Cross-fertilization of magnetic confinement fusion research, nuclear and sub-nuclear physics and accelerator science

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Apart from well-known fusion cross-sections, the study of magnetized fusion plasmas has apparently little in common with nuclear and sub-nuclear research and with accelerator science. At a closer look, however, there are commonalities in the instrumentation used (accelerators, detectors) and mutual influence in the physics studied (plasma effects in nuclear measurements, and nuclear and sub-nuclear phenomena in plasma experiments), not to mention that several ion-sources for accelerators are plasma-based. This talk will commence by briefly presenting the state of the art in fusion research, to then focus on such commonalities and mutual influence. Theoretical examples include the effect of electron screening on nuclear reactions and alpha decay, the interplay between magnetic reconnection and cosmic rays, the extension of plasma concepts to quark-gluon plasmas and the expected pair-production in fusion plasmas, as a consequence of the generation of multi-MeV “runaway” electrons. Experimental and technological examples include accelerator-based neutral-beam-injectors for plasma heating, sub-critical fission reactors, recent accelerator developments to study plasma-wall interaction under fusion reactor conditions, the use of “trace” amounts of T in D-T fusion plasmas and the development of the first toroidal electron cyclotron resonant ion source.