New preliminary results on OPE fits

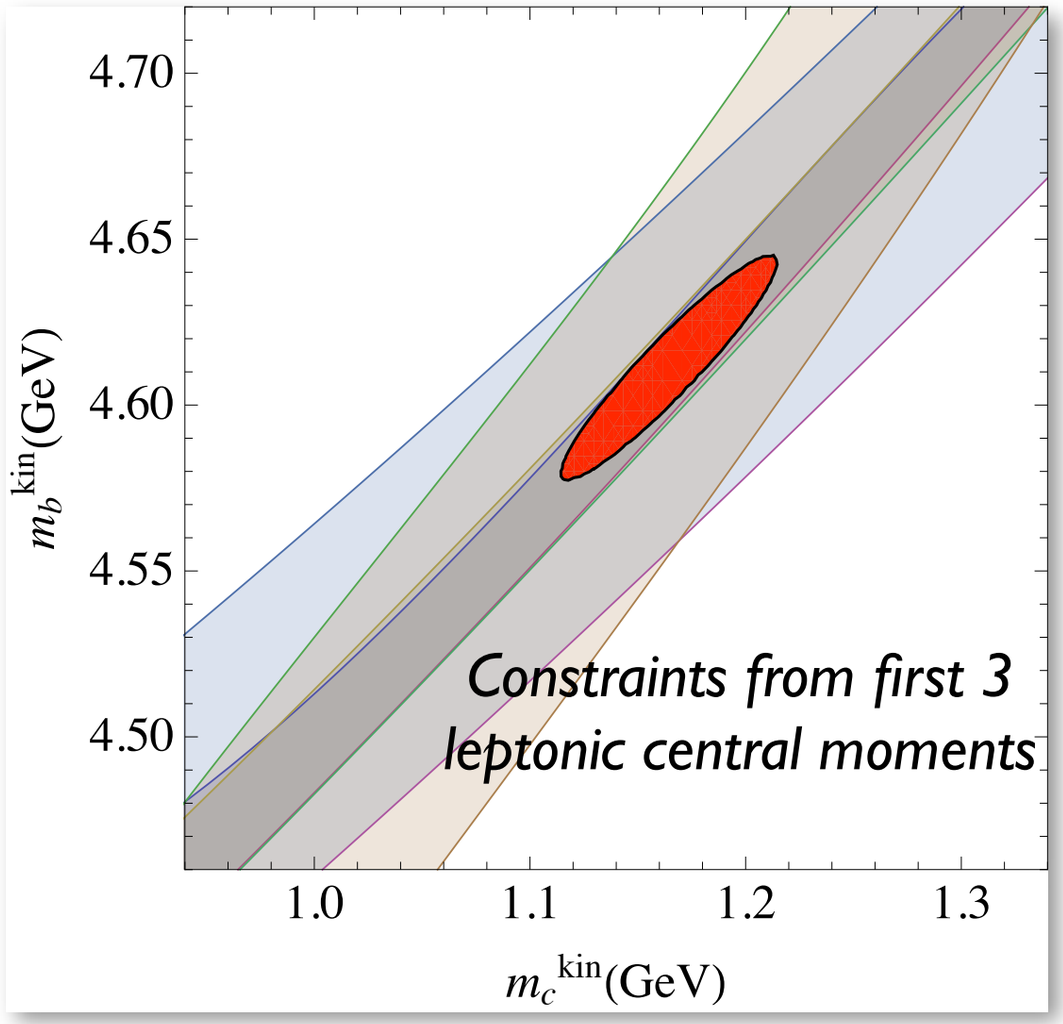
Paolo Gambino
Università di Torino

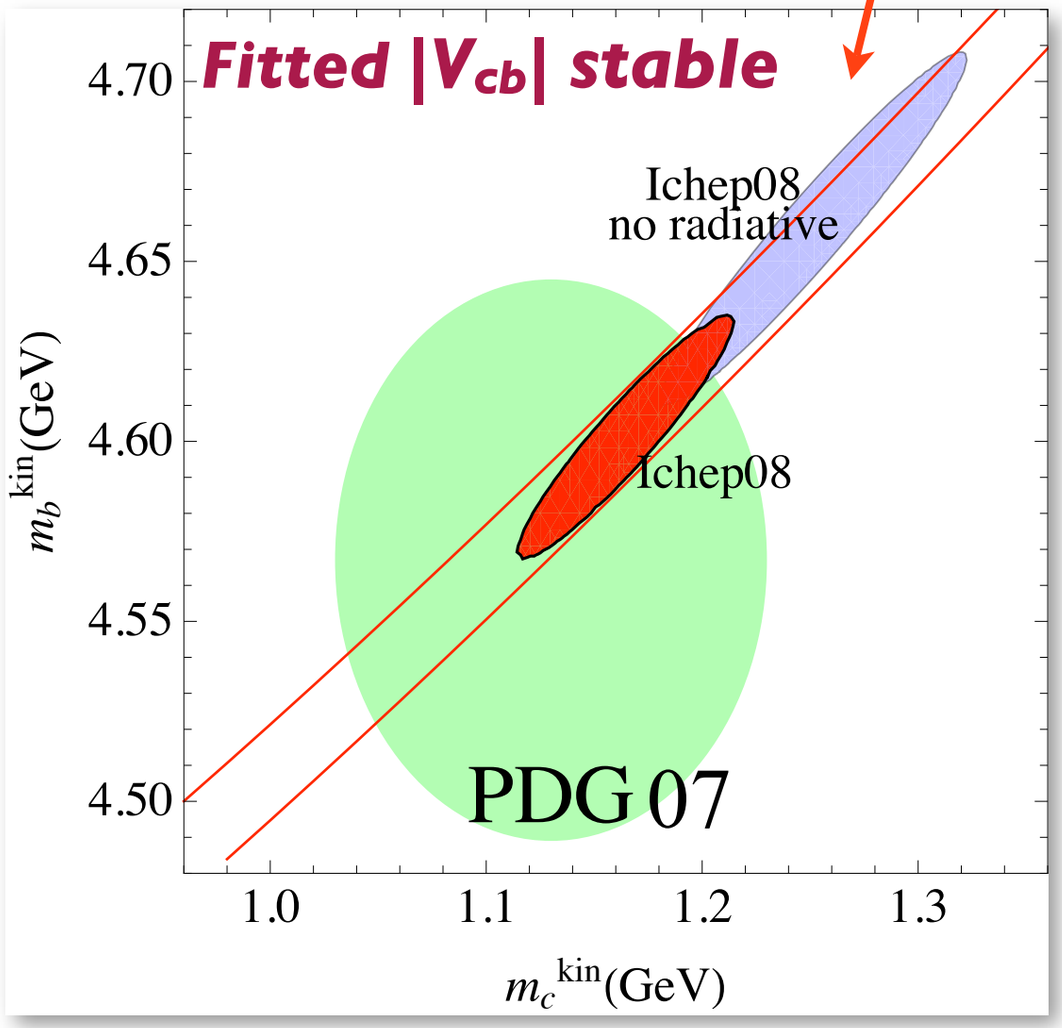
The need to check th errors

- Results of fits to semileptonic & radiative moments are crucial input in inclusive $|V_{ub}|$ determination, m_b in particular
- b quark mass determinations from e^+e^- have recently improved significantly: how do they compare with fits? do we understand/trust theory errors? (see also Hoang talk)
- central m_b value from fits depends on radiative moments whose calculation is more problematic

