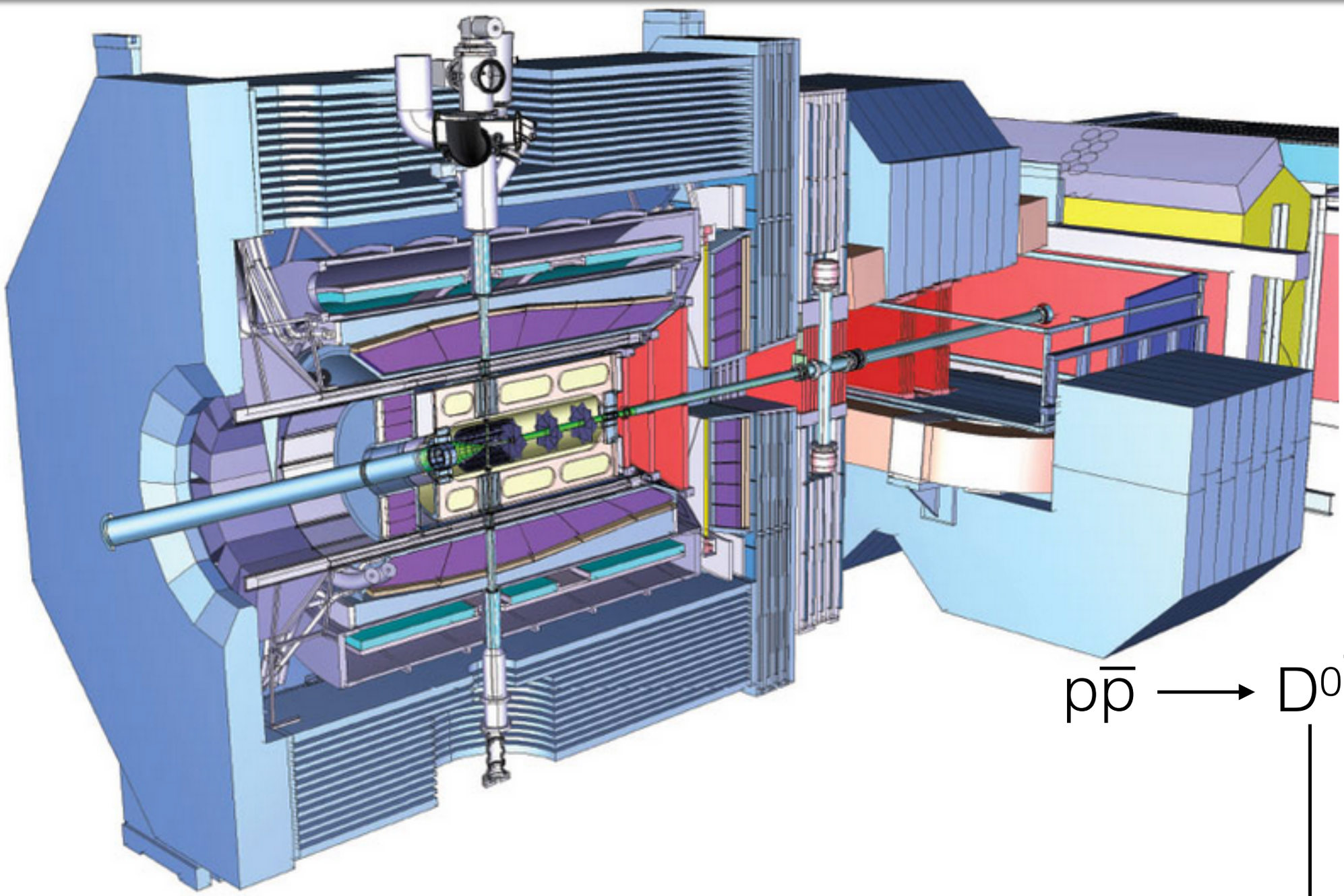
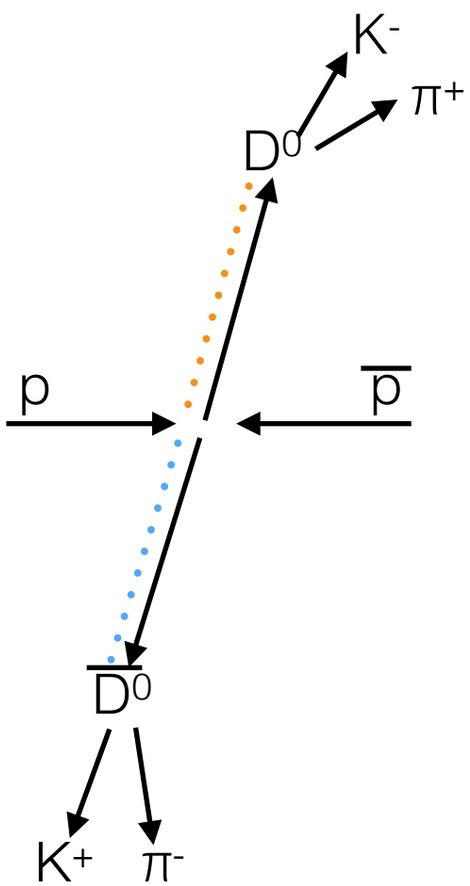
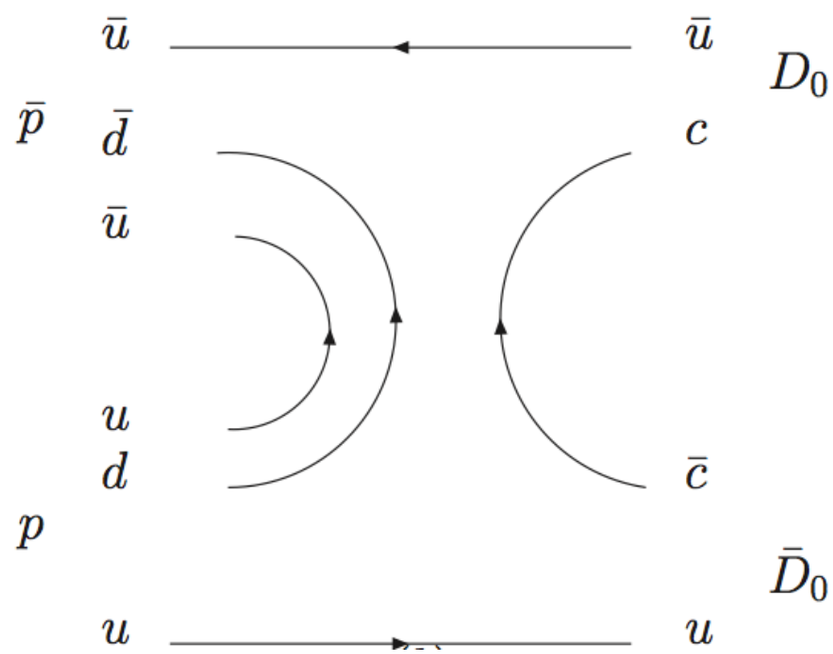


