AGATA Workshop Concluding Remarks

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GANIL

Subjective and incomplete !

AGATA Workshop Concluding Remarks

- Array
- Physics Case
- Host Laboratories
- Future Prospects

Array

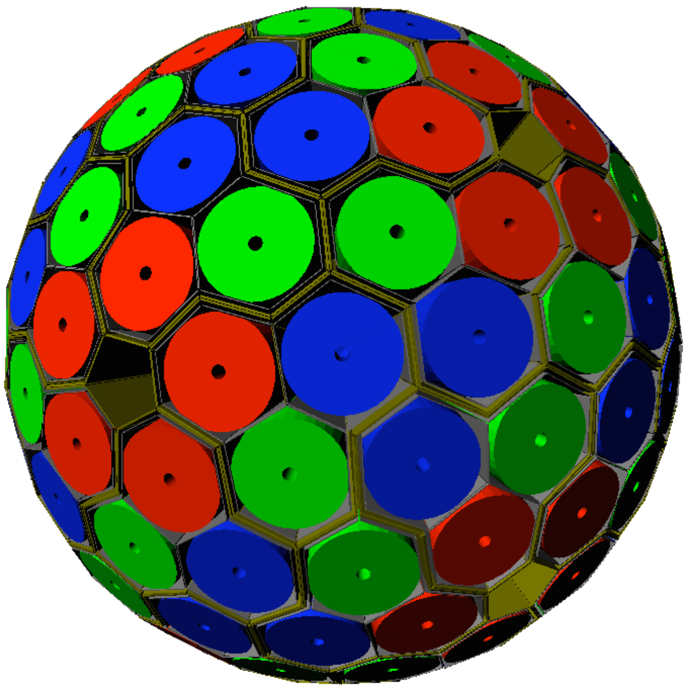
- Present status
- Choice of geometry

- *Different configurations, ancillary detectors, transportability : challenge for mechanics and infrastructure*

AGATA

(Advanced GAmma Tracking Array)

4π γ-array for Nuclear Physics Experiments at European accelerators providing radioactive and high-intensity stable beams



Main features of AGATA

Efficiency: 40% (M_γ =1) 25% (M_γ =30)

today's arrays ~10% (gain ~4) 5% (gain ~1000)

Peak/Total: 55% (M_γ=1) 45% (M_γ=30)

today ~55% 40%

Angular Resolution: ~1° →

FWHM (1 MeV, v/c=50%) ~ 6 keV !!!

today ~40 keV

Rates: 3 MHz (M_γ=1) 300 kHz (M_γ =30)

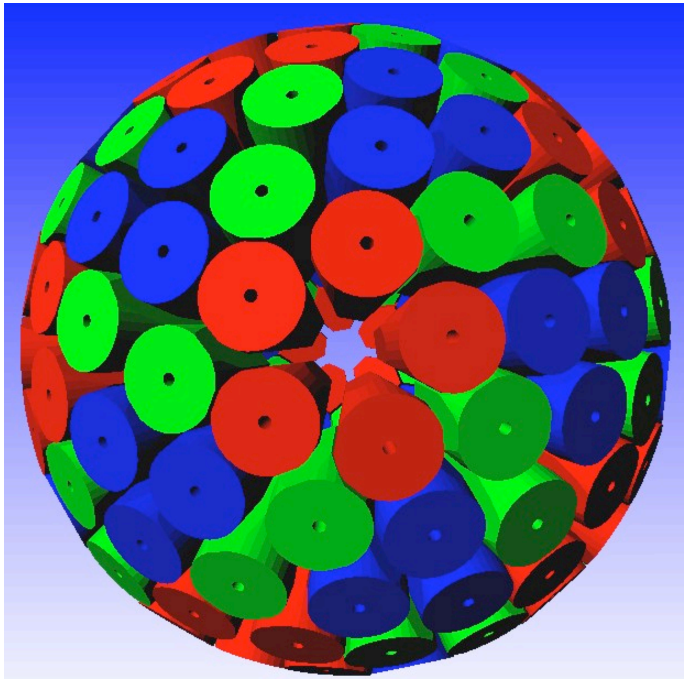
today 1 MHz 20 kHz

- 180 or 120 large volume 36-fold segmented Ge crystals in 60 or 40 triple-clusters
- Digital electronics and sophisticated Pulse Shape Analysis algorithms allow
- Operation of Ge detectors in position sensitive mode → γ-ray tracking
- Demonstrator ready by 2007
- Construction of full array from 2008 ??

