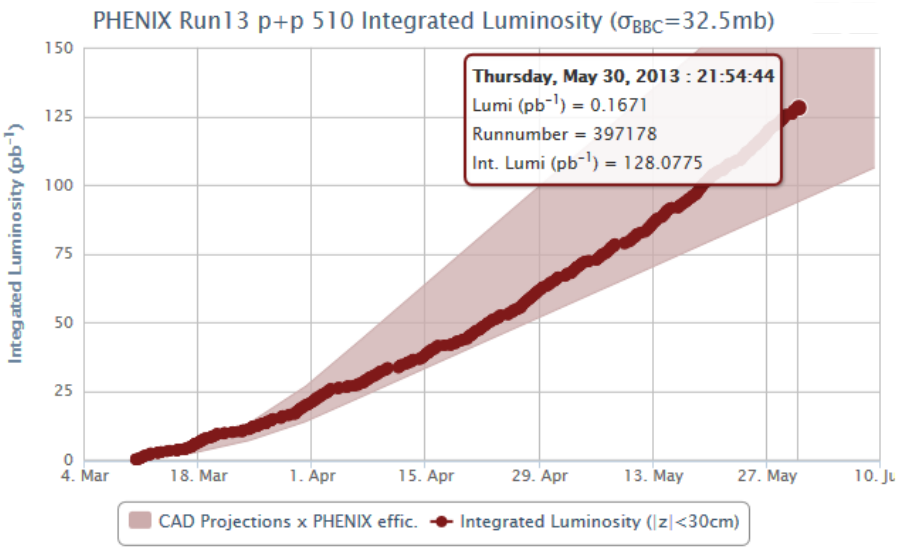
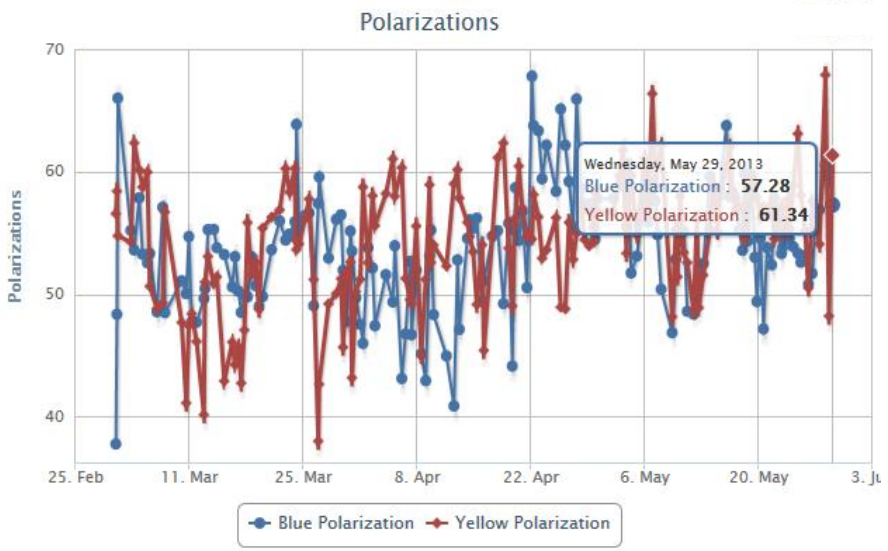
Outline

NPLab internal meeting, May 31, Chong Kim

- **PHENIX Run 13 status**
- **Reminder: S/BG ratio calculation process**
- **Cross checks progress**
  - by various RpcDCAs
    - Entries vs. $|\eta|$
    - Signal efficiency
    - S/BG ratio
    - Suggestion in RpcDCA selection
  - by different MC inputs
    - Unbalance between South and North, for mid condition
  - S/BG estimation by sidebands cut
- **Summary and To do**

PHENIX Run 13 status

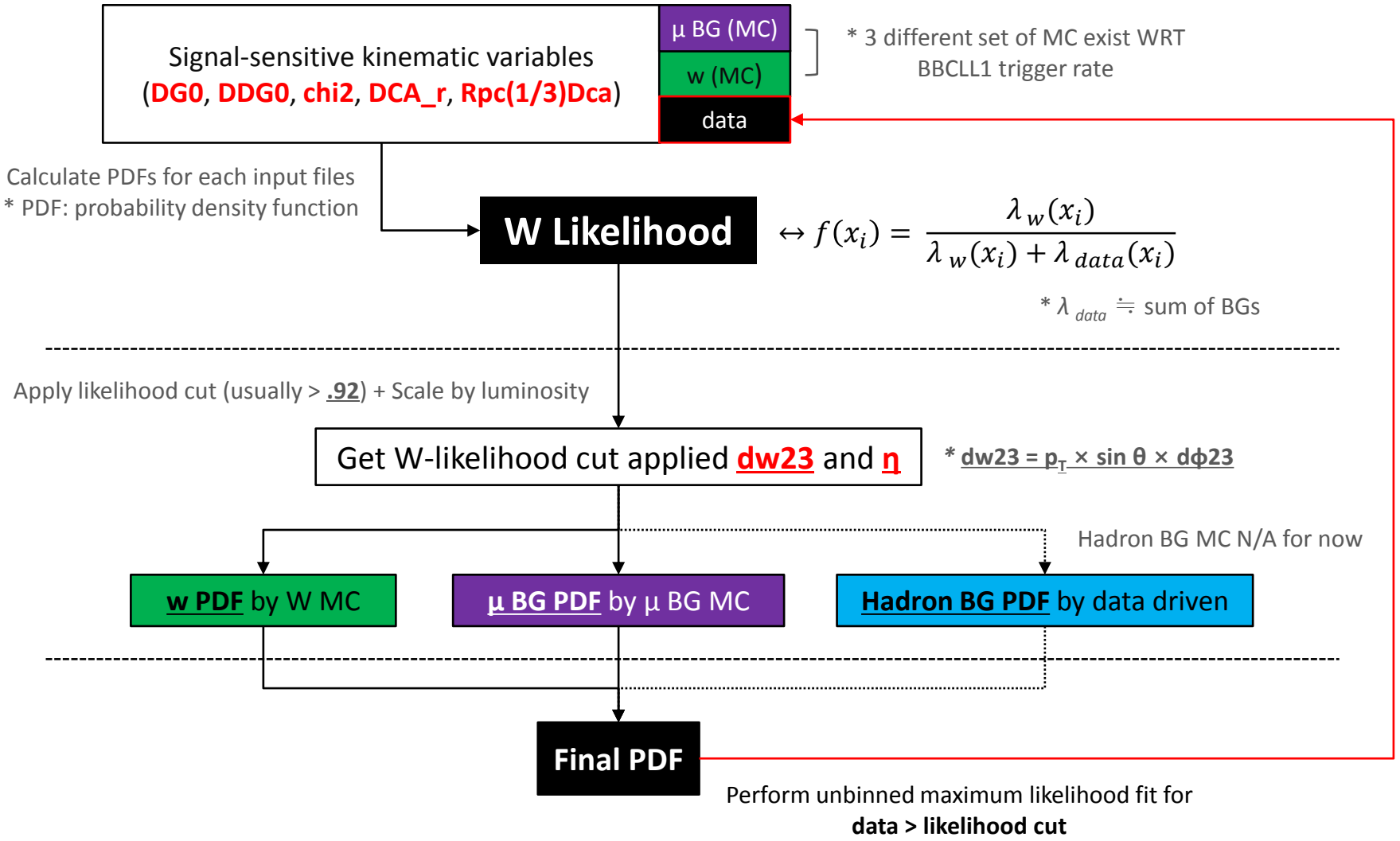




- Run ends in June 10th, pp510GeV run for whole period (15 + 2 cryo weeks)
- Integrated luminosity (May 30, today): **128** (pb^{-1}), in $BBC_{|z|}$ < 30 cm

  * Run 11: 27, Run 12: 43 (pb^{-1}) with same $BBC_{|z|}$ condition
- Avg. polarization: ~ **54** % for both beams (slightly lower than Run 12)

Reminder - S/BG ratio calculation process



Cross checks progress:

by various RpcDCAs

Various RpcDcas

- Variable RpcDCA separated after Run 12
  - four types by match, 2 categories by RPC station
    - Match: Vtx, St1, St3, and MuID
    - Rpc station: Rpc1dca and Rpc3dca

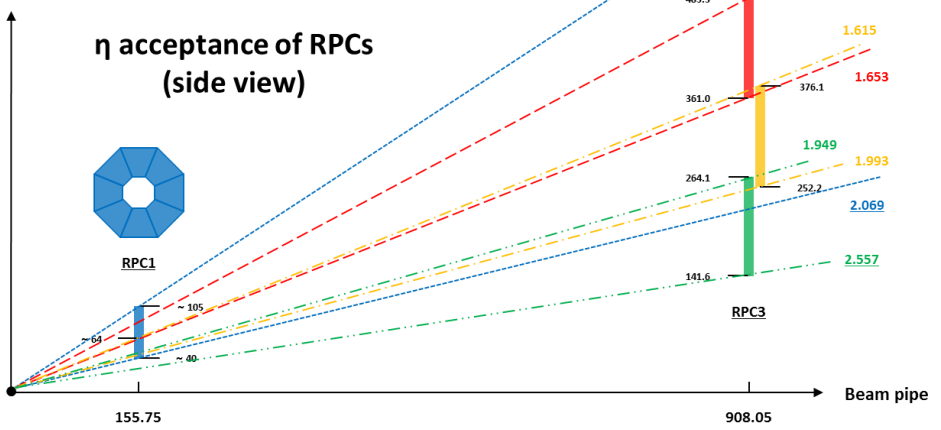
  ** ex. (RpcMatchSt1)Rpc1dca*

Cut_Min (0) < Rpc1dca < Cut_Max (100)
OR
Cut_Min < Rpc3dca < Cut_Max

- Simple **OR** condition btw Rpc1dca and Rpc3dca was used in calculating S/BG ratio at preliminary, but various combination is available:

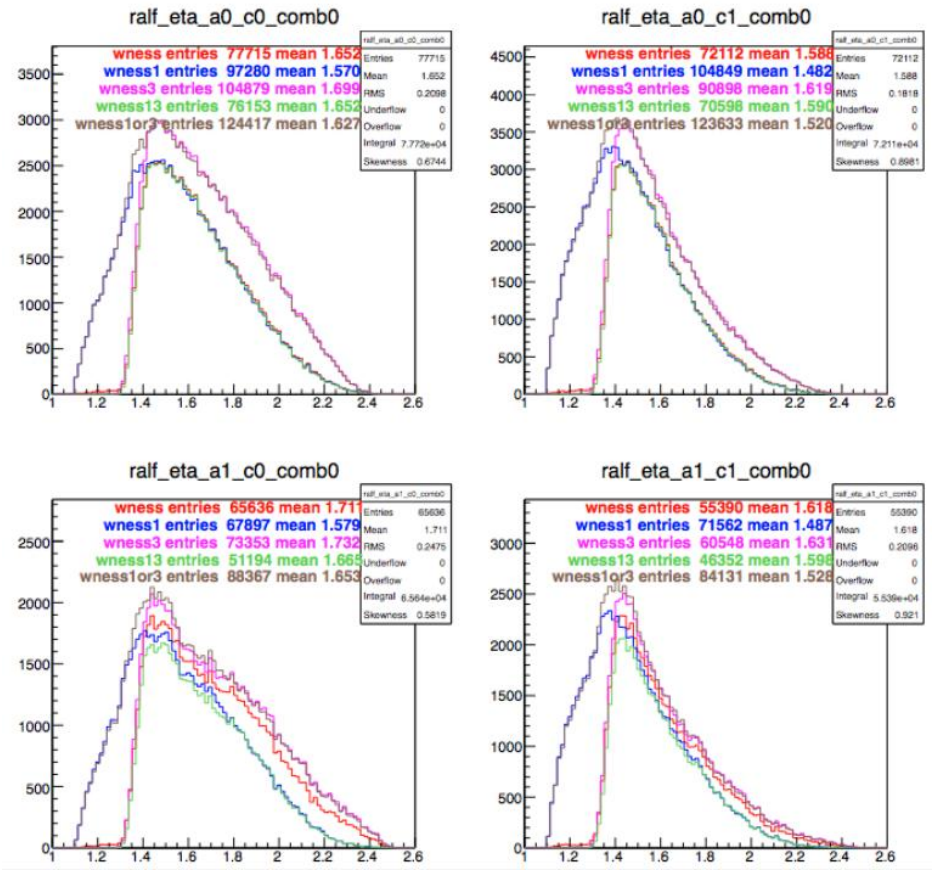
1 value
- Rpc1dca (Rpc1 acceptance)
- Rpc3dca (Rpc3)
- **OR + smaller value btw 2**

