Selection studies for prompt $D \to h^+ h'^-$ events
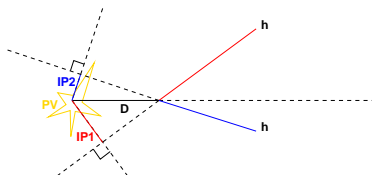
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Flavour WG,
CERN, 24 September 2008

Selection studies for prompt $D \to h^+ h'^-$ events

- ▶ Motivation
- ▶ Selection studies
- ▶ Conclusion

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Physics opportunities

- ▶ CP violation in decays of $D \to KK/\pi\pi$
- ▶ D-Mixing using DCS $D \to K^+\pi^-$
- ▶ (CP violation in) D-mixing via lifetime ratio
- ▶ D lifetime itself

At Glasgow focus on lifetime measurements
Complemetary to Oxford activities

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Starting points

- ▶ Selection for $B_{(s)} \rightarrow h^+h'^-$ events
- ▶ Selection $D^* \rightarrow D(hh)\pi$ events presented by Philip
- ▶ Aim on selection for prompt $D \rightarrow h^+h'^-$ events as a starting point
  $\Rightarrow$ can also select D not from D^*
  $\Rightarrow$ can add D^* specific part if tagging is required
- ▶ Here: study only $D^0 \rightarrow K^-\pi^+$ events

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The selection

Start with Philip's generic $D \rightarrow h^+ h'^-$ part

- $p_T(D^0) > 1500$
- $\chi^2(D^0 \, vertex) < 10$
- $FD/FDERR(D^0) > 4$
- $p(h) > 5000$
- $p_T(h) > 500$
- $PIDK(K) > 8$
- $PIDK(\pi) < -8$

Additional cuts

- $\cos(\theta) > 0.99993$
- $IP/IPERR(D^0) < 3$
- $IP/IPERR(h) > 4$

Not yet applied

- Vertex isolation cut

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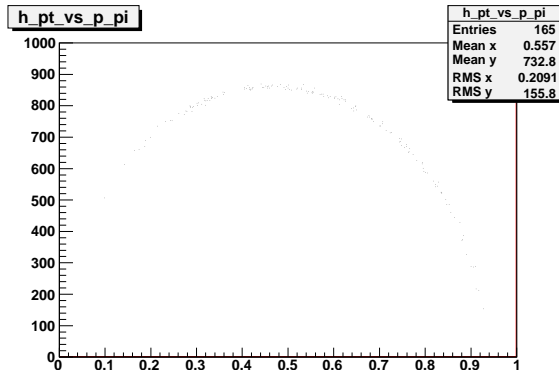
Armenteros-Podolanski?

A possible additional cut

- ▶ Armenteros-Podolanski:
  $$p_T^a = \sqrt{-M^2 x^{a2} + (M^2 + m^{a2} - m^{b2})x^a - m^{a2}}$$
  $$x^a = p_L^a/(p_L^a + p_L^b)$$
- ▶ Does it really help?

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Armenteros-Podolanski II

▶ Does it really help?

▶ No, cut implicitly done via tight mass cut.
▶ In return, applying AP means rejecting sidebands

Numbers

Where does this get us

- ▶ Run on L0-stripped minimum bias
- ▶ Used 1'758'242 events
- ▶ Evaluate numbers in tight mass window ($\pm$15 MeV)
- ▶ Selected candidates: 87
- ▶ Breakdown in background categories:

category	0	≥ 100
candidates	86	1

- ▶ $S/B = 86$
- ▶ Expected rate after L0 + selection (assuming 1MHz L0): signal: 48.9 Hz, total: 49.5 Hz
- ▶ Plus factor 2 from anti-*D*

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The mass peak

- ▶ Full selection with ± 250 MeV mass window
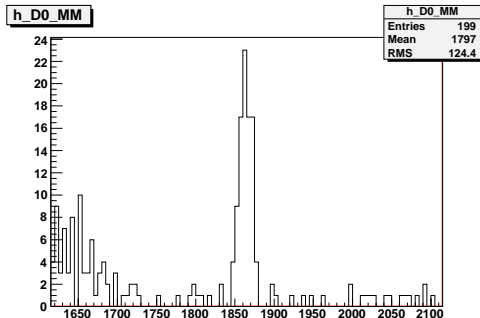
- ▶ Total yield in wide mass window: 199 candidates

category	0	40	50	60	70	80	≥ 100
candidates	92	23	52	16	1	9	6

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ToDo List

- ▶ Implement LoKi-based DV selection
- ▶ Check performance on other $D \to h^+ h'^-$ channels
- ▶ Run on all available data
- ▶ Check promptness
- ▶ Optimise cuts
- ▶ Use selected $D \to h^+ h'^-$ data in lifetime studies

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Conclusion

- ▶ Selection for prompt $D \to h^+ h'^-$ complete
- ▶ Expected signal rate for $D^0 \to K^- \pi^+ \approx 50$ Hz
- ▶ Plan first lifetime measurement in $D \to h^+ h'^-$

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- ▶ Numbers for 5 pb^{-1}:
  $D \rightarrow K^- \pi^+$ 125k, (BR 3.80%)
  $D \rightarrow K^- K^+$ 13k, (BR 0.38%)
  $D \rightarrow \pi^- \pi^+$ 5k, (BR 0.14%)
  $D \rightarrow K^+ \pi^-$ 0.5k, (BR 0.01%)
- ▶ Expect up to 0.5k events in any given $B \rightarrow Dh$ channel
- ▶ Critically depends on VELO

<div style="text-align:right">University of Glasgow</div>