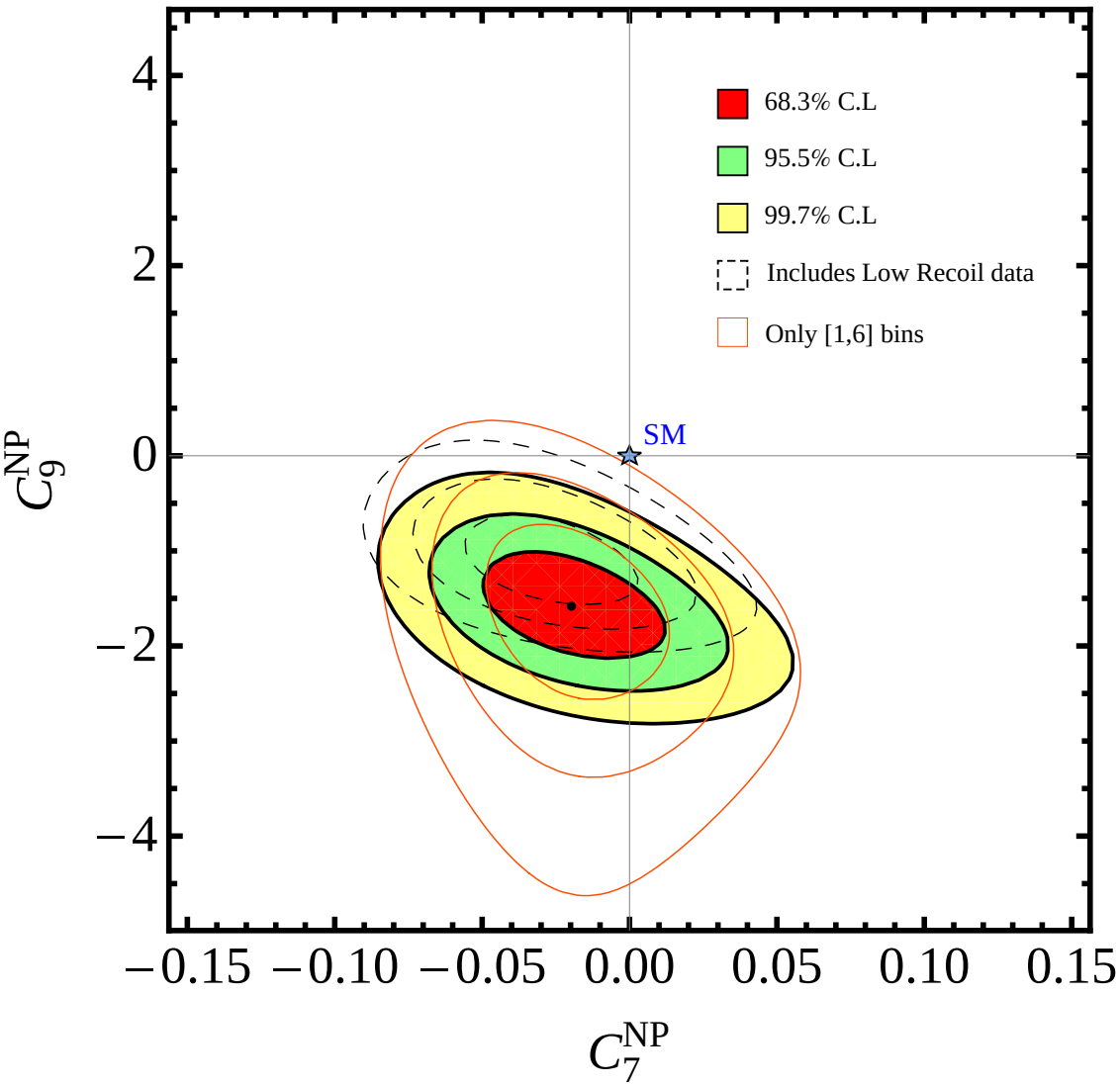
FITS

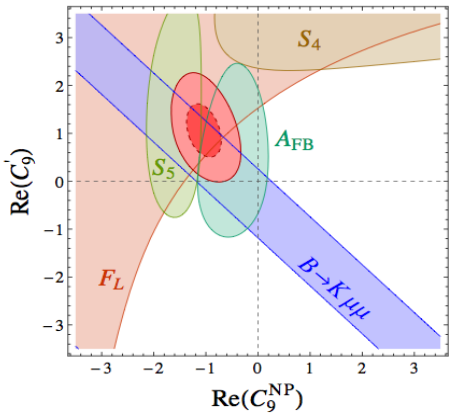
Javier Virto (U. Siegen)