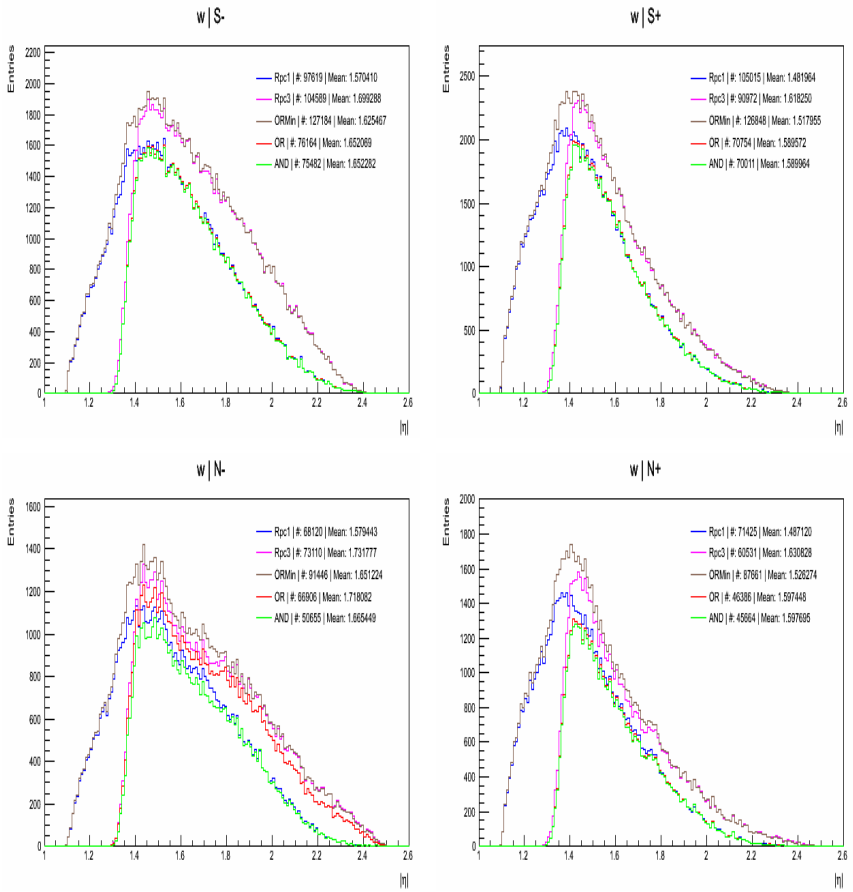
2 values
- **OR** (preliminary condition)
- AND



Entries vs. |η|

W likelihood > .92



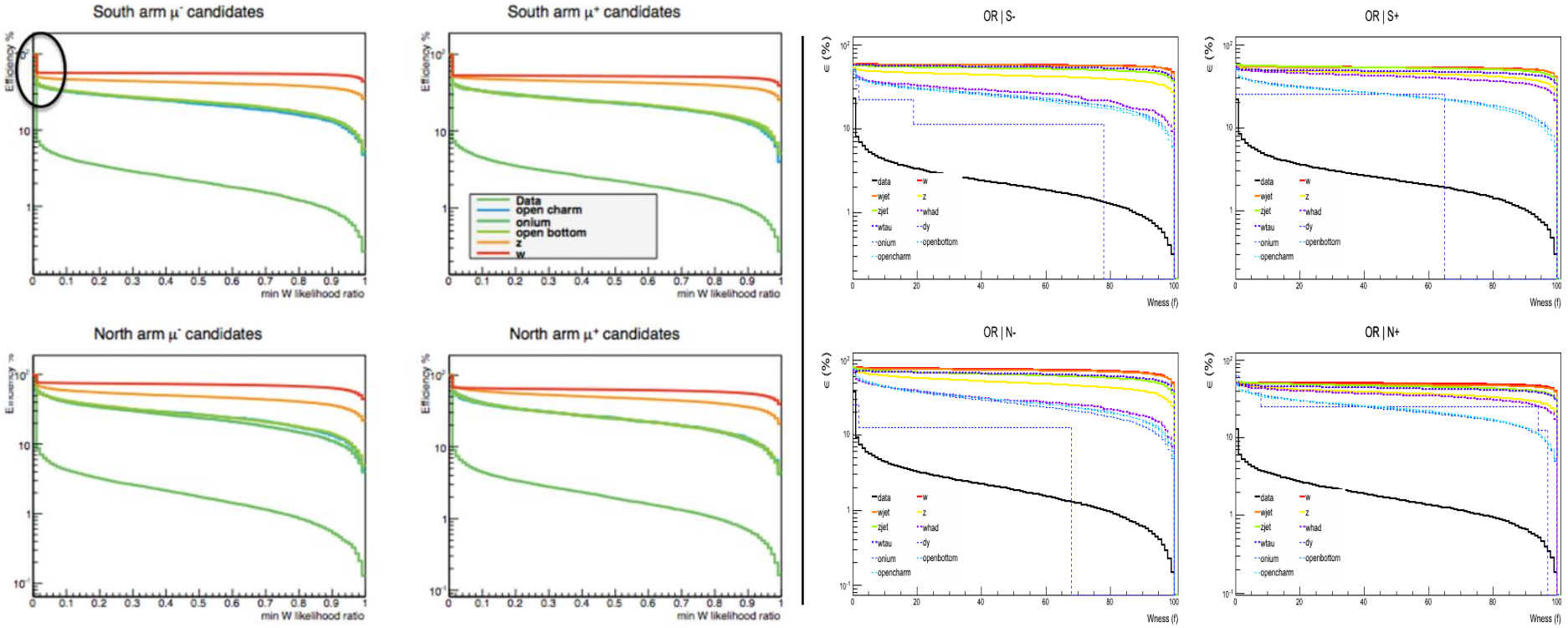


- η distribution of **signal** (*W* MC) by **various RpcDCA** condition
  - Match well in general
  - Minor difference exist in # of entries (up to 3,000), but mean values match well

Signal efficiency

$$* \varepsilon_{\text{signal}} = \frac{\#\text{ of entries} > \text{W likelihood (f)}}{\#\text{ of entries}}$$

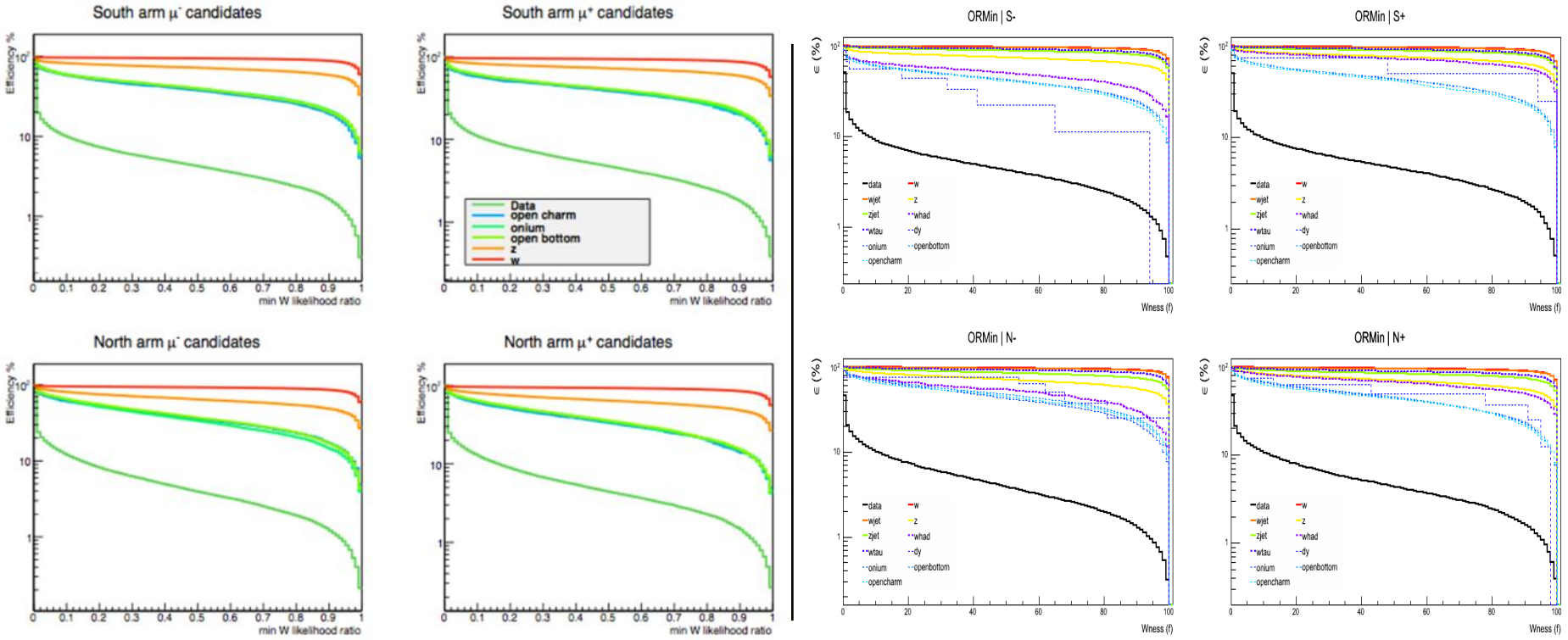
Various input, **fixed RpcDCA type**



- **Signal ε** by various input (data and each MC), for **'OR'** (previous condition)
  - Didn't check in entries level, but at a glance data and w/z match well

