Lattice WG Summary

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EF07 - Orsay, 16. November 2007

UNIVERSITÄT
BERN

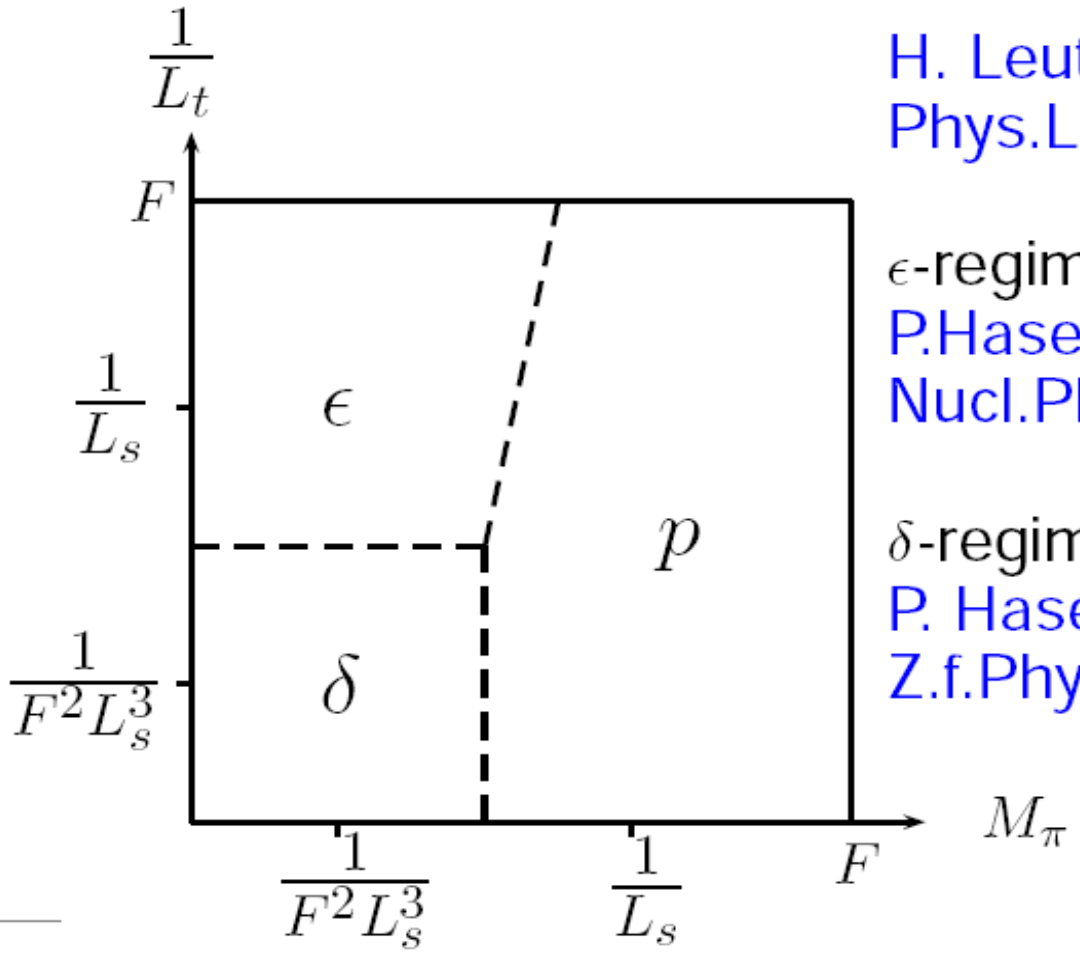
Parallel session talks

- Ferenc Niedermayer — ε and δ regimes
- Silvia Necco — LECs from lattice
- Fabio Bernardoni — CHPT in mixed regime
- Michele Della Morte — HQET on the lattice

- + discussion on a Lattice Data Group and on a topical workshop in 2008

F. Niedermayer – ε and δ regimes

According to M_π, L_s, L_t one has different regimes of QCD.