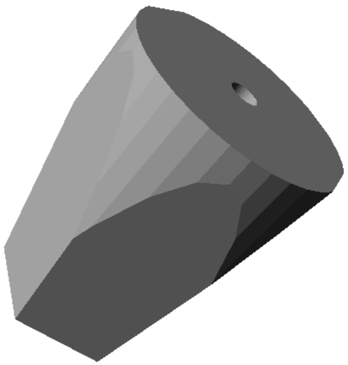
J. Simpson

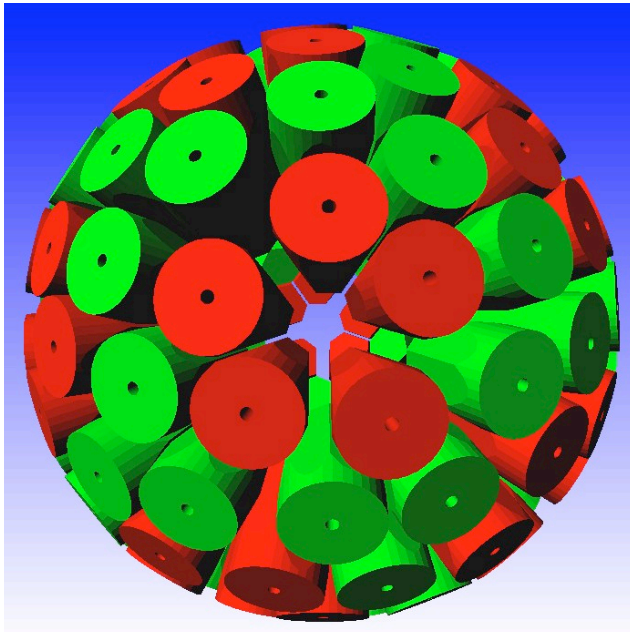
J. Simpson

The two configurations



Ge crystals size:
length 90 mm
diameter 80 mm



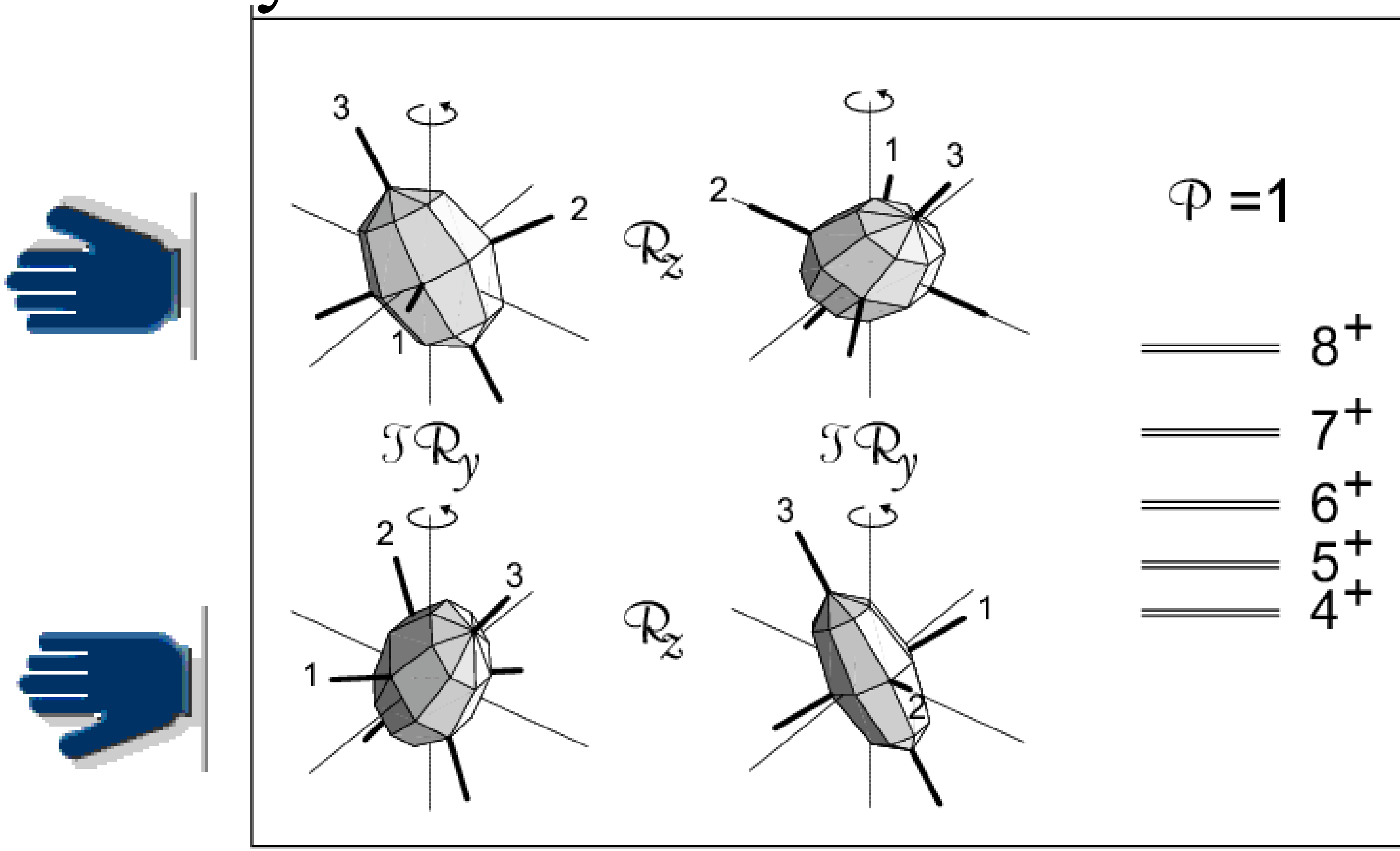


180 hexagonal crystals	3 shapes	**120** hexagonal crystals	2 shapes
60 triple-clusters	all equal	40 triple-clusters	2 shapes
Inner radius (Ge)	23 cm	Inner radius (Ge)	18 cm
Amount of germanium	310 kg	Amount of germanium	220 kg
Solid angle coverage	79 %	Solid angle coverage	72 %
Singles rate	~50 kHz	Singles rate	~70 kHz
6480 segments	50 MEuros	4320 segments	34 MEuros
Efficiency: 38% (M_γ=1)	24% (M_γ=30)	Efficiency: 33% (M_γ=1)	19% (M_γ=30)
Peak/Total: 53% (M_γ=1)	46% (M_γ=30)	Peak/Total: 52% (M_γ=1)	44% (M_γ=30)

Physics Case (1)

- Extreme nuclear deformations
  - Octupole vibrations
  - SD in light nuclei
  - Jacobi shapes
  - Tetrahedral shapes
  - New Symmetries
  - Cluster states
- Shape Coexistence and shape transitions

