The Study of Excited B-mesons at the D0 Detector.

Matt Doidge

msdoidge@fnal.gov

Lancaster University

What is the B^{**}?

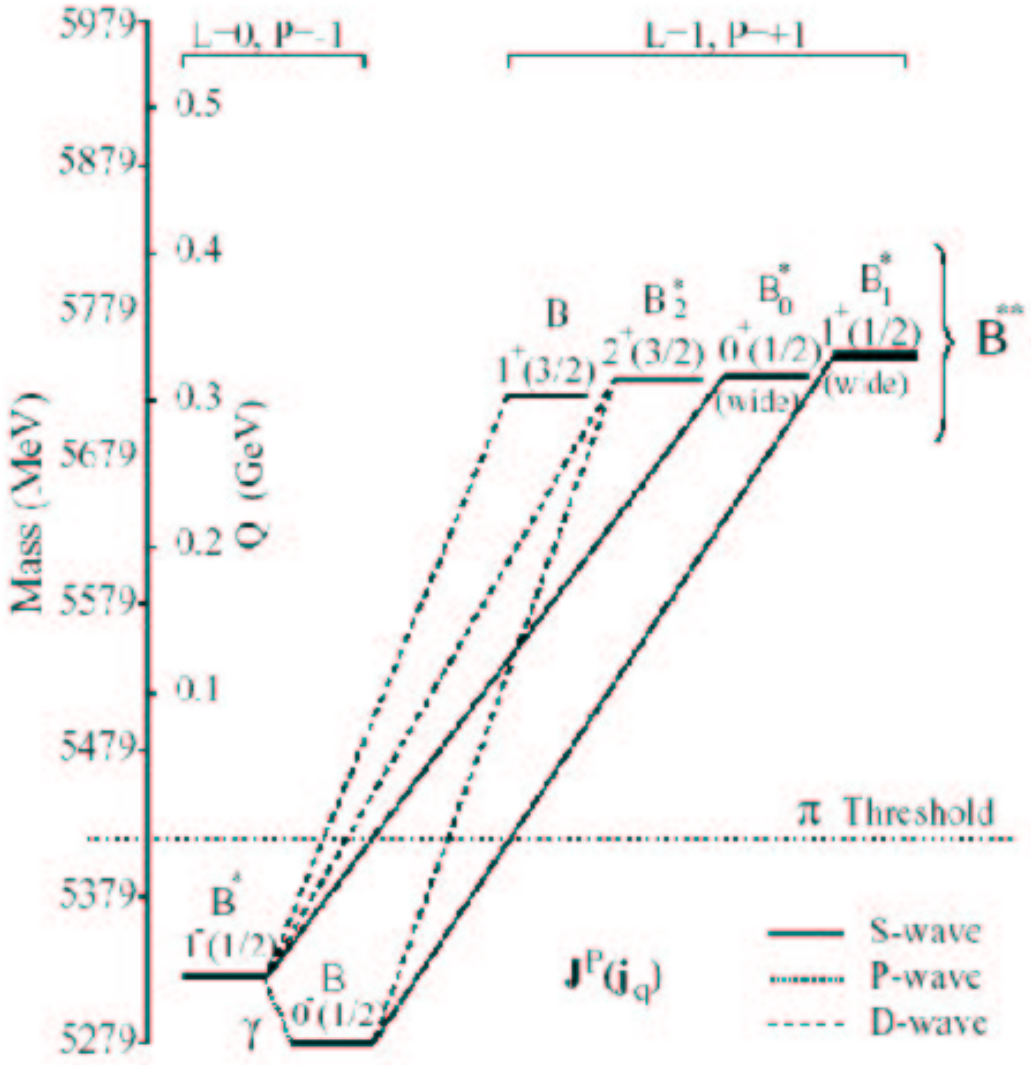
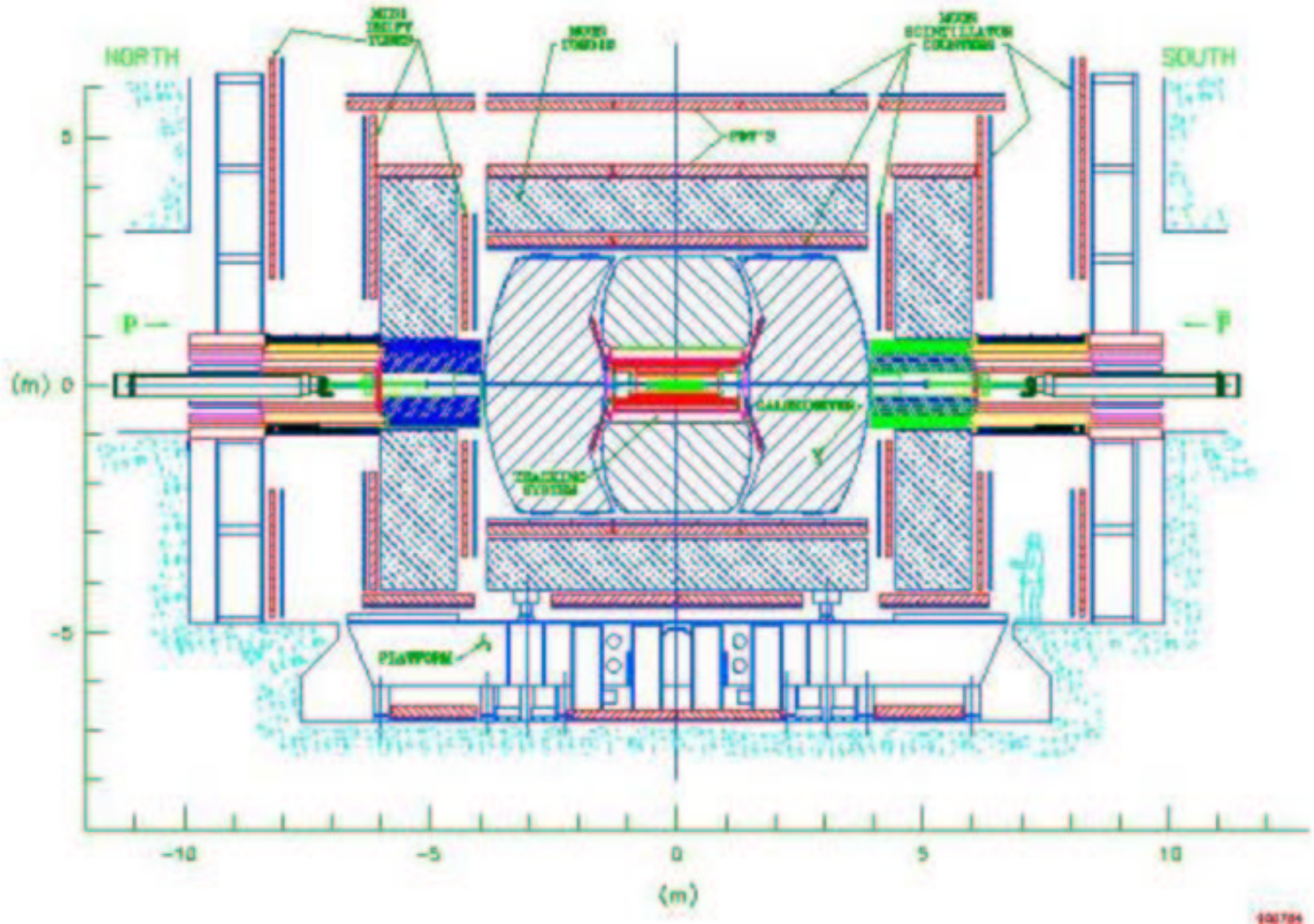


