Run 12 W → μ analysis update

NPLab Internal Meeting

Oct. 7th, 2013

Chong Kim

Outline

- **Analysis process revisited**
- **Update in Wness: FVTX variables included**
  - Wness distributions
  - Signal efficiencies
  - Ongoing discussion
- **Summary and To do**

Analysis process revisited: Before update

After preselection by Basic cut,
use signal-sensitive kinematic variables:
DG0, **DDG0**, **chi2**, **DCA_r**, **Rpc(1/3)Dca**

W (MC)
μ BG (MC)
data

* 3 different set of MC exist
WRT BBCLL1 trigger rate

Calculate PDFs for each input files
* PDF: probability density function

W Likelihood $\leftrightarrow f(x_i) = \frac{\lambda_w(x_i)}{\lambda_w(x_i) + \lambda_{data}(x_i)}$

* $\lambda_{data} \fallingdotseq$ sum of BGs

Apply likelihood cut (usually > **.92**) + Scale by luminosity

Get W-likelihood cut applied **dw23** and **η**

* **dw23 = $p_T \times \sin\theta \times d\phi$23**

Hadron BG MC N/A for now

***W* PDF** by *W* MC

μ BG PDF by μ BG MC

Hadron BG PDF by data driven

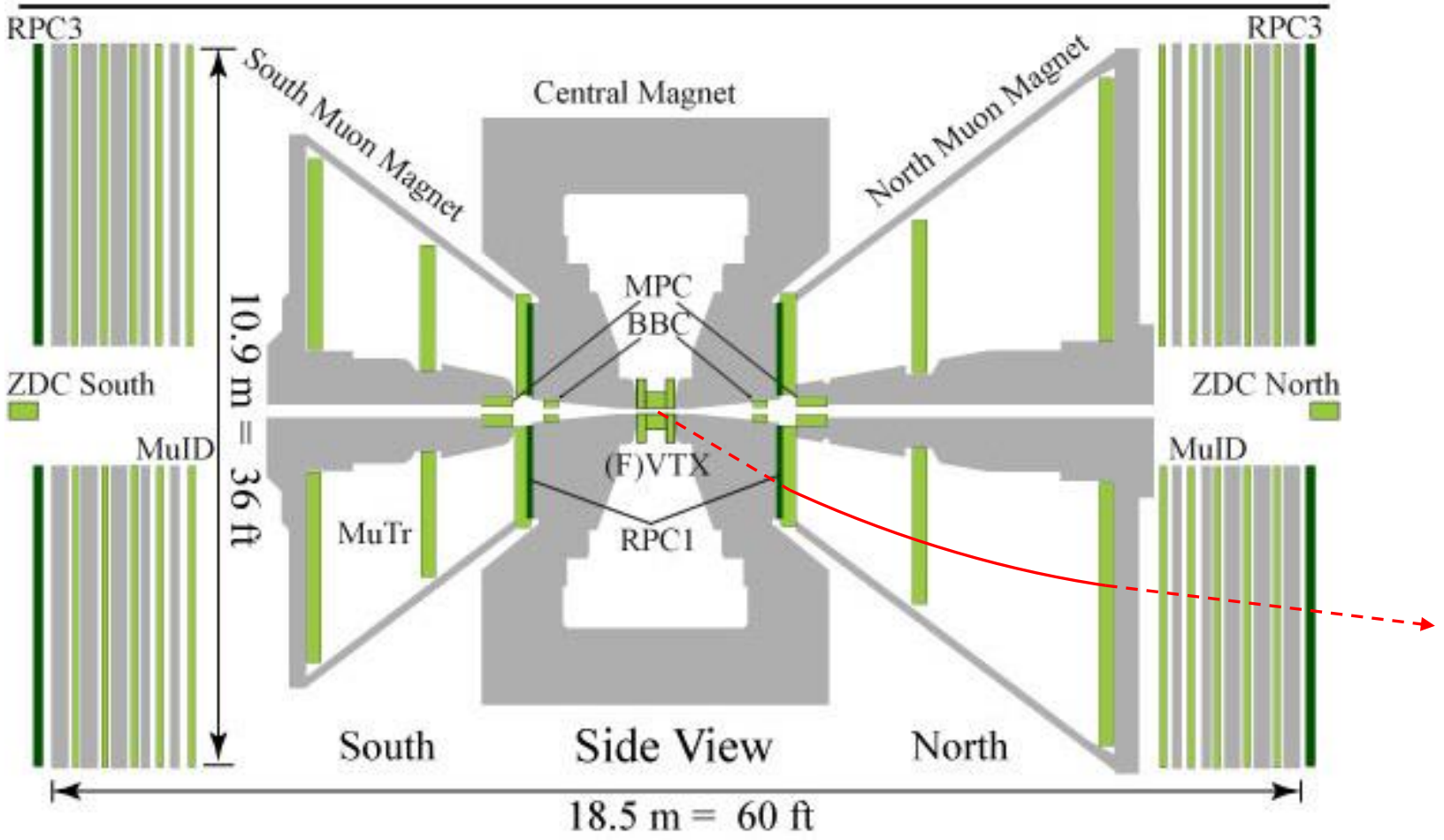
Final PDF

Perform unbinned max. likelihood fit

to data which satisfy likelihood cut

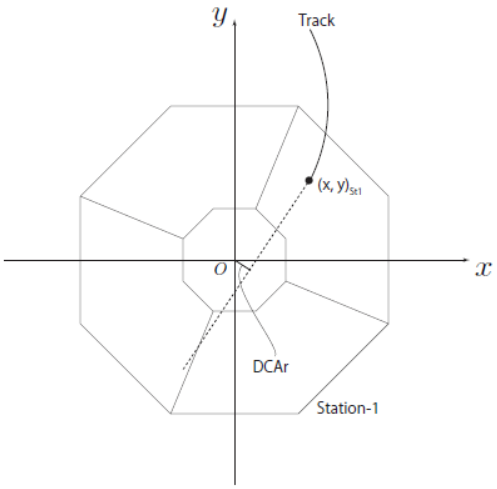
Analysis process revisited: Meaning of variables

PHENIX Muon Arms

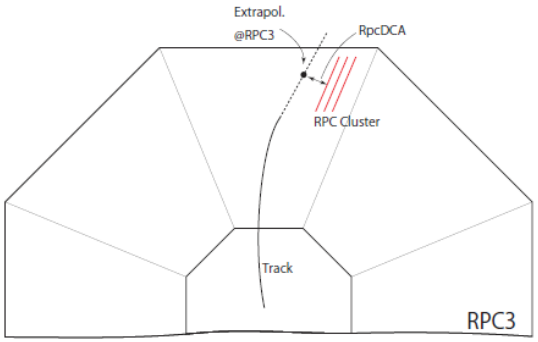


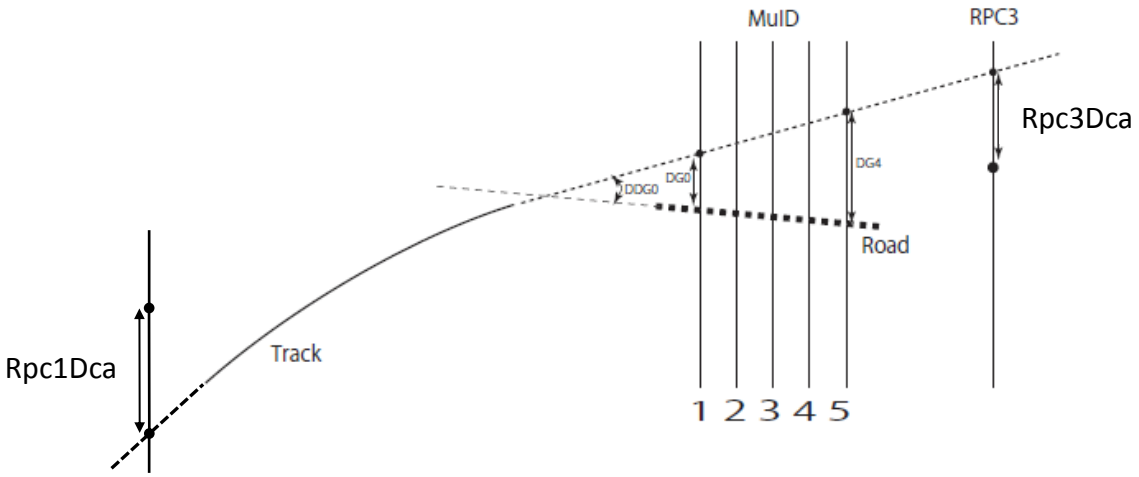
Analysis process revisited: Meaning of variables

* These figures shamelessly stolen from thesis of Hideyuki Oide



Beam view





Side view

Update in Wness: Updated process for likelihood fit

Signal-sensitive kinematic variables
(**DG0**, **DDG0**, **chi2**, **DCA_r**, **Rpc(1/3)Dca**)
+ (**FVTX_dr**, **FVTX_dϕ**, **FVTX_dθ**)

W (MC)
μ BG (MC)
data

* 3 different set of MC exist
WRT BBCLL1 trigger rate

Calculate PDFs for each input files
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W Likelihood $\leftrightarrow f(x_i) = \frac{\lambda_w(x_i)}{\lambda_w(x_i) + \lambda_{data}(x_i)}$

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Apply likelihood cut (usually > **.92**) + Scale by luminosity