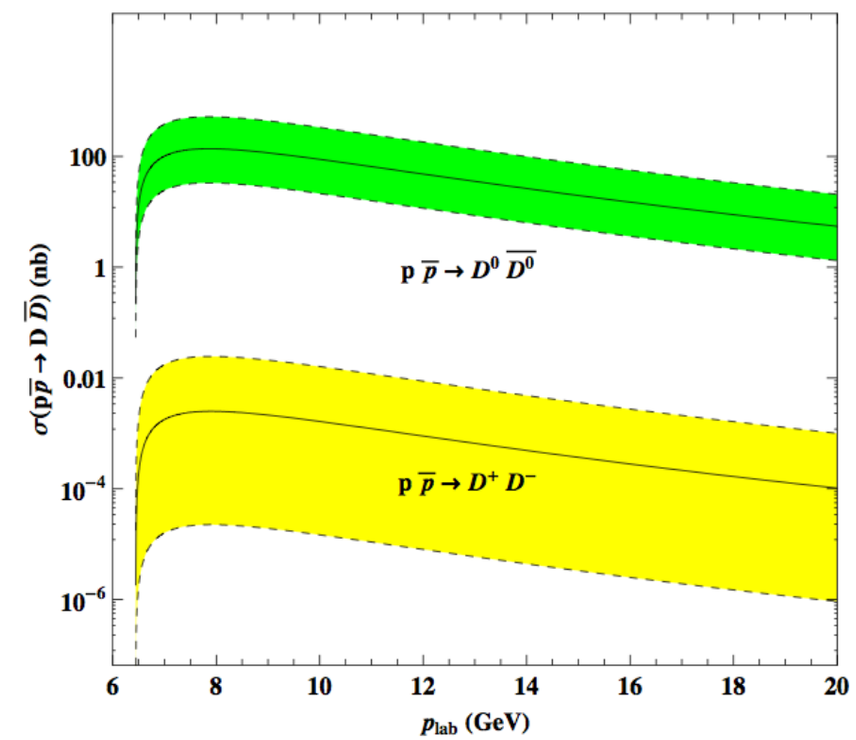
$p\bar{p} \longrightarrow D^0\bar{D}^0$

$\longrightarrow K^+ \pi^-$

$\longrightarrow K^- \pi^+$







A.Khodjamirian et al, arXiv:1111.3798v2 [hep-ph] (2012)

Why $p\bar{p}$->$D^0\bar{D}^0$?

- Cross section of $p\bar{p}$->$\bar{D}^0D^0$: unknown
- Role of the intermediate resonances?

Why D^0->$K^-\pi^+$ and $\bar{D}^0$->$K^+\pi^-$?