FIG. 1. Predicted spectrum and dominant decays of the low-lying B meson states.

Why study it at D0??

- Because studying it provides an important test of Heavy Quark Symmetry.
- The large B cross-section at the Tevatron allows for a precise measurement with good statistics.
- The B^{**} is currently languishing in the back of the PDG, with many properties unmeasured or not well known.

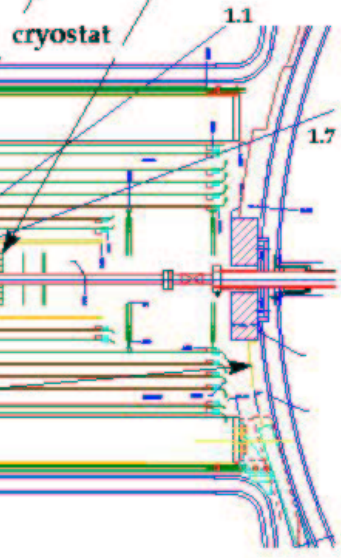
The D0 detector.



Tracking at D0.

The D0 Upgrade - Tracking

- **Silicon Tracker**
  - Four layer barrels (double/single sided)
  - Interspersed double sided disks
  - 840,00 channels
- **Fiber Tracker**
  - Eight layers sci-fi ribbon doublets (z-u-v, or z
  - 74,000 830um fibers w/ VLPC readout
- **Central Preshower**
  - Scintillator strips, WLS fiber readout
  - 6,000 channels
- **Solenoid**
  - 2T superconducting
- **Forward Preshower**
  - Scintillator strips, stereo, WLS readout
  - 16,000 channels

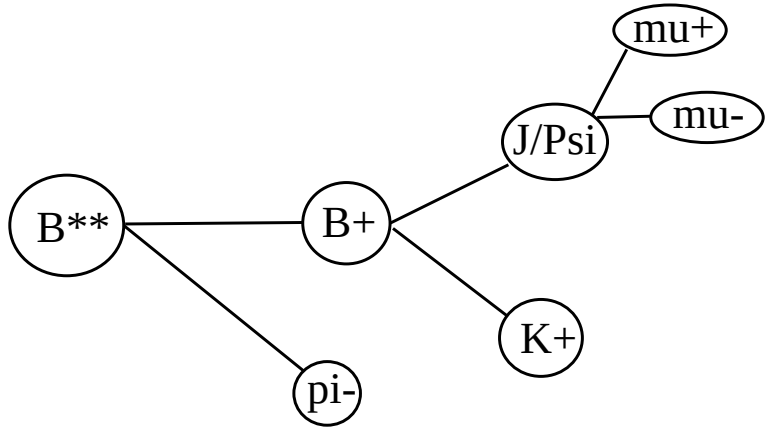


The data.

- The analysis was done using di-muon events corresponding to approx. 230 pb^{-1} of data.
- We use only tracks and muon information.
- Fully reconstructable B-decays we used to make our measurement as precise as possible.