Get W-likelihood cut applied **dw23** and **η**

* **dw23 = $p_T \times \sin\theta \times d\phi 23$**

Hadron BG MC N/A for now

***W* PDF** by *W* MC

μ BG PDF by μ BG MC

Hadron BG PDF by data driven

Final PDF

Perform unbinned max. likelihood fit

to data which satisfy likelihood cut

Update in Wness: Conditions

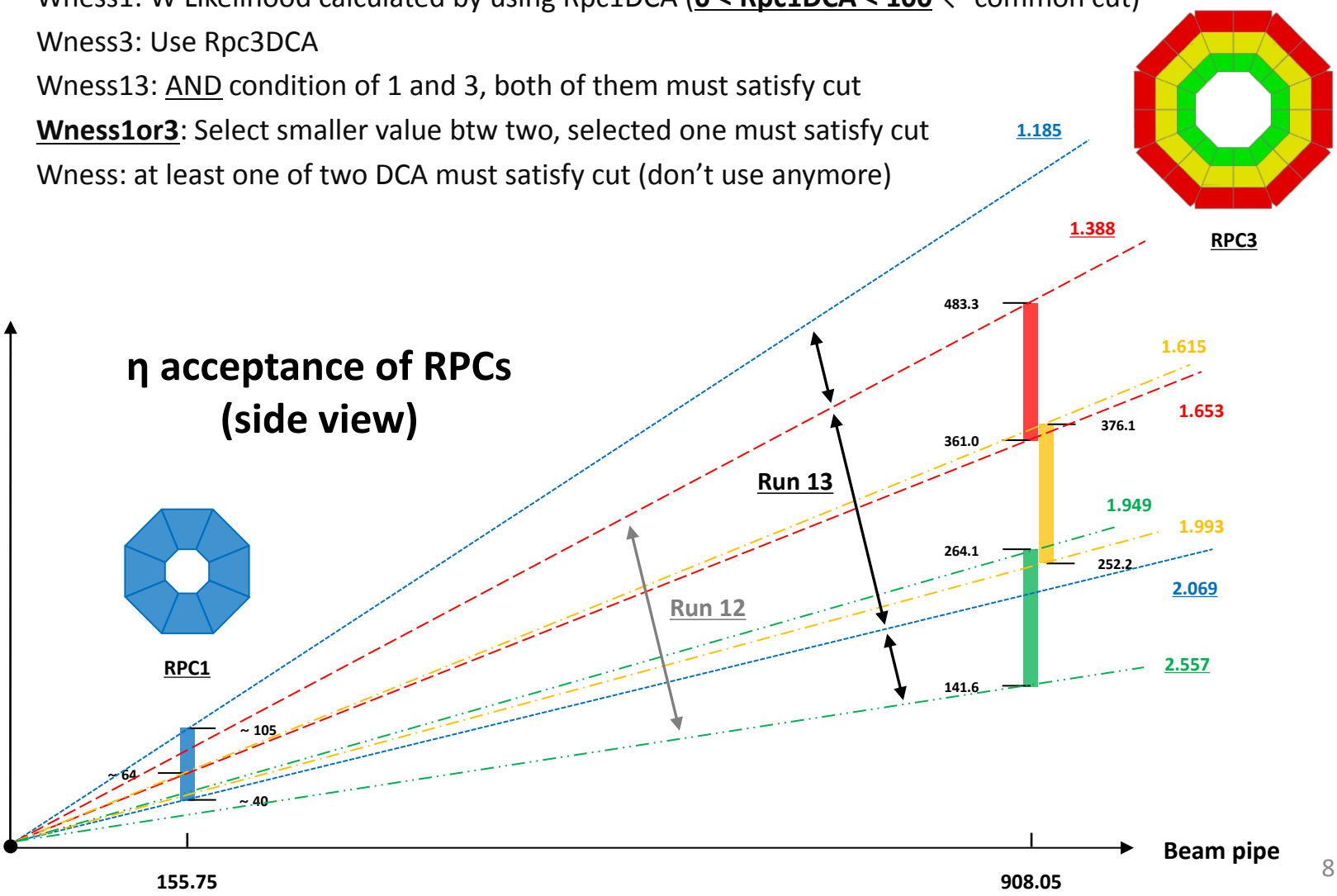
- **Added 3 FVTX variables (dr, dϕ, and dθ) in Wness calculation**
  - Input:
    - Data: pp510Run12 official pDSTs (produced in 2013 May), produced by Ralf
    - MC: 'high' condition MC set (Reference Run: 367593), produced by Ralf
      → Signal: W, Zonly
      → μ BG: Direct γ, onium, openbottom, opencharm, Whad, Wtau, and Z
  - All the other conditions (Basic cut, PDF calculation, etc…) are same except addition of FVTX variables
  - Didn't checked correlation to the original variables yet (but I do NOT expect serious correlation)
  - To check effect of newly added variables, checked:
    - Wness (W likelihood) distributions before/after update
    - Signal efficiencies ((# of μ > W likelihood condition) / total # of μ) before/after update

    ↑ above two items checked by:

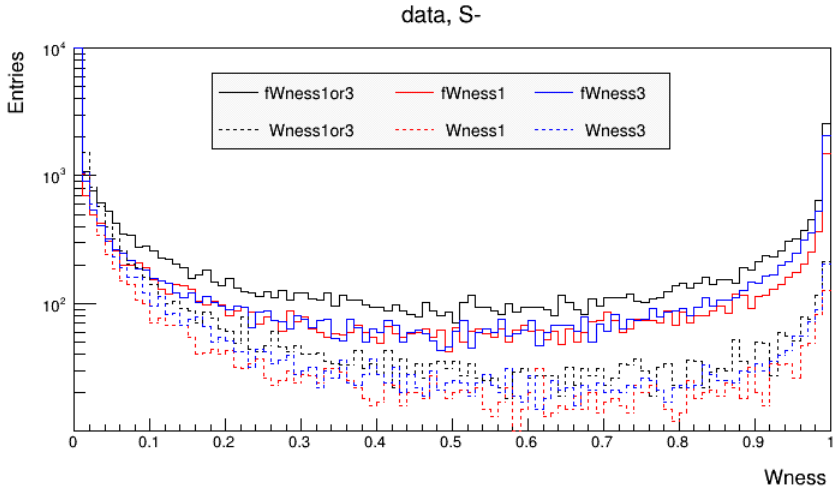
    3 different RpcDCA (Wness1or3, Wness1, and Wness3) and
    3 different Input (data, W and Zonly)

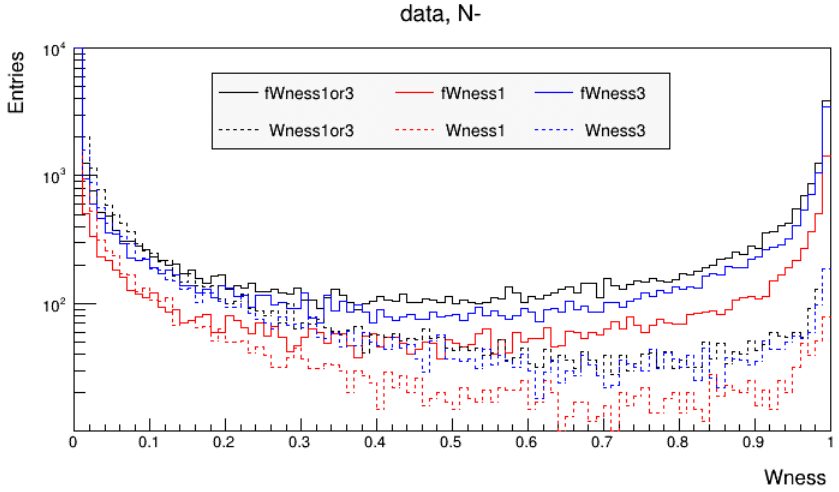
Update in Wness: Conditions

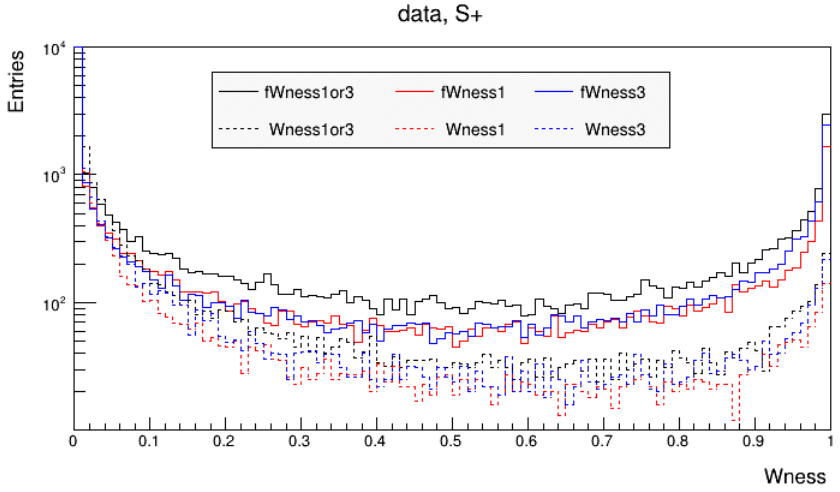
- **About RpcDCA and Wness…**
  - Wness1: W Likelihood calculated by using Rpc1DCA (**0 < Rpc1DCA < 100** ← common cut)
  - Wness3: Use Rpc3DCA
  - Wness13: AND condition of 1 and 3, both of them must satisfy cut
  - **Wness1or3**: Select smaller value btw two, selected one must satisfy cut
  - Wness: at least one of two DCA must satisfy cut (don't use anymore)