with Sébastien, Lars and Quim

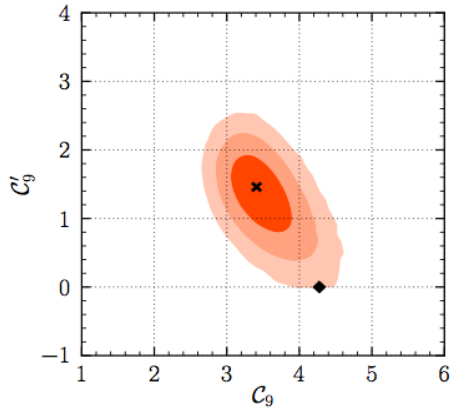
A bit of (pre)history

Descotes-Genon, Matias, JV 1307.5683

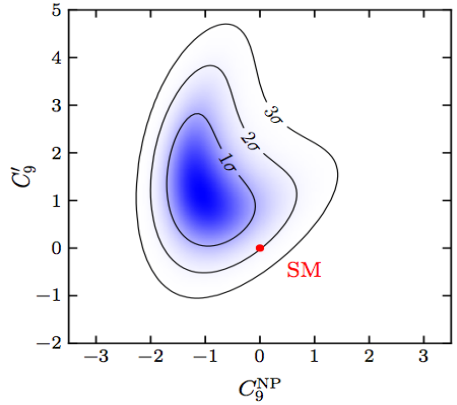




[Altmannshofer, Straub]



[Beaujean, Bobeth, van Dyk],



[Horgan et al.],

Observables for today

- $BR(B \to X_s\gamma)$
  - New theory update: $\mathcal{B}^{SM}_{s\gamma} = (3.36 \pm 0.23) \cdot 10^{-4}$ (Misiak et al 2015)
  - $+6.4\%$ shift in central value w.r.t 2006 $\longrightarrow$ excellent agreement with WA
- $BR(B_s \to \mu^+\mu^-)$
  - New theory update (Bobeth et al 2013), New LHCb+CMS average (2014)
- $BR(B \to X_s\mu^+\mu^-)$
  - New theory update (Huber et al 2015)
- $B \to K^*\gamma$: $S_{K^*\gamma}$ and A_I
  - No change with respect to 2013
- $BR(B \to K\mu^+\mu^-)$:
  - LHCb 2014 + Lattice form factors at large q^2 (Bouchard et al 2013)
- $B \to K^*\mu^+\mu^-$: Angular Observables
  - LHCb 2015 + Lattice form factors at large q^2 (Horgan et al 2013)

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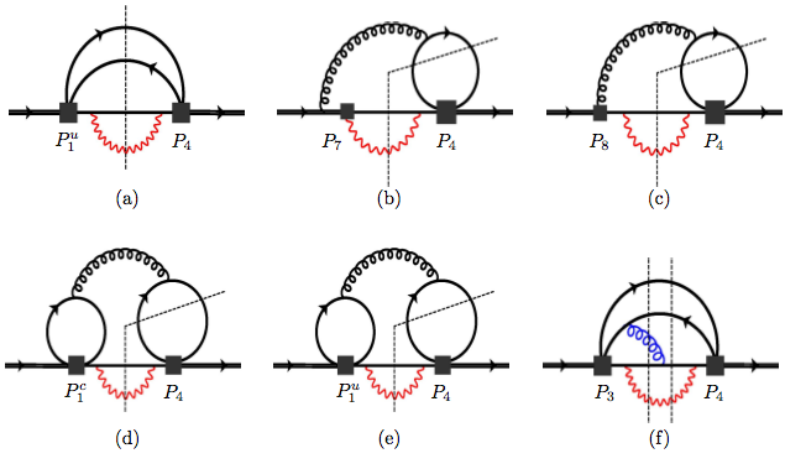
Quick merchardising:

Four-body contributions to $B \to X_s\gamma$ at NLO,
T.Huber, M.Poradzinski and JV
arXiv:1411.7677 [hep-ph] – JHEP



Updated NNLO QCD predictions for the Weak Radiative B-meson decays,
M. Misiak, H. M. Asatrian, R. Boughezal, M. Czakon, T. Ewerth, A. Ferroglia, P. Fiedler, P. Gambino, C. Greub, U. Haisch, T. Huber, M. Kamiński, G. Ossola, M. Poradziński, A. Rehman, T. Schutzmeier, M. Steinhauser, and JV
arXiv:1503.03328 [hep-ph] – PRL

