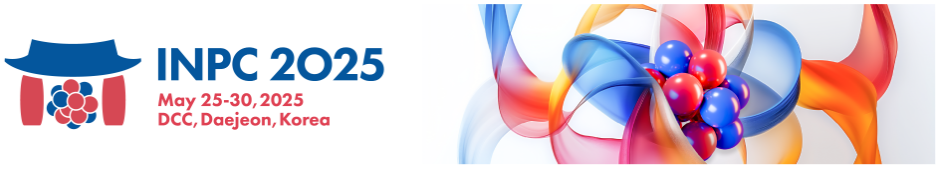

Contribution ID: **511** Type: **Contributed Poster Presentation**

Low-energy fusion of doubly magic nuclei: the remarkable case of 16O + 48Ca

Near- and sub-barrier fusion reactions [1,2] between doubly magic nuclei are important benchmarks for theoretical models to reproduce the experimental evidence. The cases of 16O + 16O, 48Ca + 48Ca, and 16O + 208Pb have been measured. We add 40Ca + 90Zr even if Z=40 is not a major shell closure. 48Ca + 208Pb populates superheavy nuclei and involves different features.
Surprisingly, no relevant data are available for 16O +48Ca (where Qfus is as large as +18.14 MeV). Qualitative considerations suggest that this case should follow a trend similar to the cited doubly magic systems (see [3]). However, this might be disproved by the experiment, possibly due to the very large positive fusion Q-value and/or to the existence of hindrance with a high energy threshold.
The experiment was recently performed at the XTU Tandem of LNL. 16O beams, with intensities up to ~20 pnA, were used in the range of 24-42 MeV. Thin 48Ca targets 50 □g/cm2 were used, with isotopic enrichment of 97%.
The evaporation residues (ER) were detected by the electrostatic deflector set-up PISOLO at 2o-3o forward angles, and identified by their energy and
the two independent time-of-fights, between the final Si detector and two MCP detectors. A good beam rejection factor has been achieved, so clean E-ToF spectra have been obtained.
The data analysis is in progress, as well as the comparison with the results of coupled-channels (CC) calculations. A preliminary excitation function has been extracted sofar, showing a regular trend down to ~1 □b. One observes a small sub-barrier fusion enhancement, as a consequence of the very stiff structure of the two colliding nuclei.
Together with the corresponding astrophysical S-factor, the excitation function shows that the fusion hindrance phenomenon is clearly observed, with a rather high energy threshold where the fusion cross section is in the range 1-10 mb. The final results of the experiment will be presented at the Conference, including a detailed analysis within CC models.

[1] C.L.Jiang, et al., Eur.Phys.J.A 57, 235 (2021).
[2] G. Montagnoli and A.M. Stefanini, Eur. Phys. J A 59, 138 (2023).
[3] A.M. Stefanini, et al., Scientific Reports 14, 12849 (2024).

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Session Classification: Poster Session

Track Classification: Nuclear Reactions