It's never too much
Talking about
B physics

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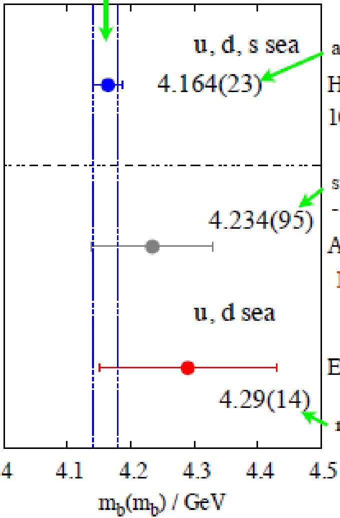
Data from HLRN and CINECA

October 14, 2011

Tests/comparison of m_b

av. inc. contnm results
CD+M.Steinhauser 2011

4.16(2) GeV



a^2 dominates

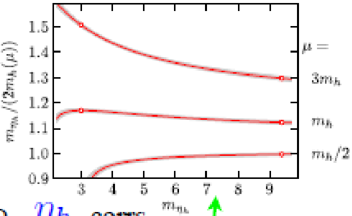
HPQCD HISQ
1004.4285

stats dominates
- can reduce

ALPHA LAT11
Fritzsch(Fri)

ETMC 1107.1441

m_h fit dominates



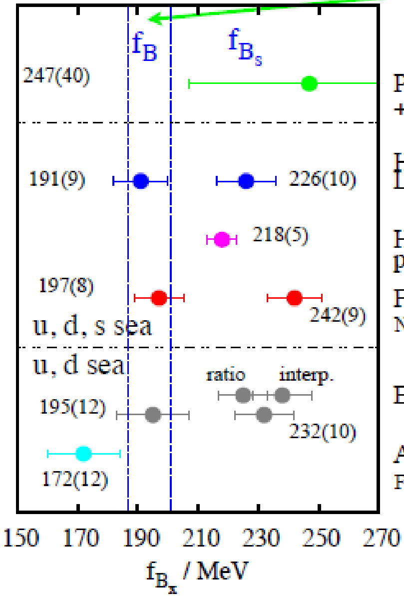
η_h corrs
a: 0.15,0.12,0.09,0.06,0.04fm
- extrap. to b from c
$m_b/m_c = 4.51(4)$

static (HYP)+1/M for
B - step scaling method
a: 0.08, 0.07, 0.05 fm -
CLS confs

TM for h - ratio of M_{Bs}
to mass with known
static limit - extrap. to b
a: 0.1,0.09,0.07,0.05 fm

Need NRQCD, Fermilab, RHQ!

f_{B_s}, f_B comparison



f_B average : 194(7) MeV (inc. corrs)

down from LAT10

PDG av BR(B->τν) + PDG av Vub ← f_B expt

HPQCD NRQCD LAT11 Shigemitsu (Mon)

HPQCD HISQ prelim.

FNAL/MILC LAT11 Neil (poster)

2.4σ apart for f_{Bs}

ETMC 1107.1441

ALPHA LAT11 Fritzsch (Fri)

static +1/M
cont. + chiral extrap
a:0.075,0.065,0.048 fm

NOTE:
$f_{Bs} < f_{Ds}$ now quite clear

f_B, m_b obtained by interpolating from $\sim m_c - 2m_c$ to static point.

The problem going to the b

Believed to be **discretization errors**: $am \sim 1$ on typical lattices.
Expect $\mathcal{O}(100\%)$ discretization effects on observable!

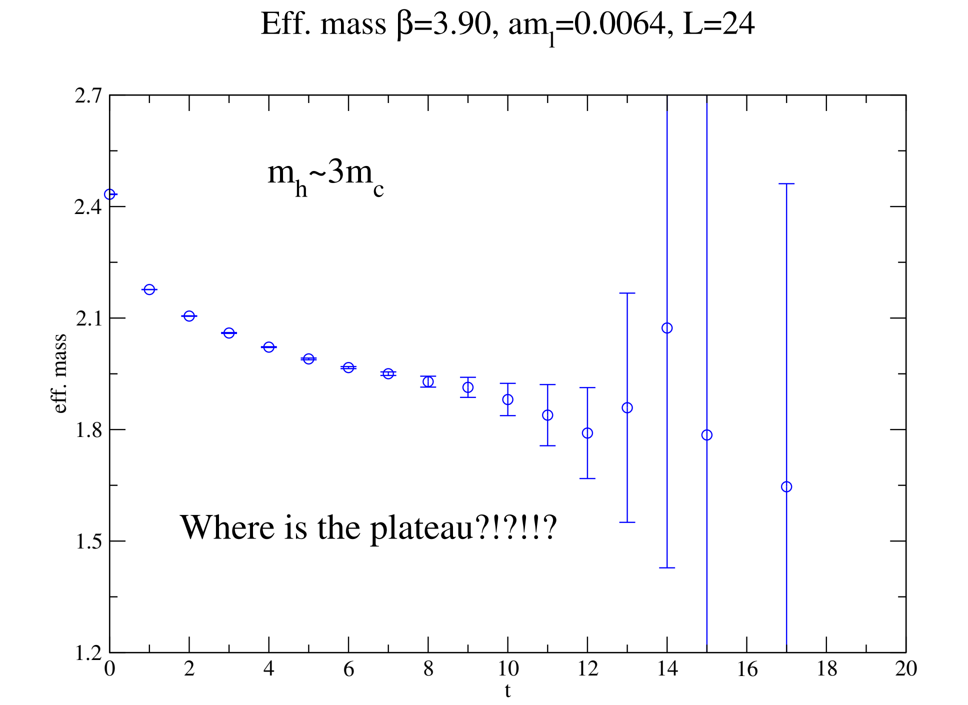
Actual experience with TM

Discretization effects increases quite slowly with quark mass.
Example, pseudo-scalar meson masses:

- Pion: $\mathcal{O}(\ 5\%)$ effects (but also compatible with 0)
- Kaon: $\mathcal{O}(\ 9\%)$ effects
- D: $\mathcal{O}(13\%)$ effects

Discretization effects are **smaller than expected.**

Why not to give higher mass correlation function mass **a try**?



