Light Neutron-Rich Hypernuclei from the IT-NCSM

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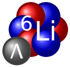
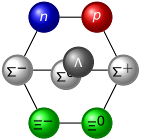
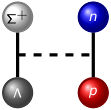
Motivation

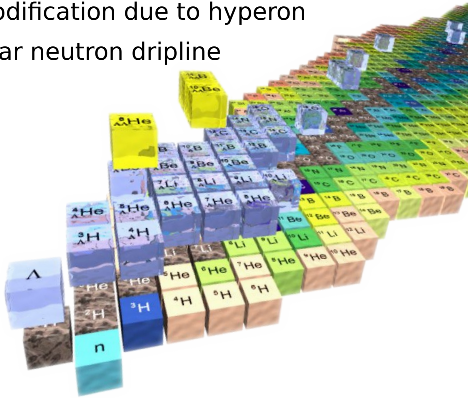






Why neutron-rich hypernuclei?

- Uncertainties in nuclear Hamiltonian under control
- Chiral EFT interactions work surprisingly well
- Investigate core modification due to hyperon
- Explore hypernuclear neutron dripline



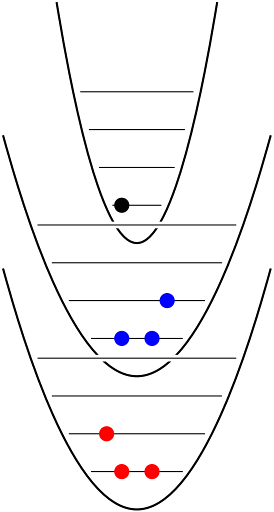
Hypernuclear Hamiltonian

$$\boldsymbol{H} = \Delta\boldsymbol{M} + \boldsymbol{T}_{\text{int}} + \boldsymbol{V}_{\text{NN}} + \boldsymbol{V}_{\text{3N}} + \boldsymbol{V}_{\text{YN}}$$

- NN: chiral N^3LO
  Entem & Machleidt
  Phys. Rev. C **68**, 041001(R) (2003)
  $\Lambda_{\text{NN}} = 500\,\text{MeV}$
- 3N: chiral N^2LO
  Navrátil
  Few-Body Syst. **41**, 117 (2007)
  $\Lambda_{\text{3N}} = 500\,\text{MeV}$
- YN: chiral LO
  Polinder, Haidenbauer & Meißner
  Nucl. Phys. A **779**, 244 (2006)
  $\Lambda_{\text{YN}} = 700\,\text{MeV}$

NN+3N yields quantitative description of *p*-shell nuclei

Importance-Truncated No-Core Shell Model



- A-body Slater determinants from HO states

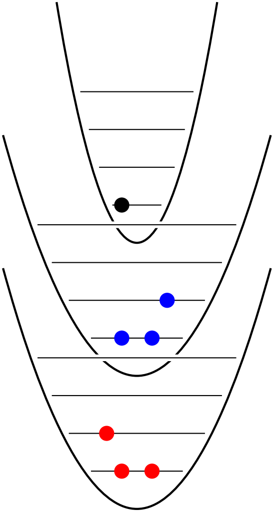
$$|s_1 s_2 \cdots s_A\rangle\,, \quad s_i \equiv |e(l\tfrac{1}{2})j\chi\rangle_i$$

- Λ-Σ conversion, e.g.

$$|pn\Lambda\rangle\,, |pp\Sigma^-\rangle\,, |nn\Sigma^+\rangle \in \mathcal{M}(^{3}_{\Lambda}\mathrm{H})$$

- Impose N_{max} truncation
- Importance truncation: discard irrelevant states + *a posteriori* extrapolation
- Diagonalize Hamilton matrix
  ⇒ Energies & wave functions

Importance-Truncated No-Core Shell Model



$^{7}_{\Lambda}$Li

- A-body Slater determinants from HO states

$$|s_1 s_2 \cdots s_A\rangle\,, \quad s_i \equiv |e(l\tfrac{1}{2})j\chi\rangle_i$$

