

Status of the "Properties" Sub-Group Analyses

M. Margoní, S. K. Swain, 20/1/2015

Physics Focus

- Measure b hadron decay properties (other than yields)

Common Tools

- Lifetime techniques, flavor tagging, angular analysis

Comment

- Precision measurement of B (decay) properties, core B-Physics

Status of the "Properties" Sub-Group Analyses

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Ongoing Analyses:

- BPH 13-010 ($B^0 \rightarrow K^* \mu \mu$ Angular Analysis) [Milano Bicocca] Pre-Appr
- BPH 13-012 ($B_s \rightarrow J/\psi \phi$) [Helsinki, Pisa, Padova] Appr (Old tagger)
- BPH 14-004 (Flavor Tagging) [Padova, Pisa, Helsinki] (New Tagger)
- BPH 13-008 ($B_s \rightarrow J/\psi f^0$, $\Lambda_b \rightarrow J/\psi \Lambda$, $\Xi_b \rightarrow J/\psi \Xi^-$ Lifetimes)
[CINVESTAV-IPN] (Ongoing)
- BPH 10-016 (Integrated χ with dimuons) [Padova] (Ongoing)
- BPH 12-003 (Semileptonic asymmetry with dimuons) [Padova] (Not started yet)
- BPH 14-007 (Integrated χ in $t\bar{t}$ events) [Padova] (Ongoing)

Measurement of the forward-backward asymmetry and other variables in $B^0 \rightarrow K^{*0} \mu\mu$

Milano Bicocca

● Status:

- Analysis on 2012 data set already finalized & Pre-Approved
- New AN-14-129-v7 available including Pre-Approval (and later) comments
- Analysis already extended to $B^+ \rightarrow K^{*+} \mu\mu$ (Peking, Purdue, NTU, NISER) no CADI line yet

● Near term Plans:

- Approval ASAP

● Long term Plans:

- Use of the angular observables free from Form Factor contributions (P'5 a la LHCb)
- Extend the analysis to $\Lambda_b \rightarrow \Lambda^0 \mu\mu$
- Include measurement of other quantities (i.e. CP and Isospin asymmetries)

$B_s \rightarrow J/\psi f^0$, $\Lambda_b \rightarrow J/\psi \Lambda$, $\Xi_b \rightarrow J/\psi \Xi^-$ Lifetimes

CINVESTAV-IPN

- Follow up of BPH-14-002: BR ($B_s \rightarrow J/\psi f^0$) (2011 dataset)
 - Final Reading on 16/1/2015, first version of the paper just provided.
- BPH 13-008: $B_s \rightarrow J/\psi f^0$ Lifetime (2011+2012 data sets)
 - Status: First version of AN available, work going on to improve fit stability. Analysis almost finalized.
 - Plan: Present the final result next week. Pre-Approval deadline easily met.
- $\Lambda_b \rightarrow J/\psi \Lambda$ Lifetime (2011+2012 data sets)
 - Status: Measurement of lifetime and of the ratio $\tau(\Lambda_b)/\tau(\overline{\Lambda}_b)$ almost finalized and competitive with LHCb.
 - Plan: Provide the first version of the AN the next week. CADI line needed; Easy to meet the April Pre-Approval deadline.
- $\Xi_b \rightarrow J/\psi \Xi^-$ Lifetime (2011+2012 datasets)
 - Status: Still working on the fit details. No results to be presented yet.
 - Plan: Need to work hard to have a chance to meet the April deadline.

Measurement of Φ_s and $\Delta\Gamma_s$ with $B_s \rightarrow J/\psi\phi$ With a New Flavor tagging algorithm

Pisa, Helsinki, Padova

Status:

- Approved preliminary results using 2012 dataset (based on the Old tagger)
- New AN-14-045-v9 available including new tagger and final results
- AN-14-065-v7 available with description of the new tagger algorithm
- Δm_d Measurement using the new tagger going on (Terhi Jarvinen, Helsinki Group)

Plan:

- Approval ASAP (meeting with the ARC at the end of this week)
- Interest in going on with the tagging studies to define an official “BPAG tagging algorithm” for all the CPV future analyses (including Opposite-Side Vertex Charge & Jet Charge, Same-Side Cone-Charge,...)
- The Sanjay & Seema Group will join Padova and Helsinki: Deepak Kumar Sahoo will be joining to work along with Jacopo Pazzini on the tagging issues in the next months

B Mixing and SL asymmetry A_{SL} with di-muons

Padova

- Status of Integrated Mixing analysis with di-muons
 - Based on $3 \cdot 10^7$ non-resonant di-muons (2010 dataset)
 - Analysis stuck for a long time due to **lack of manpower**
 - Analysis resumed since last july (**Franco Simonetto**)
- Plans:
 - Hoping to meet the April deadline for the Pre-approval
 - This analysis is however “almost mandatory” as an intermediate result before the semileptonic asymmetry (A_{SL}) measurement...

