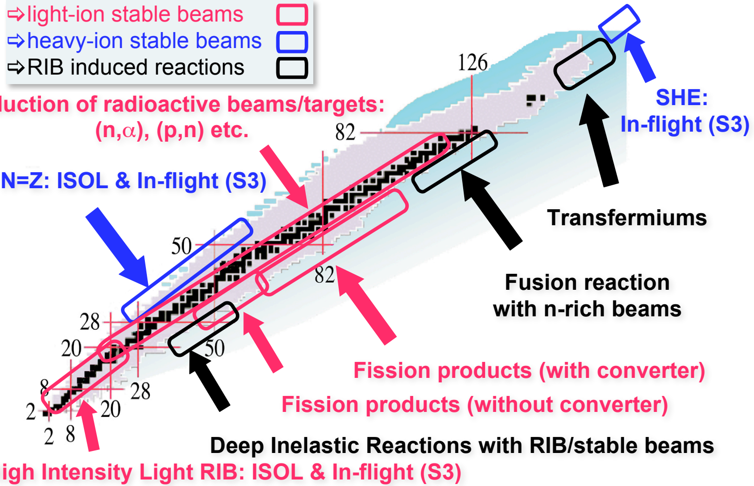
ACTAR at GANIL

Riccardo Raabe, GANIL

ACTAR Workshop
CENBG, Bordeaux, June 16-18, 2008

Future at GANIL: Spiral2



Physics cases

Structure of exotic nuclei: one-nucleon transfer reactions

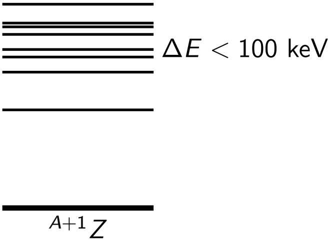
Detailed structure...?

Physics cases

Structure of exotic nuclei: one-nucleon transfer reactions

Detailed structure...?

- High density of final states
  ⇒ high resolution
  ⇒ γ-ray detection
  ⇒ reasonable beam intensities



Physics cases

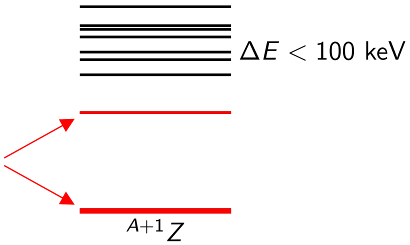
Structure of exotic nuclei: one-nucleon transfer reactions

Detailed structure...?

- High density of final states
  $\Rightarrow$ high resolution
  $\Rightarrow$ γ-ray detection
  $\Rightarrow$ reasonable beam intensities

"Niche" for active target:

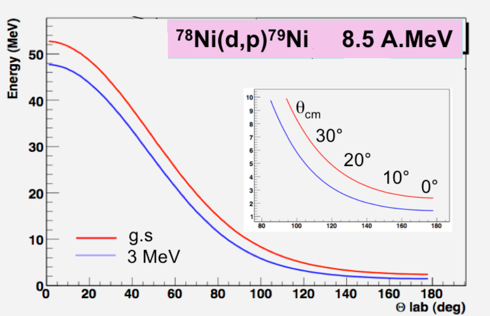
- Very exotic cases
- One or two states populated
- Very low counting rates
- Low recoil energies



Physics cases

Example 1: ^{78}Ni(d,p)

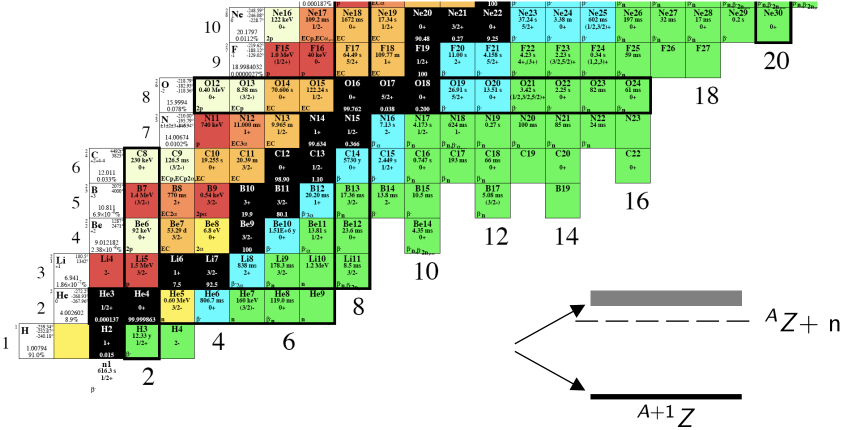
- "Thick" target
- High efficiency
- Angle and energy of light ejectile
- Detection of recoil (low threshold)



reactions: (d,p), (p,d), (^{3}He,d)...

