Weekly Update 2 - Semester 2

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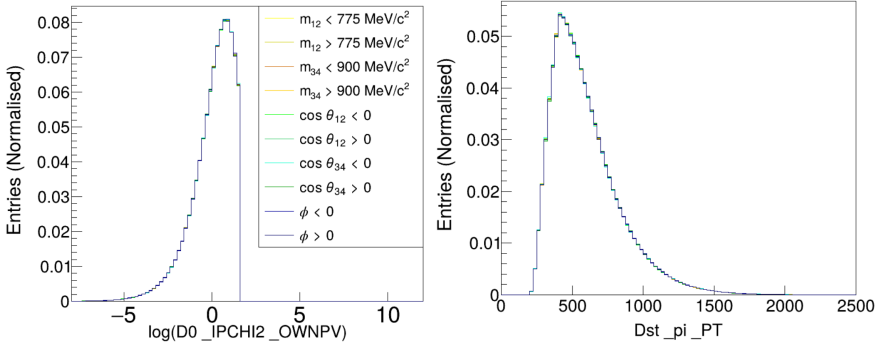
22^{th} Janurary 2025

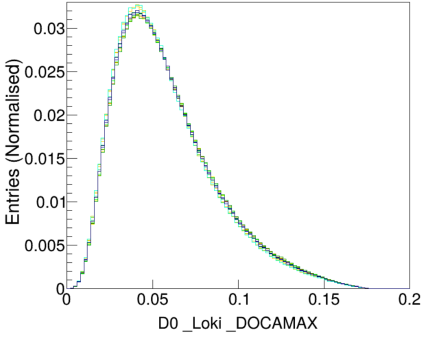
Tasks Undertaken

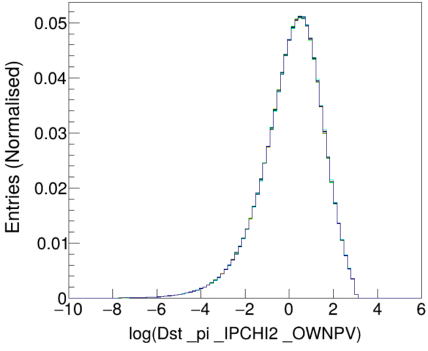
- log(D0_IPCHI2_OWNPV) cut at 1.6 taken.
- BDT variables - phase space dependencies - checked.
- Mass Fitting the new RS and WS samples with the "new" cut.
- Δm background is modelled with: $(\Delta m - 139.5 MeV)^{\alpha} e^{-\beta(\Delta m - 139.5 MeV)}$

Phase Space Dependencies in BDT variables

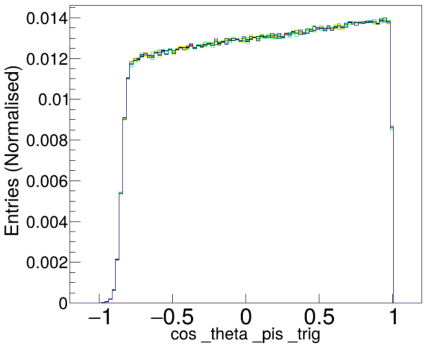


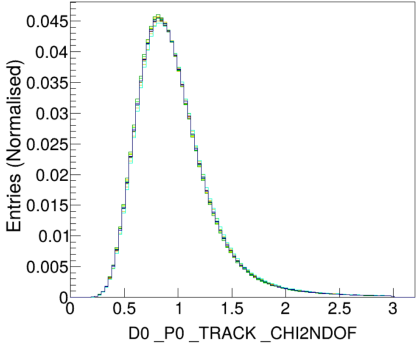
Phase Space Dependencies in BDT variables



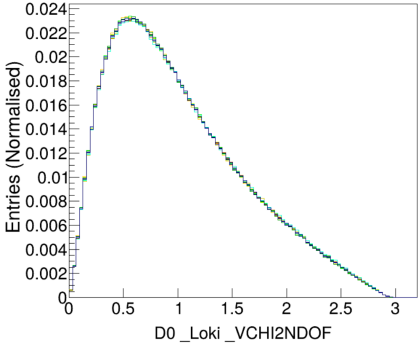


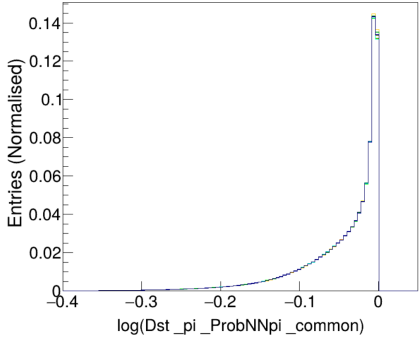
Phase Space Dependencies in BDT variables