B Mixing and SL asymmetry A_{SL} with di-muons

Padova

● Status of the A_{SL} analysis with di-muons

- Still to be started (lack of manpower) will use $3 \cdot 10^7$ same-sign low P_t di-muons (2012 dataset, data collected using a dedicated trigger)
- No need for further data, measurement will be possible only using this dataset
- Needs careful treatment of systematics uncertainties (BKG, charge-dependent muon efficiency, B^0 production asymmetry)

● Plans:

- Interest in the Padova Group, but the Integrated Mixing is a necessary preliminary validation...
- Not possible to meet the April Pre-approval dead-line.

B Mixing and A_{SL} in $t\bar{t}$ events

Padova

● Status:

- Analysis well covered (Alessio Boletti, Paolo Ronchese, Martino Margoni)
- Signal selection, pairing of the top/b-lepton already finalized
- Fit PDF to be defined

● Plans:

- PHD thesis of Alessio Boletti
- Not easy to meet the April dead line
- Use instead the Run2 data set

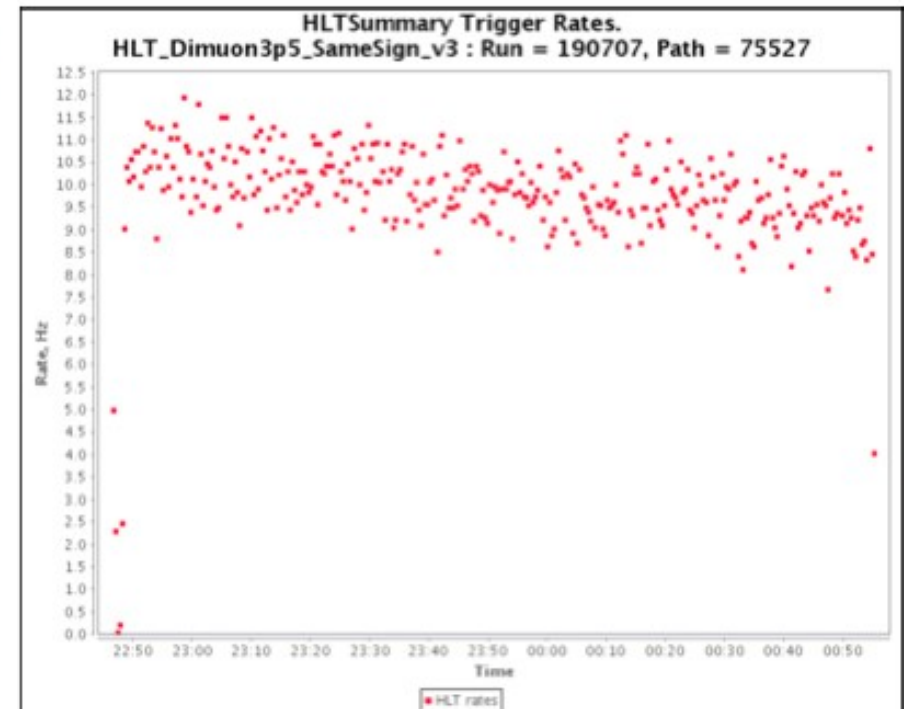
● Long Term Plans:

- Using the current tagging strategy in $t\bar{t}$ events:
 - $L_{INT} = 300 \text{ fb}^{-1}$, $\sigma = 1 \text{ nb}$ (5 time the current value) $\rightarrow \delta A_{SL} \text{ (stat)} \sim 0.3\%$