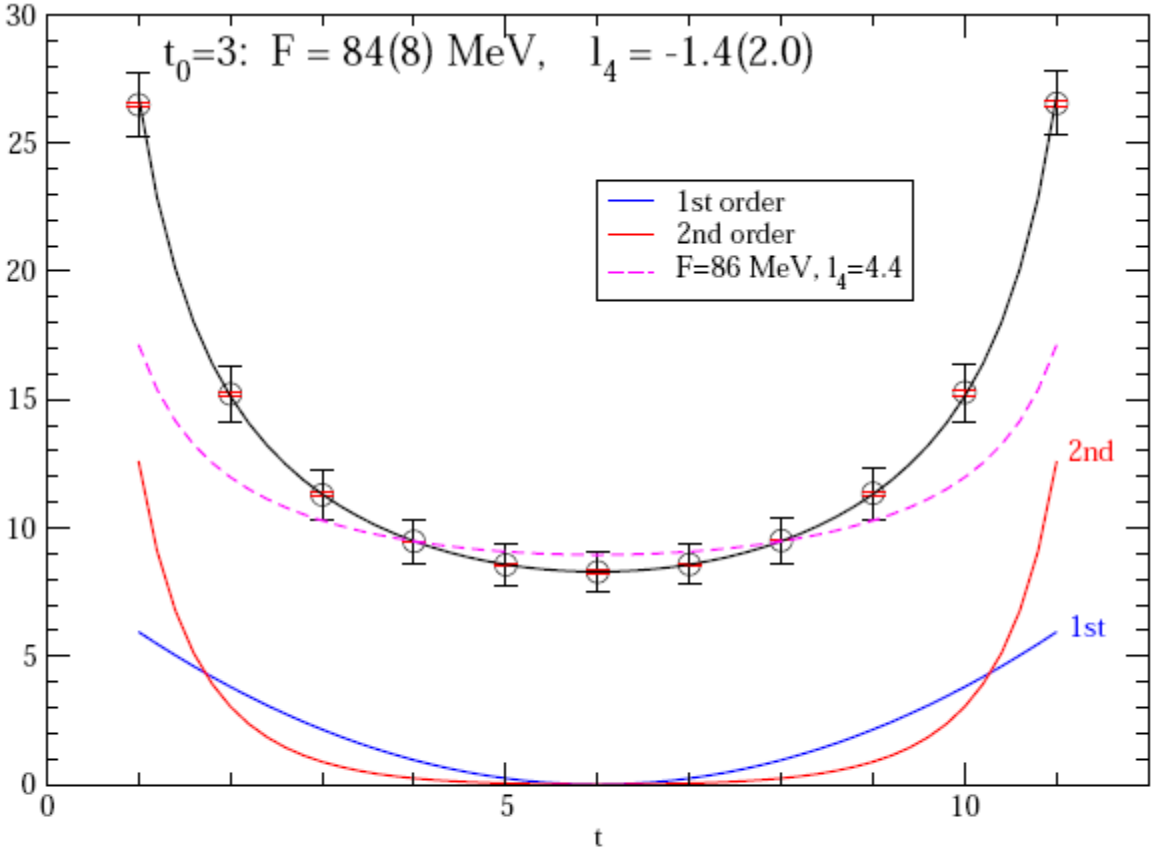


H. Leutwyler,
Phys.Lett. B189(1987)197

ϵ-regime, O(N), 2-loop:
P.Hasenfratz, H.Leutwyler,