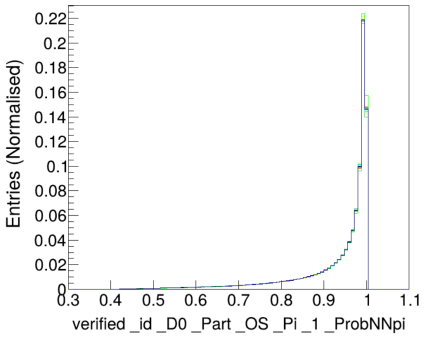


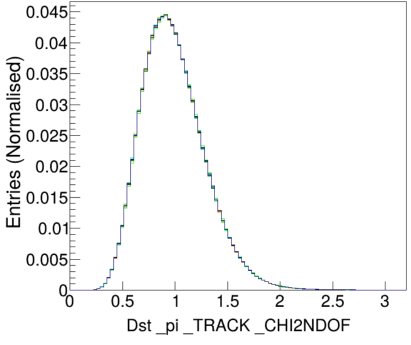
Phase Space Dependencies in BDT variables



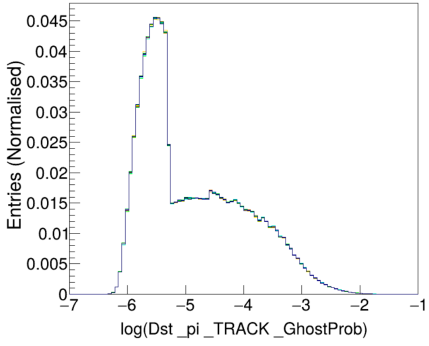


Phase Space Dependencies in BDT variables



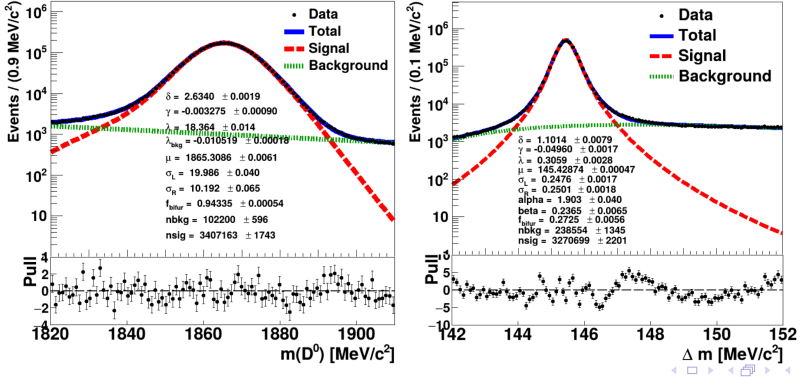


Phase Space Dependencies in BDT variables



RS Mass fitting with new log(D0_IPCHI2_OWNPV) cut at 1.6

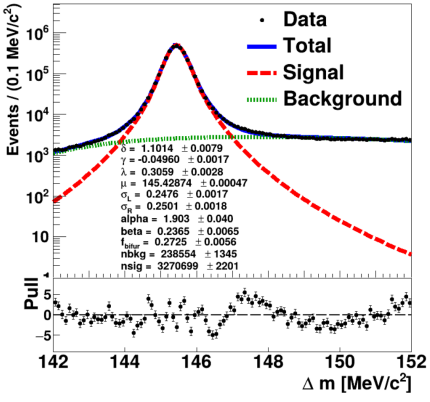
RS 1D Mass Fit: Dst_ReFit_D0_M_best and deltam_ReFit: (Signal = Johnson & Bifurcated Gaussian), (Background = Negative Exponential/ Power Law)