Back Up

Trigger for 2012 data

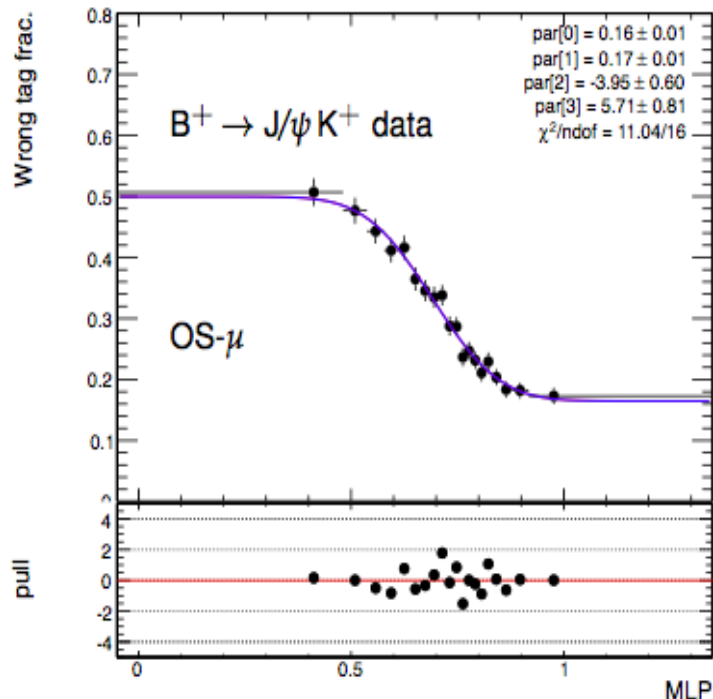
- Introduced a new trigger in 2012 to collect same-charge di-muon events
 - **HLT_Dimuon3p5_SameSign_v***
 - Based on existing di-muon paths for Onia, with optimized cuts
- Selects events with pairs of muons having:
 - $p_t > 3.5 \text{ GeV}$
 - $|\eta| < 2.2$
 - $\max(\text{DCA}_{\mu\mu}) = 2 \text{ cm}$
 - $4.5 < M(\mu\mu) < 75 \text{ GeV}$
- Trigger is prescaled and currently has a rate of $\sim 10 \text{ Hz}$



New Flavor tagging algorithm

Pisa, Helsinki, Padova

- CPV measurements using neutral mesons require knowledge of the B flavor @ production time: study Opposite-Side assuming $b\bar{b}$ production
- Flavor obtained from the charge of an OS μ / e
- TMVA analysis to disentangle $b \rightarrow l$ direct decays from $b \rightarrow c \rightarrow l$ cascade & BKG
- Mistag measured on $B^+ \rightarrow J/\psi K^+$ real data & corrected for B_s/B^+ difference using MC



[%]	μ	e	l
ϵ_{tag}	4.56 ± 0.02	3.92 ± 0.02	8.31 ± 0.03
ω	28.6 ± 0.3	32.5 ± 0.3	30.2 ± 0.2
\mathcal{P}_{tag}	0.83 ± 0.02	0.48 ± 0.02	1.31 ± 0.03

