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Recent data on fusion far below the barrier for 12C + 28Si

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Heavy-ion fusion reactions are essential to investigate the fundamental problem of quantum tunnelling of many-body systems in the presence of intrinsic degrees of freedom. Studying the fusion of light systems with Q > 0, and the identification of hindrance [a] requires challenging measurements. The investigation of slightly heavier cases allows a reliable extrapolation towards the lighter astrophysical systems.
We measured the fusion excitation function of ^{12}C + ^{28}Si down to hundreds of nanobarn, using ^{28}Si beams from the XTU Tandem accelerator of LNL. The combined setup of the γ-spectrometer AGATA [b] and two DSSD [c] around the target, was used. The fusion-evaporation charged particles were detected by the DSSD. The prompt γ-rays emitted by the evaporation residues (ER) were detected by AGATA. The fusion cross-sections are obtained from the coincident events between γ-rays and charged particles.
The light-charged particles have been identified through pulse shape discrimination, using their energy E_{part} vs the rise time of the signal *psd* (left figure). The matrix on the right combines the coincidence events between the energies of γ-rays and charged particles, detected by one ring of the forward DSSD, at E_{lab}=50 MeV. The main transitions from the ER are identified. Neutron evaporation could not be observed, but it is calculated to be not more than a few per cent for this system in the measured energy range.
Preliminary analyses provide very promising results in the study of fusion cross sections for ^{12}C + ^{28}Si and other light systems at deep sub-barrier energies. The final results of this experiment will be shown.

Figure
[a] C.L. Jiang et al., Phys. Rev. Lett. 89, 052701 (2002)
[b] J.J. Valiente-Dobon et al., Nucl. Inst. Meth. Phys. Res. A 1049, 168040 (2023)
[c] http://www.micronsemiconductor.co.uk

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