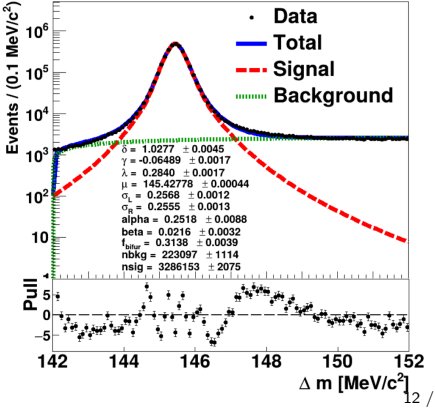
RS: 1D Δm fit

- Background modelled with $(\Delta m - m_\pi)^\alpha e^{-\beta(\Delta m - m_\pi)}$
- We look at the effect of varying the pion mass: $m_\pi = 139.5 MeV$ or $m_\pi = 142 MeV$

RS Deltam_ReFit 1D Mass Fit, varying m_π 139.5MeV and 142MeV

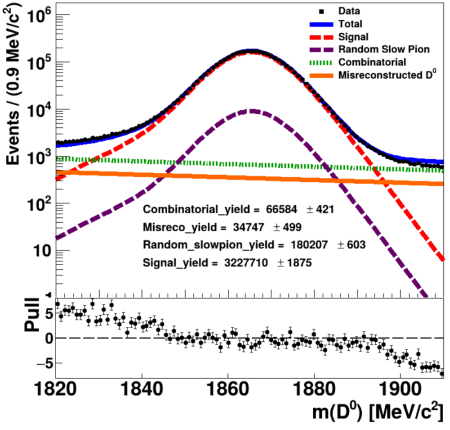


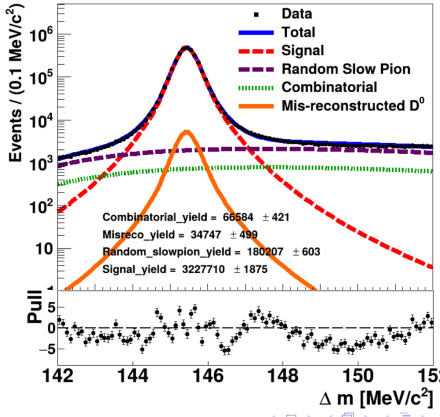
(a) $m_\pi = 139.5MeV$



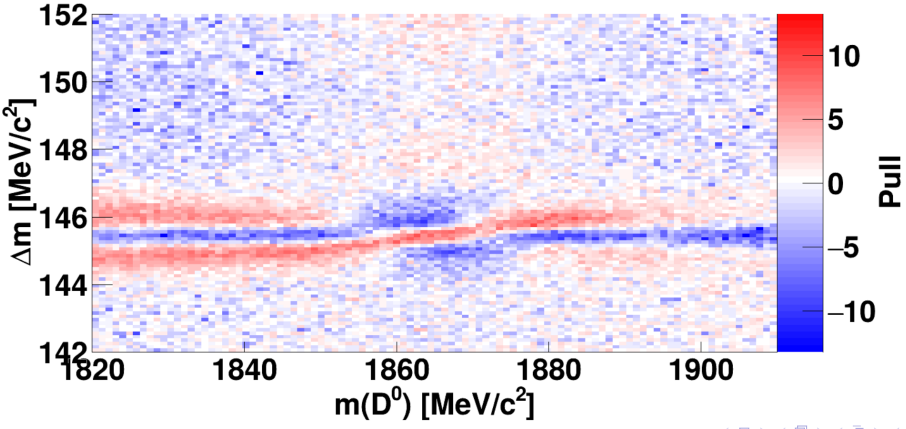
(b) $m_\pi = 142MeV$

RS 2D Mass Fit

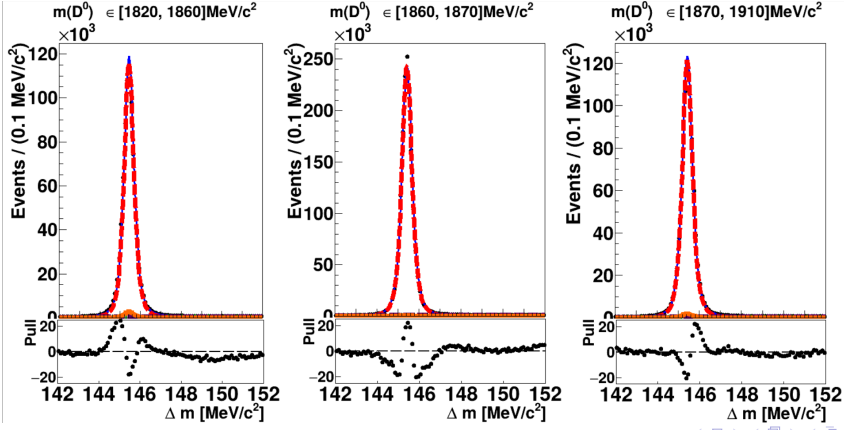




