# Efficiencies for L1 DT primiteves

## MBTF

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## Intro

- Look at efficiency for L1DTTrigger;
- Look only at bending primitives: $\phi$ superlayers (1 and 3);
- Efficiecny definition: $\epsilon = \frac{N}{D}$
  - Numerator:
    - ★ A primitive is present;
    - ★ Consider only correct BX (=0), any code;
    - ★ for legacy and new L1 primitives.
  - Denominator:
    - ★ Some DTDigi are present;
    - ★ Any number of DTDigi
    - ★ Separately for number of Layers and SuperLayers which have at least one Digi;
    - ★ For local position in chamber use centroid of wires with Digis, normalized to chamber width ($x \in [-1., 1.]$);
    - ★ For x (bending) and y (orthogonal to x).

# Details on code

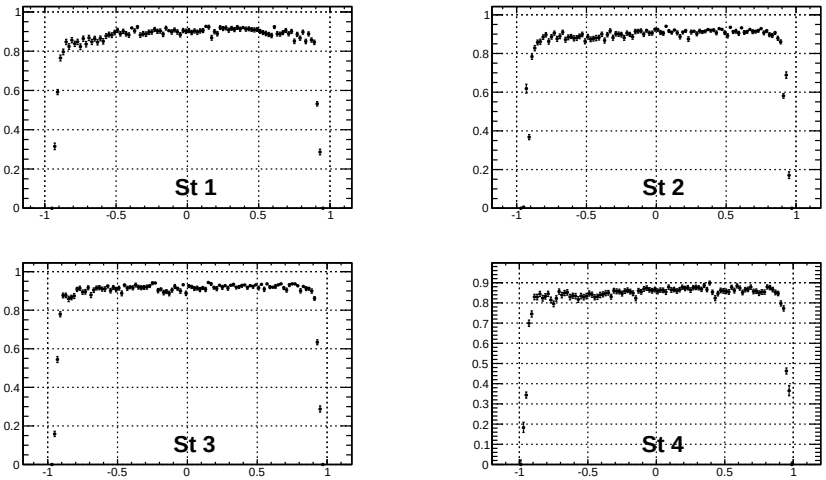
- `CMSSW_5_3_14`
- latest code from `GIT` repository `battibass/L1IntegratedMuonTrigger.git`
- datasample
  - 100k
  - SingleMu
  - flat pT Gun, $3 < p_T < 140$ *GeV*
  - charge=+1
  - $|\eta| < 0.85$
  - $-30° < \phi < 30°$
  - No PU, No noise

# Eff vs chamber position

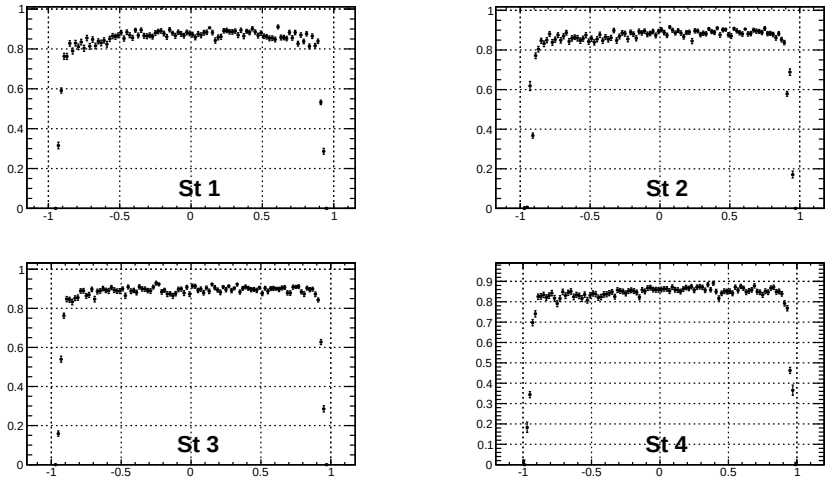
- Showing $\epsilon$ for legacy and new primitives as well as ratio New/Legacy
  - grouped by station (by wheel in backup);
  - per chamber granularity is available, but too much stuff to show here.
- only if BX is correct (BX=0)
- Inclusive in term of quality code, and number of Layers or SuperLayers with DTDigis;
  - Exclusive efficiency later;

# Efficiency vs Chamber position X by Station

## Legacy



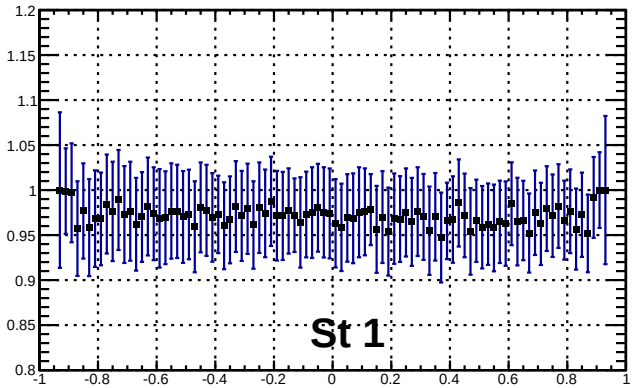

## New

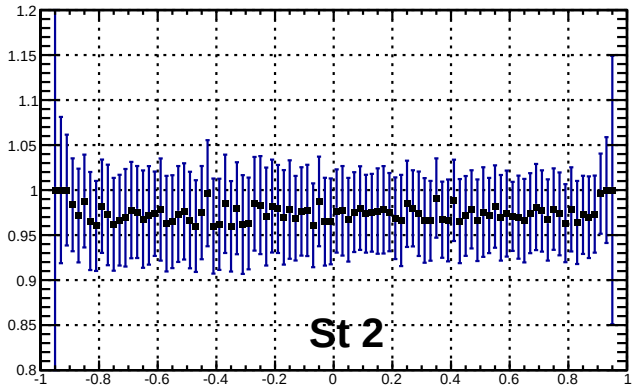


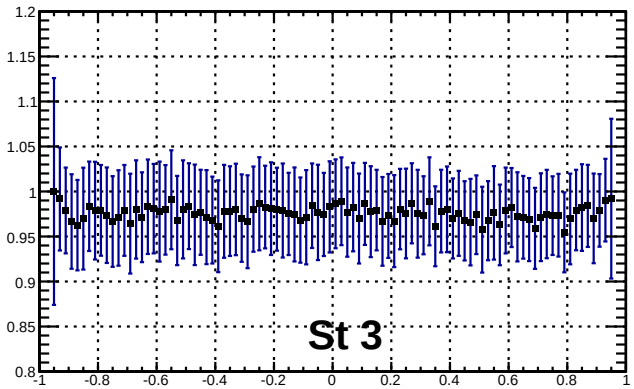

Drop at border of chamber (acceptance) Ratio New/Legacy next slide

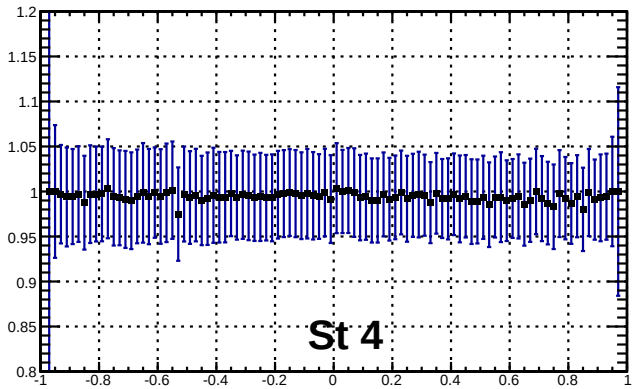
# Efficiency vs Chamber position X by Station

**New/Legacy** Some % of $\epsilon$ drop from Legacy to New, but for Station 4, and not at chamber border



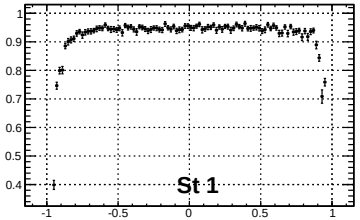



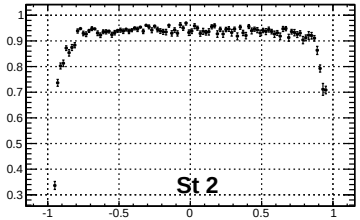



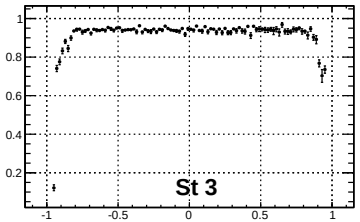



# Efficiency vs Chamber position Y by Station

## Legacy

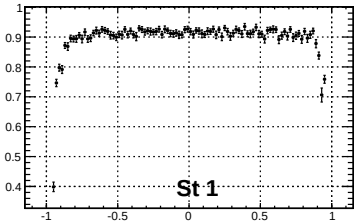


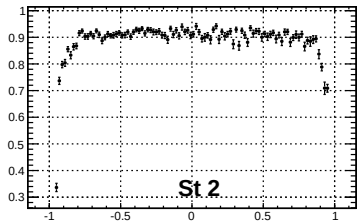



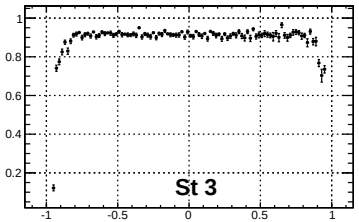




St 4

## New



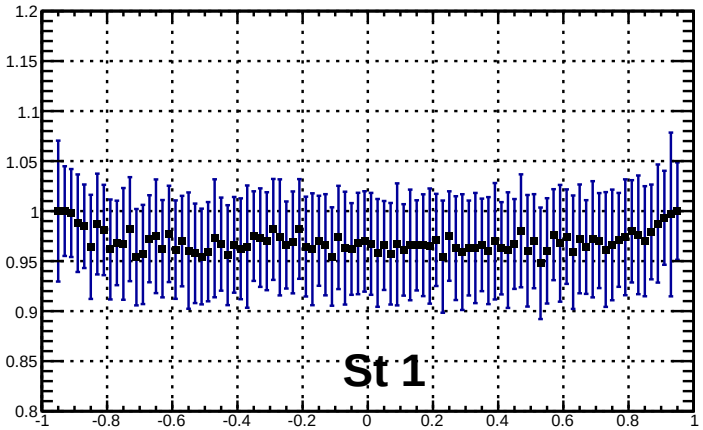



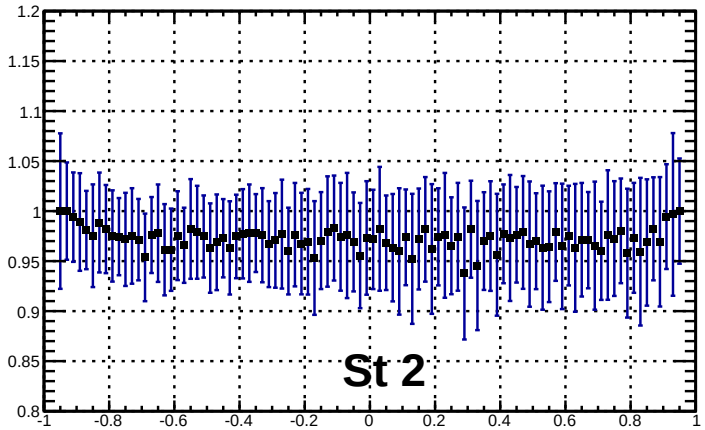

St 4

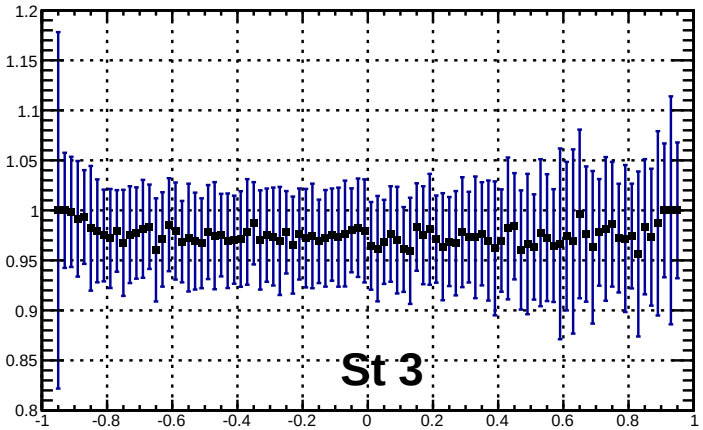
NB: local-Y (non bending) coordinate, no ST4

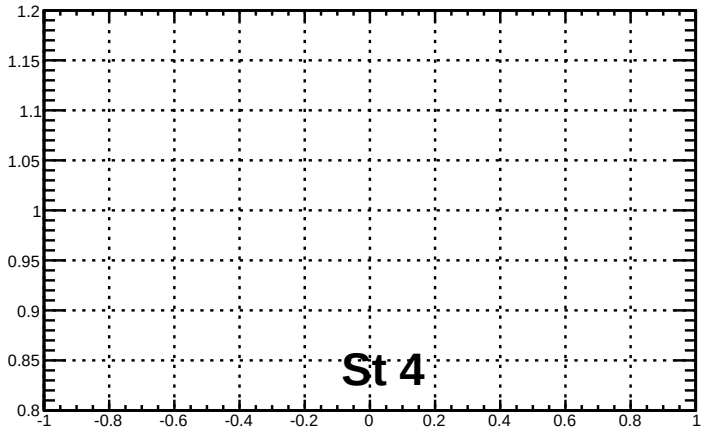
# Efficiency vs Chamber position Y by Station

## New/Legacy



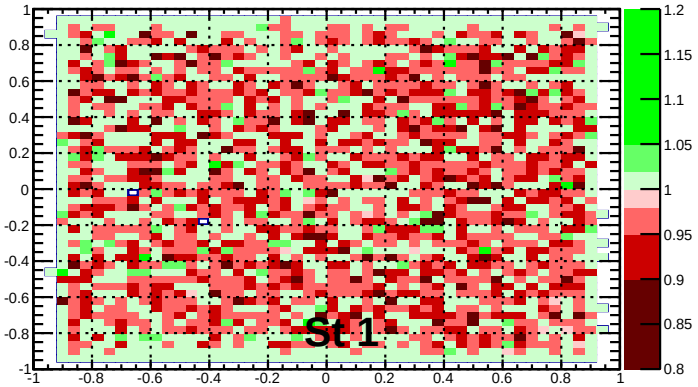



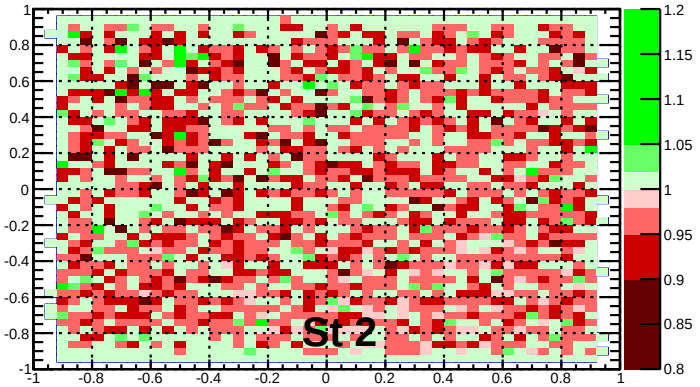



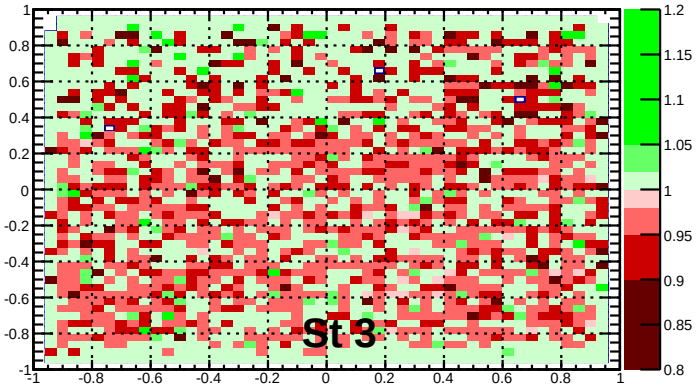



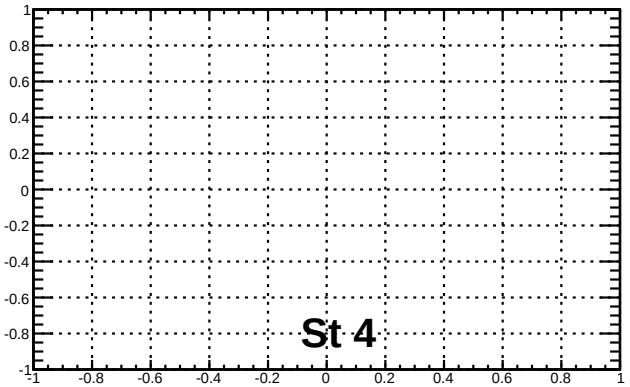
# Efficiency vs Chamber position Y vs X by Station

