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γ-electron coincidence measurements with the BeGam set-up on the 70Zn(p,x) reaction products

The Florence group is involved in a project (BeGam) aimed at the implementation of a portable device for the detection of β emitting contaminants in radiotracers used in medical diagnostics from Nuclear Medicine imaging. Its use is particular important when the radionuclide is produced in a nuclear reaction induced by medical cyclotrons. The BeGam project focuses on techniques for identifying contaminants in radiopharmaceuticals employing scintillator detectors. The approach involves coincidence and anti-coincidence measurements of γ and β radiations. A first prototype of the BeGam detector has been realized. In this design, four cylindrical slices of cesium iodide (CsI) surround a plastic scintillator. Each CsI sector measures 50 mm in height with a thickness of 133 mm. Two different plastic scintillators can be used, both of them with a height of 50 mm and an external diameter of 33 mm; however, one has a thickness of 4 mm, while the other is 13 mm thick.

The light produced by the scintillators is collected using silicon photon multipliers (SiPMs).
The energy spectra are acquired using a CAEN digitizer, which performs pulse height analysis (PHA), and a multiparametric DAQ software which allows time correlation between different channel to perform coincidence or anti-coincidence analyses.
Experimental measurements conducted using a ^{207}Bi radioactive source have validated the detector's capability for coincidence spectroscopy, thereby demonstrating the feasibility of the system for isolating and quantifying contaminants with this technique.

We propose to use the proton beam from the SPES Cyclotron to test BeGam in a more realistic situation. We plan to merge these measurements with an experimental campaign in the framework of the SPES_MED project, already approved by the INFN-CSN3 (2025-2027). Among all the proposed reactions to study the production of medical radioisotopes, the ^{70}Zn(p,x) will be measured with the SPES cyclotron in the energy range 30-50 MeV. This reaction is of particular interest to produce the ^{67}Cu isotope. We will perform a γ-electron coincidence measurement to identify it among the different isotopes produced in the reaction.

Primary authors: Dr NANNINI, Adriana (INFN); Dr CASINI, Giovanni (INFN); Dr MOU, Liliana (INFN); Dr DE DOMINICIS, Lucia (INFN); PERRI, Marco (Istituto Nazionale di Fisica Nucleare); Dr PIANTELLI, Silvia (INFN)

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