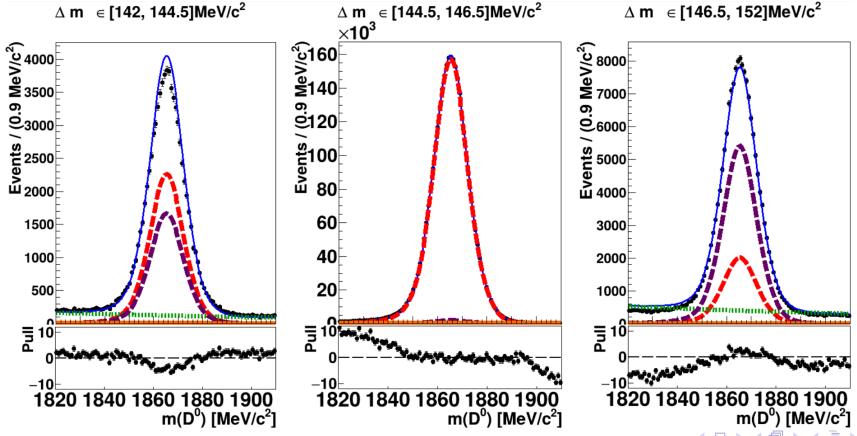
RS 2D Mass Fit - 2D Pull Plot



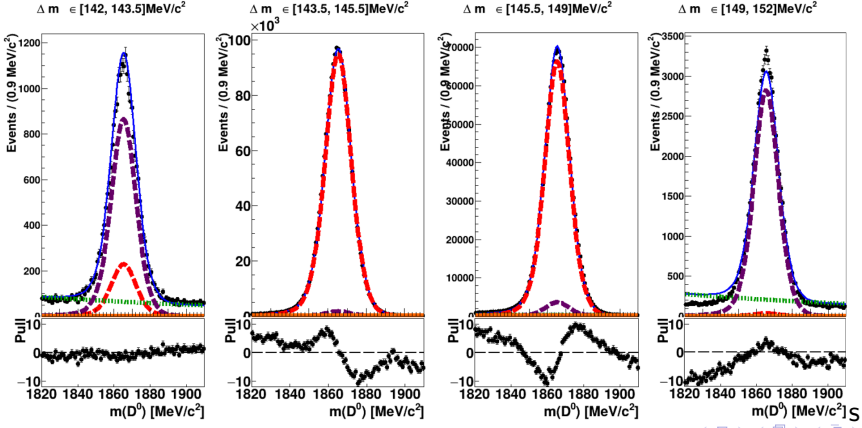
RS 2D Mass Fit, Projections.



RS 2D Mass Fit, Projections.



RS 2D Mass Fit, Projections.

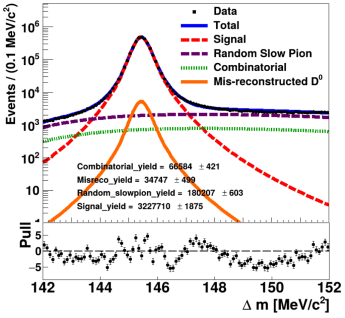


RS: 2D Mass fit

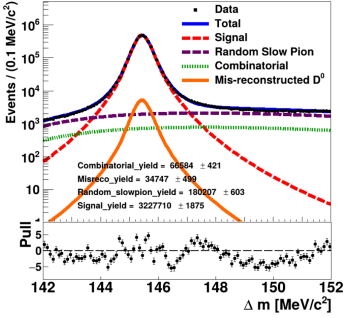
- Look at the effect of Loosening Parameters in the 2D Mass fit.
- Starting with the Δm widths, so σ_R & σ_L of the Bifurcated Gaussian, fractionally 0.2725 of the total signal PDF.