- Large branching fraction ~ 3.9%
- Easy to handle (only charged tracks)

Analysis steps

1. Fast Sim vs Full Sim @ 8GeV/c 10000 EvtGen evts (full detector setup)
2. Fast Sim @ 8 GeV/c 5000 EvtGen evts + $2.5*10^9$ DPM evts
3. Time needed to achieve at least 5σ significance(exclusive & inclusive analysis)

Fast Sim

PID Array:
PidChargedProbabiblity

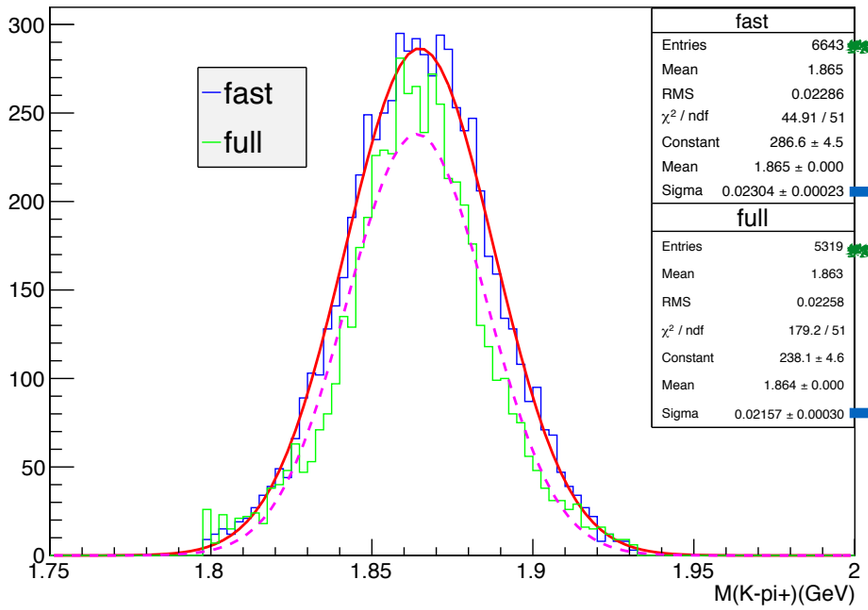
PID Criteria:
Loose

Full Sim

PID Array:
PidAlgoIdealCharged

Inclusive analysis

D^0 mass



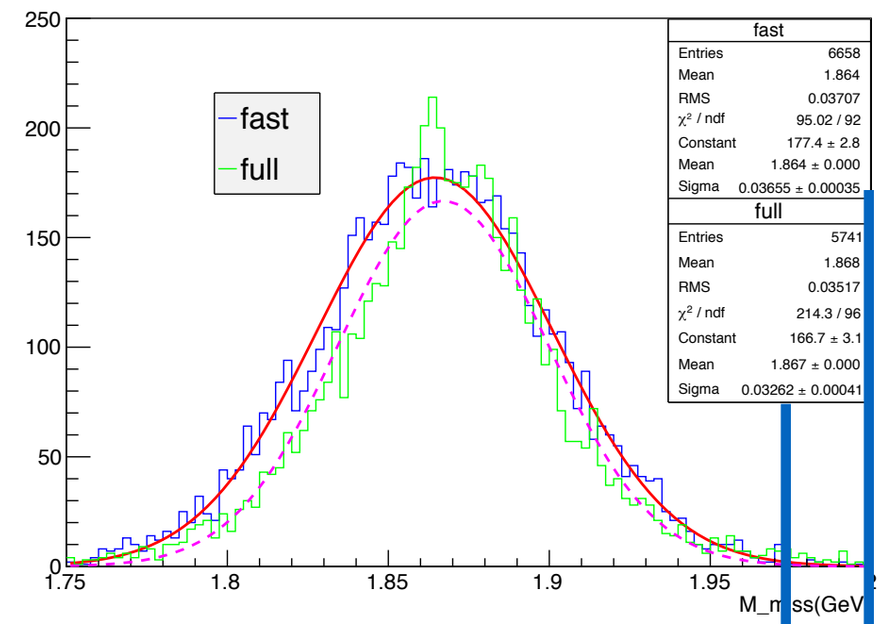
efficiency(2 charged tracks, fast): ~66%

