Gains from a 2 GeV upgrade
Which new physics becomes possible ?

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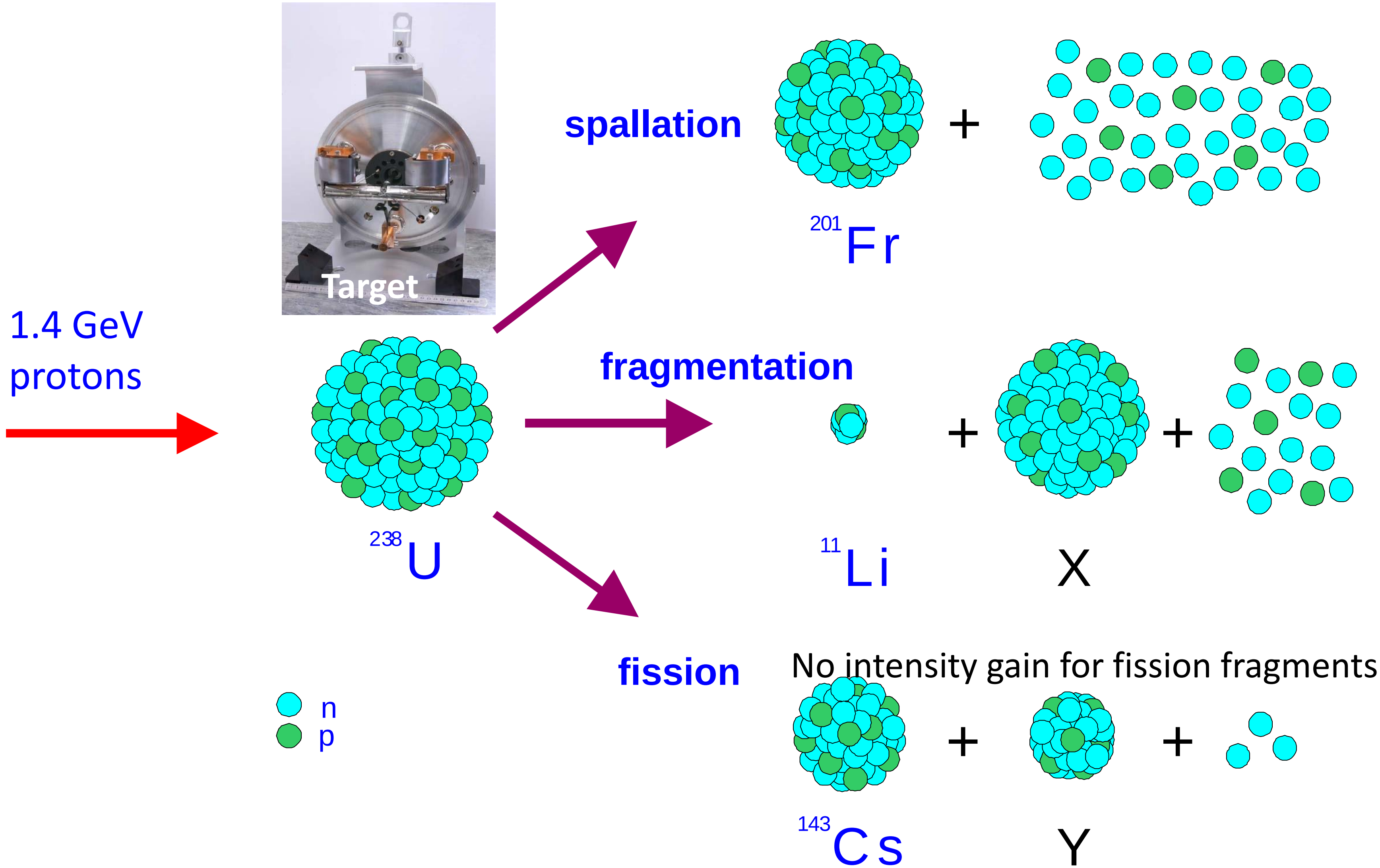
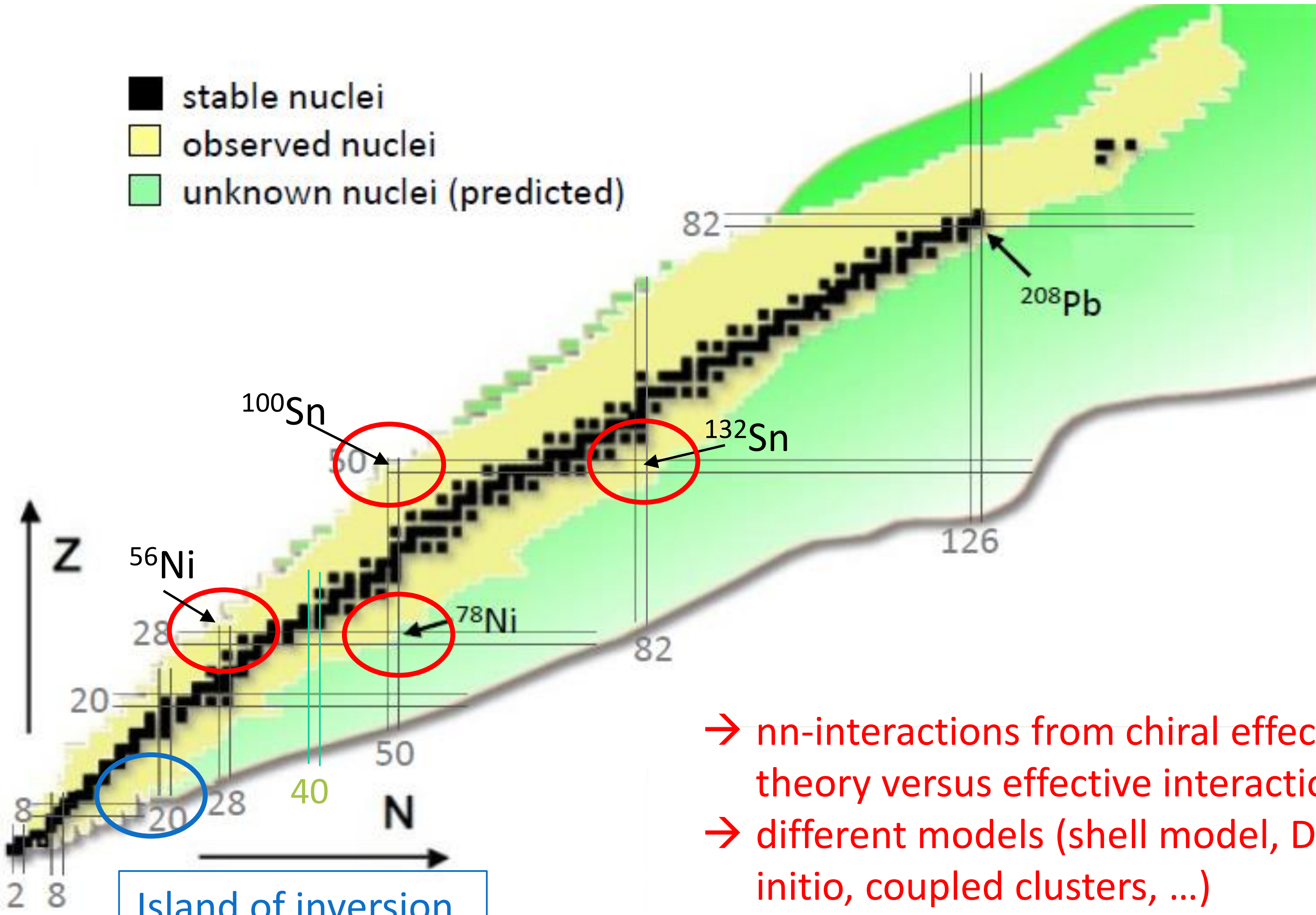
ISOTOPE production channels at ISOLDE