Signal efficiency

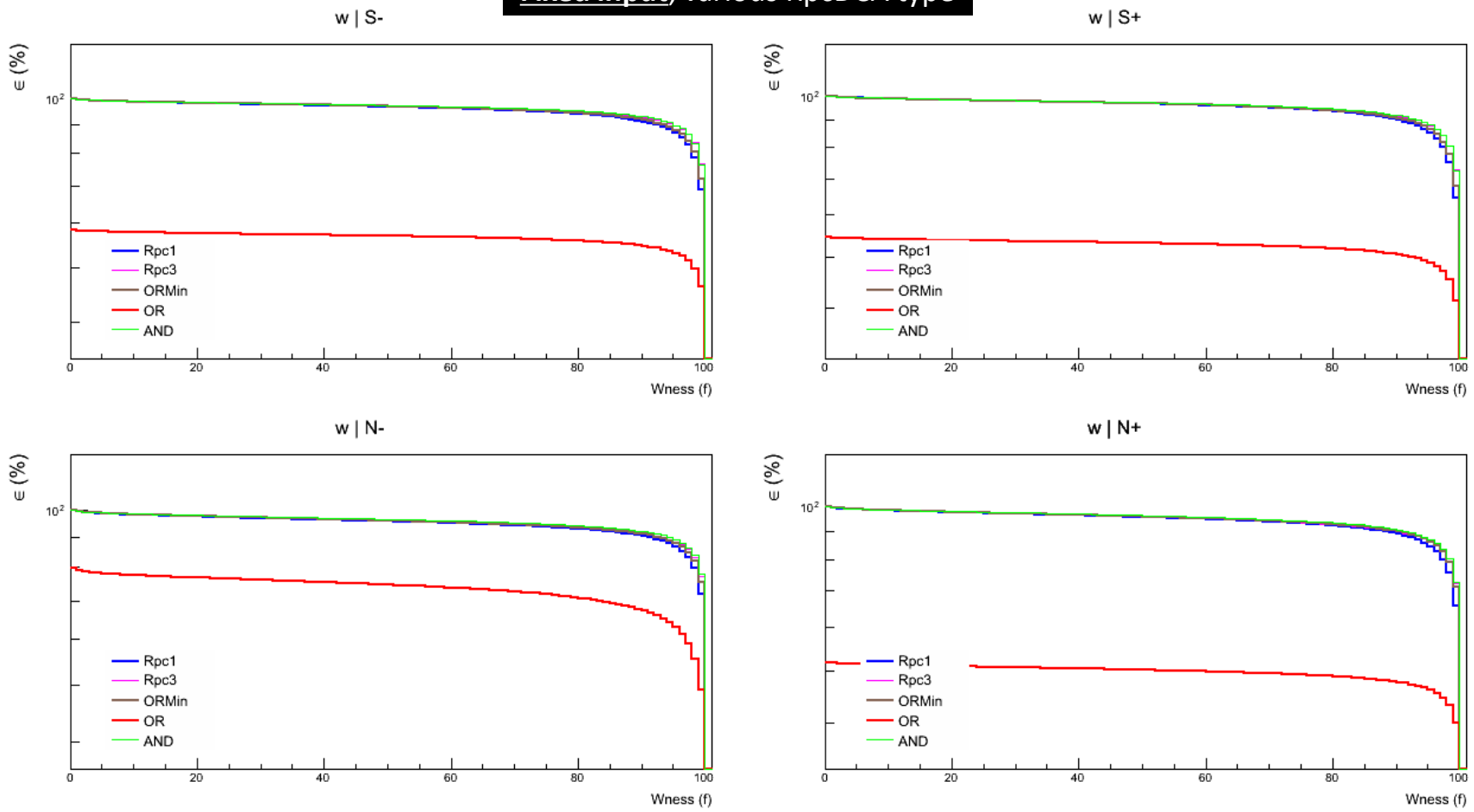
Various input, **fixed RpcDCA type**



- **Signal ε** by various input, for **'OR + smaller value'** (current condition)
  - At a glance data and w/z match well either
  - S/BG fit tested by this condition

Signal efficiency

Fixed input, various RpcDCA type



- **Signal ε** of various RpcDCA, for **W MC**
  - Looks like pretty mush portion of signal was lost in former condition (RED)

S/BG ratio

- Codes newly written for these cross check by RpcDCAs
- Checked match btw results by previous codes and results by current code's 'OR'

Self check

  - Basically they are exactly same condition: therefore results must be same
  - Confirmed exact match in distribution, entries, and S/BG fit results

w/ another analyzer

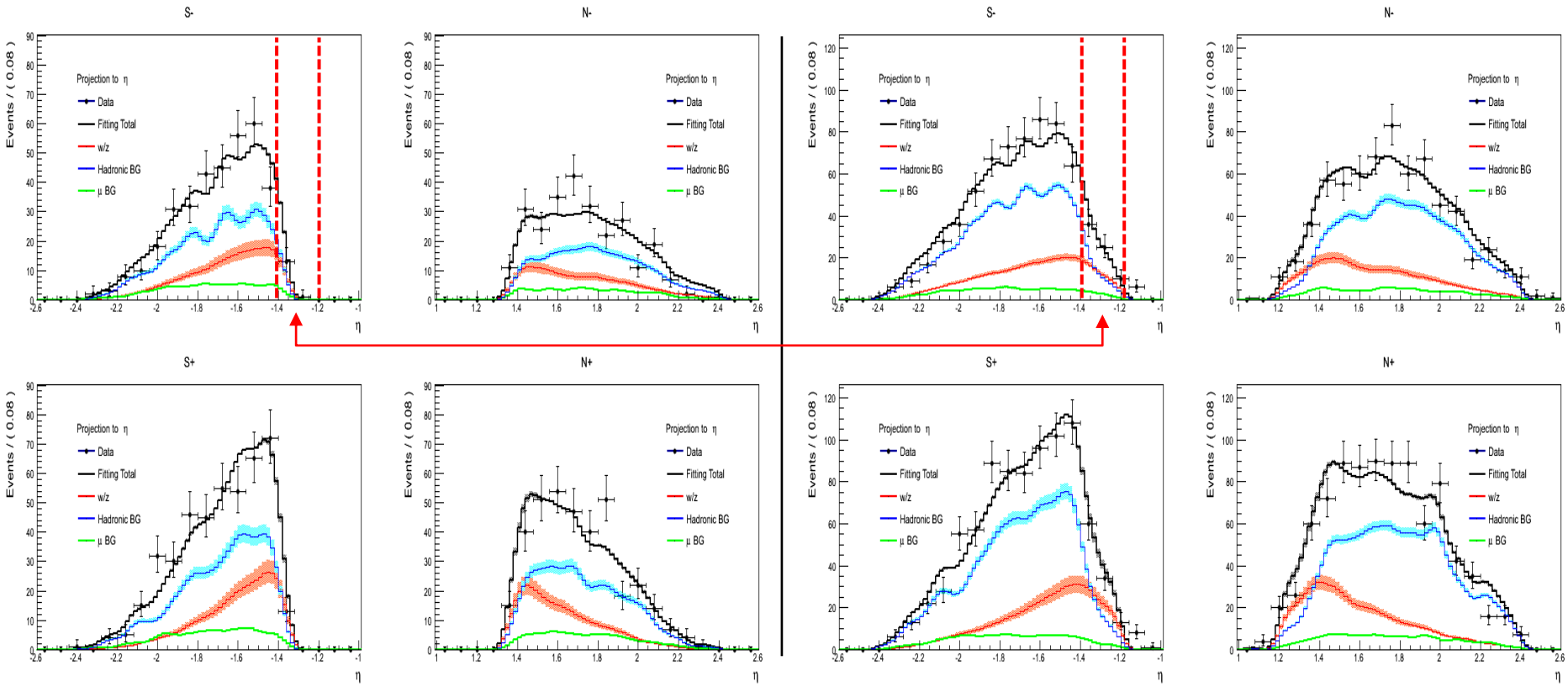
  - Checked W likelihood (f_{cut}) distribution of North side to the Sangwha's one:

    Matched exactly in distribution, entries, and RMS

- Newly written code's reliability is confirmed:
  - Compared results btw 'OR' (previous) and 'OR + smaller value' (current)

S/BG ratio

OR (previous) | **OR + smaller (updated)**

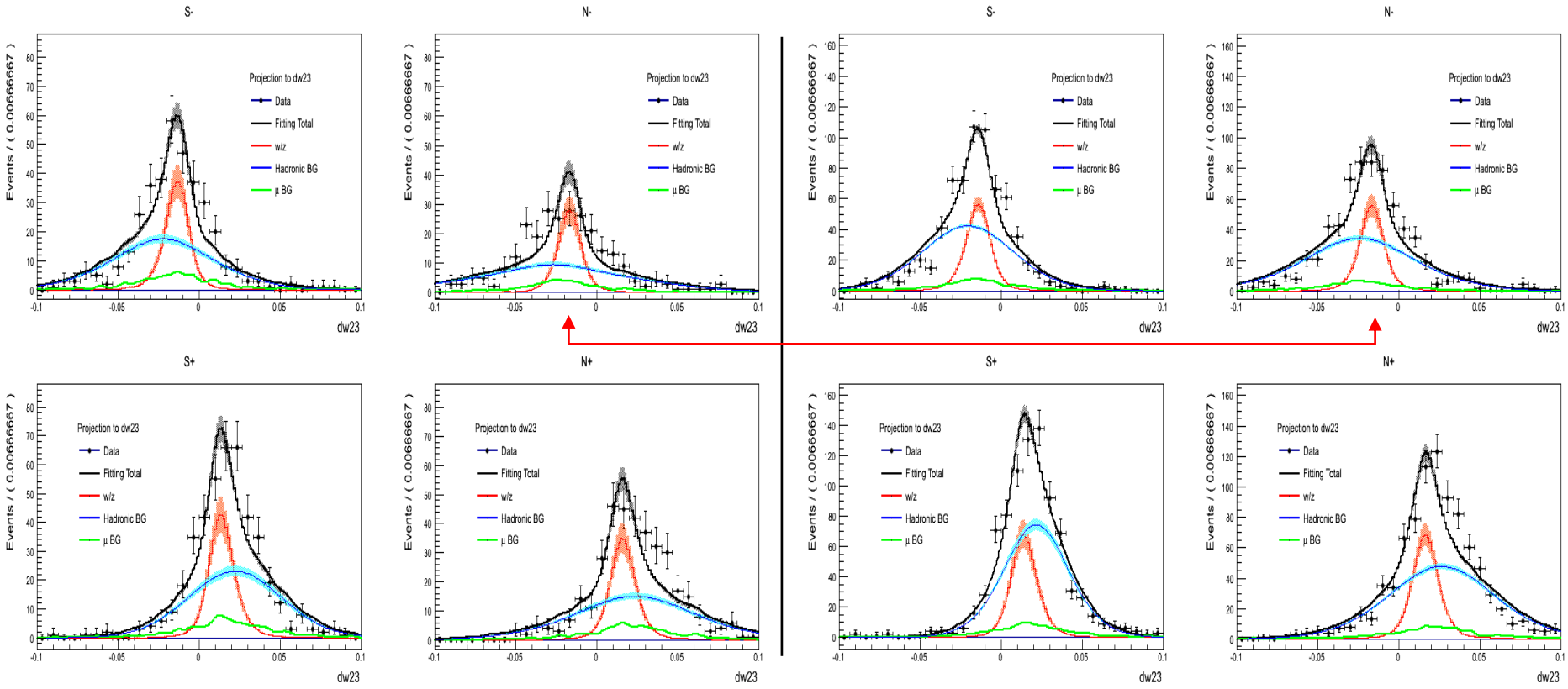


- **Fit projection to the η**
  - Overall statistics increased + acceptance around 1.2 < |η| < 1.4 recovered after update

S/BG ratio

OR (previous)

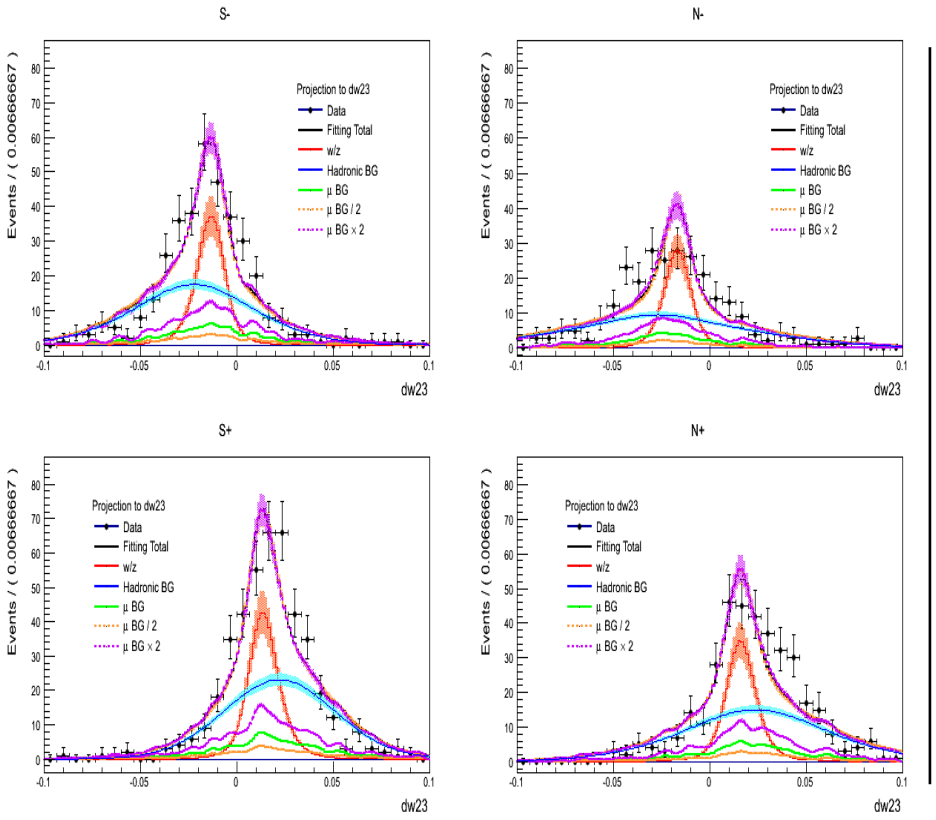
OR + smaller (updated)



