise, N. Delerue, R. Flaminio, D. Jehanno, F. Labaye, M. Lacroix, R. marie, B. Mercier, C. Michel, Y. Peinaud, L. Pinard, C. Prevost, V. Soskov, A. Variola et F. Zommer, «Non-planar four-mirror optical cavity for high intensity gamma ray flux production by pulsed laser beam Compton scattering off GeV-electrons,» *Journal of instrumentation*, Janvier 2012.

[3] A. Ferrari, P. R. Sala, A. Fasso et J. Ranft, FLUKA : a multi-particle transport code, Genève: CERN, 2011.

[4] T. T. Bölhen, F. Cerutti, M. P. Chin, A. Fasso, A. Ferrari, P. G. Ortega, A. Mairani, P. R. Sala, G. Smirnov et V. Vlachoudis, «The FLUKA Code: Developments and Challenges for High Energy and Medical Applications,» *Nuclear Data Sheets*, vol. 120, pp. 211-214, June 2014.

[5] M. J. Eller, E. Cottereau, V. Verkhoturov, A. Delobbe, J. Renaud, E. A. Schweikert et S. Della-Negra, *Andromede Project : Surface analysis and nano-particle surface interactions in the keV to Mev Energy Range*, Leuven, 2014.

[6] J.-M. Horodynski et S. Wurth, «Shielding Design and Radioprotection for Andromede and ThomX accelerators,» chez *EPJ Web of conferences - ICRS13-RPSD2016*, Paris, 2016.

[7] A. Fasso, A. Ferrari, J. Ranft et P. R. Sala, «FLUKA : Performances and applications in the intermediate energy range,» chez *Proceedings of the first AEN/NEA specialists meeting on shielding aspects of accelerators, targets and irradiation facilities (SATIF 1)*, Arlington, 1995.

■ **Presentation: Oral ( ), Poster (X)**

■ **Select Topic category (**Shielding and dosimetry**)**