p+



For specific regions a specific target is used !

Doubly magic nuclei: Benchmarks for nuclear theory

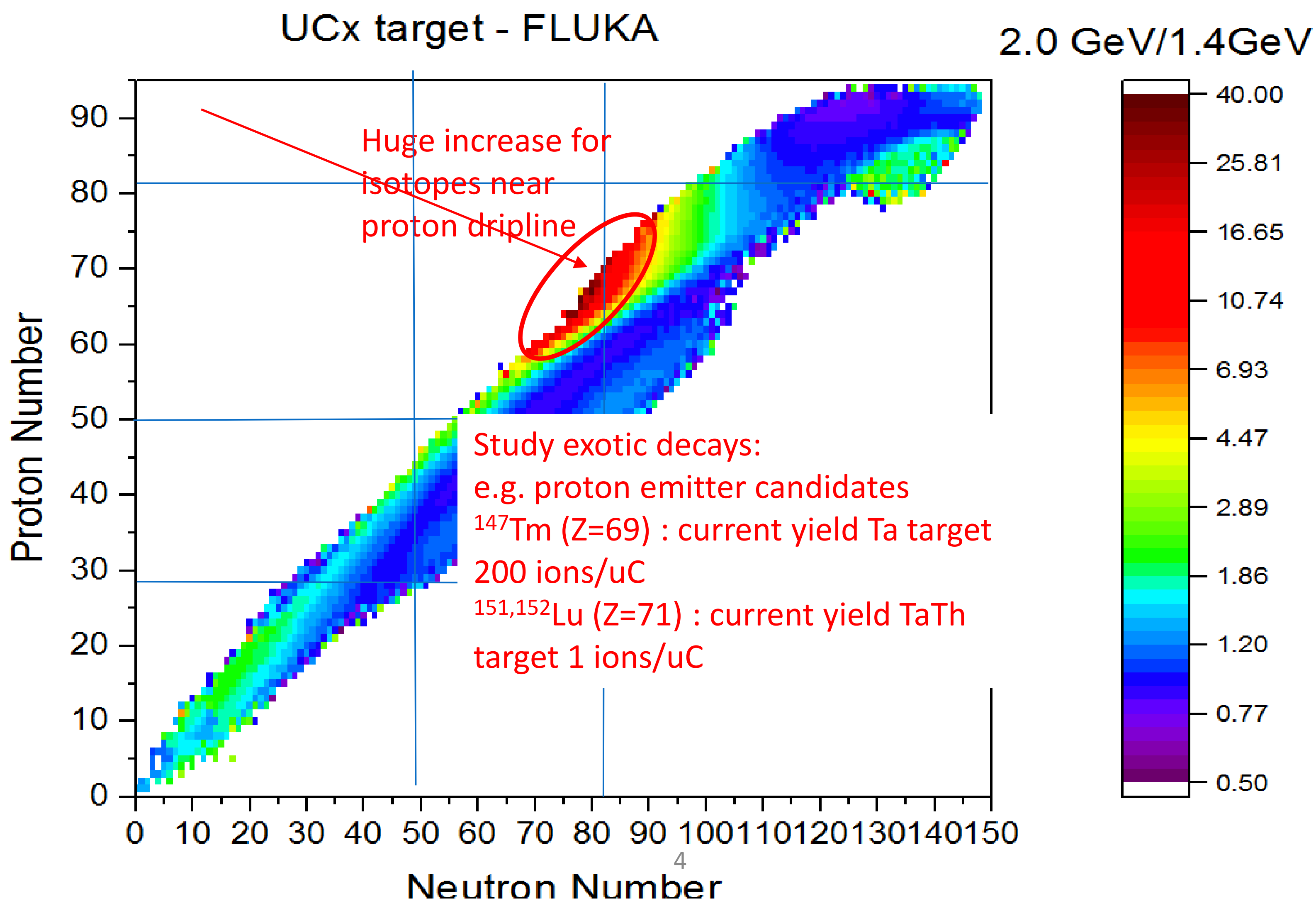


Island of inversion
Towards O-dripline

→ nn-interactions from chiral effective field theory versus effective interactions
→ different models (shell model, DFT, ab-initio, coupled clusters, …)

