Fusion reactions involving radioactive beams at GANIL

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The ISOL type SPIRAL facility at GANIL has been commissioned recently and delivers radioactive beams for physics since a couple of years. A priori, because of the low cross section as compared to other processes like electromagnetic dissociation or Coulomb excitation, the fusion reaction mechanism is not the more adapted to the use of radioactive beams. However, despite many difficulties arising from both the complexity to produce good beam quality and to setup the appropriate detection system, the first experiments with SPIRAL have demonstrated the feasibility of such studies.

Radioactive beams produced with a reasonable intensity like ^{76}Kr for instance associated with the fusion-evaporation mechanism have been used to investigate nuclei toward the proton drip line. The structure of nuclei around ^{130}Sm is such that it can be compared to some superdeformed bands in Ce or Nd isotopes. In particular self consistent Hartree-Fock-Bogolyoubov calculations predict their *ground state* quadrupole deformation to be $\beta \sim 0.40$. Spectra from this experiment show that it is possible to populate in a rather short run the most neutron deficient isotopes.

Fusion reactions involving nuclei with loosely bound neutrons like ^{6,8}He have concentrated a lot of efforts both because of the halo character of these nuclei and the "extreme" isospin in the case of ^{8}He. Attempts have been made to populate high spin states in the Po-At region where phenomena like octupole correlations, mutiparticle excitations and isomers are expected to occur.

Some emphasis will be put on an experiment which has used such beams to investigate the influence of their extended neutron distribution on the fusion cross section around the Coulomb barrier. Theoretical approaches in this domain are rather contradictory in their predictions. The role of break-up for instance on the fusion cross sections, expected to be crucial for weakly bound systems, is very different when using optical models or coupled channel calulations.

One way to probe the influence of the nuclear structure on the fusion mechanism is to use various projectile-target combinations leading to the same ^{196}Pt compound nucleus. This is what we have done at GANIL using ^{6,8}He beams from SPIRAL. In this experiment, complete and break-up fusion cross sections have been deduced at different energies around the Coulomb barrier from in-beam γ-decay of the residues measured with EXOGAM. Comparisons with an earlier experiment $\alpha+^{192}Os$ leading also to ^{196}Pt and made at the Pelletron accelerator (Mumbai, India) have been made and gives experimental indications on the role of break-up.