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The FARCOS Project - A Femtoscope ARray for COrrelations and Spectroscopy

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Correlations between two or more particles emitted during a nuclear reaction provide tools to study time properties of the reaction and can be used as well to explore spectroscopic properties of exotic clusters. With the aim of studying two- and multi-particle correlation functions the FARCOS project (Femtoscope ARray for COrrelations and Spectroscopy) has been conceived as an array of double sided silicon strip detectors and CsI(Tl) crystals characterized by high angular and energy resolution. The array will address topics covering both nuclear dynamics and spectroscopy with stable and radioactive beams.
The array will address the study of correlation measurements in nuclear dynamics with the use of high resolution imaging techniques providing sort of “space-time” snapshots of particle and complex fragments emitting sources. These “space-time images” will be shown to probe the N/Z degree of freedom in nuclear reactions, providing important probes of the sub-saturation density dependence of symmetry energy.
In the very same collision events, several exotic nuclear fragments are produced. Most of them are unbound and can be studied by means of two- and multi-particle coincidence measurements. These measurements reveal the existence of resonances and provide important spectroscopic information on the explored unbound states such as their spin and their branching ratios with respect to specific and new decay channels.
The high resolution that is planned to be available with the Farcos array will allow performing important studies of exotic decay channels by means of the complete reconstruction of their final momentum vectors. These studies can also provide important information about the formation and decay of special cluster states in stable and exotic nuclei. Examples of applications in the decay of unbound states in 10C, 12C and other light nuclei will be shown and the perspectives offered by Farcos will be stressed.
An important aspect of Farcos will be represented by its pulse-shaping capabilities that will allow the detection and identification of particles and fragments moving at low energies and stopped in the first layer of the silicon strip detector. These pulse-shape techniques will be of fundamental importance in order to study particle correlations even in low energy reactions. The electronics under development will play a special attention to new technologies in generic and integrated electronics.
The modularity of FARCOS will allow coupling it to other devices such as 4π detectors and magnetic spectrometers. The possibility of coupling to neutron detector arrays to perform high resolution proton-neutron correlation measurements is also under consideration.
The Farcos project aims at providing important perspectives for studies at the future European radioactive beams facilities such as Spiral2, Spes and Eurisol, both in the field of nuclear dynamics and spectroscopy.

Summary

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