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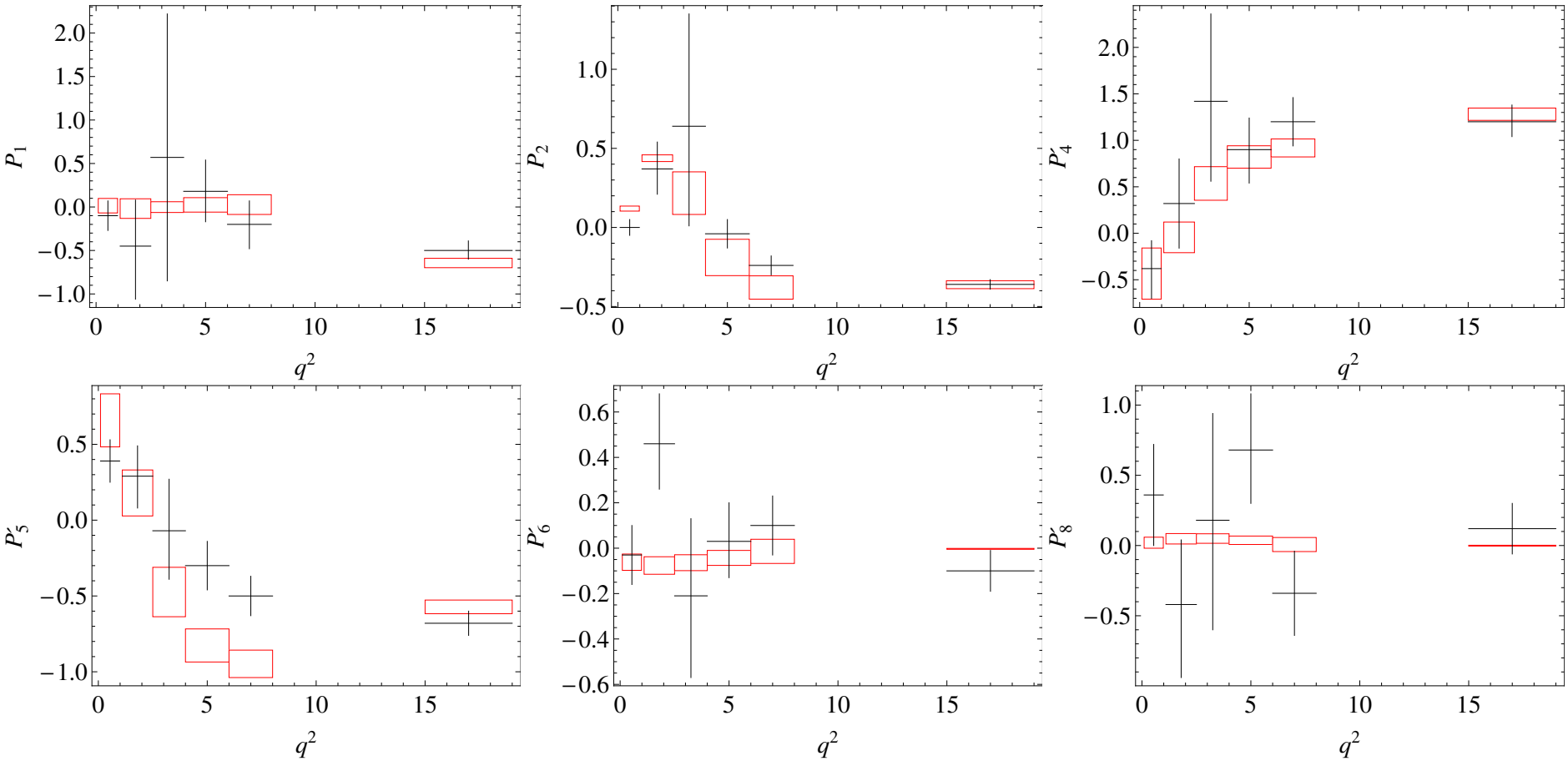
$B \to K^* \mu^+ \mu^-$ Angular Observables from LHCb Run 1



Experimental results: LHCb-CONF-2015-002 (in case you didn't know by now)

Definitions Observables: arXiv:1202.4266 [hep-ph], arXiv:1207.2753 [hep-ph]

Theory predictions: arXiv:1407.8526 [hep-ph] (DHMV)

$B \to K^* \ell\bar{\ell}$

Schematically

$$\mathcal{A}_i(s) \sim \frac{\#}{s}(\mathcal{C}_{7\text{eff}} \pm \mathcal{C}'_7)\,T(s) + \#(\mathcal{C}_9 \pm \mathcal{C}'_9)\,V(s)$$
$$+\#(\mathcal{C}_{10} \pm \mathcal{C}'_{10})\,V'(s) + h_i(s)$$

$B \to K^* \ell\bar{\ell}$: Form Factors (reminder)

Low q^2 ::

- Altmannshofer, Bharucha, Straub, Zwicky:

  LCSRs with K^* DAs + Correlations + EOM constraint

  q^2 dependence given by simplified z-expansion

- Descotes-Genon et al:

  LCSRs with B DAs (uncorrelated) + SCET relations + Power corrections

  q^2 dependence given by simplified z-expansion

- Jäger + Camalich:

  Try to rely only on HQ/LE expansion, both for $q^2 = 0$ and q^2-dependence

  Input: LCSRs, DSE, $B \to K^* \gamma$, + power corrections

Large q^2 ::

