# 2022.9.12 Group meeting

Reading Phys. Rev. Lett. 123 (2019) 212501

# Location of the Neutron Dripline at Fluorine and Neon

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# Overview

The neutron drip line has been confirmed up neon.

31F and 34Ne are the heaviest bound isotopes of fluorine and neon.

The existence of 32,33F and 35,36Ne have been excluded.

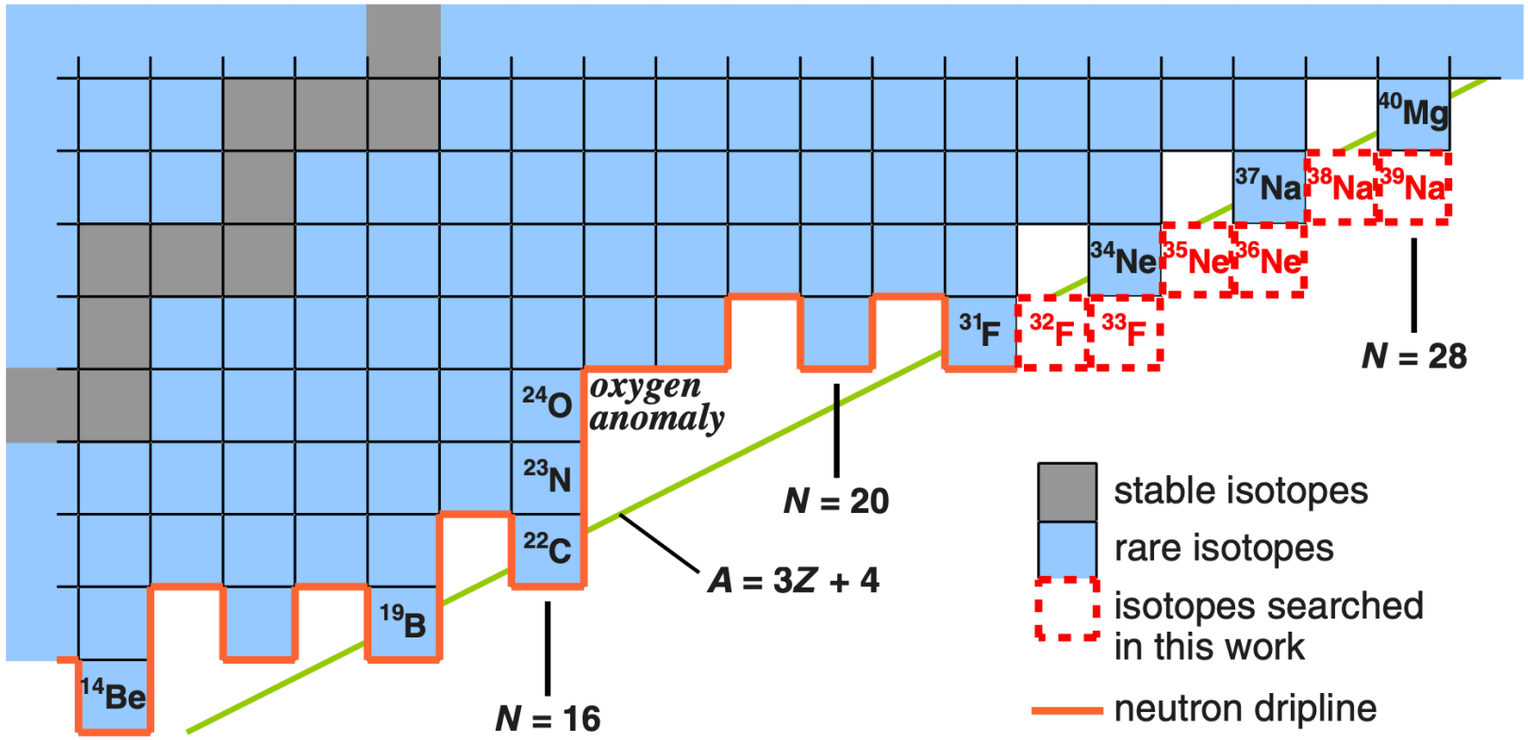



FIG. 1. Section of the nuclear chart showing the location of the isotopes studied in this work (red dotted squares).