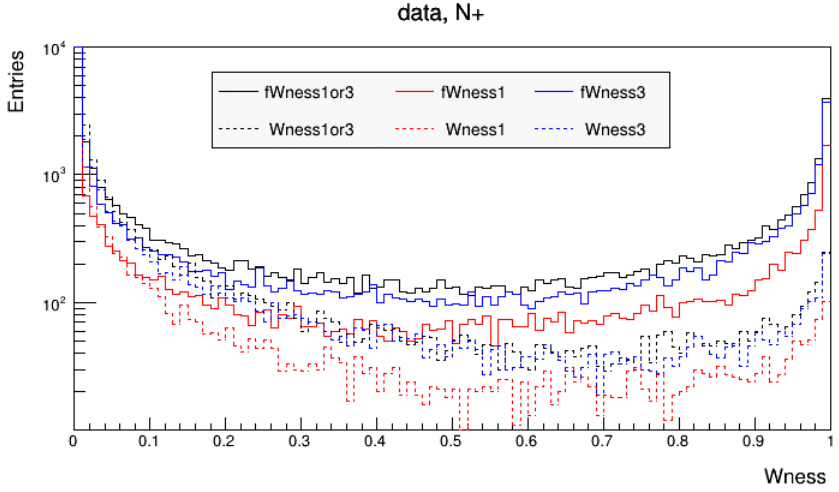


Update in Wness: Wness distributions, for **data**



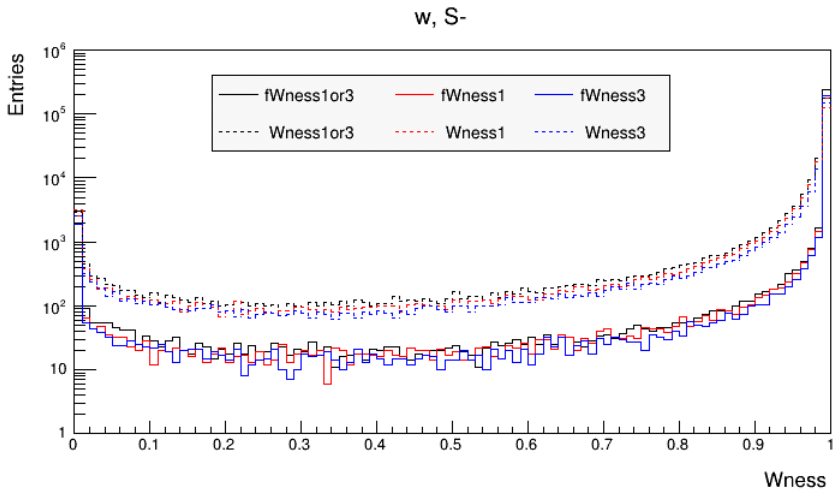


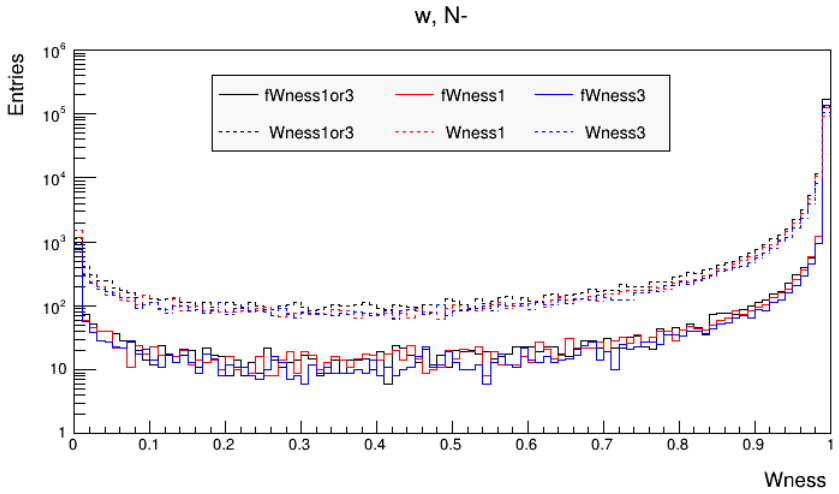


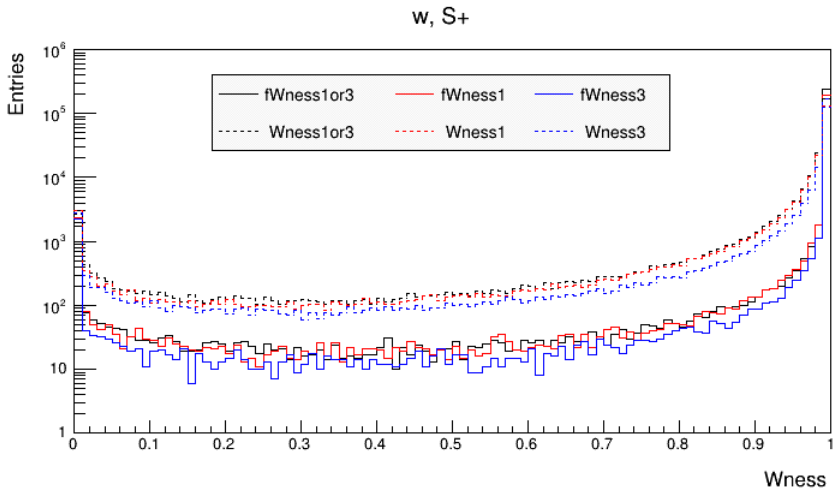


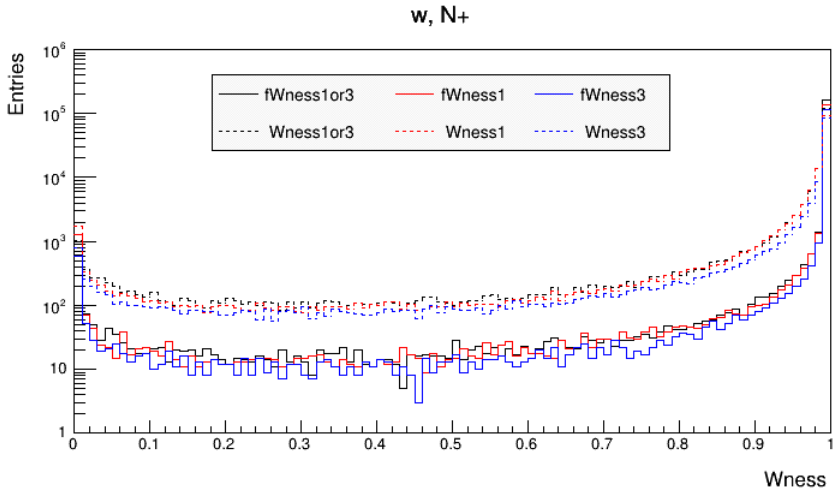
- **Solid** line: **after** update**, Dotted** line: **before** update
- Amount of **Wness < 0.01** events decreased ~ 50,000 after update (cannot see in these plots)

Update in Wness: Wness distributions, for **W** (MC)

