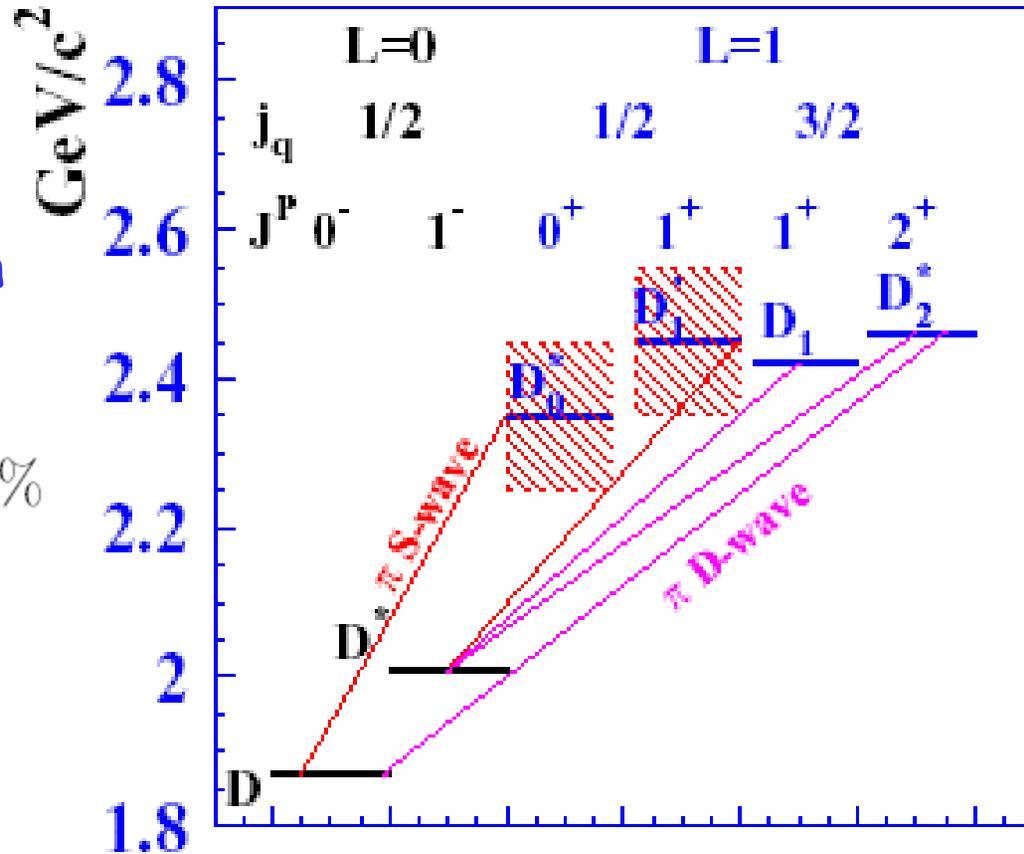




D**

Andrei Nomerotski, Fermilab,
11/20/2003

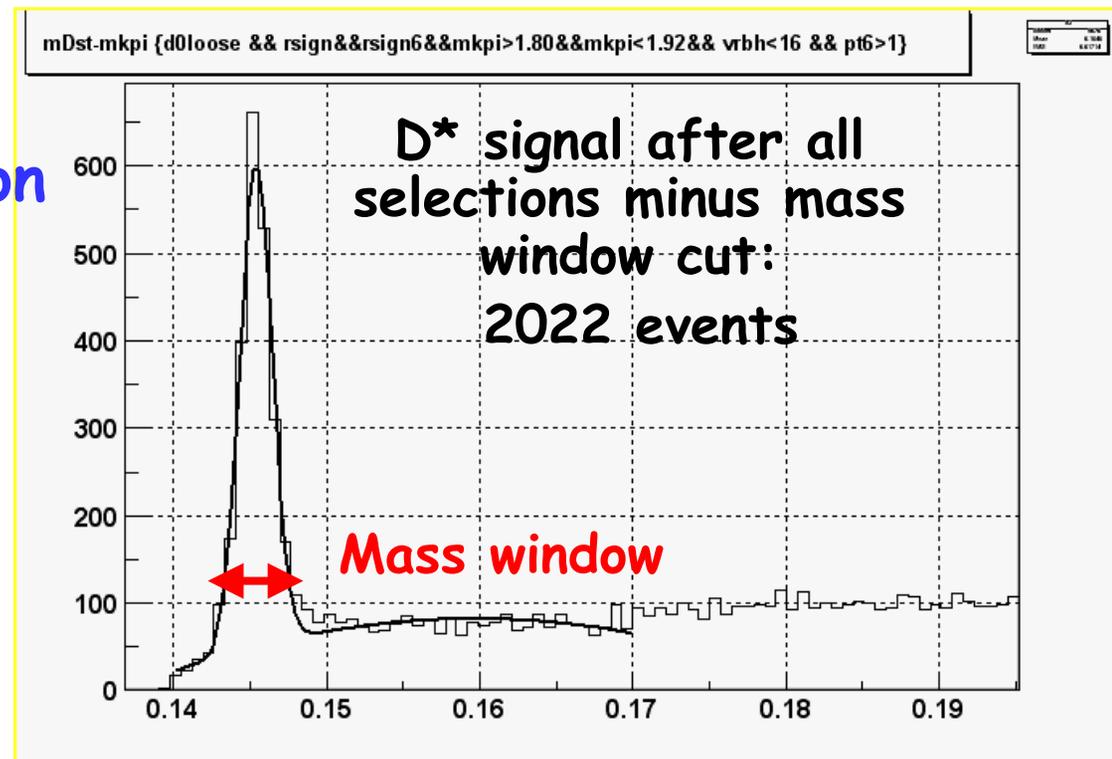
- D** denotes 4 different states, see diagram
 - ◆ Two broad states
 - ◆ Two narrow states
- QCD sum rules predict dominance of narrow states in B to D** production
- Measured $\mathcal{B}(B \rightarrow D^{(*)}\pi l^{-}\bar{\nu}) = (2.6 \pm 0.5)\%$ is not saturated by narrow states contributions (~0.86%)
 - ◆ => Large contribution of broad states
- Recent attention from BELLE, BaBar (ex.hep-ex/0307021 D^{(*)}\pi\pi states etc.)





D** in data

- Used skimmed B \rightarrow mu D* sample from lifetime ratio and B_d oscillation analyses by G. Borissov, S. Burdin & AN
 - ◆ P14 data, 47 pb⁻¹
- Required additional pion
 - ◆ Pt > 1 GeV, same jet
 - ◆ right sign correlation
 - ◆ best B vertex fit, mild vertex χ^2 cut