Nucl.Phys. B343(1990)241

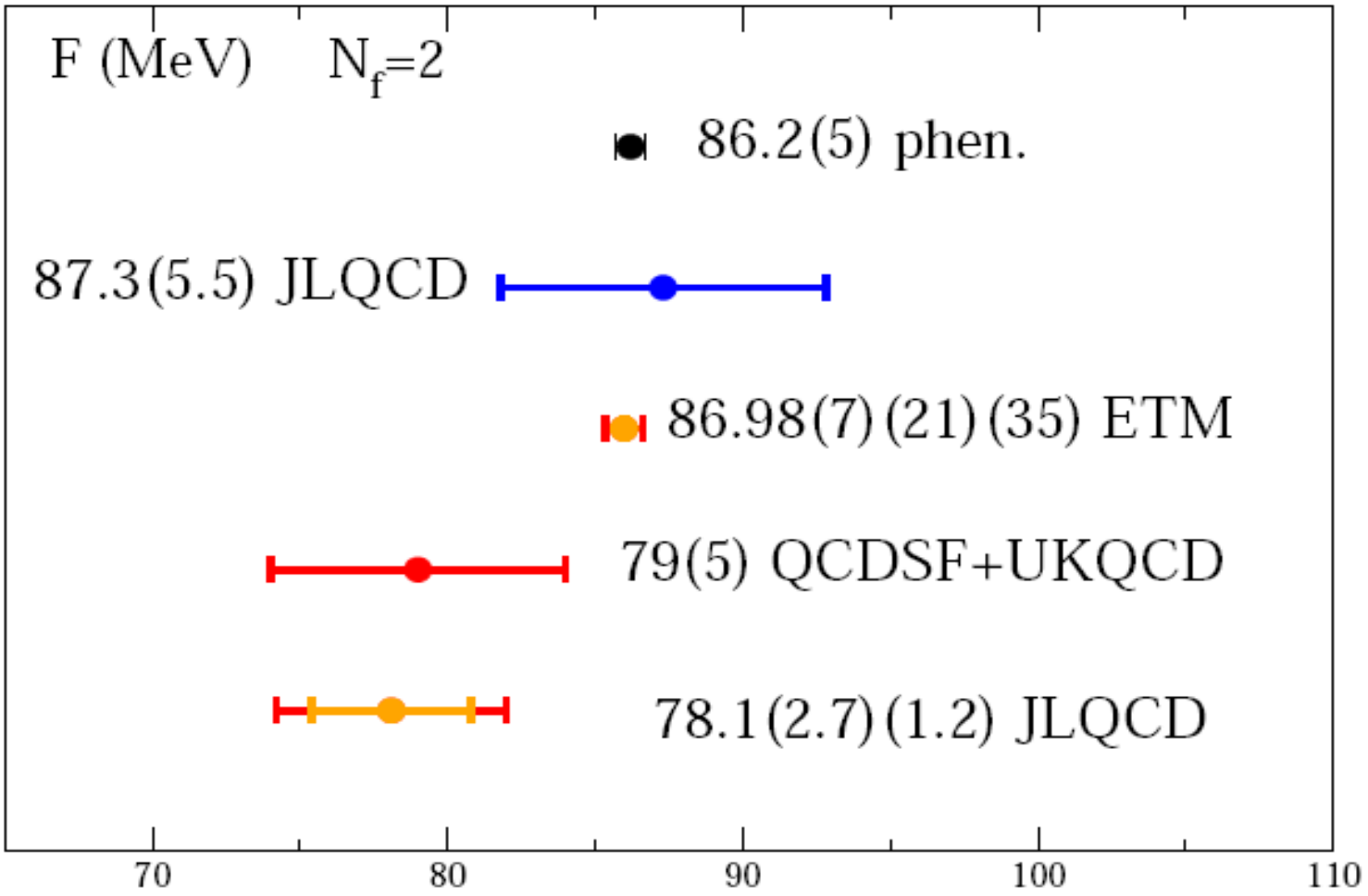
δ-regime, O(N), 1-loop:
P. Hasenfratz, F. N.,
Z.f.Phys. 92(1993)91