Eff. mass β=3.90, am_l=0.0064, L=24
m_h~3m_c
Where is the plateau?!?!!?
eff. mass
t
2.7
2.4
2.1
1.8
1.5
1.2
0
2
4
6
8
10
12
14
16
18
20

Gaussian smearing

Substitute interpolating operators O with:

$$O_s = G^n(k)\,O, \qquad G(k) \equiv \frac{1 + kH}{1 + 6k}$$

with: $H_{x,y} \equiv \sum_{\mu=1,2,3} \left(U_{x;\mu}\delta_{y,x+\hat{\mu}} + U^{\dagger}_{x-\hat{\mu};\mu}\delta_{y,x-\hat{\mu}} \right)$.

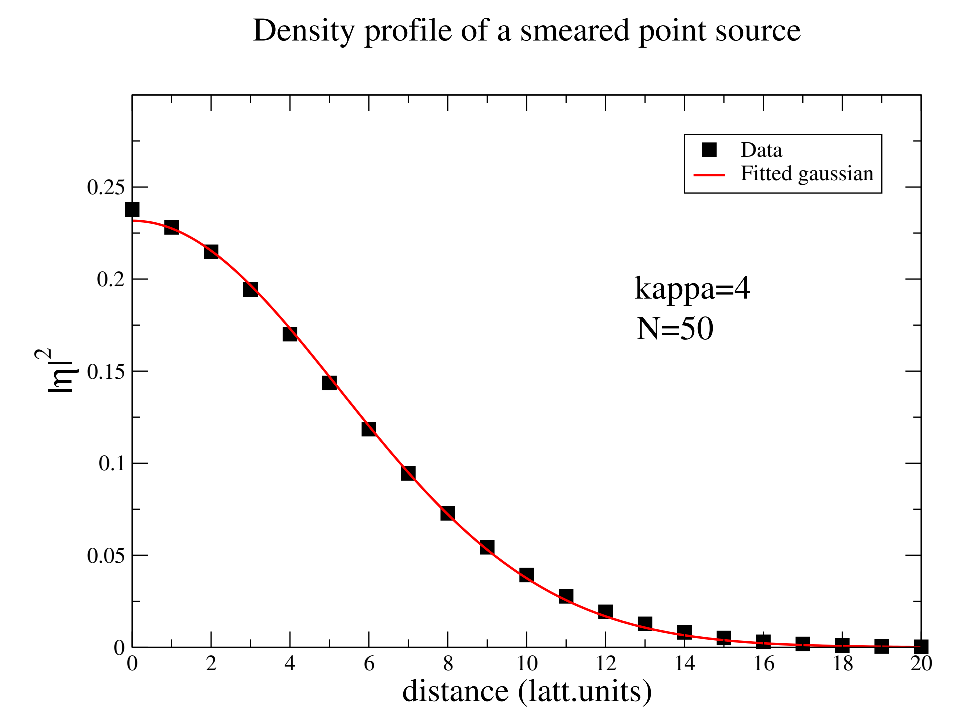
Two points correlation functions

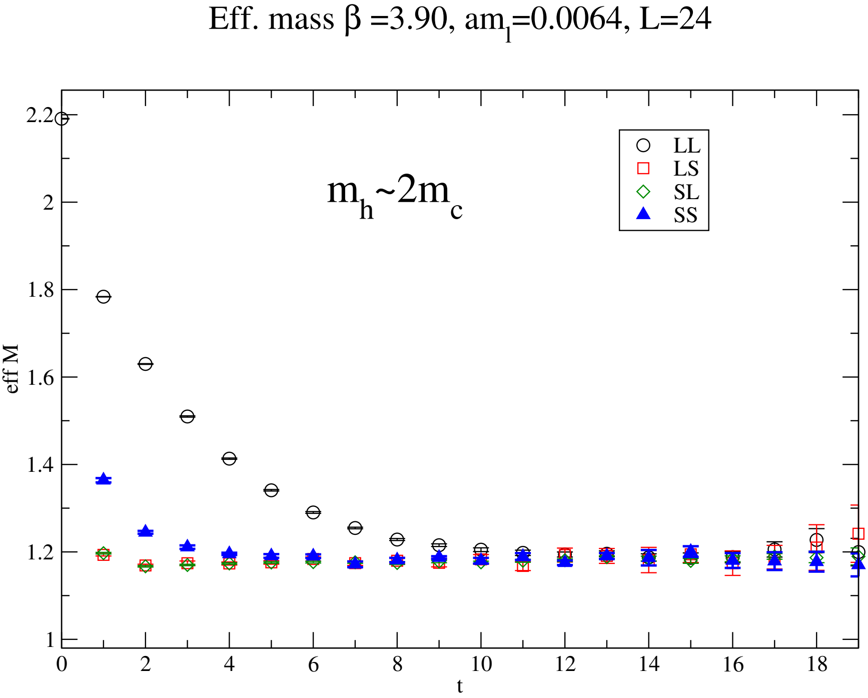
Calling A (source) and B (sink) the possible **S**meared or **L**ocal interpolators:

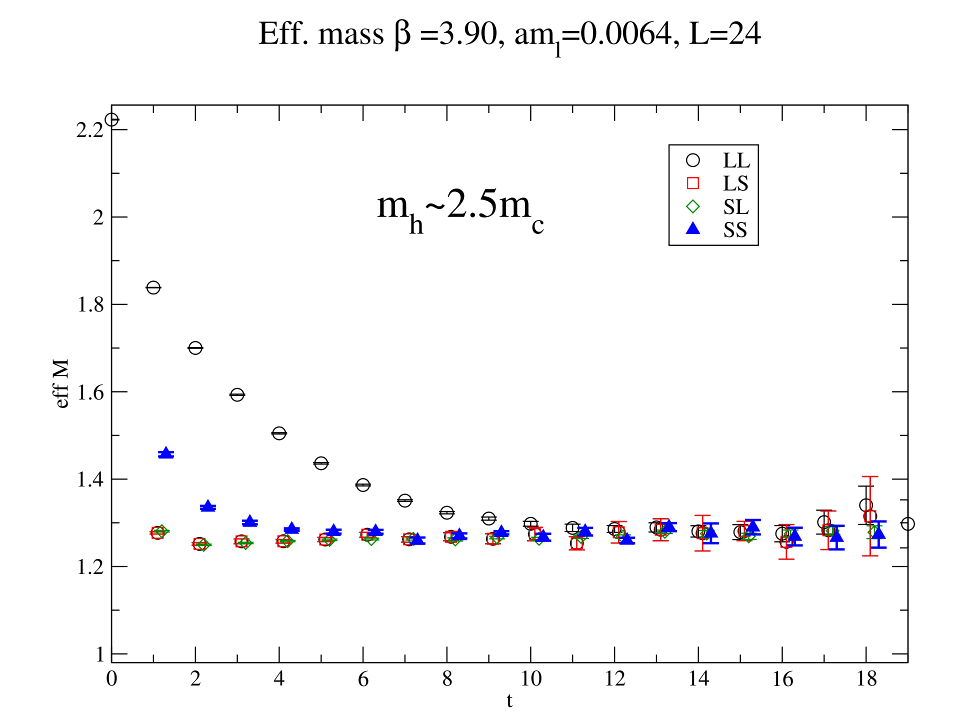
$$C^{AB}(t) = Z_A Z_B e^{-TM/2} \cosh\left[M\left(T/2 - t\right)\right]/M$$

We can obtain Z_L by fitting simultaneously $C_{\mathbf{SL}}$ and $C_{\mathbf{SS}}$:

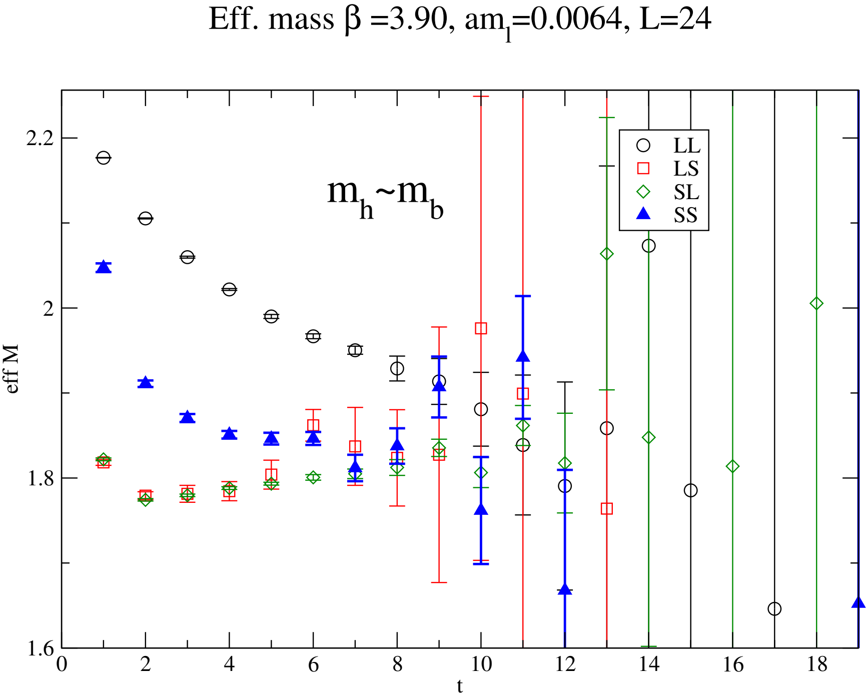
$$\begin{cases} C_{SS} & \rightarrow Z_S Z_S \rightarrow Z_S \\ C_{SL} & \rightarrow Z_S Z_L \rightarrow Z_L \end{cases}$$


Density profile of a smeared point source
Data
Fitted gaussian
kappa=4
N=50
|η|²
distance (latt.units)
0
0.05
0.1
0.15
0.2
0.25
0
2
4
6
8
10
12
14
16
18
20