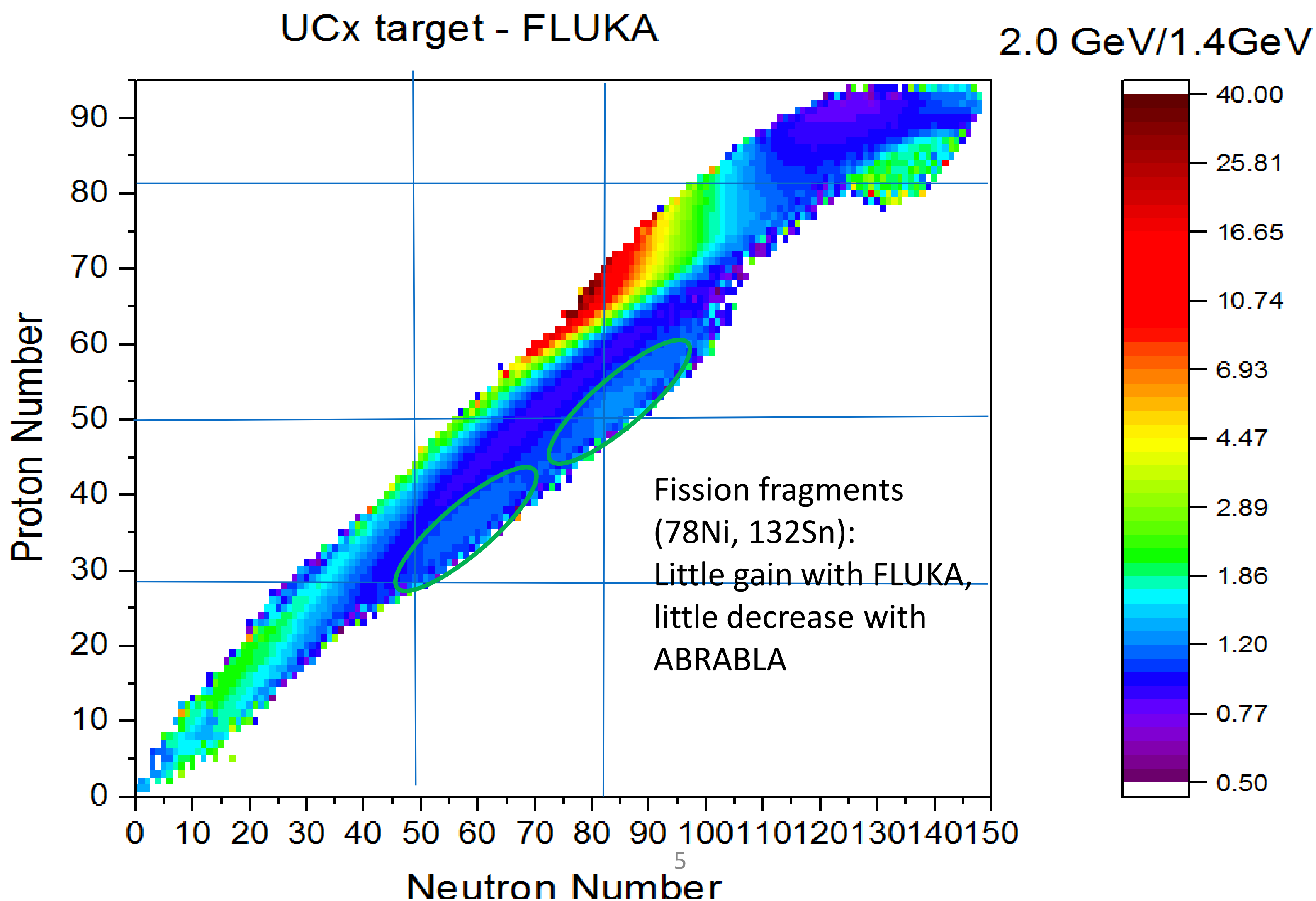
Gain in exotic beam intensity 1.4 → 2 GeV

FLUKA simulations (JP Ramos)



Gain in exotic beam intensity 1.4 → 2 GeV

FLUKA simulations (JP Ramos)



Gain for $^{100\text{-}101}$Sn isotopes from 1.4 to 2 GeV

PAST EXPERIENCE

Measured gain from 1.0 GeV→1.4 GeV: factor of 5 to 50 between ^{105}Sn and ^{110}Sn

Koster et al., NIMB266 (2008)

IS613 proposal: scheduled August 2018

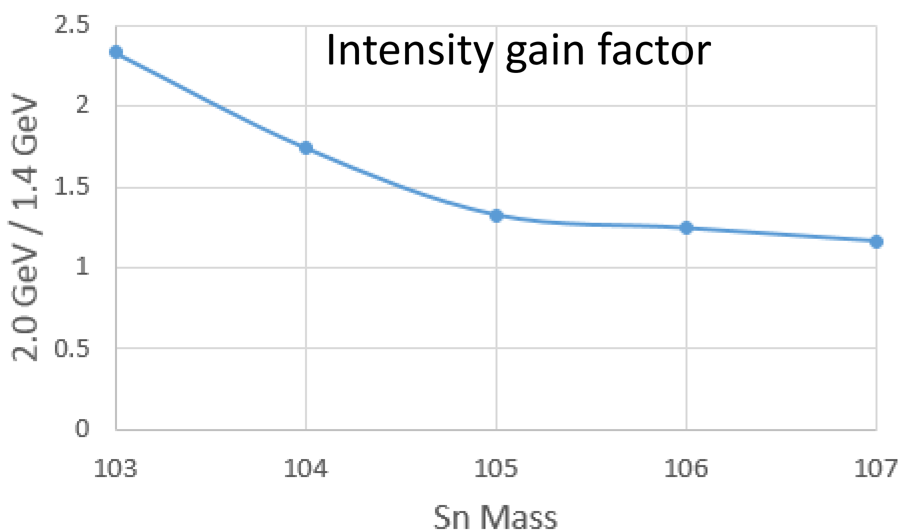
→ CURRENTLY LIMITED TO ^{103}Sn, maybe ^{102}Sn

