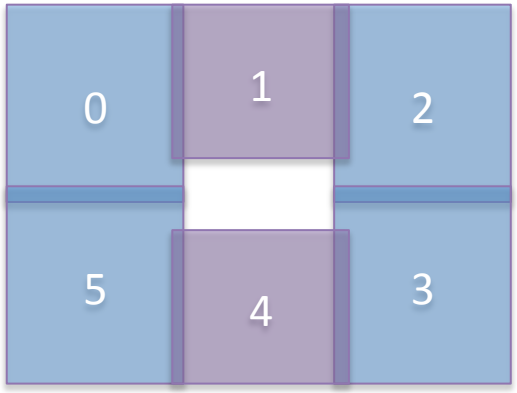
# Possible Improvement of MUID Performance

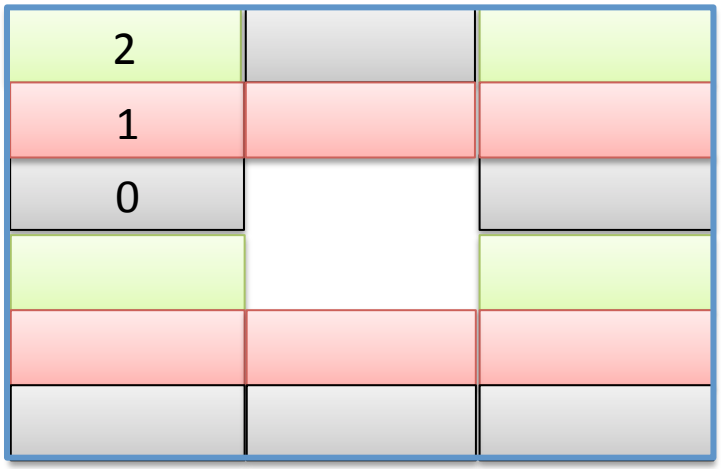
Itaru Nakagawa, Seyoung Han
(RIKEN, Ewha/RIKEN)

# MUID Structure

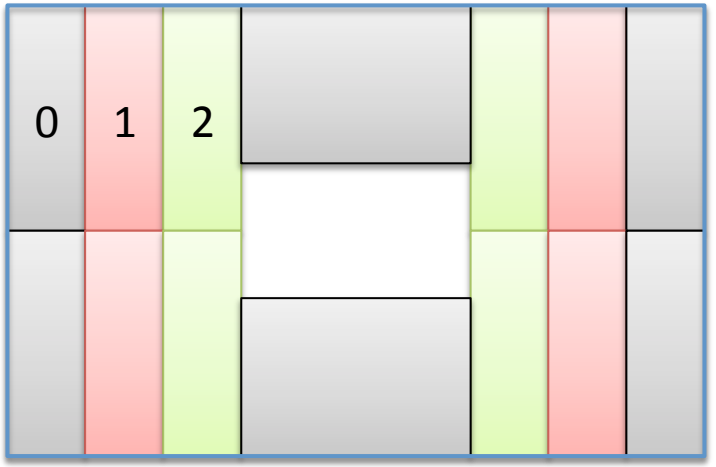



Front view

- 5 gaps per each arms
- Each gaps consist of horizontal plane and vertical plane
- Each plane consist of 6 panels

