Feedback from Semileptonic, Leptonic, Tau&QED, IHPS AWGs

- Jochen Dingfelder
- SLAC, Sep. 30, 2005
Overview

(1) Some feedback on neutrals, tracking, PID issues and impact on physics analyses
(2) “Wish List” with general issues
(3) A few new tools we can offer

Thanks to all the AWG conveners and members that gave feedback!
Special thanks to Gregory Dubois-Felsmann, George Lafferty, Mike Kelsey, Vera Luth, David Côté, Thorsten Brandt, Kerstin Tackmann, Will Roethel, Wolfgang Menges, Art Snyder, Denis Bernard, Swagato Banerjee, …
Single photon efficiency error has large impact on inclusive event reconstruction:

E.g., it’s the largest single error contribution for (semilep.) analyses with neutrino reconstruction.
Also important for analyses in Leptonic and Tau AWGs.

Can we improve on this?

Here an example: $B \rightarrow \pi/\rho \, l \, \nu$ systematics

<table>
<thead>
<tr>
<th>$g^2$ Range (GeV$^2$)</th>
<th>( \delta B_{\pi} / B_{\pi} (%) )</th>
<th>( \delta B_{\rho} / B_{\rho} (%) )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0–5</td>
<td>5–10</td>
</tr>
<tr>
<td>Track Efficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photon Efficiency</td>
<td>6.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Photon Energy Resolution</td>
<td>5.5</td>
<td>5.7</td>
</tr>
<tr>
<td>Neutrino Reconstruction</td>
<td>1.0</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Neutrals: Single Photons and $\pi^0$
Neutrals: Single Photons and $\pi^0$

- Missing mass distribution for $B \rightarrow D^* \ell \nu$ sample:

  - w/o photon killing
  - with photon killing (1.8%)

  ![Missing Mass Distribution](image)

- Tau&QED AWG raised concerns about large $\pi^0$ efficiency error of 3%:
  - Example: PDG: $BF(\tau \rightarrow \pi^+ \pi^0 \nu)$ has 0.5% error
  - BaBar: superior statistics, but 3% syst. error from $\pi^0$
  - Even worse for $\tau$ decays with several $\pi^0$!

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Neutrals: $K^0_L$ Correction & Systematics

- **Currently used $K^0_L$ corr./syst.:** BAD 1055 (Runs 1-3, CM1):
  - $ccbar \rightarrow D^{*\pm} X$, $D^{*\pm} \rightarrow D^0 \pi^{\pm}$, $D^0 \rightarrow K^0_L \pi^+\pi^-$ and
  - $ccbar \rightarrow D^{*\pm} X$, $D^{*\pm} \rightarrow D^0 \pi^{\pm}$, $D^0 \rightarrow K^0_S \pi^+\pi^-$ control samples
  - $\varepsilon_{K0L\_DATA} = \varepsilon_{K0L\_MC} \times (70 \pm 20)\%$
  - $E_{K0L\_DATA} = E_{K0L\_MC} \times f(E)$

- **We need corrections for newer releases:**
  - **compute** $\varepsilon_{MC}/\varepsilon_{DATA}$ as function of $K^0_L$ momentum
  - **more reliable systematic errors estimation** (current error on efficiency correction is huge)!

- David Côté is pursuing this with Runs 1-4, 16-series release.
- **Goal would be to have generic $K^0_L$ corrections/systematics usable for everybody, similar to PID, tracking, etc.**
Neutrals: $K^0_s$ from Tau Decays

Special request from Tau&QED AWG:

For analysis $\tau \rightarrow K^0_s \pi^- \nu$, the standard $K_s$ list is not pure enough.

$\rightarrow$ tightening of cuts necessary
$\rightarrow$ to estimate systematics, more variables are needed in $K_s$ ntuples

$\rightarrow$ Can more variables be added to $K_s$ ntuples used by $K_s$ task force to create efficiency correction tables?
Tracking

Currently there are several track lists, which have to be supported:

- In addition to GTL, many people use ChargedTracks for e.g. for $K^0_s$'s (increase efficiency for long-lived particle reco.)
- Need tracking corrections, systematics for each list.
  PID only supports GTL.
- Clean-up cuts (ghosts, loopers,...) applied at analysis level

Suggestion:
- Create one new standard track list using new track definitions by D. Brown et al. that every analysis can use:
  - special treatment for low-PT tracks (e.g. needed for $D^* \rightarrow D\pi_s$)
  - include clean-up cuts in track definition
- Produce one consistent set of PID/tracking corr. tables for this list
PID / Neutrals / Tracking

**PID:** Lack of “official” systematic errors on PID selectors

- systematics are generally different for each case (depending e.g. on kinematic cuts), but it would be nice to at least get some official recipe or “guidance”
- some systematic estimates should be usable for everyone, e.g. provide up-to-date efficiency vs. multiplicity for electrons, ...