- Horgan et al: Lattice QCD

$B \to K^* \ell\bar{\ell}$: Form Factors – DHMV

$$V(q^2) = \frac{m_B + m_{K^*}}{m_B}\,\xi_\perp(q^2) + \Delta V^{\alpha_s}(q^2) + \Delta V^{\Lambda}(q^2)\,,$$

$$A_1(q^2) = \frac{2E}{m_B + m_{K^*}}\,\xi_\perp(q^2) + \Delta A_1^{\alpha_s}(q^2) + \Delta A_1^{\Lambda}(q^2)\,,$$

$$A_2(q^2) = \frac{m_B}{m_B - m_{K^*}}\,\left[\xi_\perp(q^2) - \xi_\parallel(q^2)\right] + \Delta A_2^{\alpha_s}(q^2) + \Delta A_2^{\Lambda}(q^2)\,,$$

$$A_0(q^2) = \frac{E}{m_{K^*}}\,\xi_\parallel(q^2) + \Delta A_0^{\alpha_s}(q^2) + \Delta A_0^{\Lambda}(q^2)\,,$$

$$T_1(q^2) = \xi_\perp(q^2) + \Delta T_1^{\alpha_s}(q^2) + \Delta T_1^{\Lambda}(q^2)\,,$$

$$T_2(q^2) = \frac{2E}{m_B}\,\xi_\perp(q^2) + \Delta T_2^{\alpha_s}(q^2) + \Delta T_2^{\Lambda}(q^2)\,,$$

$$T_3(q^2) = \left[\xi_\perp(q^2) - \xi_\parallel(q^2)\right] + \Delta T_3^{\alpha_s}(q^2) + \Delta T_3^{\Lambda}(q^2)\,,$$

Fact. Power corrections: $\Delta F^{\Lambda}(q^2) = a_F + b_F\,\frac{q^2}{m_B^2} + c_F\,\frac{q^4}{m_B^4} + \ldots,$

$B \to K^* \ell\bar{\ell}$: h_i : Corrections to QCDF at low-q^2 – DHMV

$$\mathcal{T}_i^{\rm had} \to \big(1 + r_i(q^2)\big)\mathcal{T}_i^{\rm had},$$

$$r_i(s) = r_i^a e^{i\phi_i^a} + r_i^b e^{i\phi_i^b}(s/m_B^2) + r_i^c e^{i\phi_i^c}(s/m_B^2)^2.$$

With $r_i^{a,b,c} \in [0, 0.1]$ and $\phi_i^{a,b,c} \in [-\pi, \pi]$

$B \to K^* \ell\bar{\ell}$: h_i : Charm – DHMV

Inspired by Khodjamirian et al (KMPW):

$$\delta C_9^{\rm LD}(q^2) = \frac{a + bq^2(c - q^2)}{q^2(c - q^2)} \tag{17}$$

with $a \in [2, 7]$ GeV^4, $b \in [0.1, 0.2]$ and $c \in [9.3, 9.9]$ GeV^2. The resulting band contains all three $\tilde{g}$ functions (and their errors) in the range $1 < q^2 < 9$ GeV^2. We add this contribution to each amplitude $\mathcal{A}_i^{L,R}$ by substituting:

$$\mathcal{C}_9 \to \mathcal{C}_9 + s_i \delta C_9^{\rm LD}(q^2) \ . \tag{18}$$

We vary s_i independently in the range $[-1, 1]$ (only $s_i = 1$ in KMPW).

$B \to K^* \ell\bar{\ell}$: h_i : large-q^2 – DHMV

- OPE up to dimension 3 ops (Buchalla et al)
- NLO QCD corrections to the OPE coeffs (Greub et al)
- Lattice QCD form factors with correlations (Horgan et al proceeding update)
- $\pm 10\%$ by hand to account for possible Duality Violations (Lyon, Zwicky)

Fit: Statistical Approach

$$\chi^2(C_i) = [O_{\text{exp}} - O_{\text{th}}(C_i)]_j \, [Cov^{-1}]_{jk} \, [O_{\text{exp}} - O_{\text{th}}(C_i)]_k$$