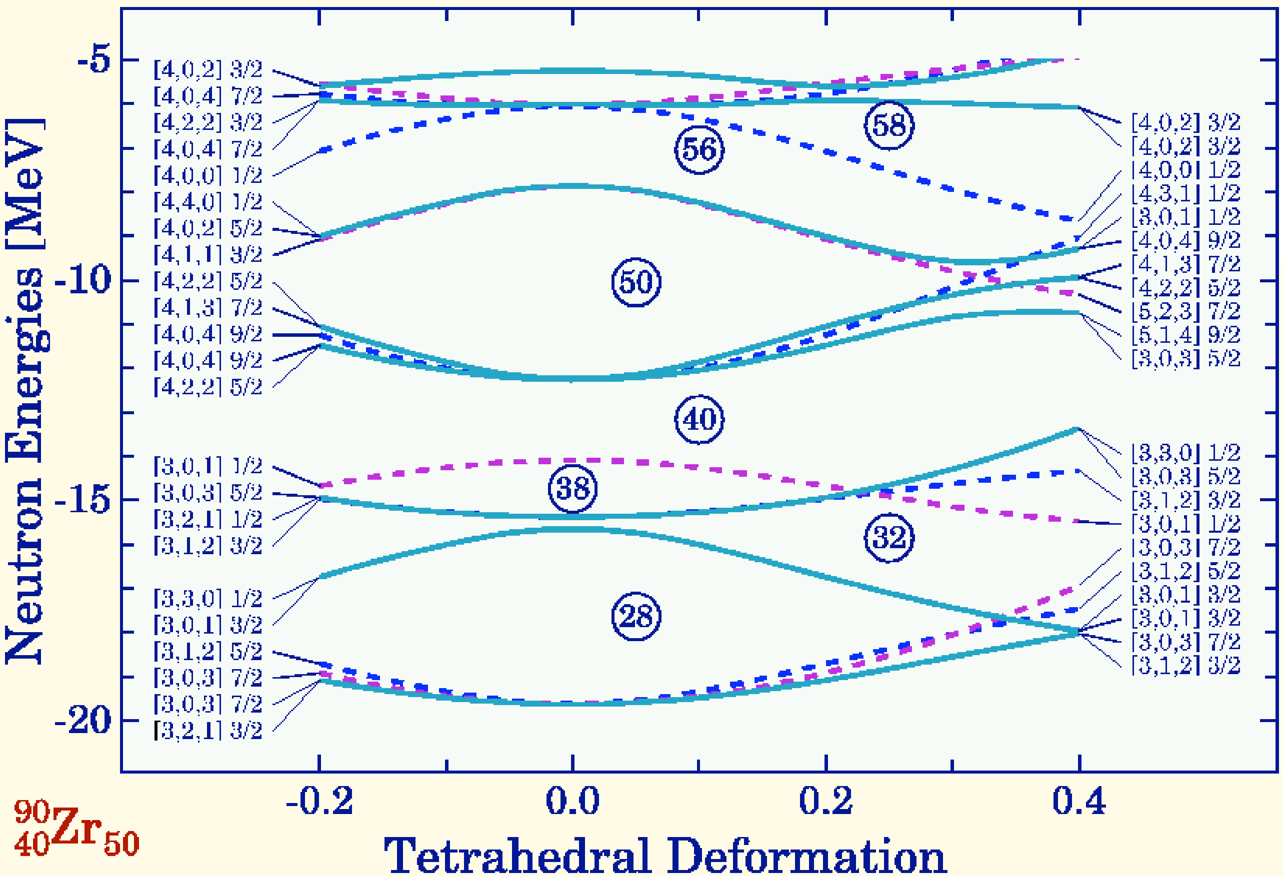
Chirality

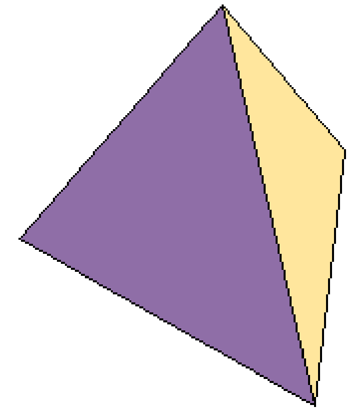


Consequence of chirality: Two identical rotational bands.

(Static approximation) *S. Frauendorf*

Tetrahedral shapes





no dipole
no E1

J. Dudek et al. PRL 88 (2002) 252502

S. Frauendorf

What about macroscopic (liquid drop) effects at very high spin?

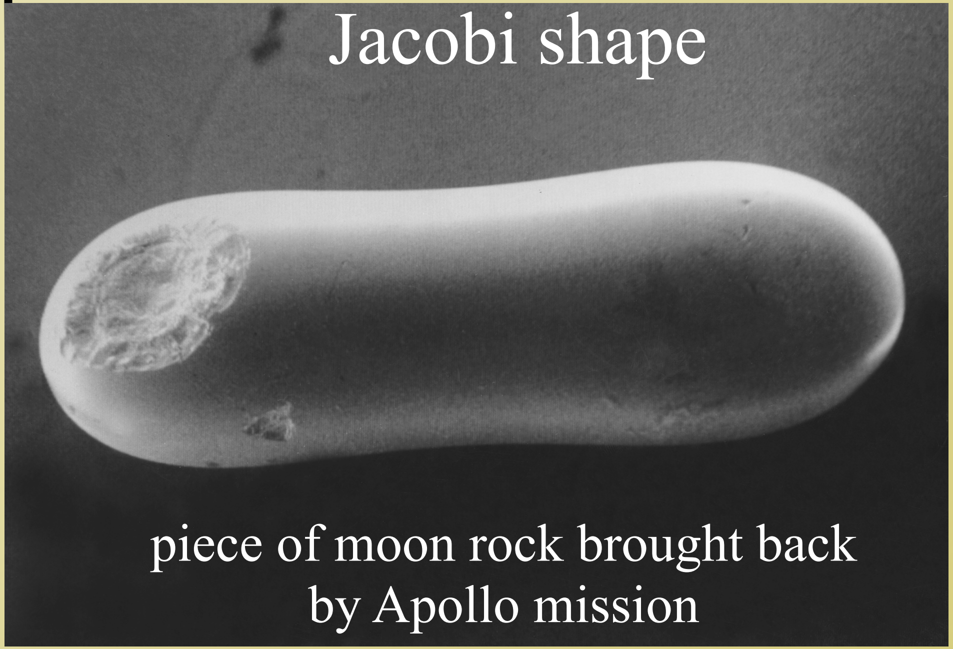
Jacobi shape transition

Superdeformed nuclei

- elongation due to shell effects
- observed down to relatively low spin
- in isolated mass regions

Jacobi shapes

- elongation due to centrifugal force
- appear only at very high spin
- over wide range of nuclei

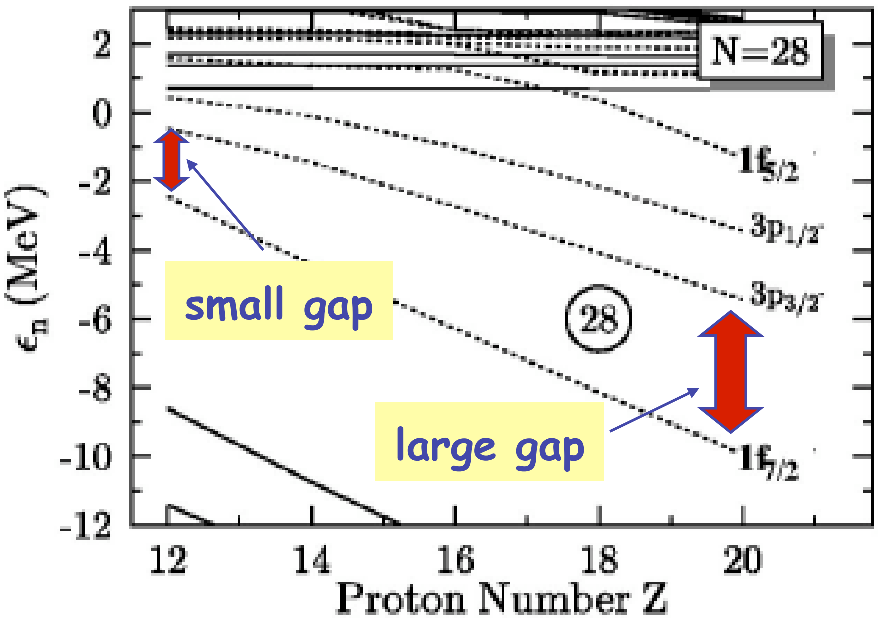


A. Görgen

Physics Case (2)

- Structure of nuclei far from stability
  - Structure of loosely bound light nuclei
  - Structure of very neutron-rich nuclei
  - Medium mass proton emitters
  - N = Z nuclei
  - Isomers far from stability
- Structure of (super)heavy nuclei

