Pre-Bless Update on **New Charm Searches**

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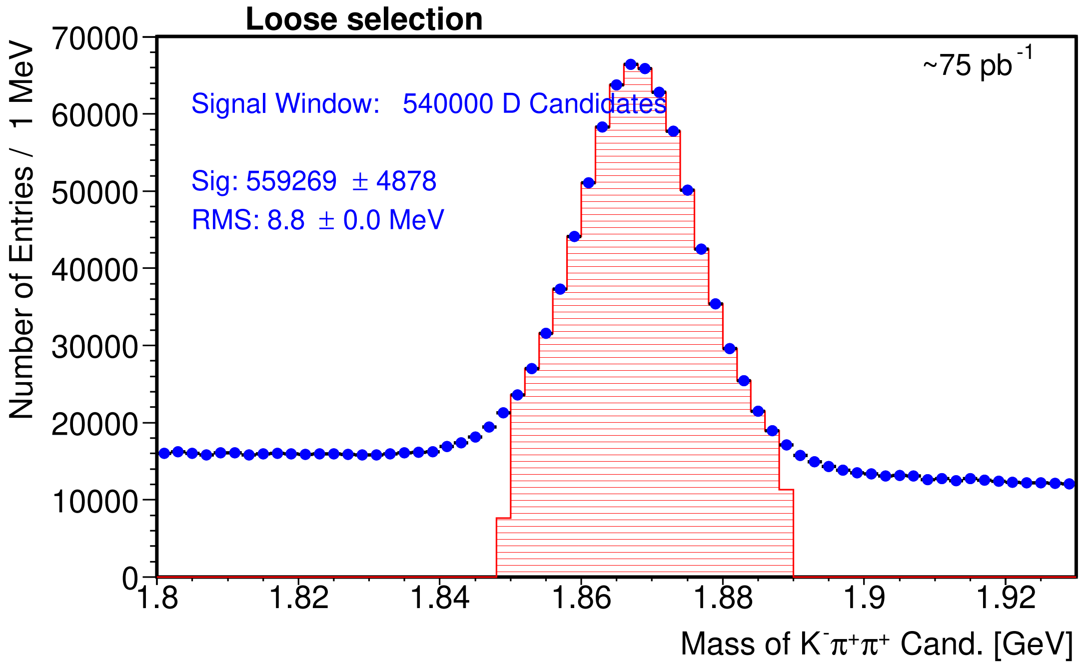
May 27, 2003

- **Review of PreBlessing Cuts/Selection**
- **Mass Differences**
- **Comments on Displacement Cuts**
- **An Exploration of Cuts**
- **New $D^+\pi^-$ & $D^0\pi^+$ Plots**
- **. . . Other Late Night Developements. . .**

D^+ Selection—No Changes

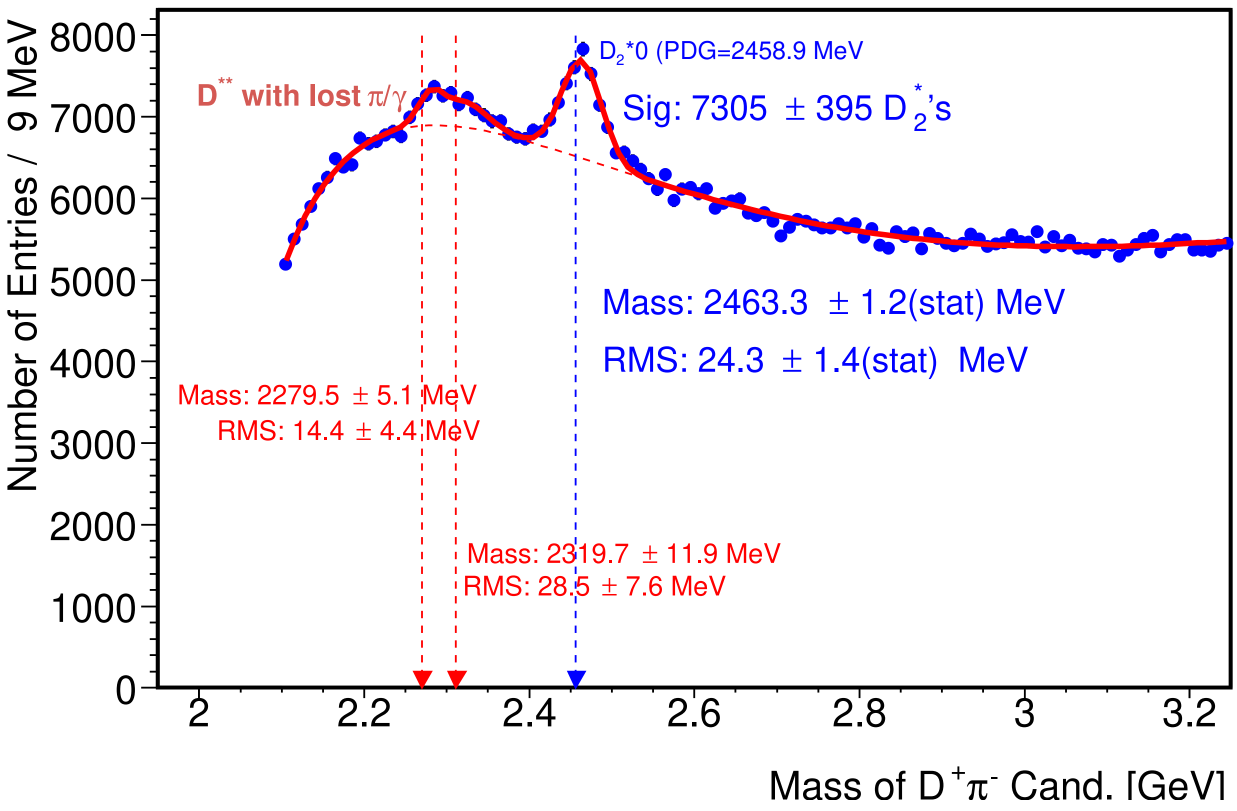


- **Si-Tracks–At Least 3 r-ϕ Hits**
- **Drop ISL & L00 (Keep Si-z)**
- **defTracks Without Si-StandAlone**
- **Min Track p_T of 350 MeV**
- **E-Loss Corrections with KAL Fitter**
- **Demand Two "Trigger" Tracks (i.e. $p_T > 1.95$ & $100\mu\mathrm{m} < d_0 < 1.2$mm)**
- $L_{xy}(\mathrm{P.V.} \to D_s^+) > 400\ \mu$m
- $\chi^2_{3D} < 10$

$\Longrightarrow \sim \frac{1}{2}$ **Million D^+'s**

$D^+\pi^-$ Reconstruction—*As Last Seen. . . . . .*

- D^+ **Mass within 20 MeV**
- $p_T(D^+\pi^-) > 5$ **GeV**
- $\chi^2_{3D} < 25$ — **NO Mass Constraints**
- **"Prompt" Selection:**
  - $d_0(D_s^+\pi^+) < 100\mu$m
  - $|L_{xy}(D_s^+\pi^+)| < 400\mu$m
  - $|L_{xy}(D_s^+\pi^+)/\sigma| < 3$



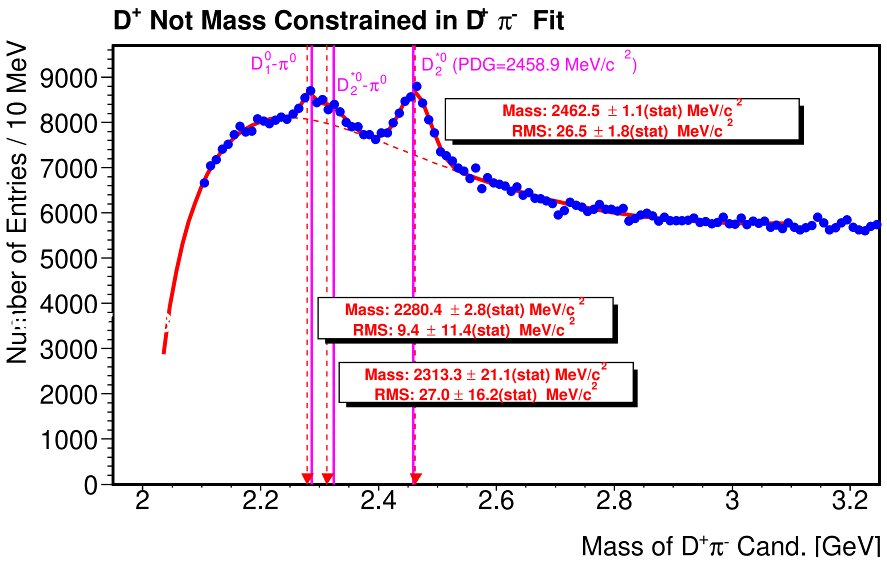
$D^+\pi^-$ Reconstruction—*Revisions*:

Popular Suggestion/Question:

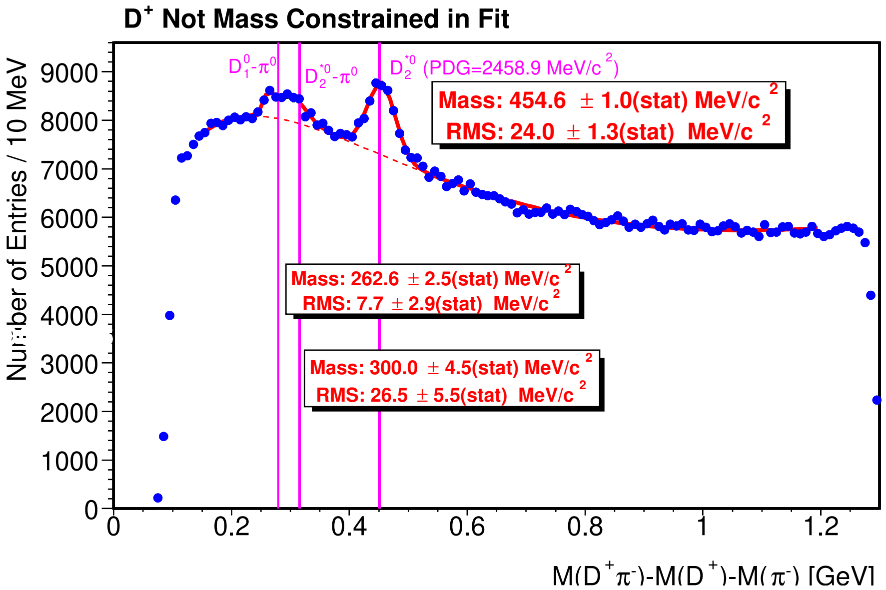
Why Not Mass Differences?