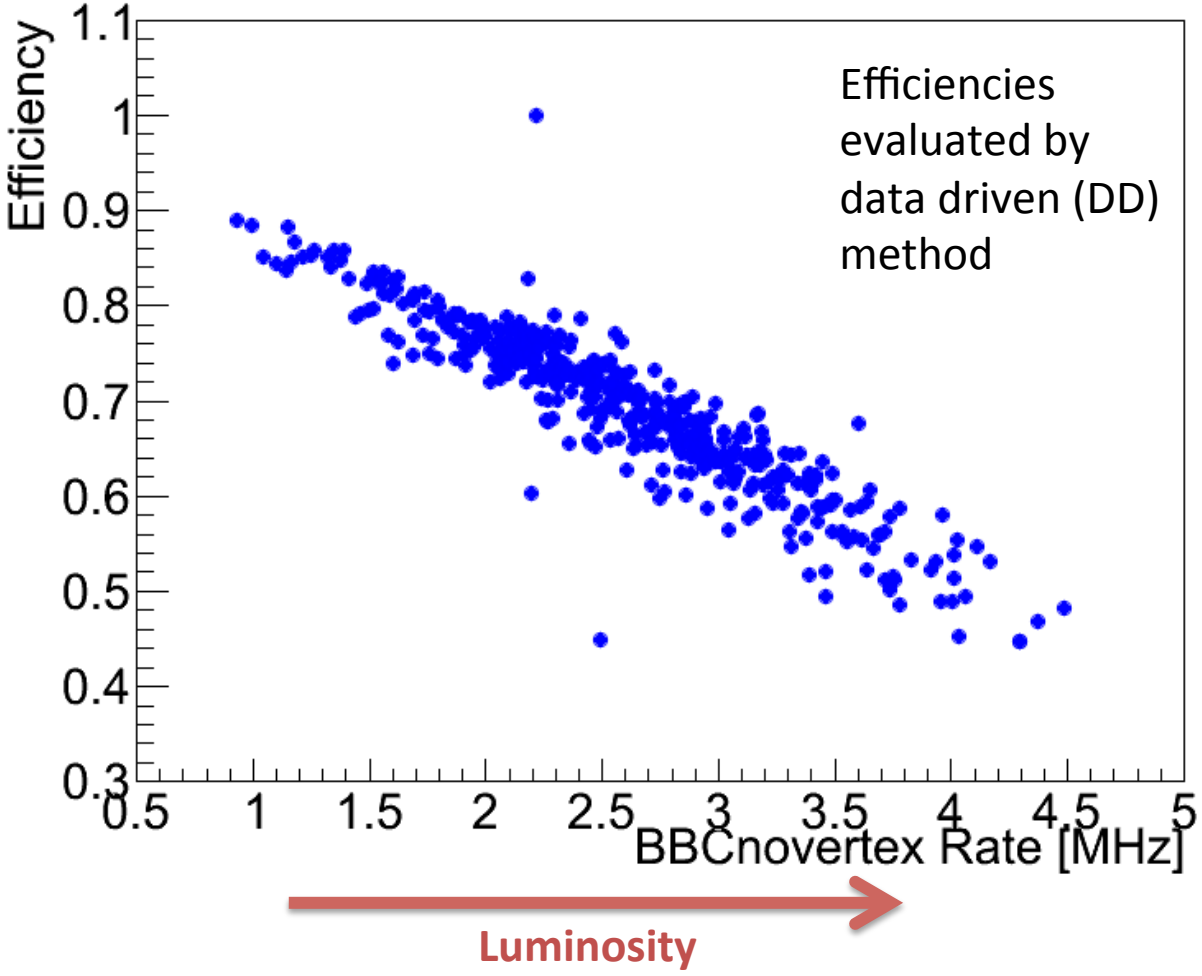



Horizontal plane




Vertical plane

# MUID Efficiency @ Run13

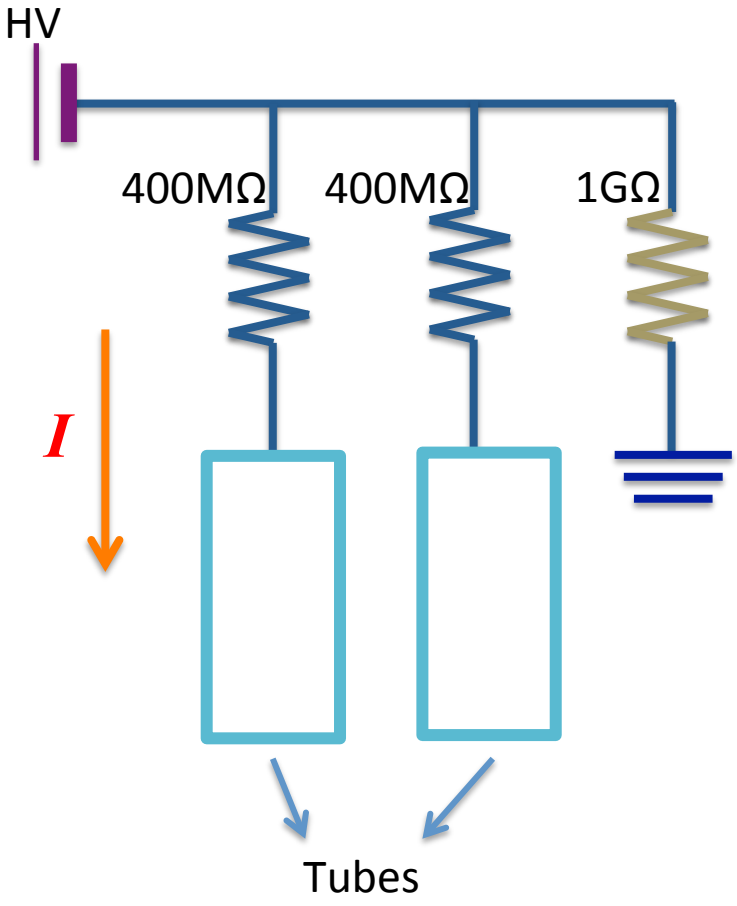



Efficiencies observed in Run13 @ pp-500GeV

As the luminosity increases, efficiency drops down to < 60%.