resolution(fast): ~23MeV

efficiency(2 charged tracks, full): ~53%

resolution(full): ~22MeV

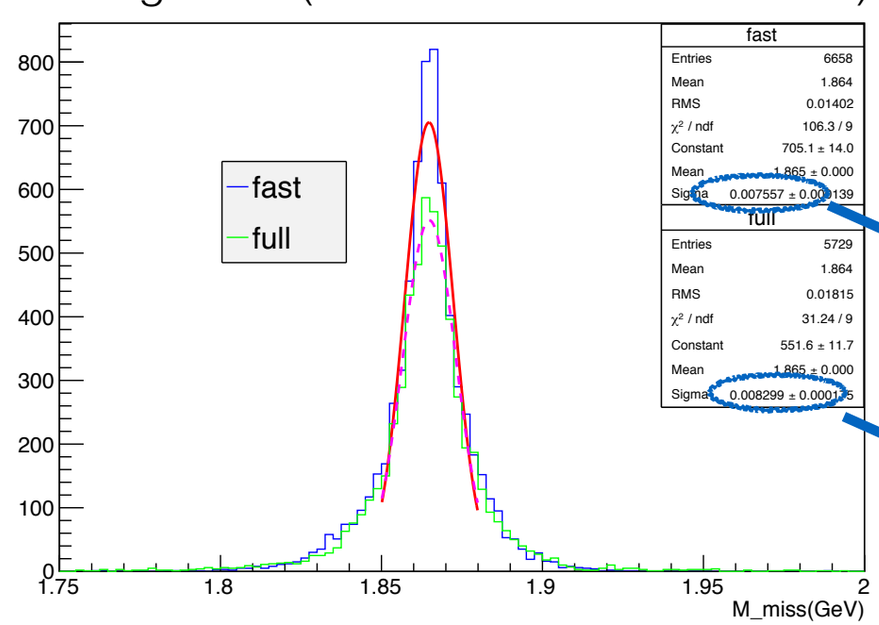
Missing mass



resolution(fast): ~37MeV

resolution(full): ~33MeV

Missing mass (mass constraint +chi2 <20)



resolution(fast): ~8MeV

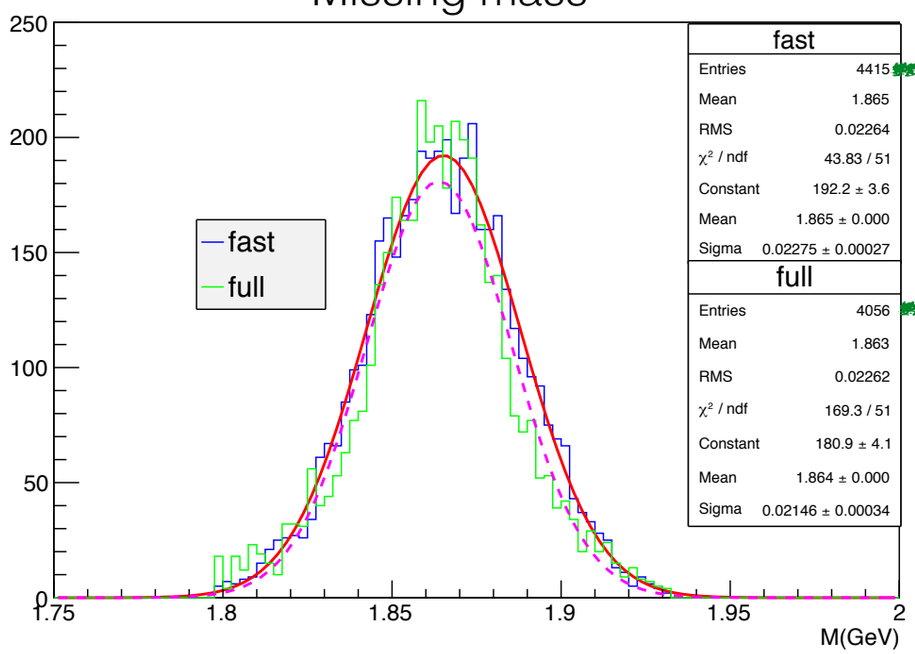
resolution(full): ~7MeV

$p\bar{p} \to D^0 + X$

$\hookrightarrow K^- \pi^+$

Exclusive analysis

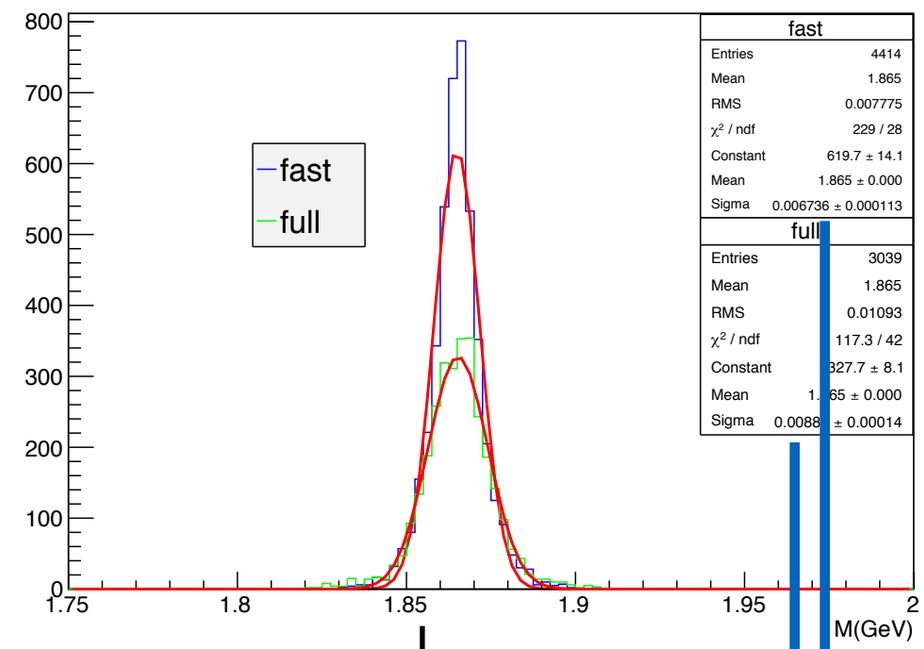
Missing mass



efficiency(4 charged tracks, fast): ~44%

efficiency(4 charged tracks, full): ~40%

Missing mass (4C constraint + chi2<20)