F. Niedermayer – ε and δ regimes

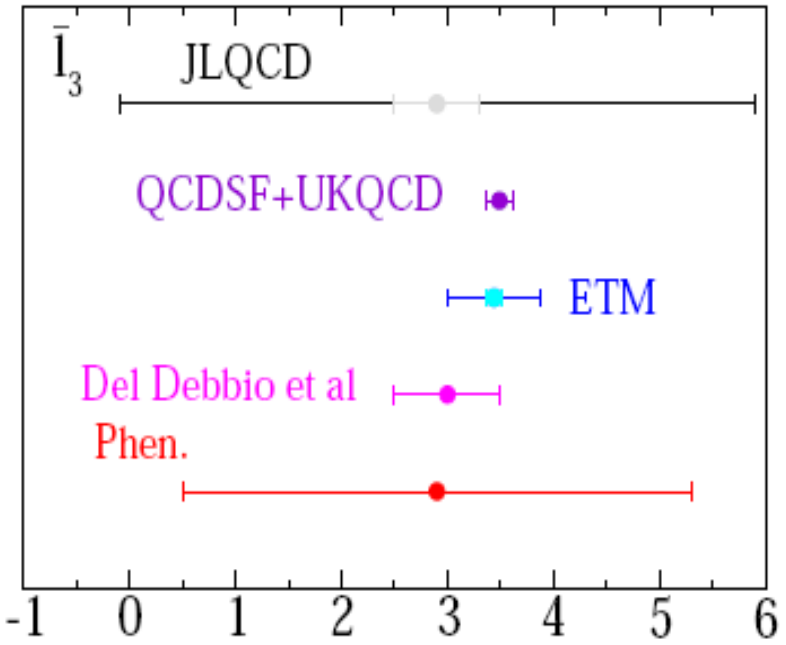


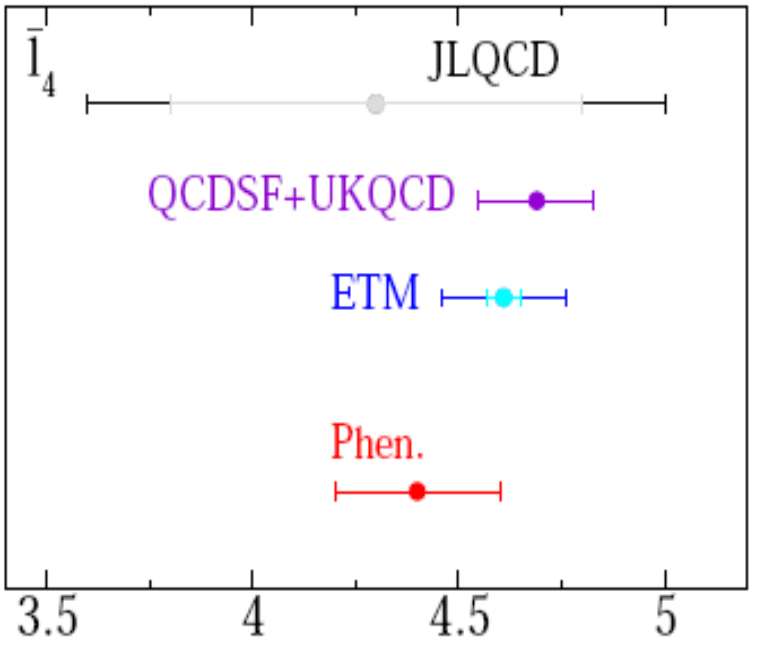
$$C(t) = C_0 \left\{ a_0(FL, \Lambda_4 L) + [a_1(FL)h_1(t) + \ldots + a_3(FL)h_3(t)] \right\}$$

S. Necco – LECs from Lattice



S. Necco – LECs from Lattice





S. Necco – LECs from Lattice

Recent results ('07):

Authors	*Dirac op.*	*gauge action*	a (fm)	L (fm)	M_{PS} (MeV)
MILC	impr. staggered	Sym. 1 loop	0.06-0.15	2.4-3.4	200
RBC-UKQCD	Domain Wall	Iwasaki	0.11	1.8-2.6	330
PACS-CS	Wilson $O(a)$ impr.	Iwasaki	0.09	2.9	210

Authors	$(2L_8 - L_5) \cdot 10^3$	$(2L_6 - L_4) \cdot 10^3$	$L_4 \cdot 10^3$	$L_5 \cdot 10^3$
MILC	$0.3(1)(1)$	$0.3(1)\binom{+2}{-3}$	$0.1(3)\binom{+3}{-1}$	$1.4(2)\binom{+2}{-1}$
RBC-UKQCD	0.247(45)	-0.002(42)	0.136(80)	0.862(99)
PACS-CS	-0.23(5)	0.10(4)	-0.02(11)	1.47(13)

