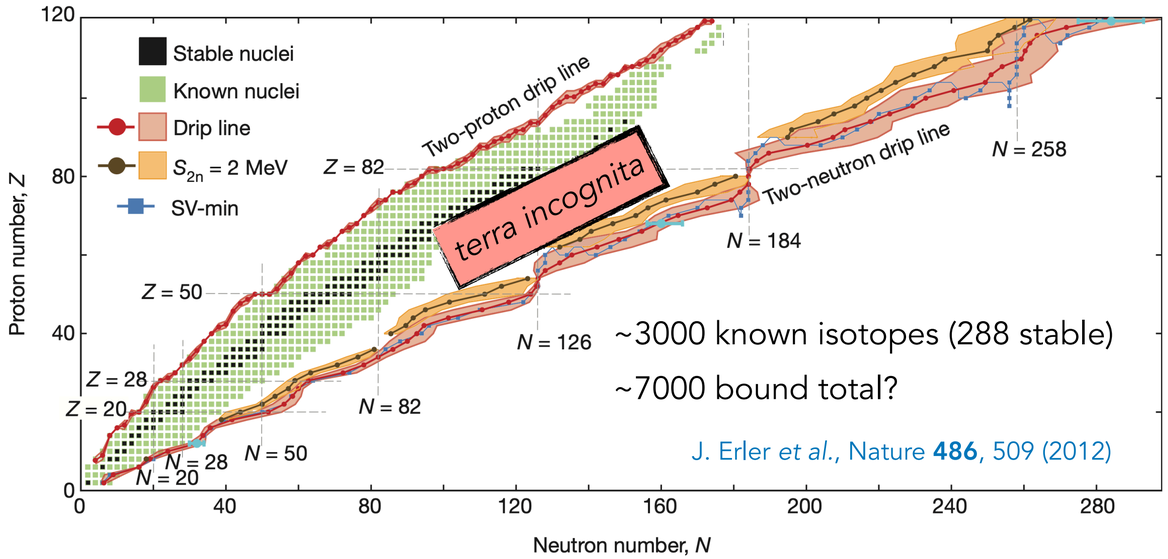
Going exotic: The case for the exploration of the drip lines

Big picture vision: Testing the limits of our knowledge, huge potential for discovery.



Active community around exotic nuclei as open quantum systems:

FRIB Topical Programs (51 co-authors total)

White paper: From bound states to the continuum

C. W. Johnson *et al.*, J. Phys. G **47**, 123001 (2020)

Perspectives on few-body cluster structures in exotic nuclei

D. Bazin *et al.*, arXiv:2211.06281 (2022)

Scientific and strategic relevance:

FRIB

- Aligned with FRIB mission.
- Strong international competition. We need to be the firsts (and bests)!
- Critical for nuclear astrophysics.

Many open questions: origin of emergent structures, origin of elements…

Several new hires in exotic nuclei physics:

G. Potel, S. König, C. Hebborn, K. Kravvaris, A. Mercenne… We work together!

Capitalizing on strong support:

U.S. DEPARTMENT OF ENERGY | Office of Science

NSF

K. Fossez, FSU - FRIB Bridge Argonne NATIONAL LABORATORY

DOE: DE-SC0013617 (Office of Nuclear Physics, FRIB Theory Alliance)

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Essential statements:

1. In the last half-century, the exploration of the drip lines has been **a driver behind theoretical, experimental, and technical advances**, and **lead to several important discoveries** (e.g. new types of radioactivity, halo structures) and to a deeper understanding of the atomic nucleus. **This scientific challenge is directly addressing fundamental questions** related to, for instance, the origin of the elements in the Universe, and the emergence of self-organized structures from QCD.

2. The coming online of FRIB will dramatically accelerate the exploration of the drip lines by giving access to more than a thousand new neutron-rich isotopes, for which almost no detailed theoretical predictions exist. It is thus imperative to **support theoretical research treating nuclei as open quantum systems and aiming at i) unifying nuclear structure and reactions, ii) understanding emergent properties and few-body effects in exotic nuclei, and iii) testing nuclear forces in extreme N/Z conditions.**

3. To ensure the success of the exploration of the drip lines and exploit its potential for discovery, fundings should be allocated to **theoretical programs and meetings fostering close collaboration between theory and experiment, notably through support to the FRIB Theory Alliance.**

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