A strip in the m_b-m_c plane

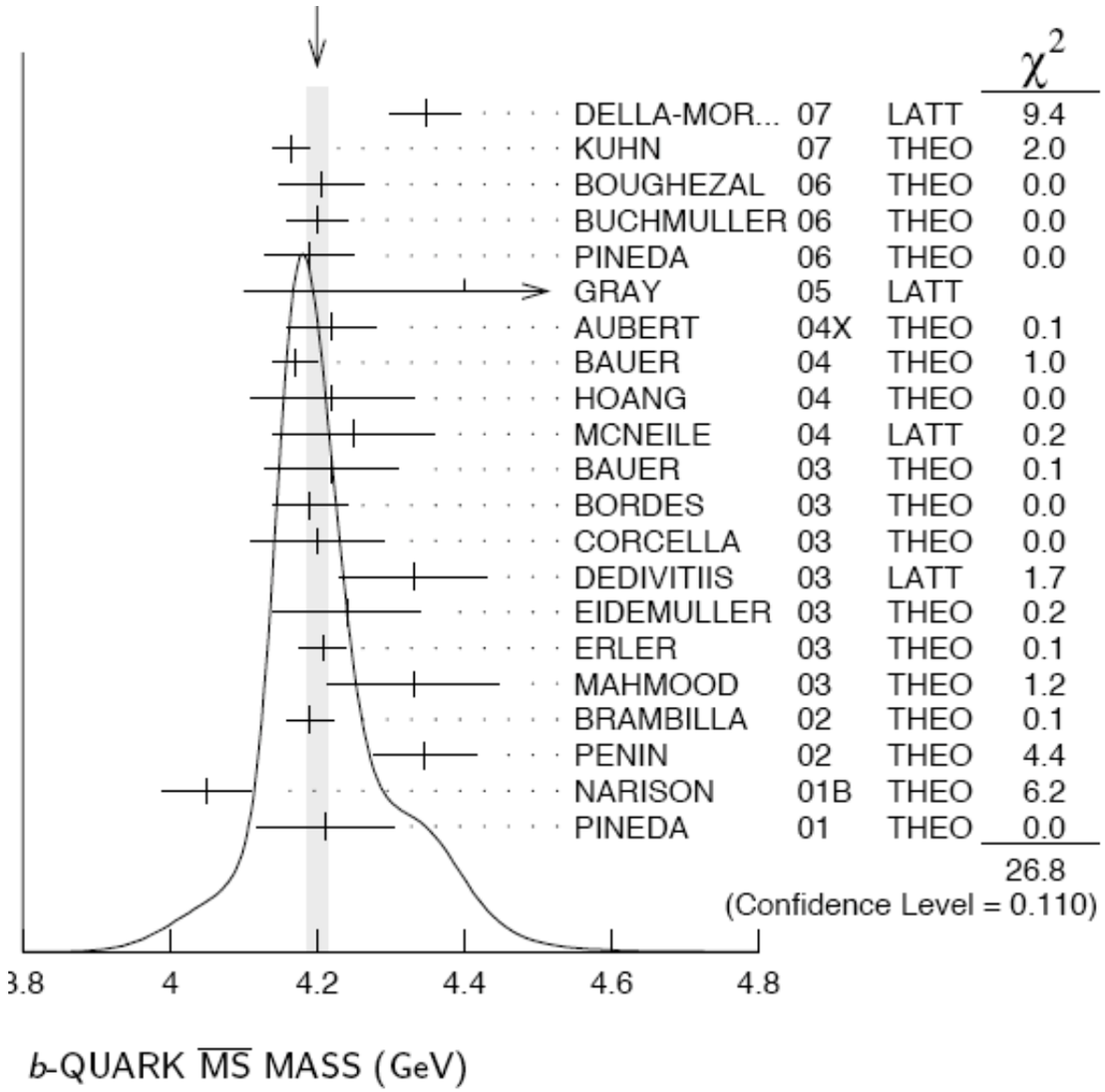
Constant values of s.l. width at fixed V_{cb}