Need to seek for the way to improve the performance

# MUID Effective Voltage




Bias voltage

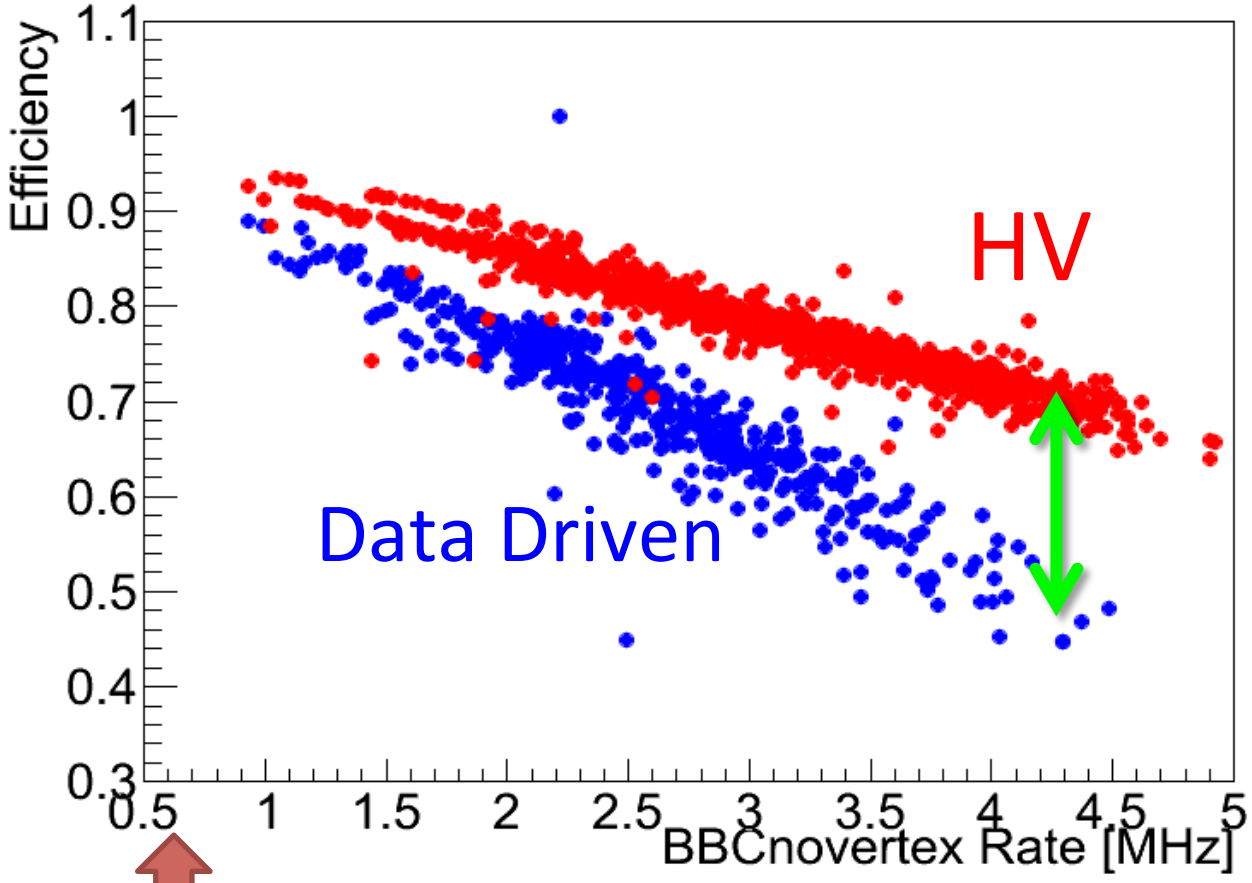
400MΩ

$$V_{eff} = V_0 - I_{measured} R$$

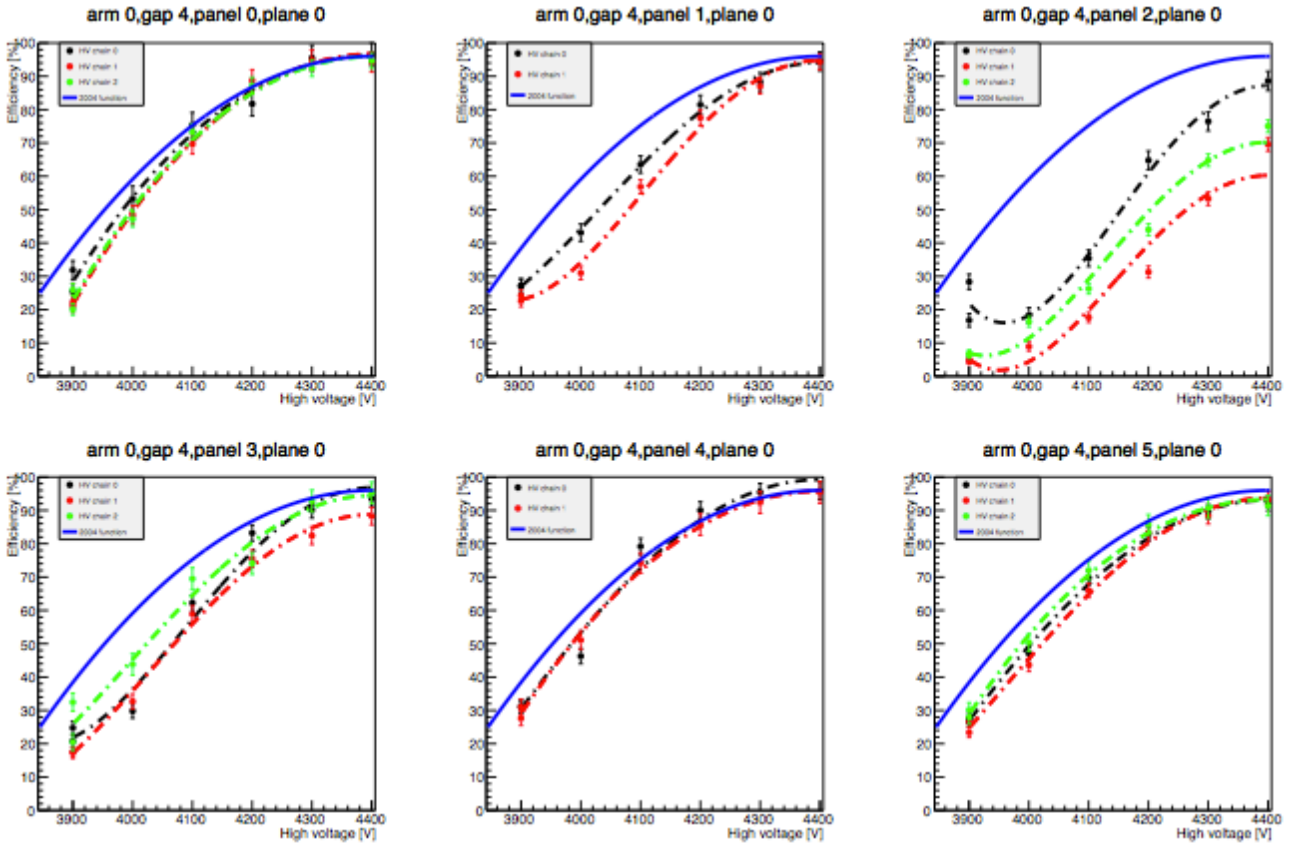
Independently measured