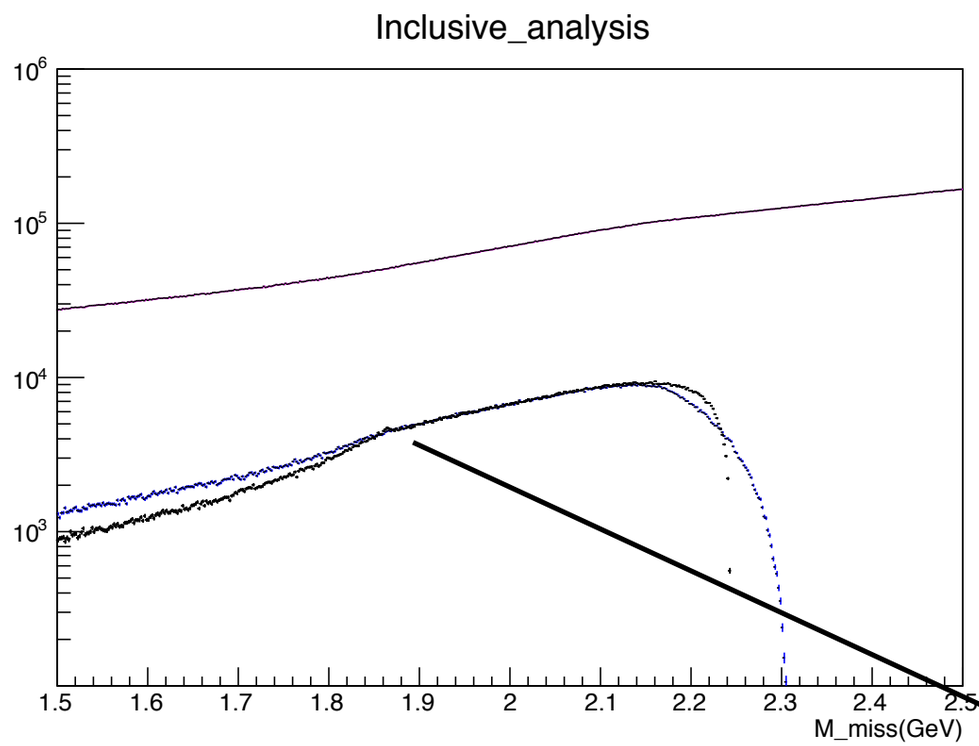
$$p\bar{p} \to D^0 + \bar{D}^0 \longrightarrow K^+\pi^-$$
$$\hookrightarrow K^-\pi^+$$