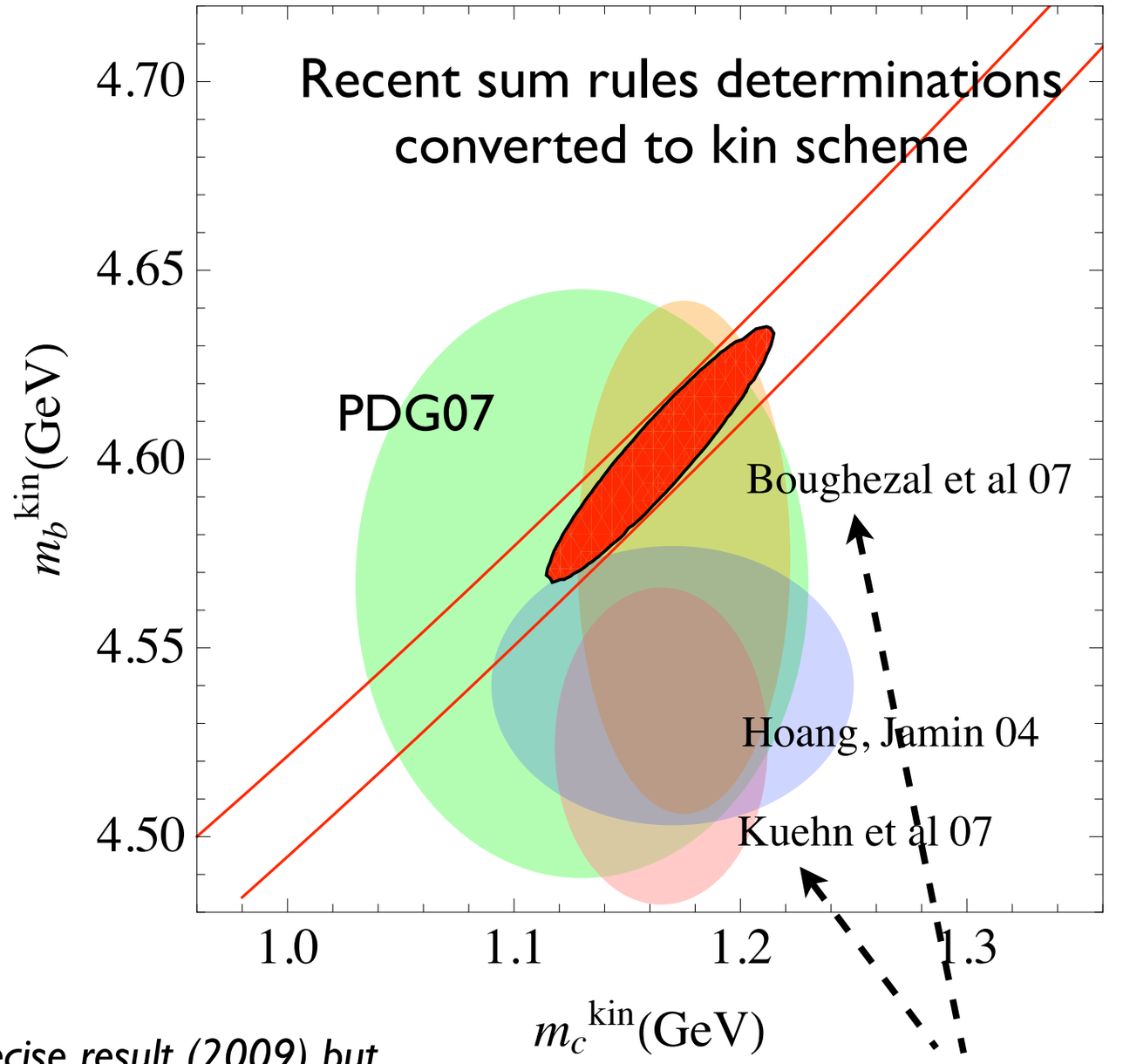


Semileptonic moments do not measure m_b well. They rather identify a strip in (m_b,m_c) plane along which the minimum is ***shallow***.

b mass determinations



PDG08 has inflated errors...



Kuehn et al have a new, similar but more precise result (2009) but the error in the MS→kin scheme conversion is ~40MeV

Understanding th errors (I)

- Complete $O(\alpha_s^2)$ corrections available for semileptonic moments, numerically or in m_c/m_b expansion Melnikov, Czarnecki & Pak 08
- Generally, non-BLM corrections small: expect limited impact
- In normalized leptonic moments pert corrections cancel to large extent, in any scheme and for any cut: hard gluon emission is comparatively suppressed. In kin scheme

$$\langle E_l \rangle_{E_l>1\mathrm{GeV}} = 0.681\frac{m_b}{2}\left[1+(3.179-3.199)\,\frac{\alpha_s}{\pi}\right. \quad (1)$$
$$\left.+\left(\frac{\alpha_s}{\pi}\right)^2((4.30-4.35)\beta_0+3.49(7)-3.36(8)+5.91-5.91)+O(1/m_b^2,\alpha_s^3)\right]$$

