The relation of nuclear physics to particle physics

"Elementary particle physics" and nuclear physics began to separate in the 1950s and after the middle of the sixties took widely different directions. Whereas particle physics concentrated more and more on classifying and understanding the fundamental interactions and thereby intensified the reductionist attitude of physics ("the simpler the structure of an object, the better the chances to understand its properties"), nuclear physics – like solid state physics – had to deal with complex relations between complex systems. This situation called for useful phenomenological models — it was the heyday of "nuclear models".

A small number of nuclear physicists – led by my teacher Amos de-Shalit, who died much too young in 1969 – began to reverse this approach and to study the complexity of nuclear structures with the more transparent methods of particle physics. A typical example is the "double charge exchange" of pions, e.g. the reaction $\pi^- + 2p \to \pi^+$, whose investigation Amos de-Shalit and I proposed as early as 1963 — a method that by now has become routine for directly 'measuring' proton correlations in nuclei.

From this and similar questions there emerged in the subsequent years an interesting, but strangely hybrid area of research between nuclear and particle physics which came to be known as "intermediate energy physics" and, presumably due to its hybrid character, was considered as being somewhat outside of the mainstream, from the point of view of both particles and nuclear physics.

Recently, however, the hybrid has entered the spotlight of physics because it became possible once again to turn the tables: to ask (and answer!) fundamental questions of particle physics by investigating *complex nuclear* phenomena. The "ultrarelativistic heavy ion" research which emerged in the nineties deals with the physics of collisions of heavy and very energetic atomic nuclei, and promises insight not only into the validity of QCD ("quantum chromodynamics"), but, perhaps more importantly, into cosmology and a more detailed understanding of the genesis of the universe in a Big Bang. In the form of ultrarelativistic heavy ion physics, nuclear physics is currently experiencing a renaissance, and it is fascinating to observe, even from an epistemological point of view, how in this area – through studies of what elementary particle physicists might have discarded as "dirty physics" only a few years ago – nuclear physics and elementary particle physics seem to coalesce again.

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