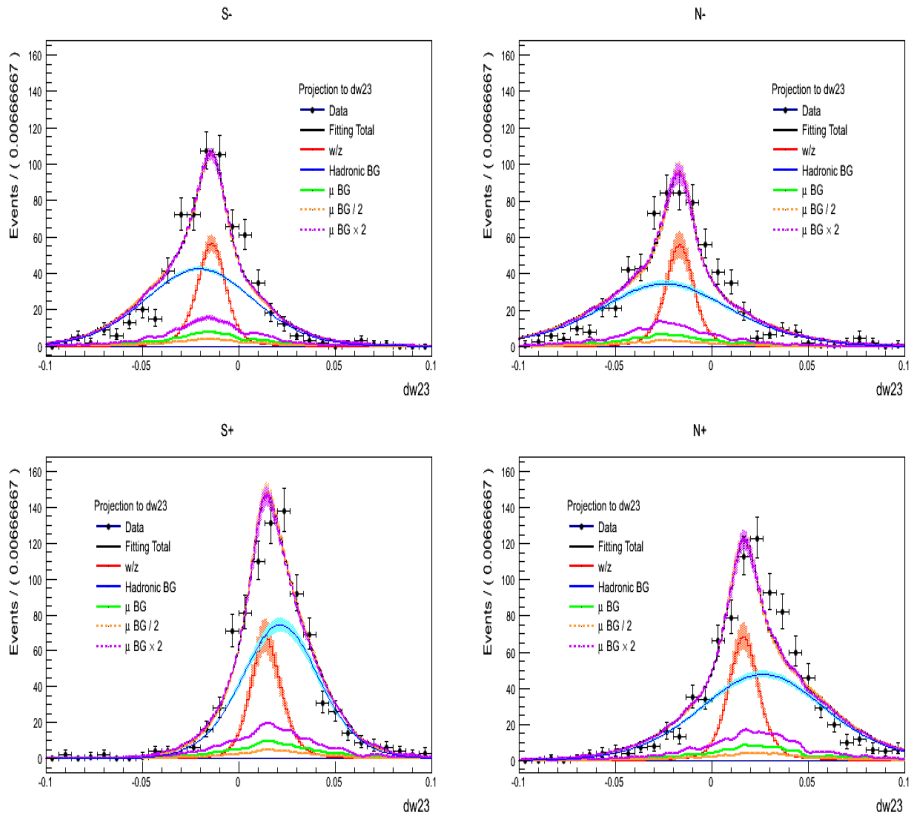
- **Fit projection to the dw23**
  - Fit of the N- looks pretty much improved

S/BG ratio

OR (previous)



OR + smaller (updated)



- **Fit projection to the dw23, w/ modification in μ BG**
  - Variation in S/BG ratio for modification in μ BG become even smaller

S/BG ratio

OR (previous)

	S/BG (μ BG × 0.5)	S/BG (μ BG × 1)	S/BG (μ BG ×2)
S -	1.03755	0.957676	0.791177
S +	0.493071	0.481017	0.453303
N -	0.45464	0.395918	0.280108
N +	0.452174	0.426802	0.377074

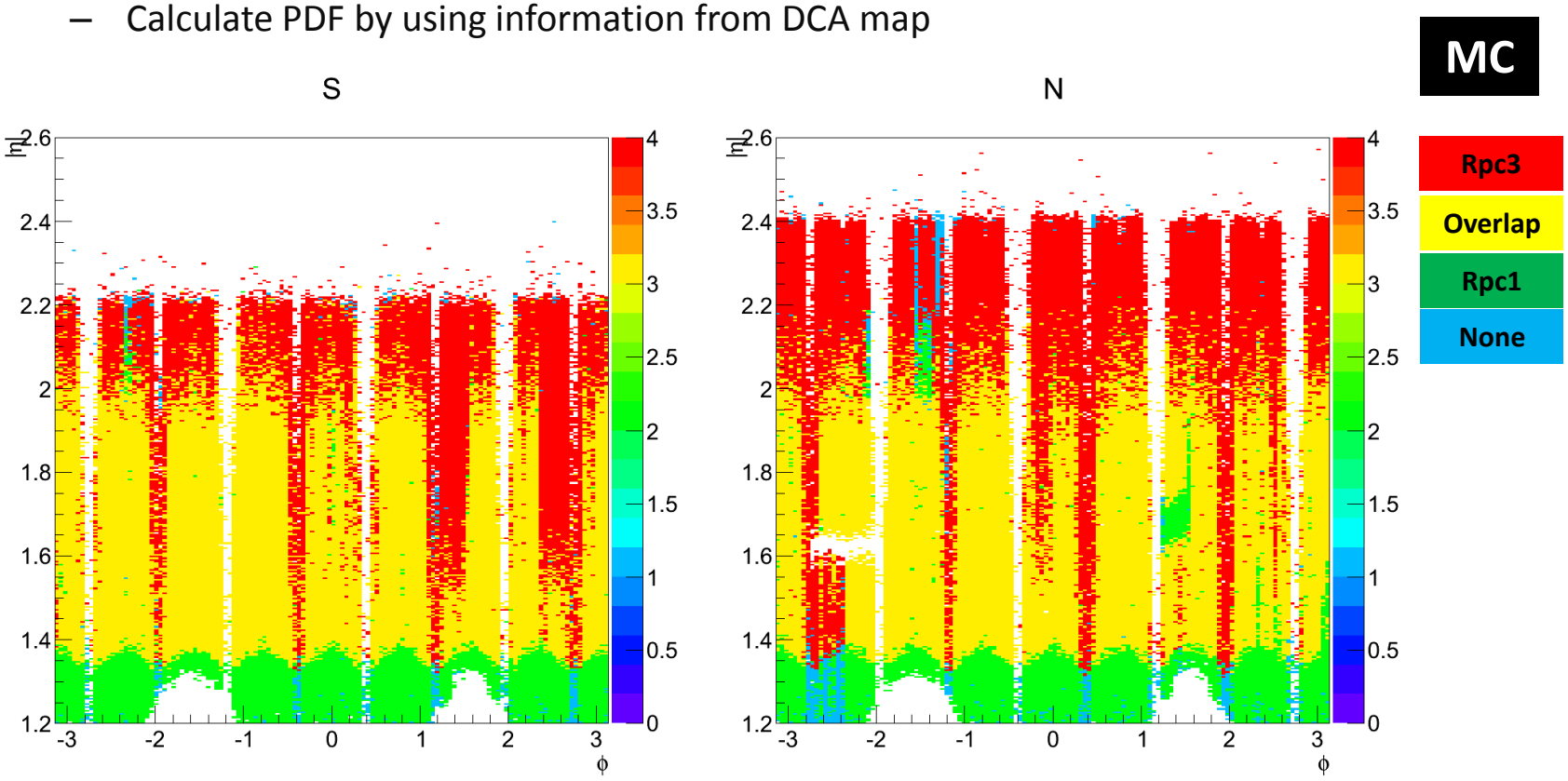
OR + smaller (updated)

	S/BG (μ BG × 0.5)	S/BG (μ BG × 1)	S/BG (μ BG ×2)
S -	0.575279	0.547162	0.491004
S +	0.285279	0.286531	0.283906
N -	0.429085	0.406467	0.363457
N +	0.342316	0.330325	0.306408

- **S/BG ratio w/ modification in μ BG**

S/BG ratio

- **Making 'DCA map' by using W MC:**
  - Separate Rpc1 only, Overlap, and Rpc3 only region
  - Calculate PDF by using information from DCA map



Sample of DCA map used in Run 12 Rpc efficiency calculation ↑

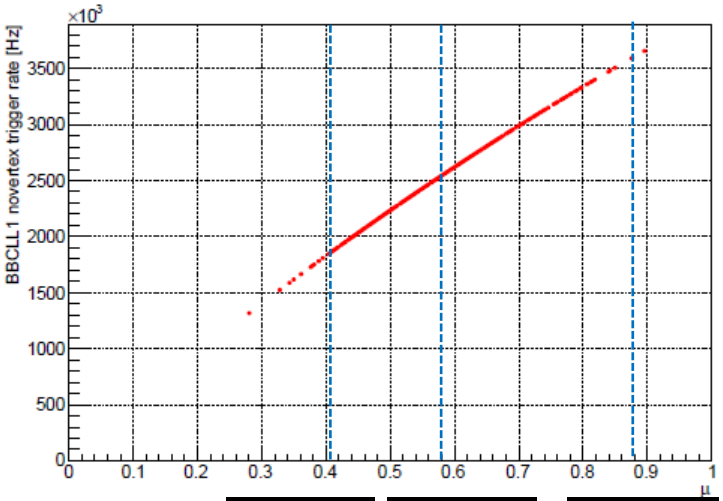
Caution: this is NOT the map produced by W MC!

Cross checks progress:

by different MC inputs

Different MC inputs

- The results so far obtained by only ONE set of MC: Run 367593, 'high' condition
- There are still two other set of MC inputs exist with respect to trigger rate (BBCLL1): low and mid condition
- Since detectors' performance affected seriously by collision (trigger) rate, thorough cross checks required for all different MC inputs with every items



368630 (low) | 367466 (mid) | 367593 (high)

Run Number	μ	L nb^{-1}	MuTr Efficiency	Asymmetry
North				
367466	0.576	56.9074	0.9051	1.4297
367593	0.876	42.8445	0.8458	2.3917
368630	0.409	60.4362	0.9281	0.9795
South				
367466	0.576	56.9074	0.9513	0.8547
367593	0.876	42.8445	0.9475	1.7696
368630	0.409	60.4362	0.9556	0.6402

μ (← & ↑): multiple collision parameter,
Avg. # of collisions per bunch crossing

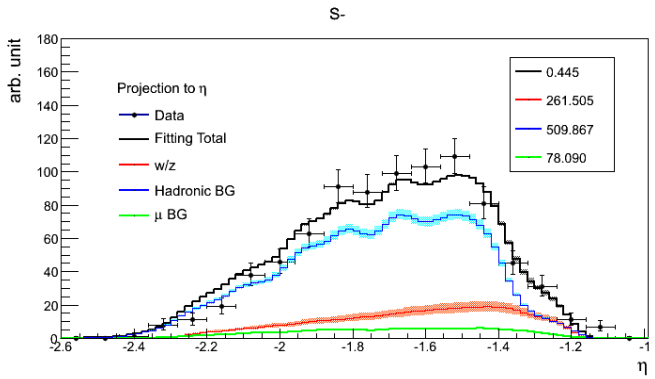
Different MC inputs

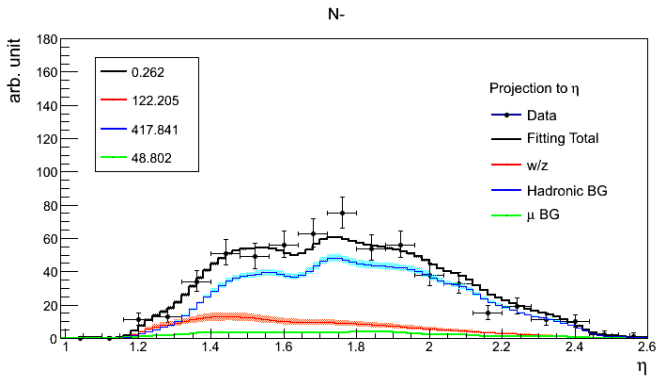
- **Inputs and basic cuts:**
  - **Data**: pp510 Run 12, 311 runs