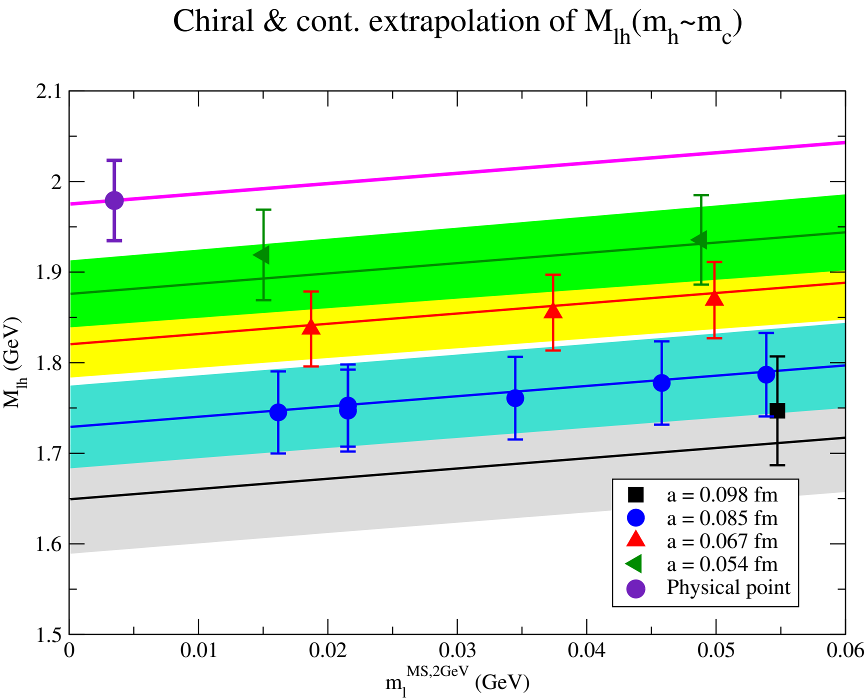

Eff. mass β =3.90, am_l=0.0064, L=24
m_h~2m_c
LL
LS
SL
SS
eff M
t
2.2
2
1.8
1.6
1.4
1.2
1
0
2
4
6
8
10
12
14
16
18



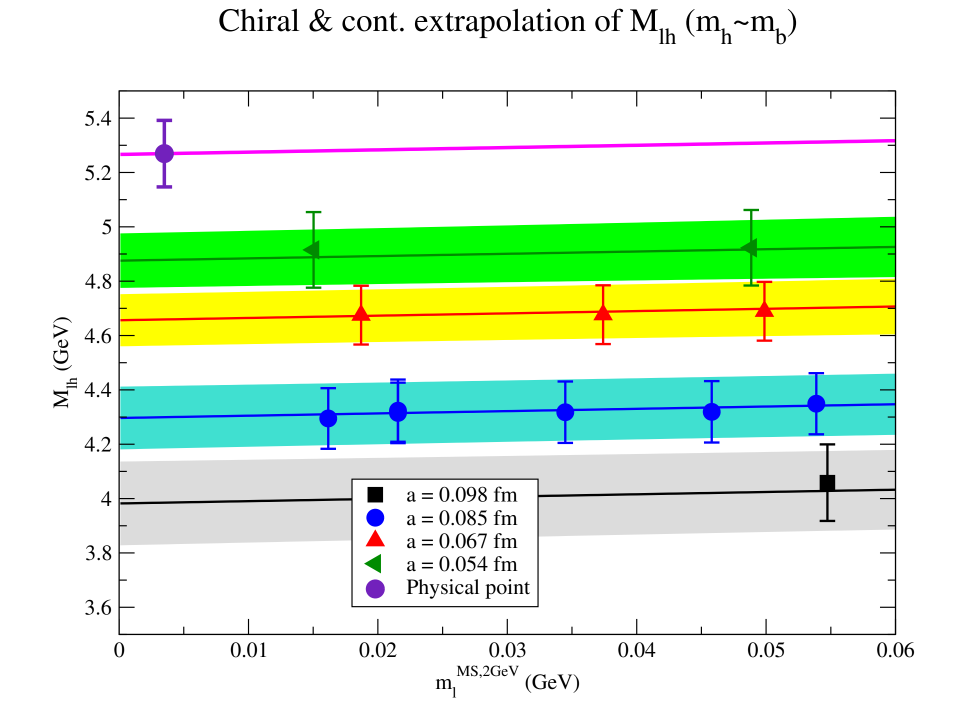
Eff. mass β =3.90, am_l=0.0064, L=24
m_h~2.5m_c
LL
LS
SL
SS
eff M
t
2.2
2
1.8
1.6
1.4
1.2
1
0
2
4
6
8
10
12
14
16
18



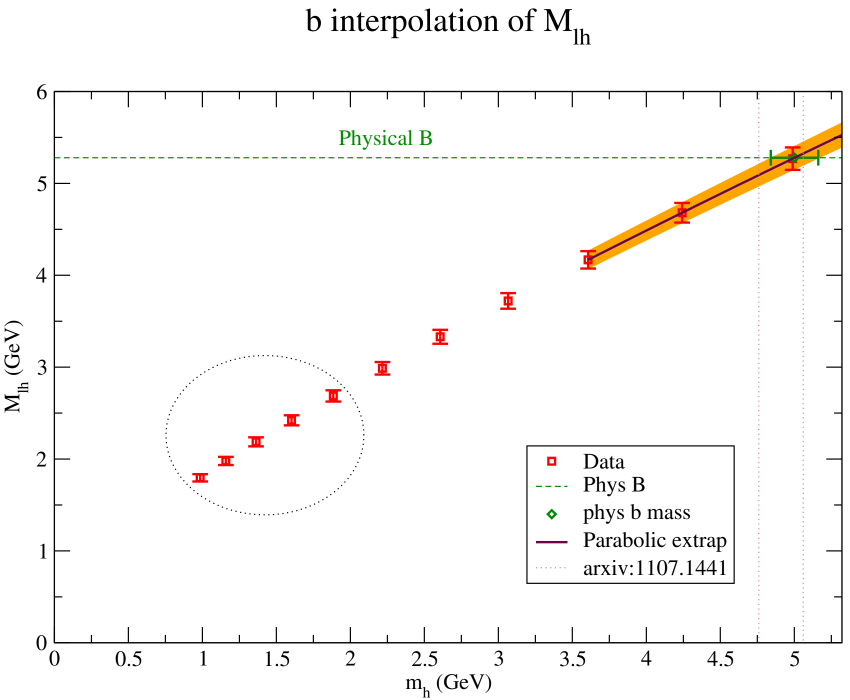
Eff. mass β =3.90, am_l=0.0064, L=24
m_h~m_b
LL
LS
SL
SS
eff M
t
2.2
2
1.8
1.6
0
2
4
6
8
10
12
14
16
18