# Three questions

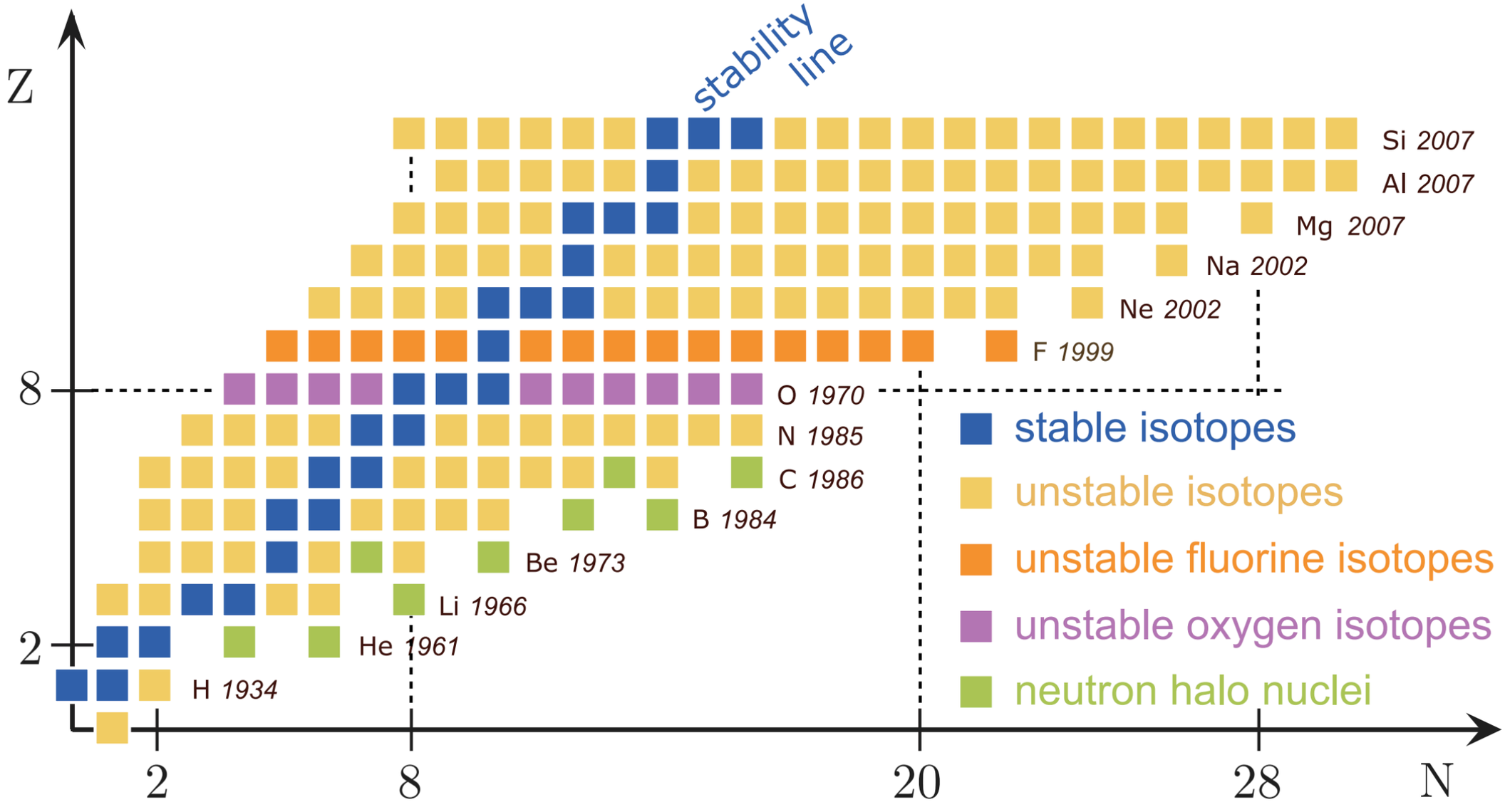
## Why locating the neutron dripline so important?