resolution(fast) ~7MeV

resolution(full): ~8MeV

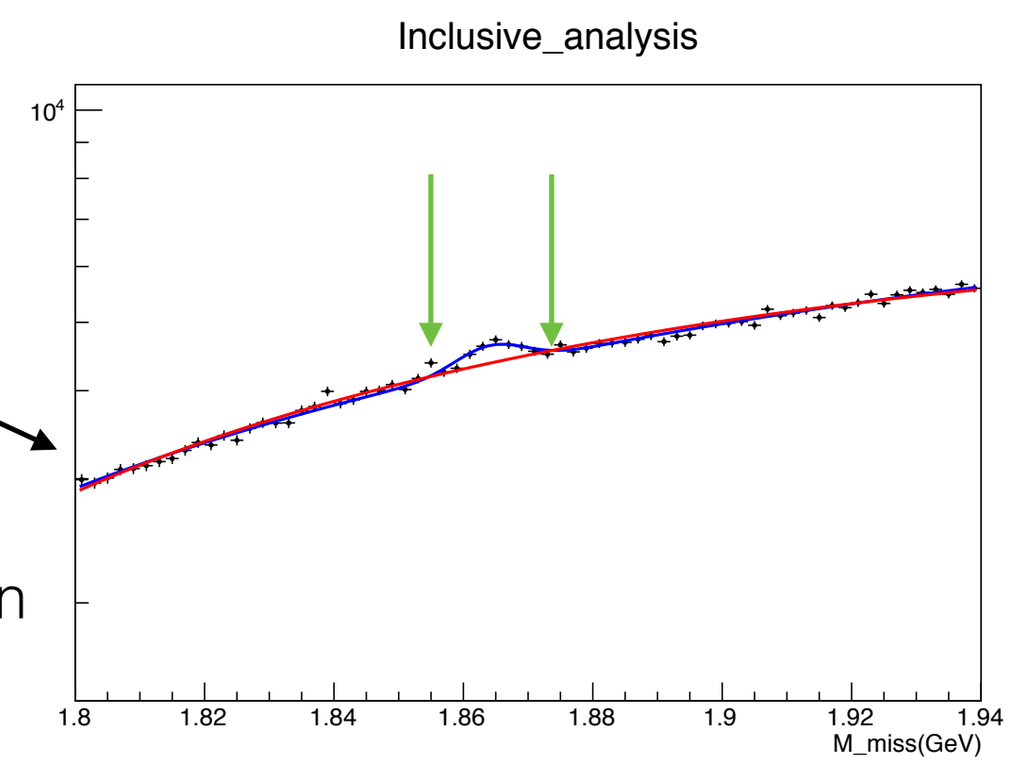
Efficiency loss for full simulations

Inclusive analysis



Cuts:

- Magenta: No cuts
- Blue: $\overline{D}^0$ (mass) =1.865 GeV +/- 3σ, $\overline{D}^0$ (energy) < 6.2 GeV, $\overline{D}$0 (theta) < 0.25rad
- Black: Blue+mass constraint in $\overline{D}^0$ +chi2<20

