The plots that follow are from H. Leutwyler’s lecture at the “School on flavor physics”, Benasque, 2008.
$M_{\pi}^2$ as a function of $m_q$

Lüscher, Lattice conference 2005 ETM collaboration, hep-lat/0701012

- Simulations with two light, dynamical quarks.
Low energy constant $\ell_3$ and $\ell_4$

$\bar{\ell}_3 \equiv \ln \frac{\Lambda_3^2}{M_\pi^2}$

$\bar{\ell}_4 \equiv \ln \frac{\Lambda_4^2}{M_\pi^2}$

Horizontal axis shows the value of $\bar{\ell}_3 \equiv \ln \frac{\Lambda_3^2}{M_\pi^2}$

Range for $\Lambda_3$ obtained in 1984 corresponds to $\bar{\ell}_3 = 2.9 \pm 2.4$.

Result of RBC/UKQCD 2008: $\bar{\ell}_3 = 3.13 \pm 0.33$ (stat) $\pm 0.24$ (syst).

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$\bar{\ell}_4 \equiv \ln \frac{\Lambda_4^2}{M_\pi^2}$

Horizontal axis shows the value of $\bar{\ell}_4 \equiv \ln \frac{\Lambda_4^2}{M_\pi^2}$

Range for $\Lambda_4$ obtained in 2007 corresponds to $\bar{\ell}_4 = 4.2 \pm 0.1$.
Scattering lengths $a_0^0$, $a_0^2$ from CHPT

Universal Band
- 1966
- 1983
- 1996

- Sizable corrections in $a_0^0$
- $a_0^2$ nearly stays put

- Colangelo, Gasser & L. 2001
- Numerical predictions from $\chi$PT
\[ a_0^0 \ a_0^2 \text{ with } \ell_3 \text{ and } \ell_4 \text{ from lattice} \]

\begin{figure}
\centering
\includegraphics[width=\textwidth]{plot.png}
\end{figure}
$a_0^0 \ a_0^2$ from experiment

- Universal band
- Tree (1966), one loop (1983), two loops (1996)
- Prediction (χPT + dispersion theory, 2001)
- $l_4$ from low energy theorem for scalar radius (2001)
- NPLQCD (2005, 2007)
- $l_3$ and $l_4$ from MILC (2004, 2006)
- $l_3$ from Del Debbio et al. (2006)
- $l_3$ and $l_4$ from ETM (2007)
- $l_3$ and $l_4$ from RBC/UKQCD (2007)
- $l_3$ and $l_4$ from PACS-CS (preliminary)
- E865 Ke4 (2003) isospin corrected
- DIRAC (2005)
- NA48 K3π (2006)
- NA48 Ke4 (preliminary) isospin corrected

Exp.