BnoC Status Report

Tim Williams on behalf of the BnoC PWG

84th LHCb week

13/06/2017

UNIVERSITY OF
BIRMINGHAM

PWG Organisation

- WG Convenors: **Stefano Perazzini, Sean Benson**
- Sub-WG Convenors:
  - 3 Body: **Rafael Coutinho, Eli Ben-Haim**
  - 2 & 4 Body: **Roberta Cardinale, Laurence Carson**
- Regular BiWeekly Meetings: **Thursdays 2PM**

Link to BnoC Twiki Page

PWG Liaisons

Current Liaisons

- Simulation: **Maria Vieites Diaz**
- Stripping: **Alvaro Gomes Dos Santos Neto**
- Trigger: **Andrea Merli**
- Tracking: **Gediminas Sarpis**
- Flavour Tagging: **Julian Garcia**
- PID: **Abhijit Mathiad**
- Calo Tools: **Jason Andrews**
- Statistics and ML Tools:**Timon Schmelzer**

Thanks for all your work!

BnoC Physics Case

- Study decays of b-hadrons to charmless hadronic final states:
  - $b \to u$ tree level decays
  - $b \to s, d$ penguin decays
- Measurements of branching fractions and CPV observables provide tests of standard model and searches for new physics
- **2 & 4 Body Examples:** Searches for $B \to baryon$ decays, Angular analysis of $B \to VV$ decays, time (in)dependent CPV
- **3 Body Examples:** Dalitz analyses and CPV observables, Bc decays, searches for unobserved decays

BnoC Activities

- **Currently in review:** 6 Analyses in WG review, 7 with review committee & 1 in collaboration wide review
- **Since last LHCb week:**
  - 2 Papers Published:
    - 4.1σ evidence for the decay $B^+ \to p\overline{\Lambda}$ (LHCb-PAPER-2016-048)
    - Upper limit on $\mathcal{B}(B_s^0 \to \phi\eta') < 0.82 \times 10^{-6}$ at 90% CL. (LHCB-PAPER-2016-060)
  - 2 Papers Submitted:
    - First observation of a baryonic B_s^0 decay (LHCB-PAPER-2017-012)
    - Observation of the charmless baryonic decays $B_{(s)}^0 \to p\overline{p}h^+h^-$ (LHCb-PAPER-2017-005)
- 32 Analyses in preperation - only able to present a few today.
- Details of all past and present analyses can be found in the WG database

$B^0_{(s)} \to p\overline{p}$ Update

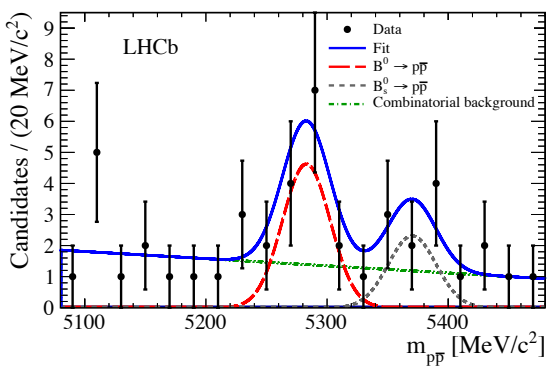
$B^0_{(s)} \to p\bar{p}$ Motivation and Status

Motivation

- No baryonic 2 body charmless B^0 decay has been observed.
- $B^0_{(s)} \to p\bar{p}$ decays predicted to be simplest to search for experimentally

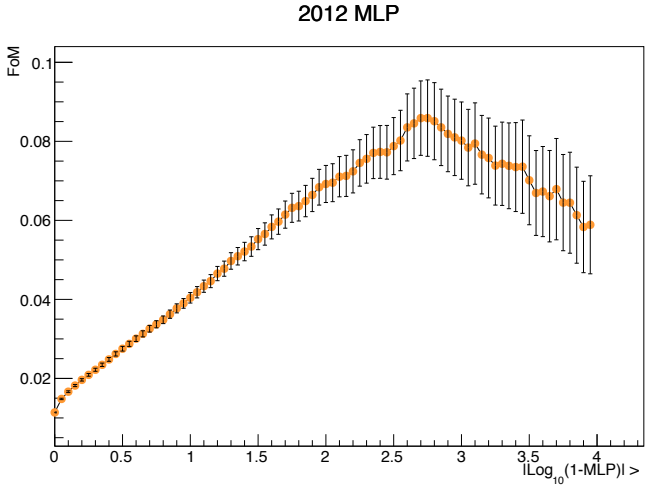
- Previous analysis using 2011 data saw 3.3σ evidence for $B^0 \to p\bar{p}$ but no evidence for the suppressed $B^0_s \to p\bar{p}$ seen.
- Hopefully addition of 2012 data can lead to an observation.