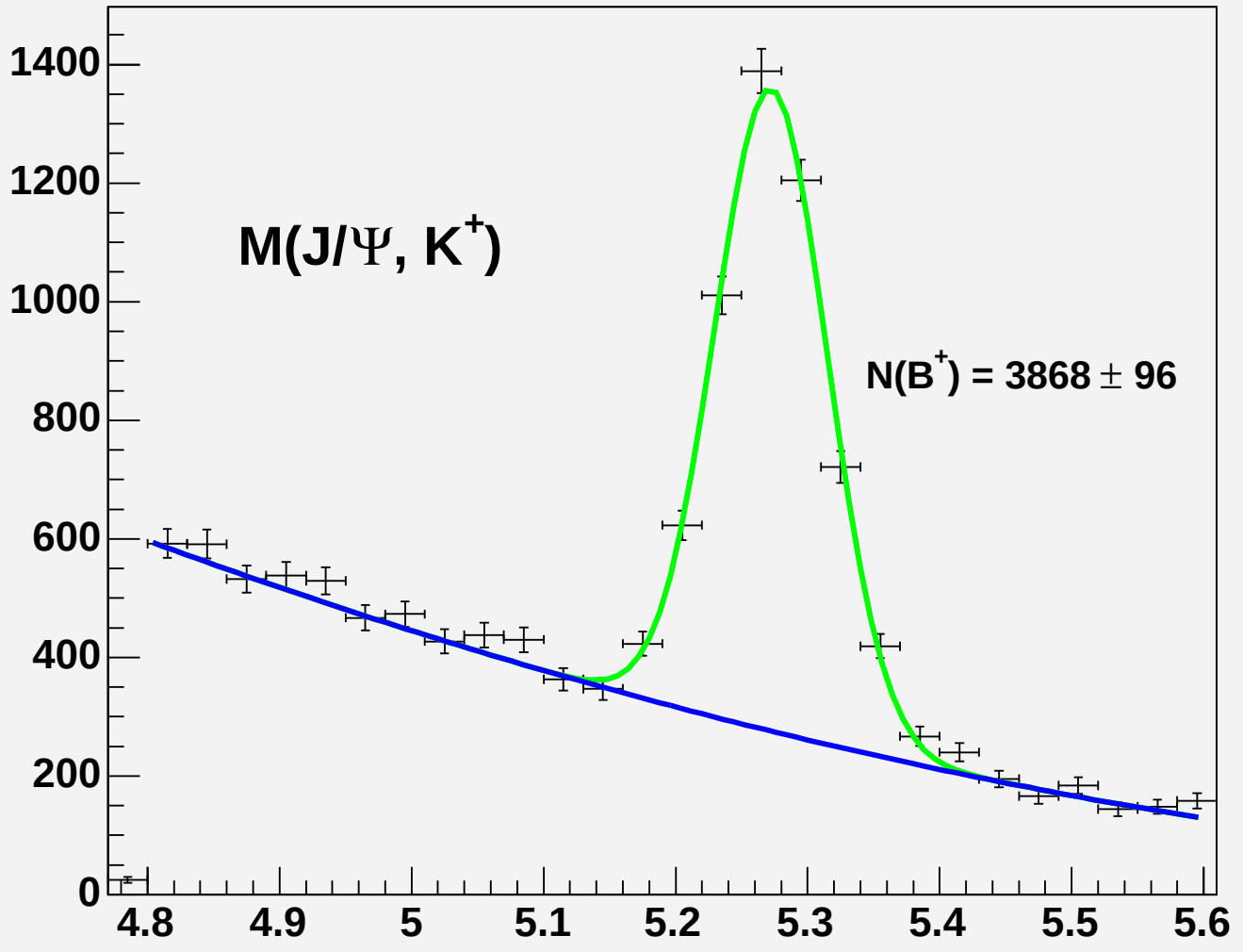
The first channel: $B \to J/\Psi, K^+$

- Originally we started with studying the decay $B_d^{**} \to B^+, \pi^-$.



- The main advantage of this decay is that we can select 'right sign' charge combinations of the 'π_{**}', this removes a sizeble proportion of the combinatoric background.

