Hypernuclear spectroscopy at the EIC

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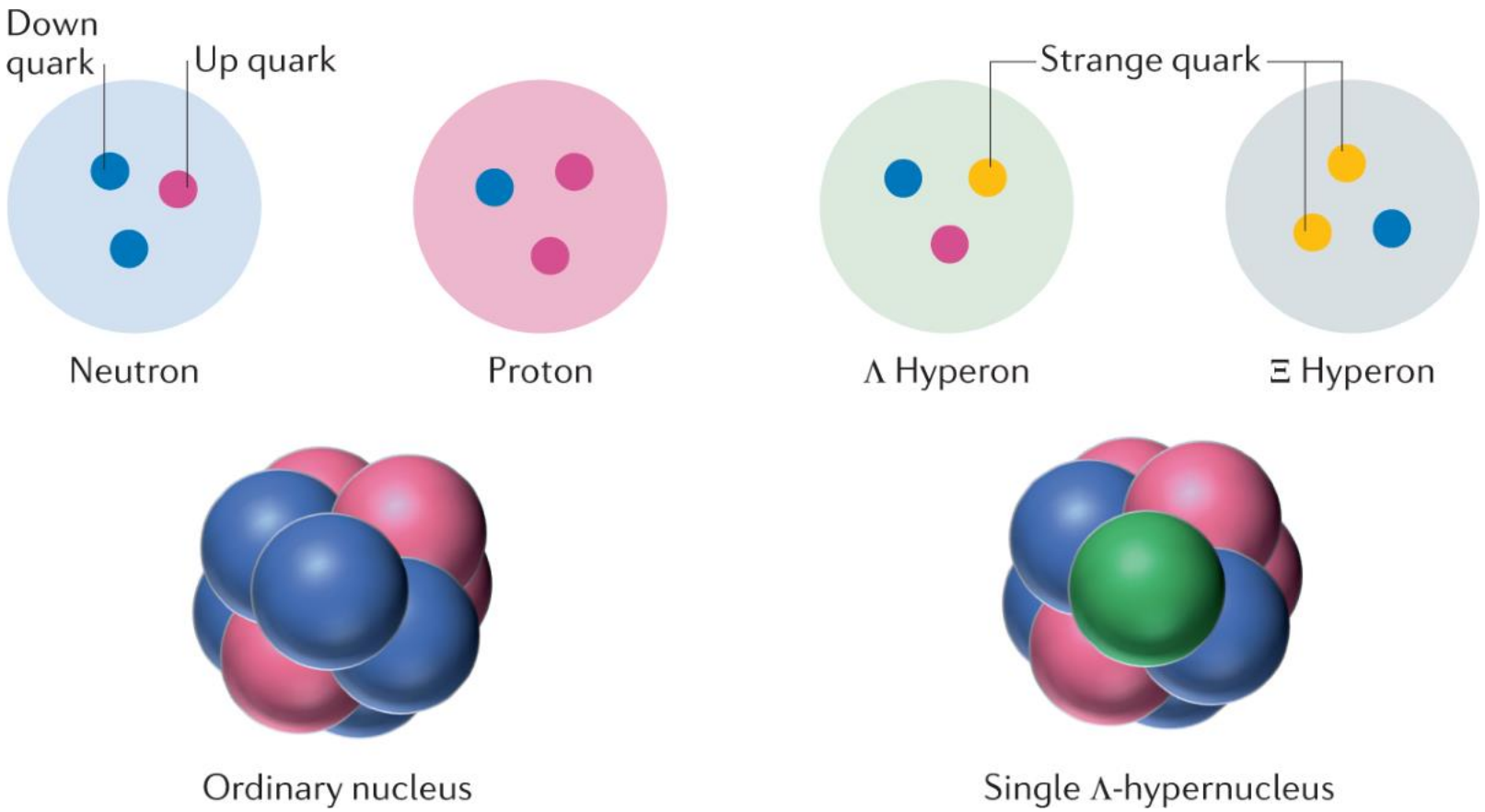
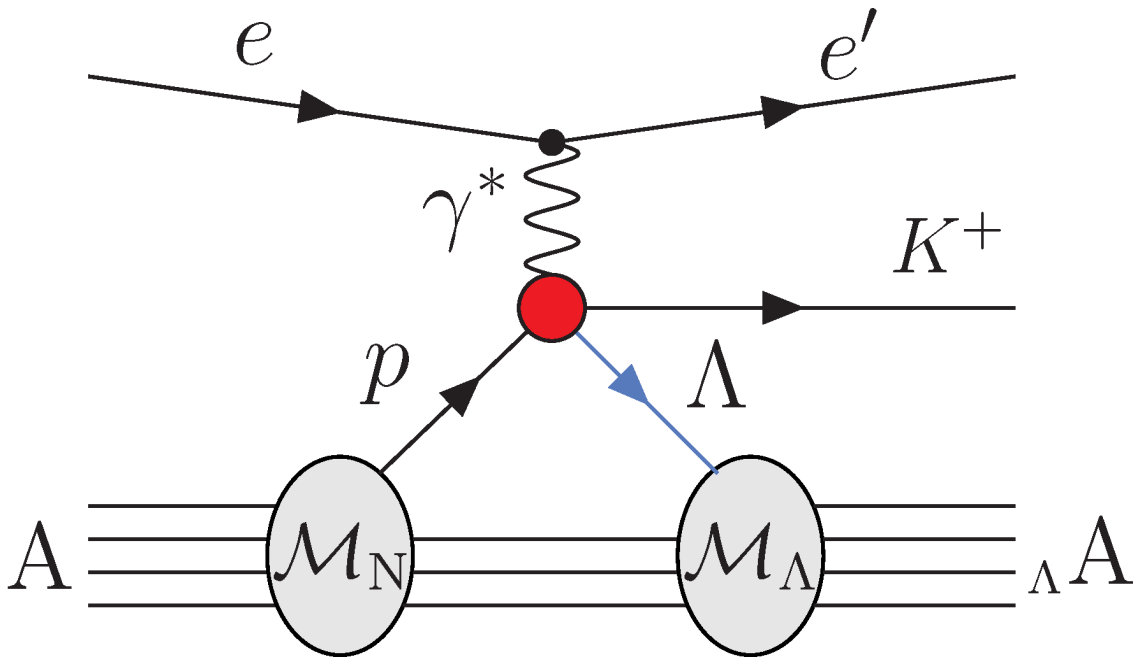
eA WG, August 6, 2024