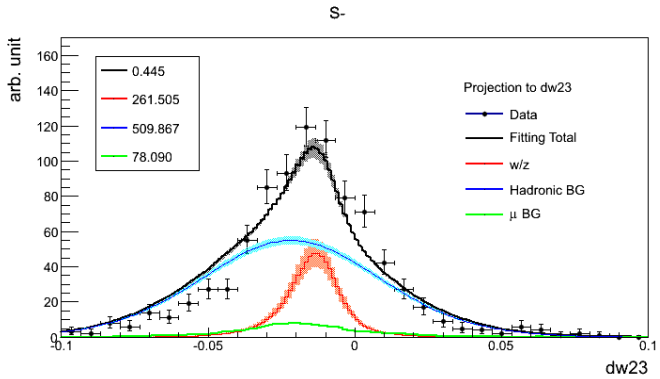
    /direct/phenix+spin/phnxsp01/rseidl/taxi/Run12pp510Muon/1655
  - **MC**: high, mid, and low (produced by Ralf, extracted by myself at May 21)
    - Signal: w and z (onlyz didn't produced in low condition, therefore use z for now)
    - μ BG: direct photon (dy), whad, wtau, onium, openbottom, and opencharm
    - Calculated each MC process' luminosity and applied in fit (table exist in backup)
  - **Basic cuts:**
    - $16 < p_T < 60$
    - DG0 < 20.0
    - DDG0 < 9.0
    - Chi2 < 20.0
    - (0 < Rpc1Dca < 100) OR (0 < Rpc3Dca < 100)
      then choose smaller value between them (marked as **ORMin** later)
    - lastGap = 4

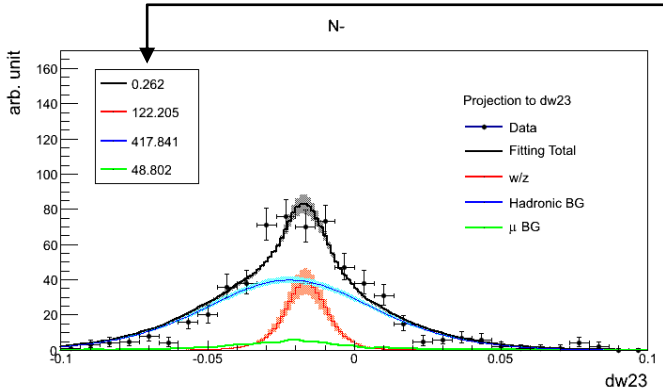
Unbalance btw South and North

- **Unbalance between South and North, in 'mid' condition MC input:**
  - Roughly checked difference btw high and mid condition MC inputs in 2 weeks ago
  - Large unbalance exist in obtained # of W by maximum likelihood fit, in mid condition
  - Yields for South side is ~2.5 times larger than North (**low** and **high** condition: **< ×2**)









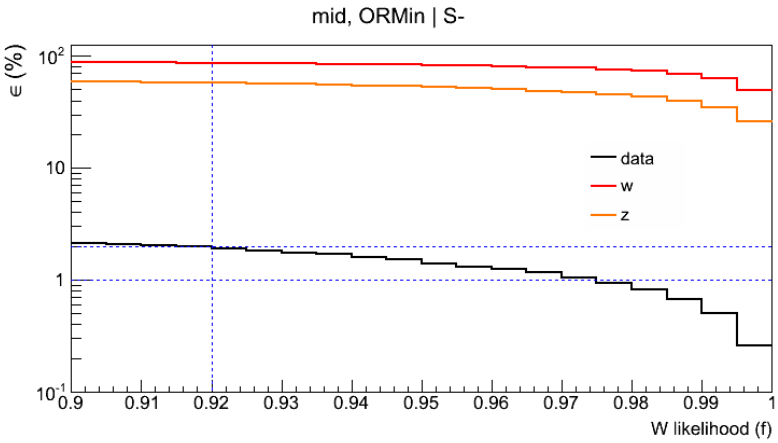
Fit results (charge: -), **mid** condition

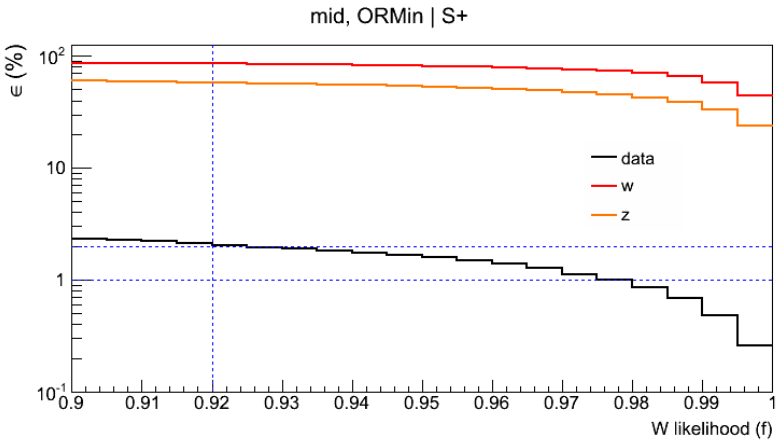
- **S/BG ratio**
- **# of W**
- **# of H BG**
- **# of μ BG**

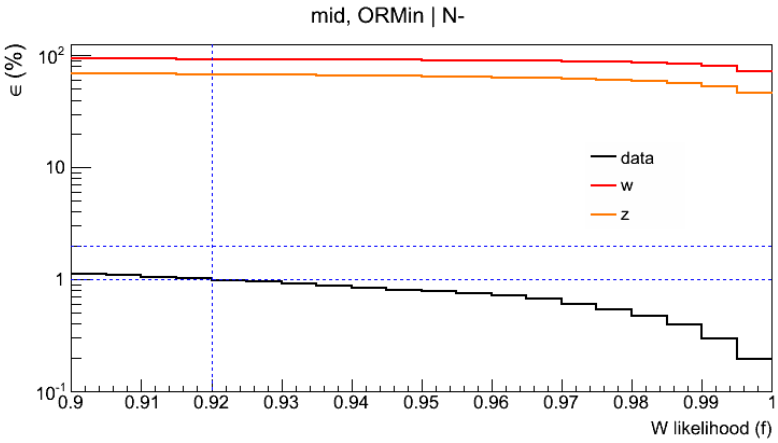
Signal efficiency

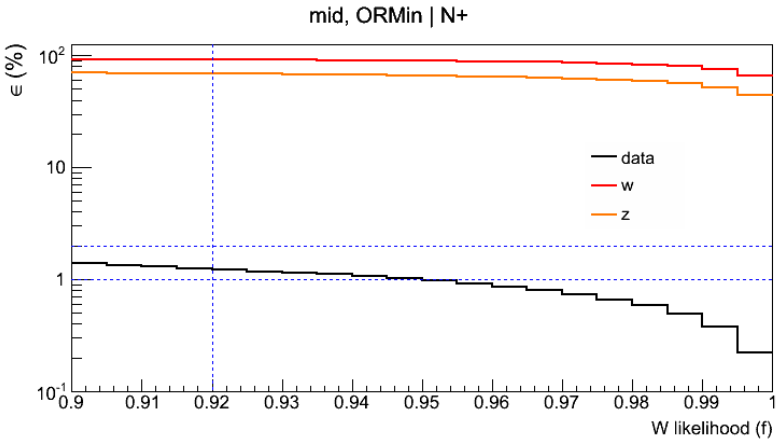
$$* \ \varepsilon_{\text{signal}} = \frac{\#\text{ of entries} > \text{W likelihood (f)}}{\#\text{ of entries}}$$

- **Unbalance between South and North:**
  - Checked signal efficiency vs. Wness (f_{cut}) for Wness > 0.9 region (↓ **mid condition**)



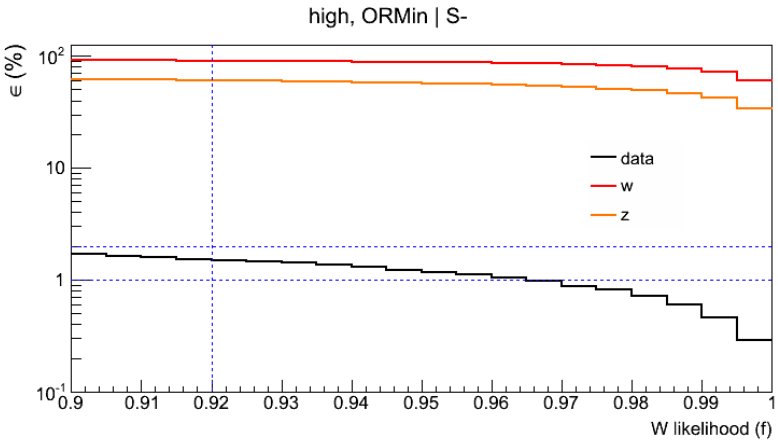


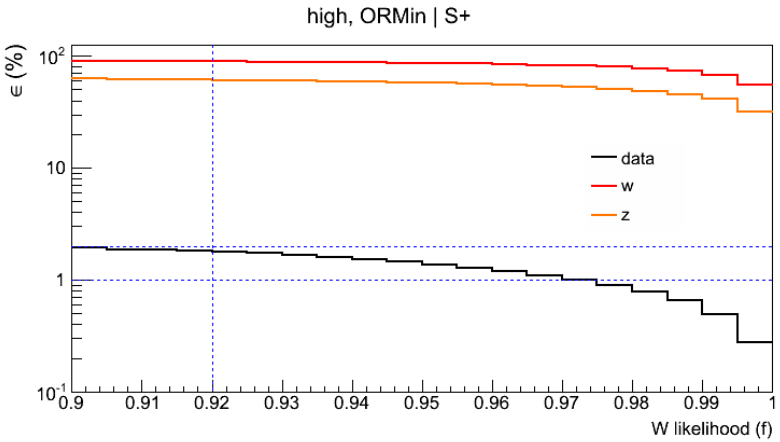


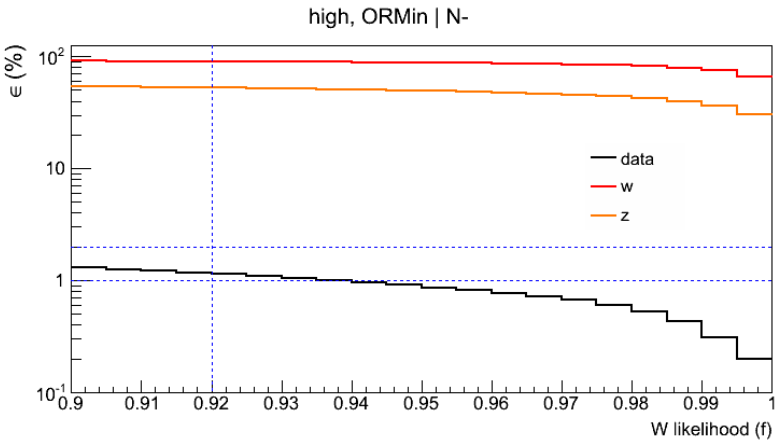


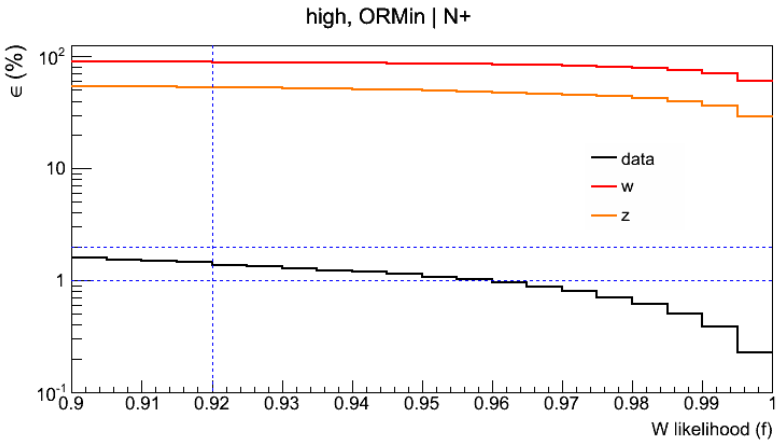
Signal efficiency

- **Unbalance between South and North:**
  - Checked signal efficiency vs. Wness (f_{cut}) for Wness > 0.9 region (**↓ high**)