## The reaction and experiment set up?

$^{48}$Ca beam at 345 MeV=nucleon with a 20-mm-thick beryllium target. Details of set up see in the paper.

## How can we exclude the existence of an isotope?

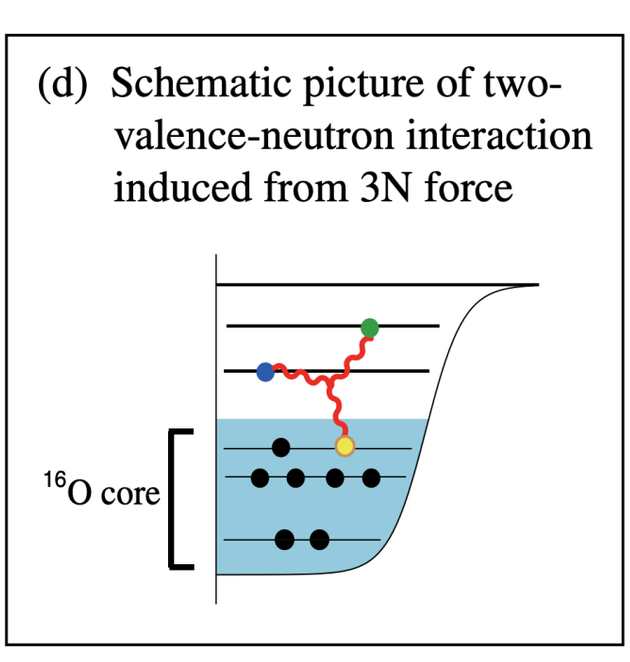
# Oxygen anomaly

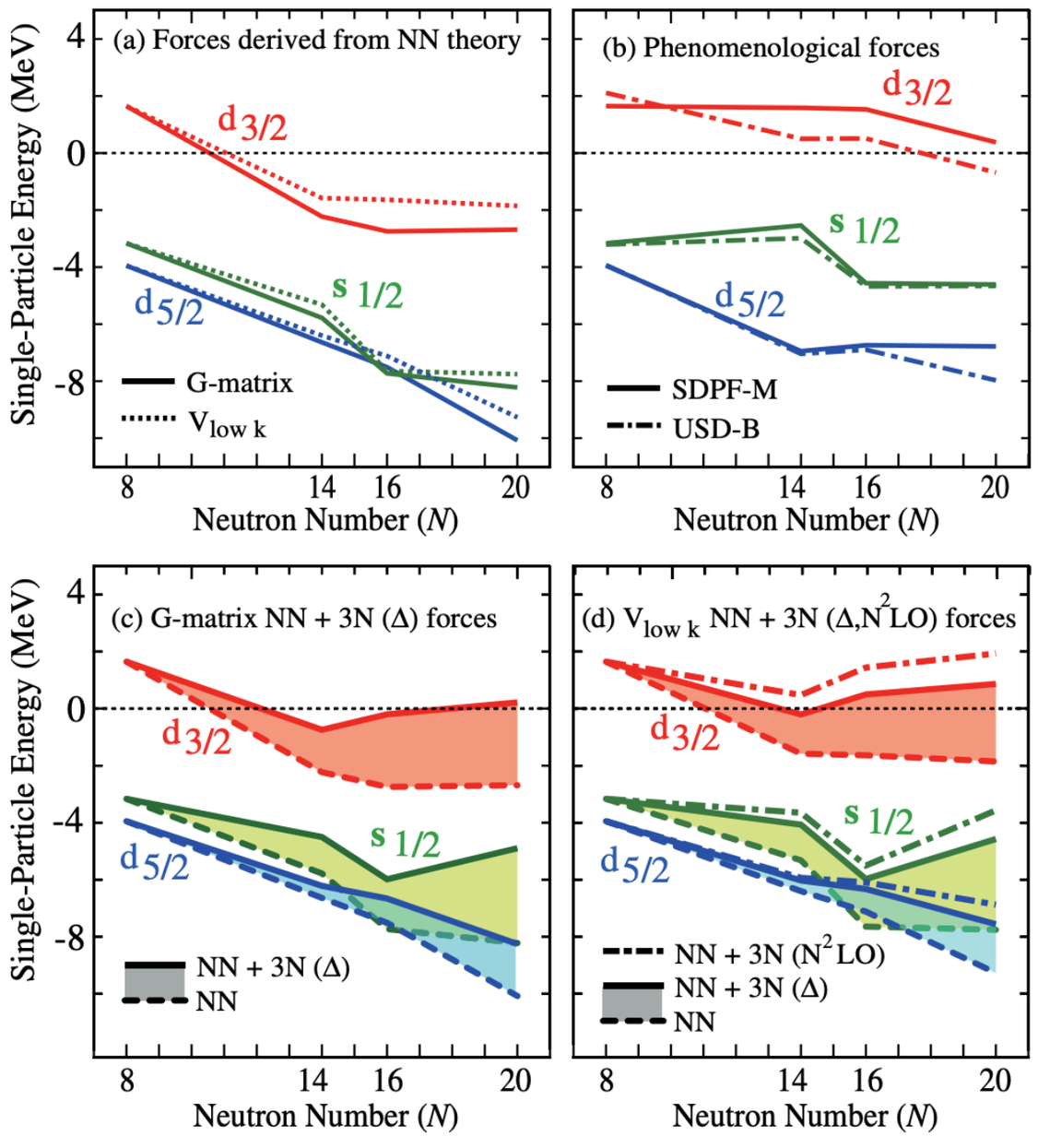


# Some attempts

1) 3N force:

3N method introduces repulsive monopole interactions between valence neutrons[1].



