

# Laser Spectroscopy

2.0 vs 1.4 GeV for ISOLDE

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# Current Experimental Programs

- COLLAPS:  
Ca, Sc, Ni, Zn, Ge, Sn, Sb.
- CRIS:  
F, K, Cu, Ga, In, Sn, Po, Fr

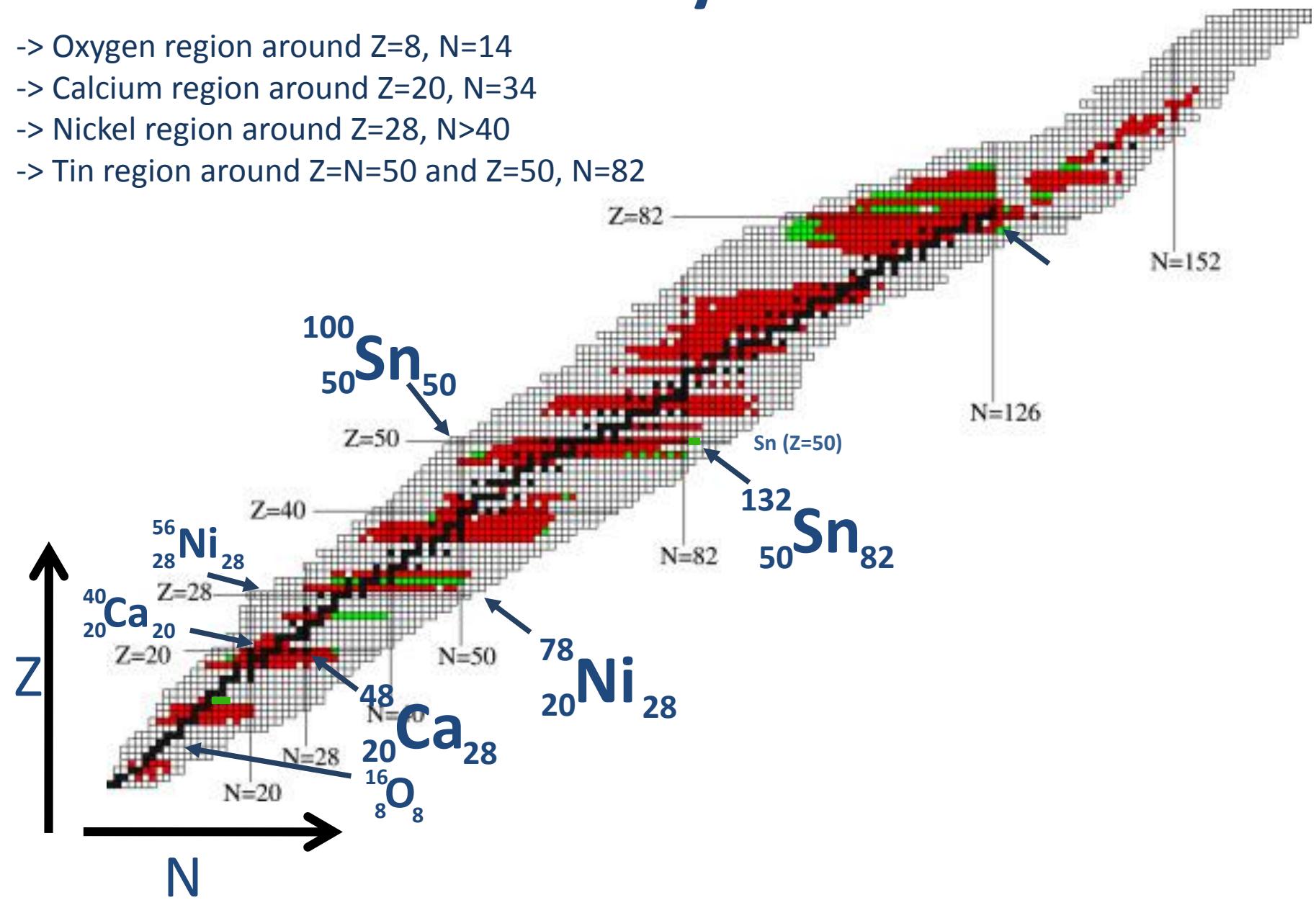
Main physics cases:

- > Oxygen region around  $Z=8$ ,  $N=14$
- > Calcium region around  $Z=20$ ,  $N=34$
- > Nickel region around  $Z=28$ ,  $N>40$
- > Tin region around  $Z=N=50$  and  $Z=50$ ,  $N=82$

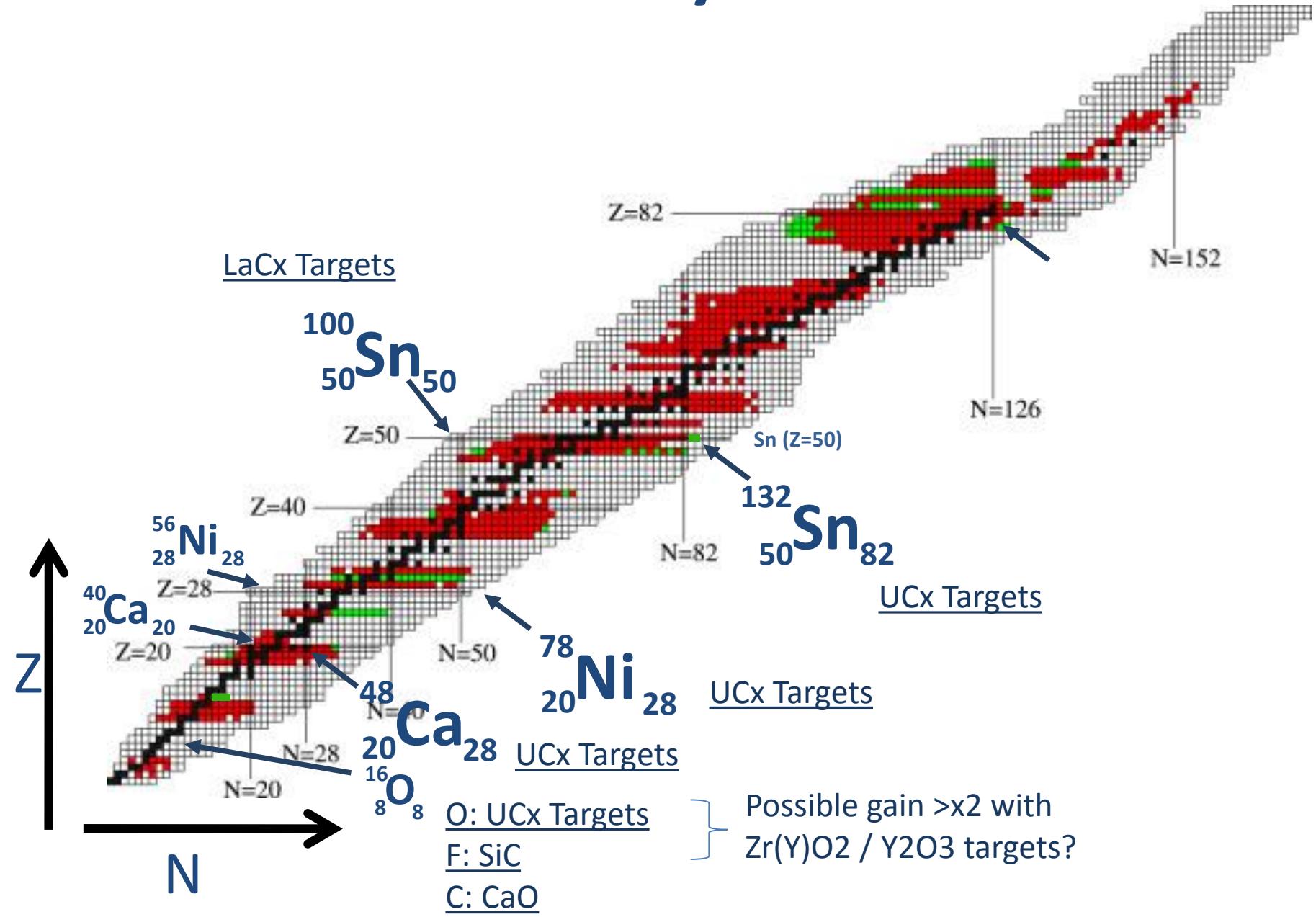
- Evolution of collectivity / single particle approaching shell closures?
- Ordering of shell-model orbits
- Development of many-body methods (Ab-intio, Shell model, DFT, ...)
- Modern descriptions of the nuclear force
- Proton-neutron interaction?
- Role of electro-weak currents?
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# Main Physics Cases

