Nuclear Structure Study with HiRA

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Is Nickel-56 doubly magic ?

Two shell structures for unstable ^{56}Ni nucleus:
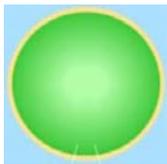
- ^{56}Ni as inert core
- All 28 protons and 28 neutrons are inside the core
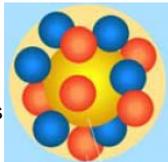
- ^{40}Ca as inert core
- 8 valence protons and 8 neutrons are outside the core

Classical tool: To use transfer reaction such as (p,d) to pick up a neutron from the ^{56}Ni nucleus. Comparison of the data to model predictions will distinguish the two models.

Two for the price of one: Since N=Z=28 in ^{56}Ni, we can test the mirror symmetry of ^{56}Ni nucleus by using (d,^{3}He) reaction to pick up a proton in the same experiment and compare the neutron and proton pickup mechanisms.

Complete Kinematics

- Projectile residues are detected with spectrometer
- Light particles are detected with Si charged particle detectors

Schematics of setup with HiRA and S800
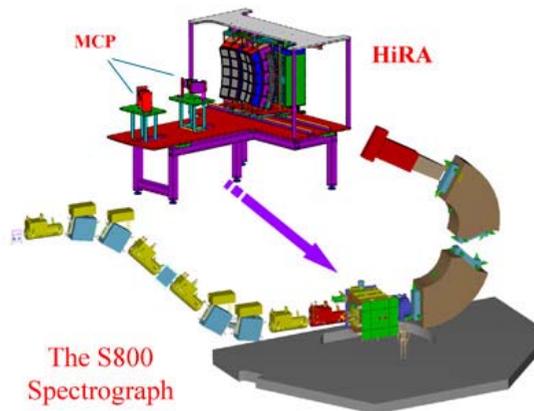
Inverse kinematics: ^{56}Ni is the radioactive beam and proton is the target.
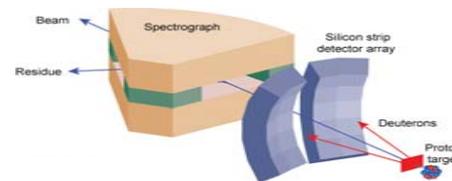

HiRA is an array of charged particle detectors:
- ✓ highly efficient
- ✓ covers large solid angle
- ✓ good energy and position resolution

Excellent for Investigation of the Structure of Exotic Nuclei using inverse kinematics

Performance of HiRA in previous transfer reaction experiments

^{66}As(p,d)^{65}As, ^{65}Ge(p,d)^{64}Ge, ^{69}Se(p,d)^{68}Se – important for Nuclear Astrophysics
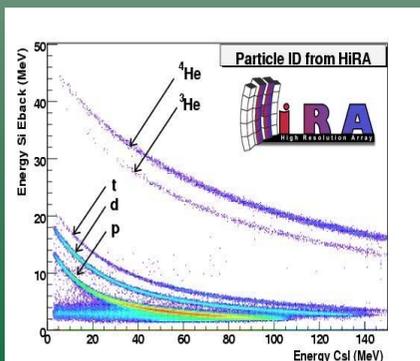
PID (Particle Identification):

- ❑ Particles are identified in HiRA by comparing the energy lost in the various detectors.
- ❑ Each band corresponds to a different nuclear species.
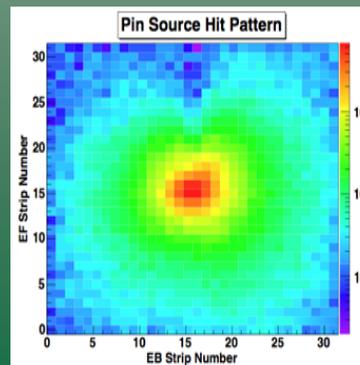
Position Resolution:

- ❑ 32 vertical strips on the front side and 32 horizontal strips on the back side of Si detector → 1024 pixels
- ❑ Each pixel is 1.8mm x 1.8 mm → Good angular resolution
- ❑ At a distance of 35cm, the angular resolution for one pixel is 0.15° degree