

From exotic atoms at accelerators to impossible atoms in the Gran Sasso

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I shall present a series of frontier experiments measuring X rays coming from exotic atoms produced at accelerators and from impossible atomic transitions we are searching for in the Gran Sasso underground laboratory and which might exist if the actual Quantum Mechanics theory is only an approximation of a theory yet to be discovered.

In the first part of the talk I shall introduce the studies of kaonic atoms in the framework of the SIDDHARTA collaboration at the DAFNE Collider at the LNF-INFN, Frascati (Roma) laboratory. Combining the excellent quality kaon beam delivered by the DAΦNE collider with new experimental techniques, as fast and very precise X ray detectors, like the Silicon Drift Detectors, we have performed unprecedented measurements on kaonic hydrogen and helium. Presently, a major upgrade of the setup, SIDDHARTA-2 is being realized to perform in the coming year(s) the first ever measurement of kaonic deuterium. Kaonic atoms studies represent an opportunity to unlock the secrets of the strong interaction in the strangeness sector and understand the role of strangeness in the Universe, from nuclei to the stars.

In the second part of the talk I shall present the VIP experiment at the LNGS underground laboratory searching for “impossible atoms”, i.e. atoms prohibited by the Pauli Exclusion principle, which might exist in some theories beyond the Standard Model. Also, I shall briefly discuss the search of the so called spontaneous radiation linked with collapse models dealing with the “measurement problem” (Schroedinger’ cat paradox) and the interplay with gravity.

Short CV:

Catalina Curceanu obtained her PhD in physics from Institute of Physics and Nuclear Engineering of Bucharest, Romania, in 1999, with a PhD thesis dedicated to the study of exotic mesons within the OBELIX experiment at CERN. She is working at Laboratori Nazionali di Frascati (LNF), INFN, Italy, having a position of Senior Researcher and leading a group of researchers performing experiments both in Italy and abroad. Her main scientific interests are in the fields of low energy QCD, strangeness nuclear physics, meson spectroscopy and foundational physics (quantum mechanics). Currently, she is the spokesperson of the SIDDHARTA-2 (spectroscopy of kaonic atoms) and VIP2 (experimental test on the Pauli Exclusion Principle violation by electrons) collaborations. She is author of more than 300 peer reviewed articles and won various awards and prizes, among which awards from the John Templeton Foundation and from the Foundational Question Institute (FQXi) for projects on quantum mechanics and the 2017 Emmy Noether prize from the European Physical Society.