B^+ Mass Plot


M(J/Ψ, K+)
N(B+) = 3868 ± 96
1400
1200
1000
800
600
400
200
0
4.8
4.9
5
5.1
5.2
5.3
5.4
5.5
5.6

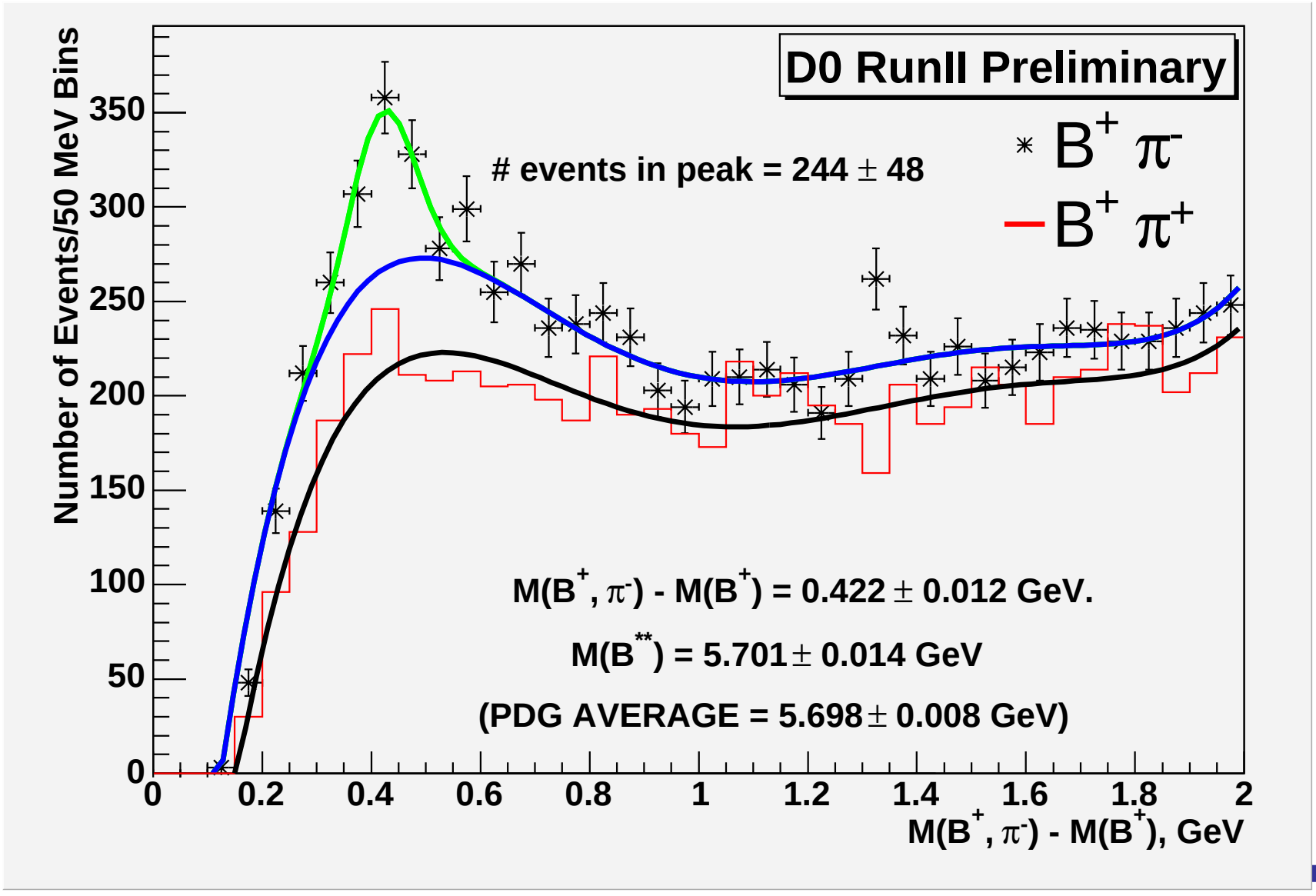
To construct a B^{**}

- To build the B^{**} we find a ‘good’ B-meson.
- We take this B-meson and associate a track from the same Primary Vertex to it- this is our pion candidate.
- If the pion passes kinematic selections we construct a particle from the system.
- To reduce uncertainties results are presented in the form $M(B^+, \pi^-) - M(B^+)$.

The kinematic selections

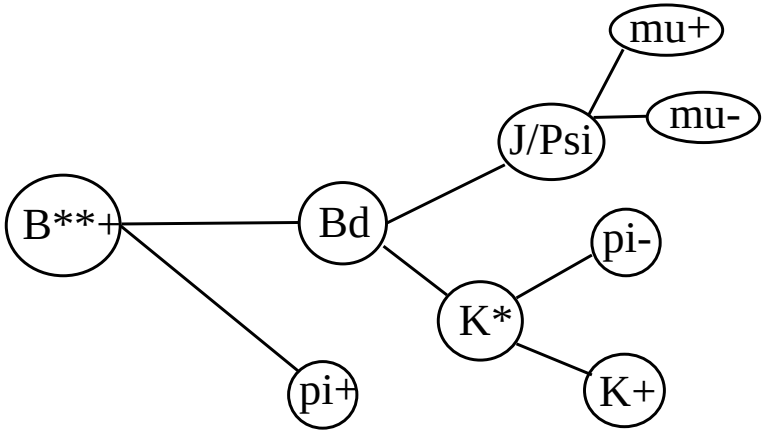
- The pion candidate is required to have:
- P_T > 0.7 GeV.
- # of hits within the Silicon Vertexing Tracker ≥ 2.
- 'χ^2_{VRT}' < 16.

$M(B^+,\pi^-) - M(B^+)$ Plot.

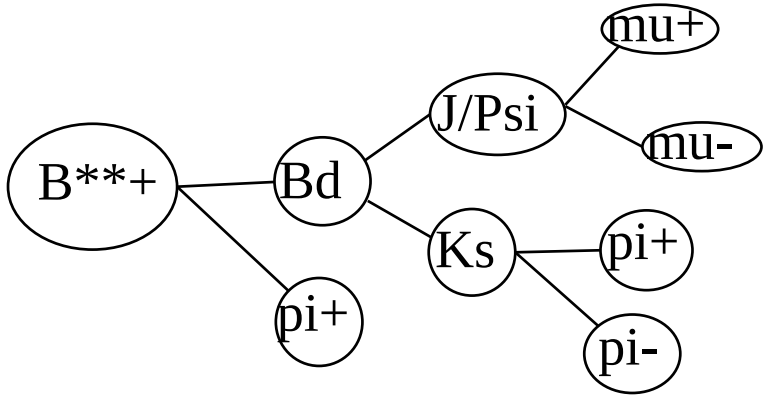

D0 RunII Preliminary
* B+ π-
– B+ π+
events in peak = 244 ± 48
M(B+, π-) - M(B+) = 0.422 ± 0.012 GeV.
M(B**) = 5.701 ± 0.014 GeV
(PDG AVERAGE = 5.698 ± 0.008 GeV)
Number of Events/50 MeV Bins
M(B+, π-) - M(B+), GeV
0
50
100
150
200
250
300
350
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2

Additional Channels.