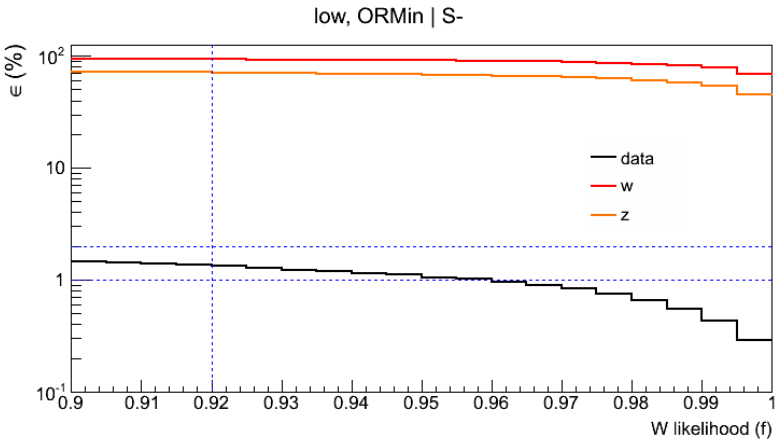


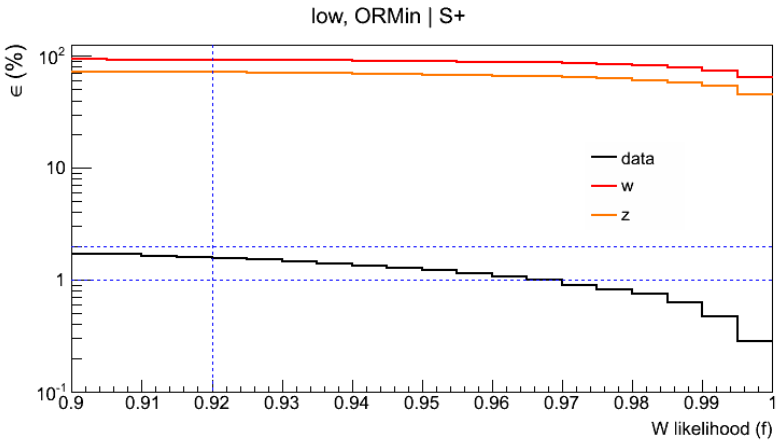


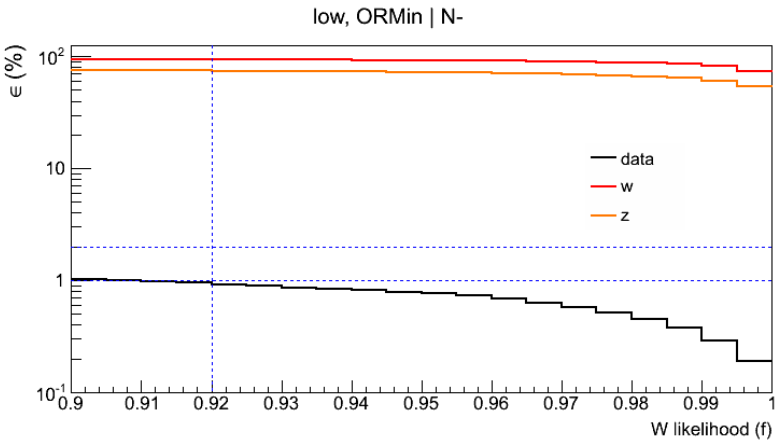


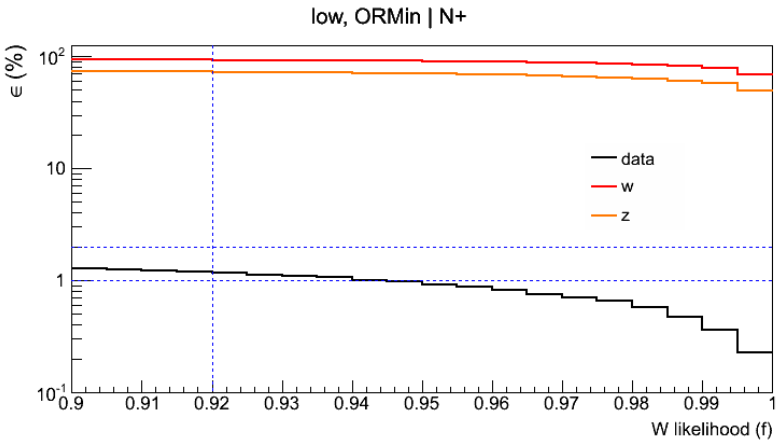
Signal efficiency

- **Unbalance between South and North:**
  - Checked signal efficiency vs. Wness (f_{cut}) for Wness > 0.9 region (**↓ low**)



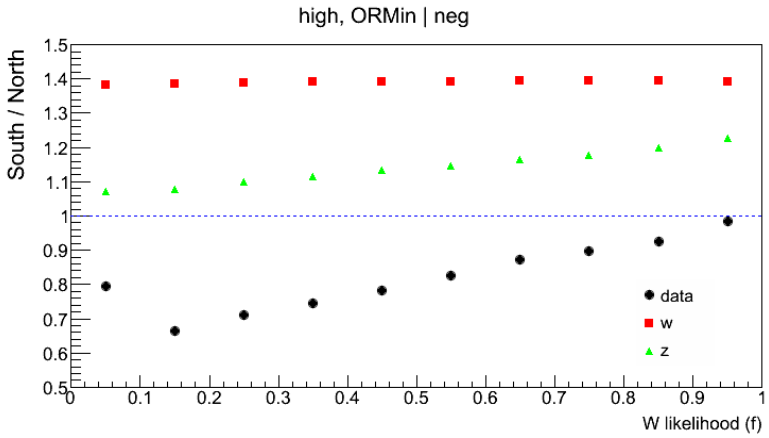


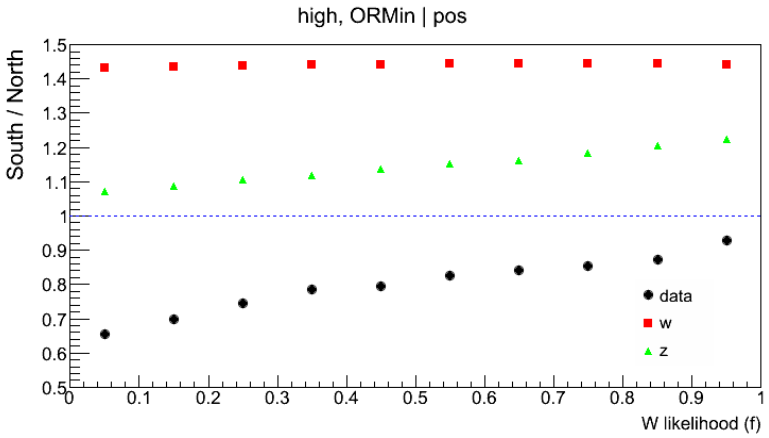


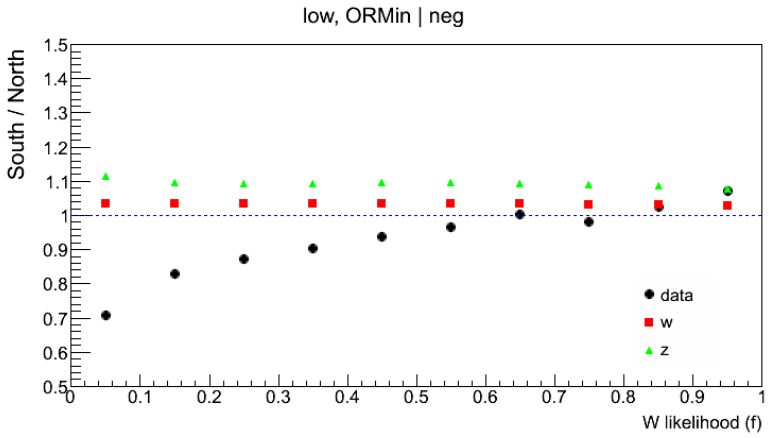


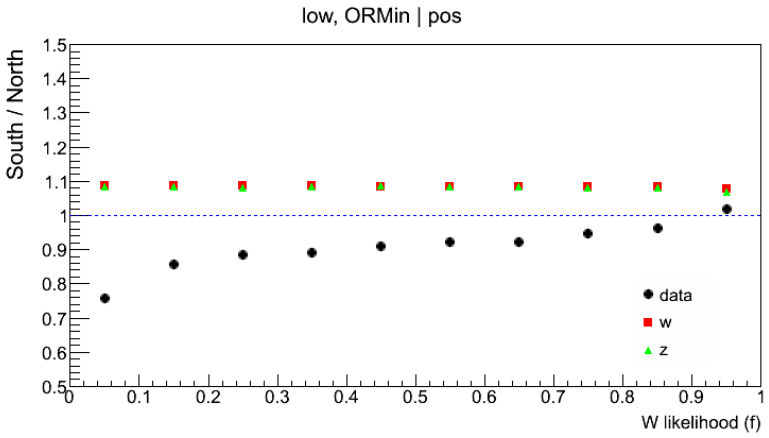
Direct comparison in Muon yields

- **Unbalance between South and North:**
  - Compared **ratio for South/North μ yields** after basic cuts, for different MC inputs: for Wness > 0.9 region, Ratio $_{South/North}$ of data should approach to 1





