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How to precisely weight one of the most exotic nuclei

Over the past years, several technical developments in radioactive ion beam delivery and trapping have allowed the precise mass measurement of increasingly exotic nuclei, reaching both drip lines. Excessive surface-ionizable contamination, which often prevents measurements of exotic nuclei produced at low yield, however remained a constraint. This issue was recently medicated with the use, for the first time on-line, of an ion guide-laser ion source. This technique was used to achieve a 6-fold suppression of surface-ionized contamination resulting in the weighting of 21Mg and 20Mg, the most proton-rich nuclei to be trapped. Furthermore, both measurements resulted in a severe breakdown of the once robust isobaric mass multiplet equation (IMME). This equation, which relates the masses of isobaric analogue states, is an important tool for predicting unmeasured masses of nuclei near the proton drip line, such as two-proton radioactivity candidates. The significant departure from the quadratic form of the IMME that we observed cannot be accounted by shell model calculations, which could potentially point to new effects not included in sd-shell interactions. Hence, more precise experimental data of very proton-rich nuclei are required to help refine nuclear interactions and better predict the relationship between the masses of isobaric analogue states.