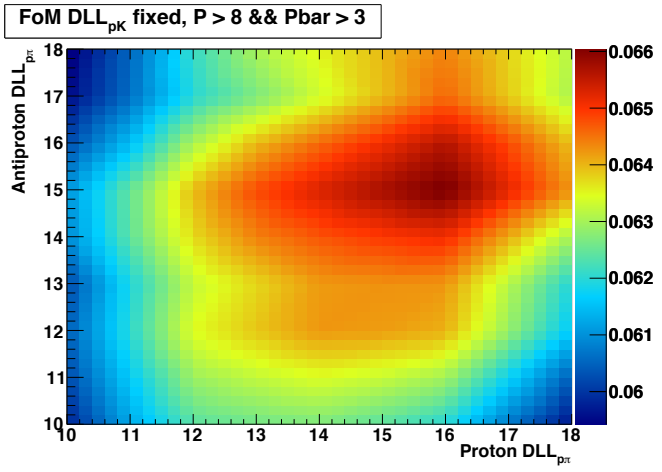
- Branching fraction results using 2011 data:
  $\mathcal{B}(B^0 \to p\bar{p}) = (1.47^{+0.62+0.35}_{-0.51-0.14}) \times 10^{-8}$
  $\mathcal{B}(B^0_s \to p\bar{p}) = (2.84^{+2.03+0.85}_{-1.68-0.18}) \times 10^{-8}$
- All previous theory calculations ruled out by at least 1 order of magnitude!



Selection

- PID Selection optimises $\mathrm{DLL}_{p\pi}$ and DLL_{pK} cuts for Punzi FoM with $a = 5\sigma$
- MVA selection (applied after PID selection) makes use of MLP with 10 variables, again optimised for Punzi FoM.

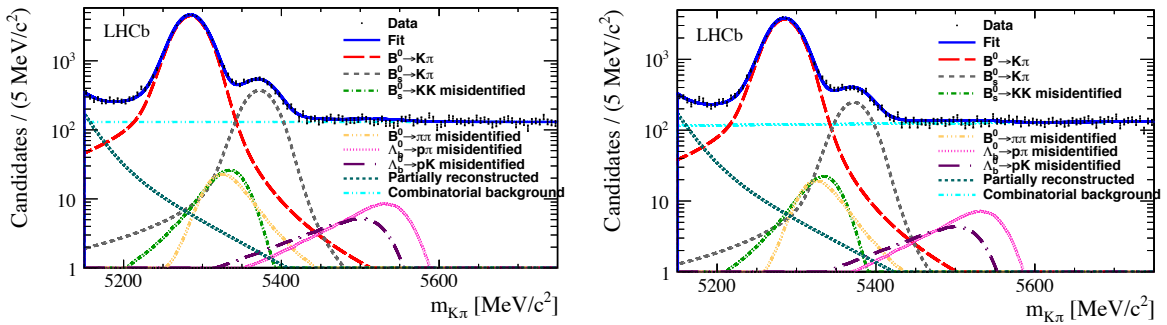




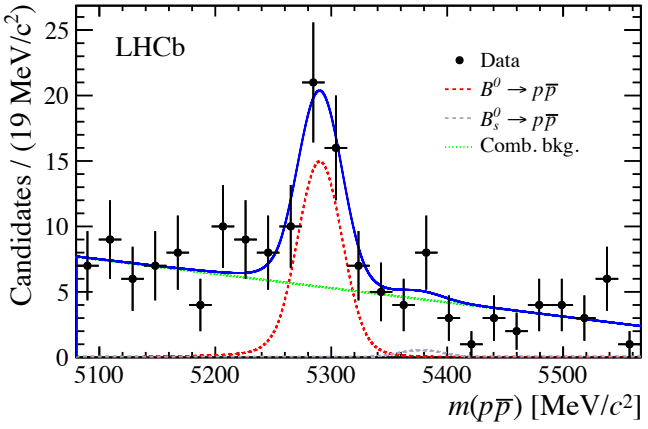
- Normalisation channel, $B^0 \to K^+\pi^-$, PID selection optimised for maximum selection efficiency whilst rejecting various mis-ID backgrounds.
- Similar MLP also used in normalisation channel, but optimised for signal significance.

Fits

- **Normalisation channel:** Mass fit seperated by charge due to known production assymmetries

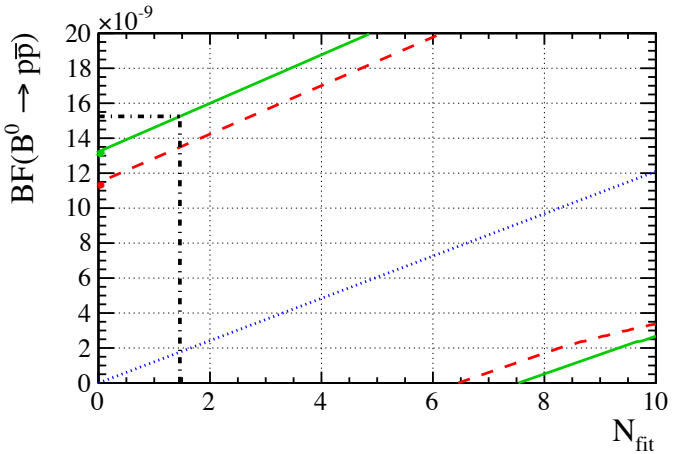


- **Signal channel:** Only signal and combinatorial background present - $38.7 \pm 8.4(\mathit{statonly})$ $B^0 \to p\overline{p}$ decays observed!



Results and Outlook

- First obeservation of $B^0 \to p\bar{p}$ with significance of 5.3σ -first obseration of 2 body charmless baryonic B^0 decay!
- $\mathcal{B}(B^0 \to p\bar{p}) = (1.25 \pm 0.27 \pm 0.18) \times 10^{-8}$.
- $B_s^0 \to p\bar{p}$ yield of only 1.5 ± 4.4 events, limit set using Feldman-Cousins method.



- $\mathcal{B}(B_s^0 \to p\bar{p}) < 1.5 \times 10^{-8}$ at 90% confidence level.
- Analysis close to publication, paper currently in collaboration wide review.

Backup

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