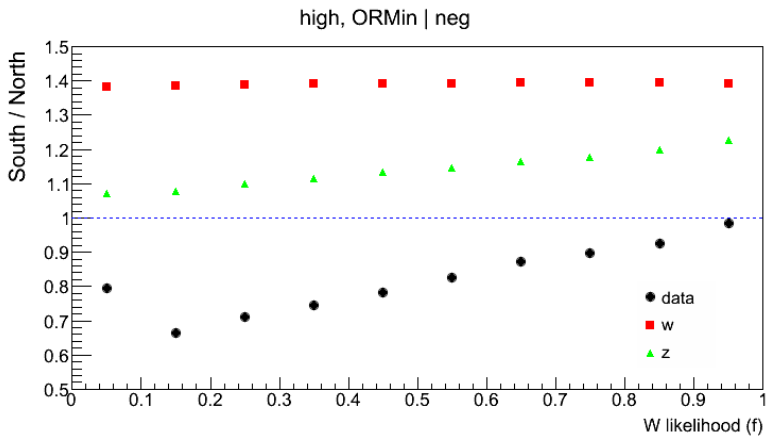


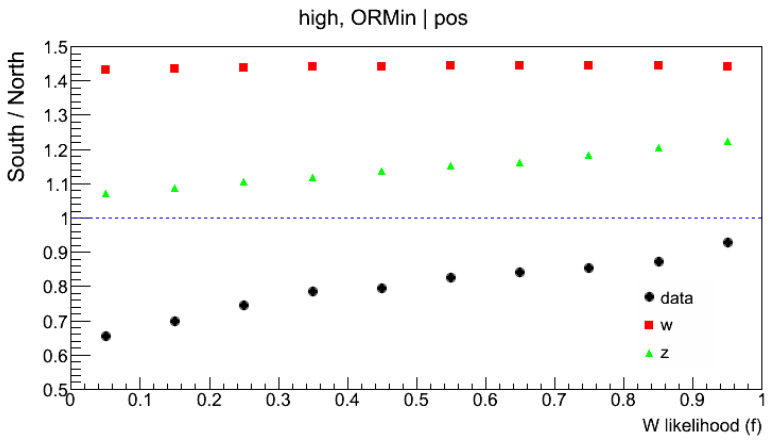


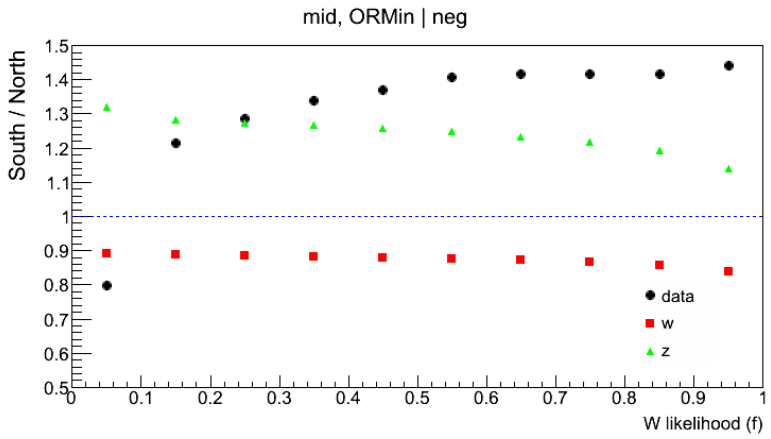
high vs. **low**

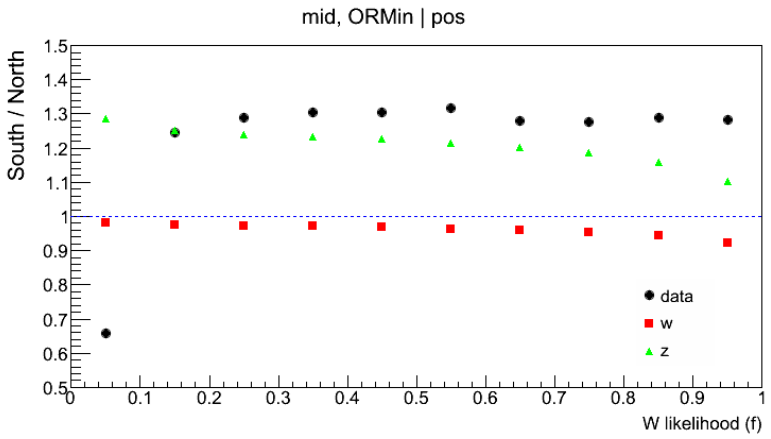
Direct comparison in Muon yields

- **Unbalance between South and North:**
  - In mid condition, South side's ratio continually increases, even W likelihood approach to 1
  - Signal efficiency for mid condition's w and z wasn't very different from the others







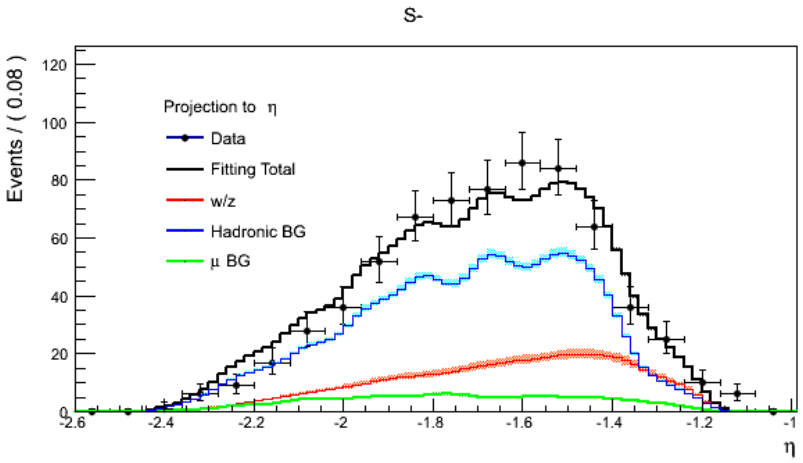


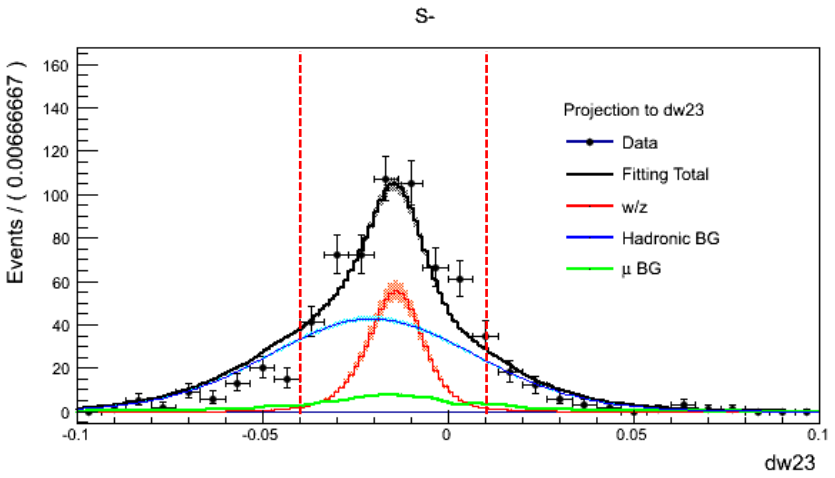
high vs. mid

Cross checks progress:

S/BG estimation by sidebands cut

Cross check – S/BG estimation by sidebands cut





- Two main variables for S/BG fit: η and dw23
- For dw23, signal region is quite focused while BGs are not:
  estimate S/BG for signal focused region will be more reasonable (suggested by Y. Akiba)
- Estimated # of Signal and BGs as Akiba's suggestion
- Overall enhancement in S/BG ratio observed (reduced HBG and μ BG, naturally)

* only high condition MC input was tested

Cross check - by various RpcDCAs: S/BG ratio

Before

	W	H BG	μ BG (fixed)	S/BG
S -	222.149 + 26.976 - 26.317	376.245 + 30.694 - 29.659	75.350	**0.492**
S +	211.126 + 30.730 - 29.775	571.452 + 37.159 - 36.345	78.753	**0.325**
N -	191.090 + 24.403 - 23.635	415.681 + 29.610 - 28.746	76.163	**0.389**
N +	227.237 + 26.759 - 25.904	565.189 + 33.323 - 32.491	77.697	**0.353**

After sidebands cut in dw23

	W	H BG	μ BG (fixed)	S/BG
S -	215.711	270.352	57.485	**0.658**
S +	203.758	474.676	59.794	**0.381**
N -	183.246	254.367	54.714	**0.593**
N +	216.104	355.045	54.058	**0.528**

- **Caution!** fit performed only one time, for whole η and dw23 range:

  this sidebands cut simply estimate numbers again in signal-focused dw23 region

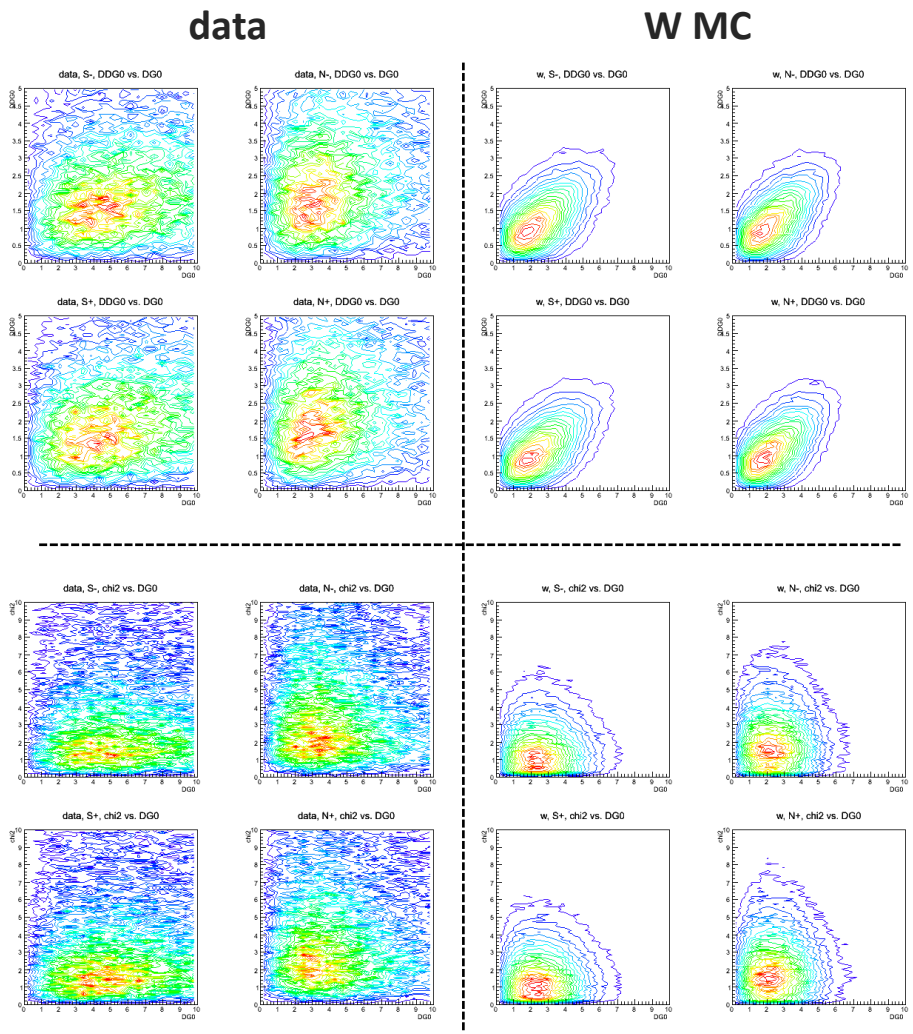
Summary and To do

- **Summary**
  - Cross checks by various RpcDCA:
    - Method confirmed for now: OR + smaller
    - Restored missing acceptance + General statistics increased
    - Suggested RpcDCA selecion by using DCA map:

      Ralf regarded optimistic, but hands are full on other cross checks
  - Cross checks by different MC inputs:
    - Serious unbalance found in mid condition W MC
  - S/BG estimation by sidebands cut
- **To do**
  - Find source of unbalance in mid condition W MC
  - Need to separate problematic (?) MC inputs in mid condition

Backup – basic cuts + RpcDca selection

Sample of signal sensitive kinematic variables' distribution



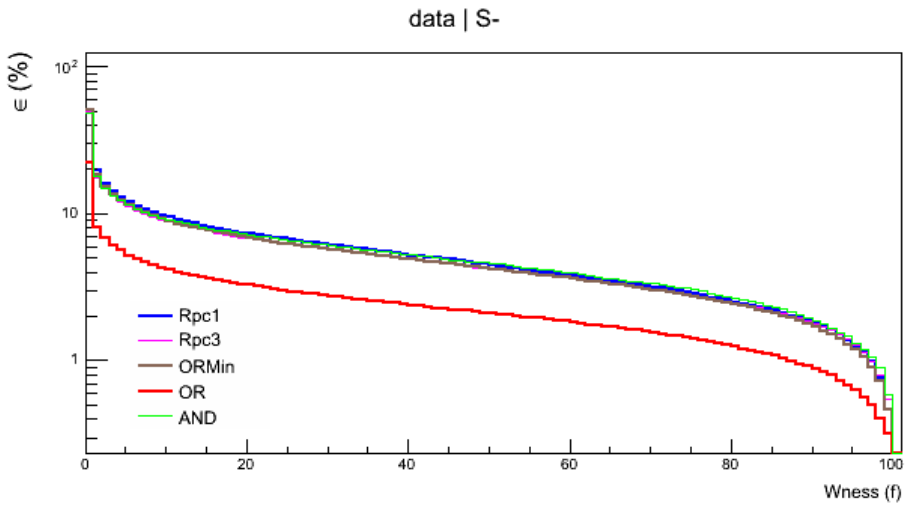
- Basic cut:
  - $16 < p_T < 60$
  - DG0 < 20.0
  - DDG0 < 9.0
  - Chi2 < 20.0
  - (0 < Rpc1Dca < 100) **OR** (0 < Rpc3Dca < 100)
    (at least one of two RpcDCA satisfy condition)
  - lastGap = 4