Previous Version† with NO Mass Constraint:

$$\sigma(D_2^{*0}) = 26.5 \pm 1.8$$



Mass Difference Version: $\sigma(D_2^{*0}) = 24.0 \pm 1.3$

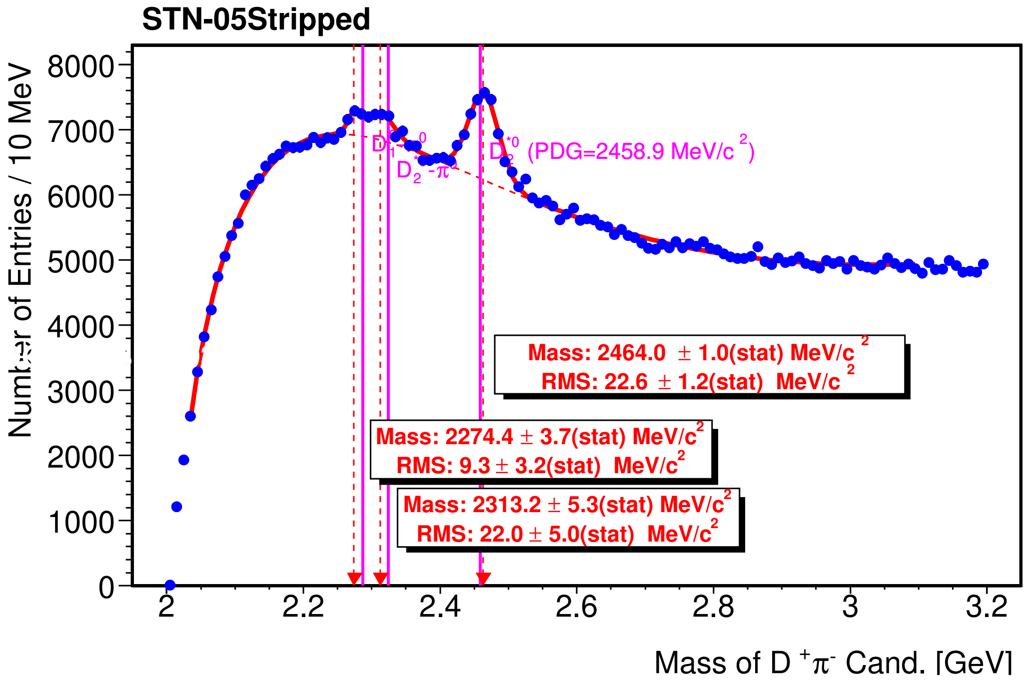


† **But With Selection Cuts that Follow...**

Difference Plot Is Indeed Better!. . .

BUT. . . . . .

DO Mass Constraint: $\sigma(D_2^{*0}) = 22.6 \pm 1.2$ **:**



Summary

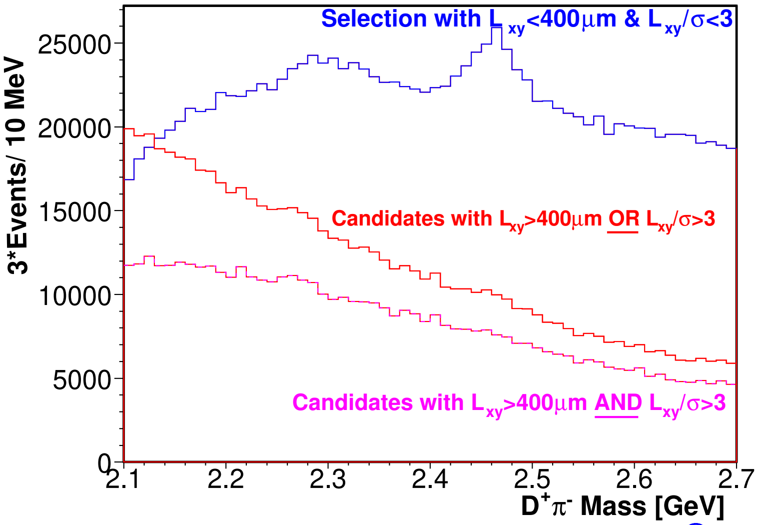
- **Absolute Mass & No Constraint:**
  $\sigma(D_2^{*0}) = 26.5 \pm 1.8$
- **Mass Difference & No Constraint:**
  $\sigma(D_2^{*0}) = 24.0 \pm 1.3$
- **Absolute Mass & Constraint:**
  $\sigma(D_2^{*0}) = 22.6 \pm 1.2$

$\Longrightarrow$ **No Small Effect Since Intrinsic RMS 10-20 MeV** *!*

$\Longrightarrow$ $\boxed{\textbf{From Now On Use Mass Constr.}}$ $\Longleftarrow$

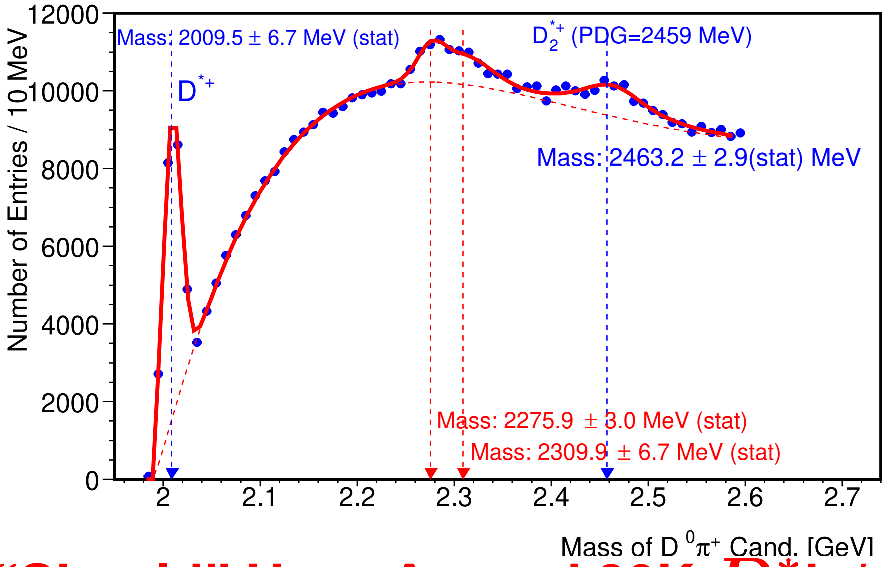
$D^+\pi^-$ Reconstruction—*Revisions*: L_{xy}

- Originally Opted for "**Prompt**" Selection
- Lifetime Distributions Broad Pos/Neg Shape
- Cursory Check:



Don't See Much Loss in D_2^{*0} Signal!

- But Rolf Noted: Most D^*'s Missing in $D^0\pi^+$:



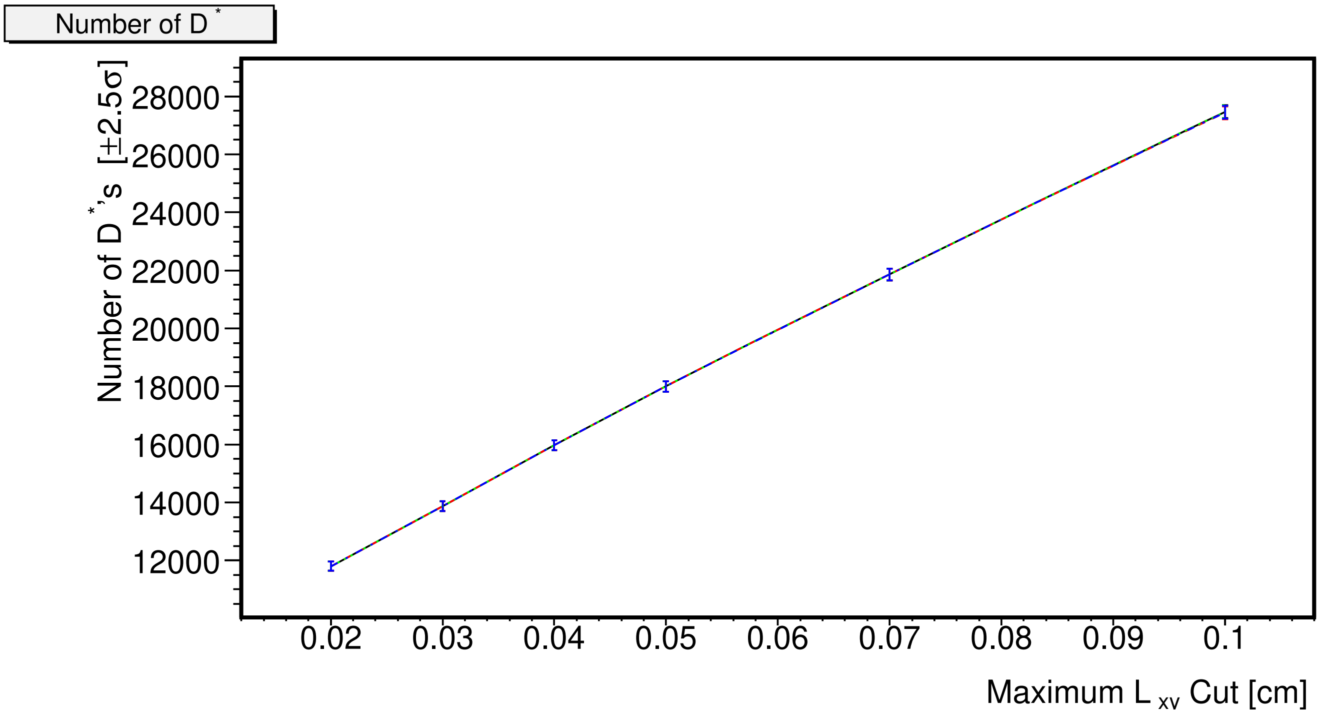
. . . "Should" Have Around 80K D^*'s!

Not *Really* Interested in Optimizing on D^*'s, But: Let's Look at D^*'s More Closely...

