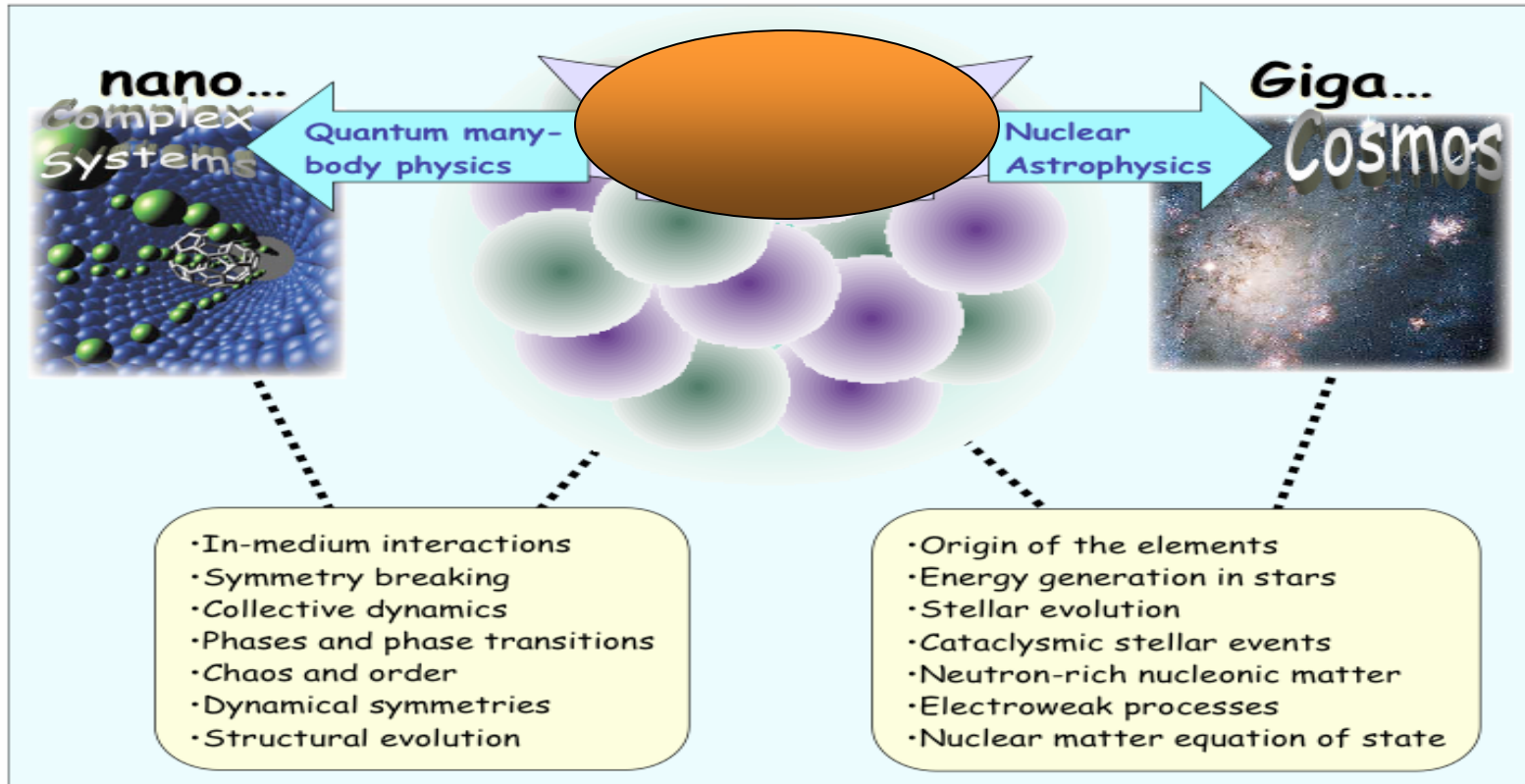




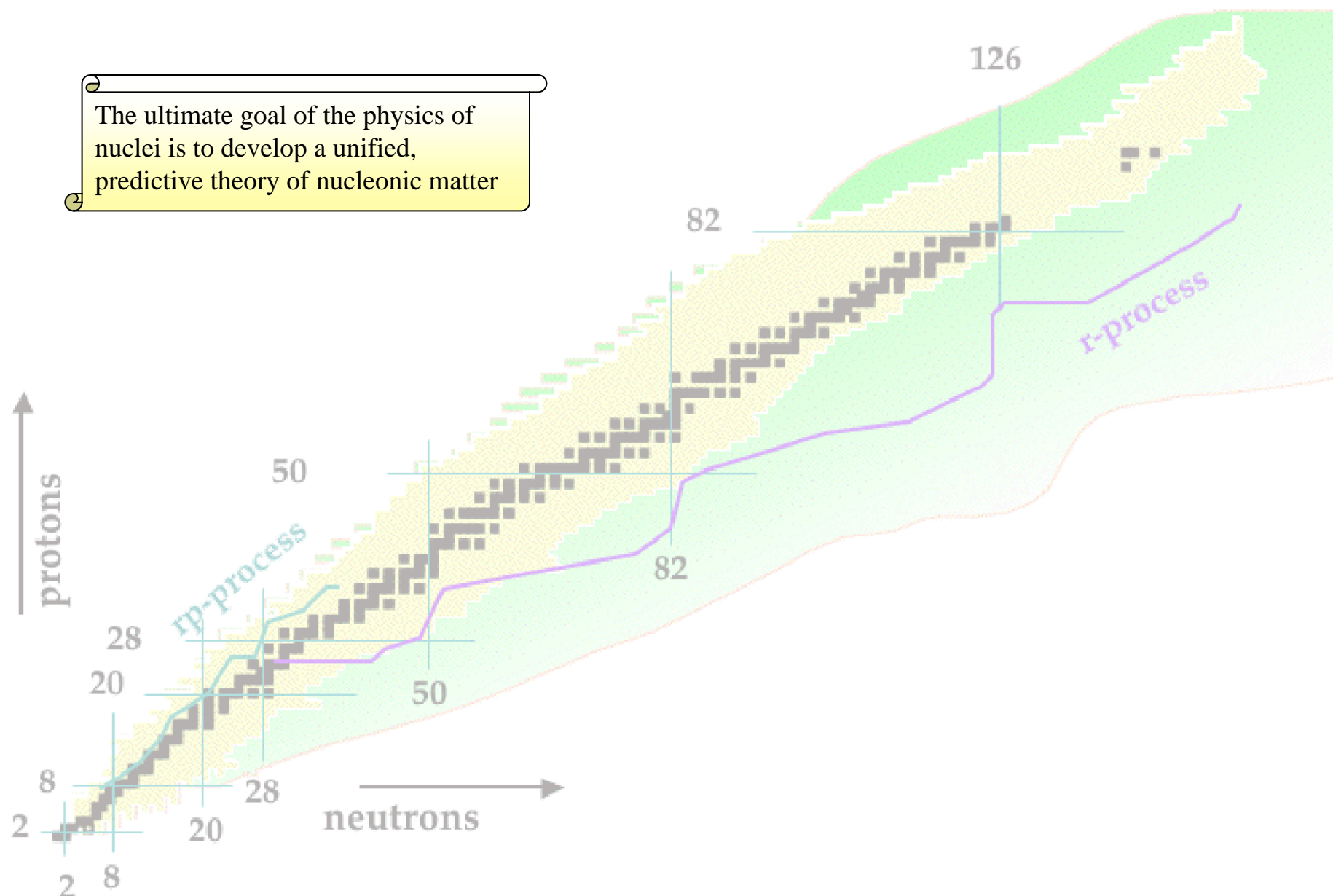
Ani Aprahamian: Research Areas

Dr. Wanpeng Tan

Institute for Structure & Nuclear Astrophysics



The ultimate goal of the physics of nuclei is to develop a unified, predictive theory of nucleonic matter



How does physics of nuclei impact the physical universe?

Research Areas

Nuclear Astrophysics

rp-process
r-process
stellar evolution

Experiments- ND, ORNL, NSCL

Half-lives
Masses
Isomers
Structure

Theory

Nucleosynthesis simulations
Mass Models
Isomers

Nuclear Structure

vibrational dynamics (nature of $K=0+$ bands)
s.p. structure near closed shells
structure of light exotic nuclei
nuclear structure aspects of mass models

Experiments- mostly ND Some....GSI, ANU, NSCL

Theory

Projected Shell Model
Pseudo SU(3)
IBM
F-spin concepts

Origin of the heavy elements.....