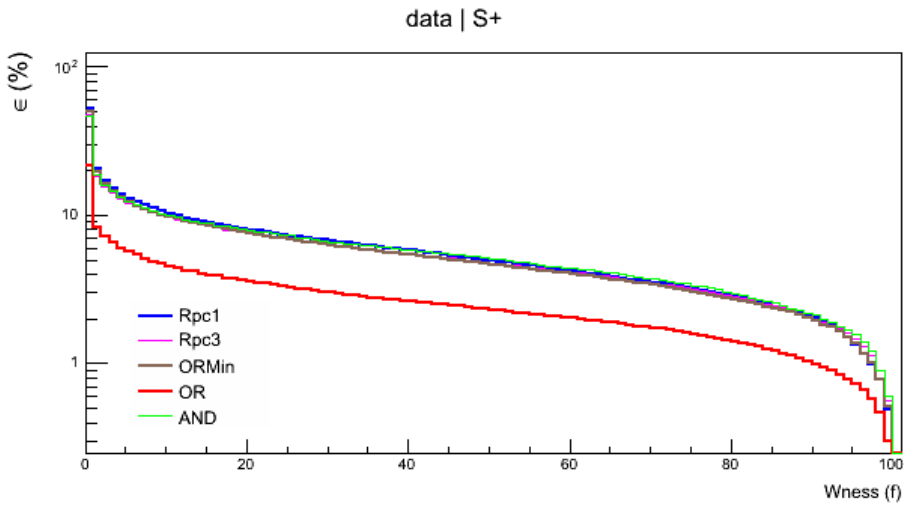
* Study is ongoing for applying RpcDca cut:

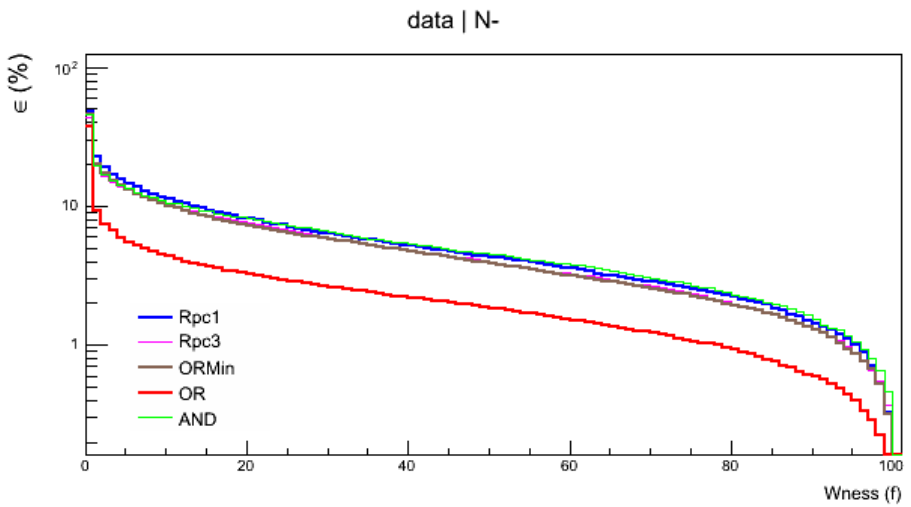
a. Rpc1Dca
b. Rpc3Dca
c. Rpc1Dca or Rpc3Dca (current set)
d. Smaller one between 2 RpcDca

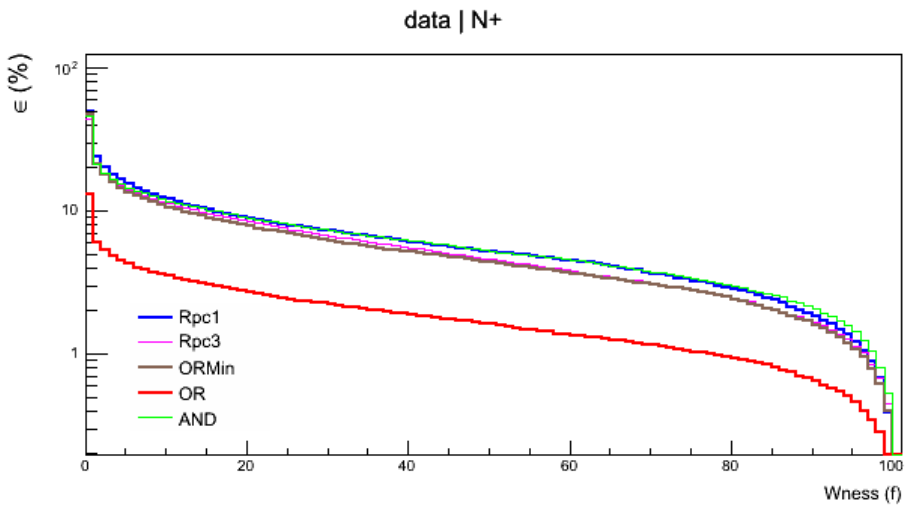
Top 8: DDG0 vs. DG0 / Bot 8 : Chi2 vs. DG0

Backup - Efficiency of data, by various RpcDCAs



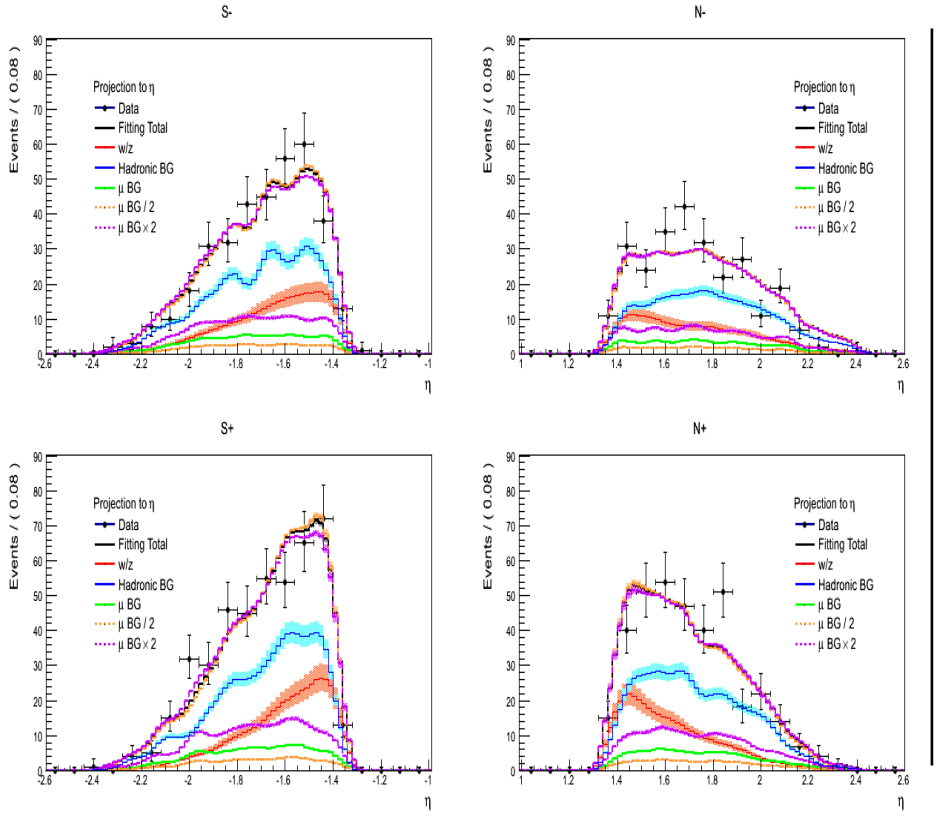




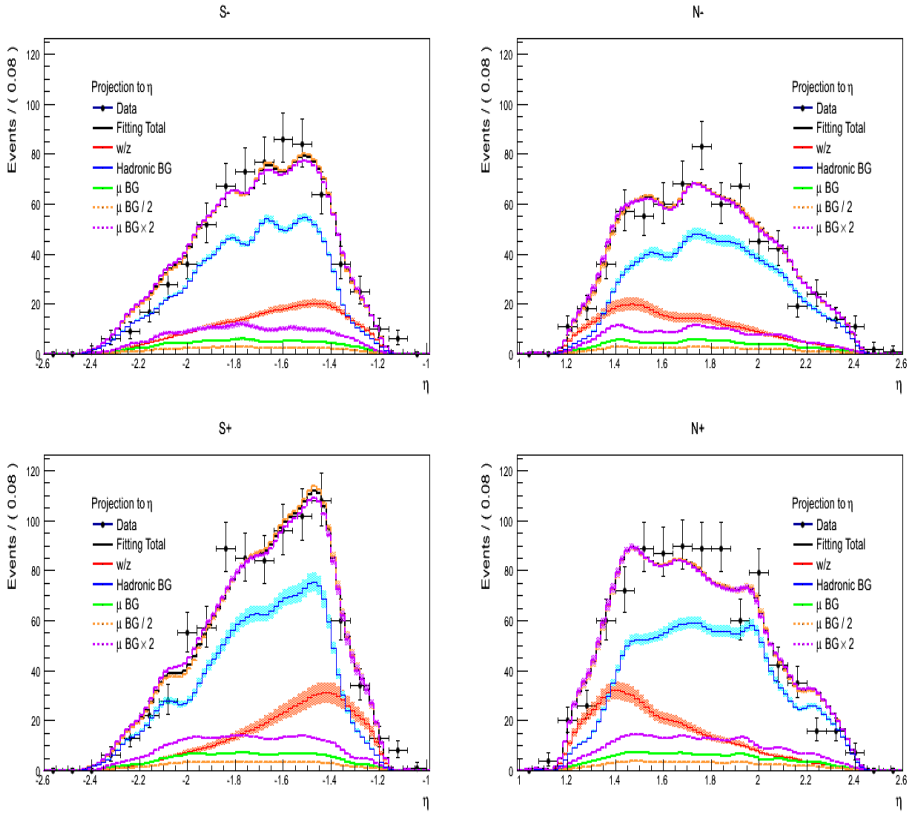


Backup - Fit projection to the η, w/ modification in μ BG

OR (preliminary)



OR + smaller (updated)



Backup - Luminosity table

Extracted at May 21st

Ref. 368630 (low)	k factor	# of gen events (M)	x-section (mb)	luminosity (pb-1)
data (common)	1.5	N/A	N/A	43
dy (direct photon)	1.5	11600	5.32E-002	218.0
light	1.5	311.1	5.94E+001	0.0
onium	1.5	32910	1.35E-001	243.8
openbottom	1.5	1552	7.30E-003	212.6
opencharm	1.5	145940	5.71E-001	255.6
w	1.5	65.1	1.66E-006	39216.9
whad	1.5	120	1.66E-006	72289.2
wjet	1.5	11.9	1.20E-006	9916.7
wtau	1.5	118	1.66E-006	71084.3
z	1.5	81.5	1.59E-005	5125.8
zjet	1.5	11.9	1.02E-006	11666.7
zonly	1.5		1.59E-005	

Ref. 367466 (mid)	k factor	# of gen events (M)	x-section (mb)	luminosity (pb-1)
data (common)	1.5	N/A	N/A	43
dy (direct photon)	1.5	19690	5.32E-002	370.1
light	1.5	152	5.94E+001	0.003
onium	1.5	34040	1.35E-001	252.1
openbottom	1.5	3735	7.30E-003	511.6
opencharm	1.5	87230	5.71E-001	152.8
w	1.5	303.6	1.66E-006	182891.6
whad	1.5	335	1.66E-006	201807.2
wjet	1.5	13.3	1.20E-006	11083.3
wtau	1.5	346	1.66E-006	208433.7
z	1.5	253.7	1.59E-005	15956.0
zjet	1.5	13.2	1.02E-006	12941.2
zonly	1.5	136.8	1.59E-005	8603.8

Ref. 367593 (high)	k factor	# of gen events (M)	x-section (mb)	luminosity (pb-1)
data (common)	1.5	N/A	N/A	43
dy (direct photon)	1.5	6400	5.32E-002	120.3
light	1.5	193.6	5.94E+001	0.003
onium	1.5	55470	1.35E-001	410.9
openbottom	1.5	4003	7.30E-003	548.4
opencharm	1.5	134220	5.71E-001	235.1
w	1.5	173.4	1.66E-006	104457.8
whad	1.5	81	1.66E-006	48795.2
wjet	1.5	8.2	1.20E-006	6833.3
wtau	1.5	82	1.66E-006	49397.6
z	1.5	245.2	1.59E-005	15421.4
zjet	1.5	8.2	1.02E-006	8039.2
zonly	1.5	106.5	1.59E-005	6698.1