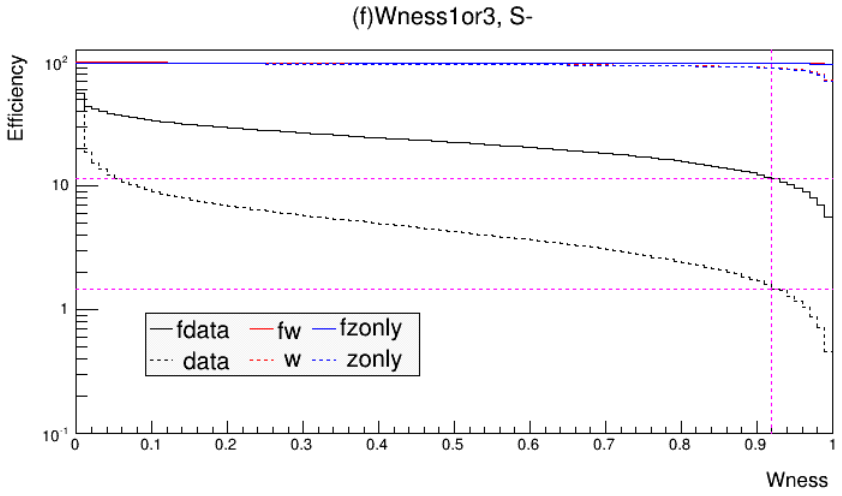


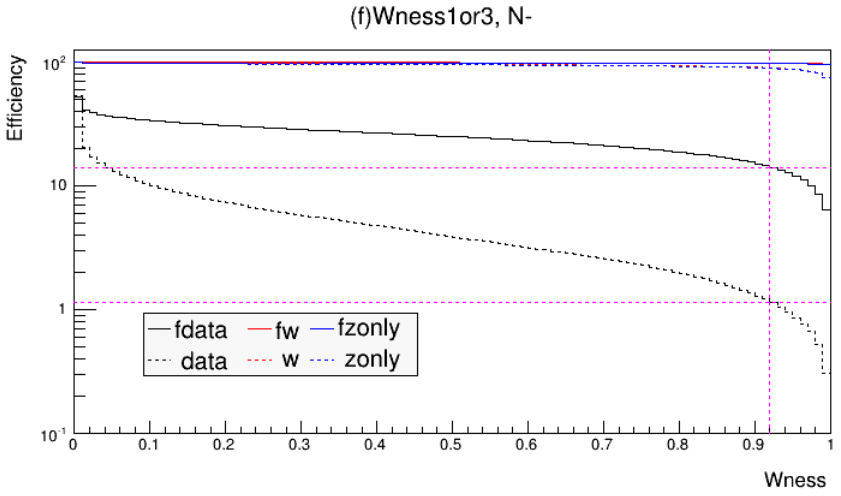


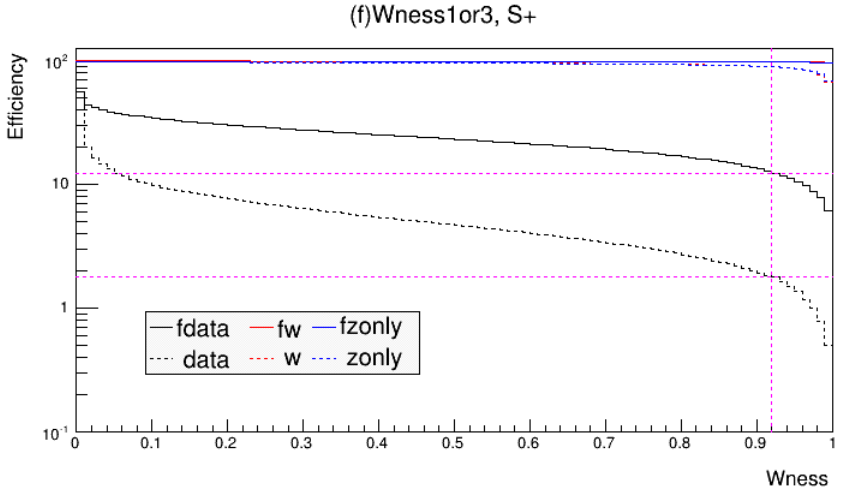


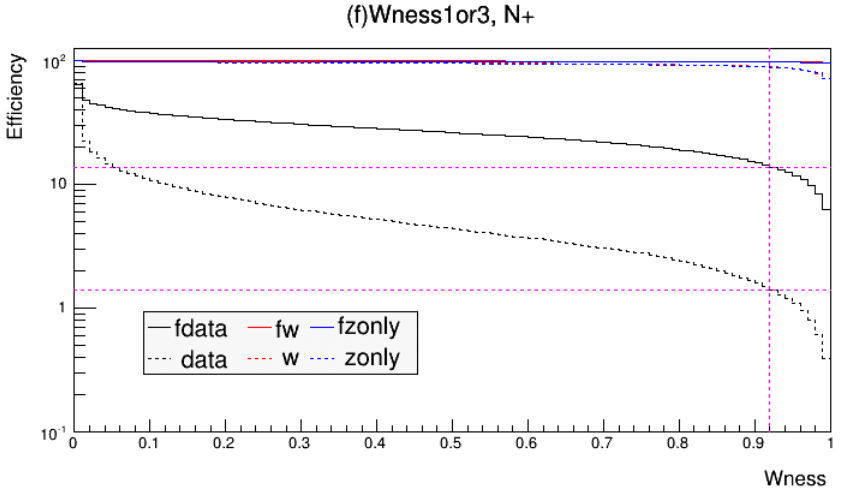


Update in Wness: Signal efficiencies, for **(f)Wness1or3**

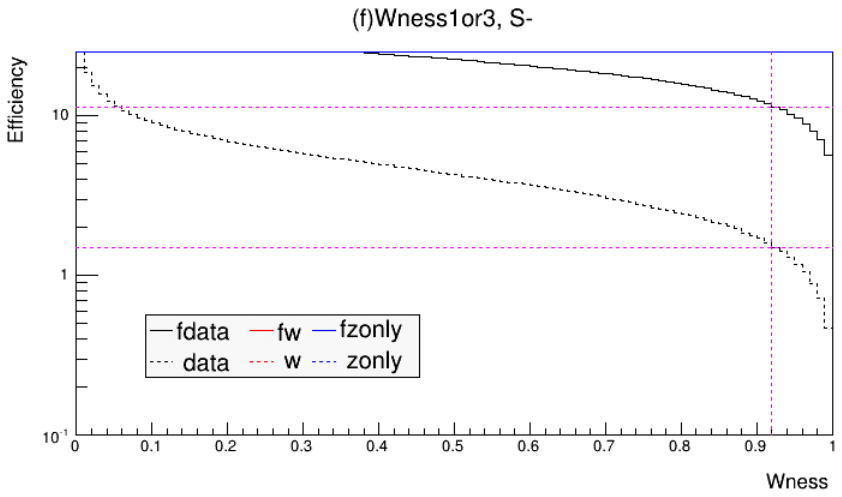


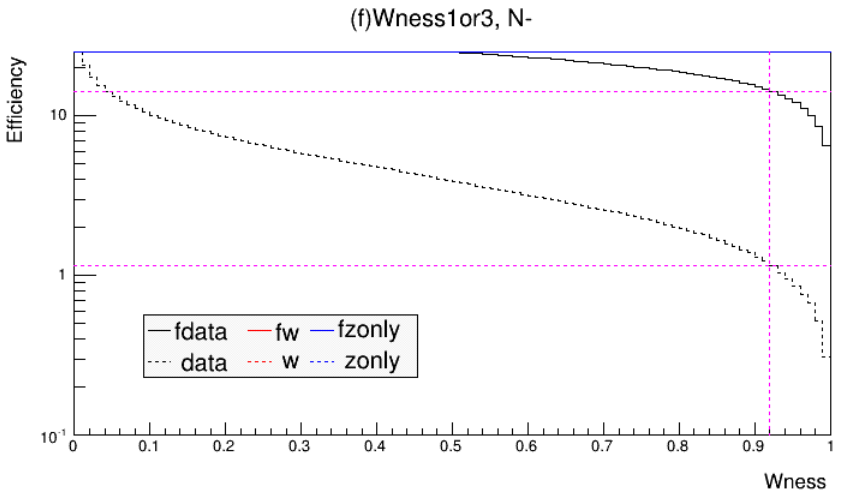


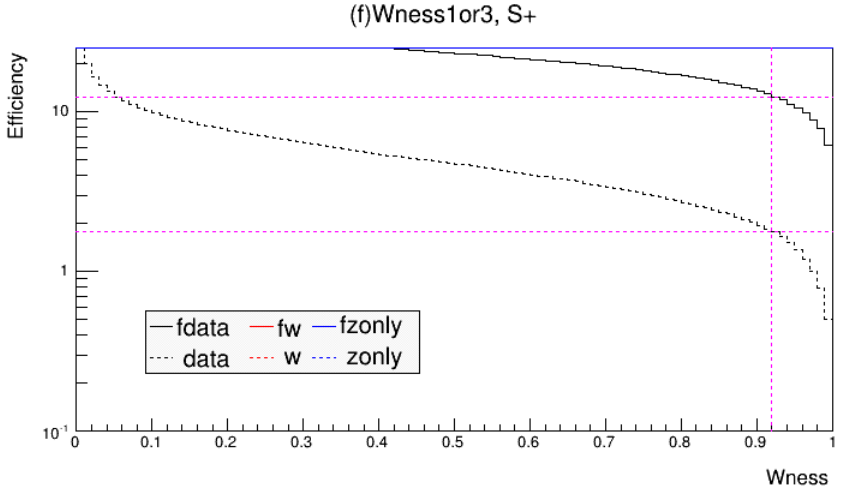


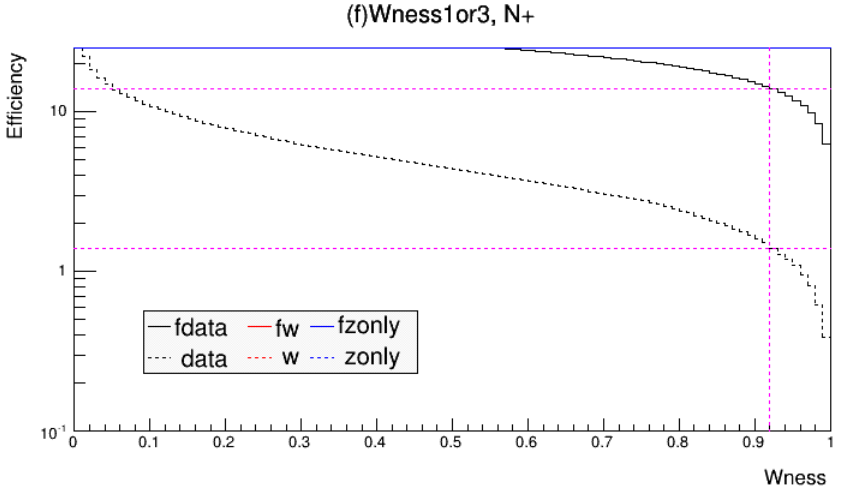


Update in Wness: Signal efficiencies, for **(f)Wness1or3**



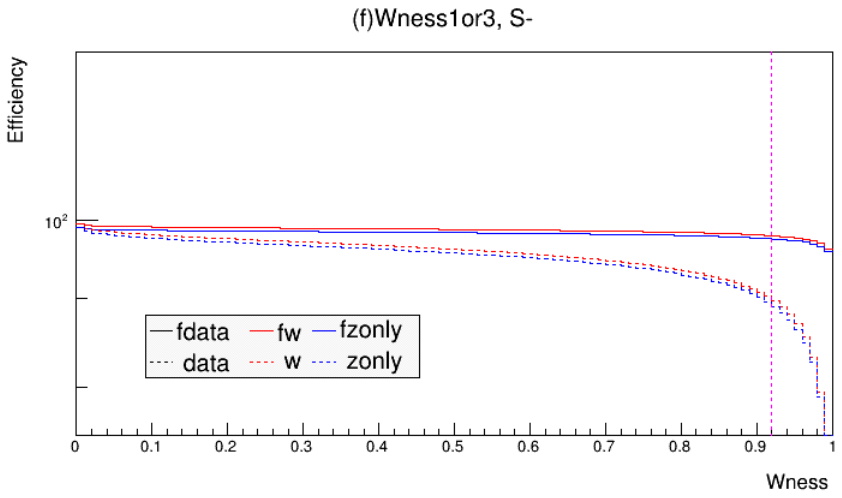