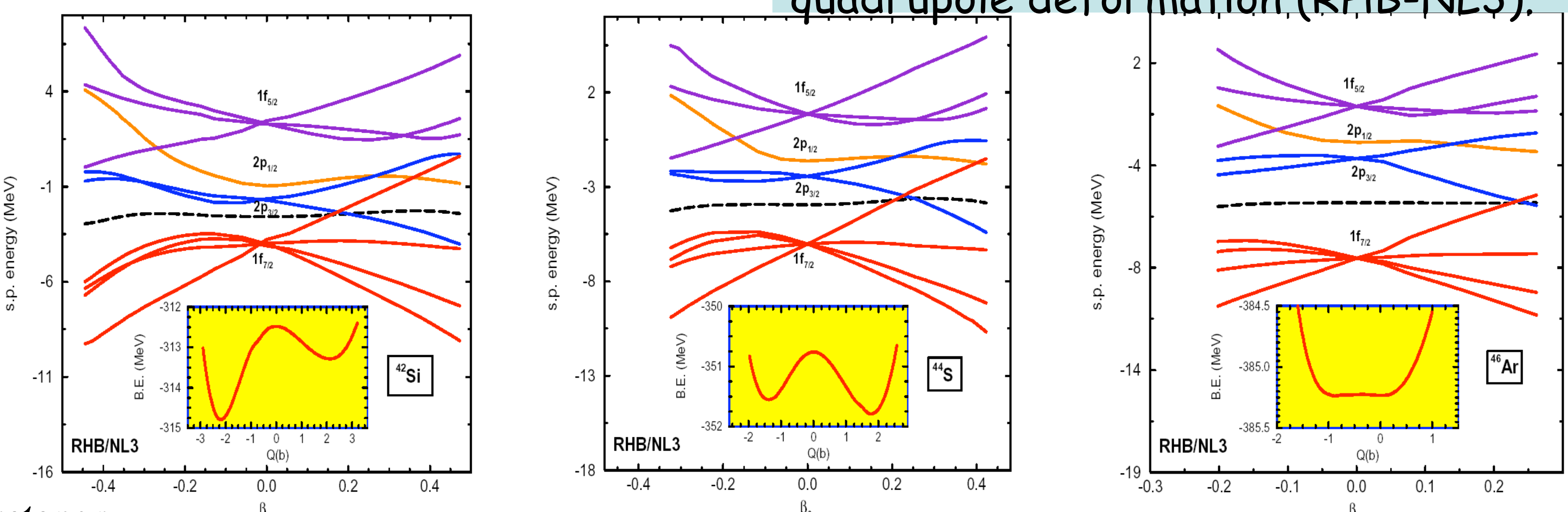
Neutron-rich nuclei: evolution of shell structure



HFB: SLy6 interaction
Rev. Mod. Phys. 75, 121 (2003)

Suppression of shell effects, the disappearance of spherical magic numbers, the onset of deformation and shape coexistence in nuclei with large N/Z ratio.

Neutron single-particle levels for ^{42}Si, ^{44}S, and ^{46}Ar as functions of the quadrupole deformation (RHB-NL3).



D. Vretenar

Recent Highlights

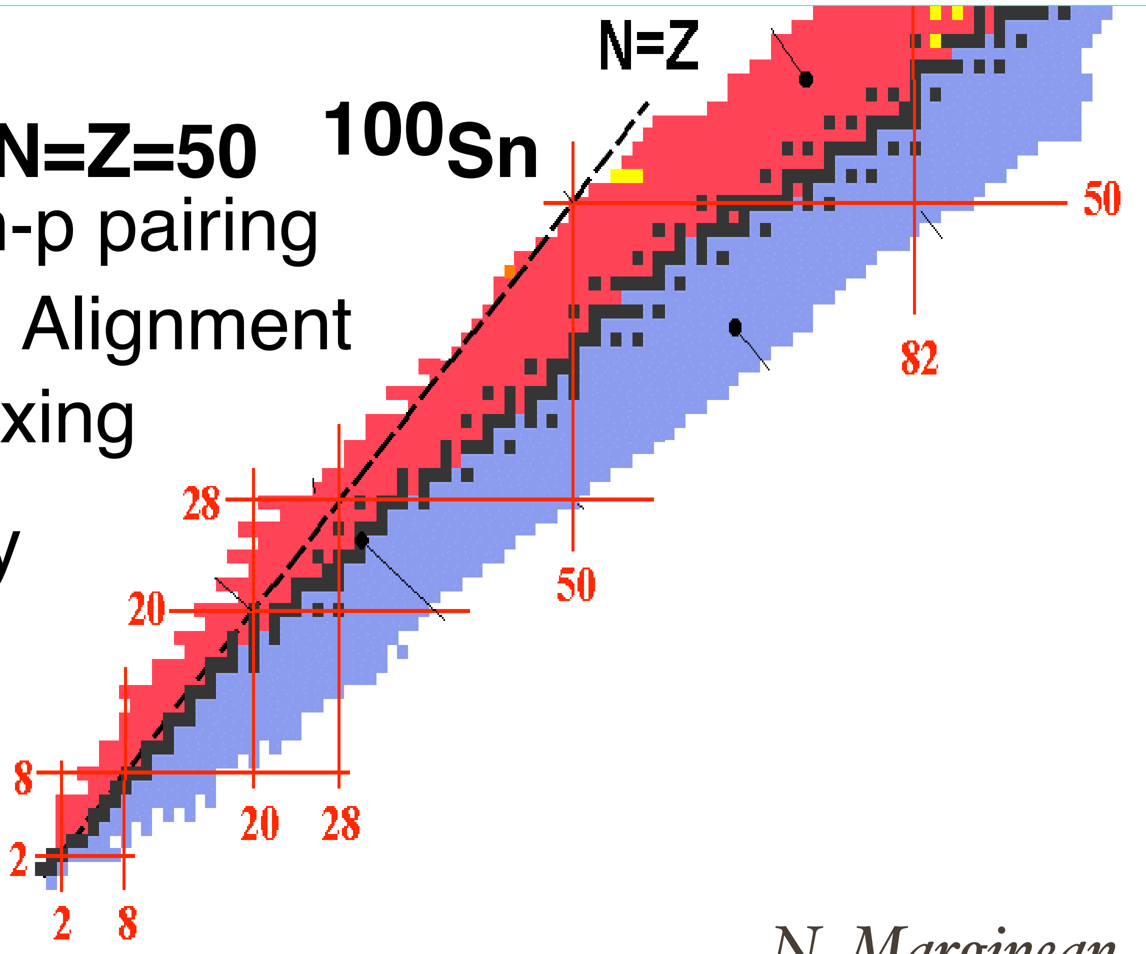
N=Z=50 ^{100}Sn

n-p pairing

Delayed Alignment

Isospin Mixing

Isospin Symmetry
Breaking



N. Marginean

Physics Case (3)