PreBlessing Cuts:

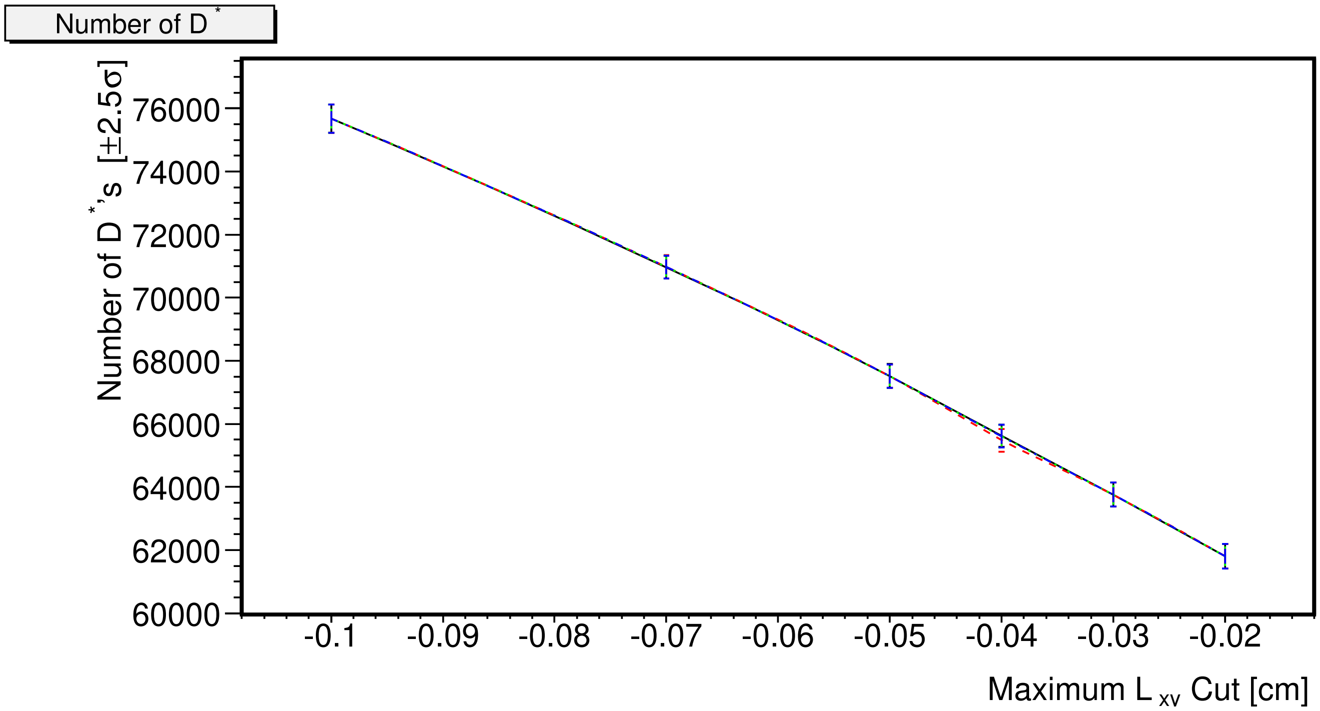
- $d_0(D_s^+\pi^+) < 100\mu\mathrm{m}$
- $|L_{xy}(D_s^+\pi^+)| < 400\mu\mathrm{m}$
- $|L_{xy}(D_s^+\pi^+)/\sigma| < 3$

—Keep Lower Cuts,
—Plot Number of D^*'s as Function of L_{xy} and L_{xy}/σ:



Multiple Lines ARE Plotted for Various L_{xy}/σ Cuts, But Make Little Difference—Can't See Them

Go Other Direction:
Remove Upper L_{xy} Cuts, Scan Lower Cuts



So, Yes!, Lots of D^*'s With Very Large L_{xy}
$\Longrightarrow$ Poor Resolution $\Longleftarrow$

But D^*'s Bad Benchmark:
D^*'s So Incredibly Clean Any Crappy Cuts Add Signal

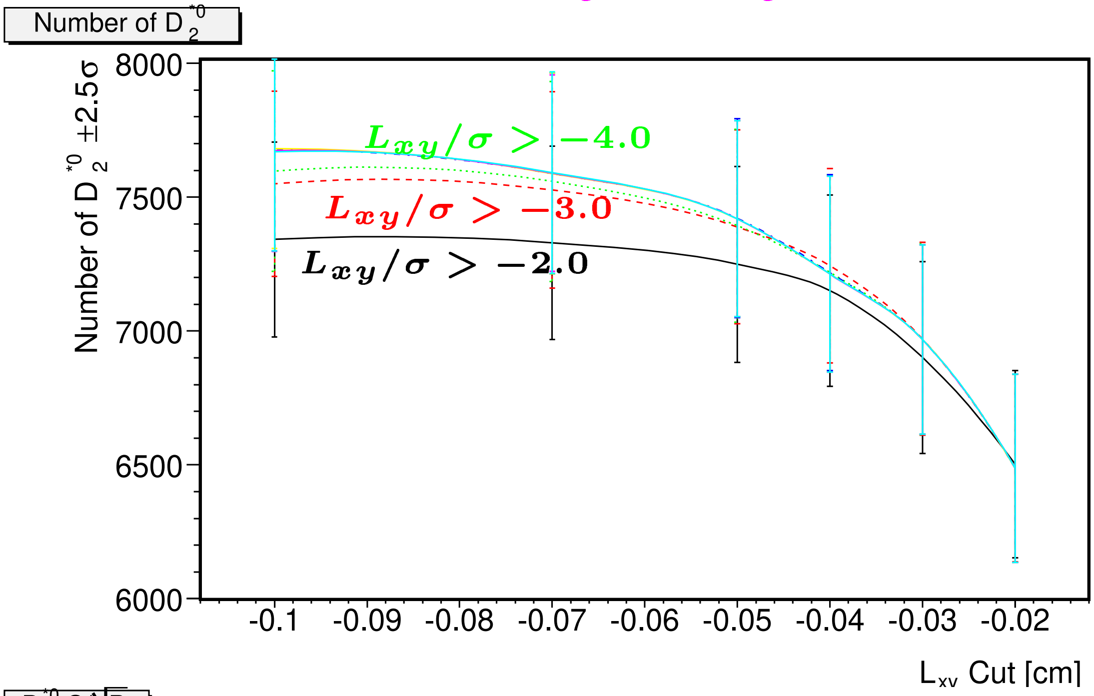
Therefore,

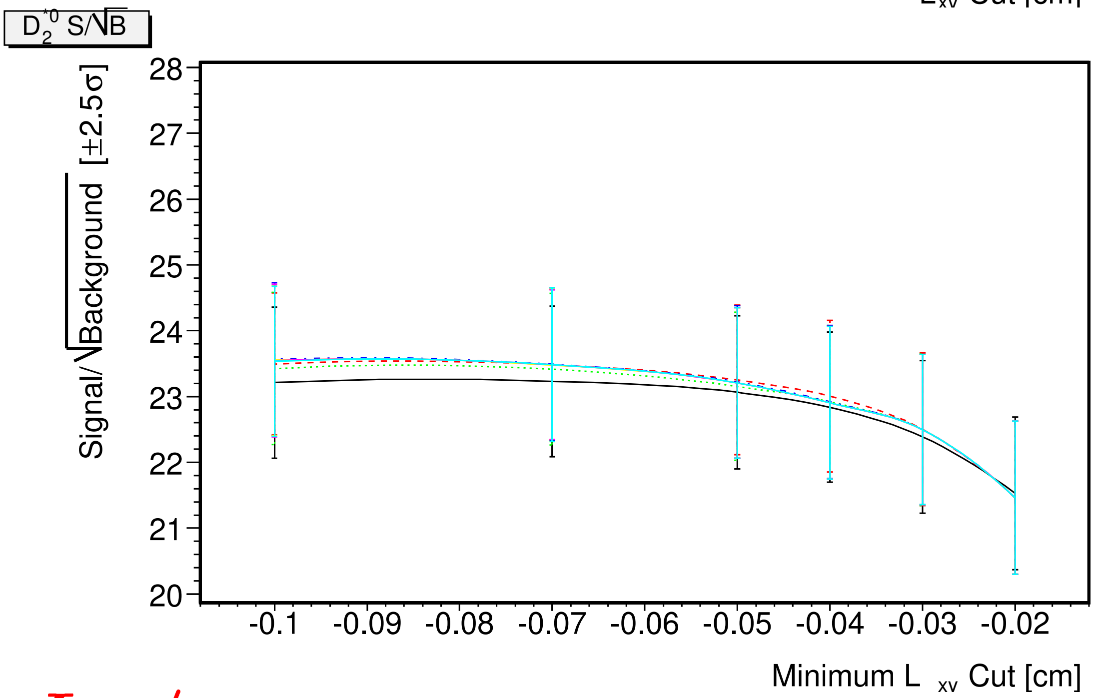
$\Longrightarrow$ Use D_s^{*0}'s $\Longleftarrow$

Cut Scans With $D^+\pi^-$:

—Remove *Displacement* Cuts

Scan of Lower L_{xy} & L_{xy}/σ Cuts:



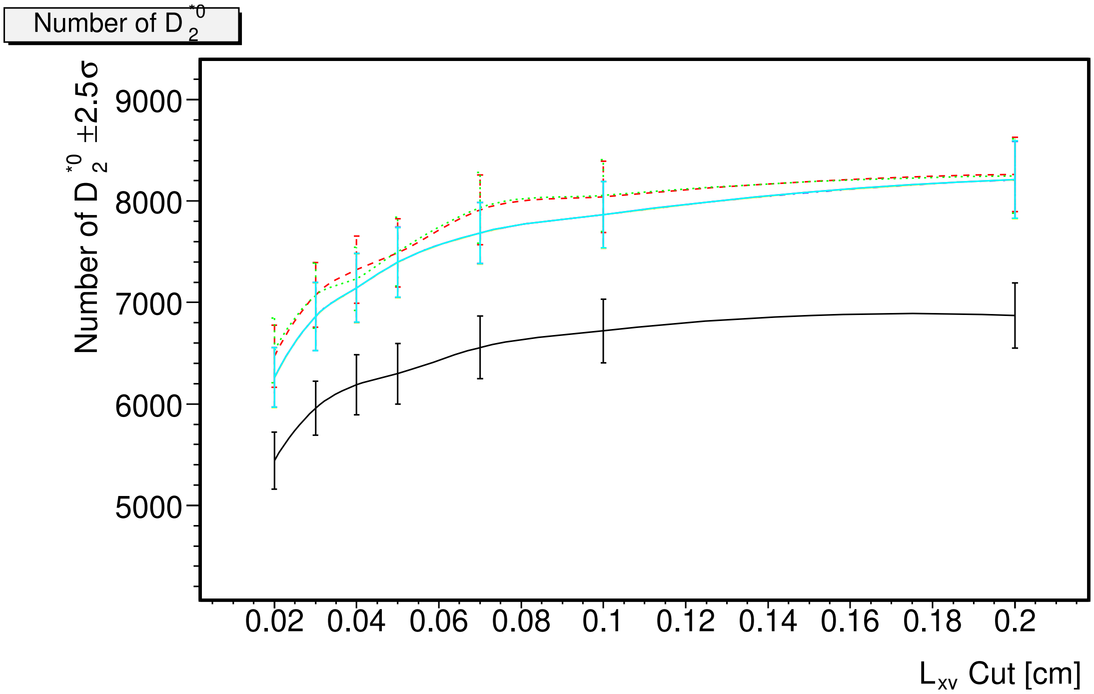


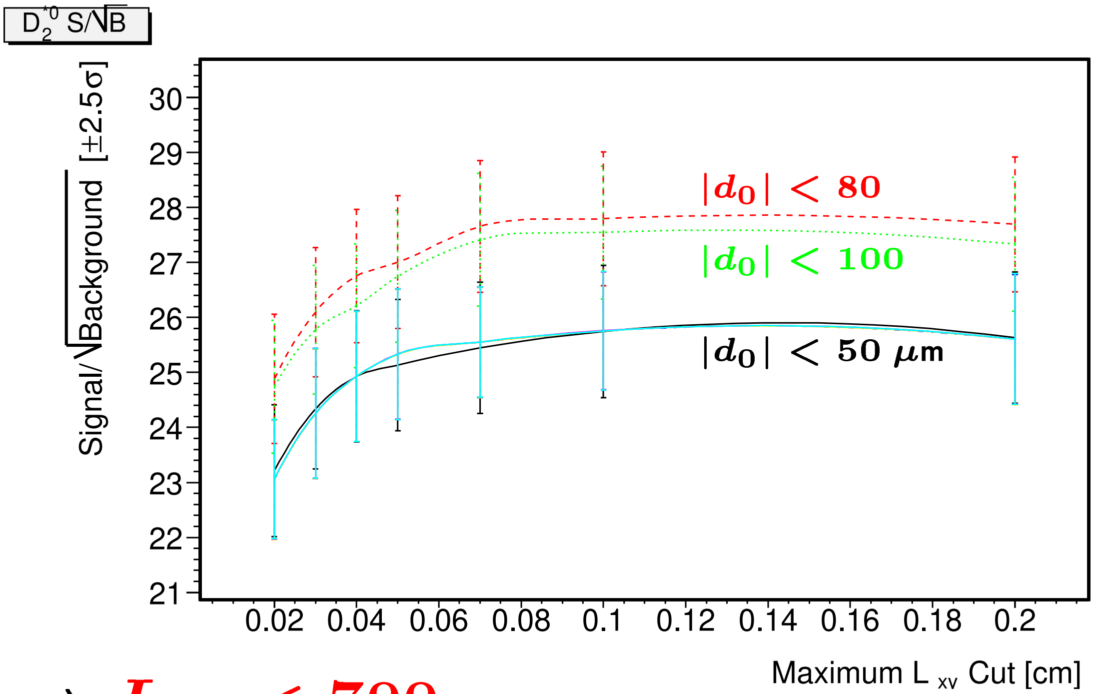
$\Longrightarrow$ L_{xy}/σ **Doesn't Matter Much**

$\Longrightarrow$ $L_{xy} > -500\ \mu\mathrm{m}$

Cut Scans With $D^+\pi^-$:

Scan of Upper L_{xy} With $d_0(D^+)$ Cuts:



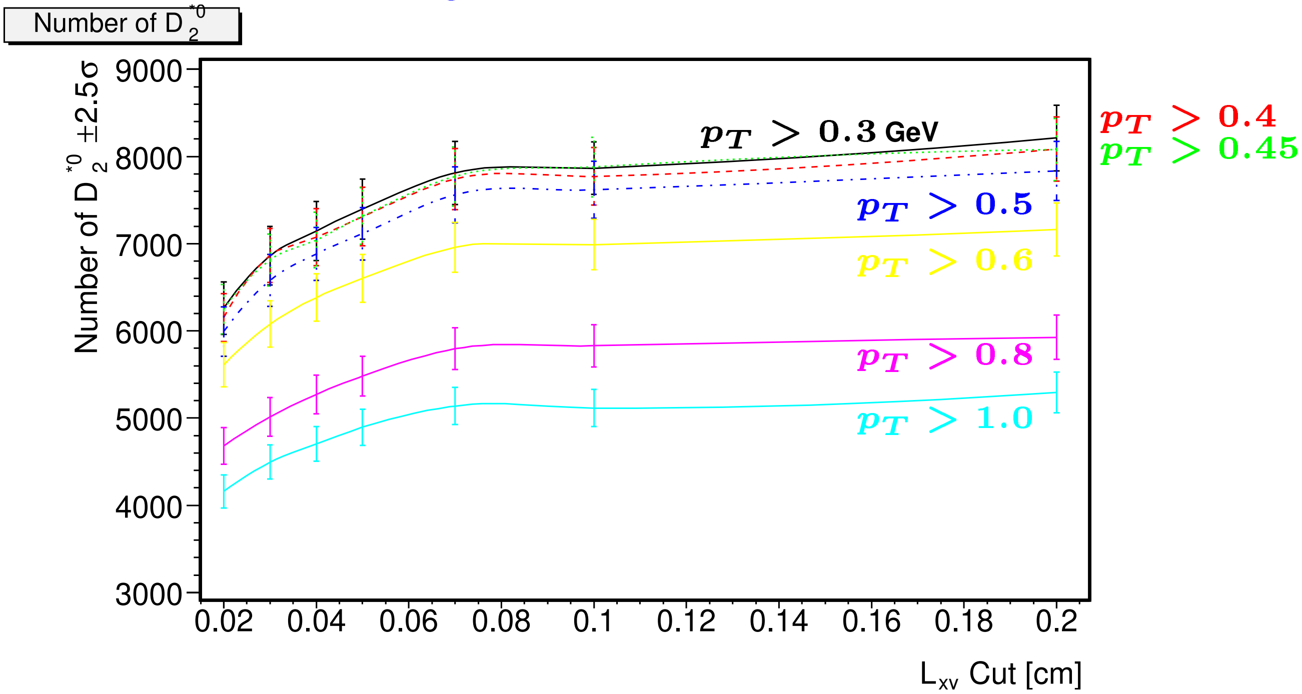


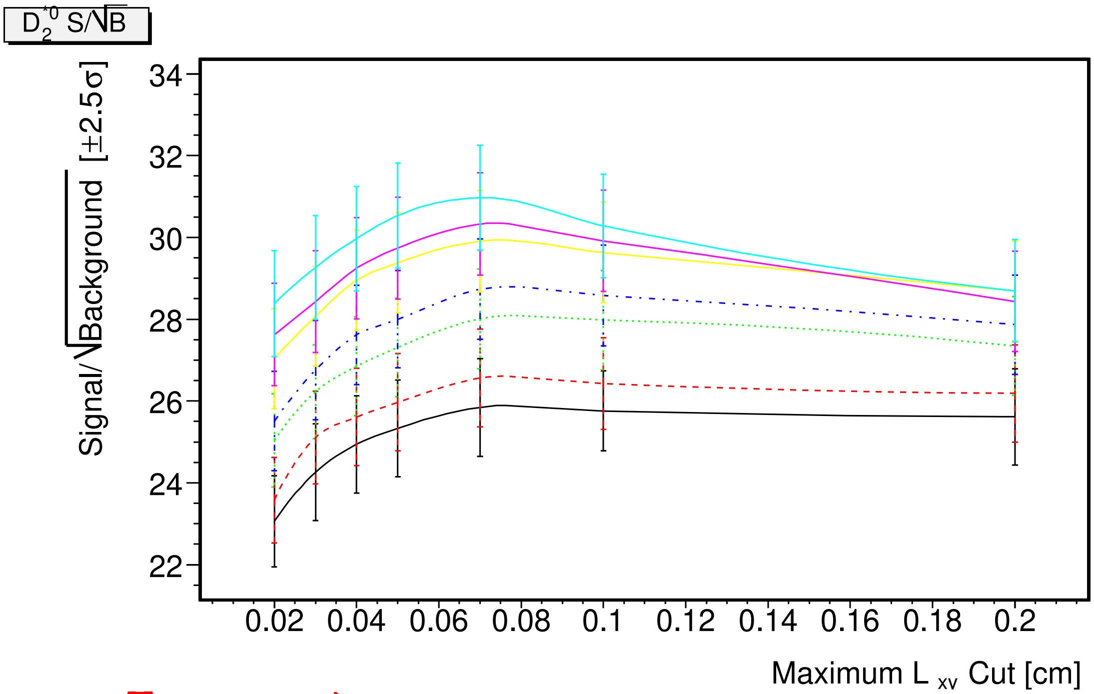
$\Longrightarrow L_{xy} < 700\ \mu$m

$\Longrightarrow |d_0| < 100\ \mu$m

Cut Scans With $D^+\pi^-$:

Scan of Upper L_{xy} With $p_T(\pi^-)$ Cuts:



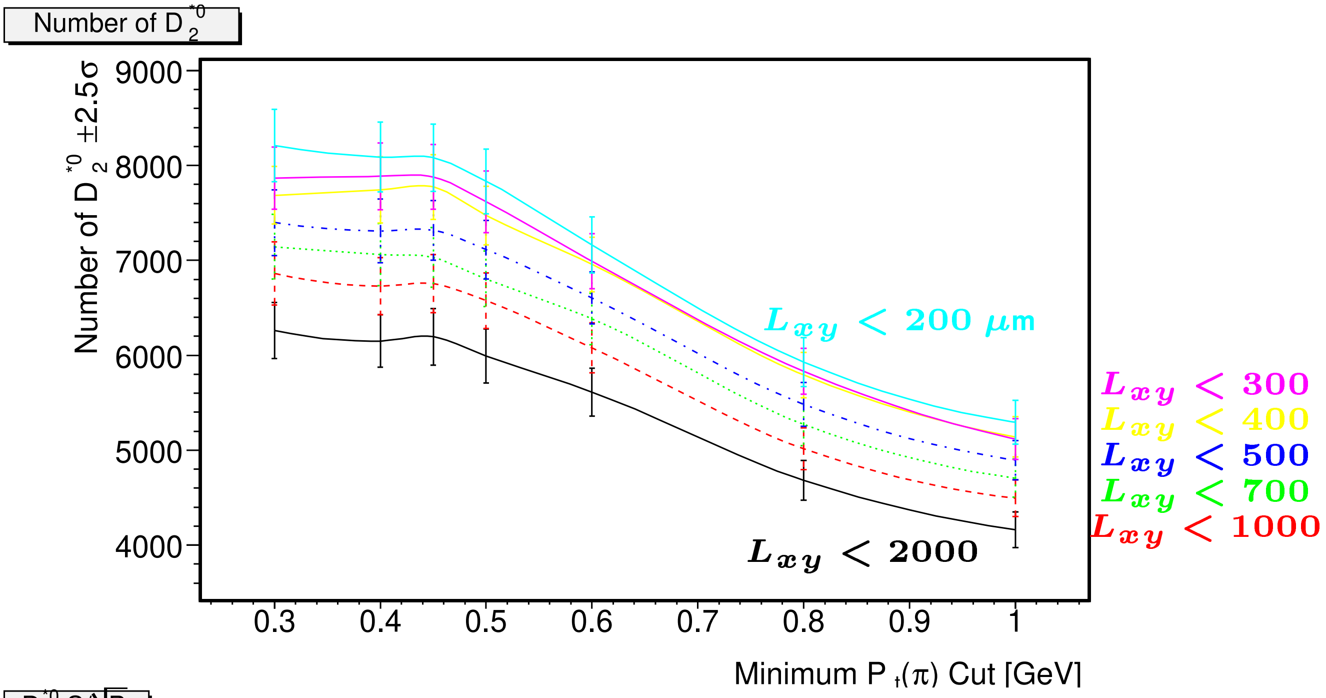


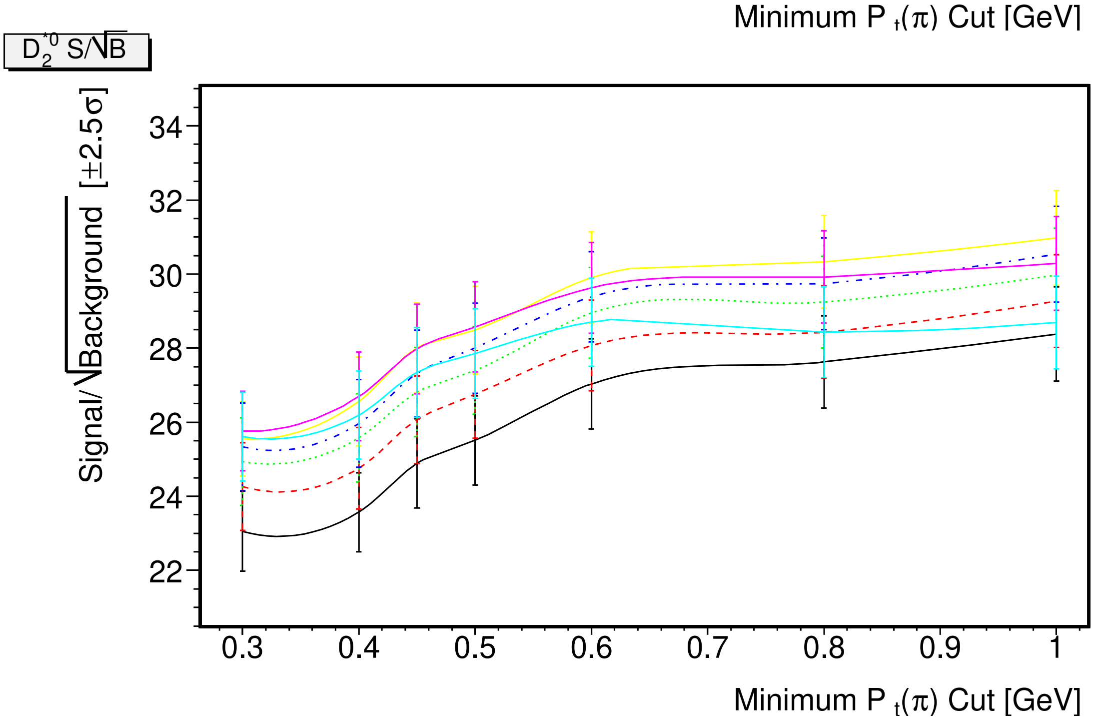
$\Longrightarrow L_{xy} < 700\ \mu$m

$\Longrightarrow$ **Higher p_T** *Goood!*

Cut Scans With $D^+\pi^-$:

Scan of $p_T(\pi^-)$ With Upper L_{xy}:

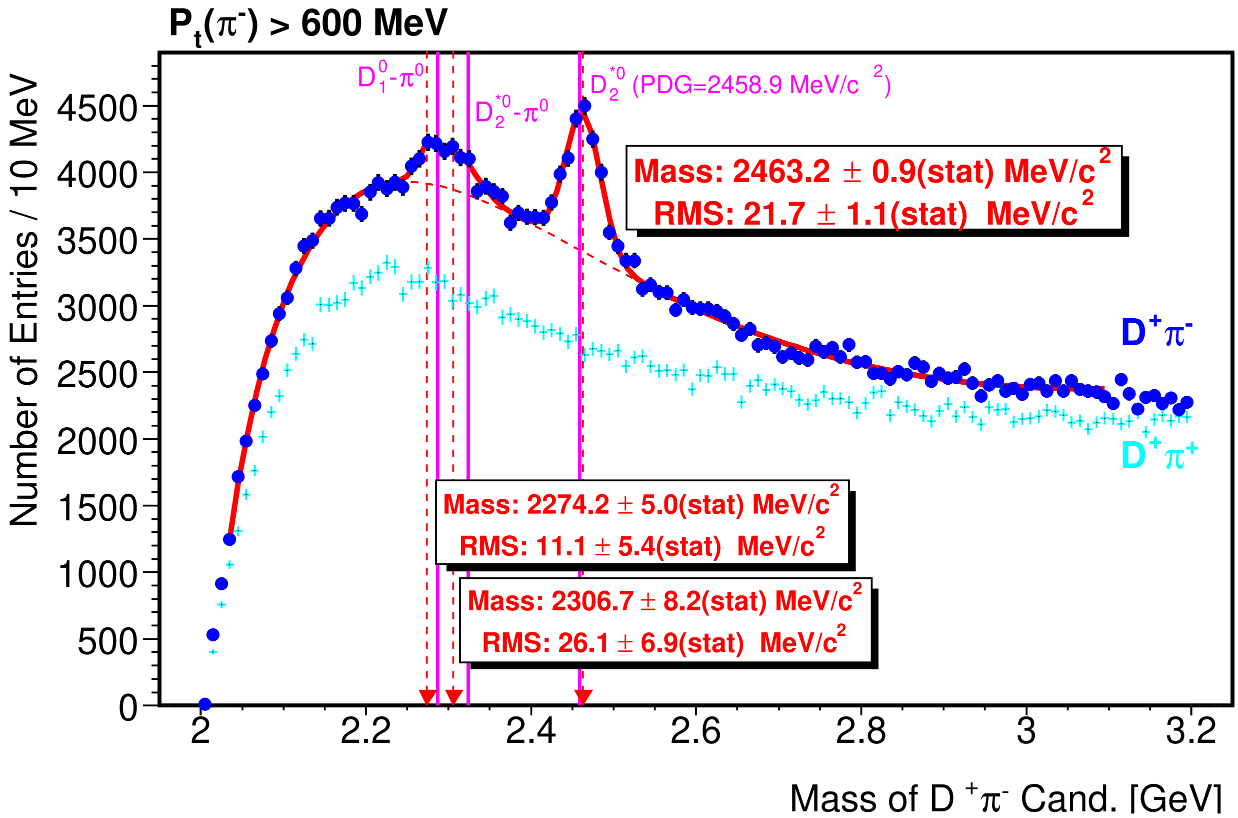




$\Longrightarrow$ *Most* **of Benefit at $\sim$500-600 MeV**

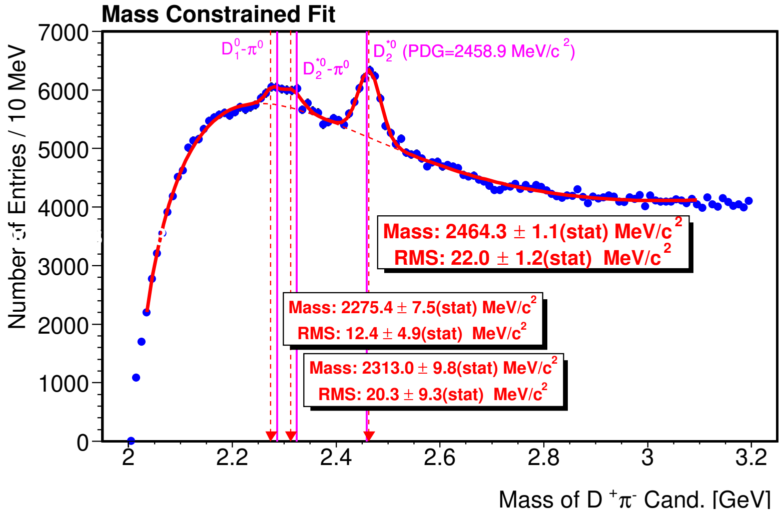
$D^+\pi^-$ Selection Summary:

- D^+ Mass within 20 MeV
- $p_T(D^+\pi^-) > 5$ GeV
- $p_T(\pi^-) > 600$ MeV
- $\chi^2_{3D} < 25$ — With Mass Constraint
- "Prompt" Selection:
  - $d_0(D_s^+\pi^+) < 100\mu$m
  - $-500 < L_{xy}(D_s^+\pi^+) < 700\mu$m
  - $-4.0 < L_{xy}(D_s^+\pi^+)/\sigma$