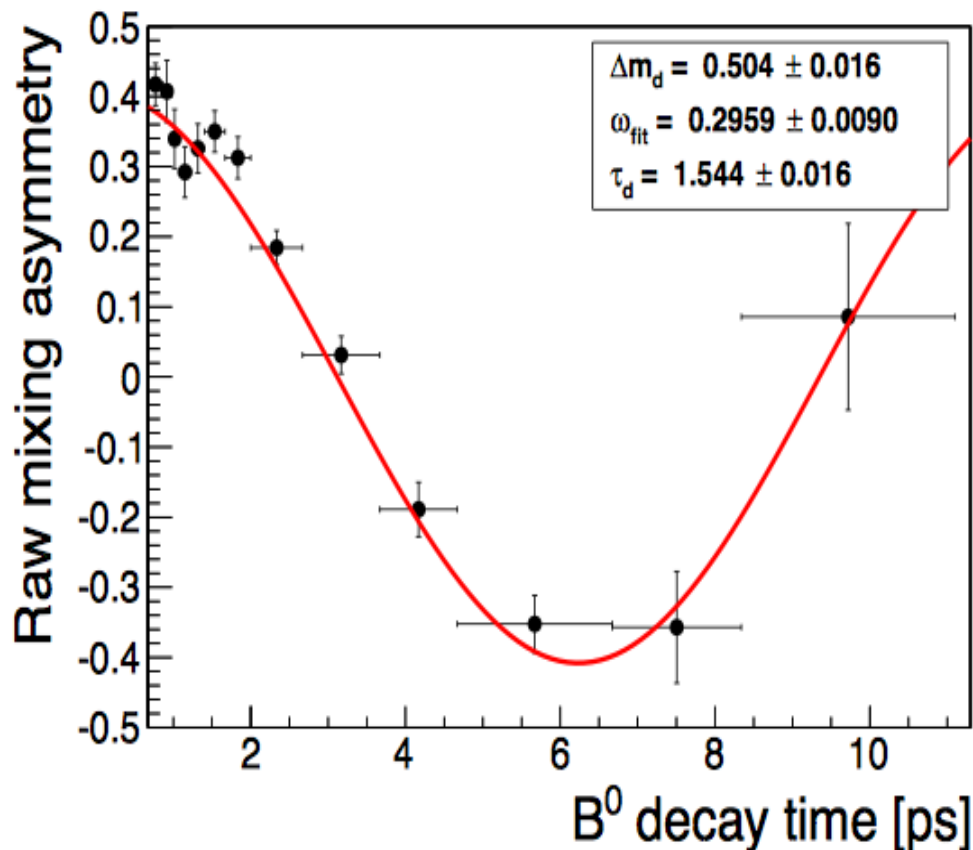
- Tagging power improved by $\sim 30\%$ wrt original cut-based strategy

New Flavor tagging algorithm

Pisa, Helsinki, Padova

Status:

- AN-14-065-v7 available with description of the new tagger algorithm
- Approval of BPH-13-012 ASAP (meeting with the ARC at the end of this week)
- Δm Measurement using the new tagger going on (Terhi):



Fit results

$$\tau_d = 1.544 \pm 0.016 \text{ ps (PDG: } 1.519 \pm 0.005 \text{ ps)}$$
$$\Delta m_d = 0.504 \pm 0.016 \text{ ps}^{-1} \text{ (PDG: } 0.510 \pm 0.003 \text{ ps}^{-1})$$

B Mixing and SL asymmetry A_{SL} with di-muons

Padova

● Hot topics due to:

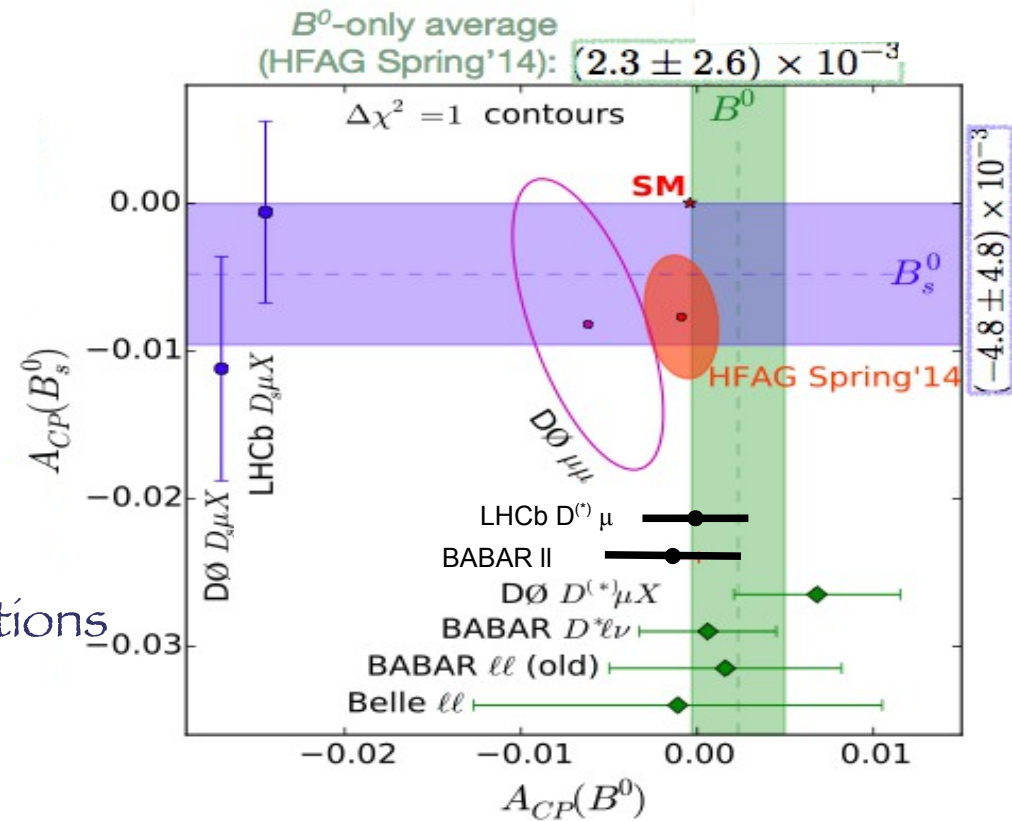
⊕ Discrepancy between LEP & CDF in the integrated mixing rate