- Giant resonances
- Hypernuclei
- Agata & Astrophysics
  - NLD parameter and Supernova explosions
  - Cross section measurements

Conclusions (A. Bracco)

Giant resonaces at zero temperature and its gamma decay

Giant quadrupole resonance

Giant dipole resonance (pygmy)

GDR on excited states (the gamma decay from compound nuclei)

superdeformation

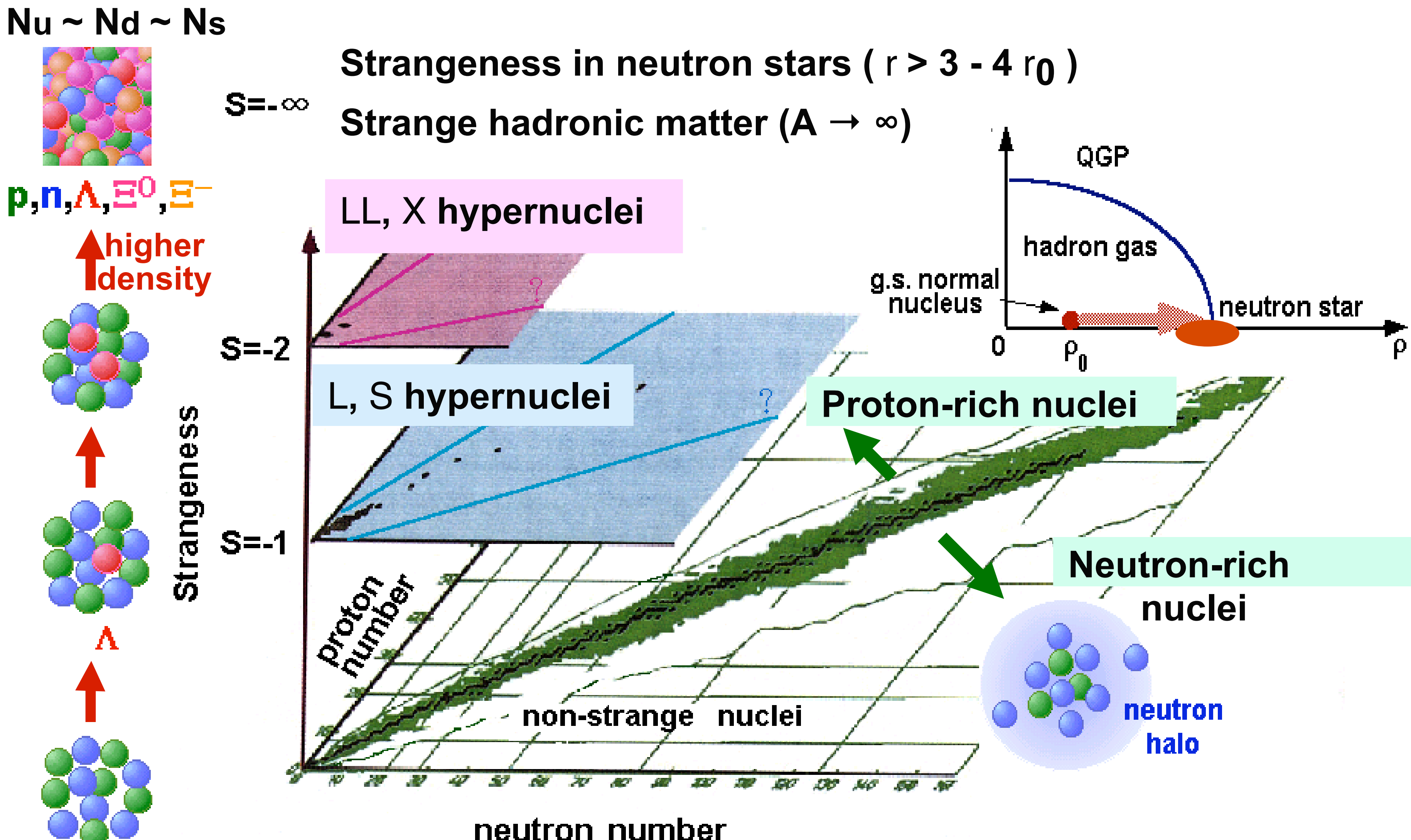
Jacobi shapes

survival of shell effects at finite temperature

GDR in reaction dynamics (isospin in the entrance channel)

Extensive work with stable and RIB facilities, low energy ISOL (SPES, SPIRAL2) and high energy fragmentation (GSI)

Why Hypernuclei?
-- Extending Our Knowledge on Matter



3-dimensional nuclear chart

H. Tamura

Why is the level density parameter of exotic nuclei relevant for Supernova explosions?
P. Pizzochero

- ***Symmetry energy***

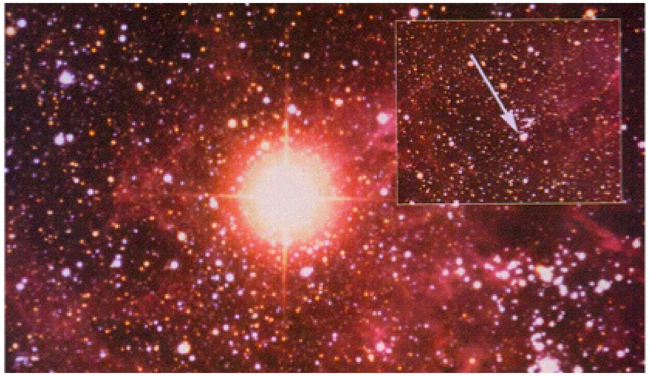
n–p energy difference is related to symmetry coefficient