**New/Legacy** non-bending vs bending coord: $\epsilon$ drop not at chamber border



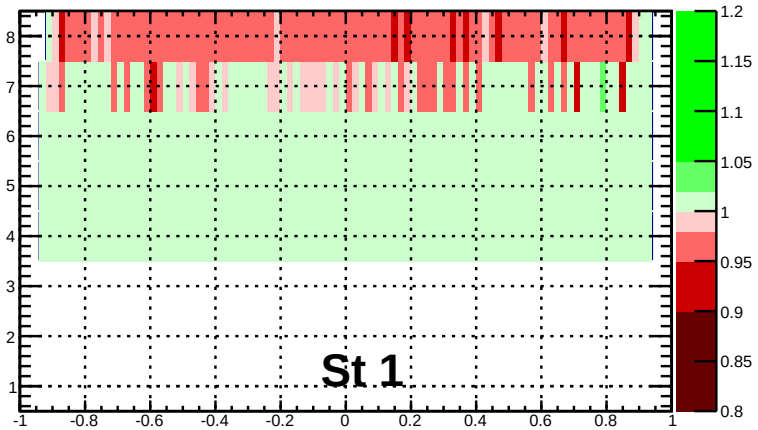



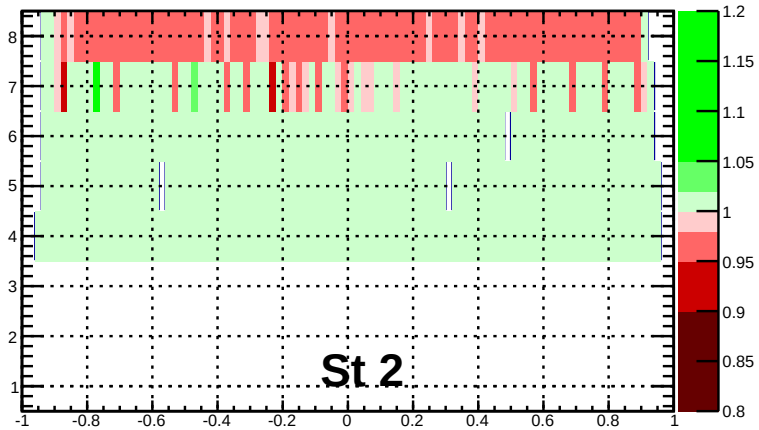
# Eff vs chamber position vs n Layers

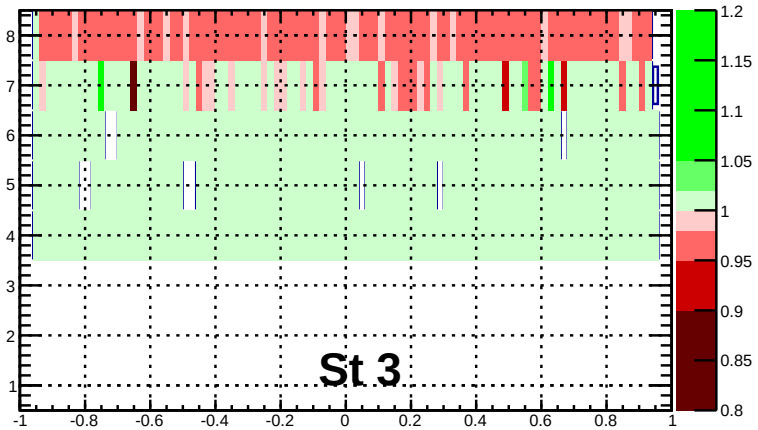
- only if BX is correct (BX=0)
- Inclusive in term of quality code
- **As a function of Num of Layers with at least one DTDigi**
- **As a function of Num of SuperLayers with at least one DTDigi**
  - NB: considering only $\phi$ Layers (SL=1,3, max N layers=8)
- $\epsilon$ drops only for nLayers=8 (and some for nLayers=7)
- $\epsilon$ drops only for nSL=2, not at the border of the chambers, and much less for Station 4

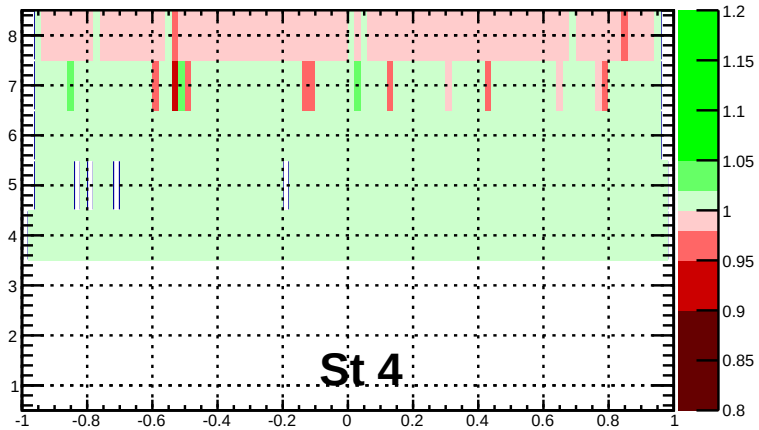
# Efficiency vs Chamber pos vs N. Layers by Station

**New/Legacy** $\epsilon$ drop is for nLayer=8, less for St4



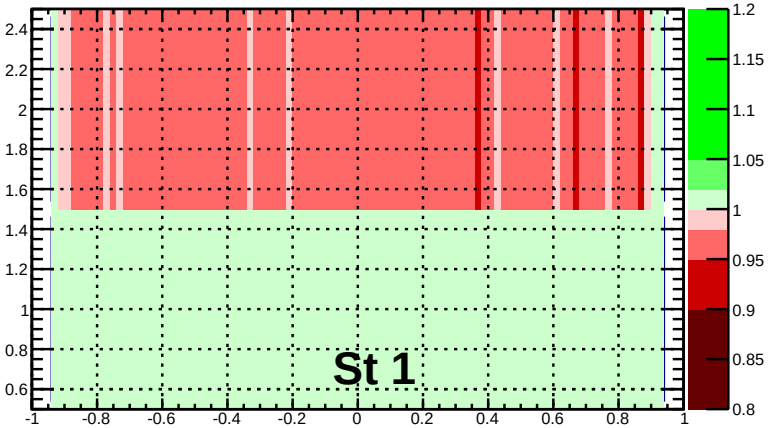



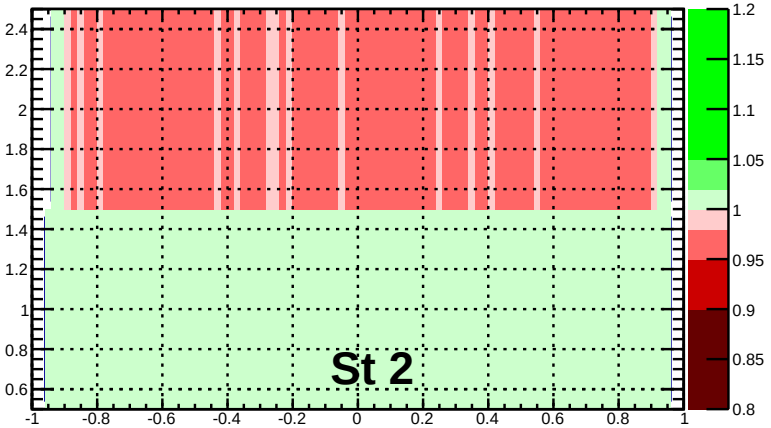



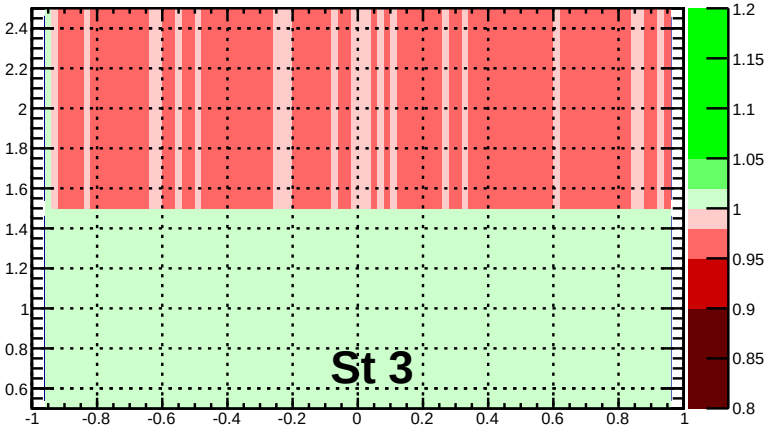



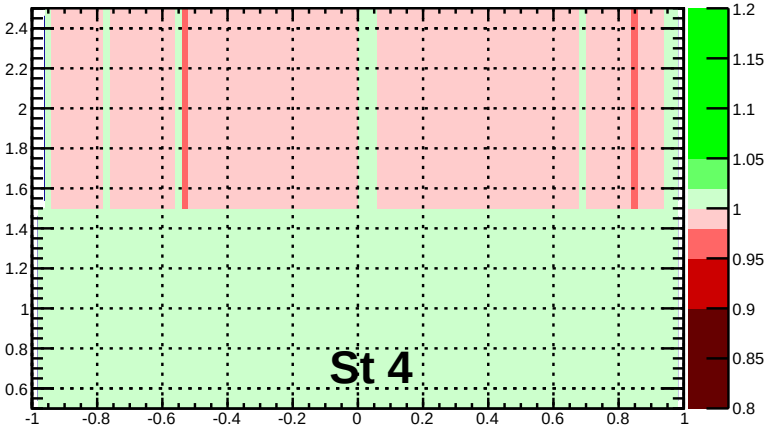
# Efficiency vs Chamber pos vs N. SL by Station

**New/Legacy** $\epsilon$ drop is for nSL=8, less for St4



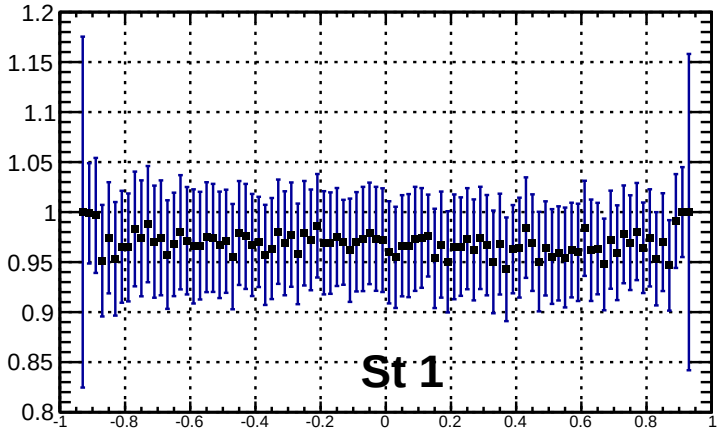



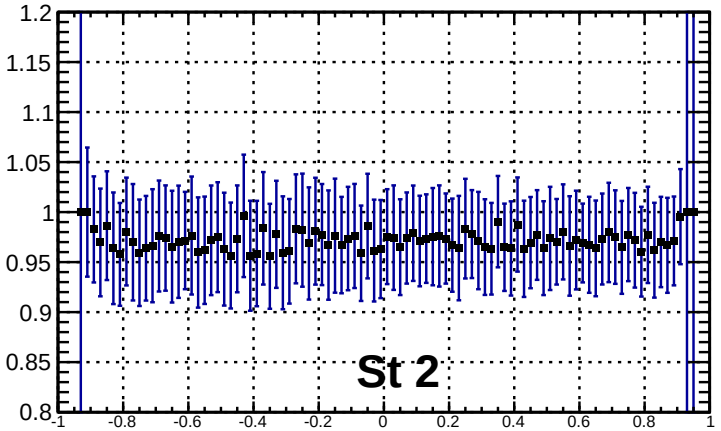



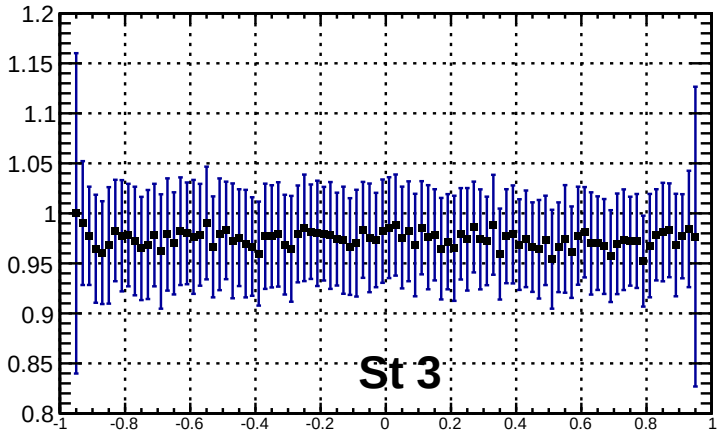



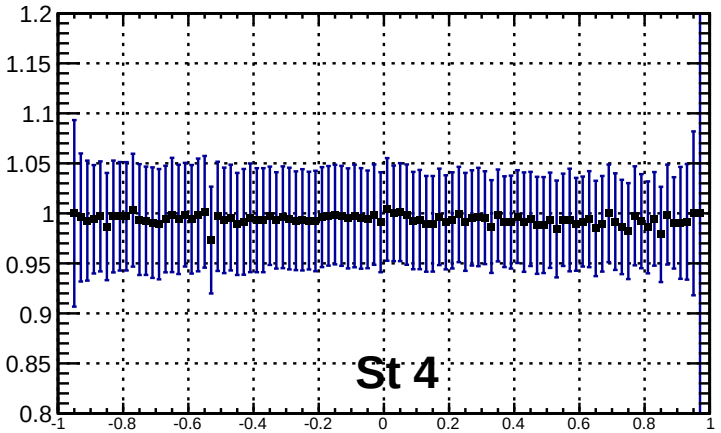
# Efficiency vs Chamber pos N SL==2 by Station