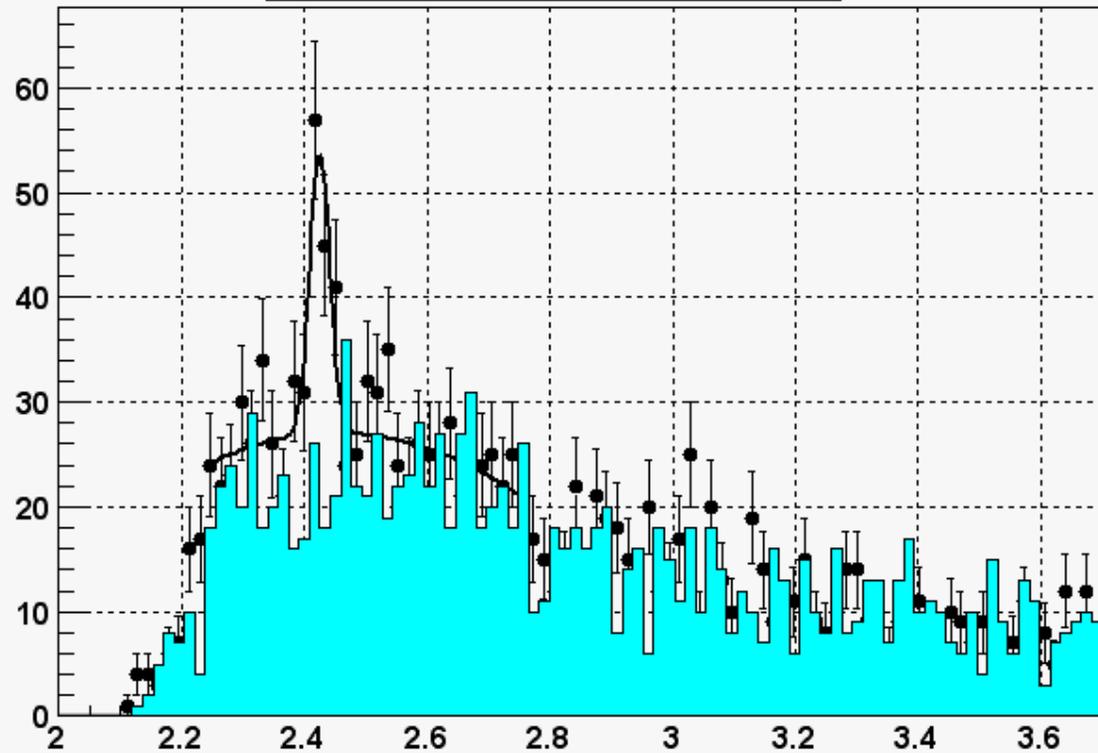




D** in data

- See $B \rightarrow D^{**} \mu$ signal
 - ◆ 65±15 events
 - ◆ Mass 2425±4 MeV
 - ◆ Sigma 16±4 MeV
 - ▲ Better than expected?
 - ▲ Natural width 19 MeV
 - ◆ No signal for wrong sign combination
- Narrow D**
 - ◆ $D_1^0(2420) \rightarrow D^{*+} \pi^-$
 - ◆ $D_2^{*0}(2460) \rightarrow D^{*+} \pi^-$

D* pi invariant mass



$$\mathcal{B}(B^- \rightarrow D_1^0 \pi^-) \times \mathcal{B}(D_1^0 \rightarrow D^{*+} \pi^-) = (7.8 \pm 1.9) \times 10^{-4},$$

$$\mathcal{B}(B^- \rightarrow D_2^{*0} \pi^-) \times \mathcal{B}(D_2^{*0} \rightarrow D^{*+} \pi^-) = (4.2 \pm 1.7) \times 10^{-4}.$$

- ◆ Ratio = 1.9 (QQ predicts 4.8)
- ◆ Two states will merge for current mass resolution

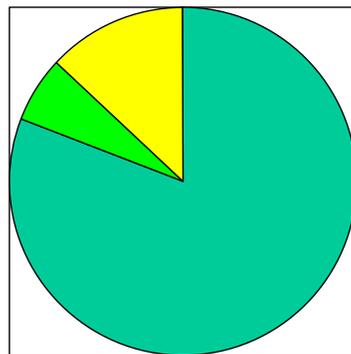
- Expected yield : 46±10 events

- ◆ Normalized to 2022 D* events
- ◆ Assumes 100% eff for pion but no contribution from $D^* \pi \pi$
- ◆ Consistent with data

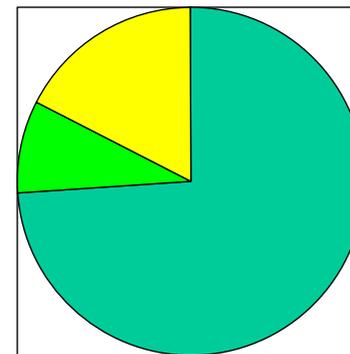
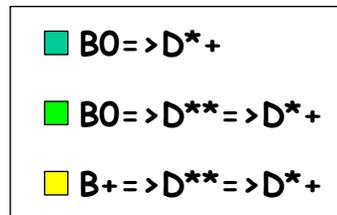


D** in lifetime ratio analysis

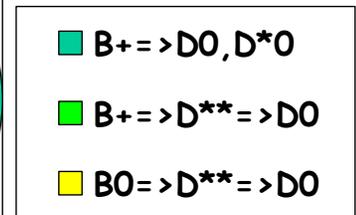
- D** is important background for B⁺/B⁰ lifetime ratio analysis (see GB talk on 9/11/03)
 - ◆ Analysis relies on the fact that
 - ▲ D⁰ sample is mostly coming from B⁺
 - ▲ D** sample is mostly coming from B⁰
 - ◆ Some (not all !) D** contributions change sign of B
 - ◆ D, D*, D** have different k-factors
- D* and D⁰ sample composition
 - ◆ Input for the lifetime ratio fit
 - ◆ QQ generator level



D* sample



D⁰ sample





D** in lifetime ratio analysis

- Next steps for the sample composition issue:
 - ◆ Plug in current PDG measurements for D**
 - ▲ Some Br in QQ decay tables are out of date
 - ◆ Do same for reconstructed MC events
 - ▲ Estimate efficiencies
- Use own measurements of D** (like shown)
 - ◆ Advantage : same analysis selections
- Possible improvement : look for additional charged pions to keep track of charge of B and decrease the exchange between B+ and B0 samples though D** : will increase purity of the samples