Physics cases

Example 2: unbound states in light nuclei



Physics cases

Resonant reactions

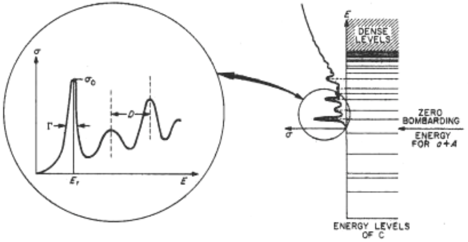
$a + A \to C^* \to b + B$, ...

Learn about...

- Structure of the resonance: energy, width, spin, parity, decay modes

Scan the energy region by

- varying the beam energy or
- using a thick target



Physics cases

Resonant reactions

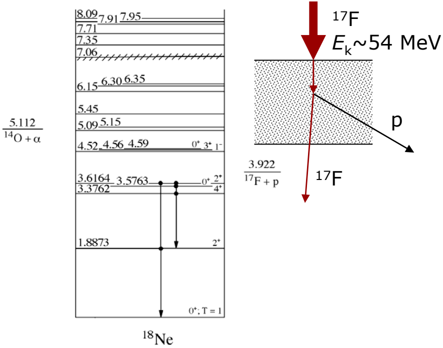
$a + A \rightarrow C^* \rightarrow b + B$, ...

Learn about...

- Structure of the resonance: energy, width, spin, parity, decay modes

Scan the energy region by

- varying the beam energy or
- using a thick target

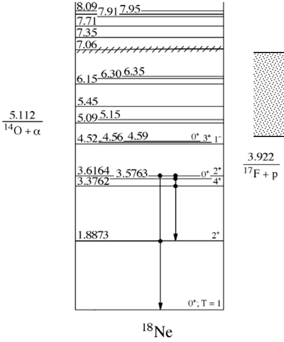


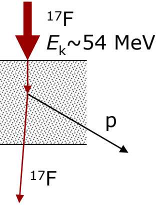
Physics cases

Resonant reactions

- Nuclear astrophysics

  reactions on p, α...





Physics cases

Resonant reactions

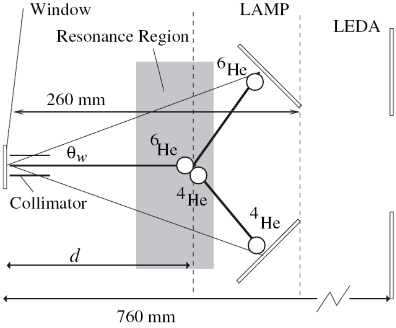
- Nuclear astrophysics

  reactions on p, α...

- Nuclear structure

  molecular states

  giant resonances



Physics cases

Resonant reactions

- Nuclear astrophysics

  reactions on p, α...

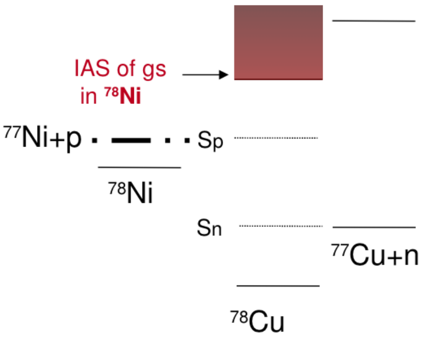
- Nuclear structure

  molecular states
  giant resonances

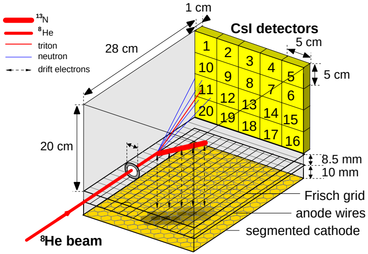
- Isobaric analog states

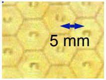
  resonant elastic scattering:
  ${}^{A}Z+\mathrm{p} \rightarrow {}^{A+1}(Z+1) \rightarrow {}^{A}Z+\mathrm{p}$
  $\Rightarrow$ information on the g.s. of ${}^{A+1}Z$

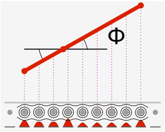
  ...angular distributions!