**New/Legacy**$\epsilon$ drop not at chamber border, less for St4



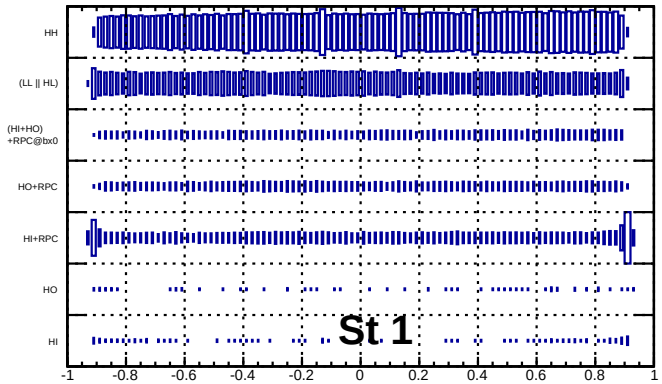
# Primitives vs Code

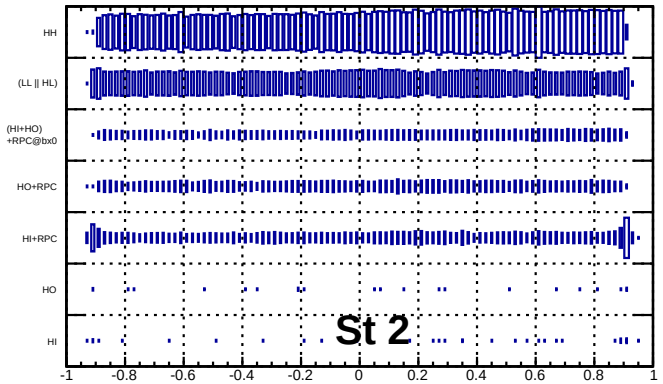
- Study the Primitive distribution as a function of chamber position
- **Subdivided for different Quality Code;**
- In case Digis in both SL, or in just in one;

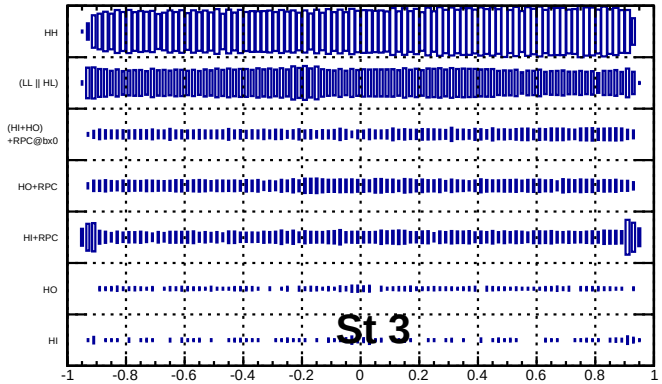
| Code | New |
|---|---|
| 1 | HI |
| 2 | HO |
| 3 | HI+RPC |
| 4 | HO+RPC |
| 5 | (HI+HO)+ RPC@bx0 |
| 6 | (LL \|\| HL) |
| 7 | HH |

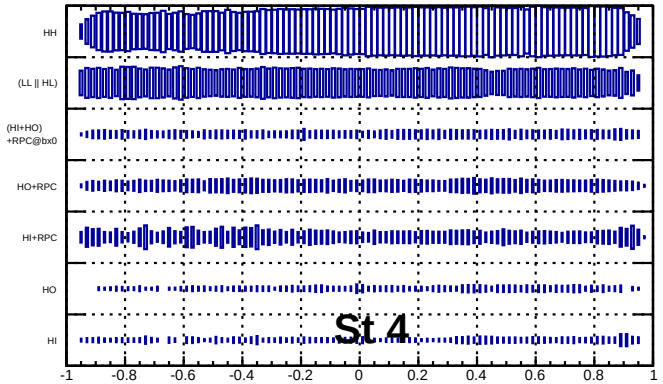
# N primitives vs Chamber pos vs Code
## by Station vs nSL

**New n SL=2**



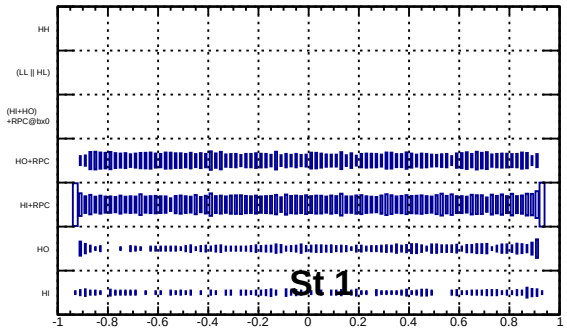



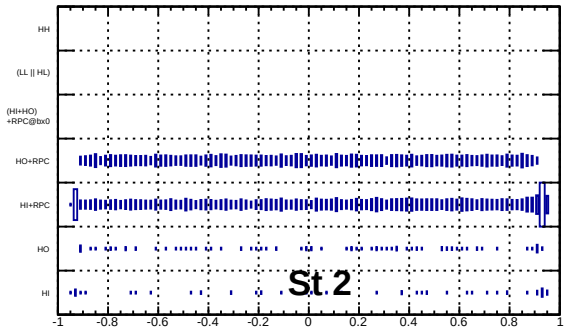



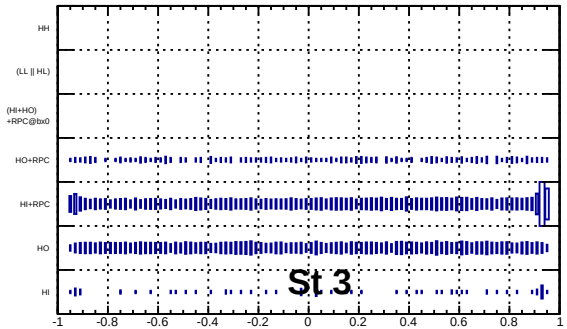



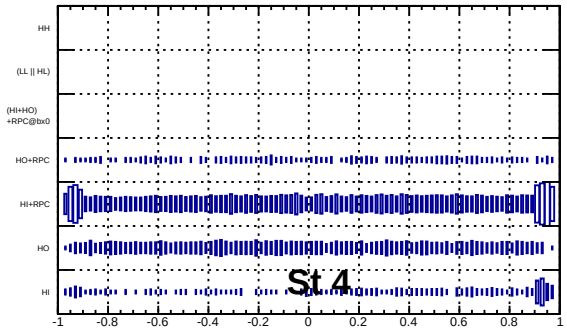

At chamber border `HI+RPC`

## New n SL=1



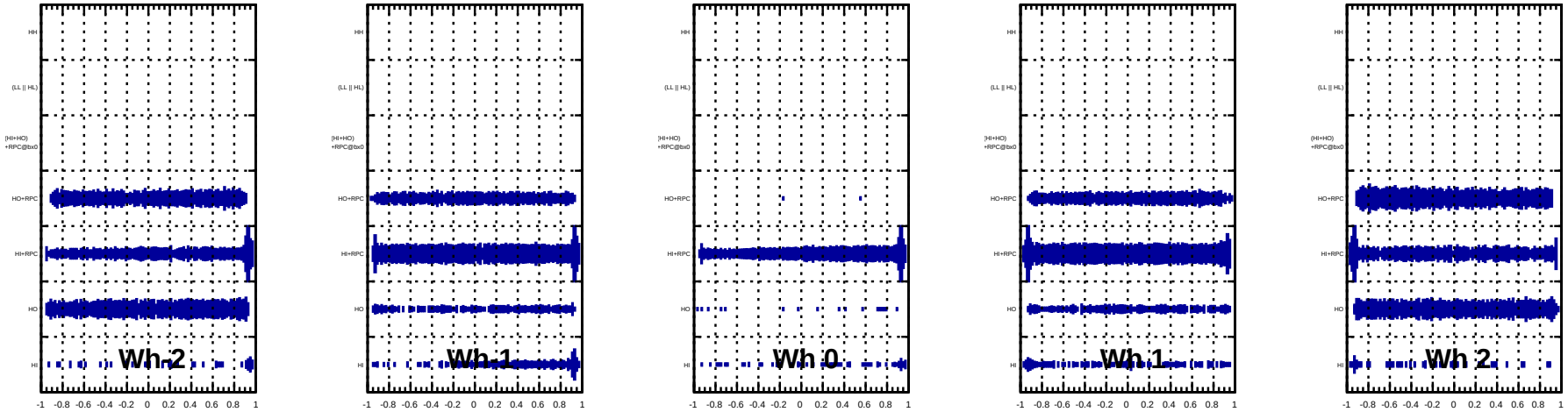




- At chamber border HI+RPC
- **ST1,2**: HI+RPC or HO+RPC
- **ST3,4**: HO or HI+RPC

# N primitives vs Chamber pos vs Code
## by Station vs nSL

**New n SL=1**




HO w/o RPC in wheel±2

Why no HO+RPC in Wheel0?

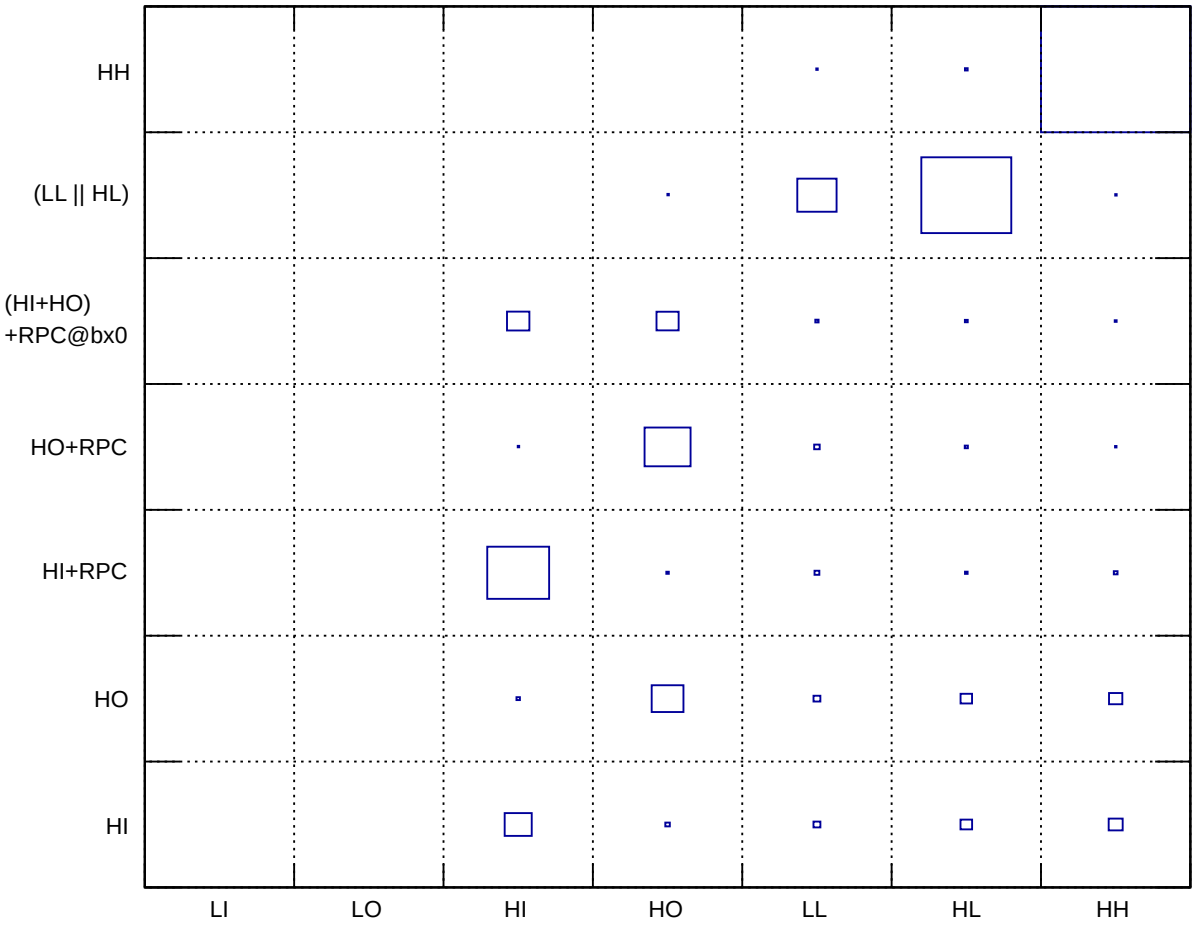
# Primitives vs Code

Study the primitives quality code legacy vs new;

- In case Digis in both SL, or in just in one;

| Code | Legacy | New |
|---|---|---|
| 1 | LI | HI |
| 2 | LO | HO |
| 3 | HI | HI+RPC |
| 4 | HO | HO+RPC |
| 5 | LL | (HI+HO)+ RPC@bx0 |
| 6 | HL | (LL \|\| HL) |
| 7 | HH | HH |

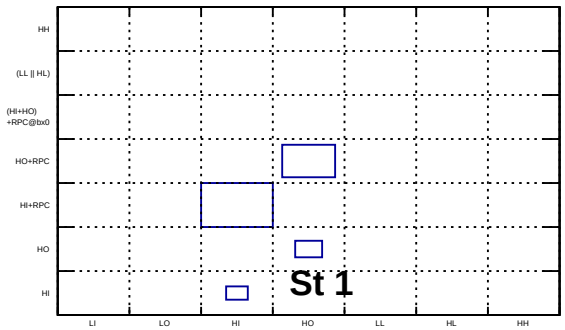
# Quality code New vs Legacy

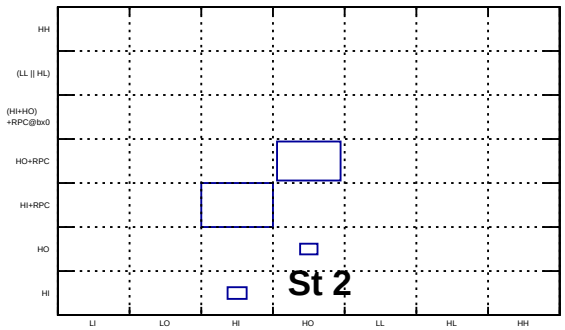


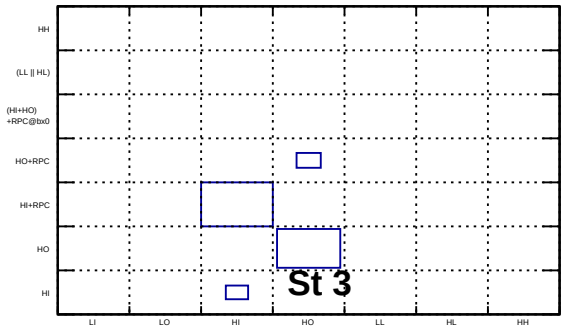

- Similar for all station/wheel;
- HI/HO mostly becomes HI/O+RPC
- Sometime LL/HL/HH becomes of lesser quality

