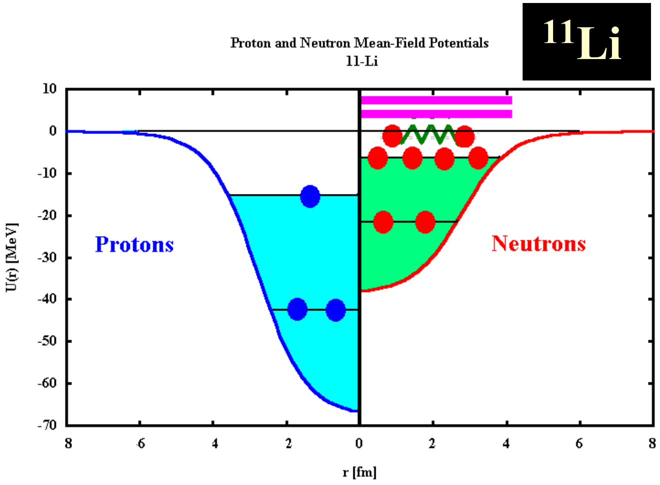
Light neutron-rich nuclei

Weak Binding: e.g. just 300 keV for last neutron in ^{11}Be

Shell structure changes: level inversion in ^{11}Be leads to $(½)^{+}$ ground state. Low angular momentum oribits are favoured.

Halo nuclei: 1n (^{11}Be, ^{19}C), 2n (^{6}He, ^{11}Li, ^{14}Be) and 4n (^{8}He)

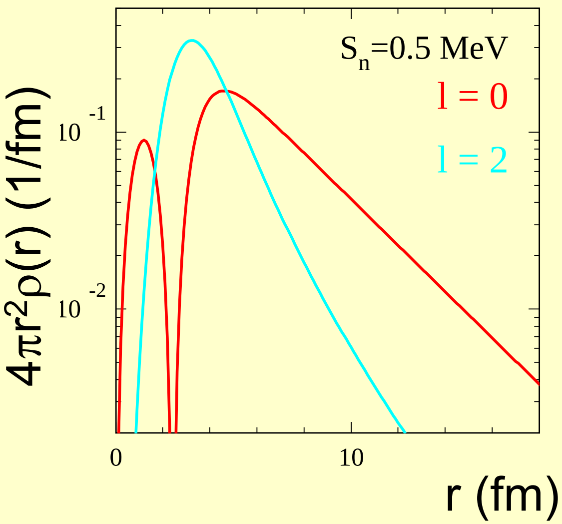
Coupling between (weakly) bound states and the continuum



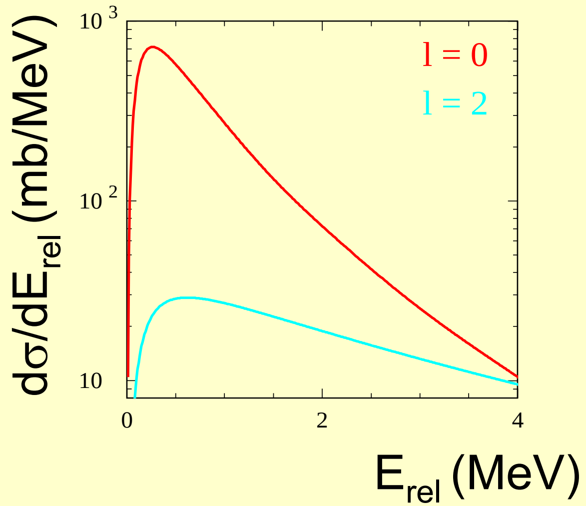
^{11}Be

Wave function: $|^{11}\text{Be}\rangle = \alpha\, |^{10}\text{Be}(0^+)\rangle \otimes 2s_{1/2}\rangle + \beta\, |^{10}\text{Be}(2^+)\rangle \otimes 1d_{5/2}\rangle + \ldots$

Density distribution



Differential cross section



Spatial extension (Halo)

$\Rightarrow$ Strong non-resonant transitions

(~ 100 mb/MeV)

Shape of differential cross section $\Rightarrow$ angular momentum *l*

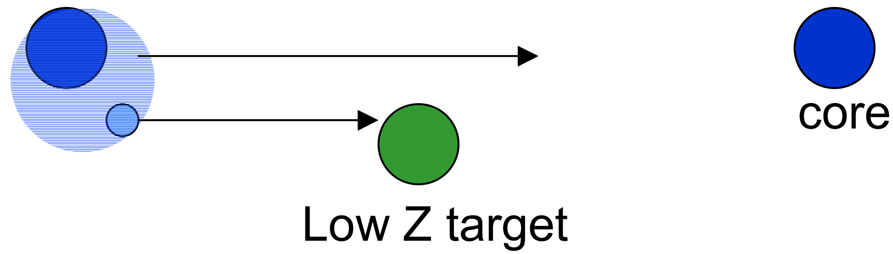
γ-ray coincidence $\Rightarrow$ identification of core state

Cross section $\Rightarrow$ spectroscopic factors α, β ..

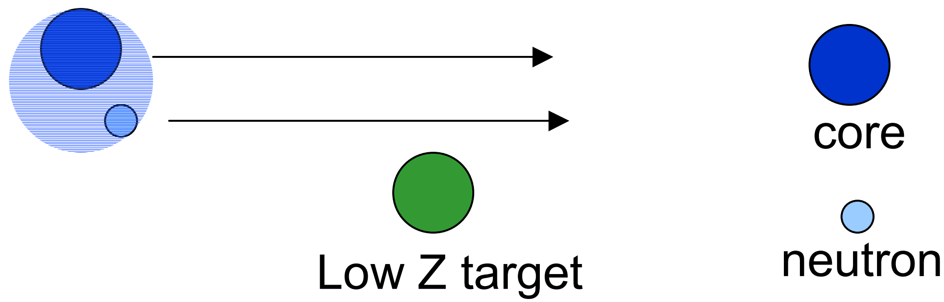
1 neutron removal reactions

Nuclear:

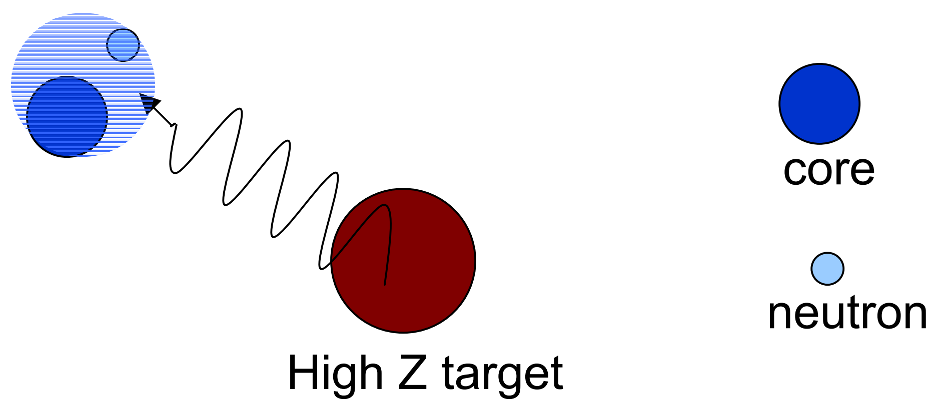
Knockout (absorption)



Diffraction



Coulomb:



Remarks

- Knockout reactions only possible at higher beam energies (fragmentation beams)
- Coulomb dissociation provides large cross sections for weakly bound (halo) nuclei
- γ-ray measurements identify core state
    - need high efficiency γ-ray detector
- 1 neutron removal reactions are a powerful tool for studying (light) neutron-rich nuclei