Towards reliable nuclear matrix elements for neutrinoless double-beta decay

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Thursday, March 15, 2018 - 3:45pm to 4:45pm
NPL Conference Room, Rm 178

Observing neutrinoless double-beta (0nbb) decay is the most promising way to detect lepton number violation in the laboratory, and it would imply that neutrinos are its own antiparticle. The decay half-life naturally depends on a nuclear matrix element that needs to be calculated theoretically. A good knowledge of this matrix element is key for the planning of 0nbb decay experiments, and also to extract information on the neutrino mass once 0nbb decay is observed. At the moment, predicted matrix-element values depend on the many-body method used to calculate them and, in addition, they may need to be “quenched”, as the matrix elements of other beta decays that, however, have a very different momentum-transfer regime. I will discuss recent efforts towards obtaining reliable nuclear matrix elements, ranging from improved calculations with standard many-body approaches, to the first application of “ab initio” many-body methods to 0nbb decay, finalizing with possible measurements that could be very useful to test calculations and to constrain the value of the 0nbb matrix elements.