$$\hat{\mu} \propto b_{sym} + \dots$$

where

$$E_{sym} = b_{sym} \cdot (1 - 2x)^2$$

is symmetry term in E_{bind}/A for nucleus with $x = Z/A$



SN 1987A

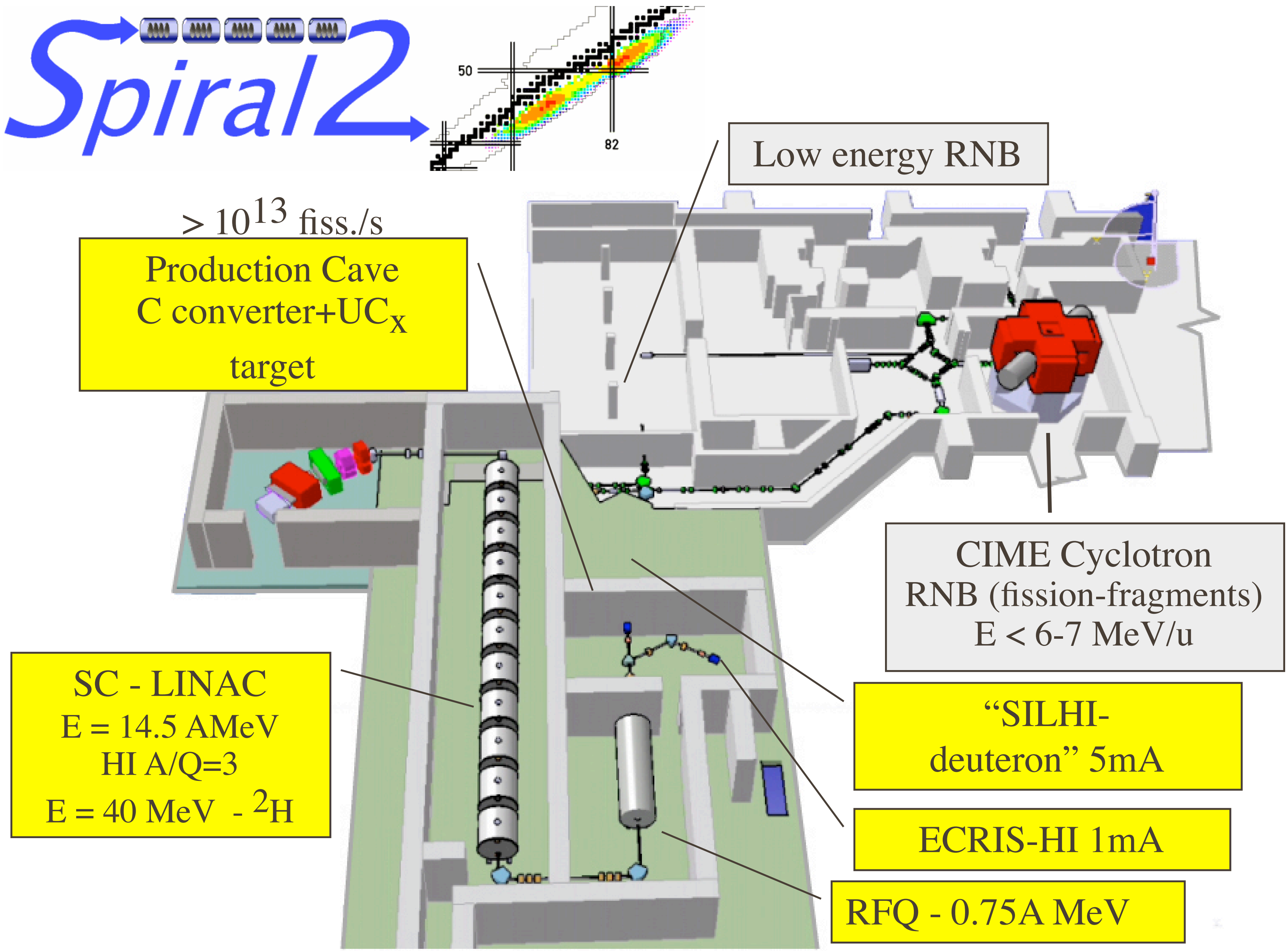
T-dependence of $b_{sym} \Rightarrow$ stronger explosion

Measure energy and spin dependence of NLD for exotic nuclei (e.g. ^{110}Mo)

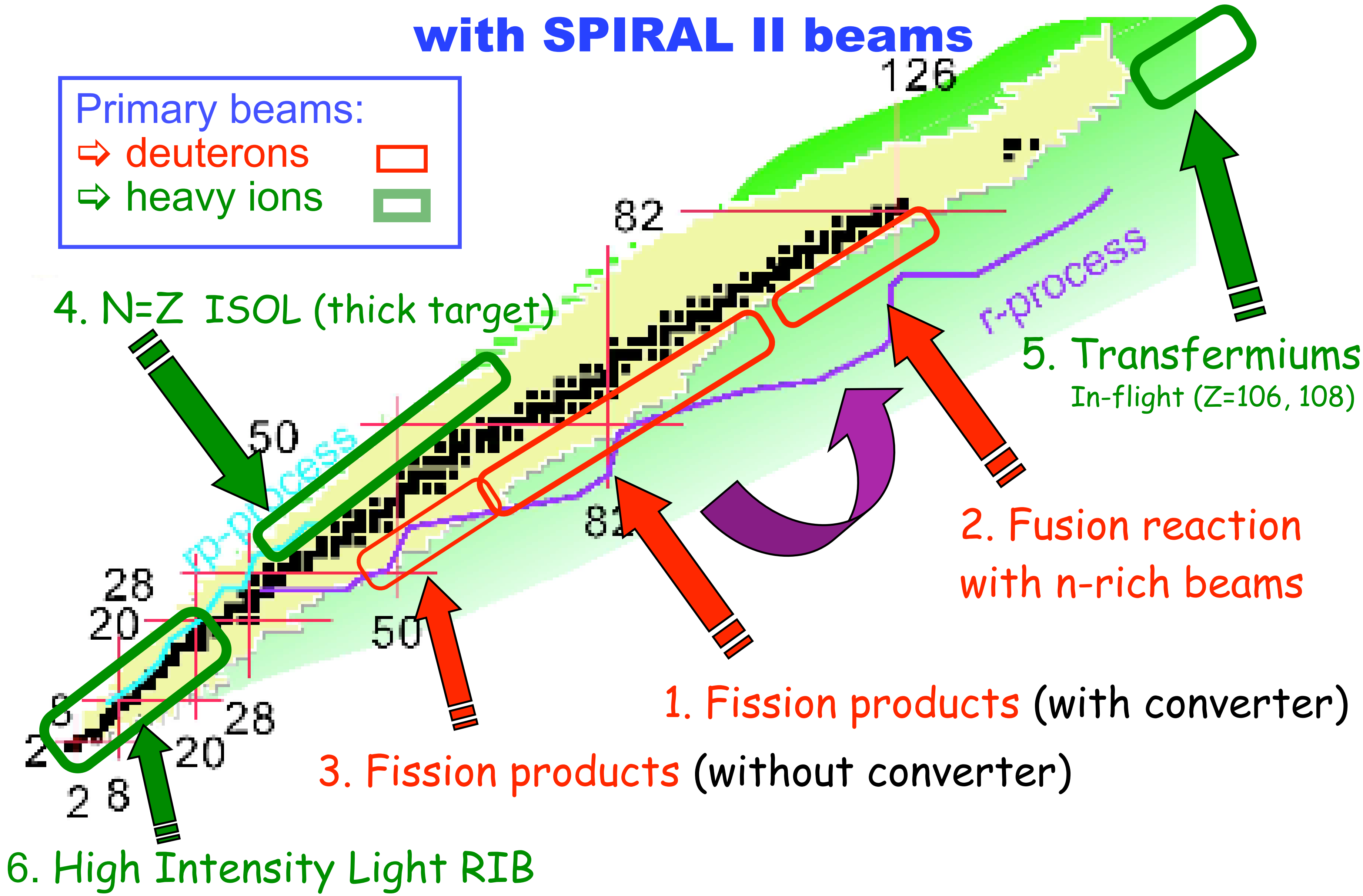
^{84}Se ^{82}Ge ^{80}Zn ^{78}Ni ^{76}Fe ^{124}Mo $^{120,122}Sr$ $^{86,118}Kr$