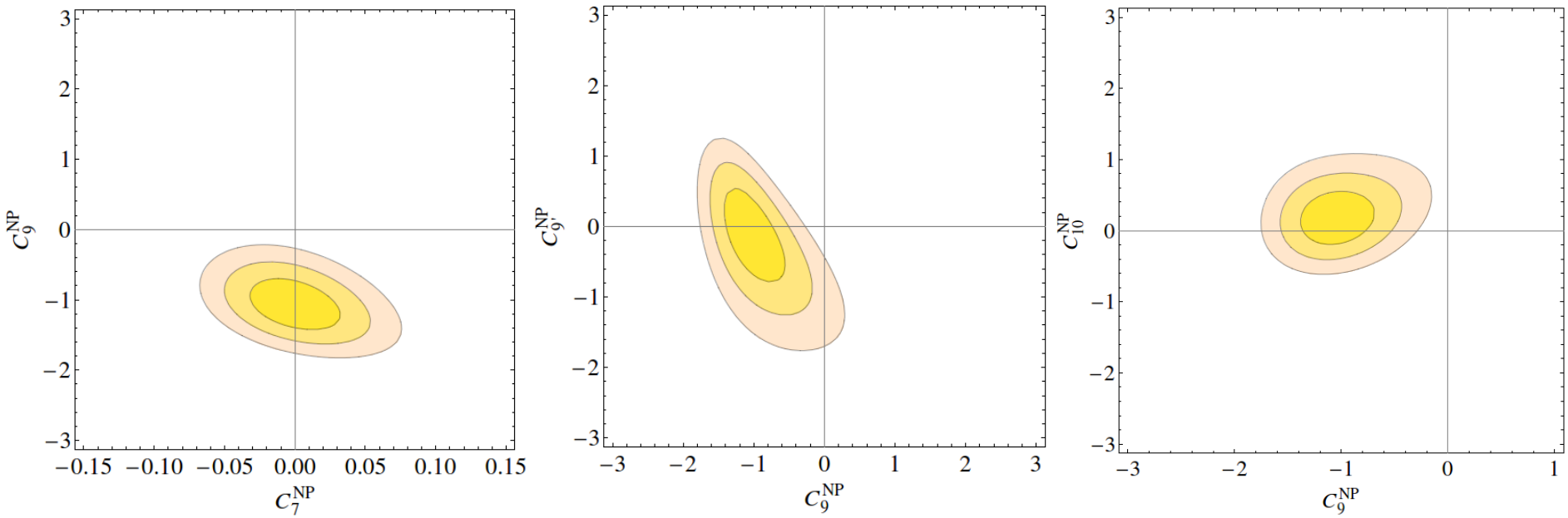
- $Cov = Cov^{\text{exp}} + Cov^{\text{th}}$
- We have Cov^{exp} for the first time
- Calculate Cov^{th}: correlated multigaussian scan over all nuisance parameters
- Cov^{th} depends on C_i: Must check this dependence

For the Fit:

- Minimise $\chi^2 \to \chi^2_{\text{min}} = \chi^2(C_i^0)$ (Best Fit Point $= C_i^0$)
- Confidence level regions: $\chi^2(C_i) - \chi^2_{\text{min}} < \Delta\chi_{\sigma,n}$
- Compute pulls by inversion of the above formula

Fit: Some results here and there...

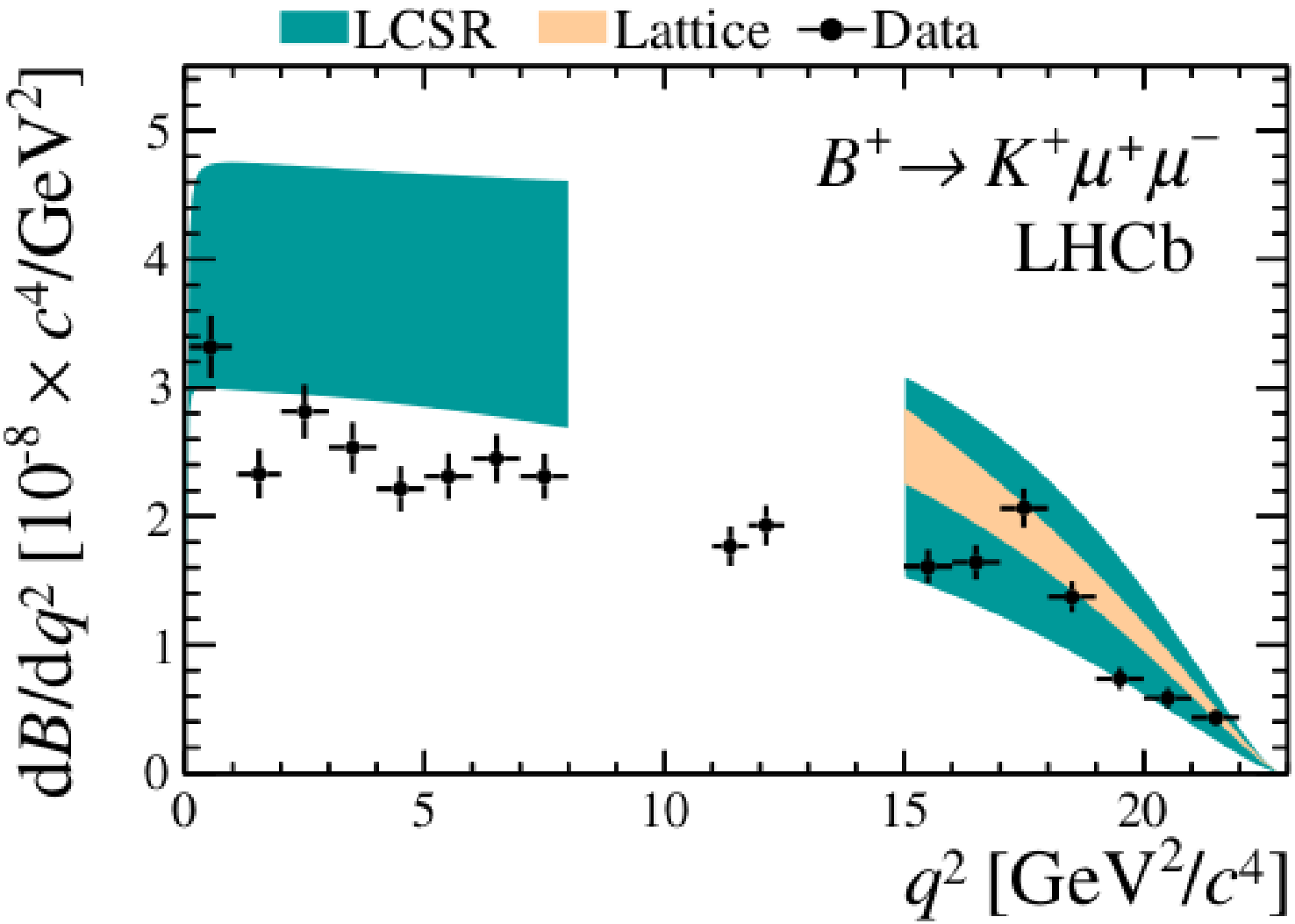
Fit to all observables *ignoring the correlations*:



Similar to 2013, also similar to AS'2015

Fit: Some results here and there...

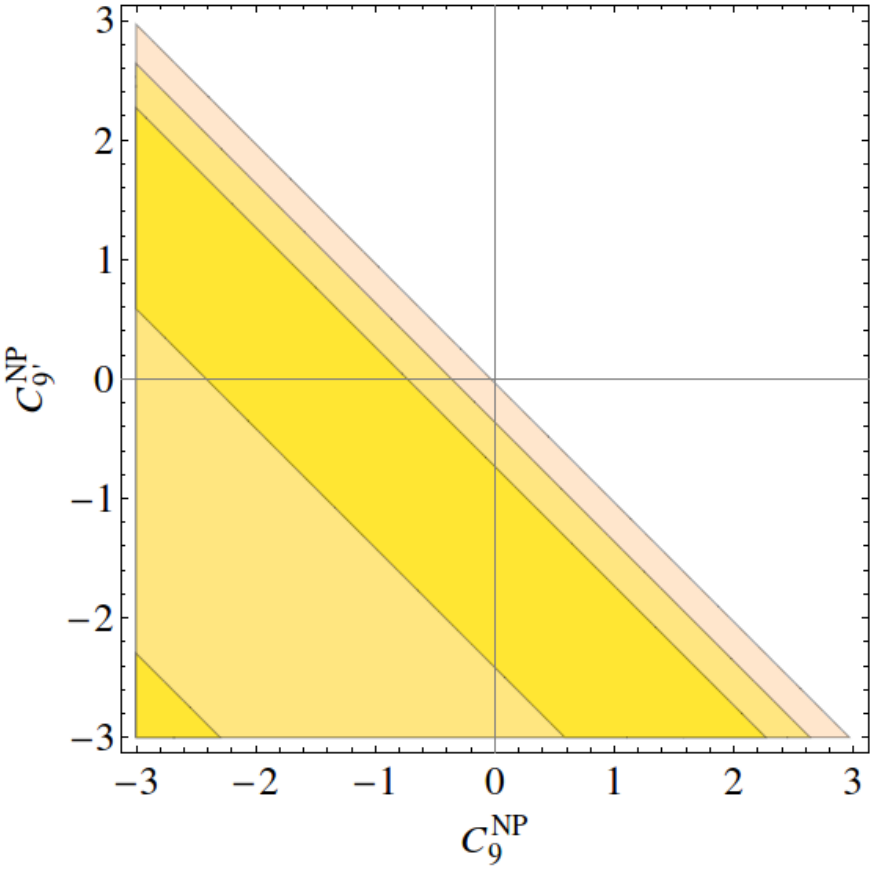
A closer look at theory correlations:



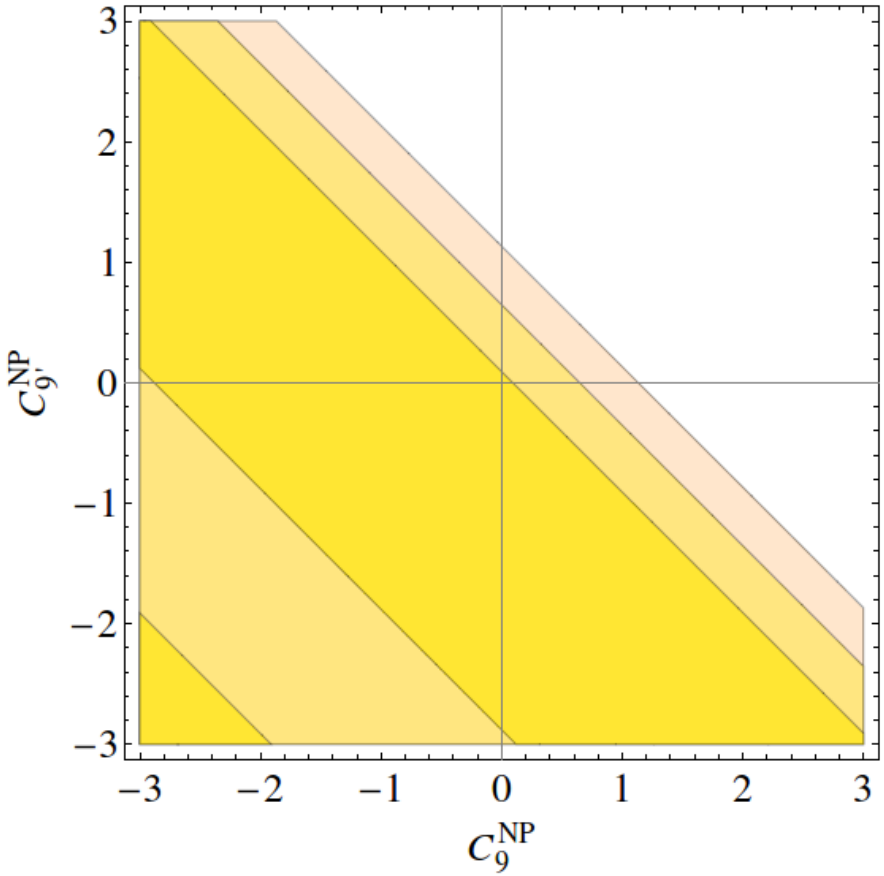
Fit: Some results here and there...