In the high luminosity situation, extra current increases so this extra current causes effective voltage drops.

# Data Driven vs. HV for Run13 Data

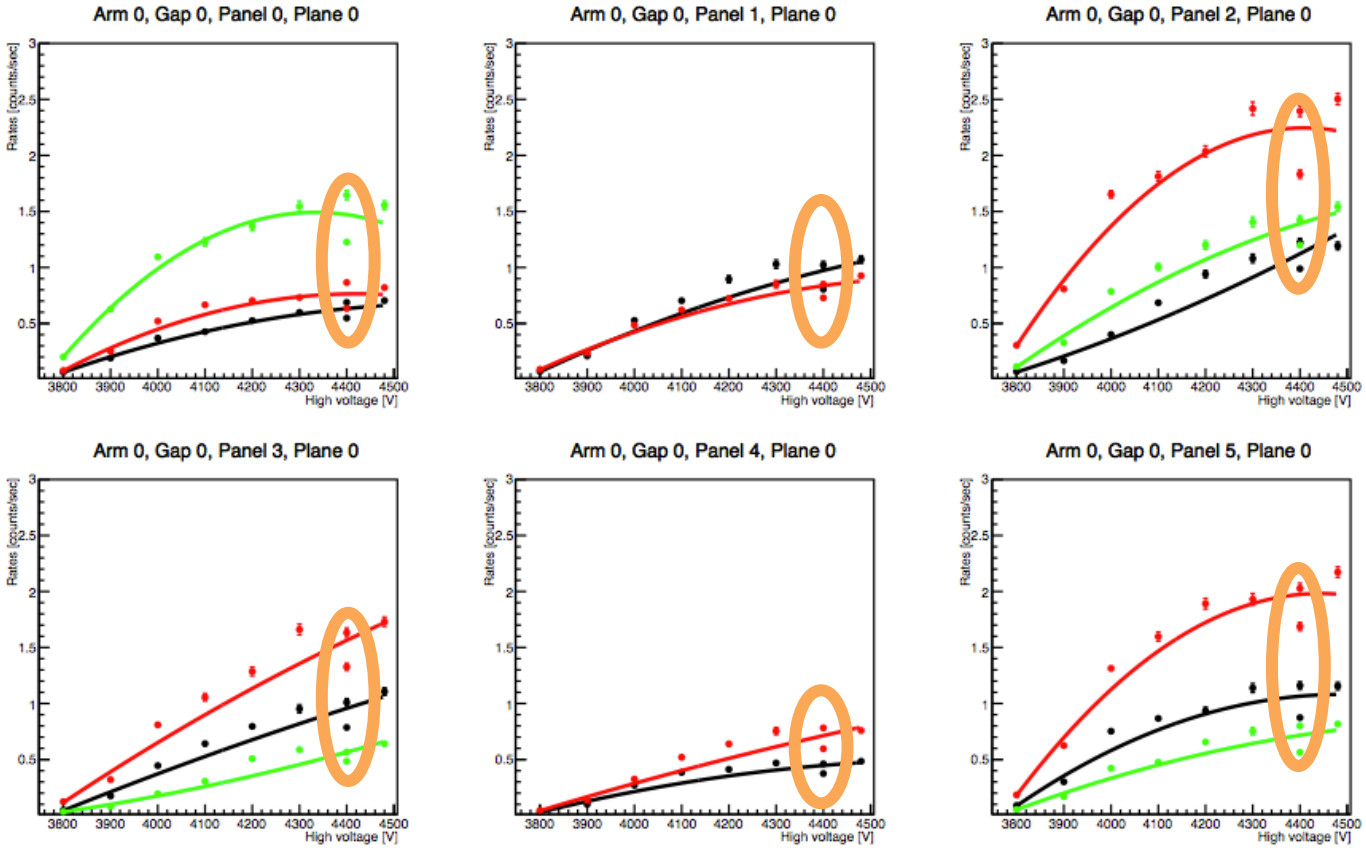



- Efficiencies calculated by HV and DD may agree at Run5 luminosity.
- However discrepancy gets larger and larger as rate goes high



