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Perspectives on the Measurement of Competitive Double Gamma Decay with the AGATA Tracking Array

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The competitive double gamma decay is a process which can be explained by the second order QED theory together with the knowledge of the nuclear structure of the decaying nucleus, making its study interesting under many aspects. Aside from the theoretical interest on this rare process, it also holds an experimental appeal as its low branching ratio puts to test all current measuring devices.
This rare decay was first observed in 137Cs with an array of LaBr3 detectors in a data taking time period of 50 days [1]. The innovative setup took advantage of the good timing properties of these scintillators to suppress the Compton background by gating on a small time difference between the events, effectively eliminating Compton scattered gamma rays from one detector to another and allowed also measurement of the angular distribution in two points.
The measurement of the process with the AGATA array [2], if achievable, would not only return more detailed physical information, namely on the energy and angular distributions, but also test the capabilities of this advanced gamma ray spectrometer. The main challenge that the measurement faces is the suppression of Compton events without relying on timing properties due to the resolution limitations of germanium detectors. We discuss the outcome of the simulated response of the detector to this type of event and a proposal of optimization of the array's tracking properties to reject unwanted events and correctly reconstruct the double decays. We thus try to asses whether the good energy resolution and spacial reconstruction properties of the detector together with a strict event selection and optimization are able to overcome the shortcomings and difficulties of the measurement. We discuss the results of this simulation approach, the difficulties and future prospects, complementing the simulated data with measurements taken with a source of 137Cs.

[1] C. Walz et al., Nature vol. 526, (2015) p. 406;
[2] S. Akkoyun et al., Nucl. Instr. and Meth., A668 (2012) p. 26.

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Nuclear Structure and Dynamics

Primary authors: GOASDUFF, Alain (Università di Padova - INFN Sezione di Padova); Mr BRUGNARA, Daniele (Università di Padova, INFN Laboratori Nazionali di Legnaro); VALIENTE DOBON, Jose' Javier (LNL)

Co-authors: MENGONI, Daniele (PD); Prof. PIETRALLA, Norbert (TU Darmstadt); Dr JOHN, Philipp (Institut fu¨r Kernphysik, TU Darmstadt); Mr NAPIRALLA, Philipp (Institut fu¨r Kernphysik, TU Darmstadt)

Presenter: Mr BRUGNARA, Daniele (Università di Padova, INFN Laboratori Nazionali di Legnaro)

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