- same pattern of cancellations at $O(\alpha_s)$ $O(\beta_0\alpha_s^2)$ $O(\alpha_s^2)$ confirms our estimate of th error, no appreciable change in fit
- *Additional* cancellations in higher central moments due to endpoint enhancement: existing results confirm cancellation pattern. Implementation in hadronic moments under way.

Understanding th errors (II)

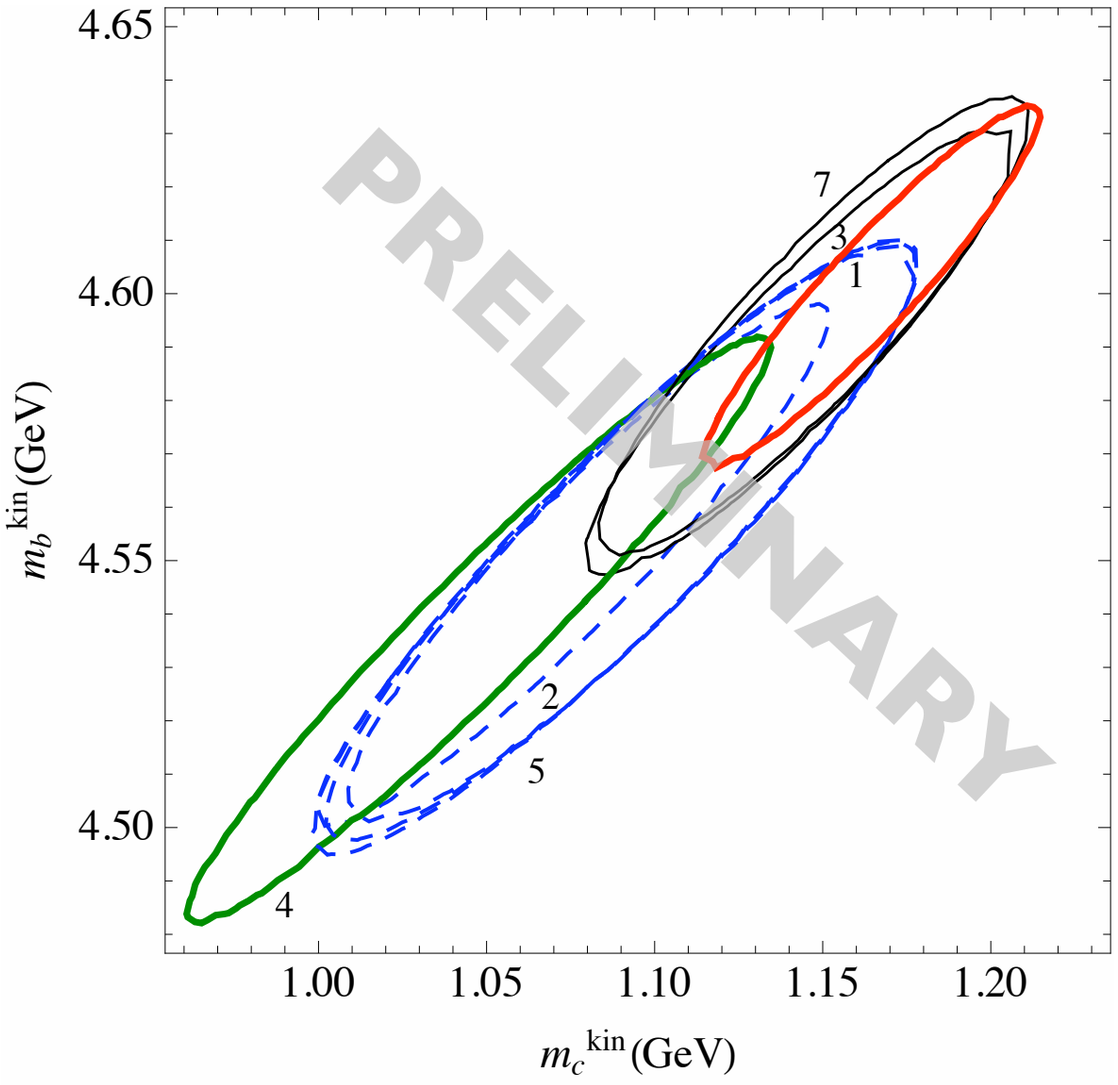
- *Correlations between theory errors of moments at different E_{cut} are difficult to estimate.*

