Towards the limits of stability - new decay study of the lightest mendeleviums

S. Kumar[1,2], D. Ackermann[1], J. Piot[1], D. Seweryniak[3], V. Karayonchev[3], S. Antalic[4], Ch. Stodel[1], B. Andel[4], A. Bahini[1], K. Bhatt[3], C. Burns[5], M. Carpenter[3], R. Chakma[3], A. Ertoprak[3], K. Hauschild[6], F.G. Kondev[3], A. Korichi[3,6], T. Lauritsen[3], A. Lopez-Martens[6], A. McFarlane[7], J. Mist[4], C. Mueller Gatermann[3], D. Potterveld[3], S. Raeder[8], W. Reviol[3], H. Savajols[1], N. Sensharma[3], R.S. Sidhu[9], M. Siciliano[3], and B. Sulignano[10]

[1] *Grand Accélérateur National d'Ions Lourds(GANIL), Caen, France*
[2] *University of Caen Normandie, Caen, France*
[3] *Argonne National Laboratory, Lemont, Illinois, USA*
[4] *Comenius University, Bratislava, Slovakia*
[5] *University of Massachusetts Lowell, Lowell, Massachusetts, USA*
[6] *IJC Lab, Orsay, France*
[7] *University of York, York, England*
[8] *GSI, Darmstadt, Germany*
[9] *University of Surrey, Guildford, UK and*
[10] *IRFU/DPhN CEA Scalay, France*

The exploration of neutron-deficient isotopes in the vicinity of the $Z = 100$ deformed shell gap, offers valuable insight into the nuclear structure and the boundaries of stability for nuclei with extreme neutron-to-proton ratios. To investigate the limits of stability and also the effects of the single-particle states on the decay modes of these nuclei, the neutron-deficient isotopes of mendelevium (^{244,245}Md) were the subject of study in two recent experiments at GSI[1] and Lawrence Berkeley National Laboratory (LBNL)[2,3]. The results of the two experiments initiated a debate[4] on the mass assignment of these observed isotopes of mendelevium.

The α-decay energies of the reported ^{244}Md events in the experiment at Berkeley were assigned to the neighboring isotope ^{245}Md in a contemporaneous as well as an earlier experiment at GSI[5]. To verify the published results from the recent Md experiments at LBNL and GSI, a new experiment was conducted in May-June, 2024 at the Fragment Mass Analyzer (FMA)[6] located at the Argonne Tandem Linear Accelerator System (ATLAS) facility of Argonne National Laboratory (ANL). In this experiment, instead of the two-step procedure applied at Berkeley[2,3], the mass (A) and α-decay energies (E_α) of the evaporation residues (ERs) were measured simultaneously. This was achieved using the mass-separation capability of FMA in conjunction with the focal plane decay station consisting of silicon detectors arranged in a box configuration surrounded by five germanium clover detectors.

The aim of this experiment was to resolve the discrepancy by assigning proper α-decay energies to the mass-identified isotopes of Md, and to establish a production cross-section for the isotope of Md under investigation. The first analysis of the data from the recent experiment indicates the occurrence of events at the utilized beam energy that correspond to the reported E_α of ^{245}Md. In this contribution, the results from the data analysis will be presented.

[1] J. Khuyagbaatar *et al.*, Phys. Rev. Lett. **125**, 142504 (2020)

[2] J. L. Pore *et al.*, Phys. Rev. Lett. **124**, 252502 (2020)

[3] J. M. Gates and J. L. Pore, Eur. Phys. J. A **58**, 1 (2022)

[4] F. P. Heßberger *et al.*, Phys. Rev. Lett. **126**, 182501 (2021)

[5] V. Ninov *et al.*, Zeitschrift für Physik A Hadrons and Nuclei **356**, 11 (1996)

[6] C. N. Davids *et al.*, Nucl. Instr. and Meth. B **70** (1992)