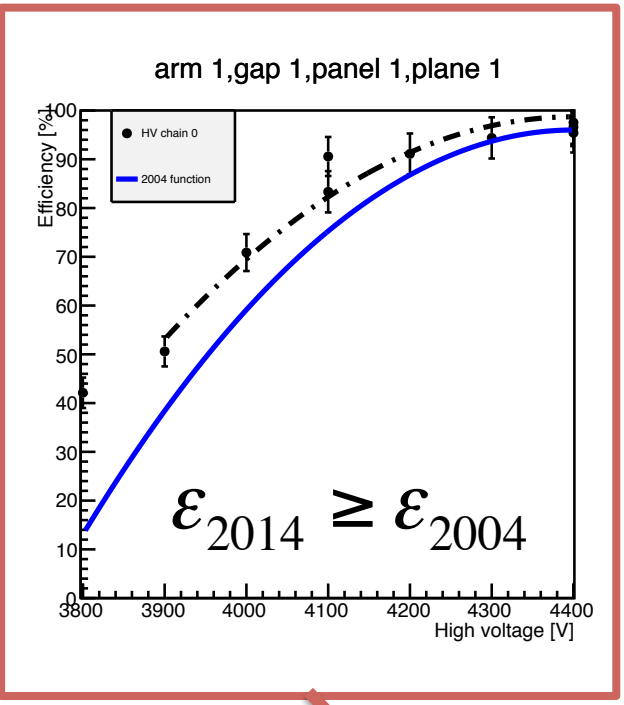

## 2014 July Efficiency

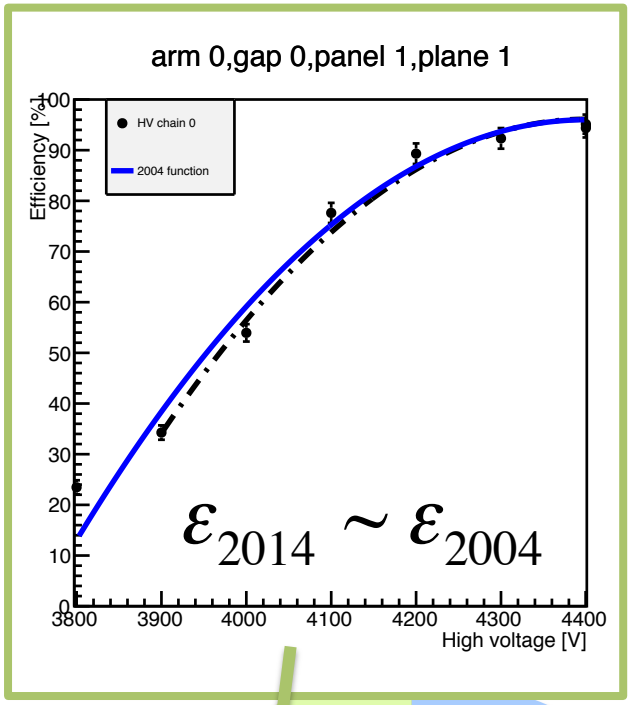
- While the voltage drops, the efficiency goes down so quickly
- 4400 V (current operation value) should be the cliff of the plateau
- Plateau curves need to be checked