Host Laboratories

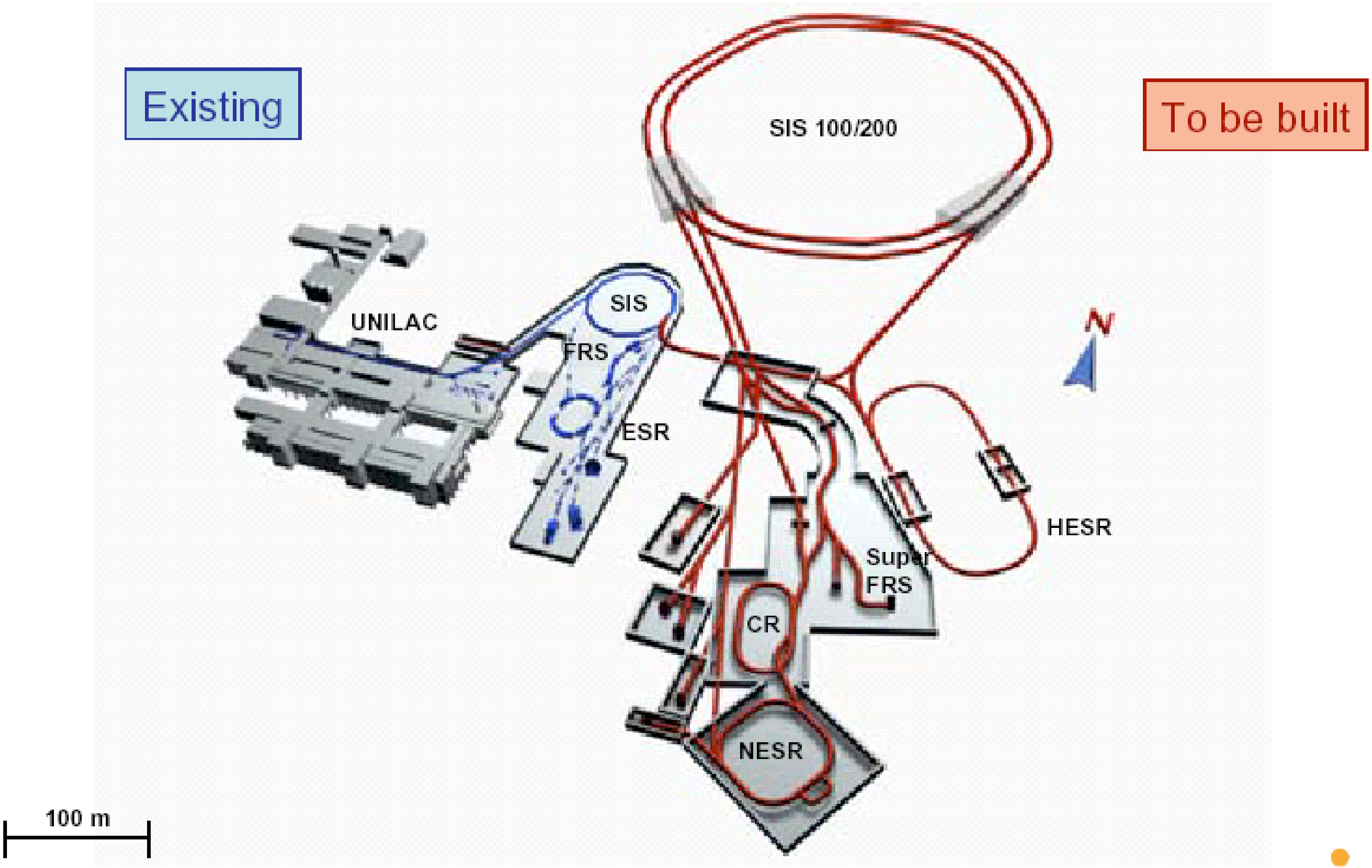
- JYFL Jyvaskyla, LNL Legnaro, FLNR JINR Dubna - stable beams at the coulomb barrier
- GANIL (REX ISOLDE, SPES)
  - High intensity, low energy stable beams
  - Low energy RNB with SPIRAL 2
- GSI
  - Relativistic and medium energy RNB
  - Hyper-nuclei
- EURISOL - high intensity RNB (+stable beams!)
- Others ?


Spiral2
50
82
Low energy RNB
> 10^13 fiss./s
Production Cave
C converter+UCx
target
CIME Cyclotron
RNB (fission-fragments)
E < 6-7 MeV/u
SC - LINAC
E = 14.5 AMeV
HI A/Q=3
E = 40 MeV - 2H
“SILHI-
deuteron” 5mA
ECRIS-HI 1mA
RFQ - 0.75A MeV