One example: Nuclear Astrophysics
r-process

Semi-empirical Mass model (n-rich, p-rich)
Predictions for the n-drip line

Special: New Learning Series on Genetics, page 70

Complexity—the Science of Surprise | Your Inner Savant

Discover

VOL. 23, NO. 2

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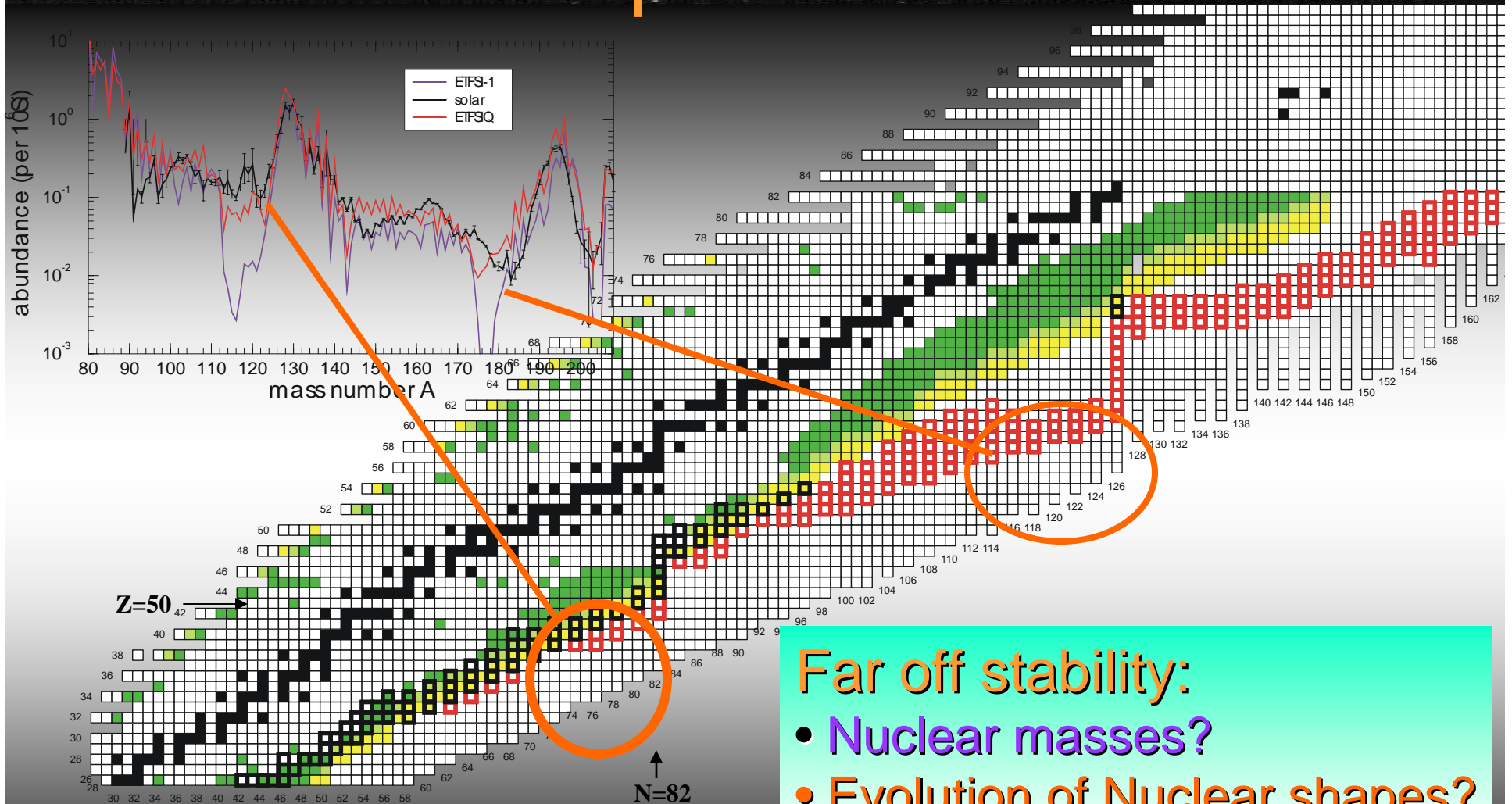
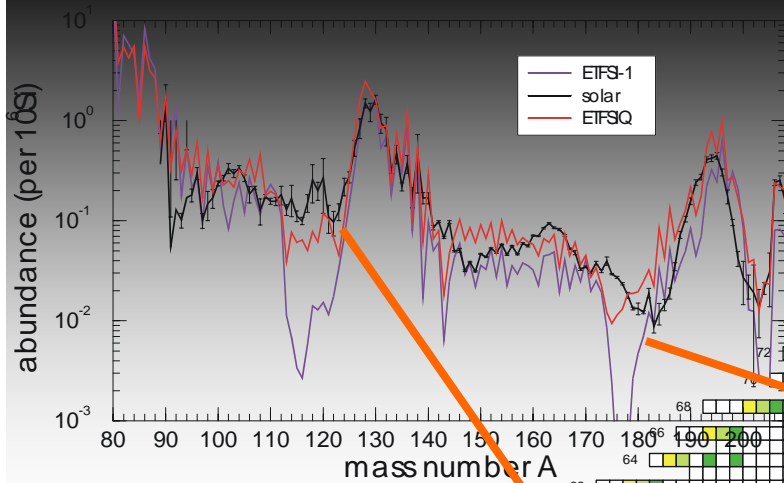


The
11
Greatest
Unanswered
Questions
of **Physics**

No.
9
What Is
Gravity?

No.
3
How Were the Elements from
Iron to Uranium made ?