How MAYA works





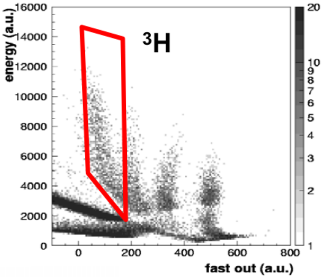


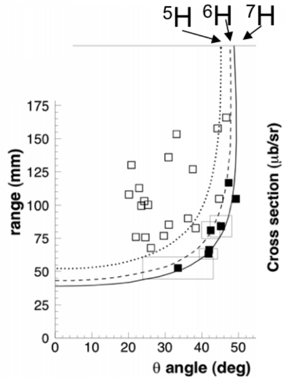
- PPAC as start detector
- reaction with a nucleus of the target gas
- drift electrons induce signals on the cathode pads (after amplification)
- 3D track determined from pads signals and drift time (resolution ≈ 1 mm)
- particle ID and energy from range $R \propto E^2/MZ^2$ or from Si and CsI detectors

MAYA: results

- Transfer reactions:

  $^{12}C(^{8}He,^{13}N)^{7}H \rightarrow {}^{3}H+4n$

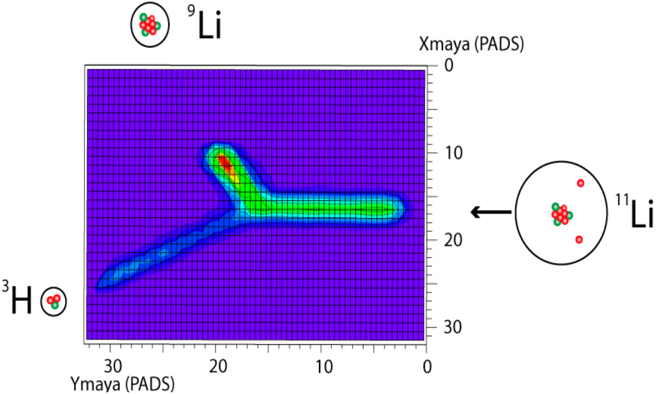




M. Caamaño et al., PRL 99 (2007) 062502

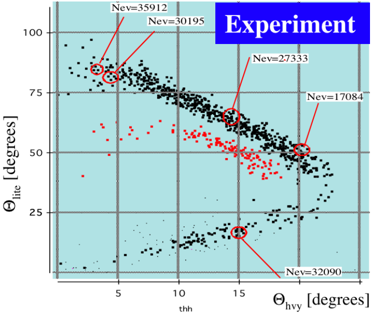
MAYA: results

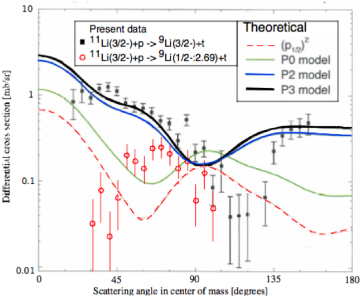
- Transfer reactions:
  ^{11}Li(p,t)^{9}Li, mass measurement...



MAYA: results

- Transfer reactions:
  ^{11}Li(p,t)^{9}Li, mass measurement...

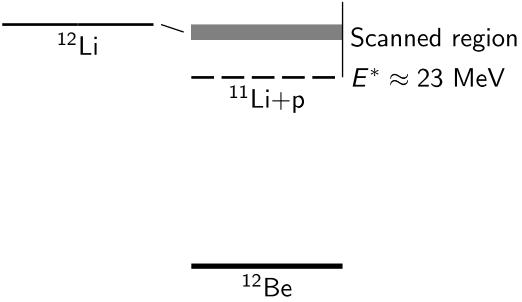




I. Tanihata et el., PRL 100 (2008) 192592

MAYA: results

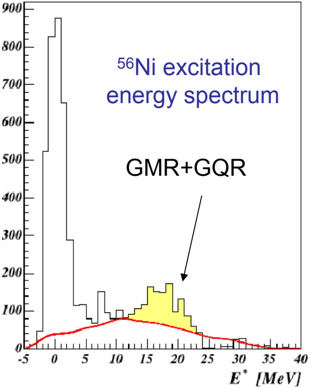
- Resonant reactions:
  ^{11}Li(p,p') $\rightarrow$ IAS of ^{12}Li g.s.

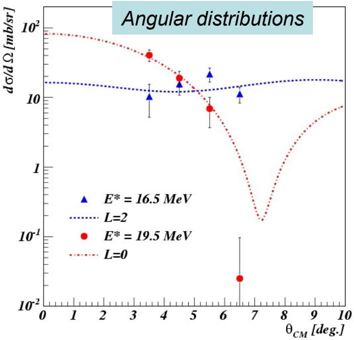


T. Roger et al., in progress

MAYA: results

- Resonant reactions:
  ^{56}Ni(d,d')





C. Monrozeau et al., PRL 100 (2008) 042501

From MAYA to ACTAR

MAYA limitations, our needs...