- We included the decays to increase our statistics: $B^{**+} \to B_d, \pi^+; B_d \to J/\Psi, K^*; K^* \to K^+, \pi^-$ **AND** $B_d \to J/\Psi, K_S; K_S \to \pi^+, \pi^-$.

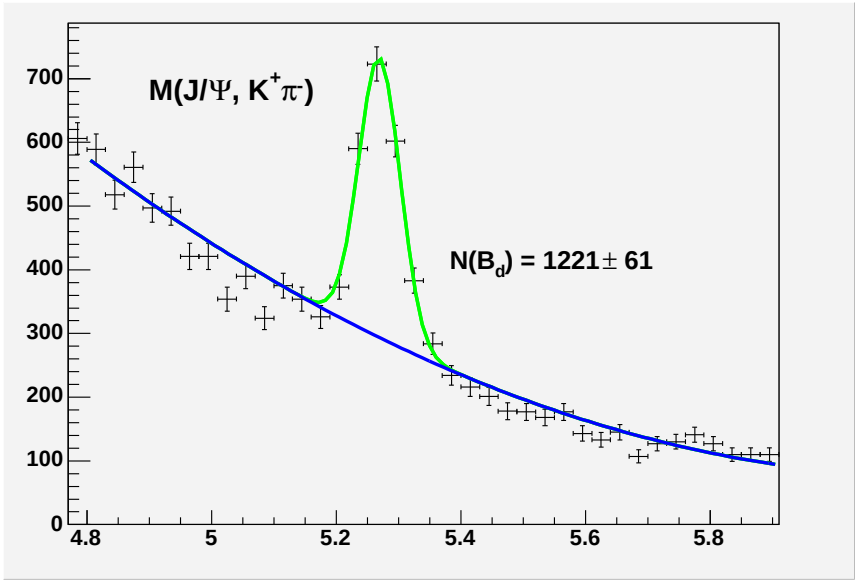


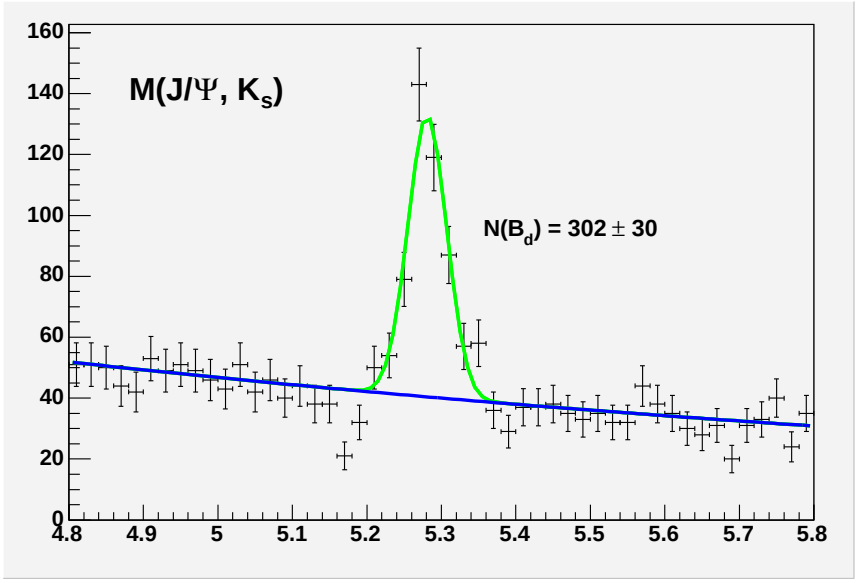
AND



- The problem with these decays is there is no ‘right charge’ selection.