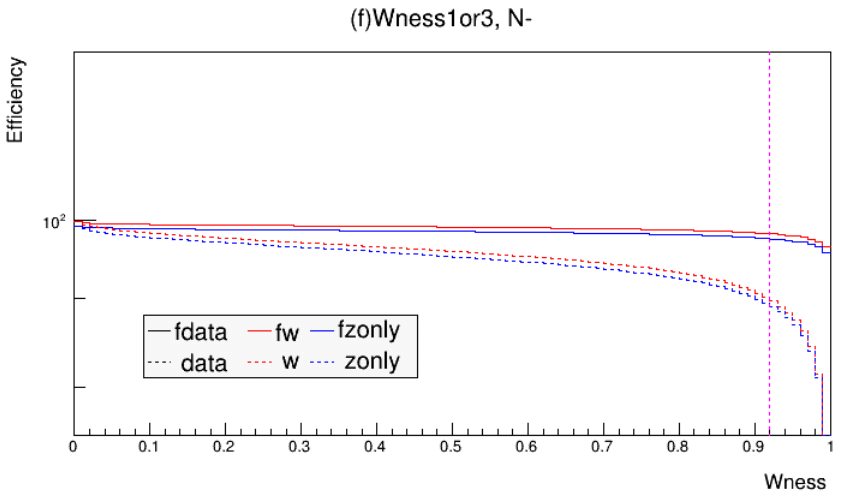


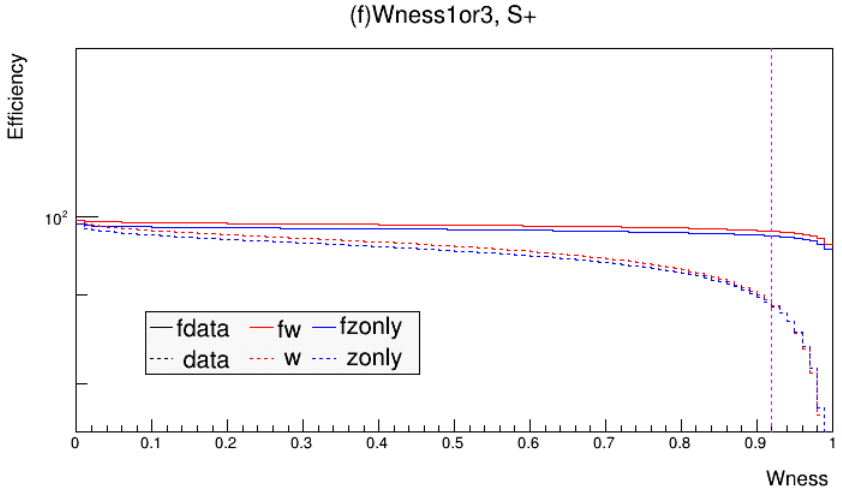


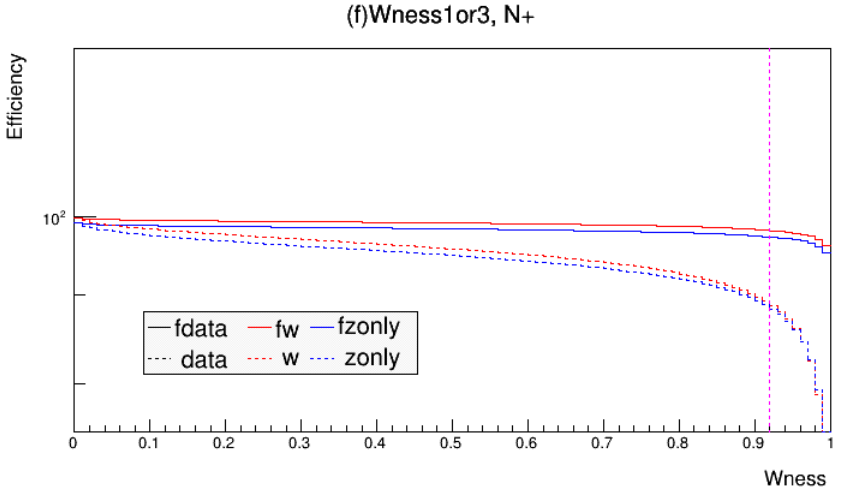
- Zoomed in plot (same to the last page) to check effect to the data

Update in Wness: Signal efficiencies, for **(f)Wness1or3**



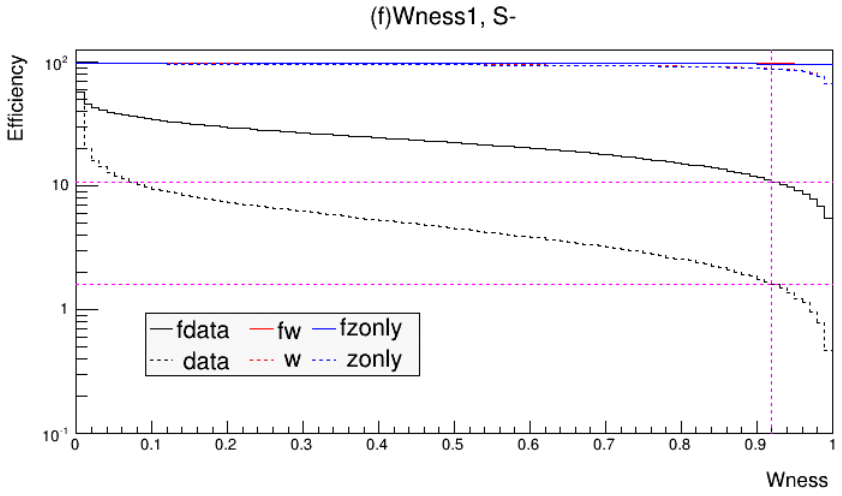


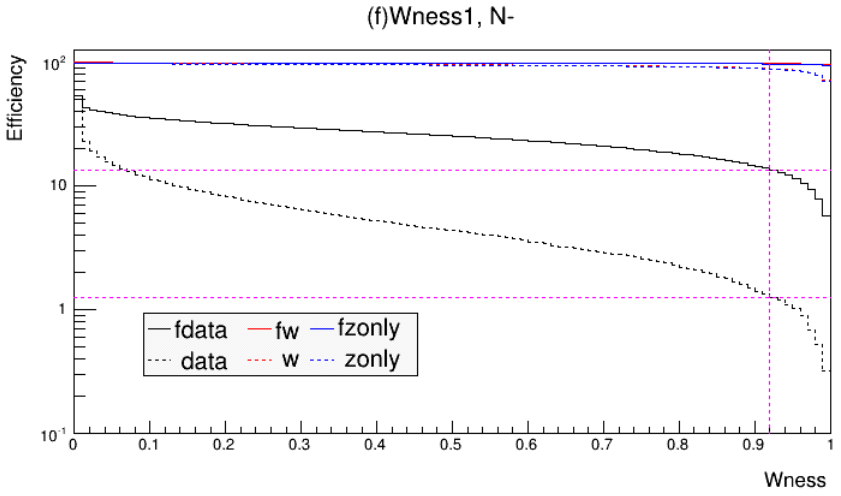


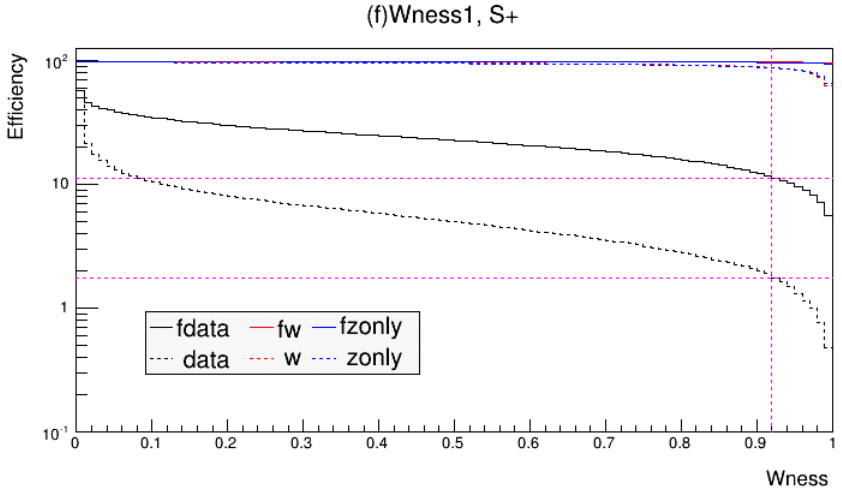


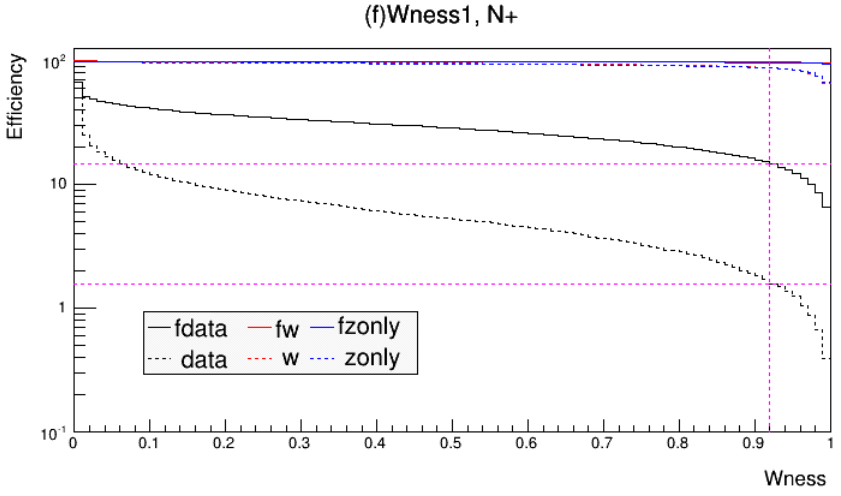
- Zoomed in plot (same to the last page) to check effect to the signal MC