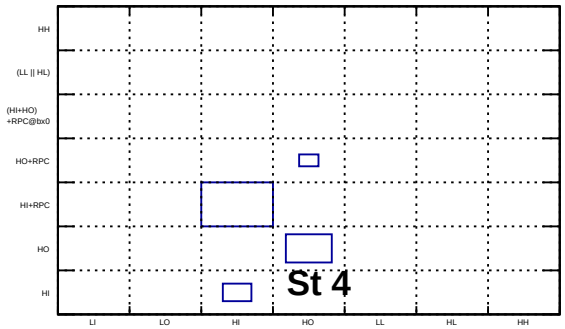
# Quality code New vs Legacy by Station if num SL=1

When only one SL has digis;




**ST1,2**

- HI/HO mostly becomes HI/O+RPC;

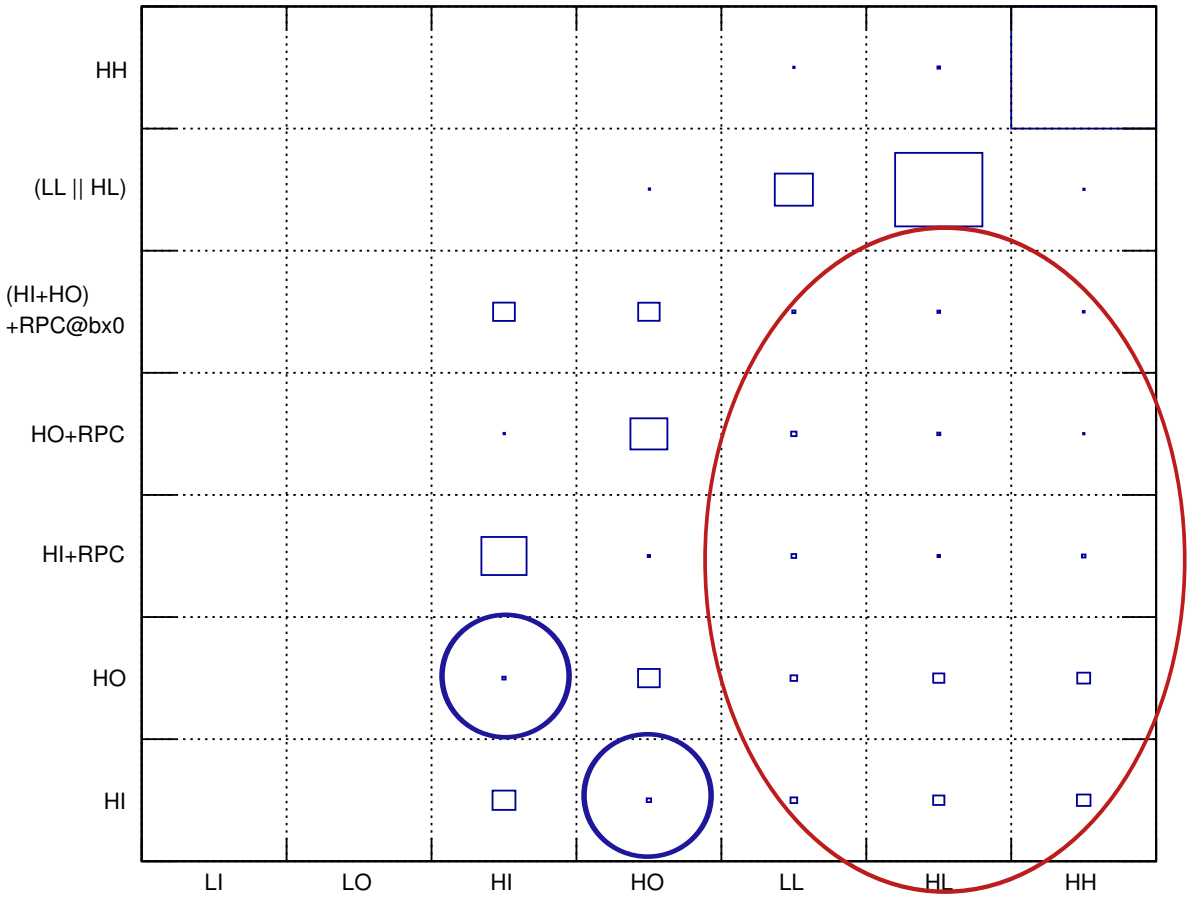
**ST3,4**

- HI mostly becomes HI+RPC
- HO mostly remains the same;

as expected

# Quality code New vs Legacy by Station if num SL=2

When both one SL has digis;




- Why some HI becomes HO (and viceversa)?
- Why some LL/HL/HH becomes HI/HO (w/ or w/o RPC)?

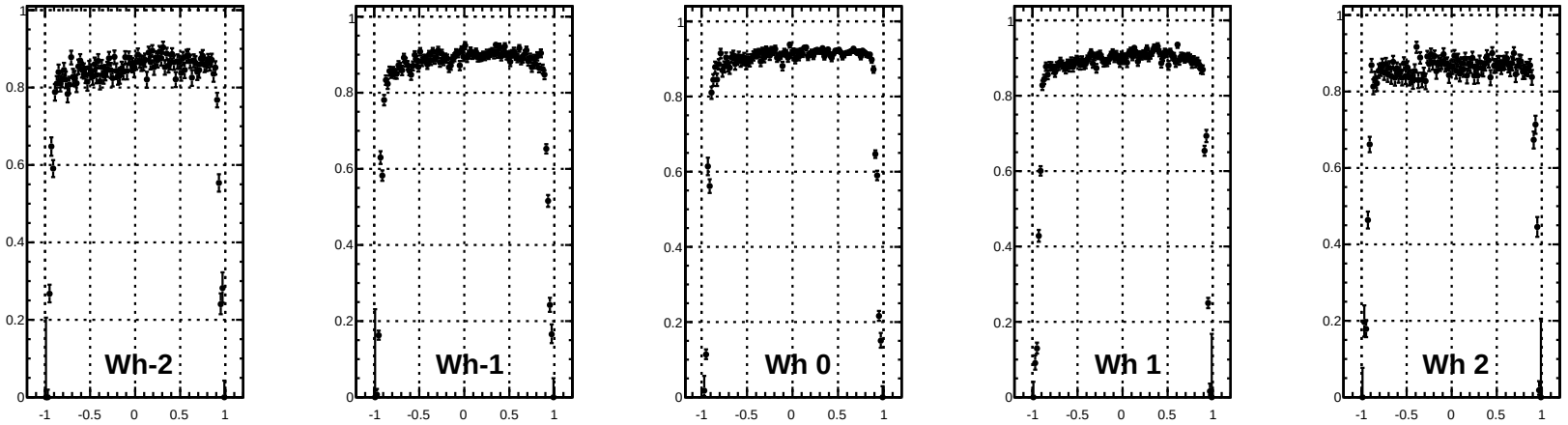
# Summary

- Infrastructure for detailed efficiency study is in place
- Overall, the New Primitives behaves as expected;
- There is a drop of efficiency at the level of few %;
- Something odd in Wheel=0 for nSL=1;
- **RPC usage**:
  - good for HI for all station and for HO only for station 1 and 2
  - at chamber edge many new superprimitives are HI+RPC, almost none HO+RPC
- Some strange migration of quality code from Legacy to New Primitives

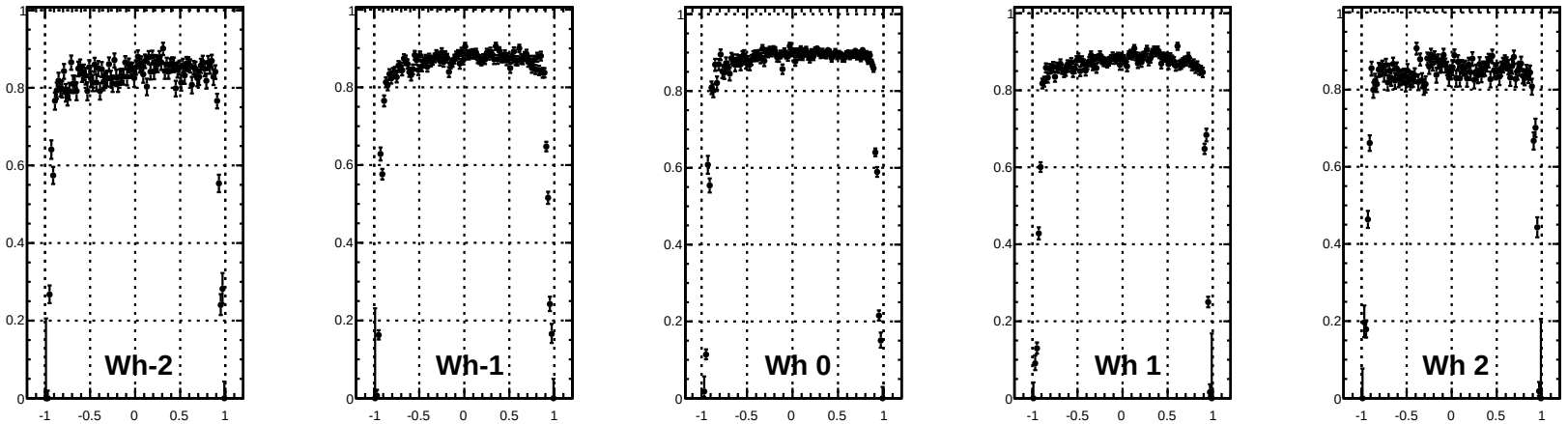
Backup slides follows

# Efficiency vs Chamber position by Wheel

## Legacy

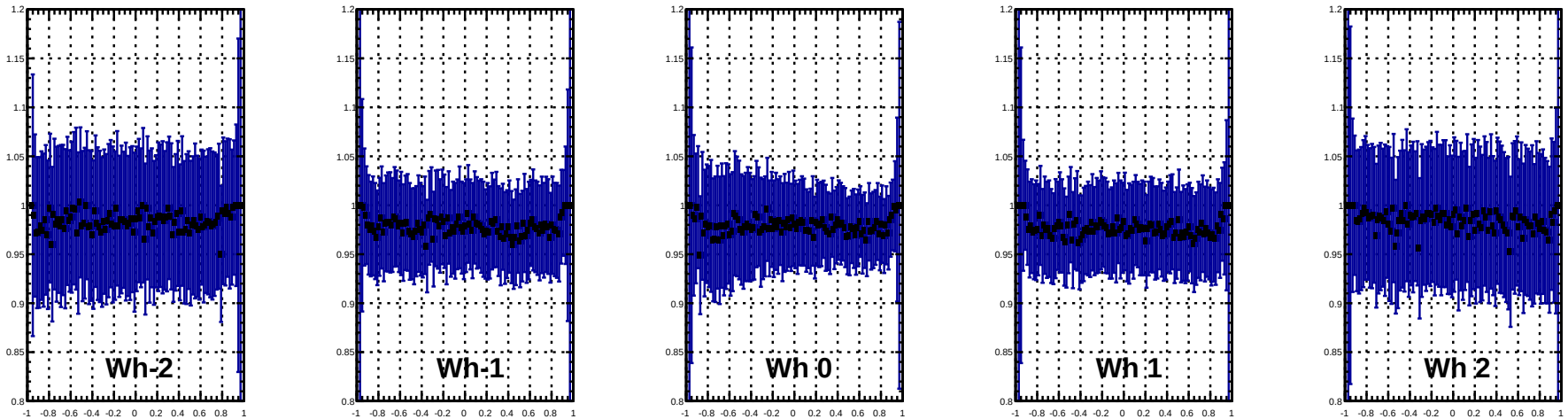



## New



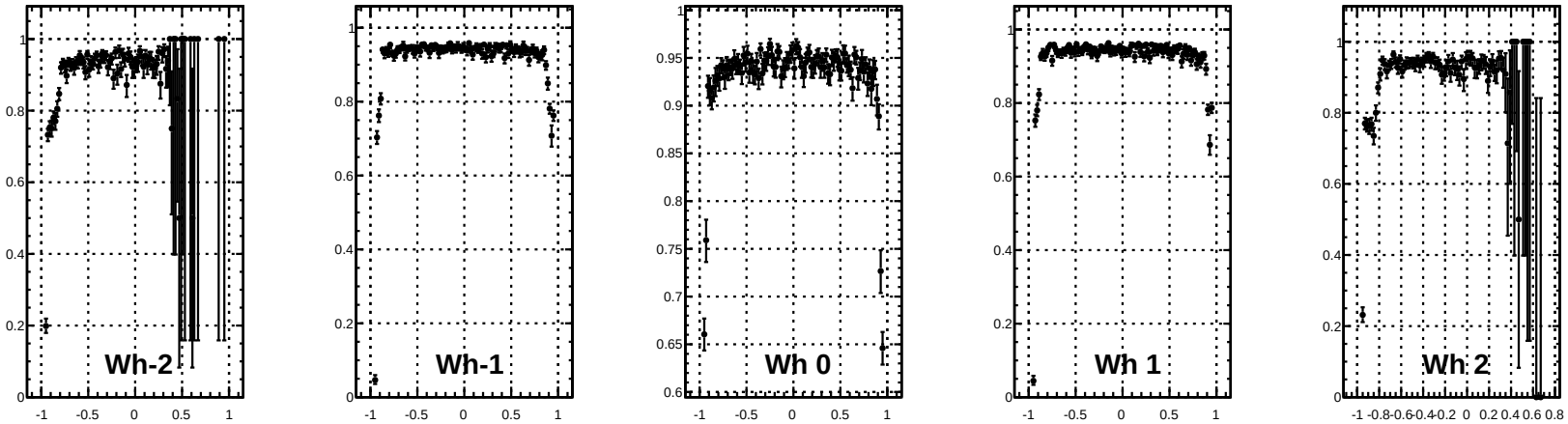
# Efficiency vs Chamber position by Wheel