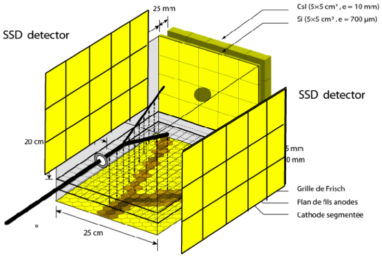
- Restricted dynamical range
  Reactions with heavy beams
- Small gain
  Low thresholds
- Vertical angle within $\approx \pm 45^\circ$
  Maximum efficiency
- Limited spatial resolution
  Efficiency...
- One time signal each row
  Efficiency, multiple tracks

...and the solutions

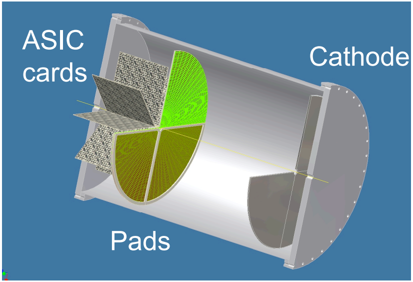
- Magnetic field
  (electronics)
- Read-out with
  GEMS or MICROMEGAS
- Geometry
  (electronics)
- Smaller pad size
- One time signal each pad:
  electronics

The geometry

Cubic geometry

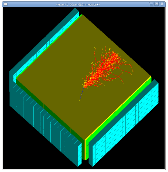


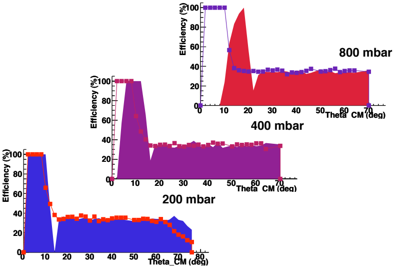
Cylindrical geometry



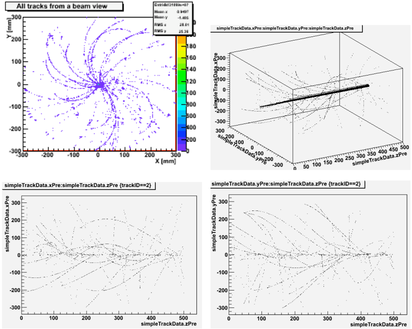
The geometry, simulations

Cubic geometry

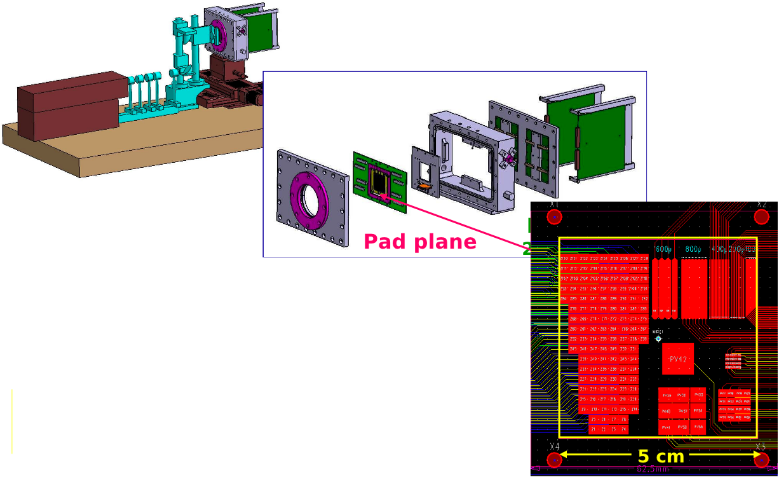




Cylindrical geometry



Tests with MICROMEGAS at IPN Orsay



From MAYA to ACTAR

MAYA limitations, our needs...

- Restricted dynamical range
  Reactions with heavy beams
- Small gain
  Low thresholds
- Vertical angle within $\approx \pm 45°$
  Maximum efficiency
- Limited spatial resolution
  Efficiency...
- One time signal each row
  Efficiency, multiple tracks

...and the solutions

- Magnetic field
  (electronics)
- Read-out with
  GEMS or MICROMEGAS
- Geometry
  (electronics)
- Smaller pad size
- One time signal each pad:
  electronics