A closer look at theory correlations for $B^+ \to K^+ \mu\mu$:

Without correlations



With correlations

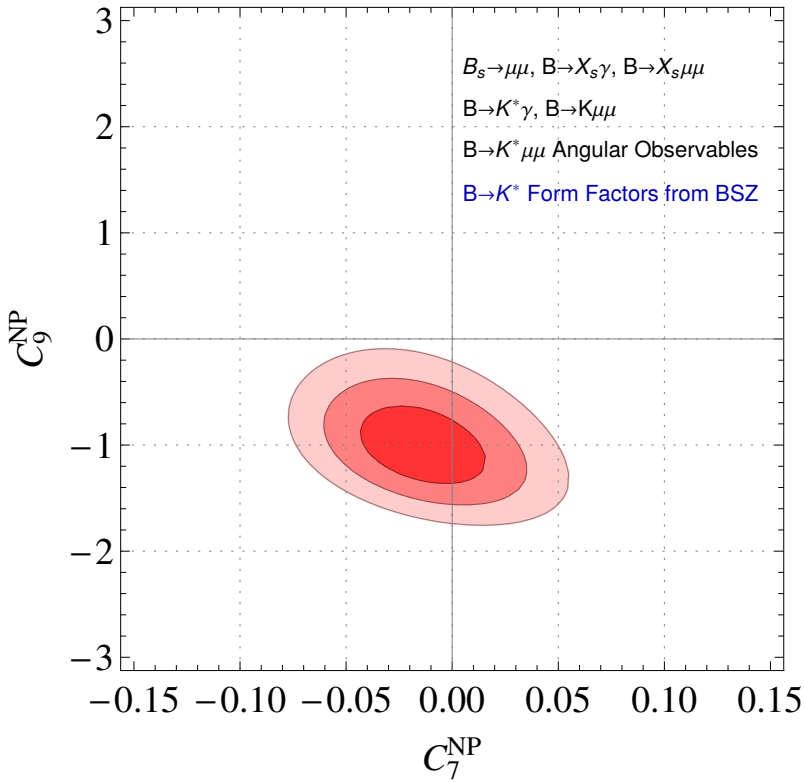


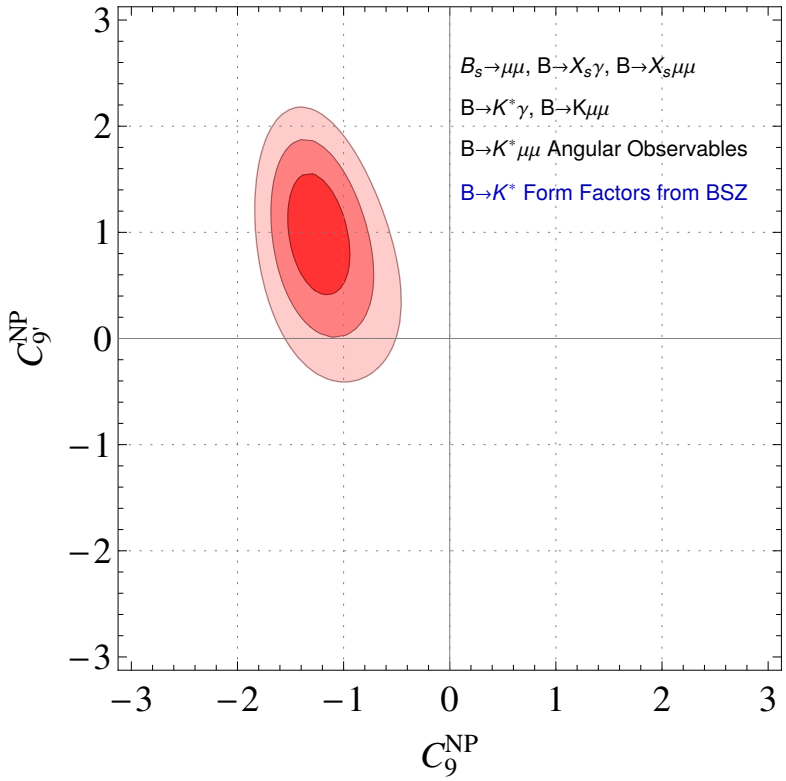
Probably the result is similar for one large bin at large recoil

Fit: Some results here and there...