**Applying PID, neutrals, tracking corrections is harder than it should be!**

- the three types of corrections have different interfaces
- Documentation is differently organized and sometimes hard to find!
- Can’t we unify this and make is more user-friendly !?
List of General Issues

- **Submitting/Monitoring Jobs:**
  - Everyone writes own private tools to submit jobs
    Would be better to join effort to central tools instead!
  - Simple Job Manager (SJM) exists
    - submitting/bookkeeping/monitoring of ntuple/skim jobs
    - what is the status – when is it fully usable?
    - looking forward to talk by Will Roethel

- **Skimming of signal MC:**
  - control of which signal mode gets skimmed
  - documentation for analysts of how to run own skims over other modes and get same results as prod. skim

- **Bug fixes for releases:**
  - Easy way to become aware of availability of bug fixes
  - Tool to be used in test release that checks if all recommended bug fix tags are checked out and built?
New tools we can offer!
Form-factor reweighting of semileptonic B decays is important for all analyses requiring a lepton (as signal or background). **XslFFReweighting** → standard tool to do so.

It can:
- **Reweight** B to pseudo-scalar and B to vector meson SL decays
- Use standard $f^+(q^2)$, $A_1(q^2)$, $A_2(q^2)$, $V(q^2)$ param. (e.g. $B \to \pi/\rho \ell \nu$)
- Use HQET R1, R2, rho2 “linear” parametrization for $B \to D^*\ell \nu$

Also, it is:
- Easy to use within the BaBar Framework or standalone
- Easy to implement new form-factor models
- Documented in **BAD 809** and hep-ex/0409046 (Eur.Phys.J.C)

**XslFFReweighting** is part of analysis-24. **V00-03-05** includes BaBar’s latest $B \to \pi\ell \nu$ & $B \to D^*\ell \nu$ FF measurements.

by David Côté
XslFFReweighting

Code’s nice’neasy-to-use object oriented structure

<table>
<thead>
<tr>
<th>“interface”</th>
<th>XSELevtFFWeight</th>
</tr>
</thead>
<tbody>
<tr>
<td>FromFLATQ2ToThisModel()</td>
<td></td>
</tr>
<tr>
<td>FromPHSPToThisModel()</td>
<td></td>
</tr>
<tr>
<td>FromISGW2ToThisModel()</td>
<td></td>
</tr>
<tr>
<td>FromSP4ToThisModel()</td>
<td></td>
</tr>
<tr>
<td>FromSP5ToThisModel()</td>
<td></td>
</tr>
<tr>
<td>FromSP6ToThisModel()</td>
<td></td>
</tr>
</tbody>
</table>

XSLPseudoScalarFF

XSLPseudoScalarISGW2

XSLBall04

XSLFnal04

XSLVectorFF

XSLVectorISGW2

XSLBall05

XSLDstarToDstarlnuFF

XSLDstarToDpi_LinearParam

XSLDstarToDgam_LinearParam

9/30/2005

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XslFFReweighting/XSLKin is another very useful class providing $q^2$, $\theta_l$, $\theta_V$, $\chi$ given the $B$, $D^*$, $l$ and $D^0$ HepLorentzVector in LAB frame.
Unfolding Tool(s)

- Package: RooUnfHistoSvd
- Tool to unfold 1D spectra from e.g. acceptance or resolution effects
- Can be compiled as shared library and loaded into ROOT
- Method uses singular value decomposition of the detector response matrix provided as 2d histogram
- Covariance matrix of unfolded spectrum can be determined using toys

→ Tim Adye has been working on a ROOT framework to allow usage of different unfolding methods with consistent interface. Includes also unfolding of 2D histograms (see talk at Dec04 CM).
γ → e⁺ e⁻ Finder in CompositionSequences

Swagato Banerjee studied γ → e⁺e⁻ conversions in events e⁺e⁻ → μ⁺μ⁻ γ

→ New conversion finder with higher purity than default:

<table>
<thead>
<tr>
<th></th>
<th>Efficiency</th>
<th>Purity</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Conversion finder</td>
<td>96.6%</td>
<td>87.5%</td>
</tr>
<tr>
<td>GammaToEE_Default</td>
<td>99.7%</td>
<td>77.4%</td>
</tr>
</tbody>
</table>

see Talk at:

→ implementation in SimpleComposition ?

Speaking of SimpleComposition: there is a question about making new variables available in SimpleComposition (e.g. total PT of event, Dalitz mass² for 3-body decays, …)

→ general call for input with a HN forum ?
Extension of Barlow Fit in ROOT

**TFractionFitter** = ROOT implementation of Barlow&Beeston binned max.-likelihood fit

**Added feature:**
Weight histogram that is used to weight each histogram entering the fit can be parameter-dependent.  
→ allows us to fit not only relative proportions of each type of distribution, but to adjust the shapes of the component distributions for different parameters.  
→ new class “TBinWeighter” should be added to ROOT.

Hope all this feedback is useful!