## New/Legacy

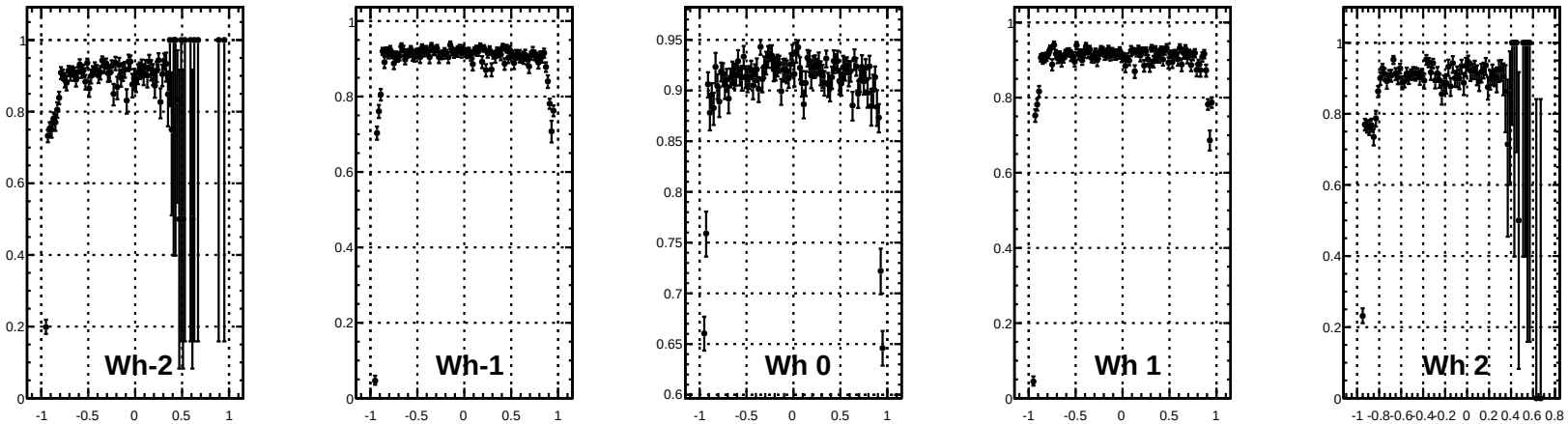


# Efficiency vs Chamber position Y by Wheel

## Legacy

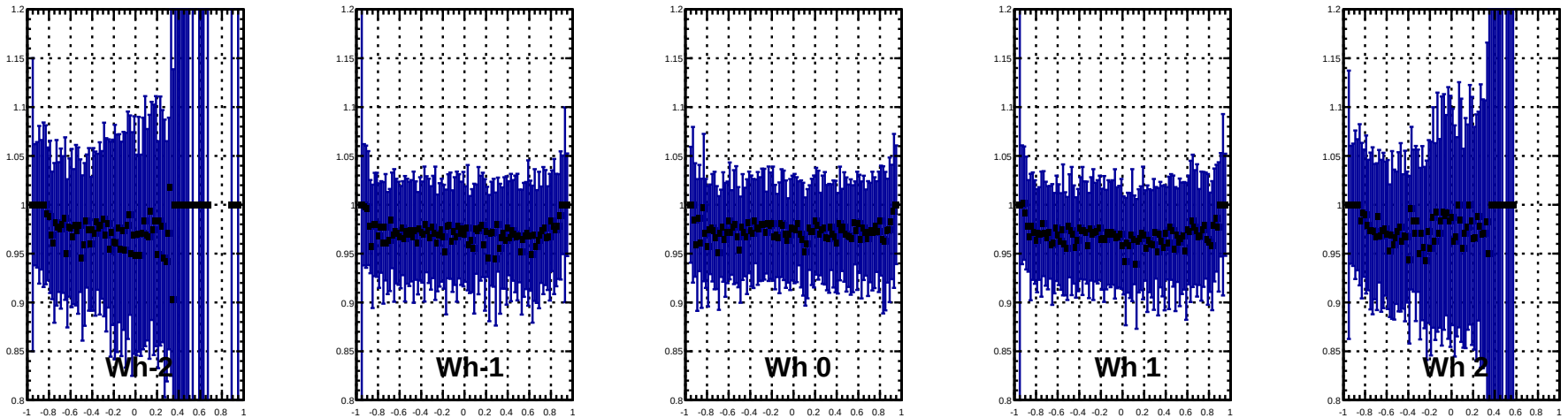



## New



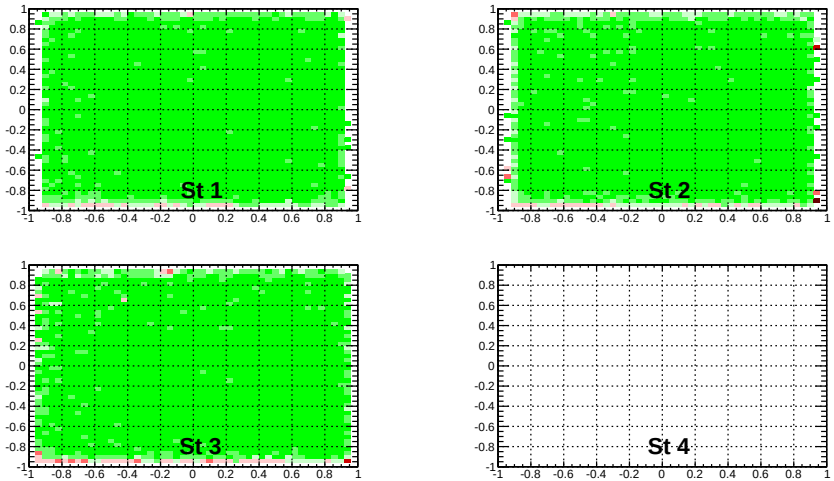
# Efficiency vs Chamber position Y by Wheel

## New/Legacy

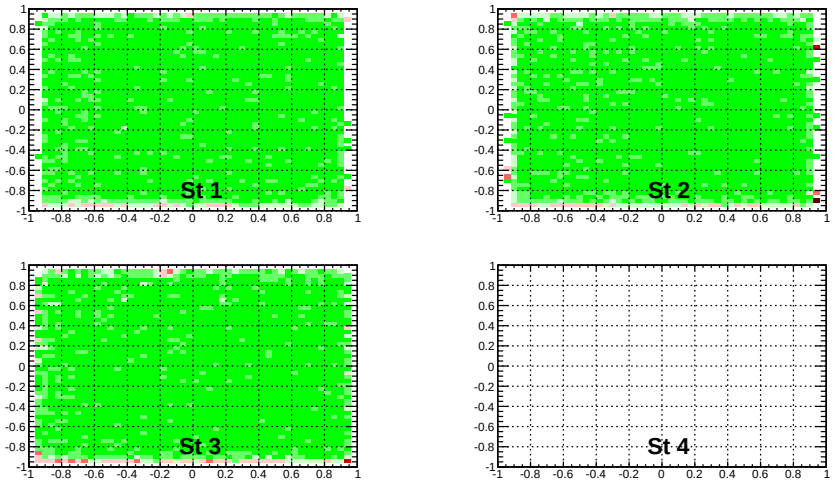


# Efficiency vs Chamber position Y vs X by Station

## Legacy

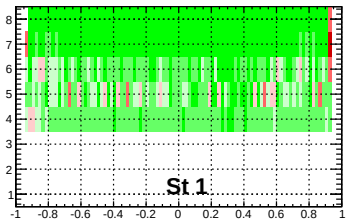


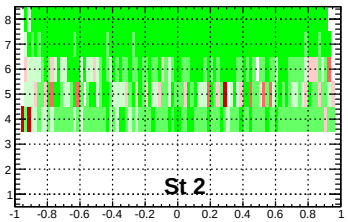

## New

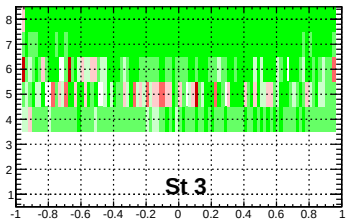


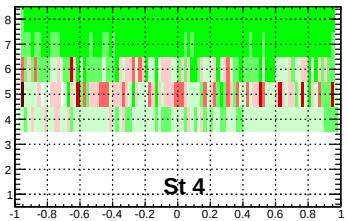
# Efficiency vs Chamber position vs #Layers by Station

## Legacy

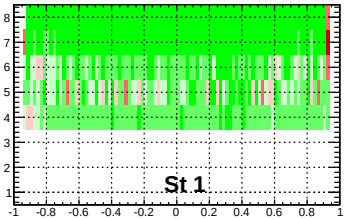


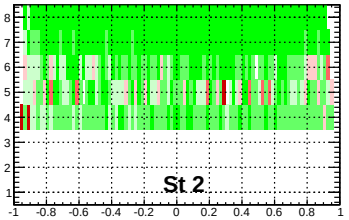



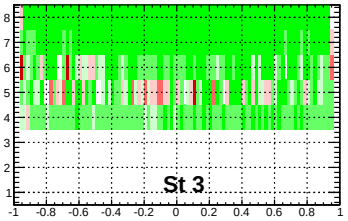



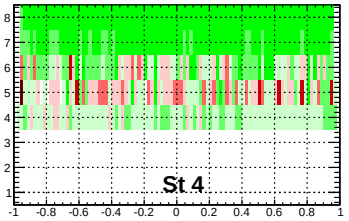




## New



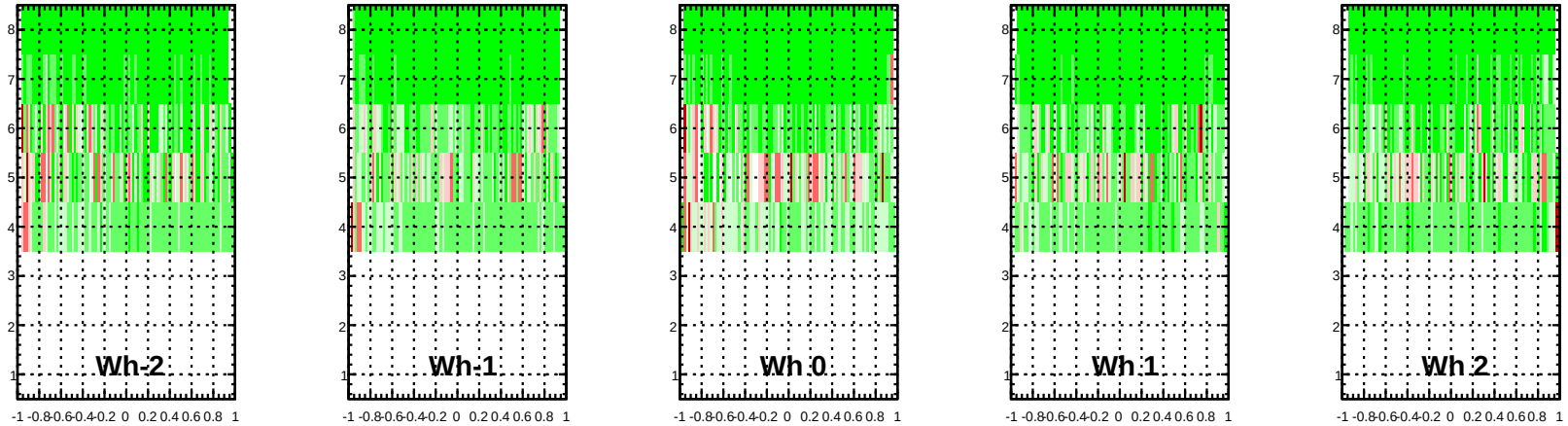



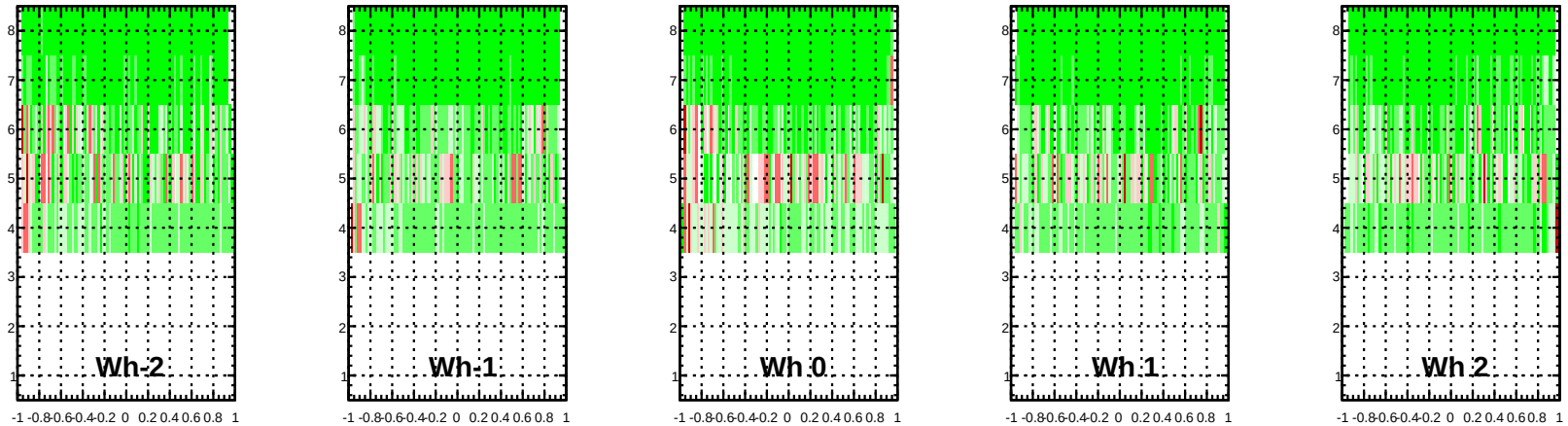



# Efficiency vs Chamber position vs #Layers by Wheel

## Legacy

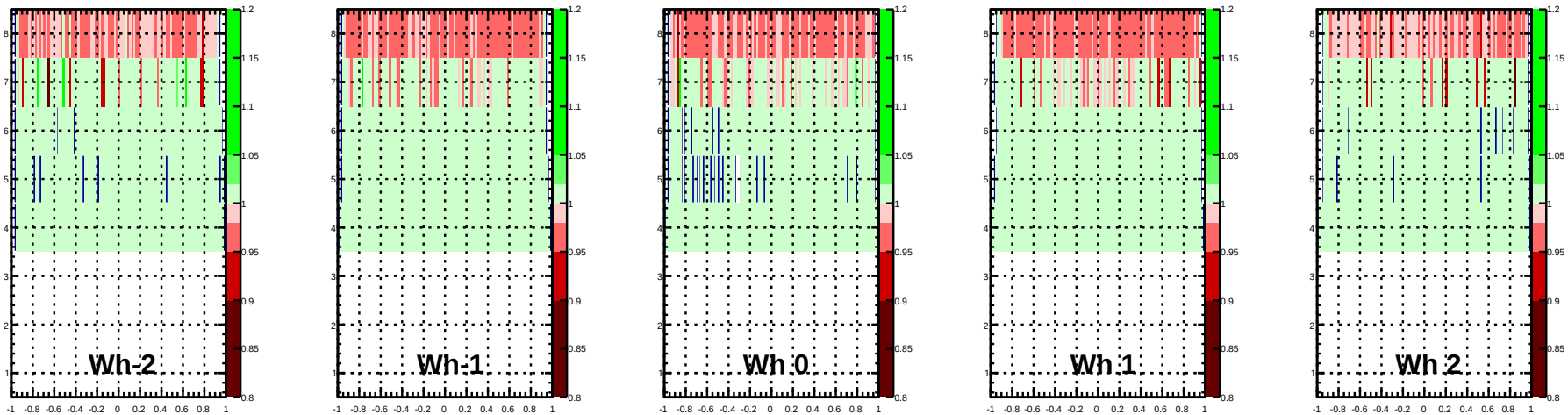



## New



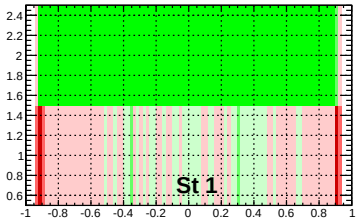
# Efficiency vs Chamber position vs #Layers by Wheel

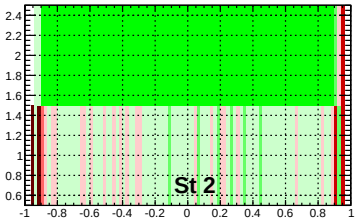
## New/Legacy

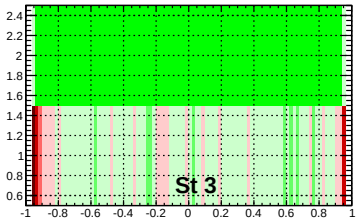


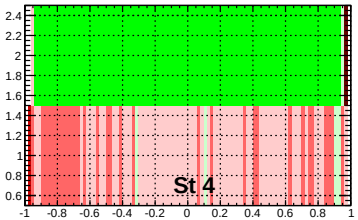
# Efficiency vs Chamber position vs #SL by Station