All observables (including all correlations) with $P_i^{(\prime)}$ for $B \to K^* \mu\mu$

with Form factors + correlations from BSZ





Good agreement with AS'2015 (remember that **we** are using $P_i^{(\prime)}$)

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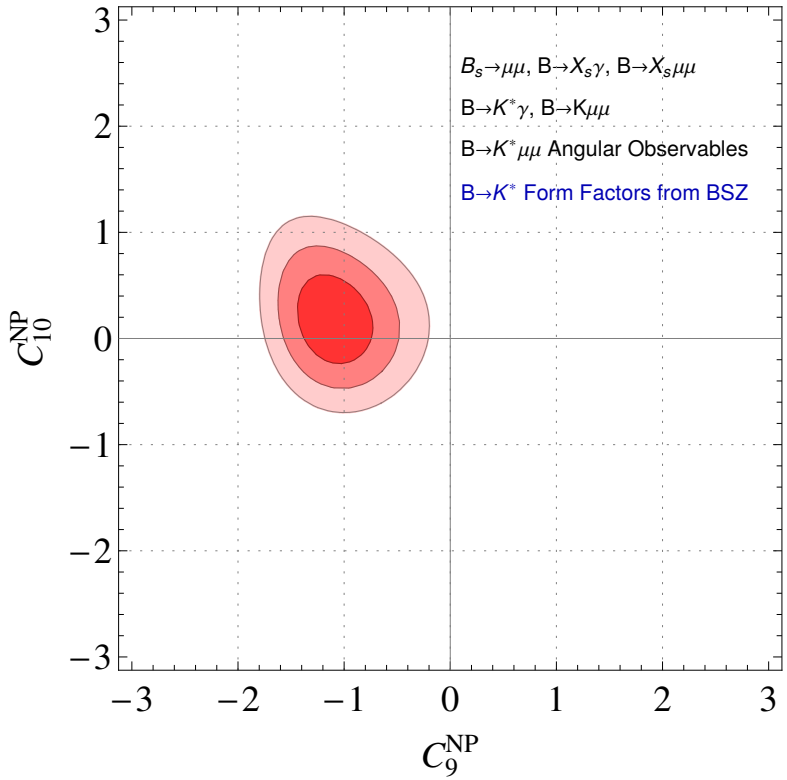

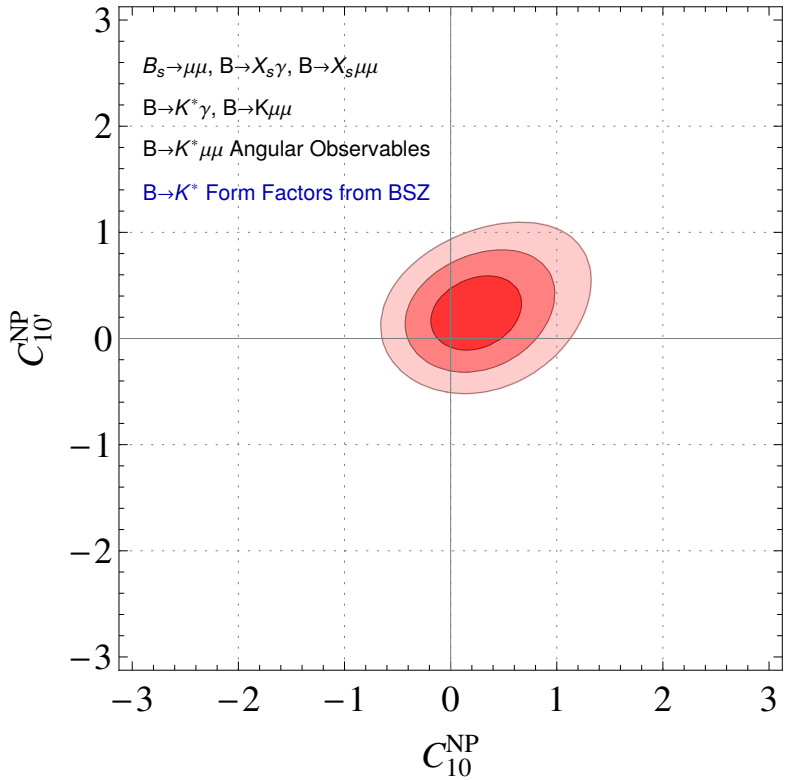

Good agreement with AS'2015 (remember that **we** are using $P_i^{(\prime)}$)

With form factors ala DHMV: Work in progress. We expect some differences, as correlations here are *intrinsically of different nature*. Soon out. Time is scarce. Patience is the mother of science.


Einfach gut aussehen.
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16,90 €