Hypernuclei



Significant interest among, for instance, Japanese groups.

Production and detection of hypernuclei at the EIC



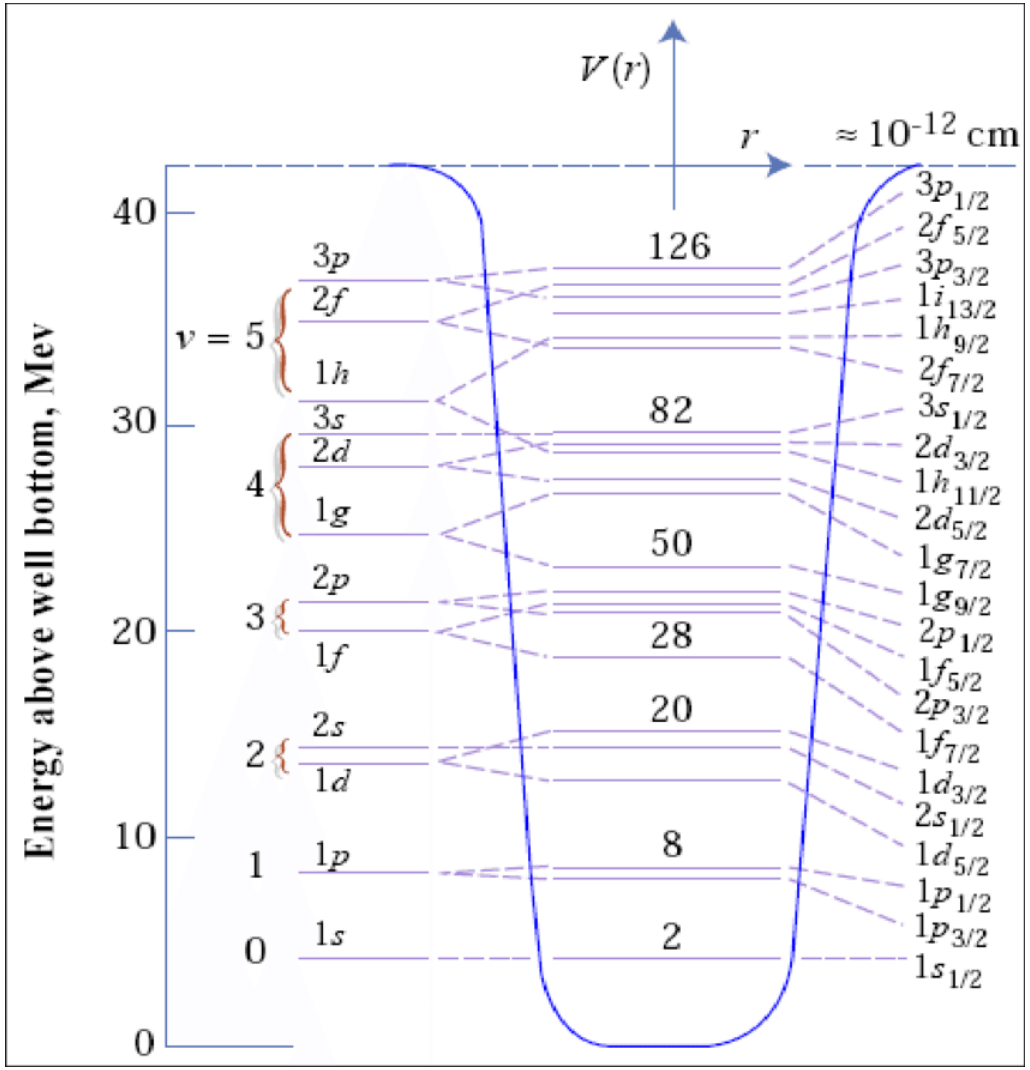
Detected in the central detector

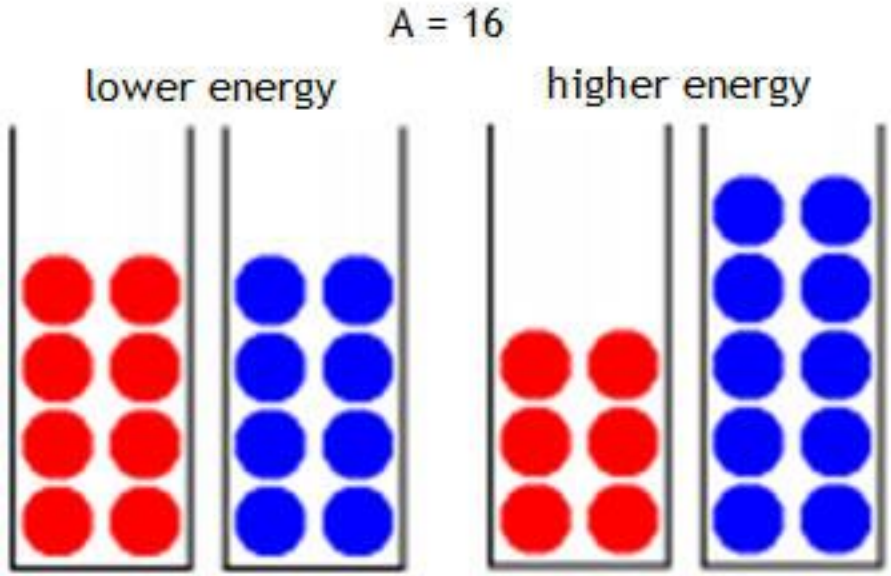
Detected in far forward detectors
- IR8 can detect all hypernucleui
- IR6 only the lightest ones