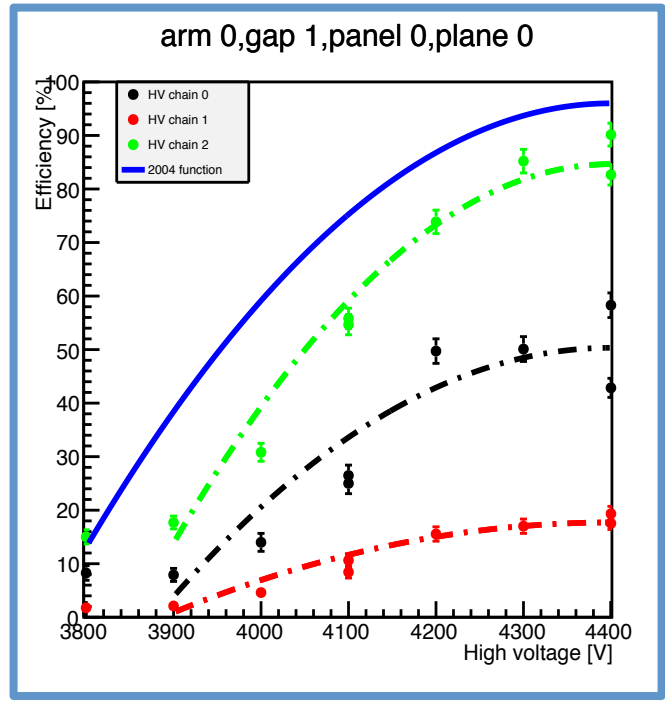



## 2014 July HV vs. Rate

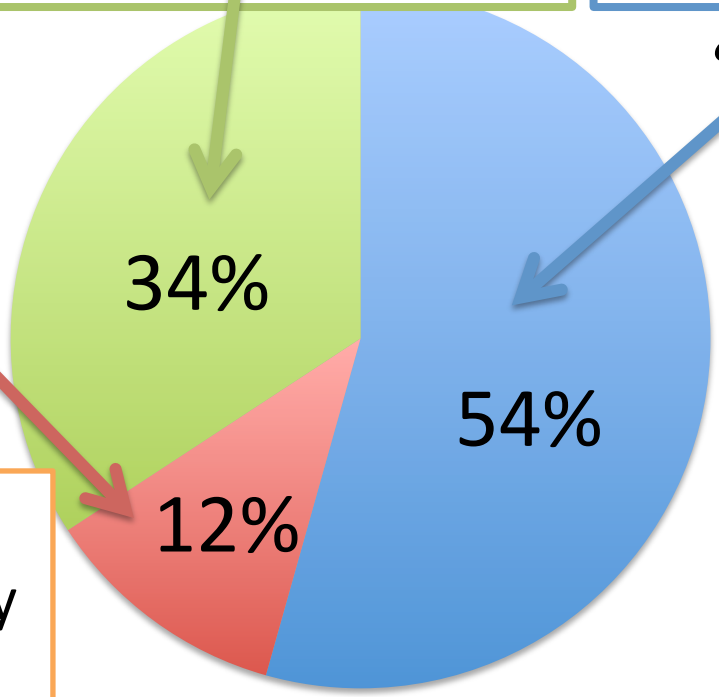
- Using roads/sec
- 4400 V (current operation value) is about the cliff of the plateau region
- We need to check the performance below the 5kV



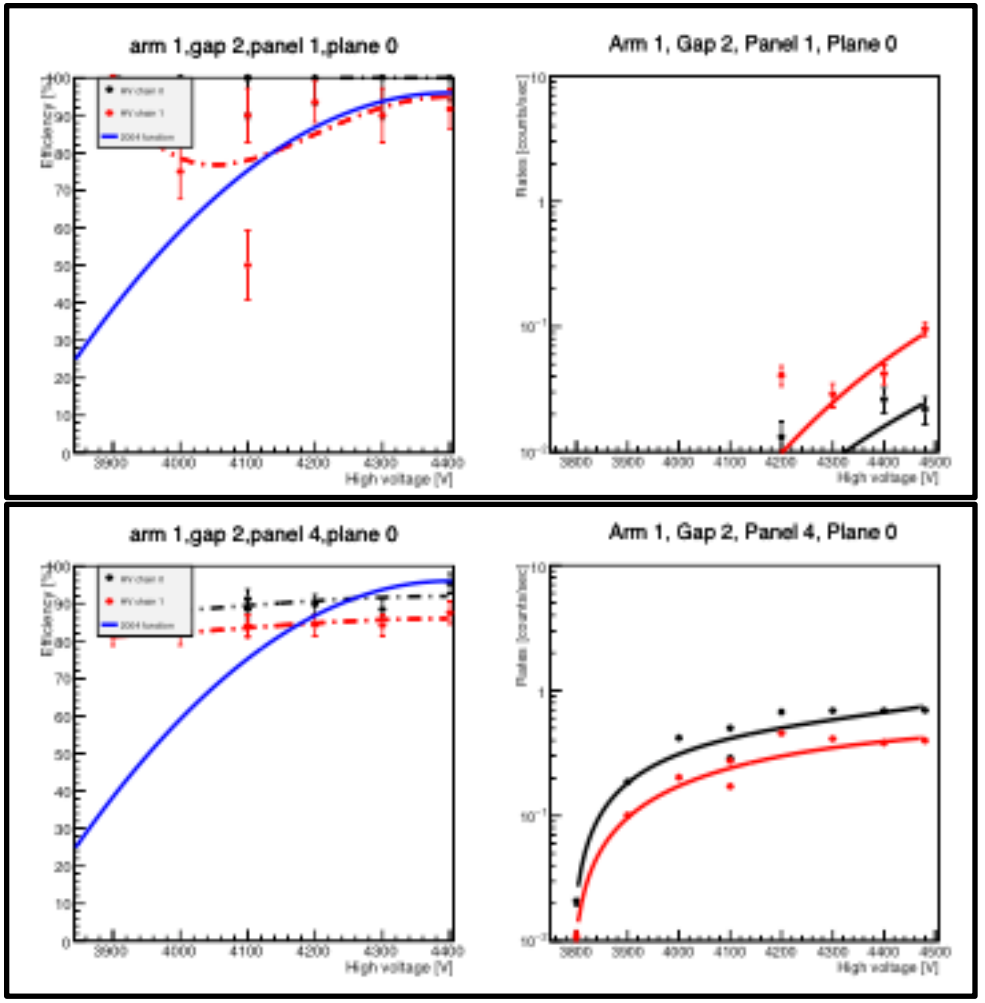

$\varepsilon_{2014} < \varepsilon_{2004}$




Nearly half of HV groups are degraded in efficiency response than 2004.