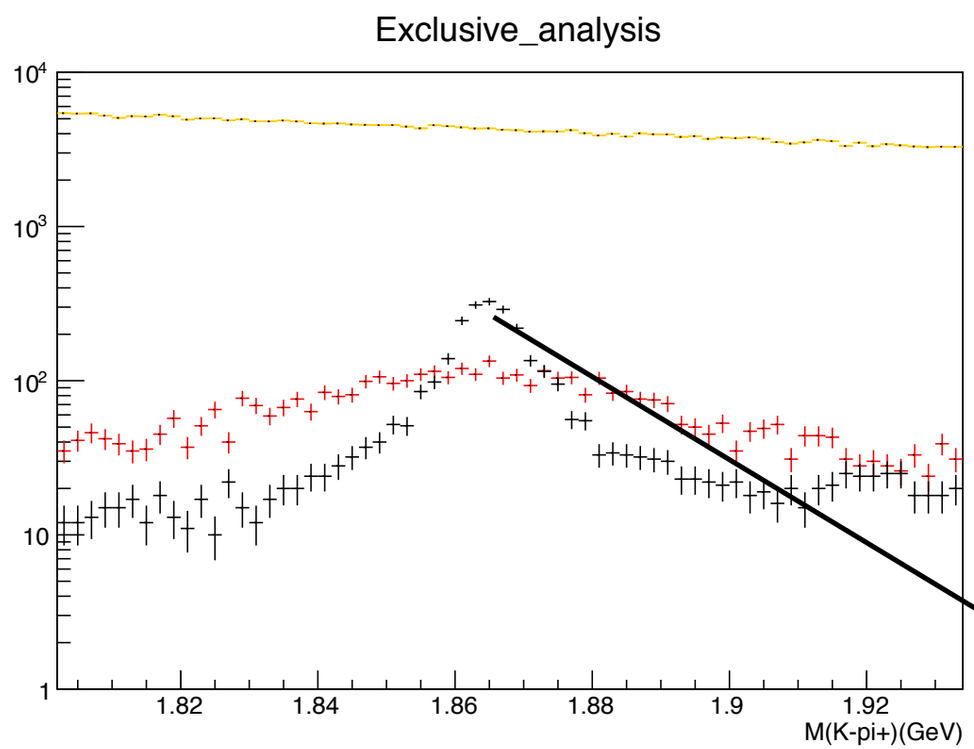


10^4 suppression

Fast Sim @ 8 GeV/c 5000 EvtGen evts + 2.5*10^9 DPM evts

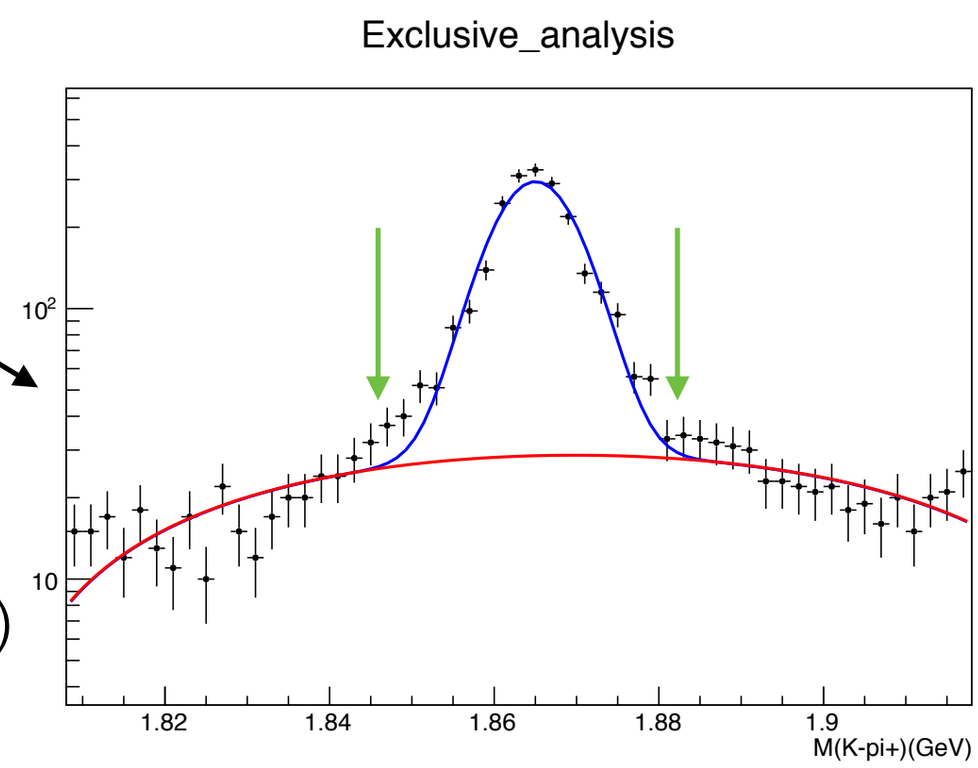
Alexandros Apostolou KVI-CART

Exclusive analysis



Cuts:

- Orange: No cuts
- Red: $\overline{D}^0$ (mass) =1.865 GeV +/- 3σ, $\overline{D}^0$ (energy) < 6.2 GeV, $\overline{D}$0 (theta) < 0.25rad, D^0 (energy) < 6.2 GeV, D0 (theta) < 0.25rad, $D^0\overline{D}^0$ (mass) >4GeV && < 4.2GeV
- Black: Red+4Cfit in $D^0\overline{D}^0$ +chi2<20



10^7 suppression
Background left: $K^-K^+\pi^-\pi^+$ (~9μb)

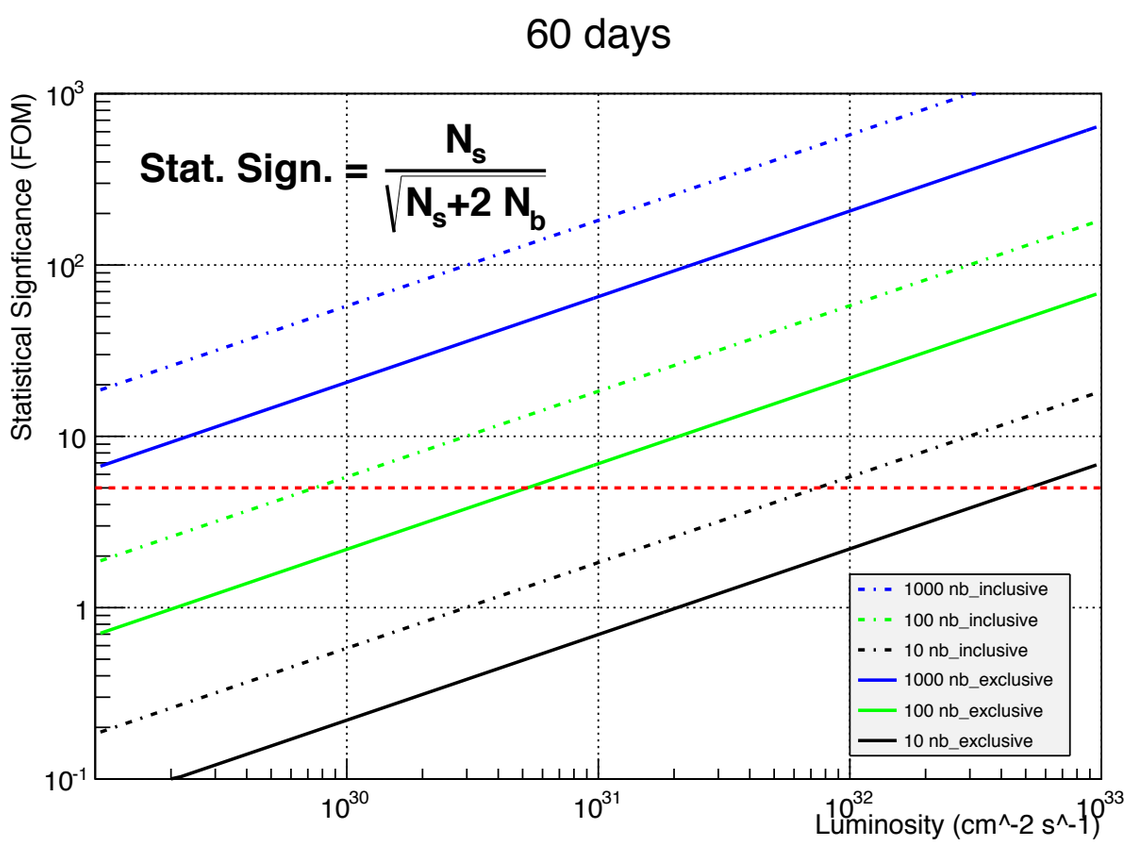
Fast Sim @ 8 GeV/c 5000 EvtGen evts + $2.5*10^9$ DPM evts