r-process



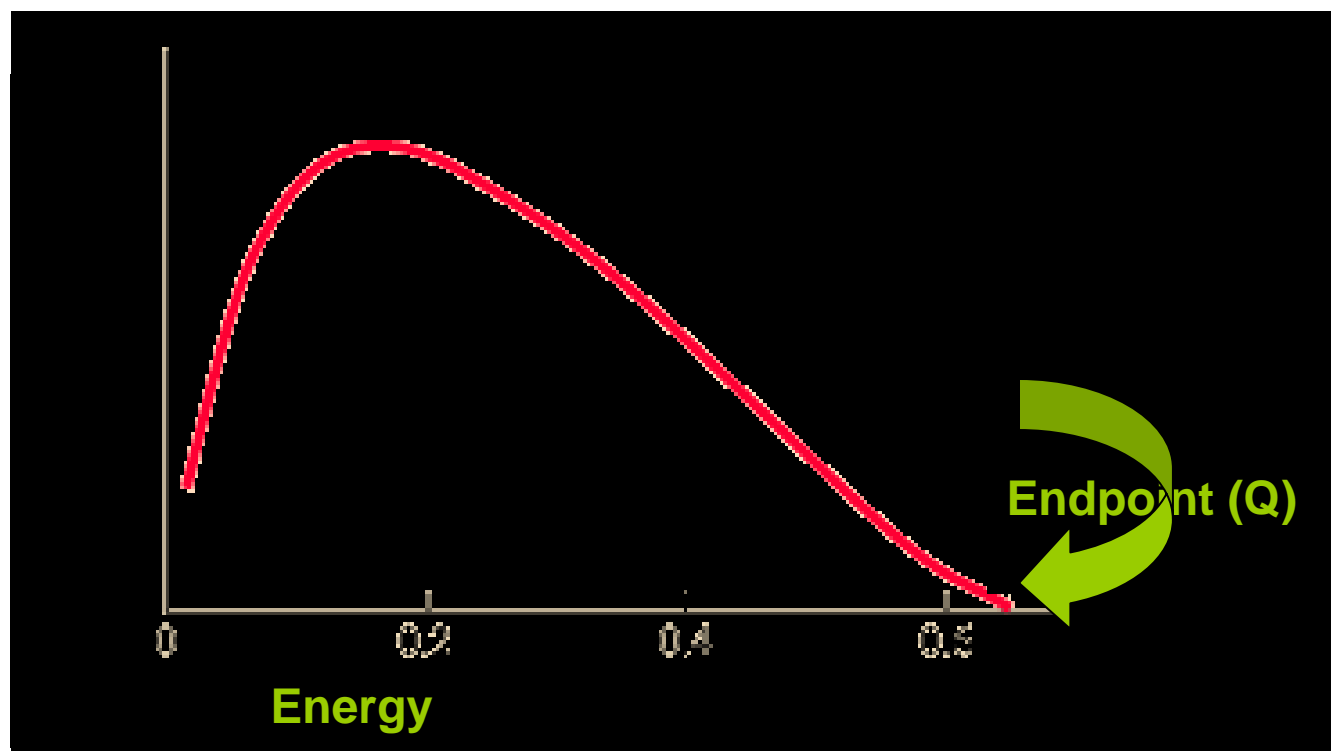
Far off stability:

- Nuclear masses?
- Evolution of Nuclear shapes?

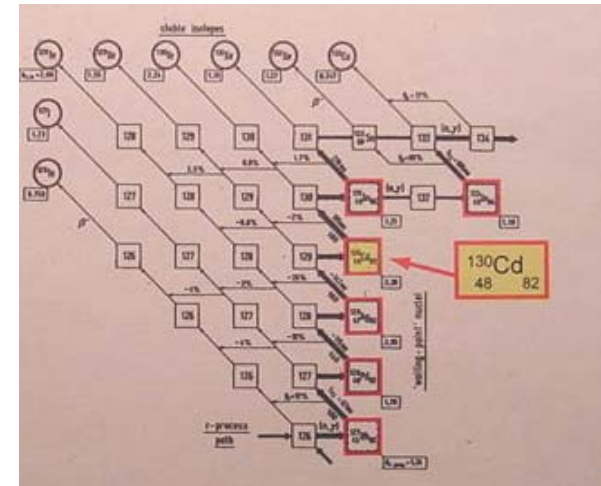
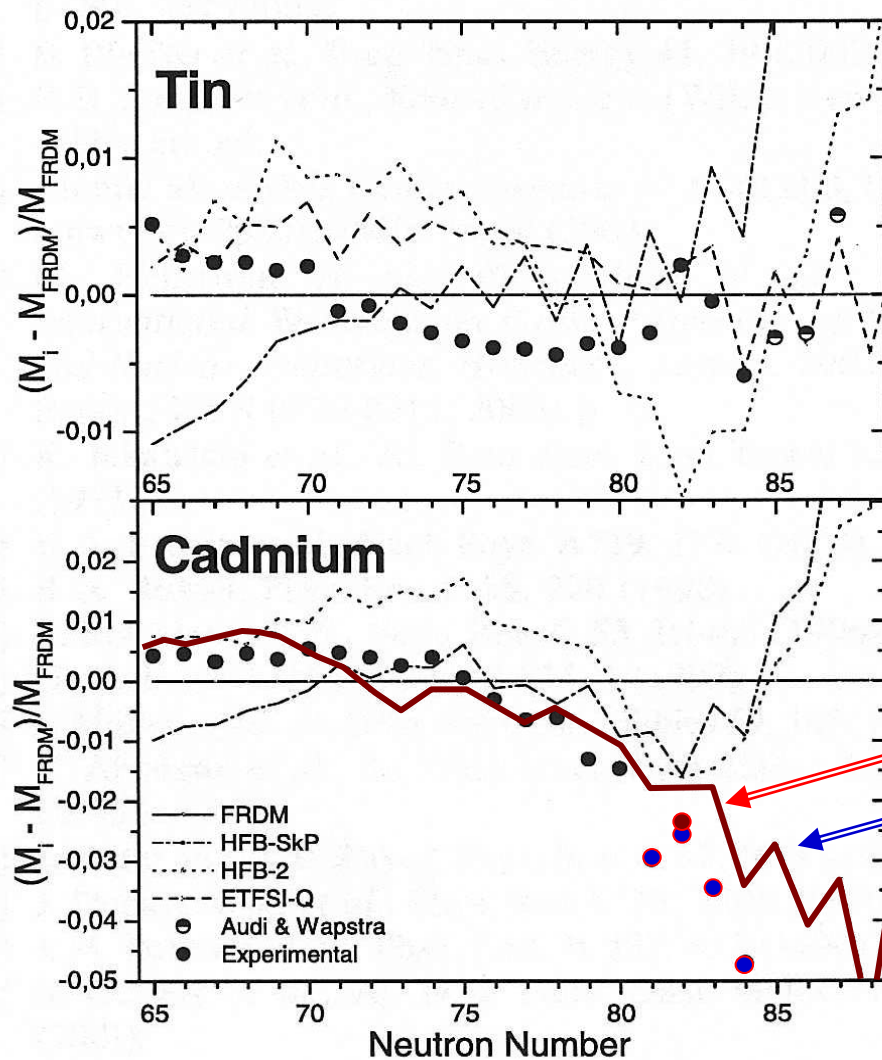
Onset of deformation