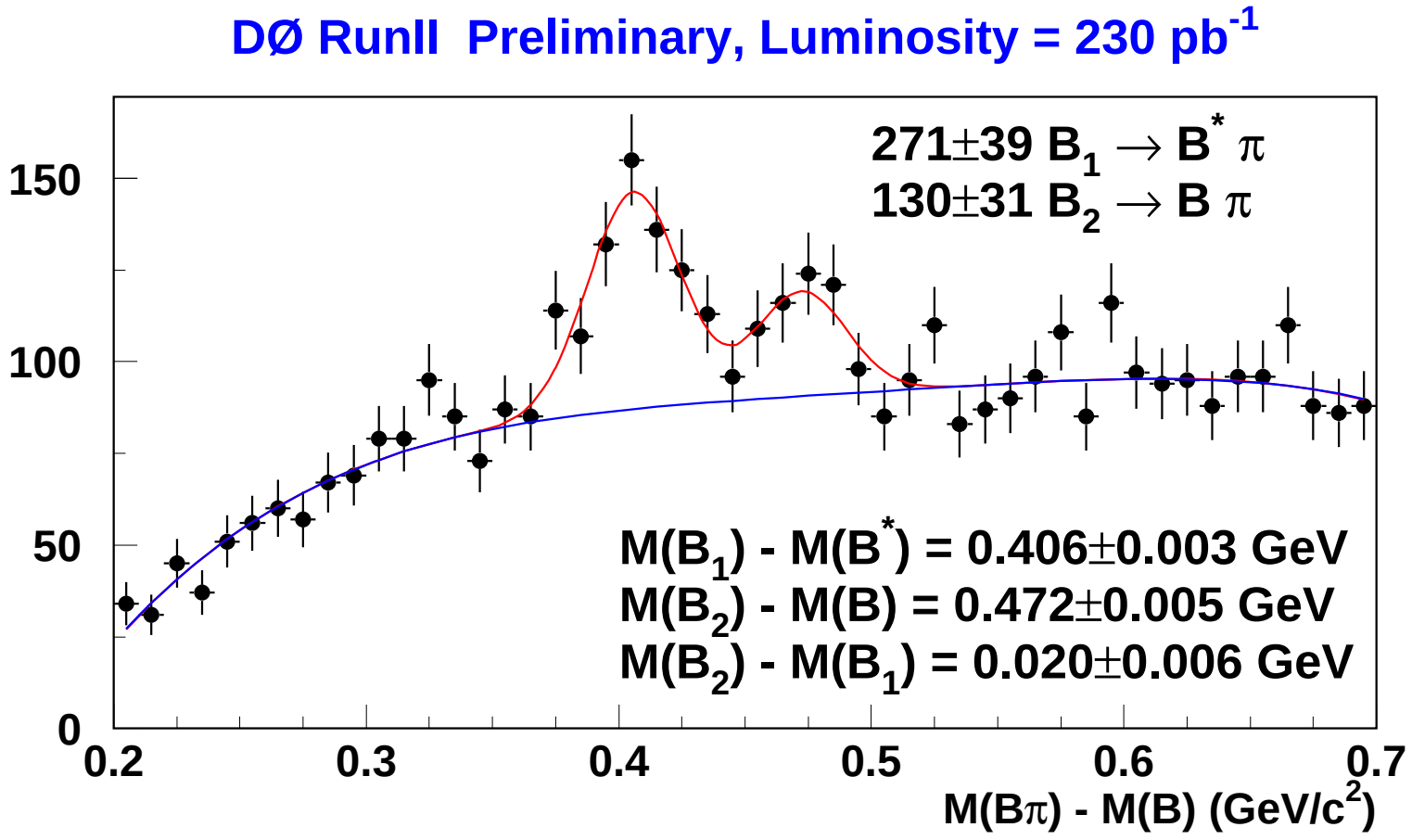
B_d Mass Plots.





- The addition of these channels increase our statistics by nearly 50%.

With the addition of more statistics...



In Summary.

- A study of our efficiency yielded a value of $\frac{b\to B^{**}}{b\to B^{+}} = 0.354 \pm 0.105$.
- Our statistics are now high enough that we can resolve the narrow B^{**} states.
- We obtained a new measurement of $M(B_d^{**}) = 5.701 \pm 0.014$ GeV. (PDG AVERAGE$= 5.698 \pm 0.008$ GeV.
- Systematic errors are still being studied.