Update in Wness: Signal efficiencies, for **(f)Wness1**

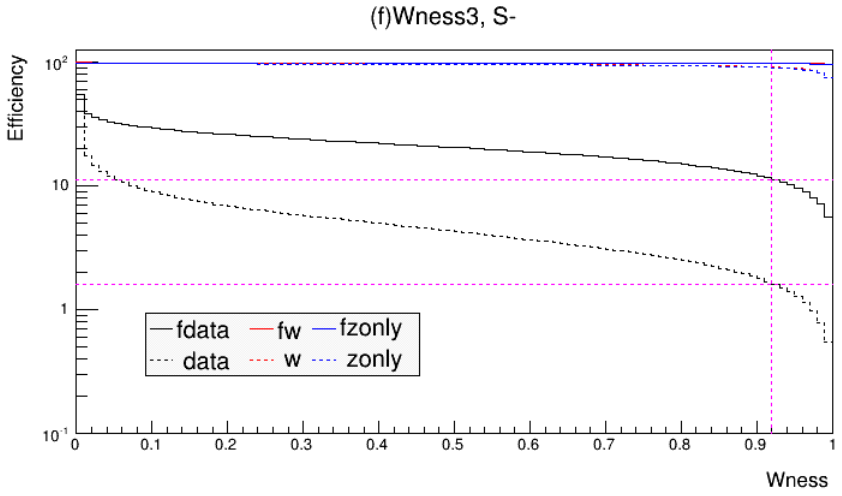


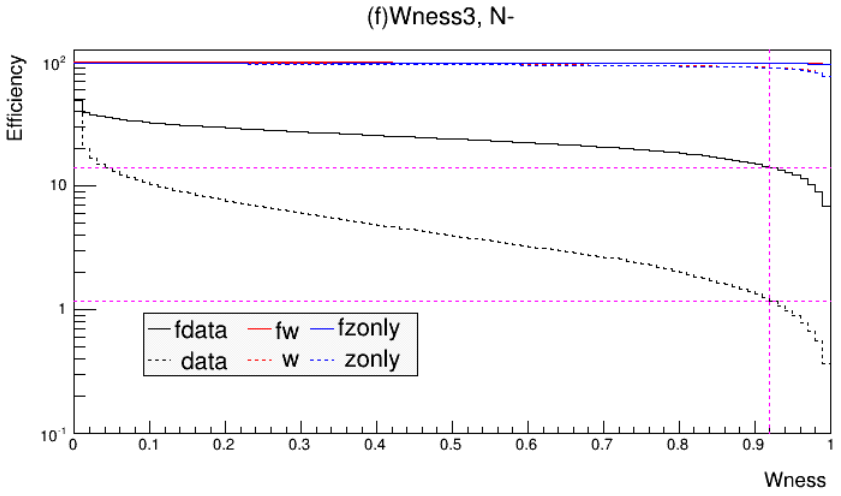


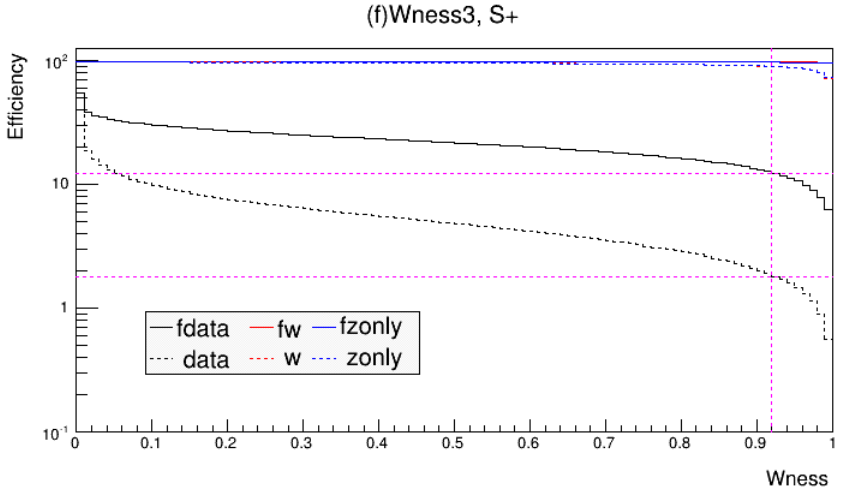


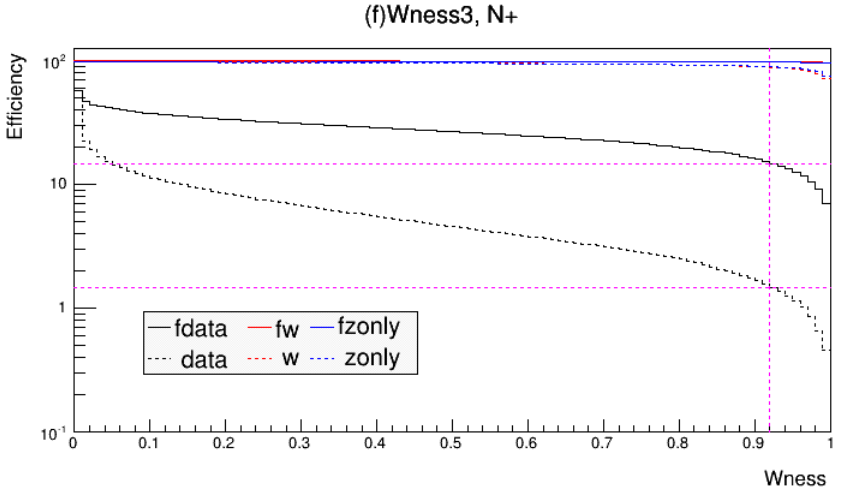


Update in Wness: Signal efficiencies, for **(f)Wness3**





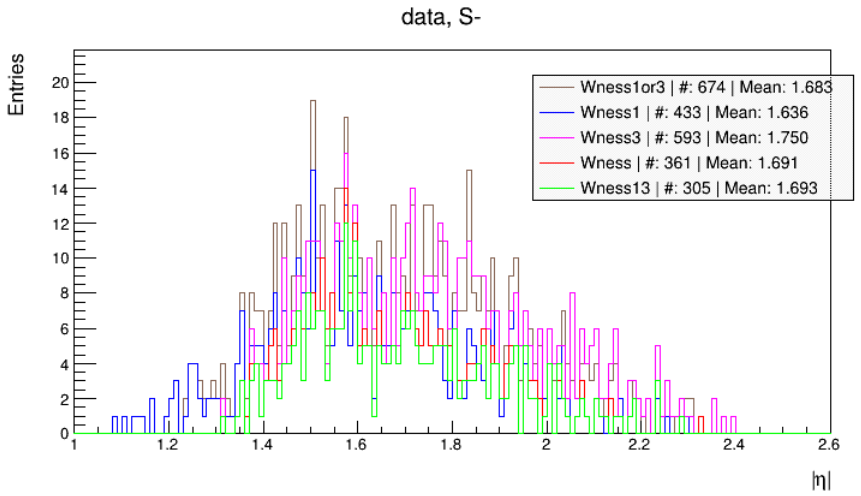


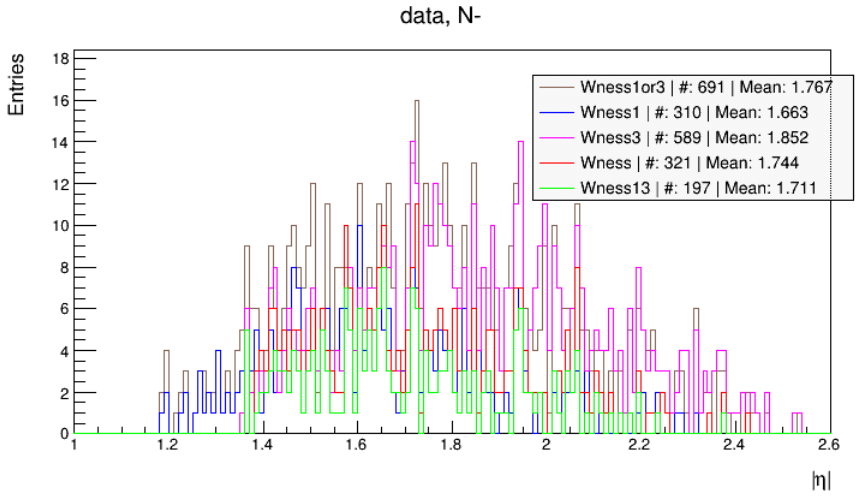


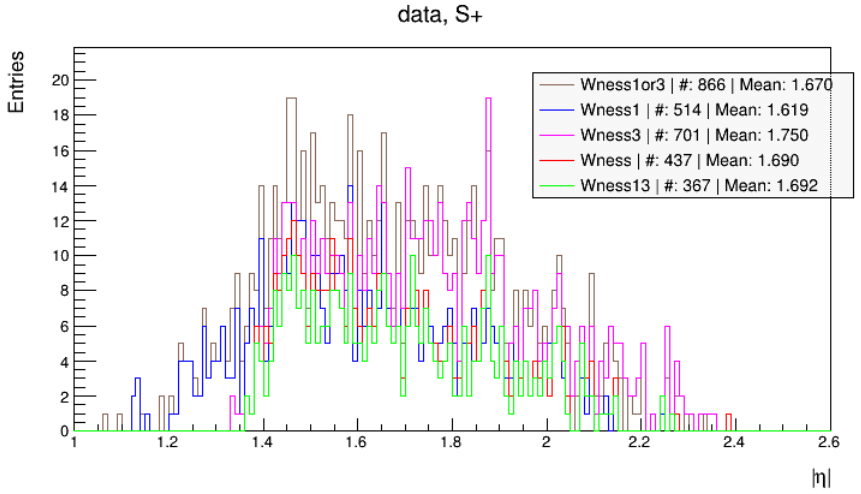
The effect is apparent and optimistic, but…