Isotope	Half life	Yield (old) (ions/s)	Target +RILIS	Shifts required
^{101}Sn	0.86 s	$\sim$1	LaC_x	not possible
^{102}Sn	3.8 s	$\sim 10^1$	LaC_x	7.5
^{103}Sn	7.0 s	$\sim 10^2$	LaC_x	6
^{104}Sn	21 s	10^3 (Ref. [2])	LaC_x	1
^{105}Sn	33 s		LaC_x	1

Courtesy R.F. Garcia Ruiz

Gain for $^{100-101}$Sn isotopes from 1.4 to 2 GeV

FLUKA simulations (JP Ramos)
La target



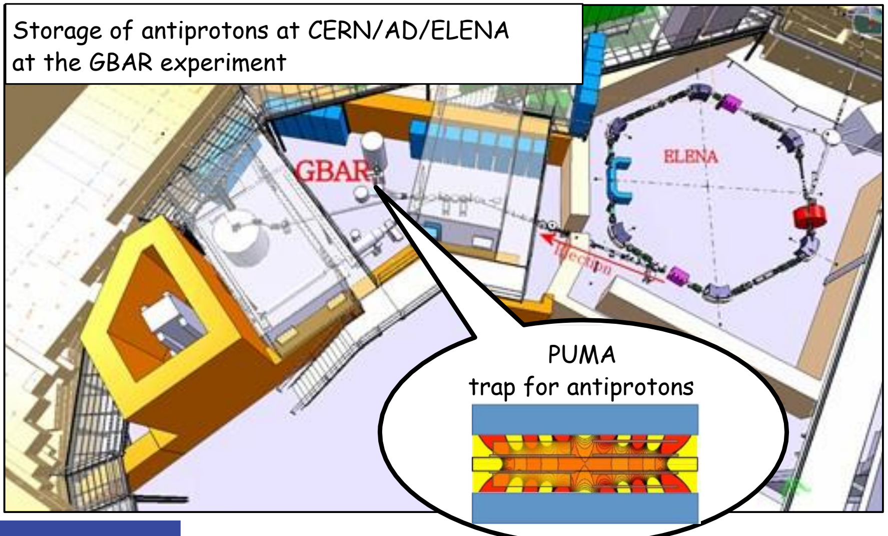
Gain increases towards n-deficient isotopes
More than a factor of 2 from ^{103}Sn downwards
(calculations impossible below 102Sn but expected to increase further)

→ ^{102}Sn (5/s) in reach for precision measurements on masses, radii, moments, β–decay (if background allows !)
→ With further target improvements also ^{101}Sn

Courtesy Joao Pedro Ramos

ISOLDE

PUMA: Pbar Unstable Matter



Anti-proton annihilation: a probe for the nuclear density tail

European Research Council

Alexandre Obertelli
TU Darmstadt

"Day one" physics cases

Nucleus	Expected ρ_n/ρ_p
^{6}He	Neutron halo > 100
^{8}He	Thick skin 70(10)
^{11}Li	Neutron halo > 100
^{17}Ne	Proton halo < 0.010
^{31}Ne	Neutron halo > 100
^{104}Sn - ^{138}Sn	Progression of skin: From 1.0(2) to 4.0(6)