- *Recent fits in kin scheme, contrary to the original prescription, have unrealistically assumed 100% correlation between central moments at different E_{cut}, and (correctly) no correlation between different central moments.*

- *The assumptions on th correlations can have a* ***strong impact on the fits***

- *shown are HFAG-like fits with ichep08 data using different assumptions varying between no correlation (green) and 100% correlation (red): both unrealistic. Note that $|V_{cb}|$ is affected very little.*

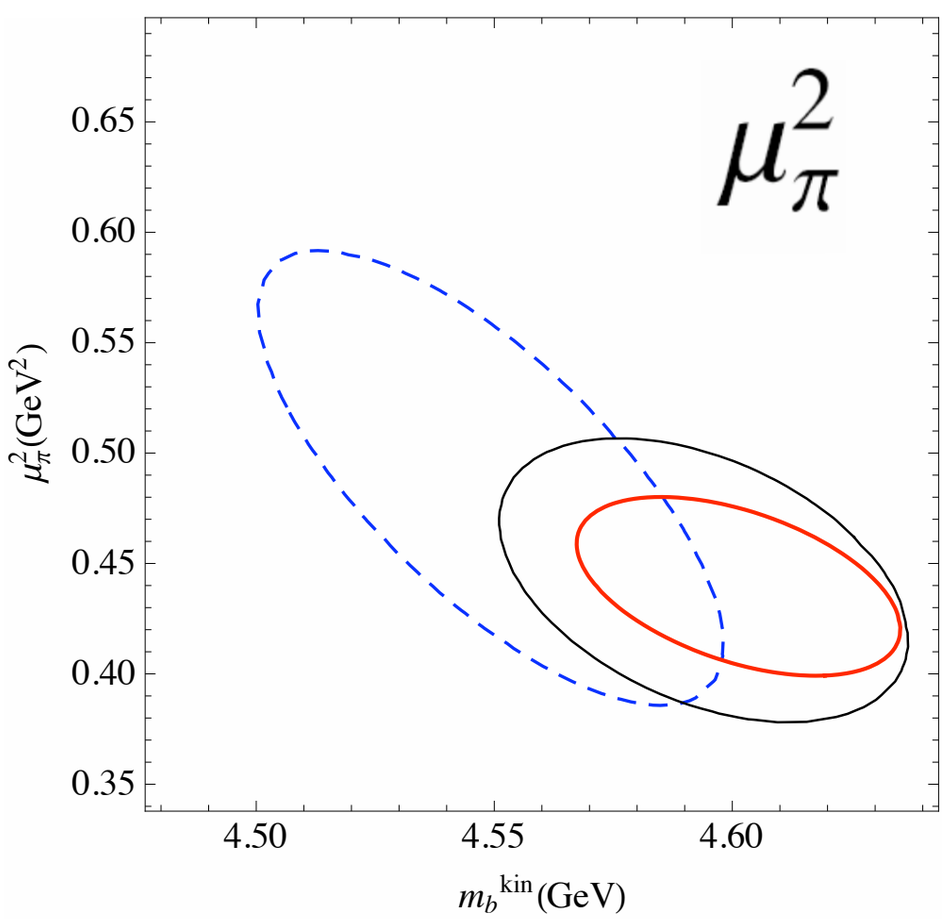
- *χ^2/dof is always low, lowest for green (~0.1) highest for red (~0.5)*