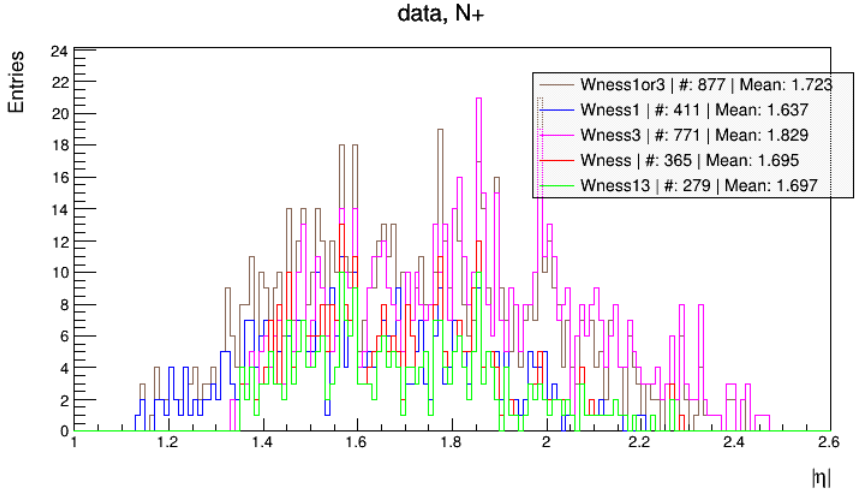
- **Different Wness setup was used in Run 13 analysis**
  - Setup used in Run 13: Separate η acceptance into 3 region: 1.1 - 1.4 - 1.8 - 2.6 (in |η|)
    Rpc1 (Wness1), overlap (Wness13), and Rpc3 (Wness3)
  - Mainly used Wness condition in Run 12: Wness1or3 (or + smaller)
    apparently its quality worse than 1, 3, and AND condition (Wness13),
    but unlike Run 13 case, this 1, 3, and AND condition's statistics is quite poor
    (especially for Rpc1 acceptance) in Run 12
- **Asked to Ralf, still discussion is ongoing**

Entries vs. |η| for various RpcDCAs



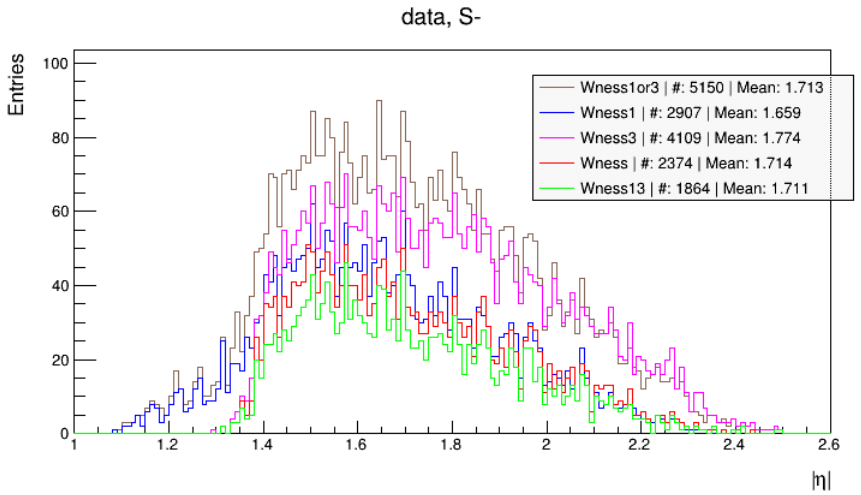


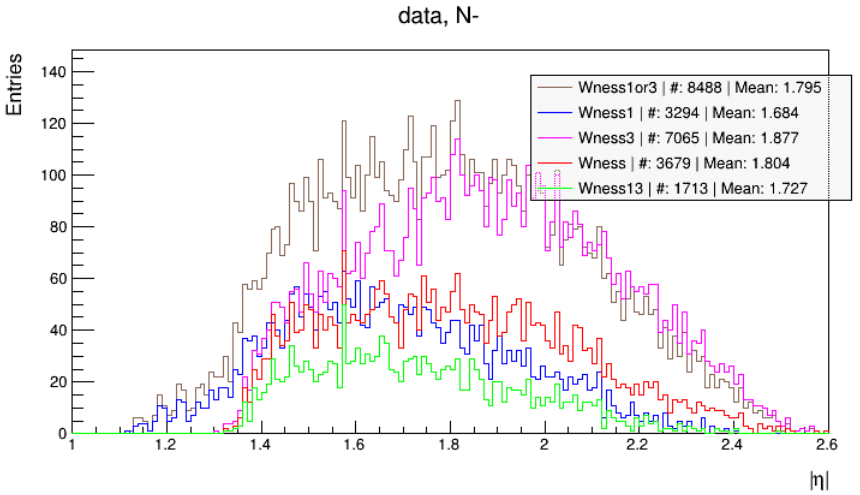


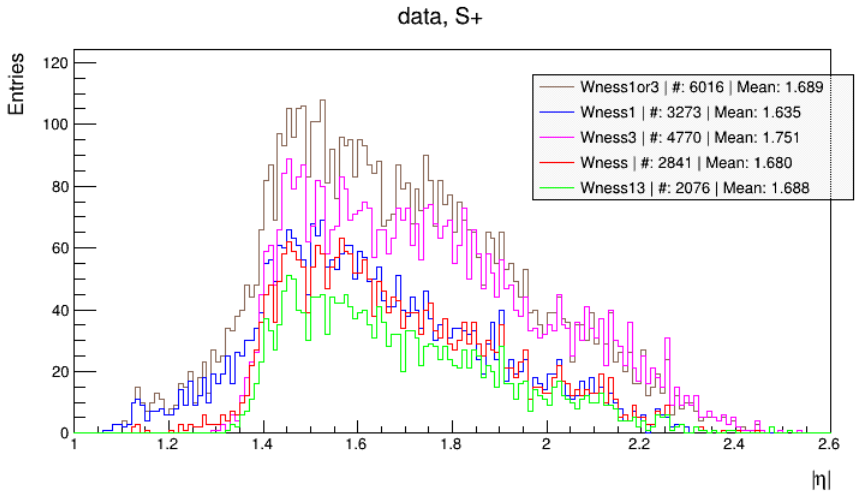


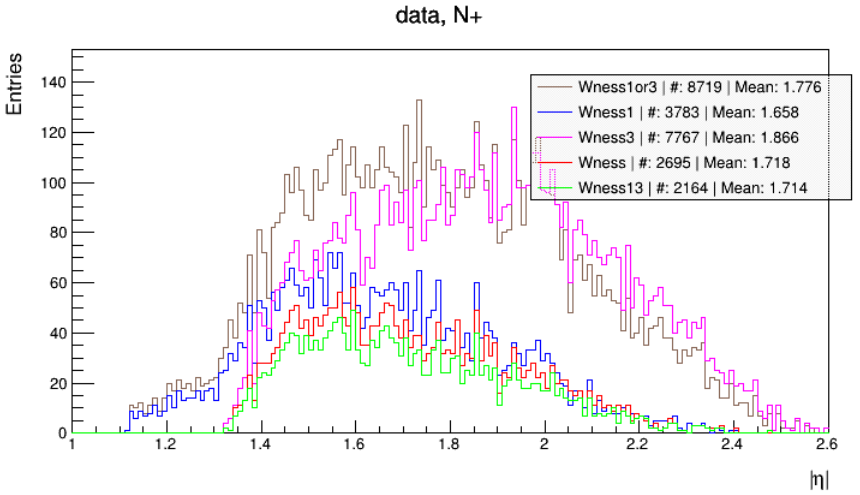
w/ Wness > 0.92 condition, before update

