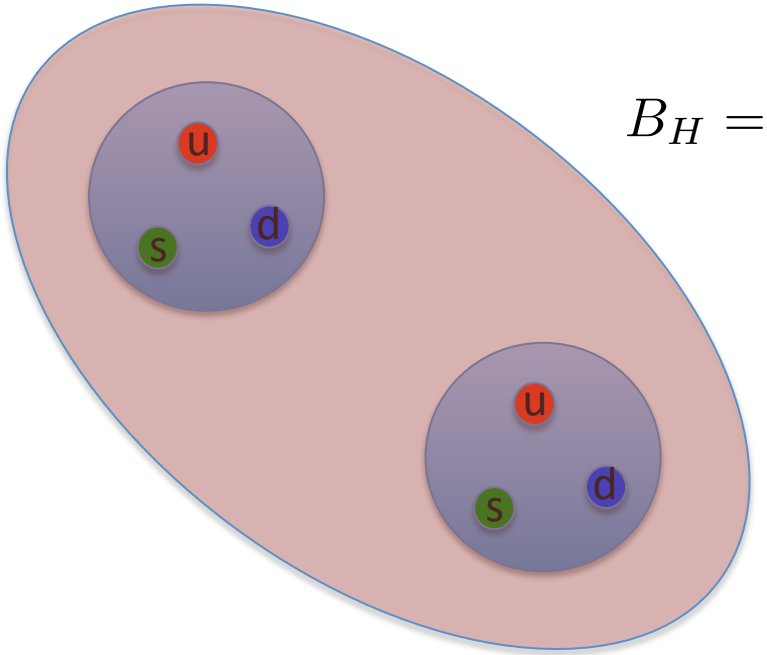
The first LQCD prediction for a bound two-body Hyperon system

Luu ⊂ NPLQCD

Phys.Rev.Lett. 106 (2011) 162001



$$B_H = 16.6 \pm 2.1 \pm 4.6 \text{ MeV} \quad @ \quad m_\pi = 389 \text{ MeV}$$

Second prediction by Japanese HALQCD collaboration corroborates our finding (Phys.Rev.Lett. **106 (2011) 162002**)

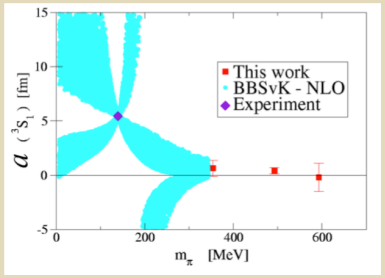
Does the bound state persist as $m_\pi \rightarrow$ 140 MeV?

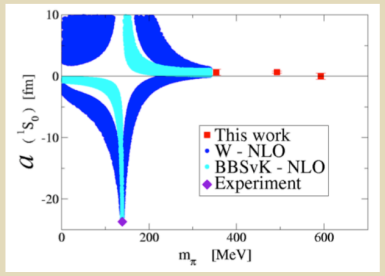
BBN constraints on allowed quark mass variations

Bedaque, ***Luu,*** Platter

Phys.Rev. C83 (2011) 045803

Using pionless EFT, lattice-constrained low-energy constants, and observed BBN abundances, we derive limits on allowed early universe quark mass variations



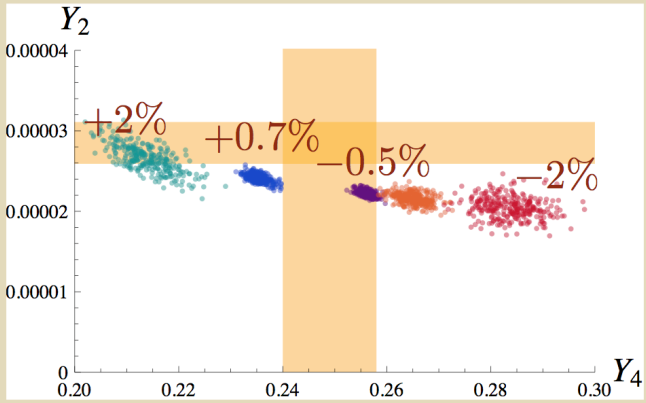


$$\frac{m_q}{B_2}\frac{dB_2}{dm_q} = -4.4 \pm 4.1$$

$$\frac{da_s}{dm_\pi} = -0.75 \pm 1.0\ \frac{\text{fm}}{\text{MeV}}$$

Beane, P.B., Orginos,Savage (2006)

$$\eta_{10} = 6.23$$



$$\left|\frac{\Delta m_q}{m_q}\right| > 1\%$$ **excluded**

Explicit formulas relating continuum scattering phase shifts to cubic irreps

Luu & Savage

PRD *in press* [arXiv:1101.3347]

We derive the requisite formulas needed to extract *l*>0 partial wave information from LQCD calculations

S-wave

"Luscher's formula"

What was already known

$$q\cot\delta_0 = \frac{2}{\sqrt{\pi}L}\mathcal{Z}_{0,0}\left(1;\tilde{q}^2\right)$$

A_1 irrep

Generalized Zeta function

P-wave

$$q^3\cot\delta_1 = \left(\frac{2\pi}{L}\right)^3 \frac{1}{\pi^{3/2}}\tilde{q}^2\mathcal{Z}_{0,0}\left(1;\tilde{q}^2\right)$$

T_1 irrep

D-wave

$$q^5\cot\delta_2 = \left(\frac{2\pi}{L}\right)^5 \frac{1}{\pi^{3/2}}\left(\tilde{q}^4\mathcal{Z}_{0,0}\left(1;\tilde{q}^2\right) + \frac{6}{7}\mathcal{Z}_{4,0}\left(1;\tilde{q}^2\right)\right)$$

E irrep

$$q^5\cot\delta_2 = \left(\frac{2\pi}{L}\right)^5 \frac{1}{\pi^{3/2}}\left(\tilde{q}^4\mathcal{Z}_{0,0}\left(1;\tilde{q}^2\right) - \frac{4}{7}\mathcal{Z}_{4,0}\left(1;\tilde{q}^2\right)\right)$$

T_2 irrep