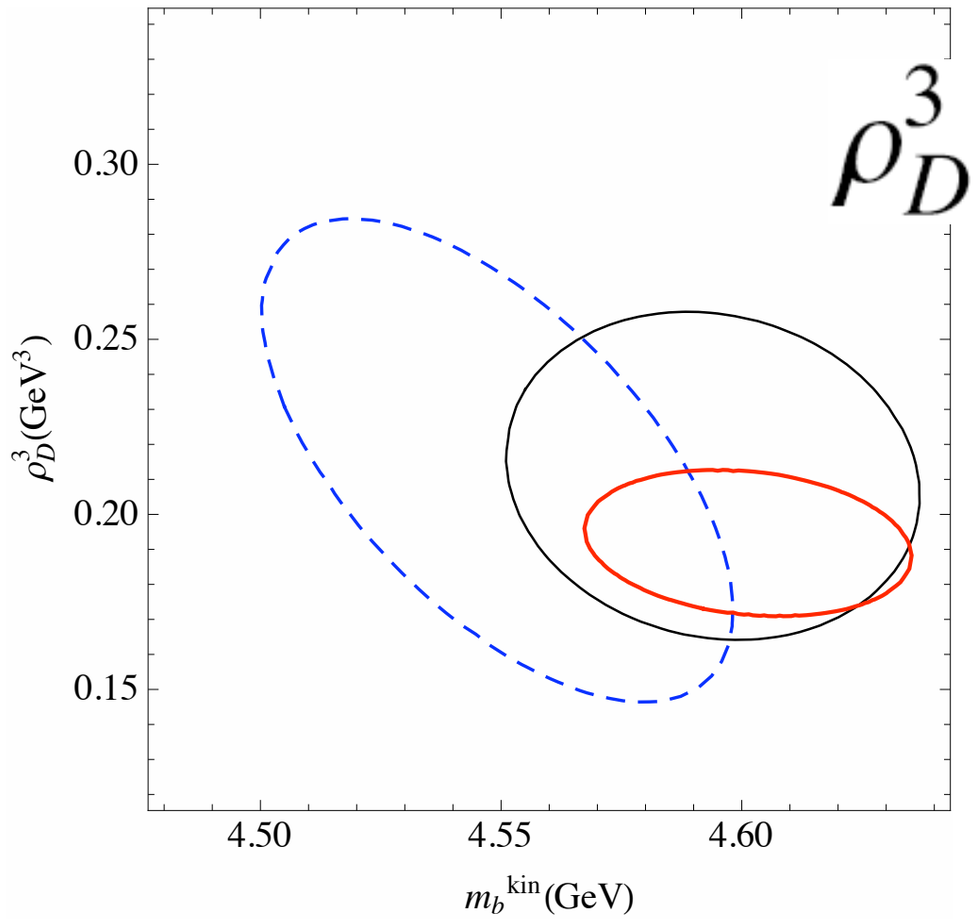


But not all assumptions are reasonable!
High correlations are inevitable

Understanding th errors (III)

Th correlations are also important for other OPE parameters





Always larger errors, somewhat lower m_b

Black: correlations between different cuts computed using th error recipe, encodes existing correlations in computation: probably a good default!