## Legacy

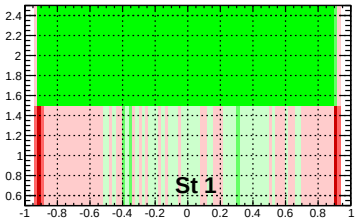


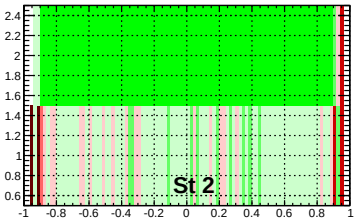



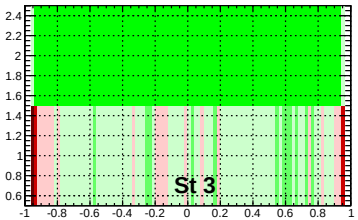



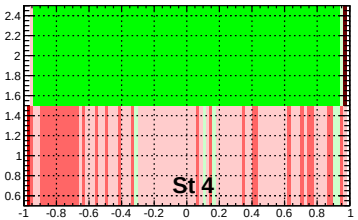




## New



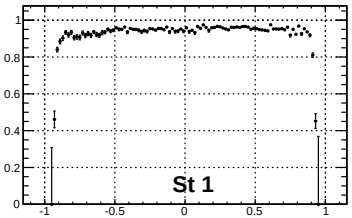



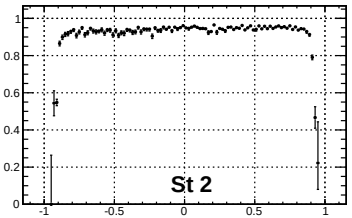



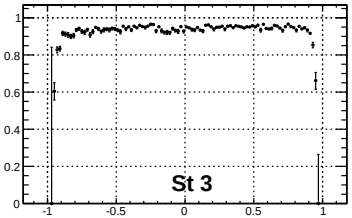



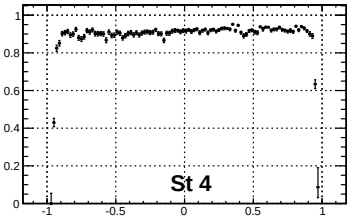
# Efficiency vs Chamber position #SL==2 by Station

## Legacy

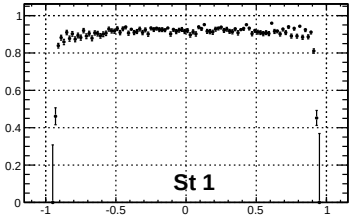


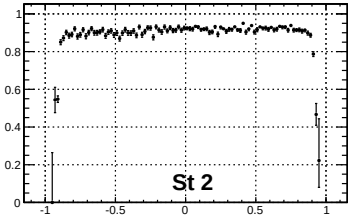



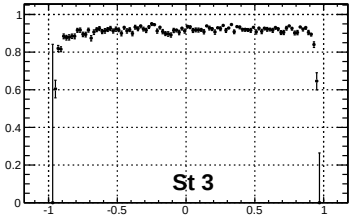



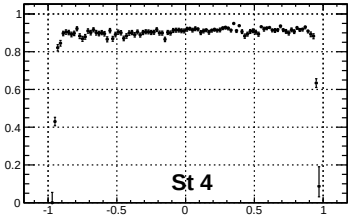




## New



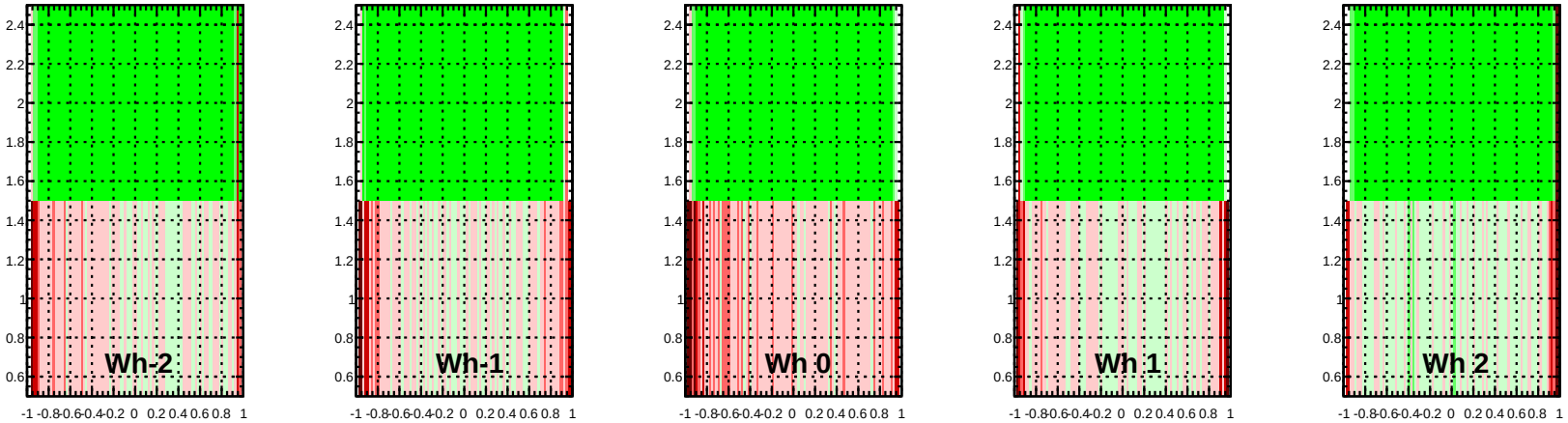



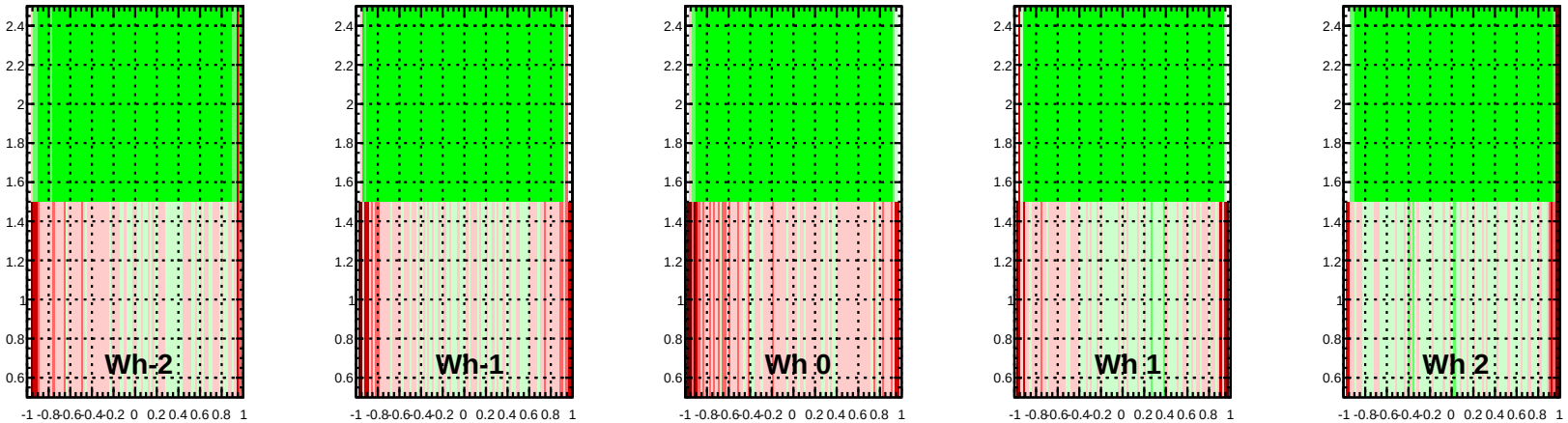



# Efficiency vs Chamber position vs #SL by Wheel

## Legacy

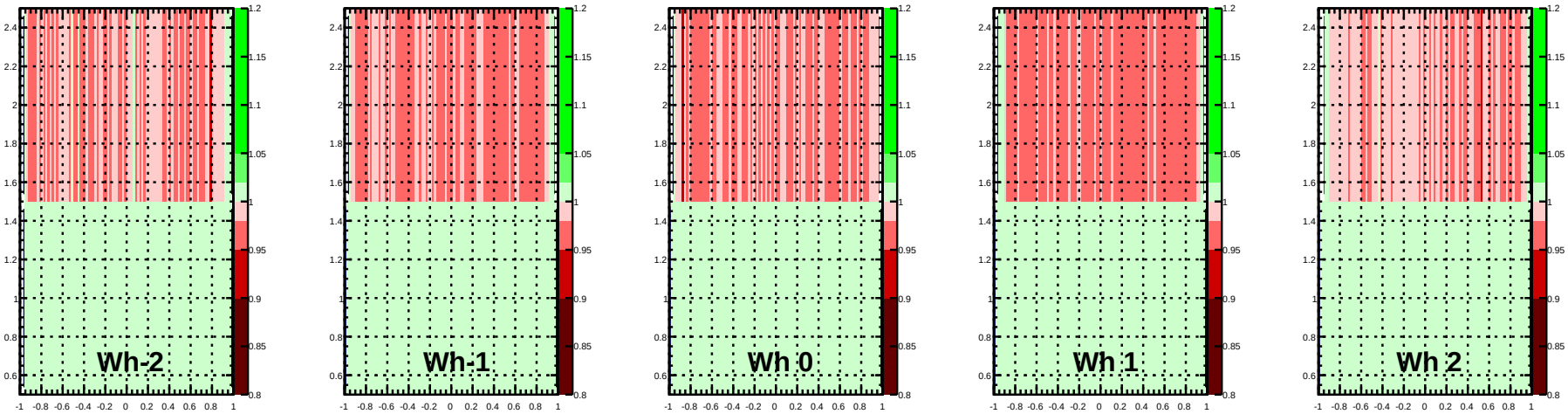



## New



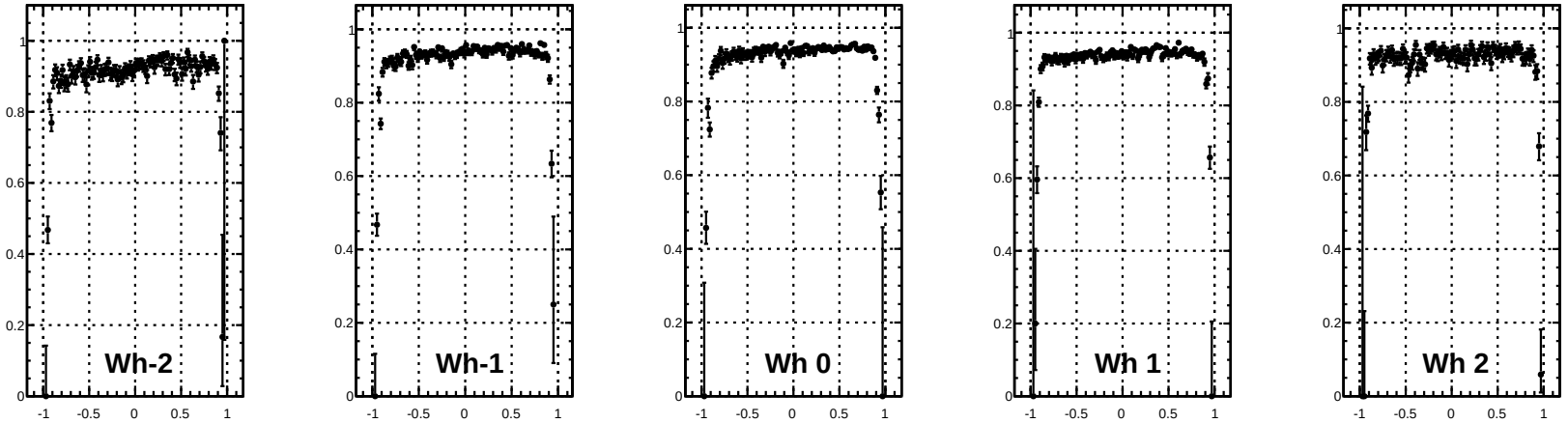
# Efficiency vs Chamber position vs #SL by Wheel

## New/Legacy

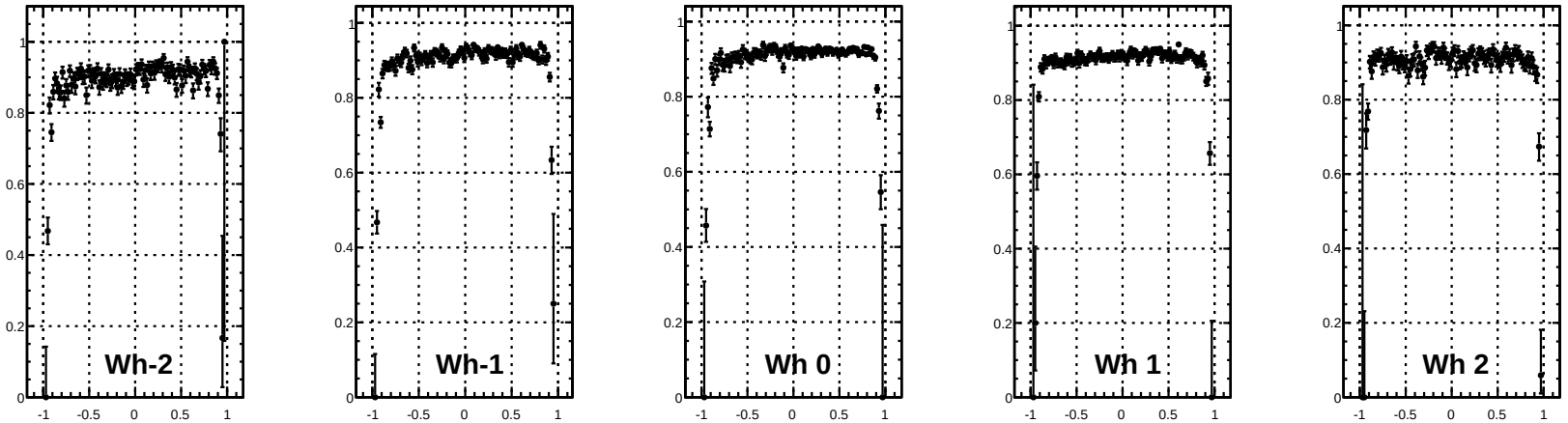


# Efficiency vs Chamber position #SL==2 by Wheel

## Legacy

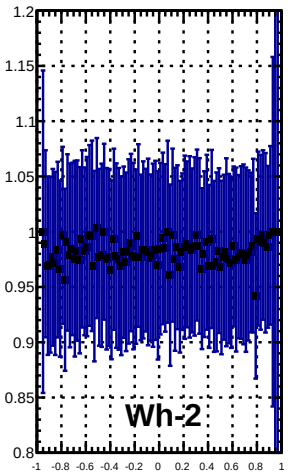


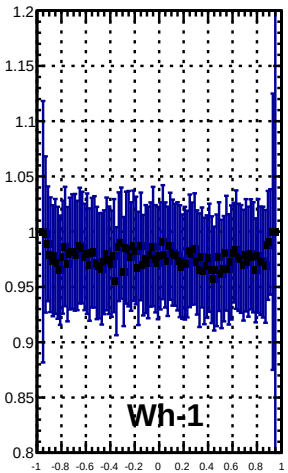

## New

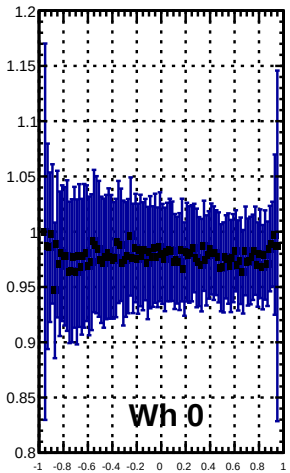


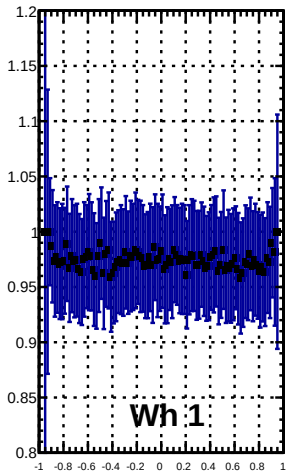
# Efficiency vs Chamber position #SL==2 by Wheel