Regions of the Chart of Nuclei Accesible with SPIRAL II beams

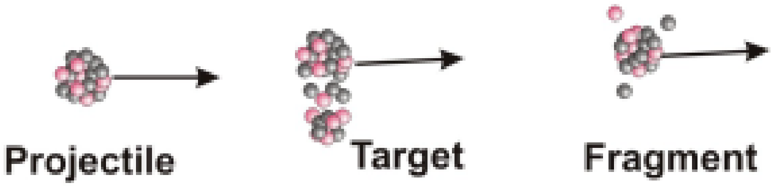


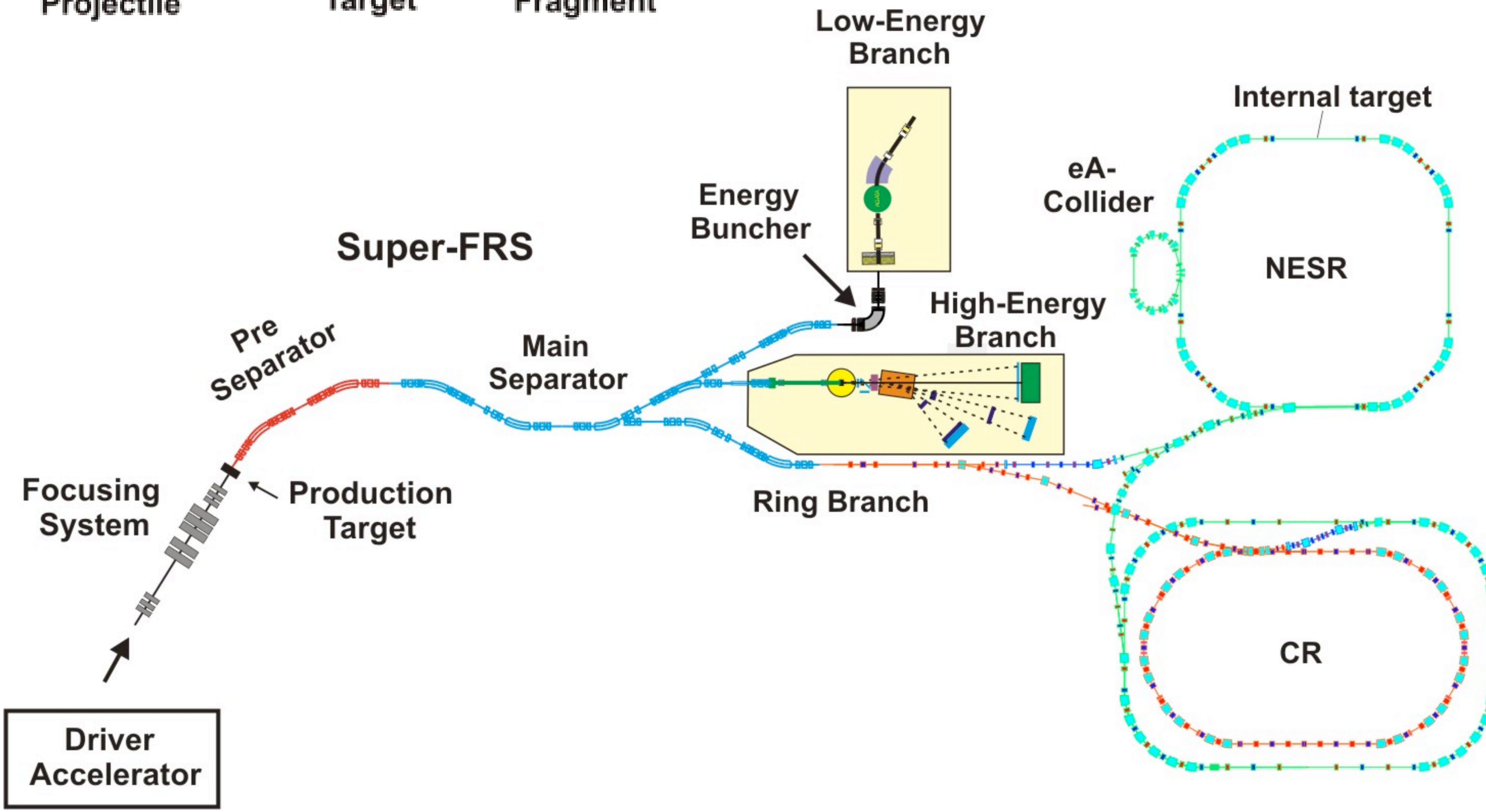
The Future International Facility at GSI: Beams of Ions and Antiprotons



The Super-FRagment Separator

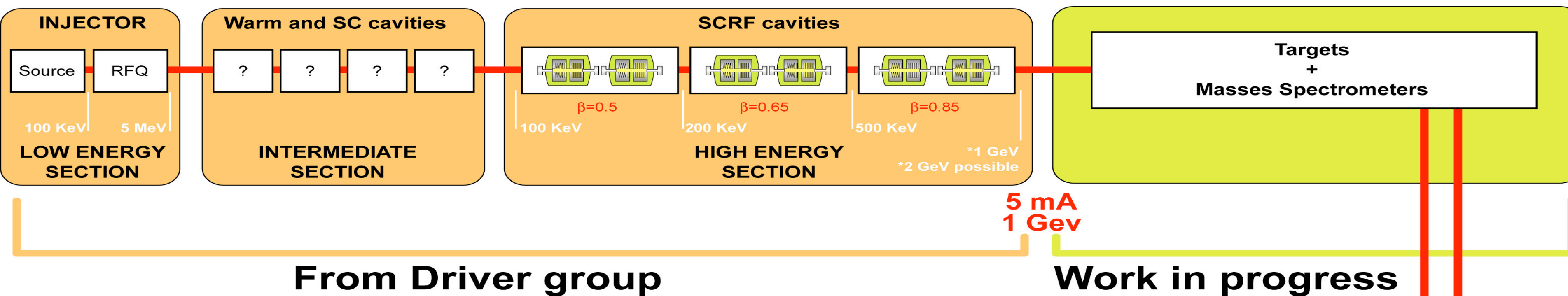
Projectile Fragmentation





EURISOL Driver as proposed today :
1GeV proton SC-LINAC, up to 5mA
(light heavy-ion option under consideration)

EURISOL PROVISIONNAL FACILITY LAYOUT



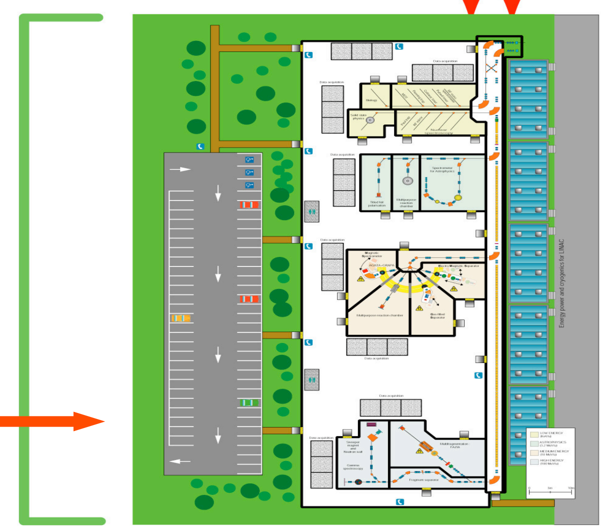
Note the synergies with others

High-Power Accelerators:

- –ν factory
- -Neutron spallation
- -XADS-transmutation
- -Irradiation of material

Two beams:
100μA
5mA

Experimental areas



EURISOL - Post Accelerator & Experimental Area lay-out

Low energy (<670 keV/u)

Astrophysics (<3.2 MeV/u)

Medium energy (<18 MeV/u)

High energy (<100 MeV/u)

Future Prospects

- **Very high quality of presentations**
- **Excellent starting point for the preparation of the detailed and convincing AGATA Physics Case**
  - ***Very well defined "exotic shapes and high-spin physics" part***
  - ***Nuclear structure studies with AGATA - might be still improved (ex. gain factor, ancillary detectors)***
  - ***Many interesting "interdisciplinary" applications***
- **Physics case -> Choice of geometry**
- **Discussion with funding agencies:**
  - ***Strongly related to projects of the new facilities***
  - ***It will take time ! Be patient !***