Gain in beam time (factor 2-3) thanks to 2 GeV protons

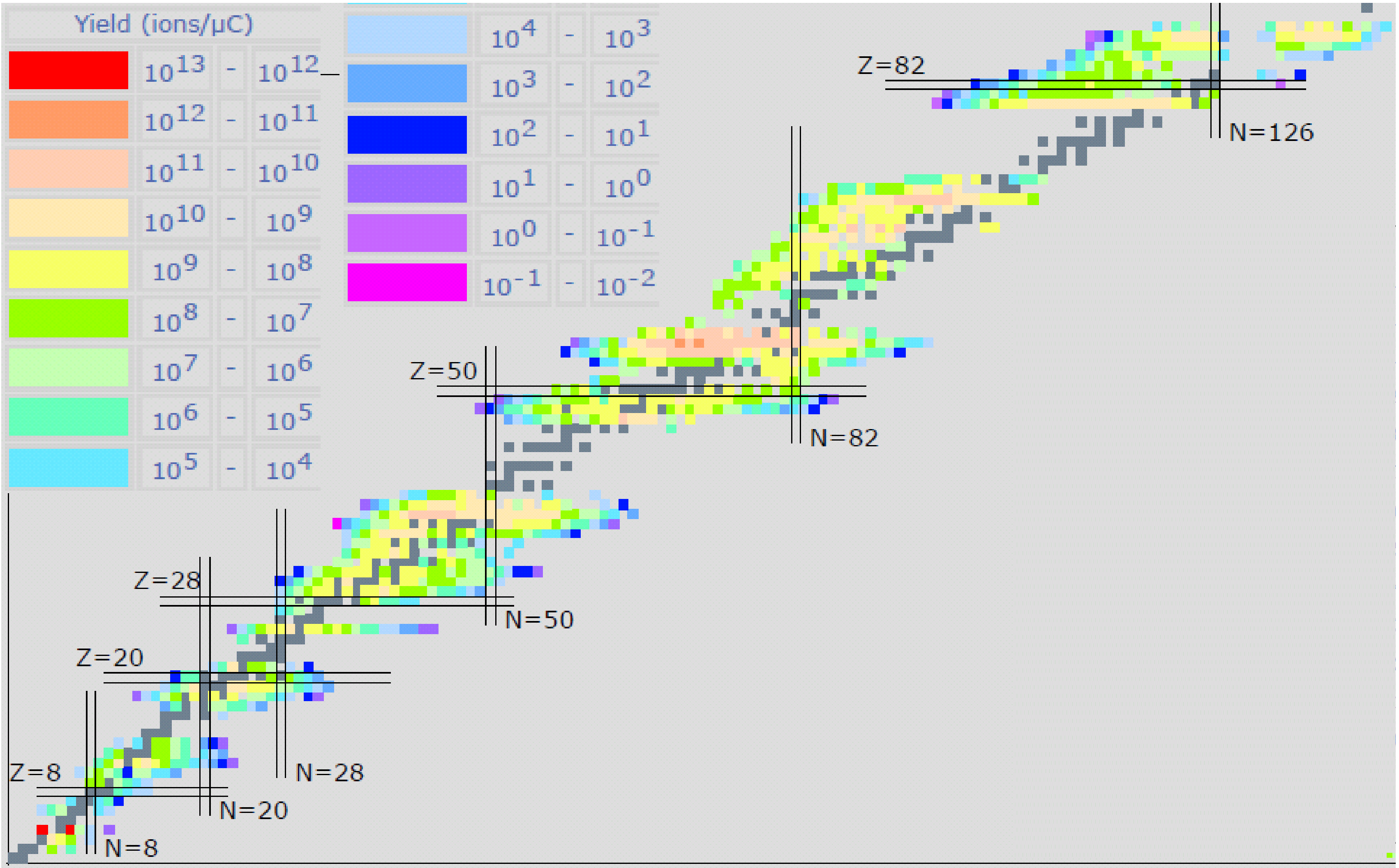
Impact on Physics

- Most of HIE-ISOLDE and many ISOLDE proposals suffer from low intensity => **unnecessary prolongation of beam times.**
- **New and more exotic species will be available** with the increase of intensities: **from x2-x5** for fragmentation, x1 – x2 for fission, **x6-x10** for spallation.
- **Important to keep 1.4 GeV proton beam** for certain nuclei.

Physics cases:

- Increase in neutron deficient nuclei: ^{20}Mg, ^{31}Ar, ^{35}Ca, ^{100}Sn, ^{114}Cs.
  - Study of particle-gamma branches of states of astrophysical relevance for will become available in neutron deficient nuclei.
  - Exotic decay modes
- Increase in neutron-rich medium-light nuclei allowing detailed spectroscopy studies: , such as ^{55}Ca, ^{34}Mg, to explore shell structure.
- HIE-ISOLDE proposals => number of requested shifts at the present limit of target lifetime (due to low production) .

Present ISOLDE beams



- Nearly 1300 isotopes available from over 72 chemical elements – largest choice for any ISOL facility in the World