ORNL/UTK team maps the nuclear landscape

The Chart of Nuclides is bounded by drip lines, where nuclear binding ends. The placement of these limits of nuclear existence, usually estimated from theoretical models, is uncertain because of the extreme extrapolations involved. But, how uncertain is it?

The nuclear density functional theory, coupled with state-of-the-art computational tools, was used to estimate the borders of the nuclear landscape and elucidate its properties.

The theoretical error on the position of the neutron drip line was shown to grow steadily with distance from the valley of stability.

Model extrapolations turned out to be unexpectedly consistent between the current effective interactions, leading the team to estimate that the number of bound nuclei with Z between 2 and 120 is around 7,000.

"The results can provide an estimate of the theoretical uncertainty with which modern nuclear theory is able to predict a property as fundamental as the limits of nuclear existence."– Referee, *Nature* magazine
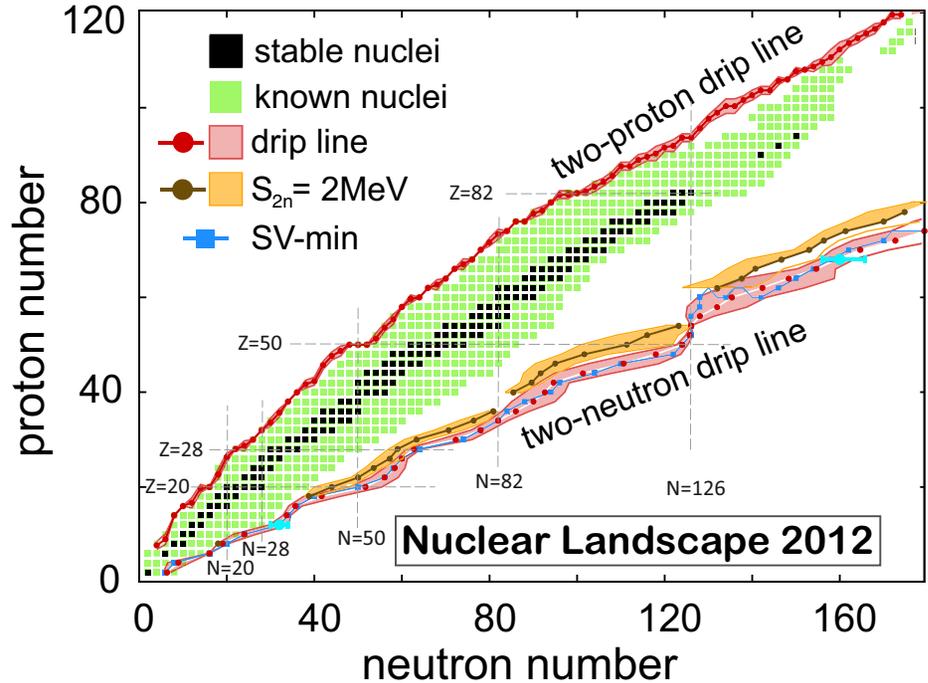
The limits of the nuclear landscape, J. Erler, N. Birge, M. Kortelainen, W. Nazarewicz, E. Olsen, A.M. Perhac, M. Stoitsov, Nature (2012)

Map of bound even-even nuclei as a function of the proton number Z and the neutron number N. There are 767 even-even isotopes known experimentally: both stable (black squares) and radioactive (green squares). Mean drip lines and their uncertainties (red) were obtained by averaging the results of different models. The two-neutron drip line of SV-min (blue) is shown together with the statistical uncertainties at Z=12 and 68 (blue error bars). The S_{2n}=2 MeV line is also shown (brown) together with its systematic uncertainty (orange).

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