- > Oxygen region around Z=8, N=14
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- > Nickel region around Z=28, N>40
- > Tin region around Z=N=50 and Z=50, N=82



# Main Physics Cases

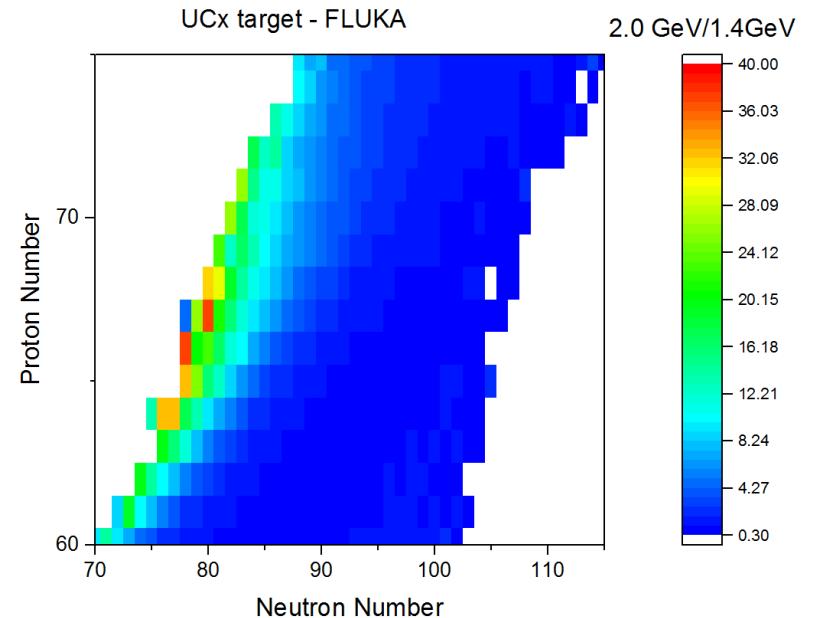


# Future Physics Cases

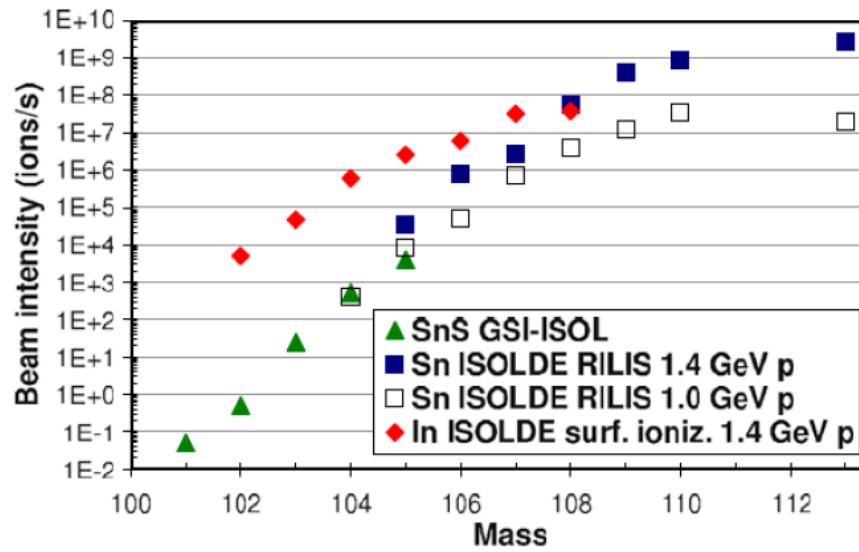
The 2 GeV upgrade would bring several advantages for the research on neutron-deficient lanthanides, such as the cluster decay search and the study of proton emitters.