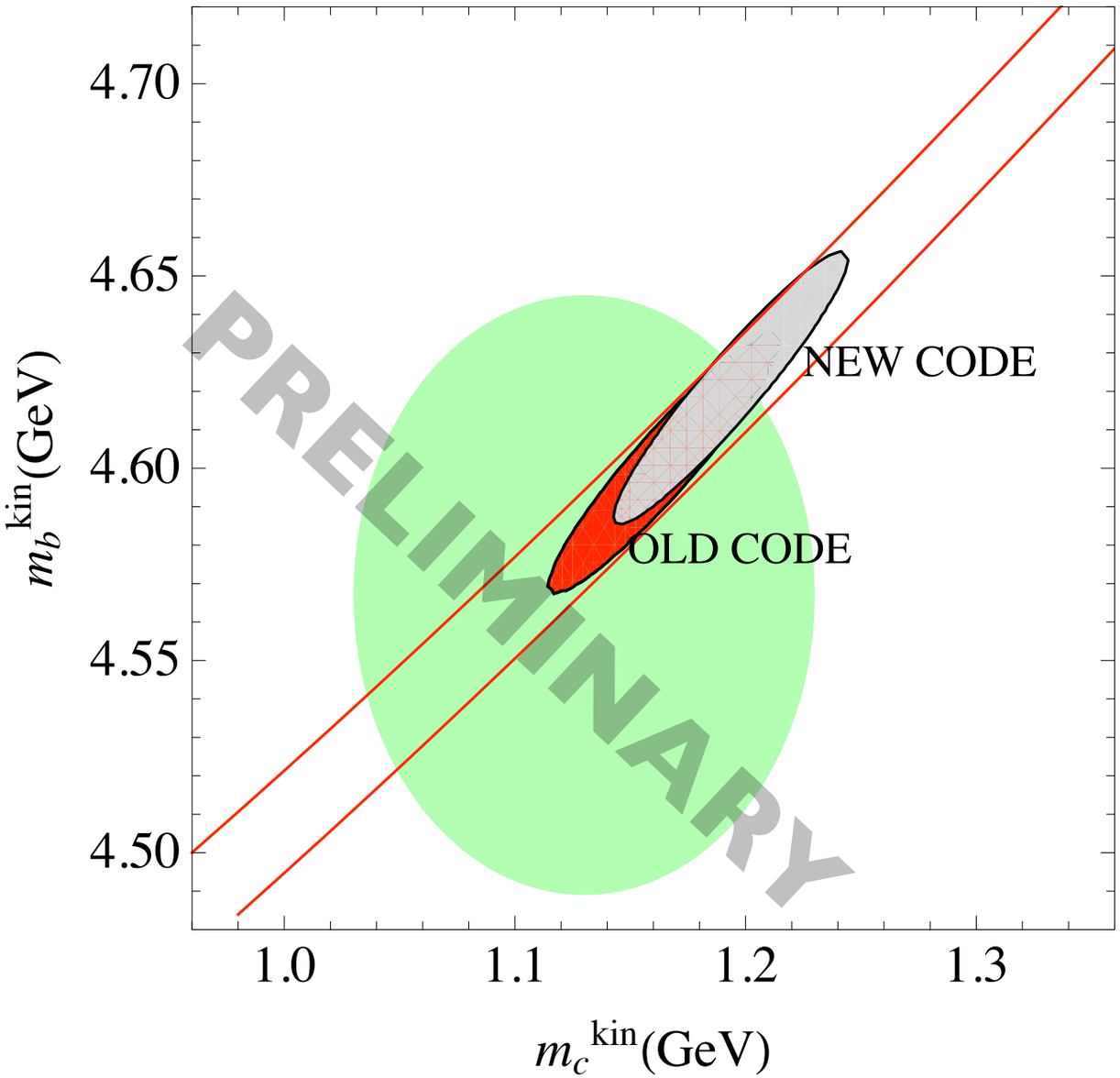
Fitting properly radiative moments

Since the bsγ moments are measured with a high cut on E_γ, local OPE is insufficient.

SF can be implemented at NLO + BLM (Benson et al) and depends on m_b,μ_π^2, ... ie the OPE inputs one wants to fit.

For the first time the fit is now performed with the full parameter dependence.

Also: much larger sample of functional forms



Towards a new OPE fit...

There is some skepticism with rad moments as OPE fails for bsγ at $O(\alpha_s)$ with operators $\neq O_7$. But radiative moments, though interesting, will eventually be largely irrelevant to the fits!

Already now their role in the fits is almost identical to using PDG07 bound $m_b(m_b)$=4.20(7)GeV → m_b^{kin} =4.57(8)GeV. And 70MeV is hardly extreme...

The fits will greatly profit from using additional external constraints. In particular m_c seems to me appropriate.

The new kin code will fit $m_c(\mu)$ in MSbar scheme directly: precise lattice & e^+e^- determinations of m_c could then be employed without conversion error and help m_b and $|V_{ub}|$ determinations.

NEW CODES & FITS AVAILABLE SOON, STAY TUNED!