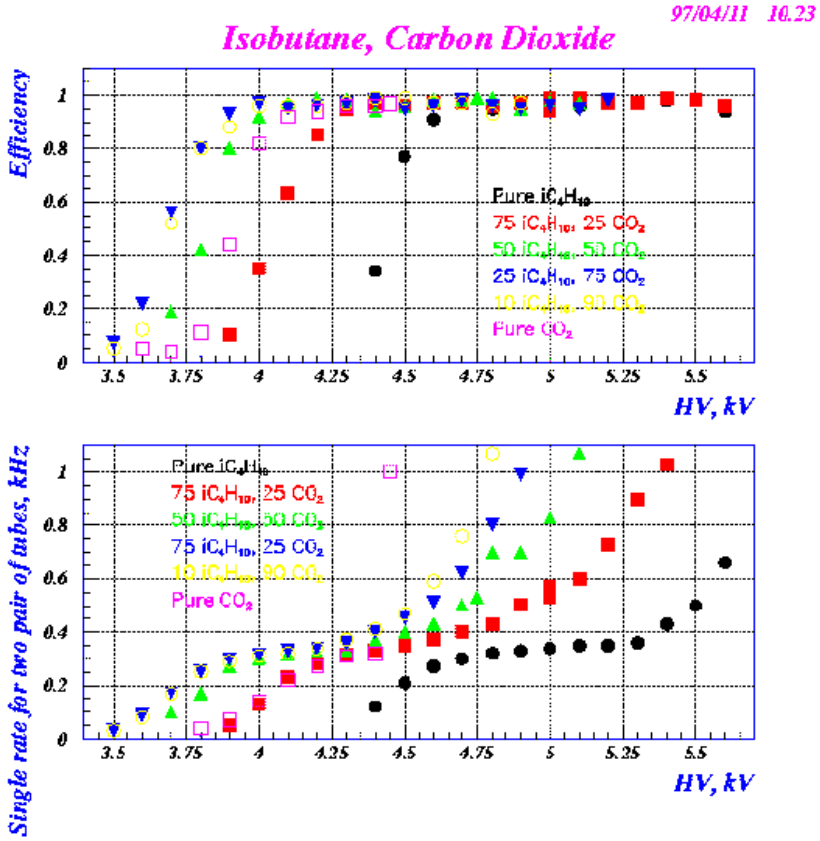
# Panel to Be Addressed

- Arm 1 Gap 2 Plane 0 Panel 1 may have some problem



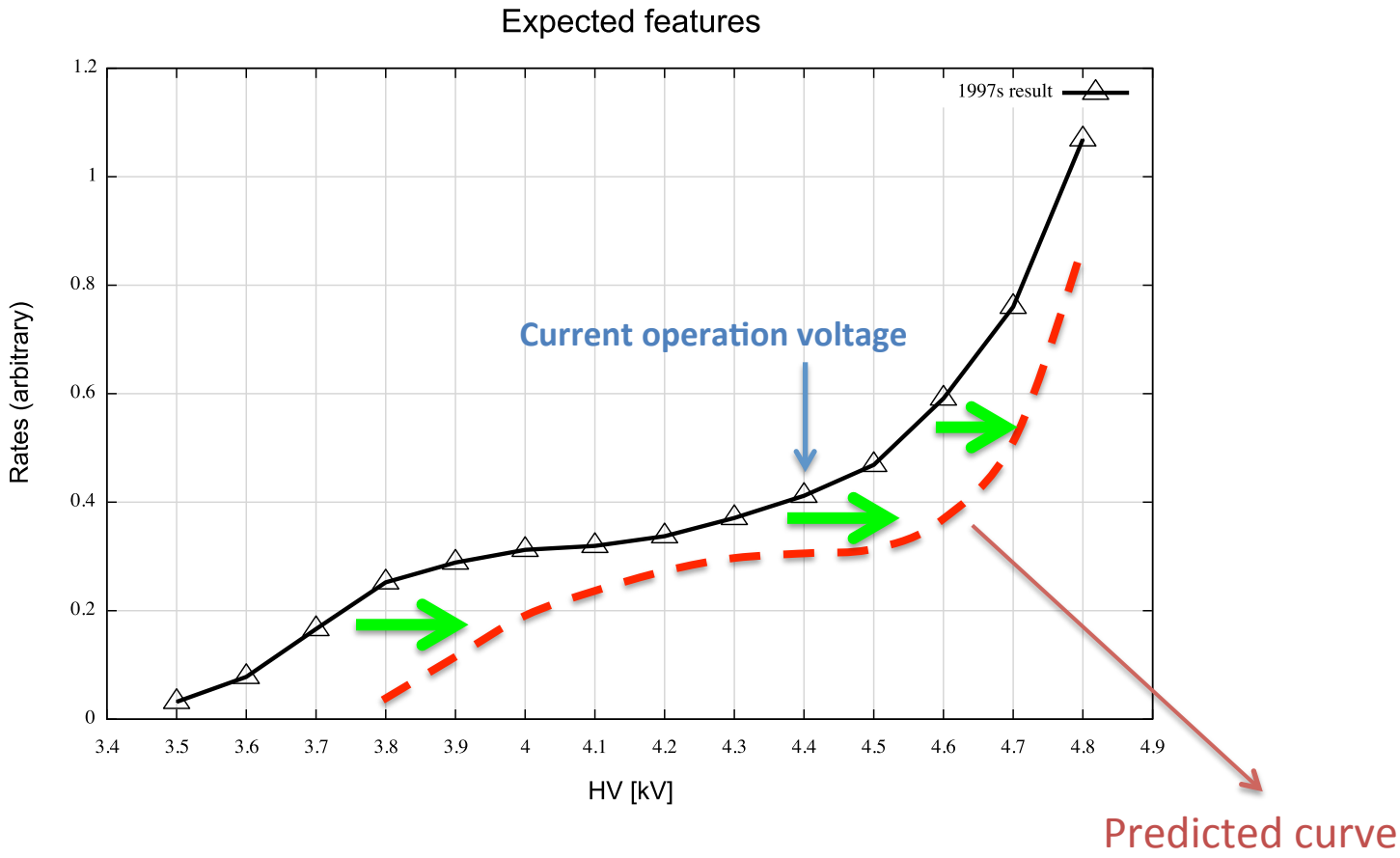
# Way of Solution

- Current limiting resistor change
  - Fundamental improvement
  - Disassemble MUID
- Operate HV even higher voltage to gain the distance from the efficiency fall off.