Measurements:

Masses



Mass Predictions as Signature for Quenching



β -endpoint measurement
for ^{130}Cd at CERN Isolde!

Resulting mass and
mass extrapolation by Audi
 \Rightarrow quenching signature?

Dillmann et al., PRL 91 (2003)

Nucleosynthesis in the r-process

JINA

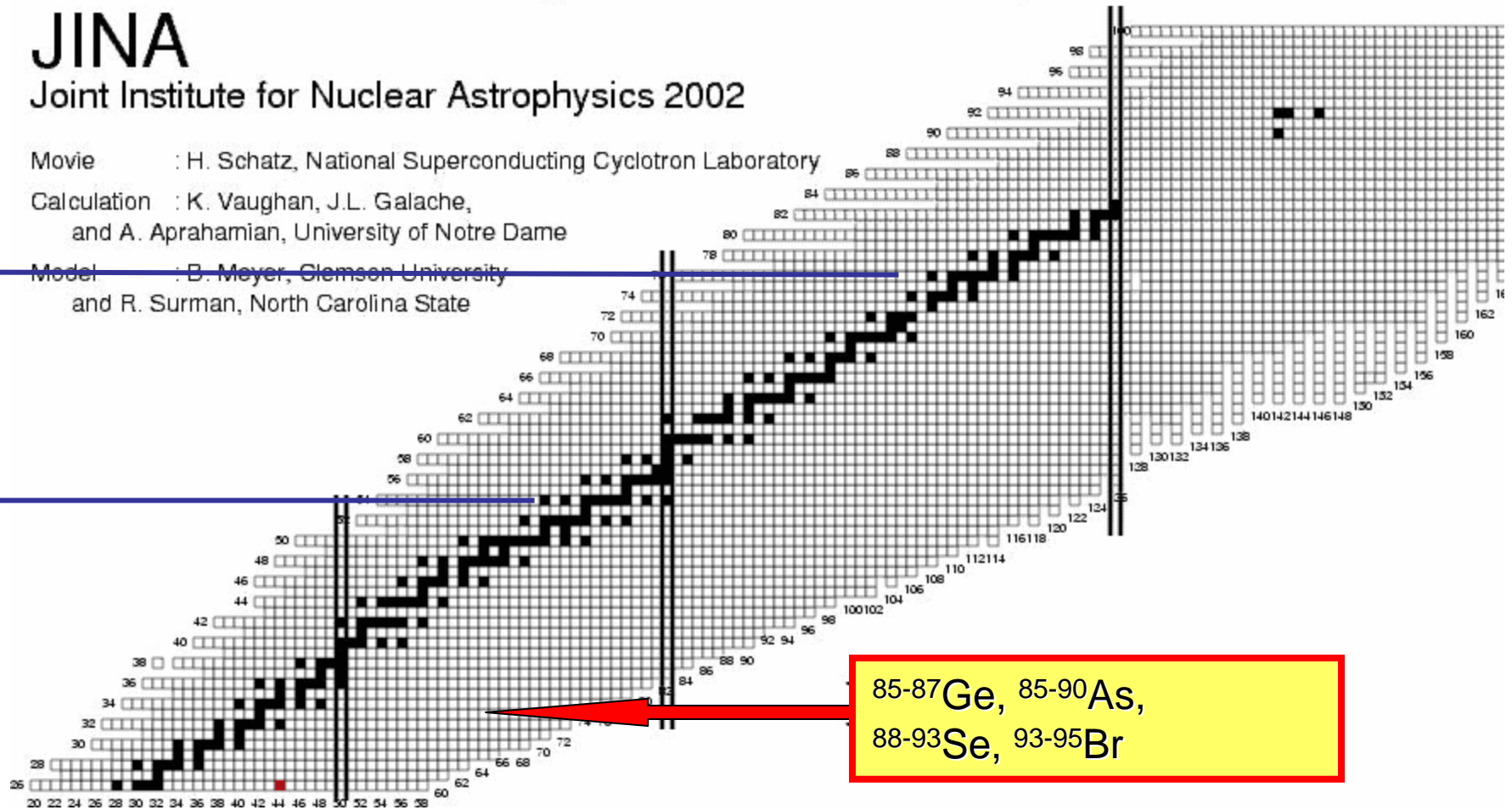
Joint Institute for Nuclear Astrophysics 2002