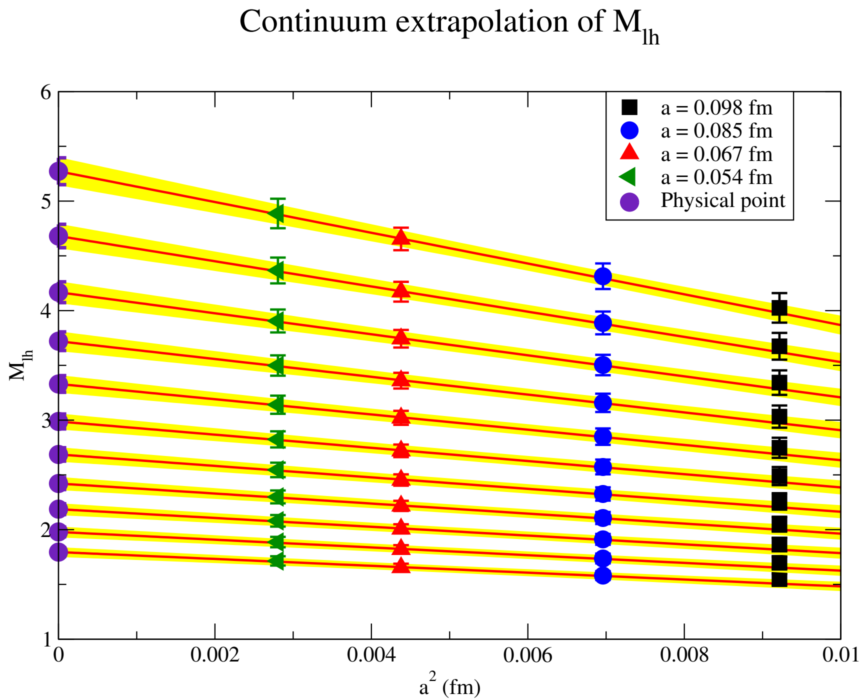
Chiral & cont. extrapolation of M_lh(m_h~m_c)
2.1
2
1.9
1.8
1.7
1.6
1.5
M_lh (GeV)
0
0.01
0.02
0.03
0.04
0.05
0.06
m_l^MS,2GeV (GeV)
a = 0.098 fm
a = 0.085 fm
a = 0.067 fm
a = 0.054 fm
Physical point



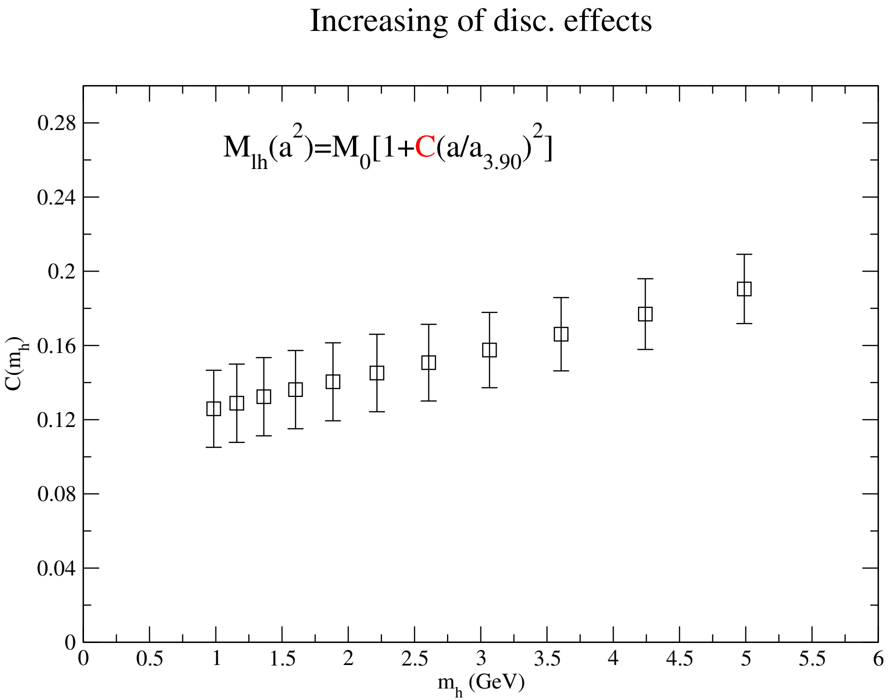
Chiral & cont. extrapolation of M_lh (m_h~m_b)
M_lh (GeV)
m_l^MS,2GeV (GeV)
a = 0.098 fm
a = 0.085 fm
a = 0.067 fm
a = 0.054 fm
Physical point
5.4
5.2
5
4.8
4.6
4.4
4.2
4
3.8
3.6
0
0.01
0.02
0.03
0.04
0.05
0.06