RS: 2D mass fit with loosened Deltam_ReFit Bifurcted Gaussian width

- σ_L: *before* $= 0.2476 \pm 0.0017$, *after* $= 0.24542 \pm 0.00055$.
- σ_R: *before* $= 0.2501 \pm 0.0018$, *after* $= 0.24800 \pm 0.00057$.



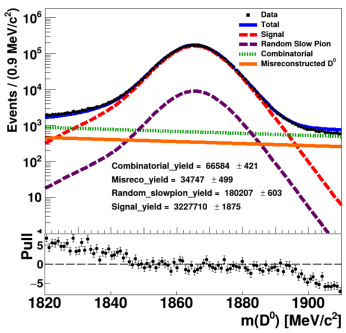
(a) Before



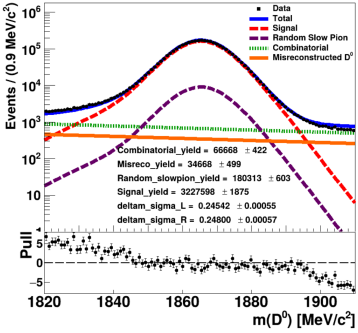
(b) After

RS: 2D mass fit with loosened Deltam_ReFit Bifurcted Gaussian widths

- σ_L: *before* $= 0.2476 \pm 0.0017$, *after* $= 0.24542 \pm 0.00055$.
- σ_R: *before* $= 0.2501 \pm 0.0018$, *after* $= 0.24800 \pm 0.00057$.



(a) Before



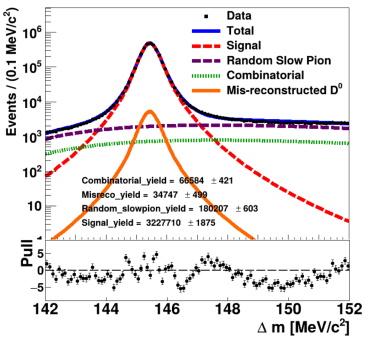
(b) After

RS: 2D Mass fit

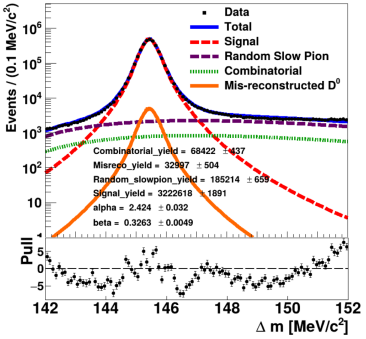
- Varying Δm background parameters, α, β.
- Δm background PDF: $(\Delta m - m_\pi)^\alpha e^{-\beta(\Delta m - m_\pi)}$

RS: 2D mass fit with loosened Deltam_ReFit background parameters

- α: *before* $= 1.903 \pm 0.040$, *after* $= 2.424 \pm 0.032$
- β: *before* $= 0.2365 \pm 0.0065$, *after* $= 0.3263 \pm 0.0049$



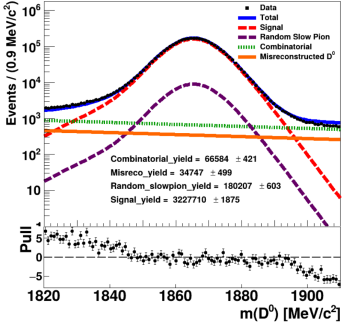
(a) Before



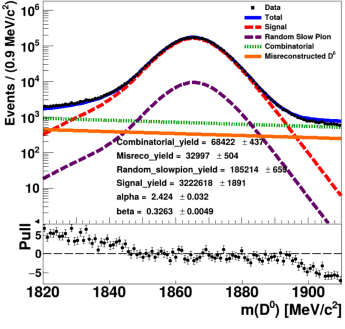
(b) After

RS: 2D mass fit with loosened Deltam_ReFit background parameters

- α: *before* $= 1.903 \pm 0.040$, *after* $= 2.424 \pm 0.032$
- β: *before* $= 0.2365 \pm 0.0065$, *after* $= 0.3263 \pm 0.0049$