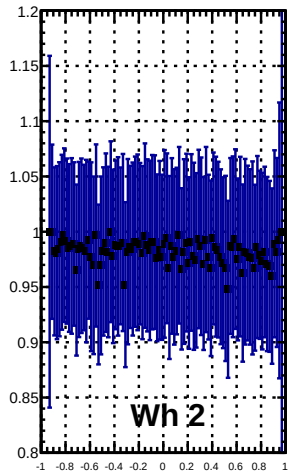
## New/Legacy



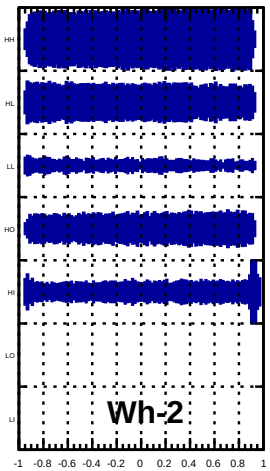



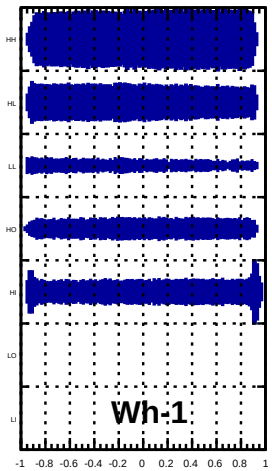



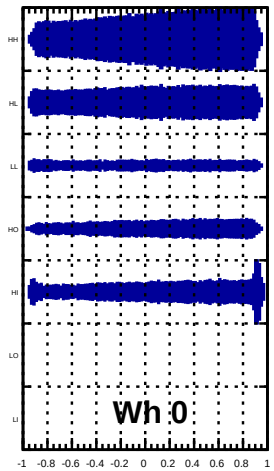



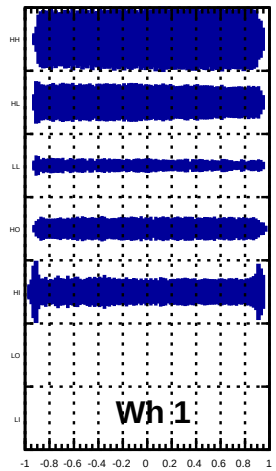
# N primitives vs Chamber position vs Code by Wheel

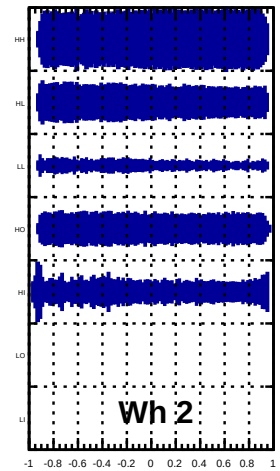
## Legacy



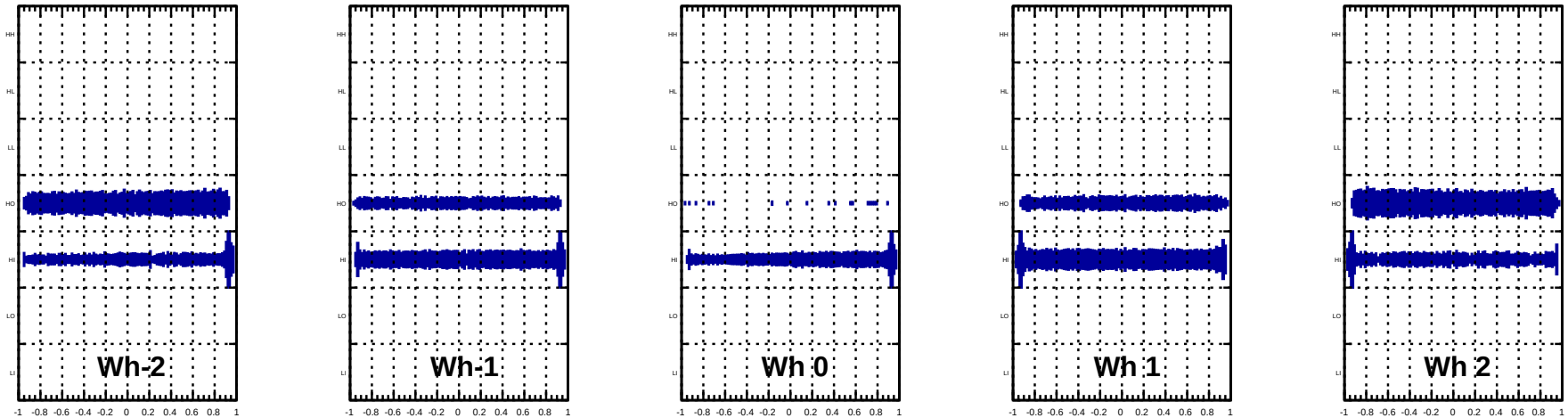



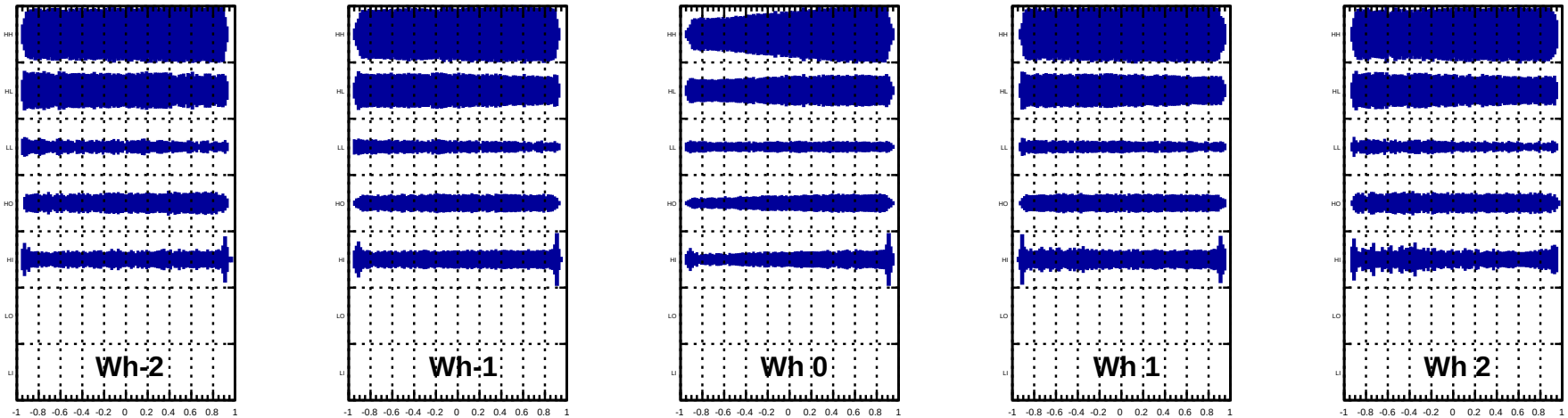
# N primitives vs Chamber position vs Code by Wheel vs nSL

## Legacy n SL=1



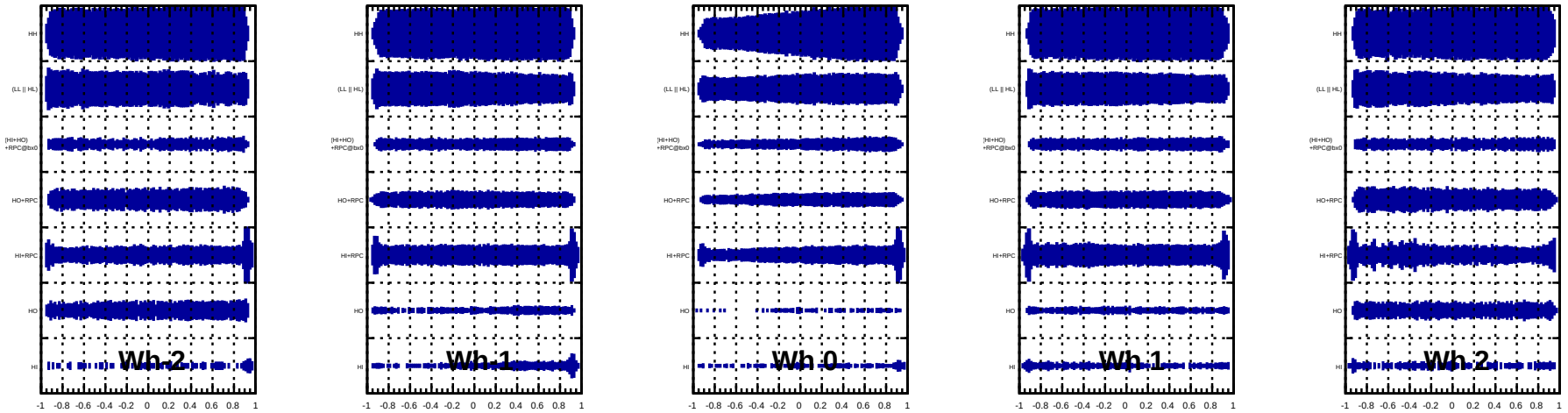
# N primitives vs Chamber position vs Code by Wheel vs nSL

## Legacy n SL=2



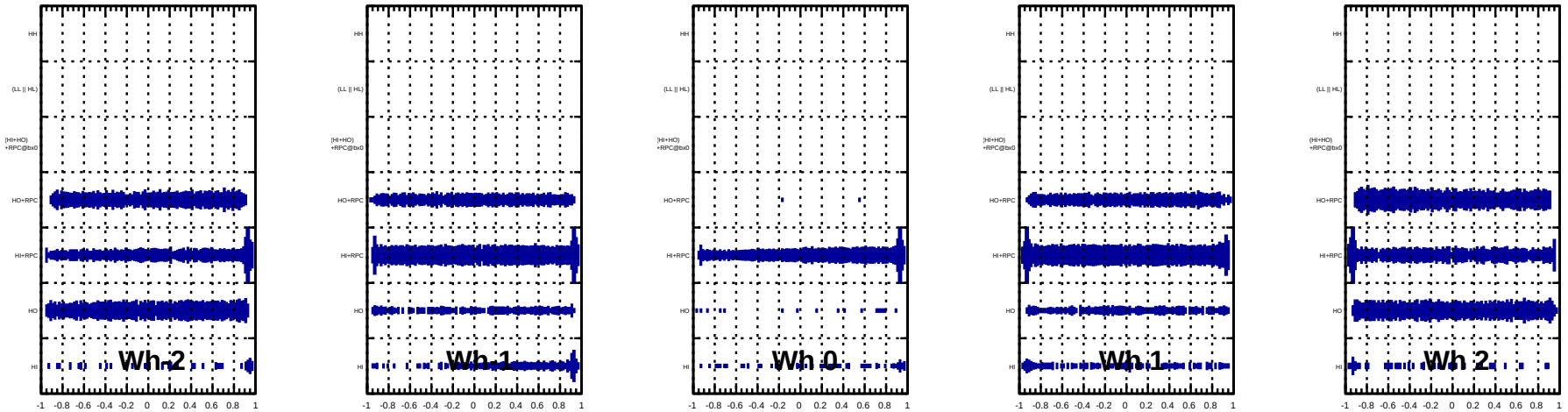
# N primitives vs Chamber position vs Code by Wheel

**New**



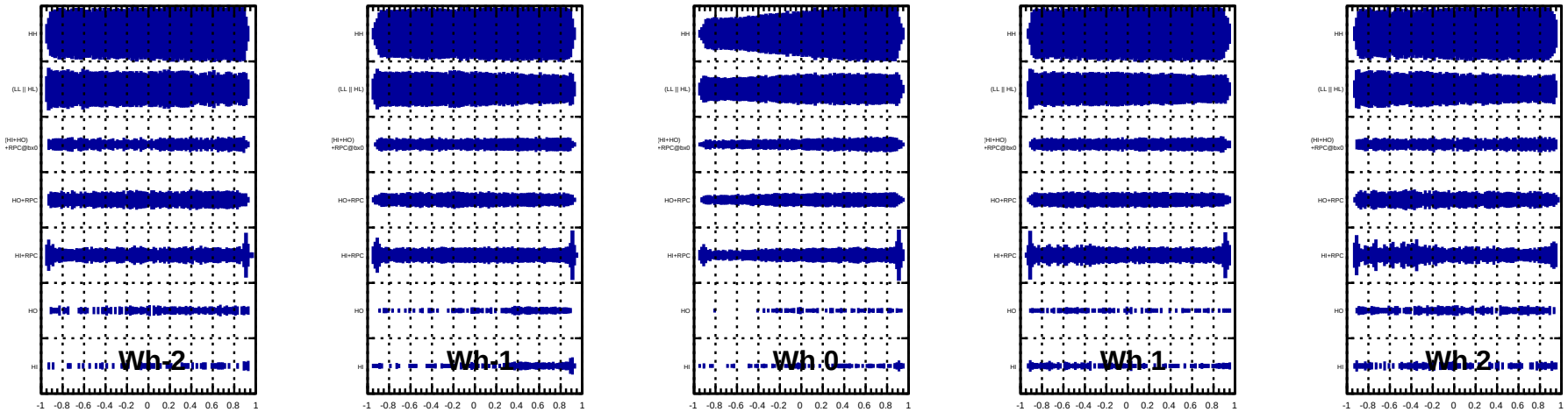
# N primitives vs Chamber position vs Code by Wheel vs nSL

## New n SL=1



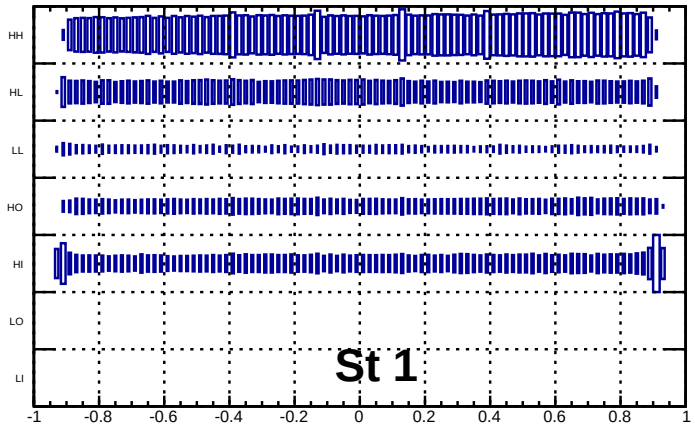
# N primitives vs Chamber position vs Code by Wheel vs nSL