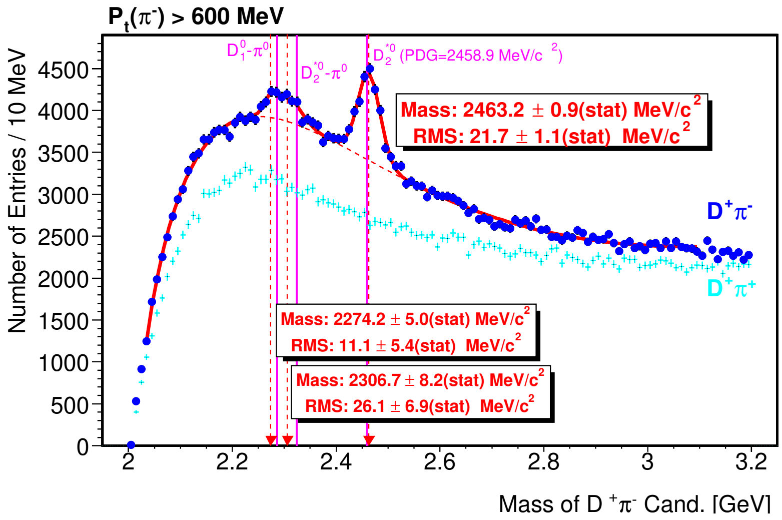


Only $\sim$ 70 pb^{-1} —Some Failed Jobs

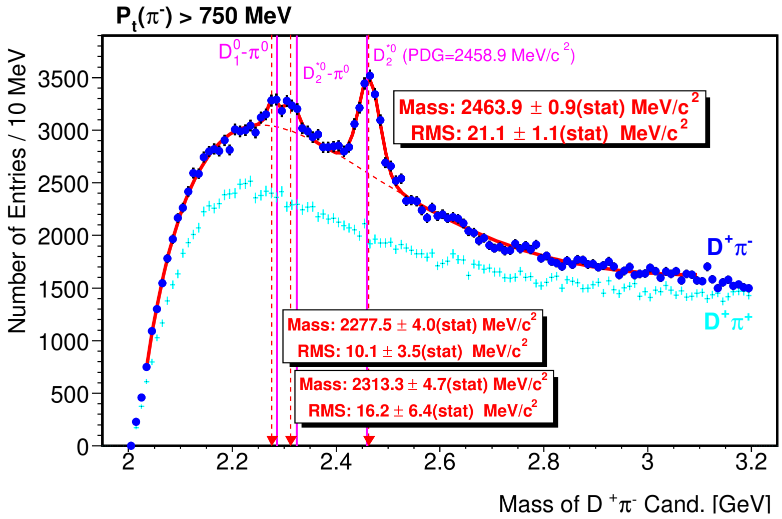
$p_T(\pi^-) > $ 400 MeV



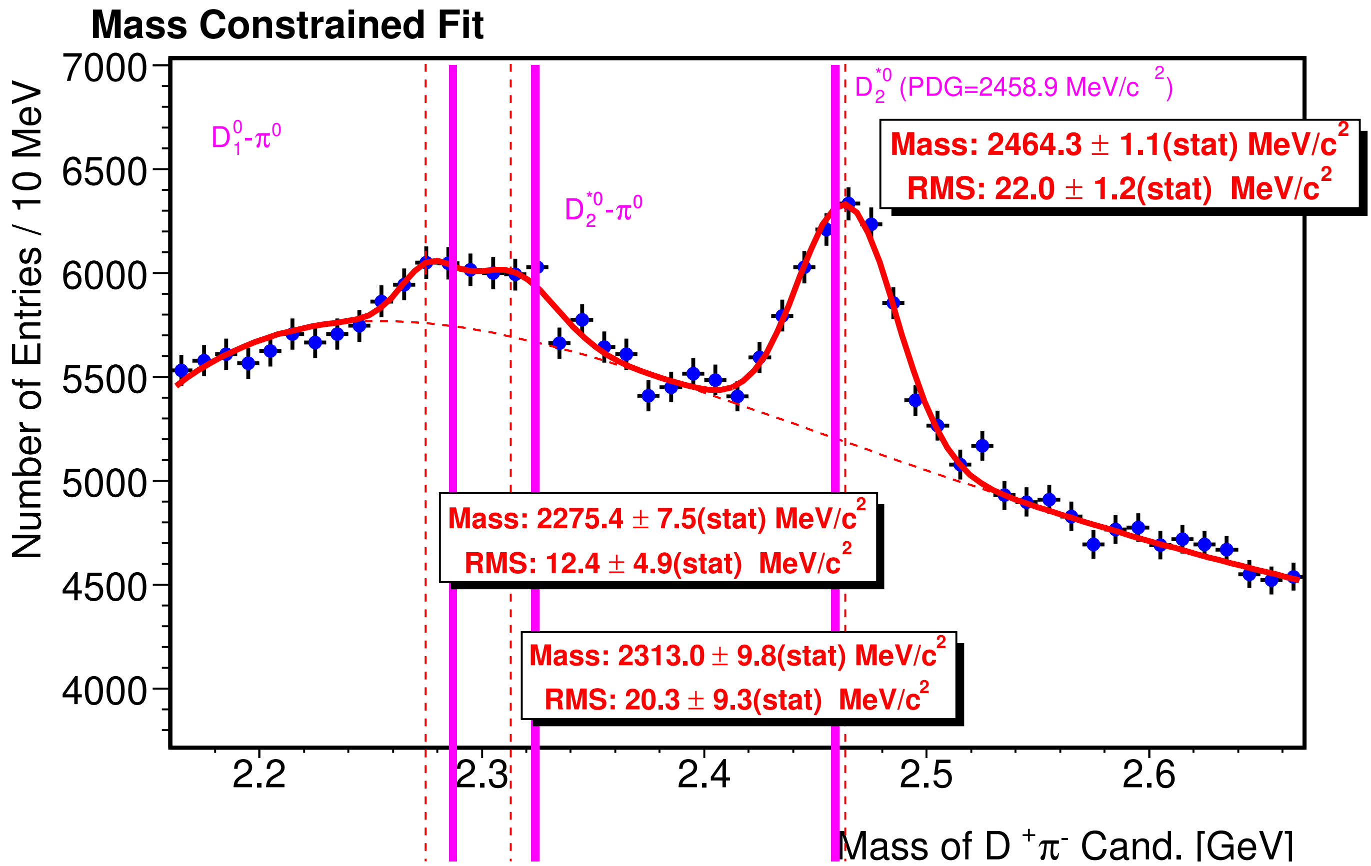
$p_T(\pi^-) > $ 600



$p_T(\pi^-) > $ 750



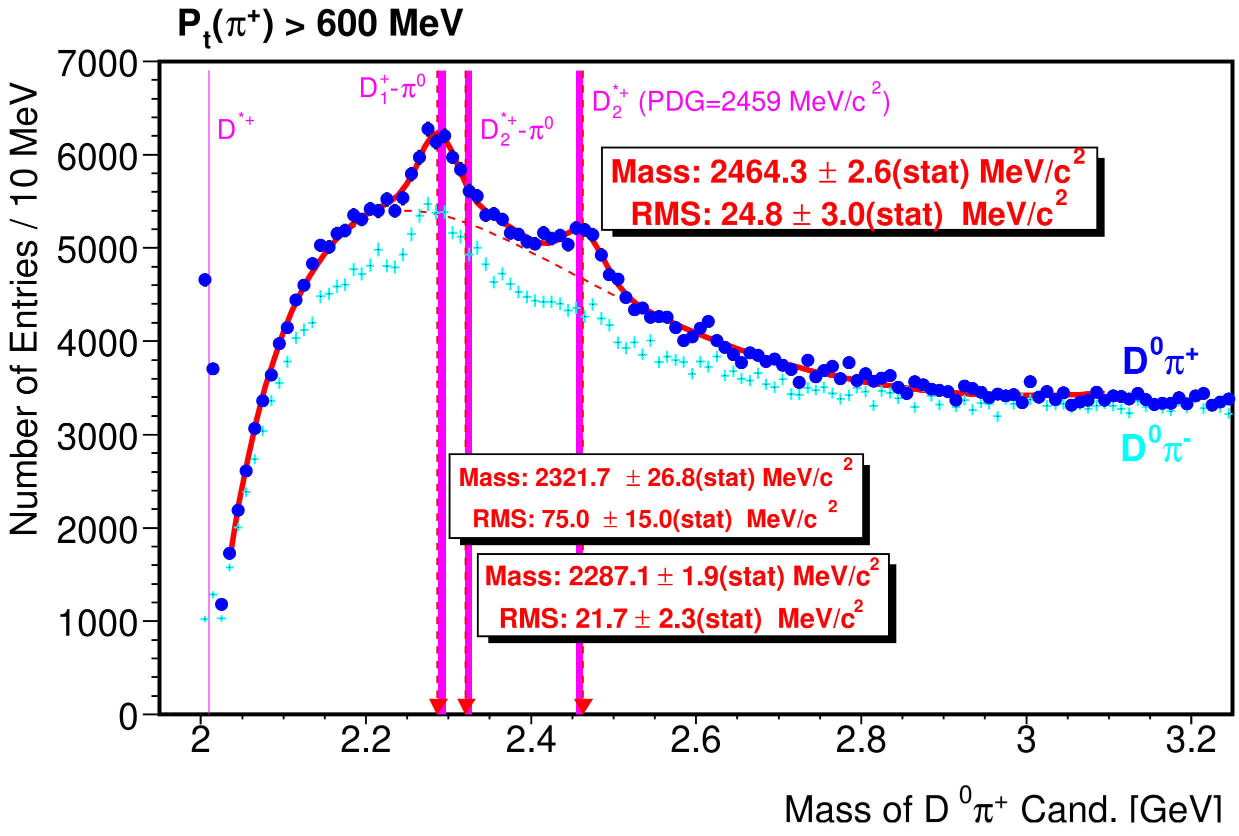
$D^+\pi^-$ Blow-Up (600 MeV):