Phenomenogical determinations:

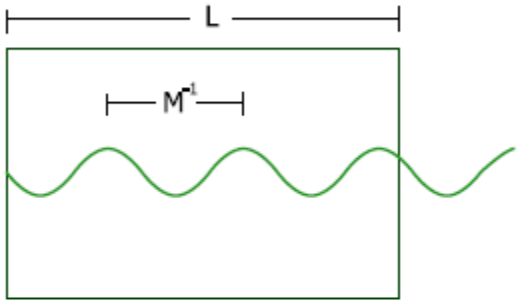
$$L_4 \equiv 0; \quad L_6 \equiv 0; \quad 10^3 \cdot L_5 = 1.46; \quad 10^3 \cdot L_8 = 1.00$$

J. Bijnens, lat07

F. Bernardoni – Mixed regime

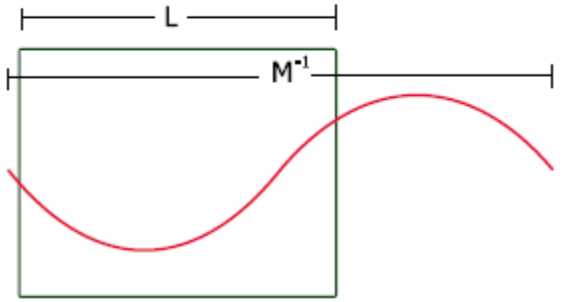
In a finite volume there are two regimes:

- p-regime ($m_q \Sigma V \gg 1,\ L\Lambda_\chi \gg 1$)



  - χPT predicts L, m_q scaling
    - m_q scaling relevant
    - finite size scaling $\sim e^{-LM_\pi}$
    - up to 12 LECs at NLO

- ϵ-regime ($m_q \Sigma V \lesssim 1,\ L\Lambda_\chi \gg 1$) [Gasser & Leutwyler 1987]



  - χPT predicts L, m_q, ν scaling (ν is the topological sector)
    - L, ν scaling relevant
    - m_q scaling is usually less relevant
    - only F and Σ at NLO

F. Bernardoni – Mixed regime

It is necessary to consider the mixed regime: ie. some quarks in the p and some in the ϵ-regime, in the following situations:

1. Split the s and u/d quarks in full theory computations:

$$m_s \Sigma V \gg 1 \qquad m_{u,d} \Sigma V \lesssim 1$$

2. Split of valence and sea quarks in Partially Quenched simulations with mixed actions [Baer, Rupak, Shoresh]:

$$m_{sea} \Sigma V \gg 1 \qquad m_{valence} \Sigma V \lesssim 1$$

M. Della Morte – Lattice HQET

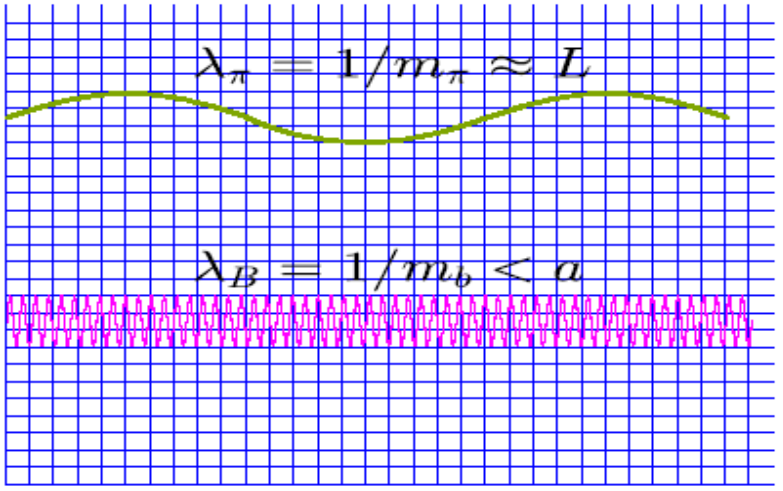
Lattice HQET

Why HQET on the lattice ? The reason is mainly practical:

- finite volume effects are mainly triggered by the light degrees of freedom. The usual requirement is $m_{PS}L > 4$ and m_{PS} is typically around the kaon mass in real lattice simulations $\Rightarrow L \simeq 2$ fm.
- cutoff effects are tuned by the heavy quark mass. $a << 1/m_b \simeq 0.03$ fm .