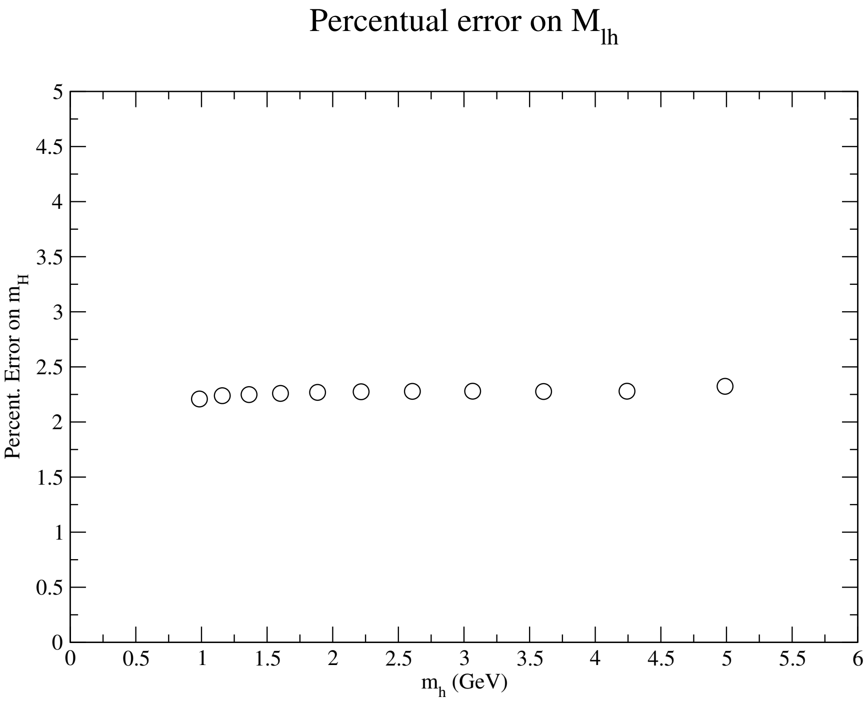
b interpolation of M_lh
Physical B
M_lh (GeV)
m_h (GeV)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
6
Data
Phys B
phys b mass
Parabolic extrap
arxiv:1107.1441



Continuum extrapolation of M_lh
a = 0.098 fm
a = 0.085 fm
a = 0.067 fm
a = 0.054 fm
Physical point
M_lh
a^2 (fm)
1
2
3
4
5
6
0
0.002
0.004
0.006
0.008
0.01

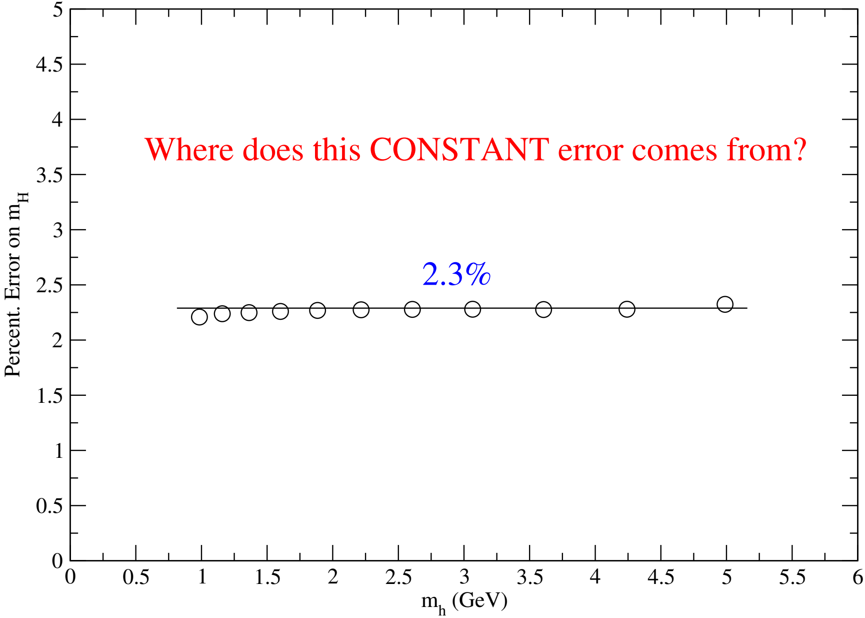


Increasing of disc. effects
$M_{lh}(a^2)=M_0[1+C(a/a_{3.90})^2]$
C(m_h)
m_h (GeV)
0
0.04
0.08
0.12
0.16
0.2
0.24
0.28
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6



Percentual error on M_{lh}
Percent. Error on m_H
m_h (GeV)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6