(a) Before



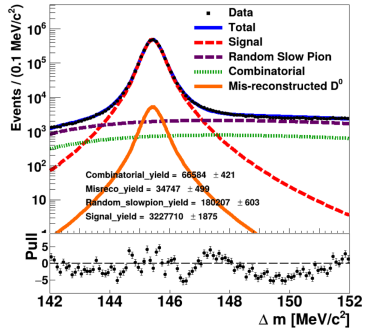
(b) After

RS: 2D Mass fit

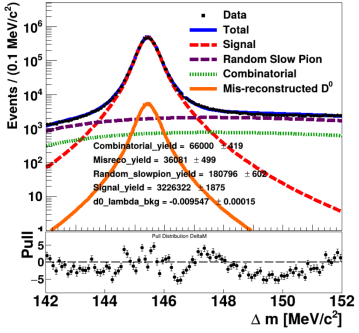
- Varying $m(D^0)$ (Dst_ReFit_D0_M_best) background parameter, $\lambda_{bkg}^{D^0}$.
- $m(D^0)$ background PDF: $e^{-\lambda_{bkg}^{D^0}}$

RS: 2D mass fit with loosened Dst_ReFit_D0_M_best background parameter

- $\lambda_{bkg}^{D^0}$: $before = -0.010519 \pm 0.00018$, $after = -0.009547 \pm 0.00015$



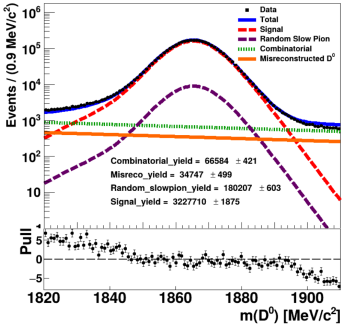
(a) Before



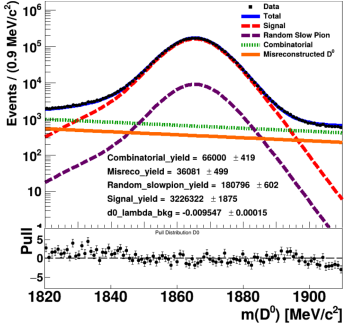
(b) After

RS: 2D mass fit with loosened Dst_ReFit_D0_M_best background parameter

- $\lambda_{bkg}^{D^0}$: $before = -0.010519 \pm 0.00018$, $after = -0.009547 \pm 0.00015$

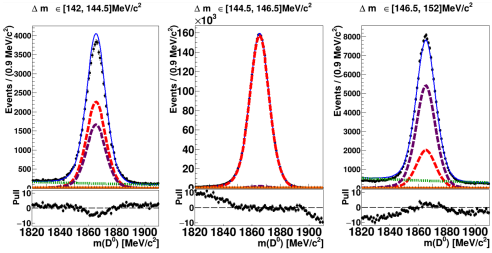


(a) Before

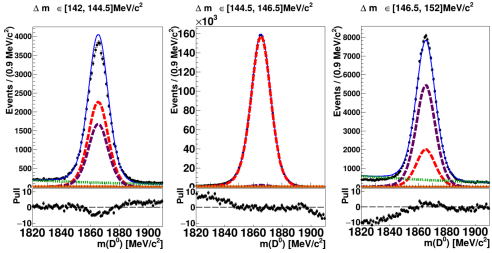


(b) After

RS: 2D mass fit projections with loosened Dst_ReFit_D0_M_best background parameter

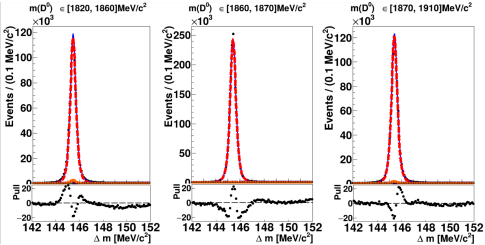


(a) Before

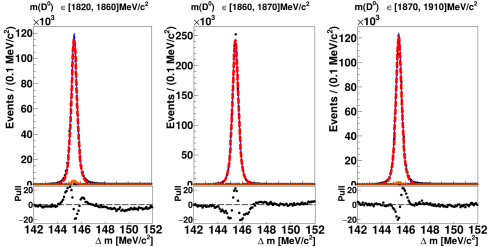


(b) After

RS: 2D mass fit projections with loosened Dst_ReFit_D0_M_best background parameter