Entries vs. |η| for various RpcDCAs



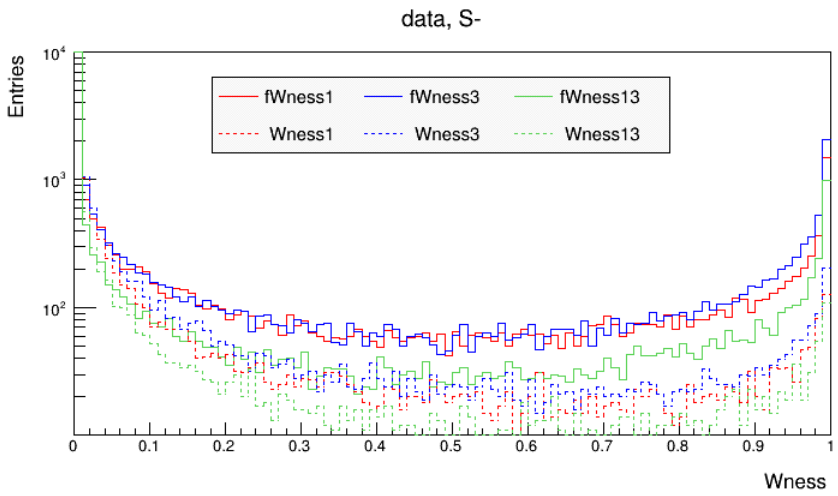


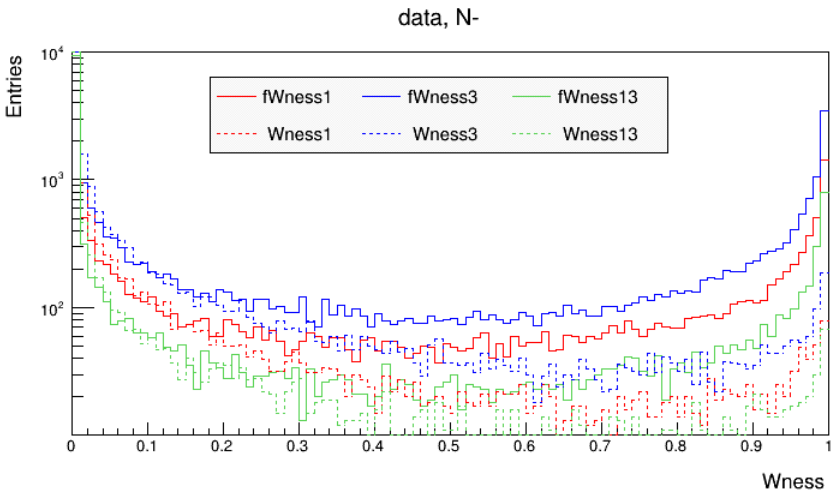


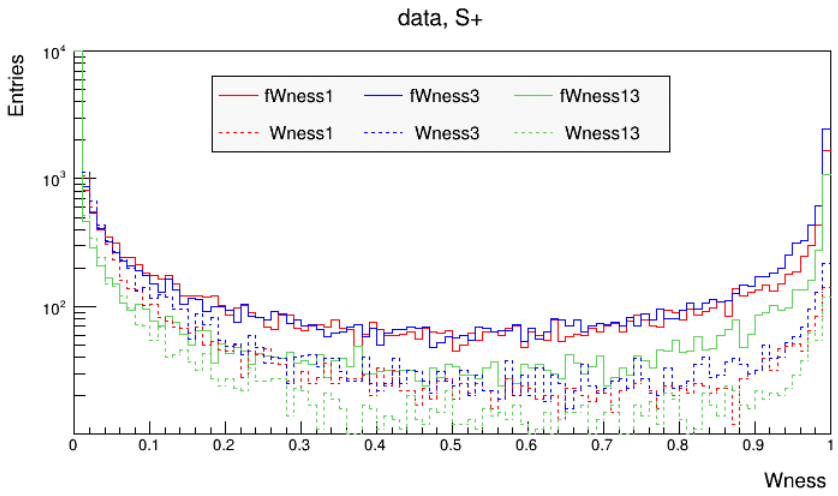


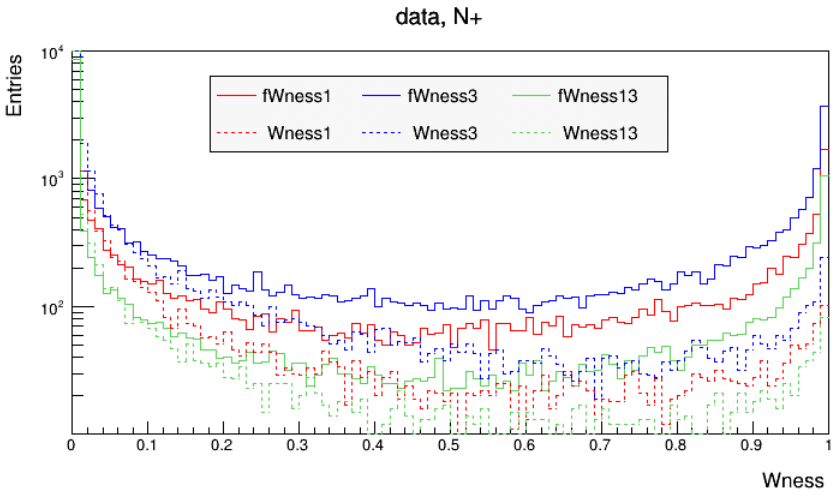
w/ Wness > 0.92 condition, after update

Entries vs. Wness, for AND condition

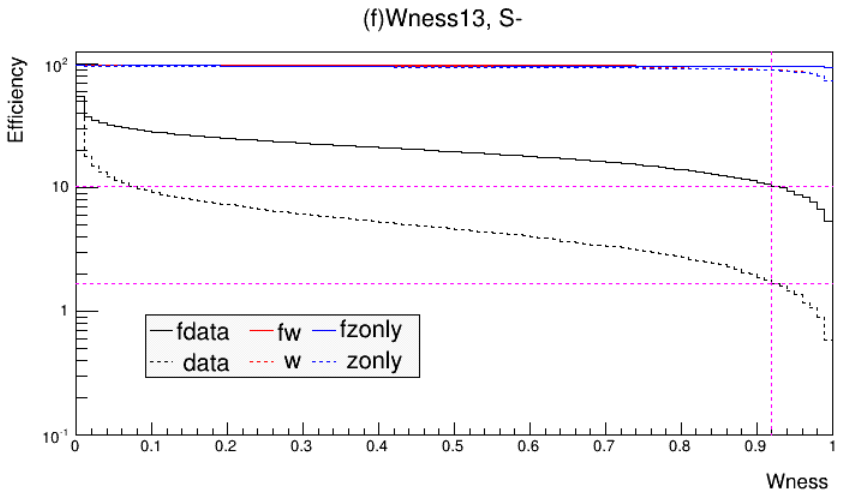


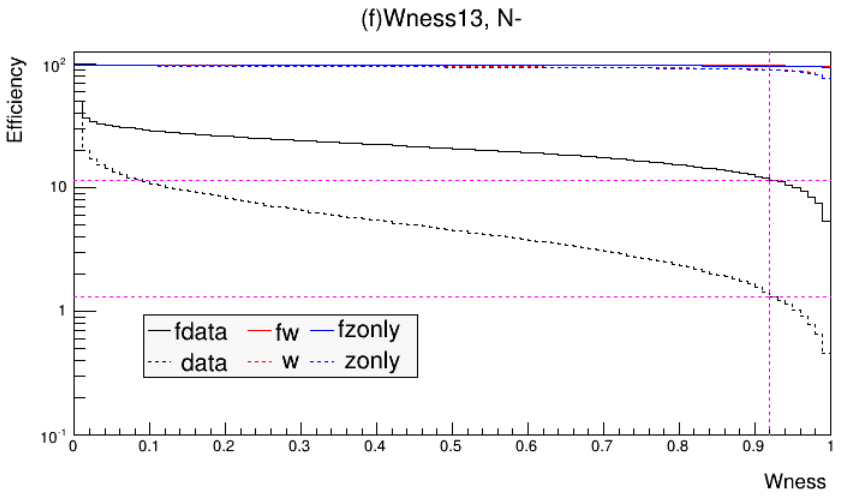


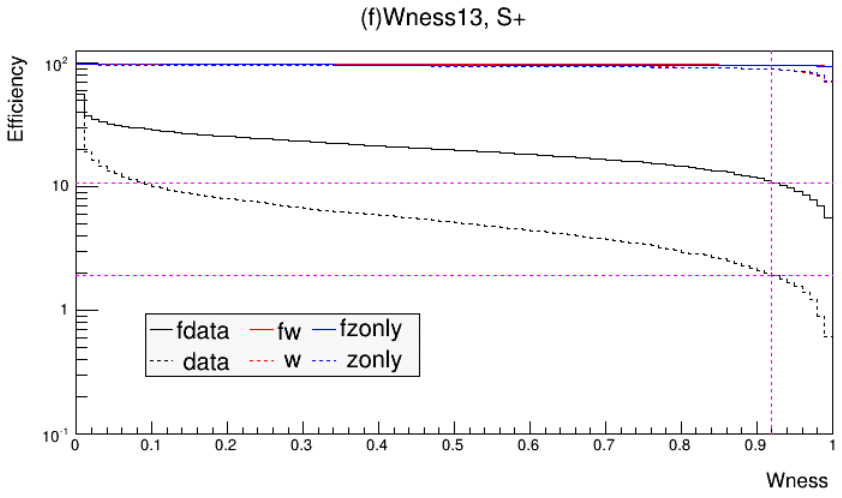


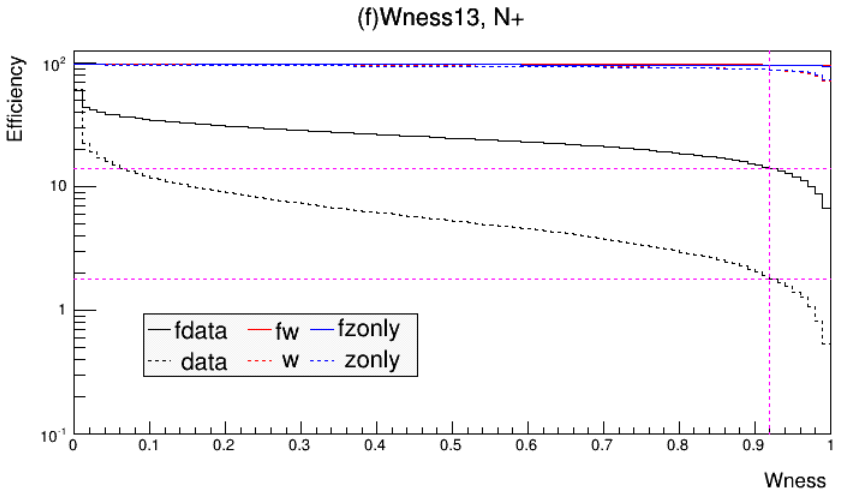


Signal ε vs. Wness, for AND condition









Summary and To do

- **Summary**
  - Updated Wness by adding 3 FVTX variables
  - Overall increase observed in # of events and Signal efficiency in target Wness region (Wness > 0.9)
  - Especially amount of Wness < 0.01 events decreased to ~ 50,000 after update (about 1/4th of total # of events!)
  - Expected enhancement in statistics and efficiency in target region, but feels this enhancement is pretty (or way too much, in a sense) dramatic

- **To do**
  - Trigger efficiency parts require same type of Wness calculation: plan to use these efficiencies as chance of self cross check
  - Need to revisit every process related to Wness: Trigger efficiency, RPCs hit efficiency, S/BG likelihood fit…

Backup: Wness distributions, for **Zonly** (MC)