Movie : H. Schatz, National Superconducting Cyclotron Laboratory

Calculation : K. Vaughan, J.L. Galache,
and A. Aprahamian, University of Notre Dame

Pt Model : B. Meyer, Clemson University
and R. Surman, North Carolina State

Xe



85-87Ge, 85-90As,
88-93Se, 93-95Br

^{79}Cu and ^{78}Ni first bottle necks in n-capture flow (^{80}Zn later)
(half-lives ^{79}Cu : 188 ms (Kratz et al, 1991)
 ^{78}Ni : ? (predicted to be comparable)

Mass Models

- Most mass models involve macroscopic parameters, microscopic parameters, or some combination of the two.
- Macroscopic: Liquid Drop Model based on Z, A, r_0 with coeff's to fit.
 - Surface term, Symmetry term, Volume term
- Microscopic: Shell Model, interactions between individual nucleons.
 - Choose wave functions and solve Schrodinger Eqn.
 - Skyrme forces, Wigner terms, BCS pairing

FRDM – great globally
Locally not so great....

283* experimental masses taken from Audi & Wapstra 2003 compilation:

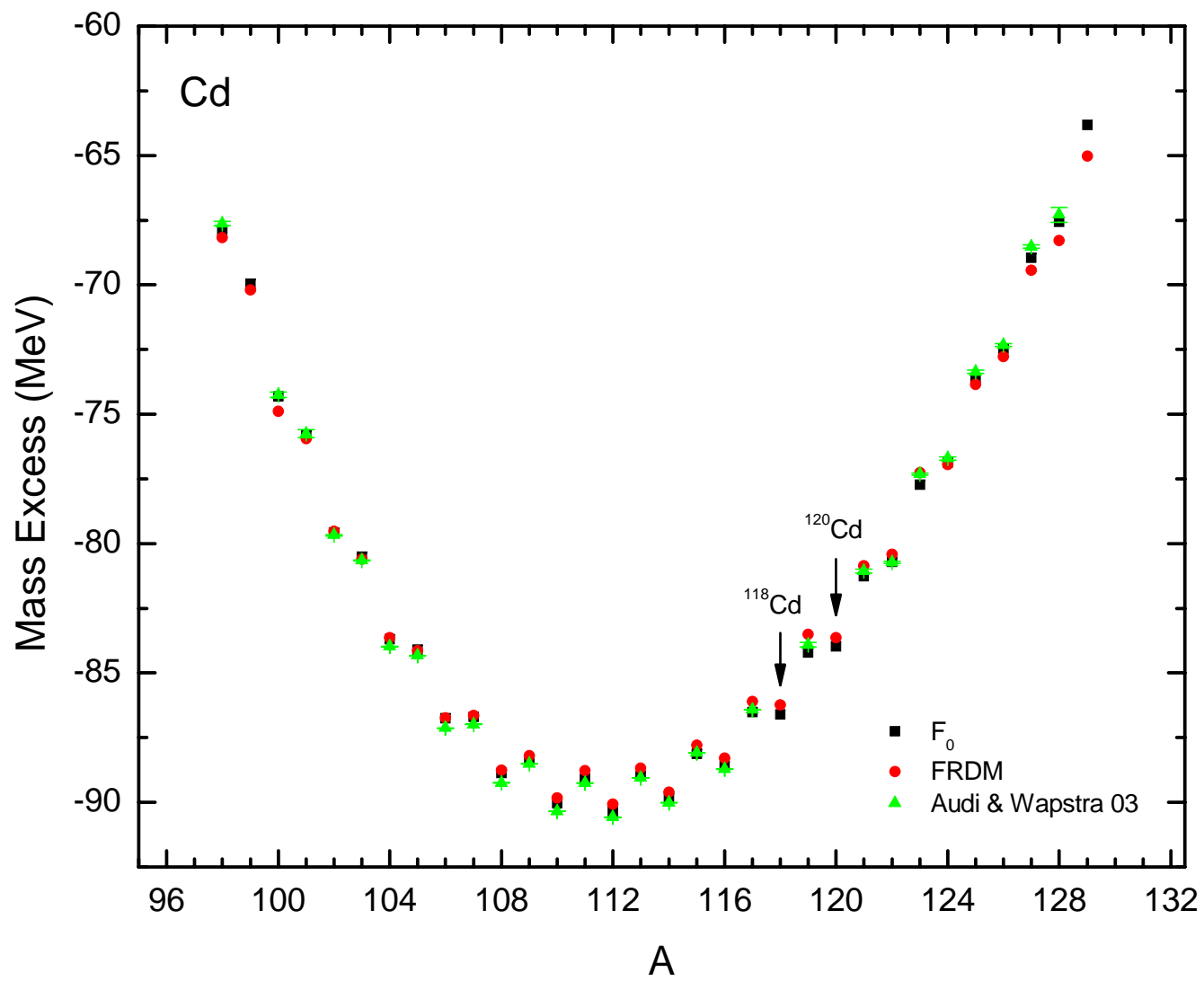
Z=28-49, N=50-81

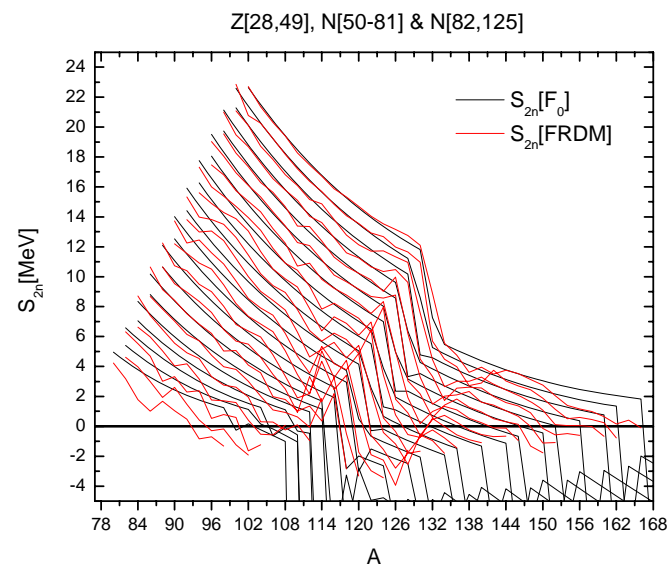
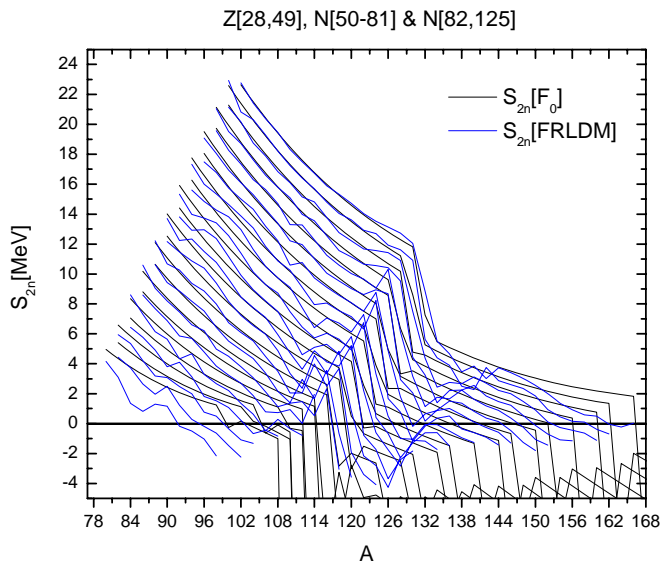
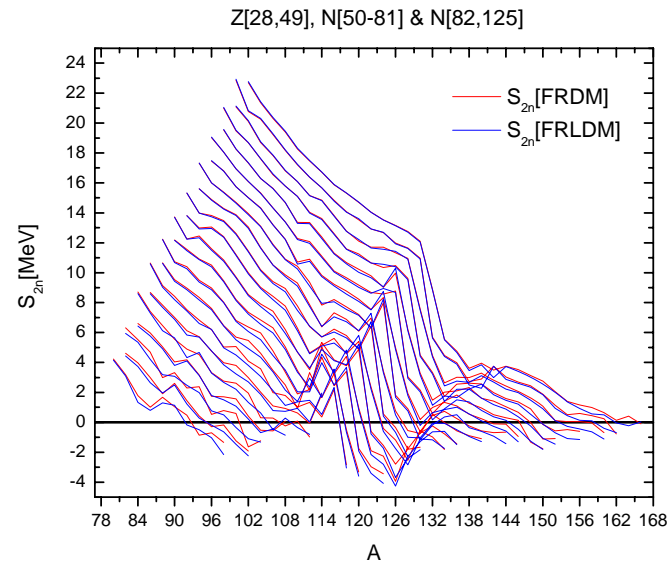
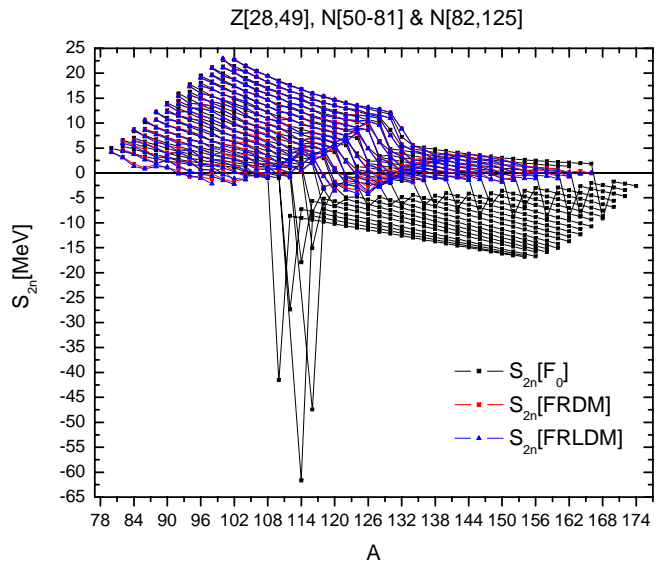
Model	σ_{rms} (MeV)	σ_{th} (MeV)	σ_{th}^* (MeV)	μ_{th}^* (MeV)
F ₀	0.352	0.347	0.346	-0.001
FRDM	0.700	0.699	0.650	-0.253
FRLDM	0.664	0.663	0.640	-0.168