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  a posteriori extrapol
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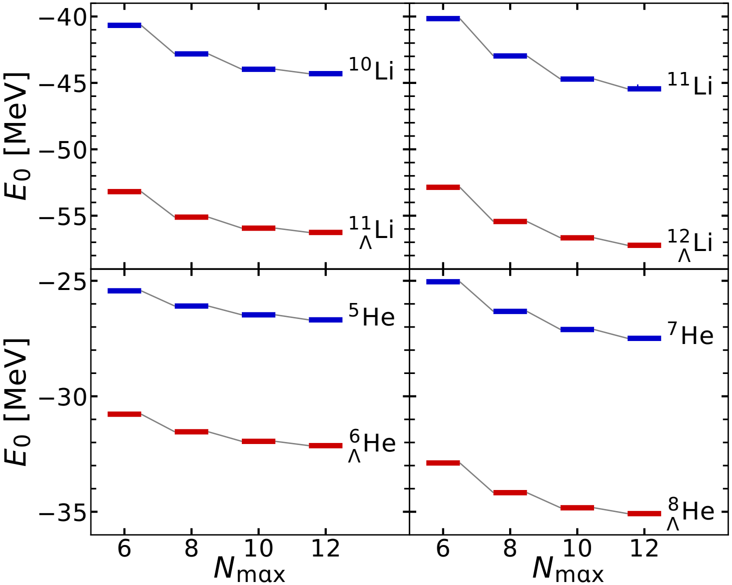
  ⇒ Energies & w unctions

Important: SRG-Induced YNN terms

Ground-State Energies



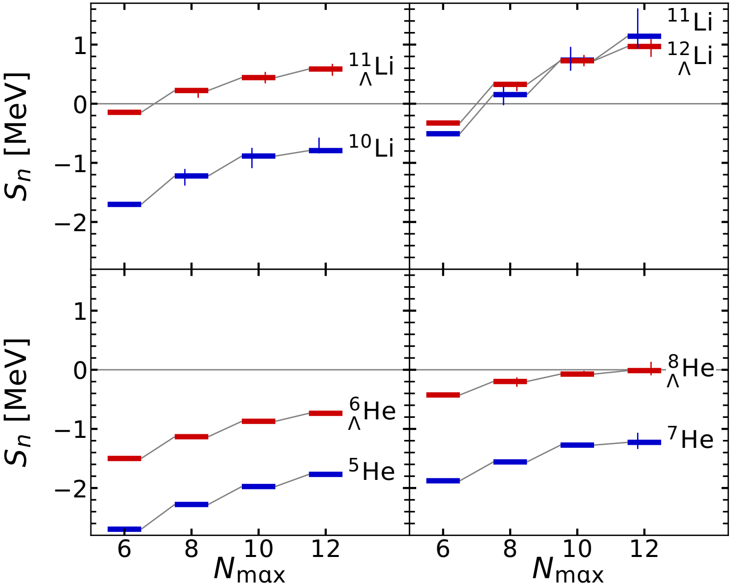
$\hbar\Omega = 20\,\text{MeV}$

$\alpha = 0.08\,\text{fm}^4$

Good convergence

Hyperon bound by ∼1 MeV per nucleon

Neutron Separation Energy



$\hbar\Omega = 20\,\mathrm{MeV}$

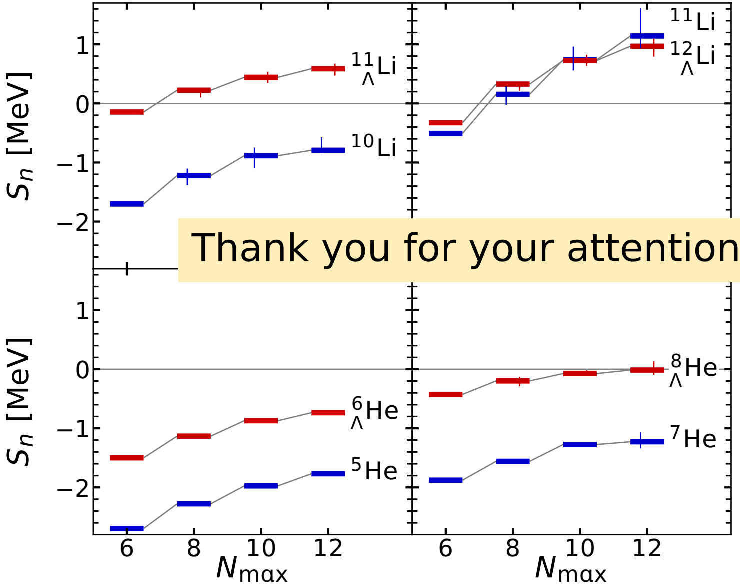
$\alpha = 0.08\,\mathrm{fm}^4$

Hypernuclei add ∼1 MeV to S_n

Stabilizes some

$^{12}_{\Lambda}$Li qualitatively different

Neutron Separation Energy



$\hbar\Omega = 20\,\text{MeV}$

$\alpha = 0.08\,\text{fm}^4$

Hypernuclei add ~1 MeV to S_n

Stabilizes some

$^{12}_{\Lambda}$Li qualitatively different

Thank you for your attention!