(a) Before

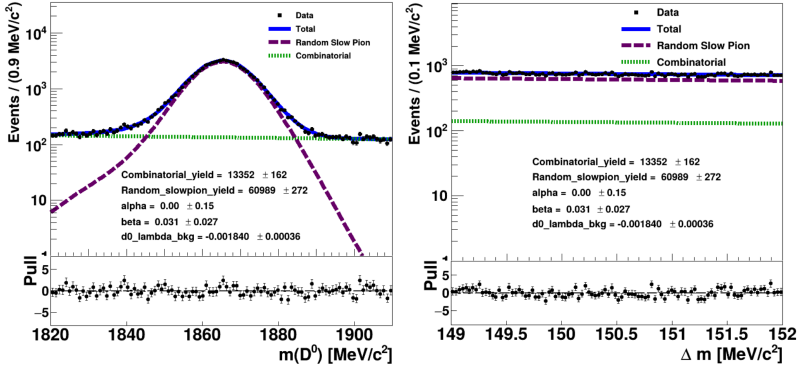


(b) After

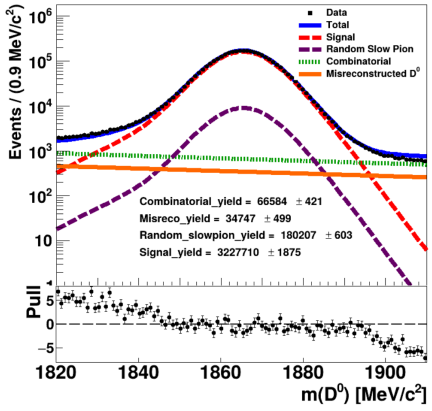
RS: 2D Mass fit, Looking at Combinatorial events in right Δm sideband

- Perform a 2D mass fit while loosening both Δm and $m(D^0)$ background parameters and keeping all signal parameters fixed from 1D mass fits.
- This fit assumes signal contribution in Δm right side band is 0, signal included fit didn't work (yet).
- From this we can see if there is Combinatorial leakage into RSP in this region.

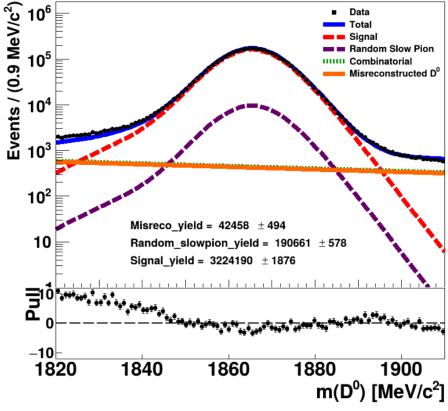
Combinatorial events $\in [149, 152] MeV = 13352$, assuming flat the total combinatorial events for the whole mass range $\frac{13352}{3} * (152 - 142) = 44506$