* experimental values for ¹¹⁸Cd and ¹²⁰Cd were not included in fits

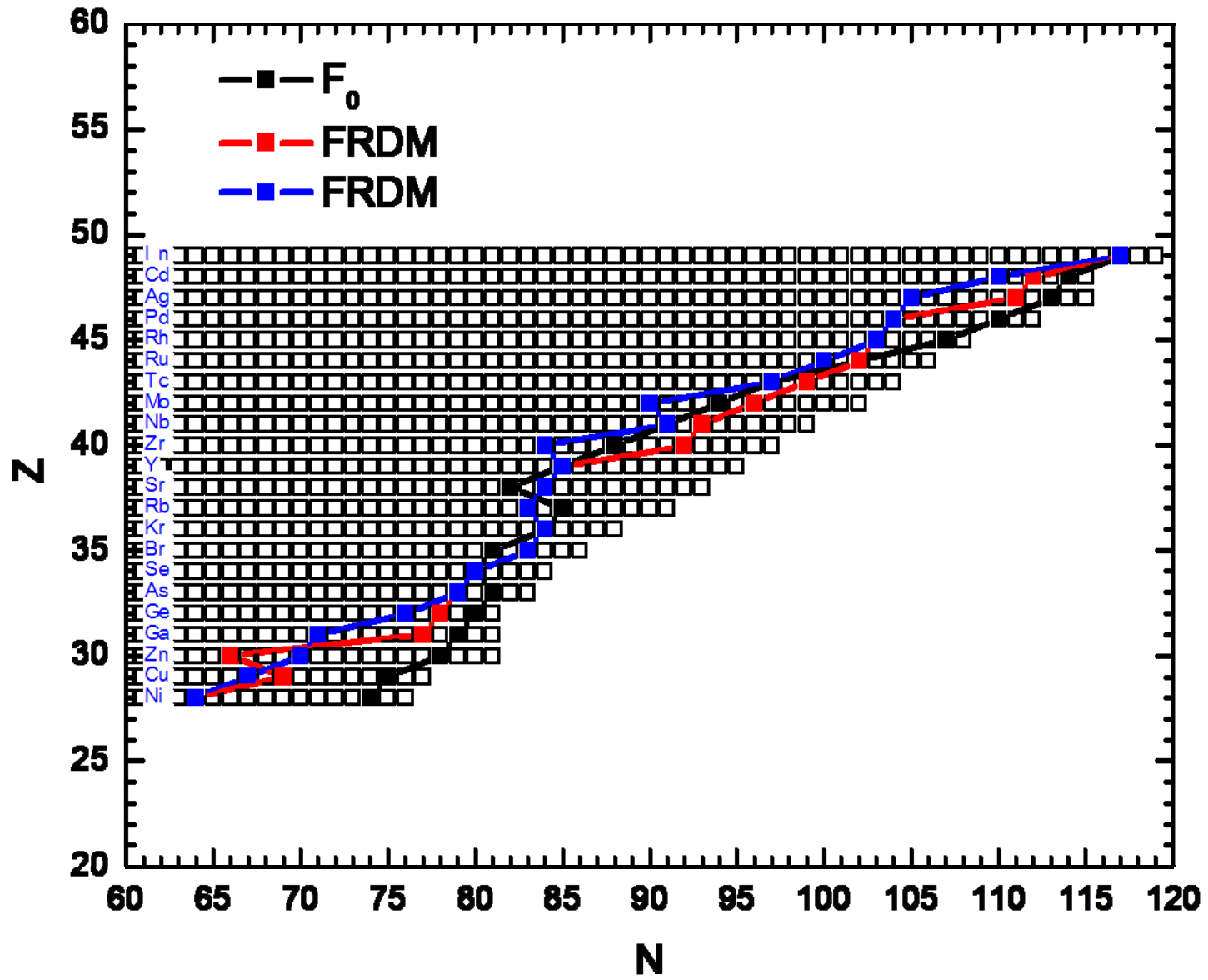
F_0 (9 parameter case)

Z [28,49] & N [50,81]





n-dripline



Group