- >  $^{147}\text{Tm}$  ( $Z=69$ ) : current yield Ta target 200 ions/uC
- >  $^{151,152}\text{Lu}$  ( $Z=71$ ) : current yield TaTh target 1 ions/uC

Expected increase > x 20



# Yields



# Motivation

Laser spectroscopy

$$\rightarrow T, \Delta \langle r^2 \rangle, \mu, Q$$

## Nuclear force

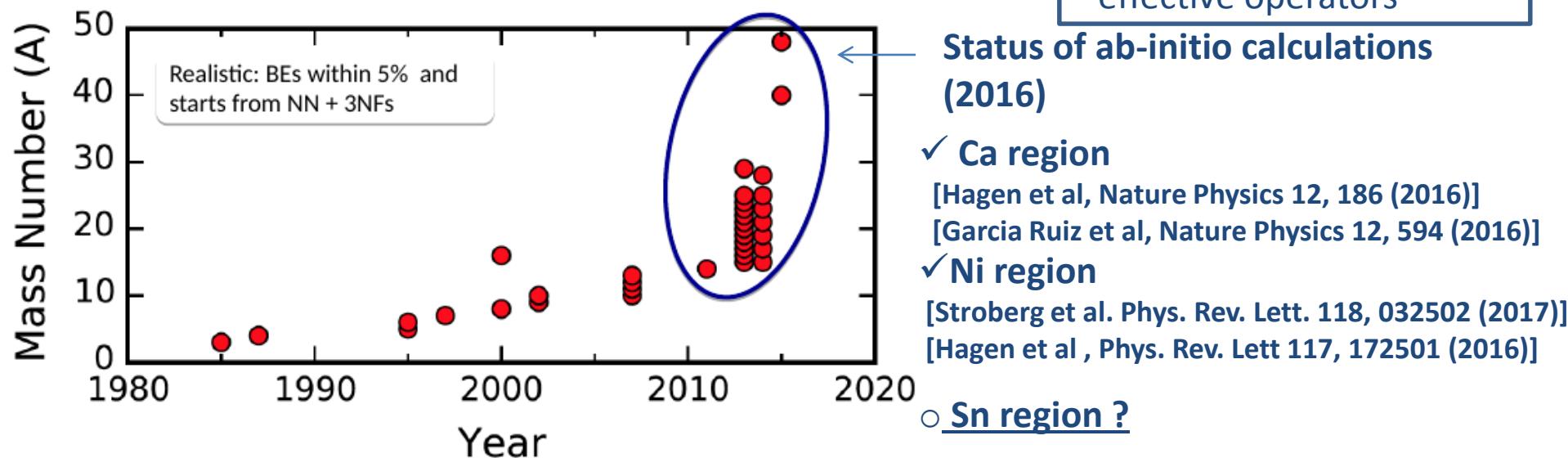
- Phenomenology
- Chiral effective field theory

## Many-body methods

- Ab-initio
- Shell-model
- DFT

## Electro-weak currents

- Effective neutron/proton charges
- Microscopic description of effective operators



## New developments in EFT + Normalization group + many-body methods:

### Coupled clusters

[Hagen et al. Phys. Rev. Lett 117, 172501 (2016)]

### In-Medium SRG

[Phys. Rev. Lett 118, 032502 (2017)]

### Gorkov-Green Function

[Phys. Rev. Lett 117, 052501 (2016)]

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