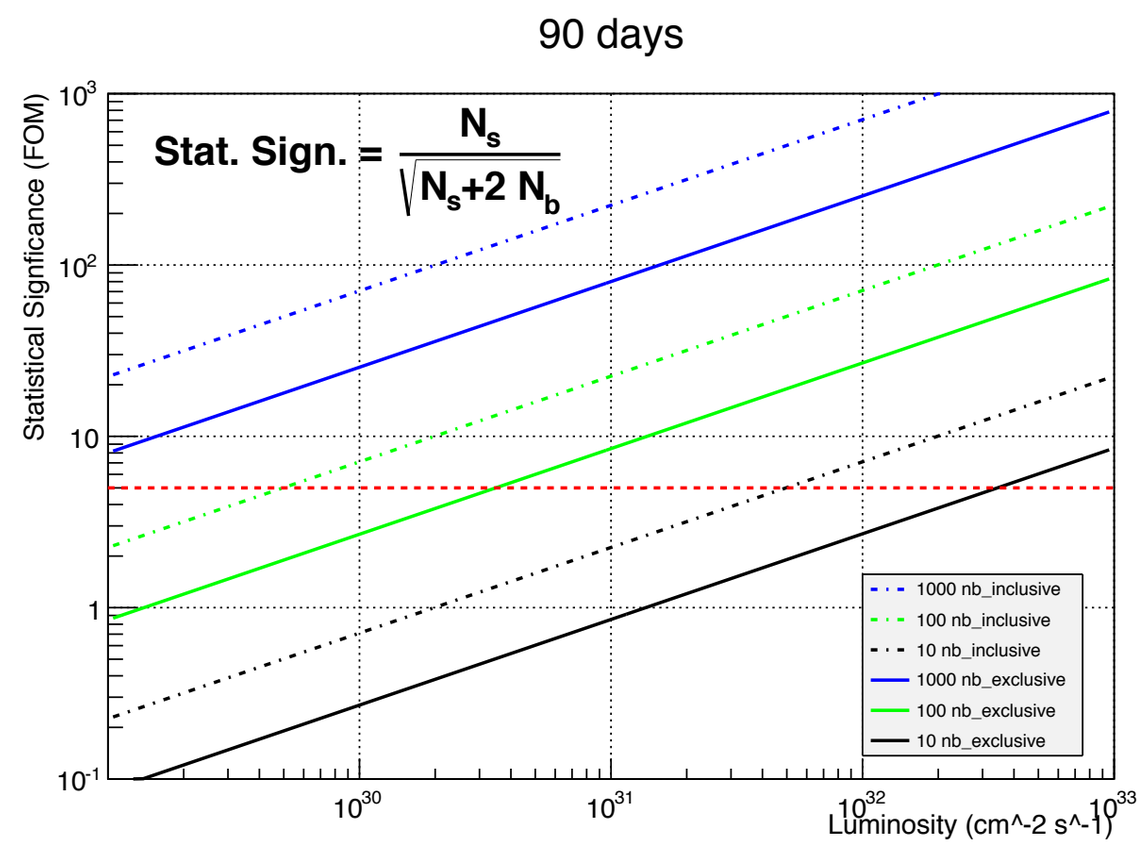
FoM-Time to achieve 5σ significance

Time needed to achieve 5σ significance = S / sqrt(S+2B)

1. Background cross section: ~ 50mb
2. Signal cross section: ~ 10nb, 100 nb, 1000nb
3. Efficiency: ~ 44% for exclusive, 66% for inclusive
4. Branching fraction: $(3.9*10^{-2})^2$ for exclusive and $2*(3.9*10^{-2})$ for inclusive
5. Luminosity: 10^{29} - 10^{32} cm^{-2} sec^{-1}
6. Background suppression: 10^7 for exclusive and 10^4 for inclusive

FoM-Time to achieve 5σ significance





Inclusive analysis improves FOM by a factor of 2!!!

Conclusion and future steps

- Nice agreement between fast and full simulations
- 4C fitter influences efficiency differently in fast and full simulations
- Available tools are working
- Inclusive analysis works efficiently -> For 10nb signal, 10^{32} luminosity needed
  -> For 100nb signal, 10^{31} luminosity needed
  -> 10^{30} luminosity: NO!!!

1. Apply vertex fitter to further reduce the background (ongoing analysis)
2. Insert more channels in the analysis ($D^0 \to K^- \pi^+ \pi^0$ and/or $D^0 \to K^0_s \pi^+ \pi^-$)