$$\bar{\chi} = 0.126 \pm 0.004 \quad (LEP)$$

$$\bar{\chi} = 0.147 \pm 0.011 \quad (Tevatron)$$

⊕ D0 anomaly @ 3.6σ in A_{SL} from SM predictions

$$A_{sl}^q = \frac{N_{B_q^0}(\mu^+ \mu^+) - N_{B_q^0}(\mu^- \mu^-)}{N_{B_q^0}(\mu^- \mu^-) + N_{B_q^0}(\mu^+ \mu^+)}$$



● Mixing analysis using $3 \cdot 10^5$ non-resonant di-muons (2010 dataset)

⊕ Fraction of events from B decays from a fit to $P_t(\mu)$ relative to jet direction for different charge correlation samples (SS, OS, SS^{++} , S^{--})

$$\bar{\chi} = 0.126 \pm 0.002 \pm 0.005 \quad (BLIND) \quad (\text{data set 2010, } P_t(\mu) > 3 \text{ GeV no prescaling})$$

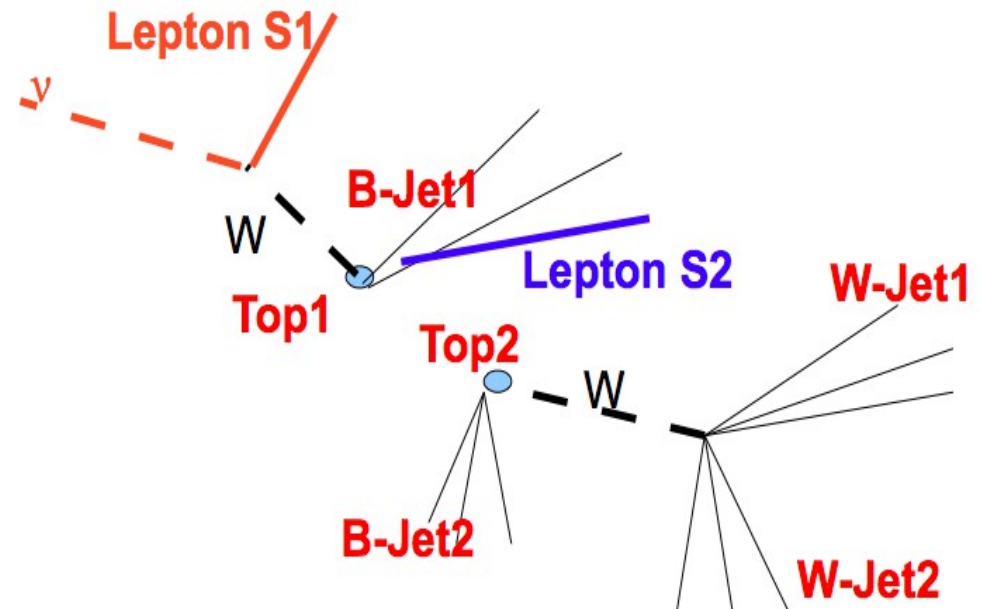
⊕ Issues: fit convergence, fit/data agreement, BKG composition

B Mixing and A_{SL} in $t\bar{t}$ events

Padova

- Semileptonic top decays: $t\bar{t}, t \rightarrow b\bar{\nu}, \bar{t} \rightarrow bX$
 - Lepton from top decay tags the flavor of both the B jets at the production time

- Test QCD factorization from comparison of $\chi(mt)$ with $\chi(mZ)$
- Expected statistical error $\delta\chi=0.003$ (0.002 adding electrons) on 2012 dataset
- Future test of A_{sl}



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