RS: 2D mass with fixed Combinatorial yield

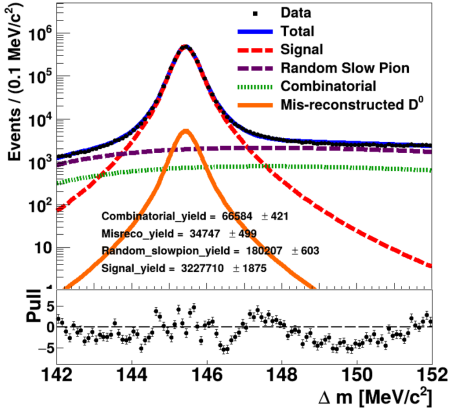


(a) Before

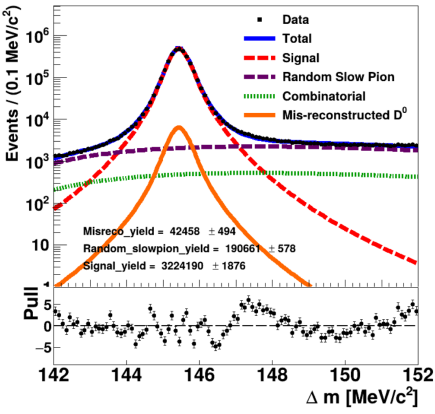


(b) After

RS: 2D mass with fixed Combinatorial yield

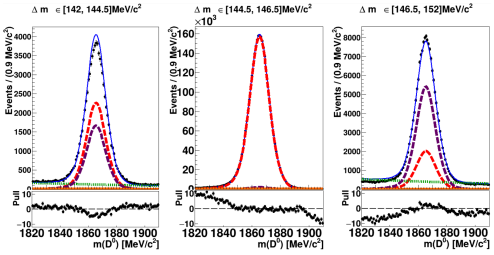


(a) Before

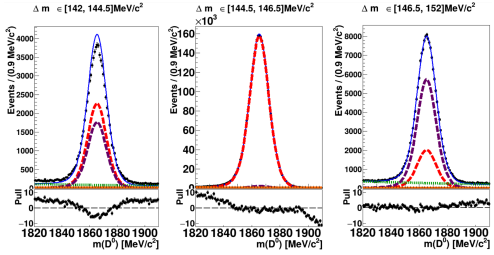


(b) After

RS: 2D mass fit projections with fixed Combinatorial yield

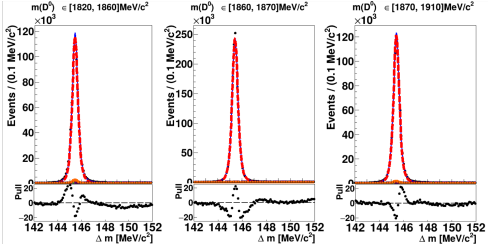


(a) Before

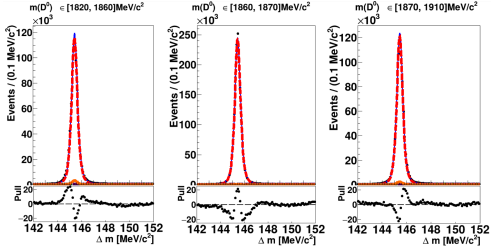


(b) After

RS: 2D mass fit projections with fixed Combinatorial yield



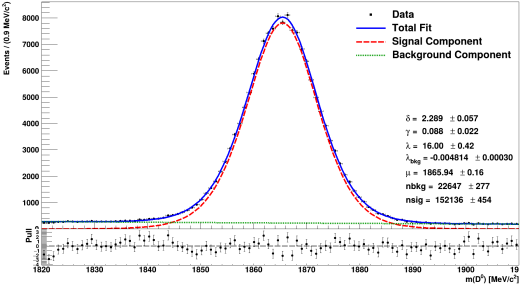
(a) Before

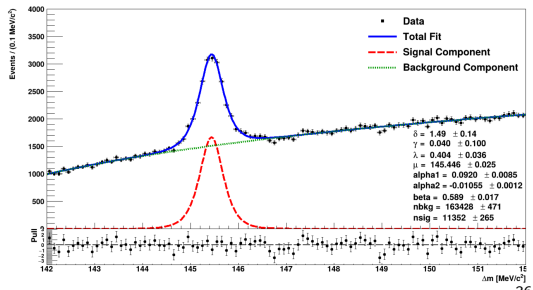


(b) After

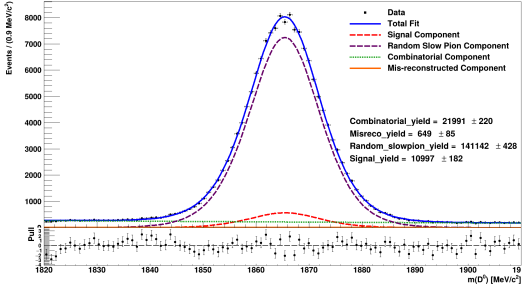
WS Mass Fits

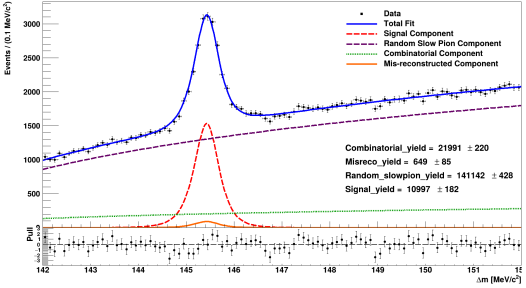
WS 1D Mass Fit: Dst_ReFit_D0_M_best and deltam_ReFit: (Signal = Johnson & Bifurcated Gaussian), (Background = Negative Exponential/ Power Law)





WS 2D Mass Fit





WS 2D Mass Fit - 2D Pull Plot