- Coherent exclusive kaon production creates a hypernucleus that differs by one unit of charge.
  - Sufficient for any nucleus to be detected at the 2nd focus of IR8
  - Coincidence with K^+ is a clean signature

- Lifetime of excited states < lifetime of hypernucleus (~ lifetime of free hyperon)
  - The hypernucleus will de-excite to its ground state before decaying
  - Boosted gamma photons can be detected at the ZDC and B0

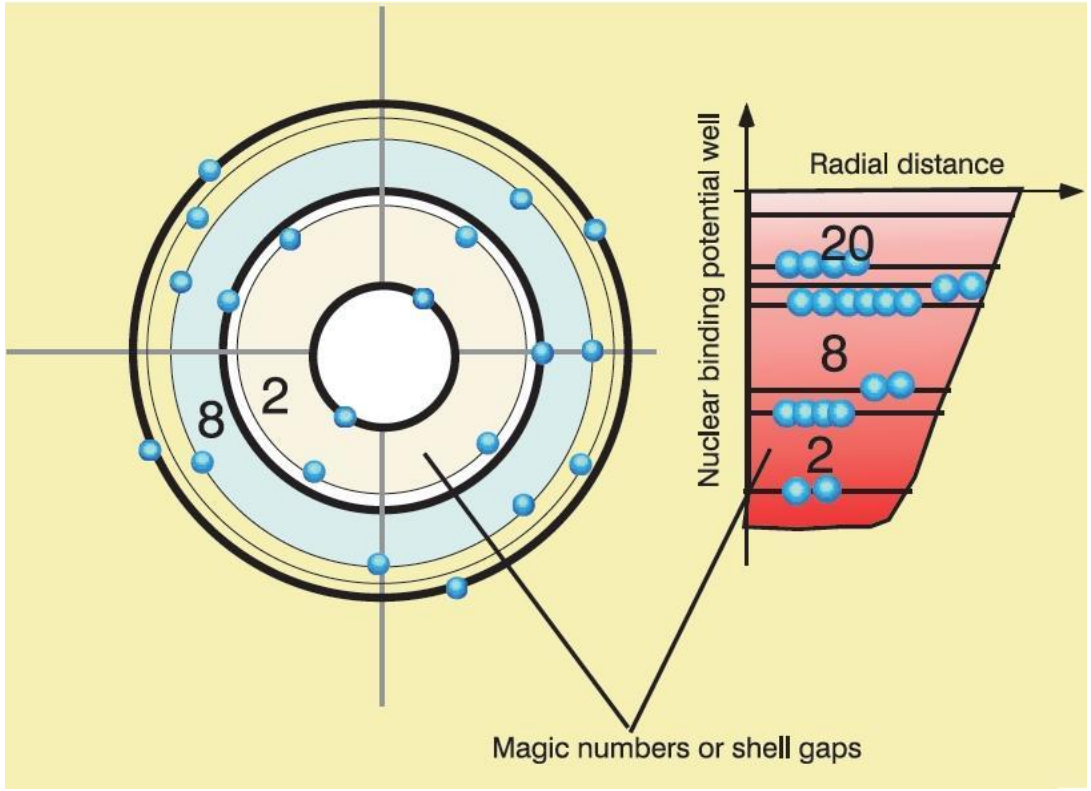
Nuclear levels and the Pauli principle





- The Pauli principle requires nucleons to fill different states in the shell structure.
- Protons and neutrons are not identical particles and thus fill shells independently.
  - Energy levels are slightly different due to the Coulomb potential experienced only by protons

Hypernuclear spectroscopy



- Hyperons are different from nucleons and thus fill a separate set of shells.
- Hyperons are heavier and their shells are thus closer to the center of the nucleus.
- In K^+ production, the hyperon will initially be in an orbital close to the one of the proton on which it was produced.
- Since all lower hyperon levels will be unoccupied, it will cascade down to the lowest one emitting a cascade of gamma photons.
- The photons can be detected in the ZDC and B0, boosted to a higher energy (up to a factor 100).