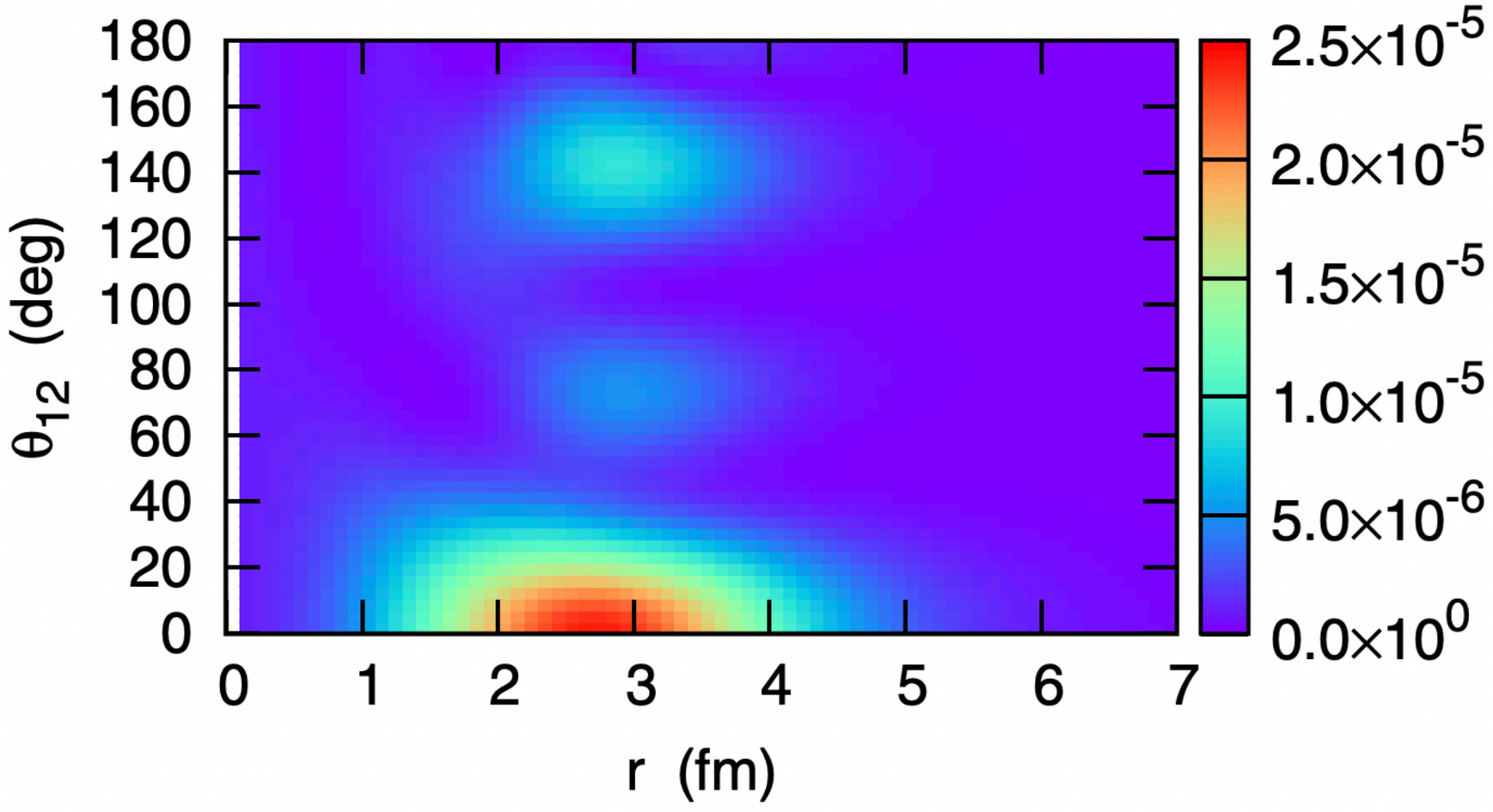




[1] T. Otsuka, T. Suzuki, J. D. Holt, A. Schwenk, and Y. Akaishi, Phys. Rev. Lett. 105, 032501 (2010).

# Some attempts

2) Effects of dineutron correlation

"We find an enhancement of two-neutron emission in back-to-back directions. This is interpreted as a consequence of dineutron correlation, with which the two neutrons are spatially localized before the emission."[2]




[2] K. Hagino and H. Sagawa, Phys. Rev. C 89, 014331 .