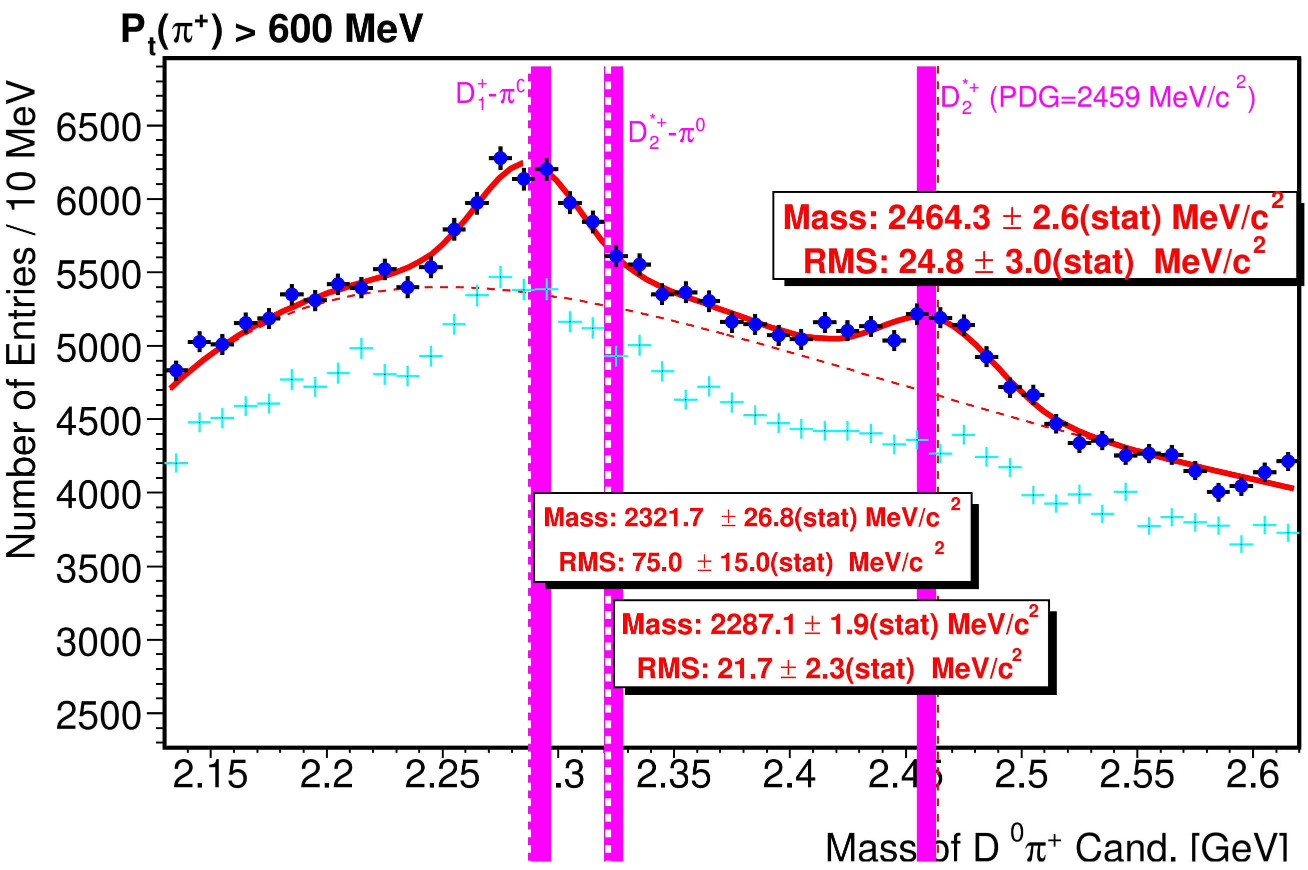
$D^0\pi^+$ Selection Summary:

Basically Same Selection (Except for Red)

- D^+ **Mass within 20 MeV**
- $p_T(D^+\pi^-) > 5$ **GeV**
- $p_T(\pi^-) > 400$ **MeV (Loose Sel.)**
- $\chi^2_{3D} < 16$ — **With Mass Constraint**
- **"Prompt" Selection:**
  - $d_0(D_s^+\pi^+) < 100\mu$m
  - $-500 < L_{xy}(D_s^+\pi^+) < 700\mu$m
  - $-4.0 < L_{xy}(D_s^+\pi^+)/\sigma$



$D^0\pi^+$ Blow-Up ($\pi^+ > 600$ MeV):



NOTE: D_2^{*+} RMS NOW In-Line With D_2^{*0}

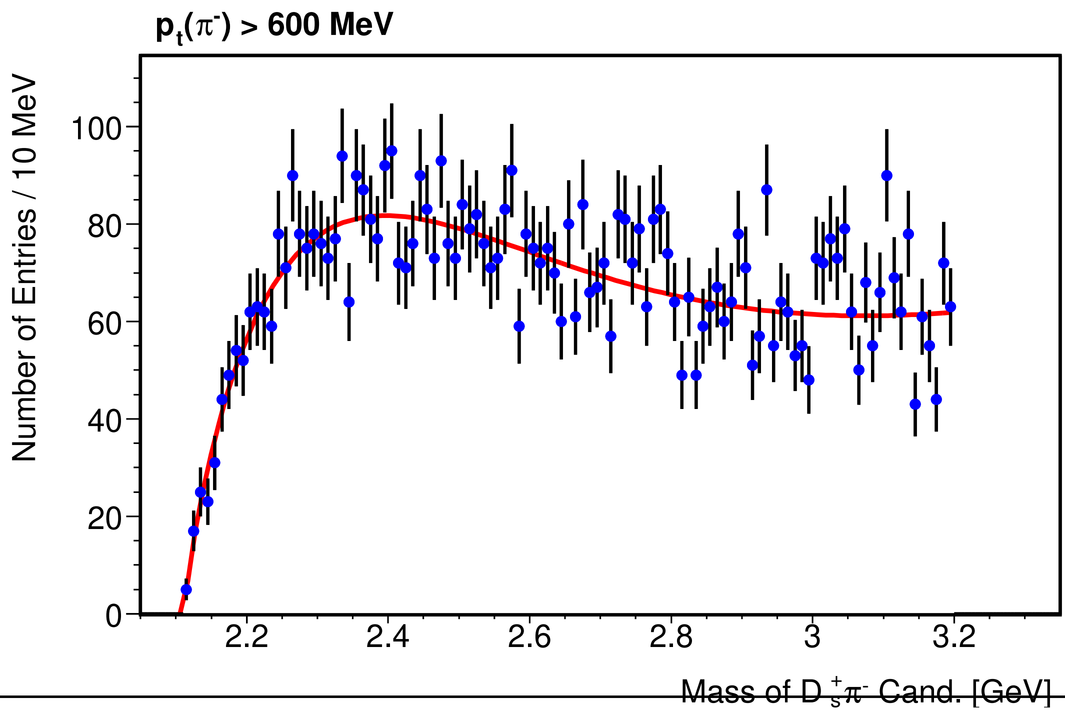
—In PreBless Was Unusually Broad!

$\Longrightarrow$ Suspect Truncated Fit Range

$D_s^+\pi^-$ Selection Summary:

Basically Same Selection (Except for Red)

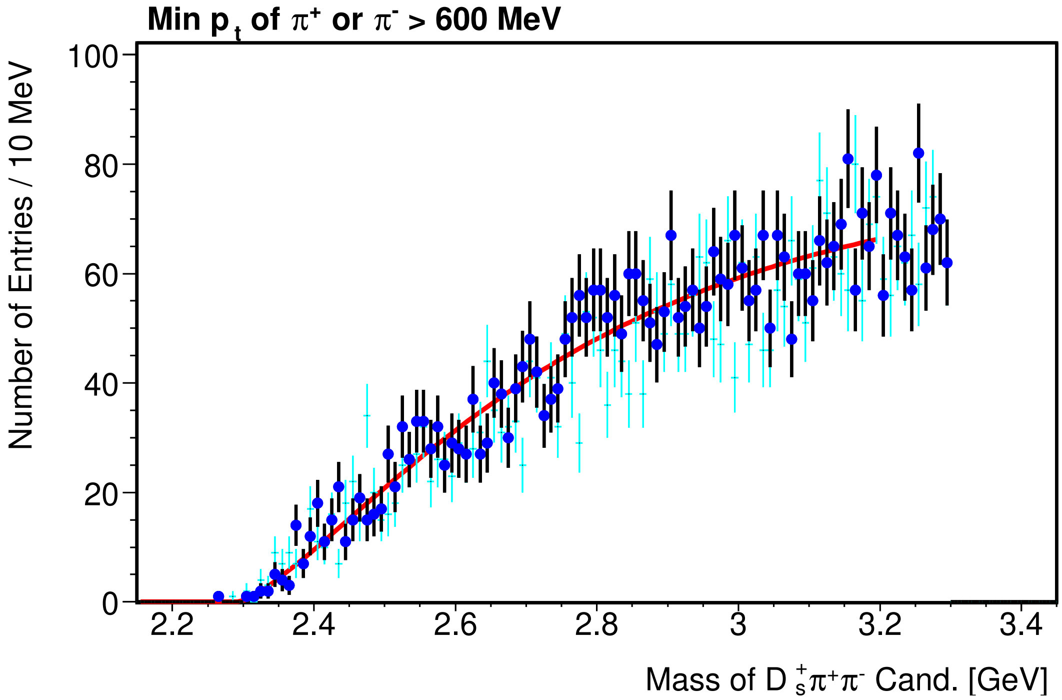
- D_s^+ Mass within 20 MeV
- $p_T(D^+\pi^-) > 5$ GeV
- $p_T(\pi^-) > 600$ MeV (Loose Sel.)
- $\chi^2_{3D} < 20$ — With Mass Constraint
- ϕ Mass Within 7 MeV
- $|\cos\theta_{Helicity}| > 0.4$
- "Prompt" Selection:
  - $d_0(D_s^+\pi^+) < 100\mu$m
  - $-500 < L_{xy}(D_s^+\pi^+) < 700\mu$m
  - $-4.0 < L_{xy}(D_s^+\pi^+)/\sigma$



$D_s^+\pi^+\pi^-$ Selection Summary:

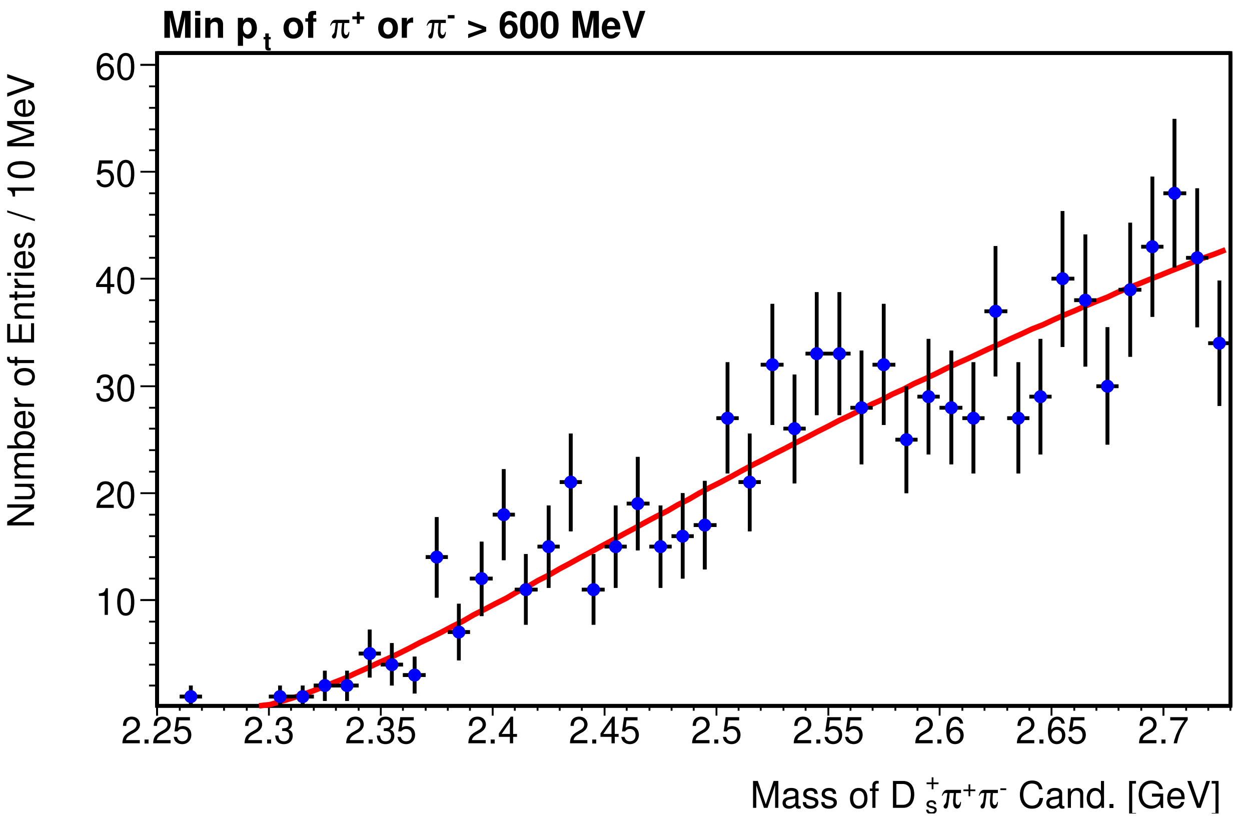
Basically Same Selection (Except for Red)

- D_s^+ **Mass within 20 MeV**
- $p_T(D^+\pi^-) > 5$ **GeV**
- $p_T(\pi^\pm) > 600$ **MeV (Loose Sel.)**
- $\chi^2_{3D} < 25$ — **With Mass Constraint**
- **"Prompt" Selection:**
- ϕ **Mass Within 7 MeV**
- $|\cos\theta_{Helicity}| > 0.4$
  - $d_0(D_s^+\pi^+) < 100\mu$m
  - $-500 < L_{xy}(D_s^+\pi^+) < 700\mu$m
  - $-4.0 < L_{xy}(D_s^+\pi^+)/\sigma$



$D_s^+\pi^+\pi^-$ Blow-Up (600 MeV):

No Wrong Sign. . .

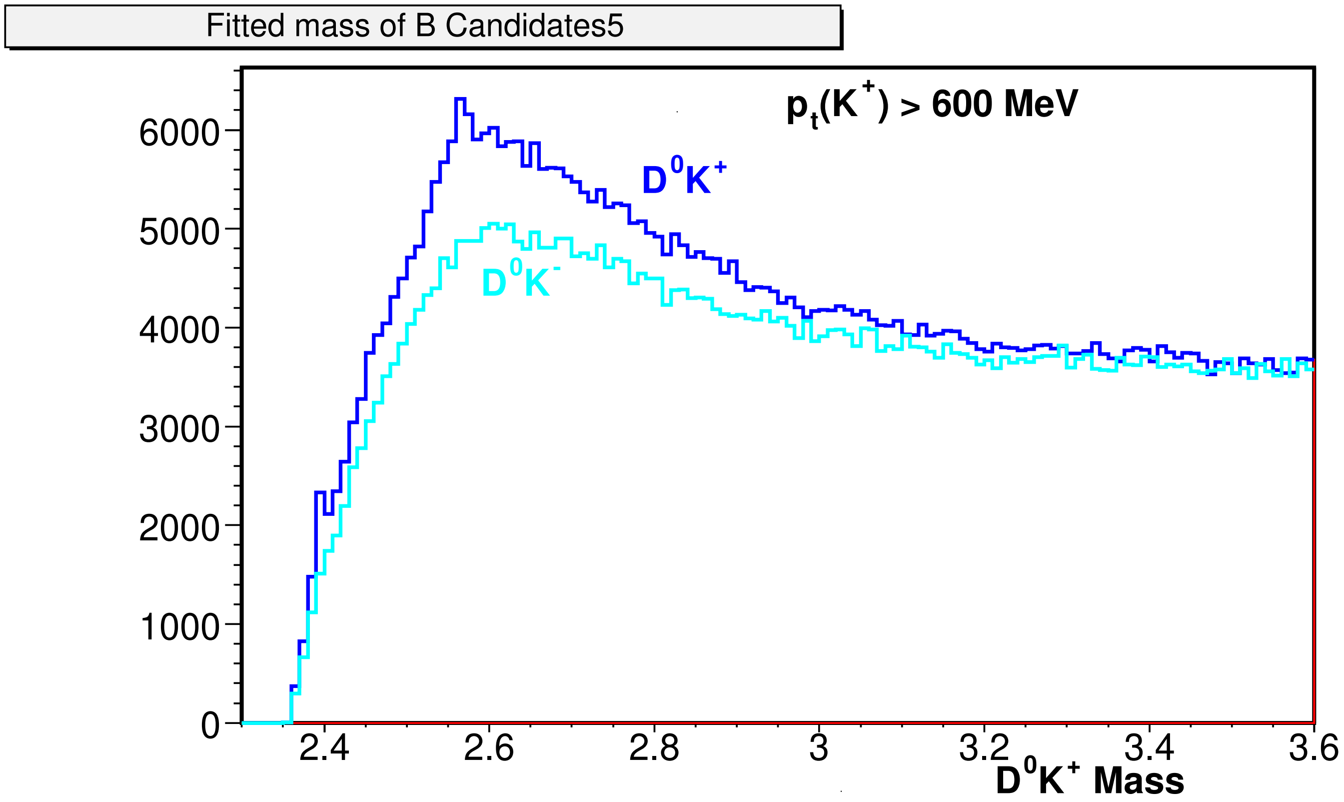


Expanding Inventory of Modes. . .

Hot of the Presses— Last Night's Work!!

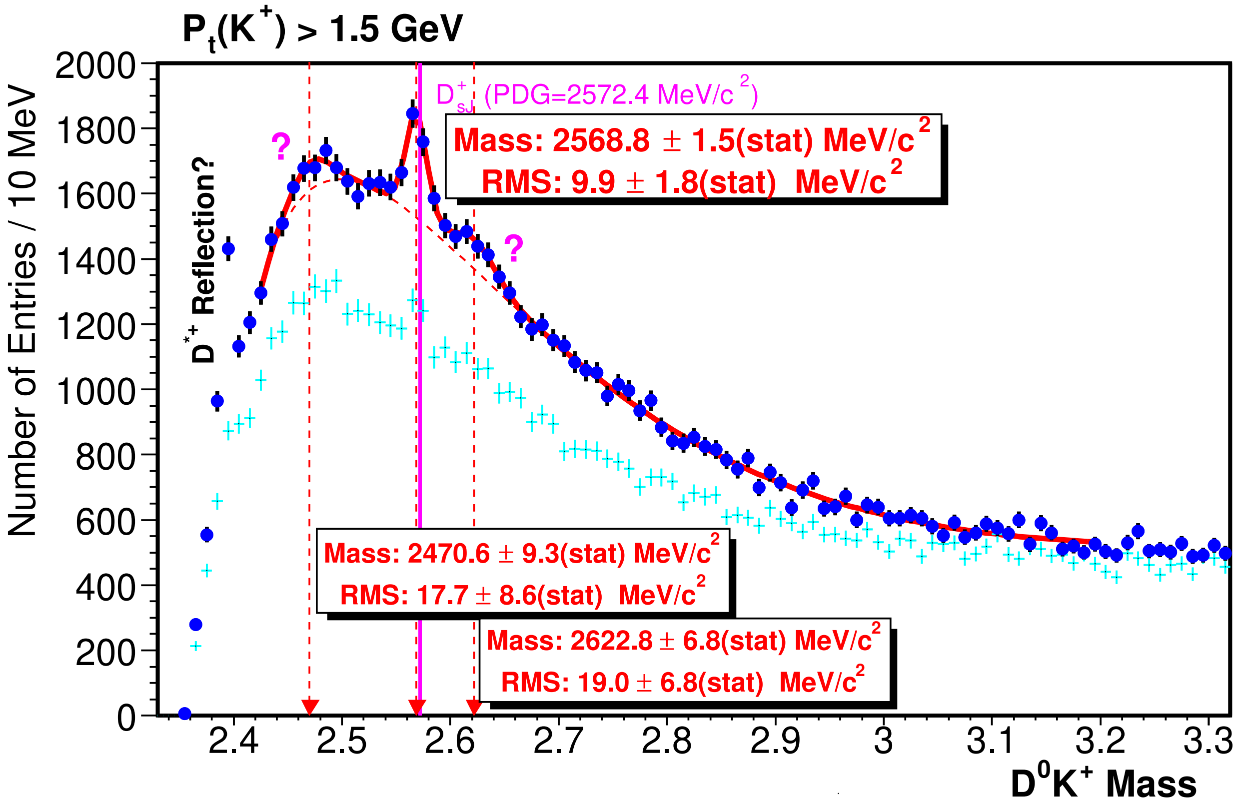
$D^0 K^+$ Reconstruction:

Standard Selection cuts, i.e. $p_t(K^+) > 600$ MeV:



A *HINT* of Something?. . .

Raise $p_t(K^+) > 1.5$ *GeV:*



- **Clear** $D_{sJ}(2573)^+ \to D^0 K^+$
- **Two OTHER Structures?**
- **Reflections?**

Summary:

- Have Wrong-Signs Implemented
  —*Except* $D_s^+\pi^-$*)*
- Find (Absolute) Mass Constraint Best
- Re-Examined Cuts $\Longrightarrow$ Relax Displacement Cuts
- See First Signs of Known D_s^{**} States