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Measurements and FLUKA simulations of aluminium, bismuth and indium activation by stray radiation from the annihilation of low energy antiprotons

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The Antiproton Decelerator at the CERN Proton Synchrotron complex provides antiprotons at a kinetic energy of 5.3 MeV to several experiments where the antiprotons finally annihilate. The stray radiation from these annihilations is the most important radiation field with respect to radiation protection in the Antiproton Decelerator experimental areas.

In August 2018, aluminium, bismuth and indium samples were exposed to the annihilation stray radiation. The activation experiment was performed with antiprotons being directed onto a closed vacuum valve, that acts as beam stopper. The average beam intensity amounted to 2.59E+7 antiprotons per pulse with one pulse every ~100 seconds. The samples, placed upstream of the vacuum valve, were irradiated for ~3 hours by the secondary radiation field. The resulting induced radioactivity of Na-24, Bi-201, Bi-202, Bi-204 and In-115m was measured by γ-ray spectrometry and compared to the predictions of FLUKA Monte Carlo simulations. In addition, dedicated FLUKA simulations were performed to assess the contribution of neutrons in the activation process.

The observed agreement between the FLUKA predictions and the measured values is better than a factor of 2. This agreement demonstrates that FLUKA is a very suitable tool for describing the stray radiation from the annihilation of low–energy antiprotons.

Presenters: INFANTINO, Angelo; AHDIDA, Claudia; ILIOPOULOU, Elpida; FROESCHL, Robert; JENSEN, Simon

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