$\Rightarrow L/a \simeq 100$ is needed to have those systematics under control !!

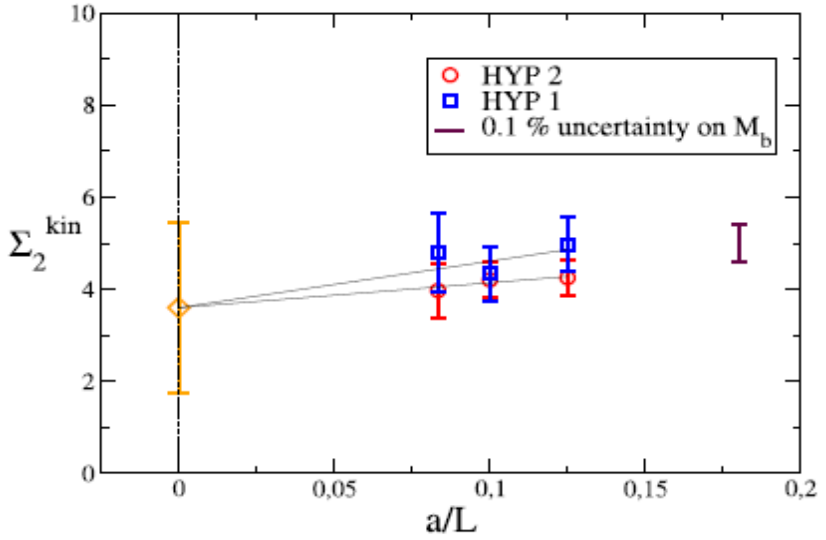
Integrating out the heavy quark mass in this case is useful !!



M. Della Morte – Lattice HQET

$$m_{B^{av}} = m_B^{stat} + m_B^1$$

with m_B^1 in terms of E^{kin}, SSF and $\Phi_k(L_1, M_B^{stat})$, eg (notice a/L now):



and $M_B^1 = -\frac{m_B^1}{S}$

In the $\overline{\mathrm{MS}}$ scheme at the scale m_b

$$m_b(m_b) = 4.347(48)\ GeV$$

A Lattice Data Group? (L. Lellouch)

- For certain quantities, many (partially-quenched) calculations, using different actions, different approaches to renormalization, etc.
- More recent does not necessarily mean more reliable or accurate: we try new approaches

$\Rightarrow$ situation can be very confusing for non-experts (even for experts!)

$\Rightarrow$ central values and errors used in phenomenological analyses can vary substantially for no objective reason

- Help non-experts by providing them with a *succint and reliable* summary of the state of the art
- Make the best possible use of the results and experience that we have accumulated

A Lattice Data Group? (L. Lellouch)

Came to a grinding halt when actual work had to be done!

A few reasons for this failure

- most of us would rather push forward original research than review past work

$\rightarrow$ hard to fight against

- discomfort with producing an LDG booklet which would contain mostly (partially-)quenched results

$\leftrightarrow$ more and more $N_f = 2 + 1$ results now

- "It is too Euro-centric"and US colleagues were reluctant to get involved

$\leftrightarrow$ people like Claude Bernard have recently expressed interest

A Lattice Data Group? (L. Lellouch)

- "It is a great way to make enemies"

→ cite everyone, but only include in an "average" those results which satisfy a number of scientific criteria

Flavianet Lattice Data Group

- GC
- S. Dürr
- A. Jüttner
- L. Lellouch
- H. Leutwyler
- V. Lubicz
- S. Necco
- C. Sachrajda
- T. Vladikas
- H. Wittig

Lattice Workshop in 2008

- Two options have been discussed:
  - CERN (Giusti and Lüscher)
  - Groningen (Pallante)

- Final decision/consensus not yet reached