# Some attempts

3) open decay and continuum coupling

+ 3N force + many-nucleon correlation

EFT provides the framework to introduce the 3N force naturally

Gamow shell model deals with the many-nucleon correlation

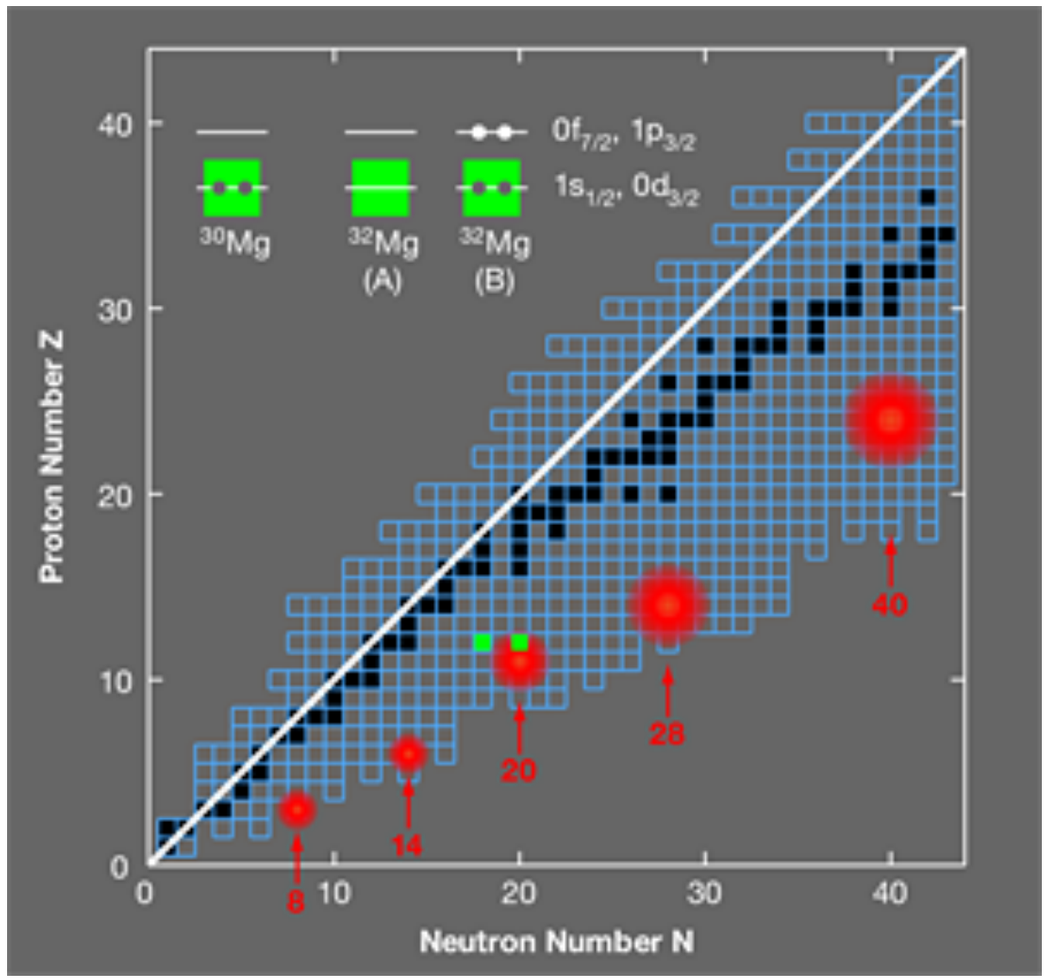
$$1 = \sum_i |\phi_i\rangle\langle\phi_i| + \int dk\, |\psi_k\rangle\langle\psi_k|$$

[3] G. Hagen, M. Hjorth-Jensen, G. R. Jansen, Phys. Rev.Lett. 108, 242501 (2012).

# Island of inversion

An **island of inversion** is a region of the chart of nuclides that contains isotopes with a non-standard ordering of single particle levels in the nuclear shell model.

Since then further studies have shown that five such regions exist within the known table of nuclides. These are centered at neutron-rich isotopes of five elements, namely, $^{11}$Li, $^{20}$C, $^{31}$Na, $^{42}$Si, and $^{64}$Cr.



# Island of inversion

## Example: 31Ne

"Comparison with direct-breakup model calculations suggests that the valence neutron of 31Ne occupies a low l orbital (most probably 2p3/2) with a small separation energy instead of being predominantly in the 1f7/2 orbital as expected from the conventional shell ordering."

**"These findings suggest that 31Ne is the heaviest halo system known."**

**B.A.Brown concludes[5]:**

1) **the reduction in the single-particle gap**
2) **the increase in the pairing energy E**
3) **increase in the proton-neutron interaction energy**

[5] E. K. Warburton, J. A. Becker, and B. A. Brown, Phys. Rev. C 41, 1147 (1990).