Proposition de sujet de stage M2 (2021) à l'Institut de Pluridisciplinaire Hubert Curien (IPHC)

Assessment of scintillating detectors for space radiation protection

The growing interest for exploratory space missions on Mars drives the necessity of the accurate characterization of the space radiation environment. Indeed, the main hindrance to long-duration interplanetary missions is the important exposure of astronauts to galactic cosmic rays (GCR). This radiation fields characterization is currently mainly achieved with computational models and Monte Carlo simulations. Although important improvements have already been done in these models, a significant lack of cross sections data of high-energy and charge particles (HZE) on tissue equivalent targets still exists.

In this context, the DeSIs group of IPHC laboratory is developing an experimental setup allowing the measurements of total and double differential cross sections ($d^2\sigma/dEd\theta$) of HZE nuclear reactions on targets of interest for spacecraft shielding (graphite, PMMA, Al_2O_3, …). This setup will consist in a ΔE-ToF (Time of Flight) telescope, made by two plastic scintillators and a $CeBr_3$ crystal. The start signal for the time measurement will be achieved by a plastic scintillator located upstream from the target, and the stop by the crystal detector (placed after the target). This telescope will achieve the secondary charged particles identification, as well as the measurement of the kinetic energy of the impinging particle. Another plastic scintillator, called veto, will be placed in front of the $CeBr_3$ in order to discriminate neutrals from charged particles. Thanks to this veto, the crystal scintillator will also be able to measure the high-energy secondary neutrons and γ-ray spectra. The secondary neutrons of low energy will be measured by a recoil proton telescope (RPT) developed by our group , placed at symmetrical angle from the ΔE-ToF apparatus.

This internship aims at characterizing the plastic scintillators and $CeBr_3$ detectors of this project. The candidate will have to calibrate the detectors with radioactive sources, and will also have to carry out a beam test at Cyrcé cyclotron, where the full setup will be tested with the 25 MeV proton beam. An important part of the work will also be the comparison between the obtained data with Monte Carlo simulations performed with Geant4. This internship might be pursued by a PhD thesis.

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