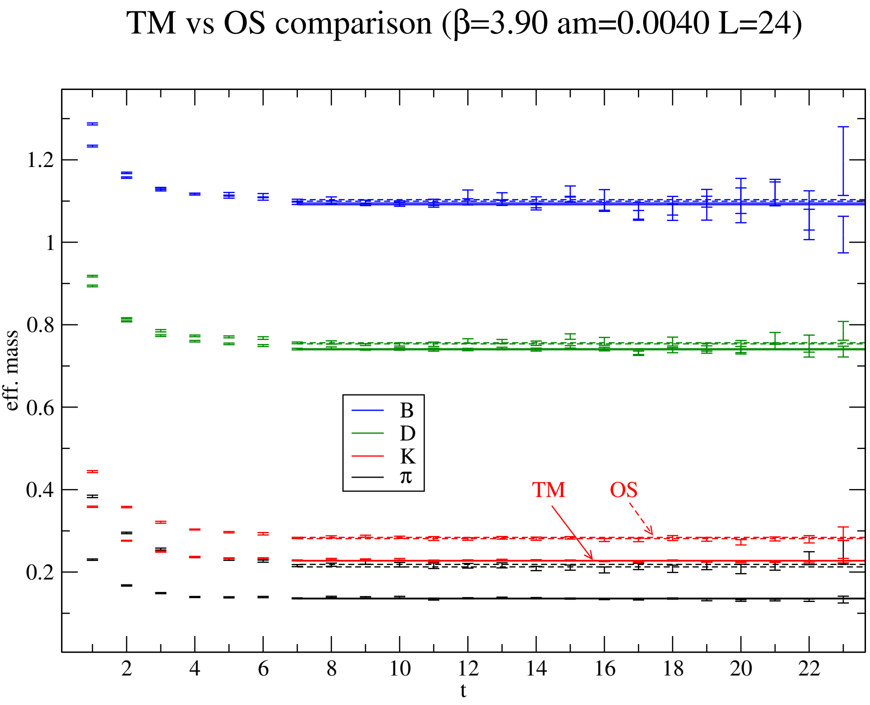
Percentual error on M_{lh}



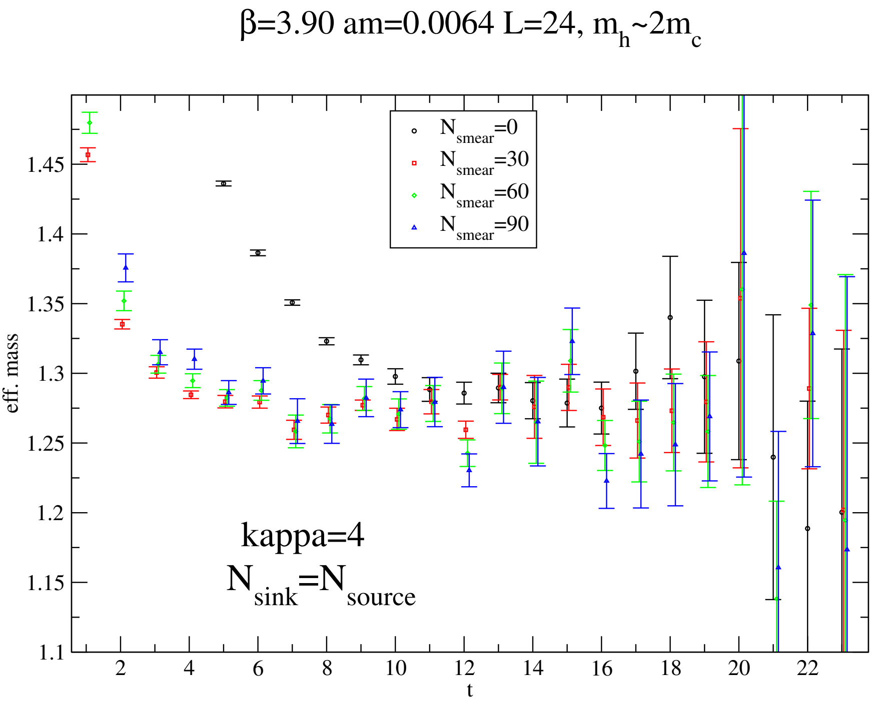
Hint... **Lattice spacings** uncertainties

β	$a\left(10^{-3} fm\right)$	$\delta a/a$
3.80	97.7(3.1)	3.2%
3.90	84.7(2.3)	2.7%
4.05	67.1(1.6)	2.4%
4.20	53.6(1.2)	2.3%

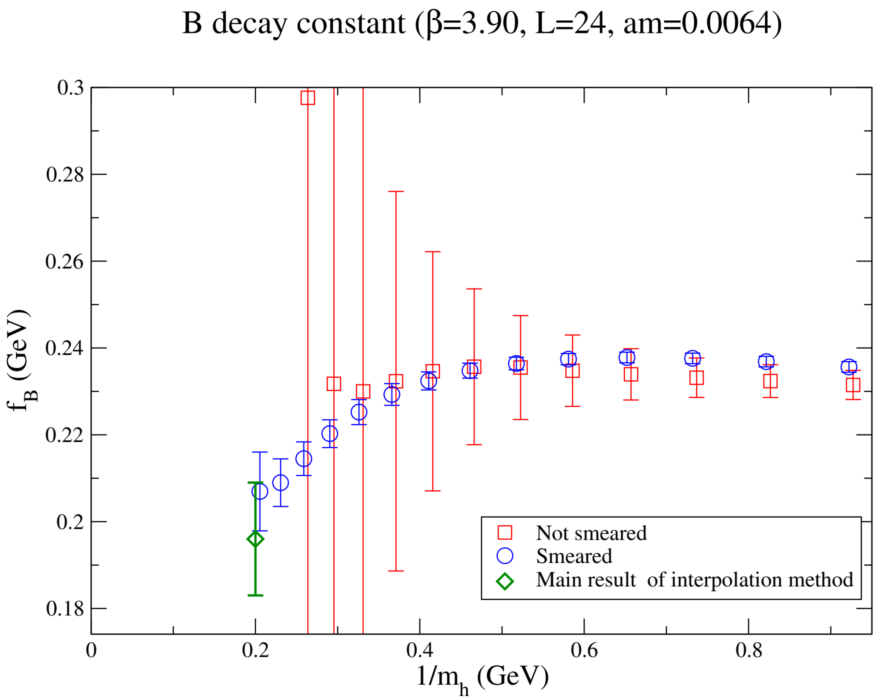
This errors enters **directly** in the conversion to physical units...