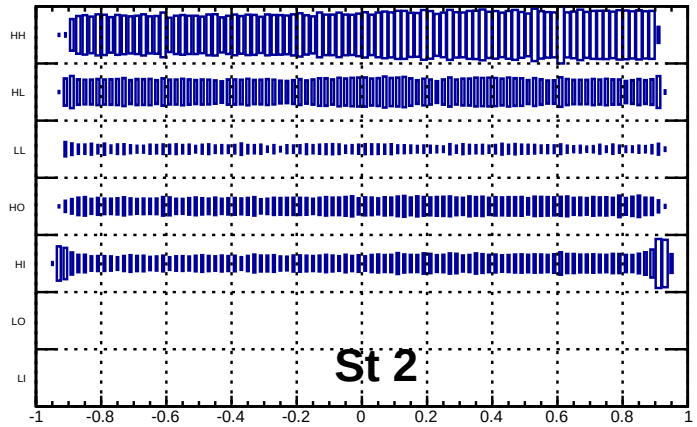
## New n SL=2

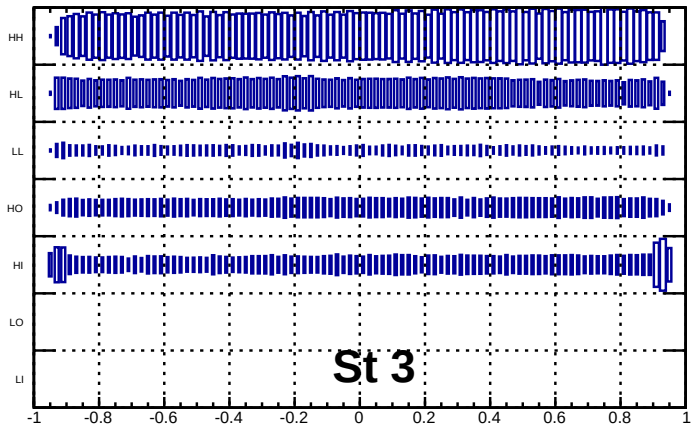


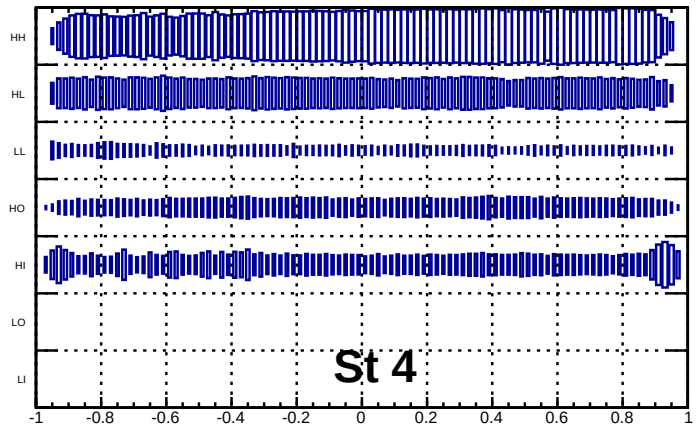
# N primitives vs Chamber position vs Code by Station

## Legacy



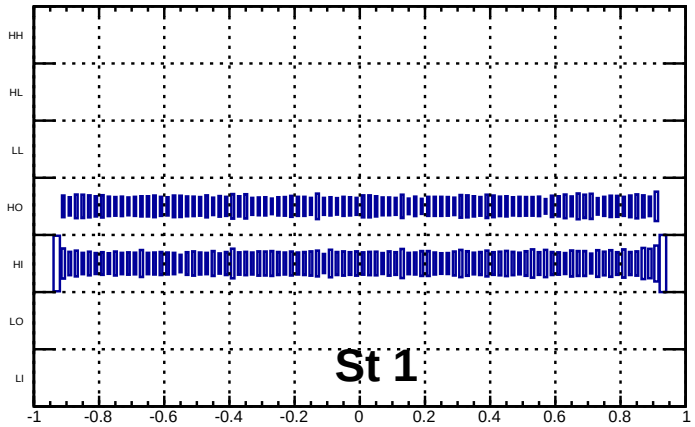



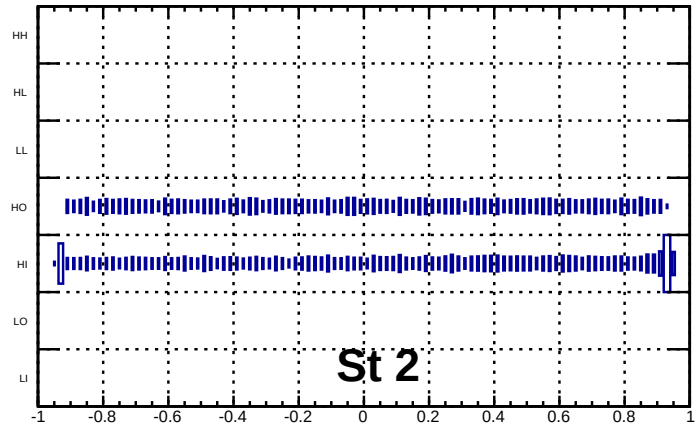



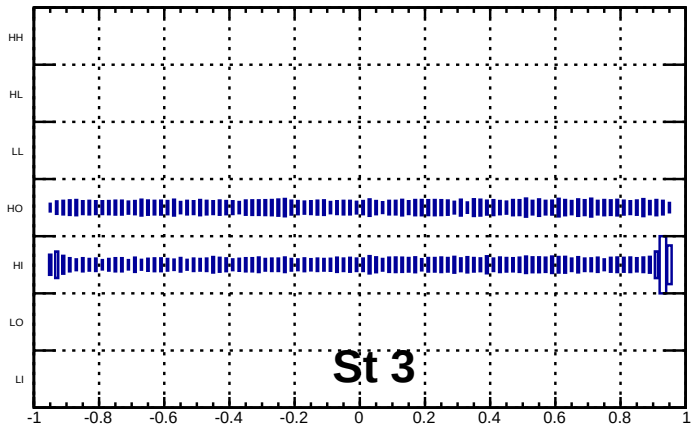



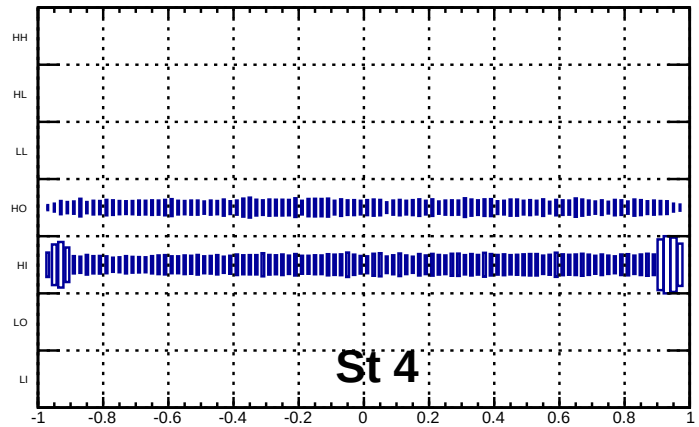
# N primitives vs Chamber pos vs Code by Station vs nSL

## Legacy n SL=1



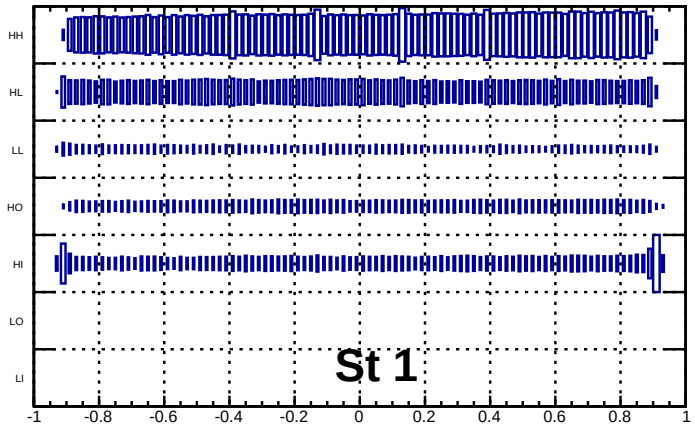



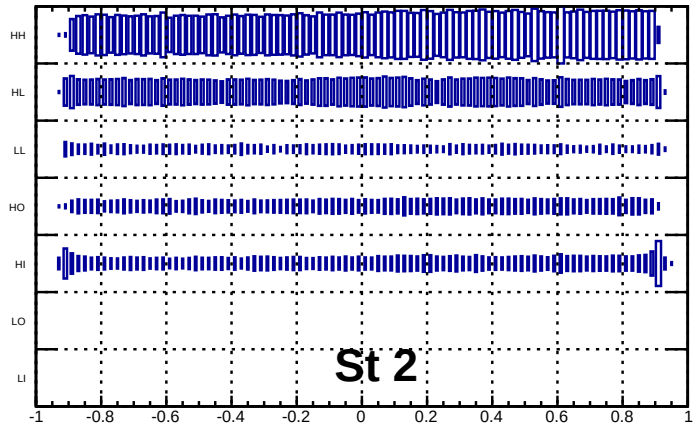



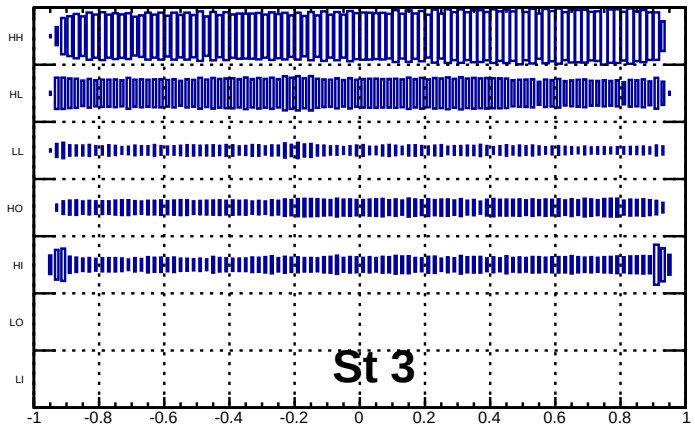



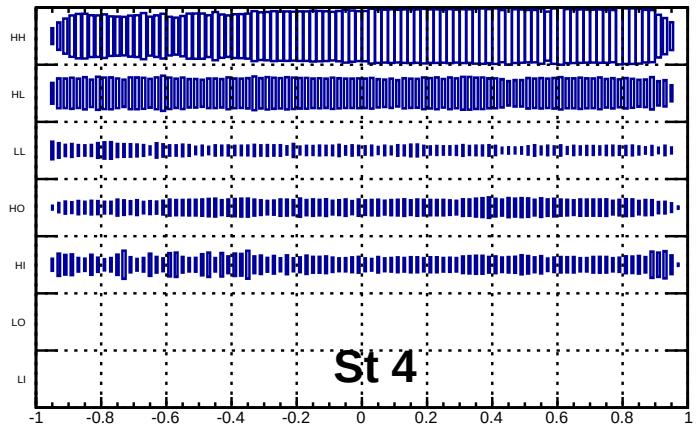
# N primitives vs Chamber pos vs Code by Station vs nSL

## Legacy n SL=2



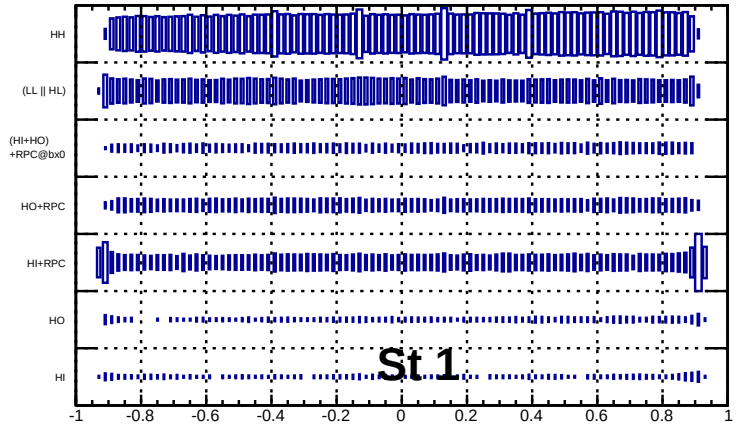



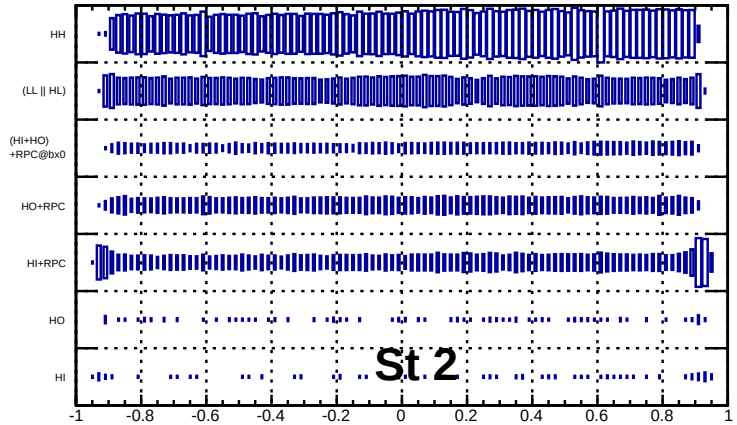



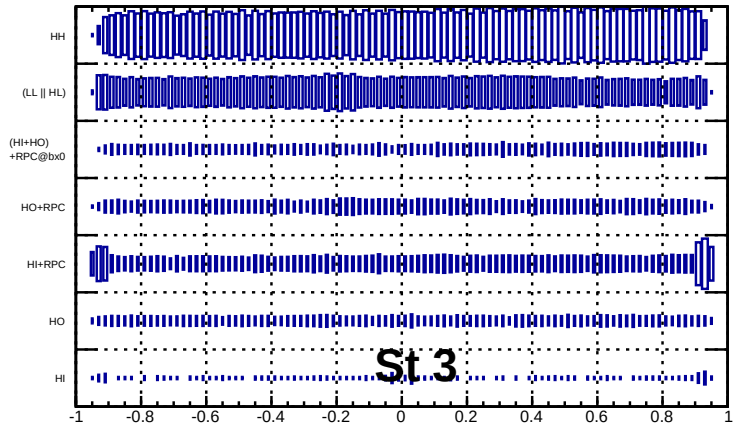



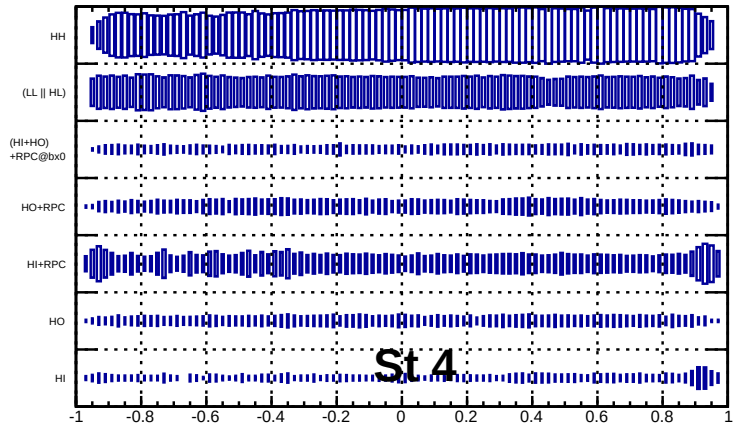
# N primitives vs Chamber position vs Code by Station

## New



# Quality code New vs Legacy by Wheel