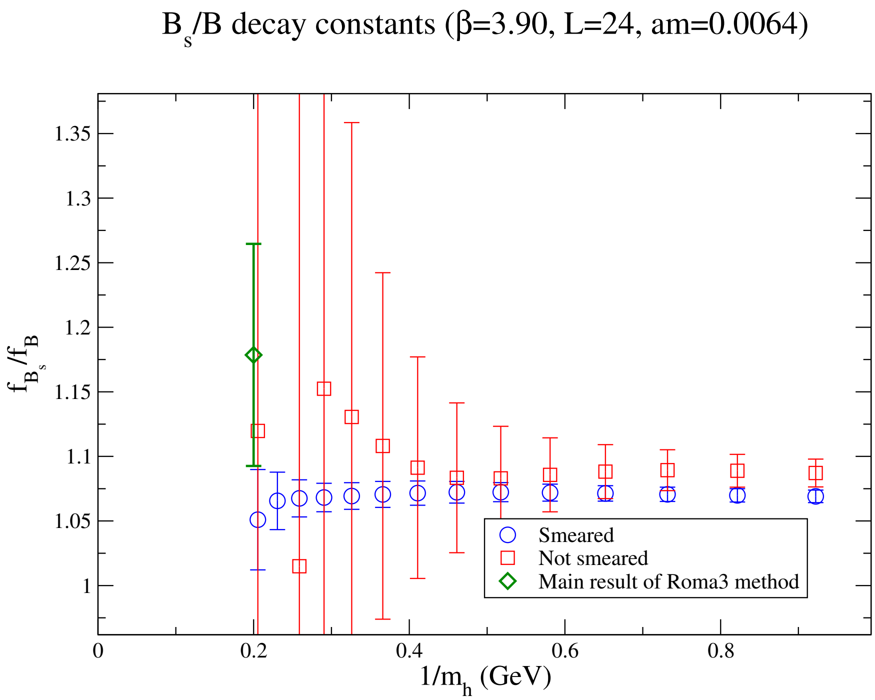


TM vs OS comparison (β=3.90 am=0.0040 L=24)
eff. mass
t
B
D
K
π
TM
OS
1.2
1
0.8
0.6
0.4
0.2
2
4
6
8
10
12
14
16
18
20
22

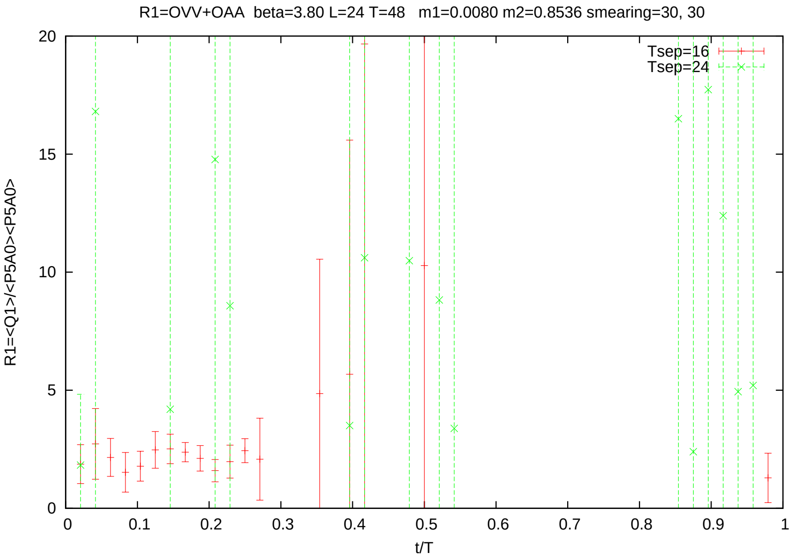


β=3.90 am=0.0064 L=24, m_h~2m_c
N_smear=0
N_smear=30
N_smear=60
N_smear=90
kappa=4
N_sink=N_source
eff. mass
t
1.1
1.15
1.2
1.25
1.3
1.35
1.4
1.45
2
4
6
8
10
12
14
16
18
20
22


B decay constant (β=3.90, L=24, am=0.0064)
f_B (GeV)
1/m_h (GeV)
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0
0.2
0.4
0.6
0.8
Not smeared
Smeared
Main result of interpolation method



B_s/B decay constants (β=3.90, L=24, am=0.0064)
f_{B_s}/f_B
$1/m_h$ (GeV)
Smeared
Not smeared
Main result of Roma3 method


R1=OVV+OAA beta=3.80 L=24 T=48 m1=0.0080 m2=0.8536 smearing=30, 30
R1=<Q1>/<P5A0><P5A0>
t/T
Tsep=16
Tsep=24
0
5
10
15
20
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

Conclusions

Smearing	$\mathcal{O}(a)$ improvement
• Seem very interesting. • Why nobody tried it before? • Space for tuning of procedure adjusting smear size.	• Much better than expected. • Can some TM guru explain it? • Does anybody else (Fodor) have this nice feature?

Future directions

- Finish f_B, f_{B_s}, B_X trying also with ratio method.
- Look at three point functions.

Hope not to have disgusted you (too much)!