- Seek for new gas mixture to achieve the wider plateau response.



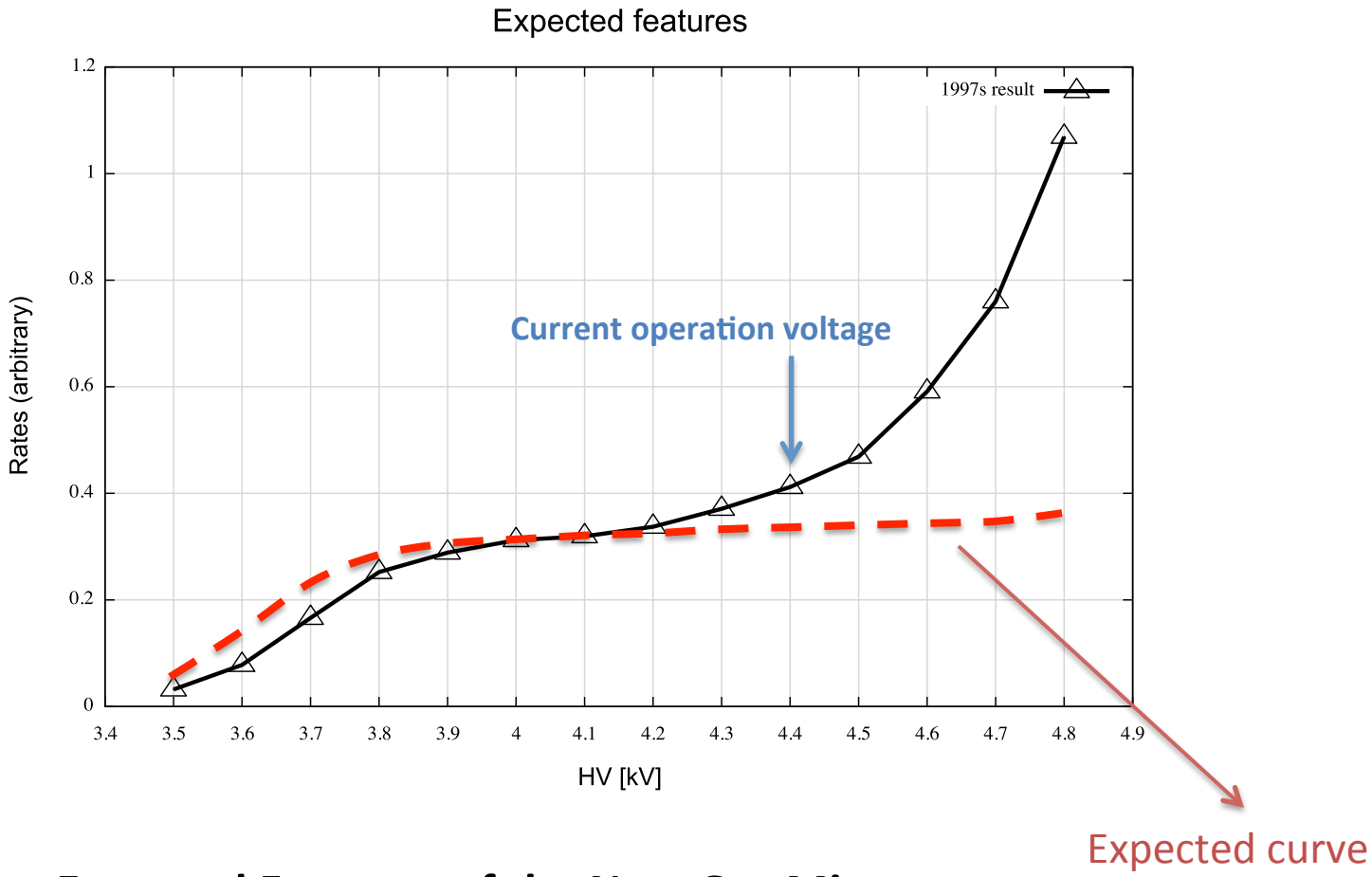

## 1997s HV vs. Rate

- Currently we use 10% iC4H10 + 90% CO2 (Yellow mark in graph)
- BNL regulation do not arrow to increase C4H10 rate
- Plateau region narrow




## Predicted Situation

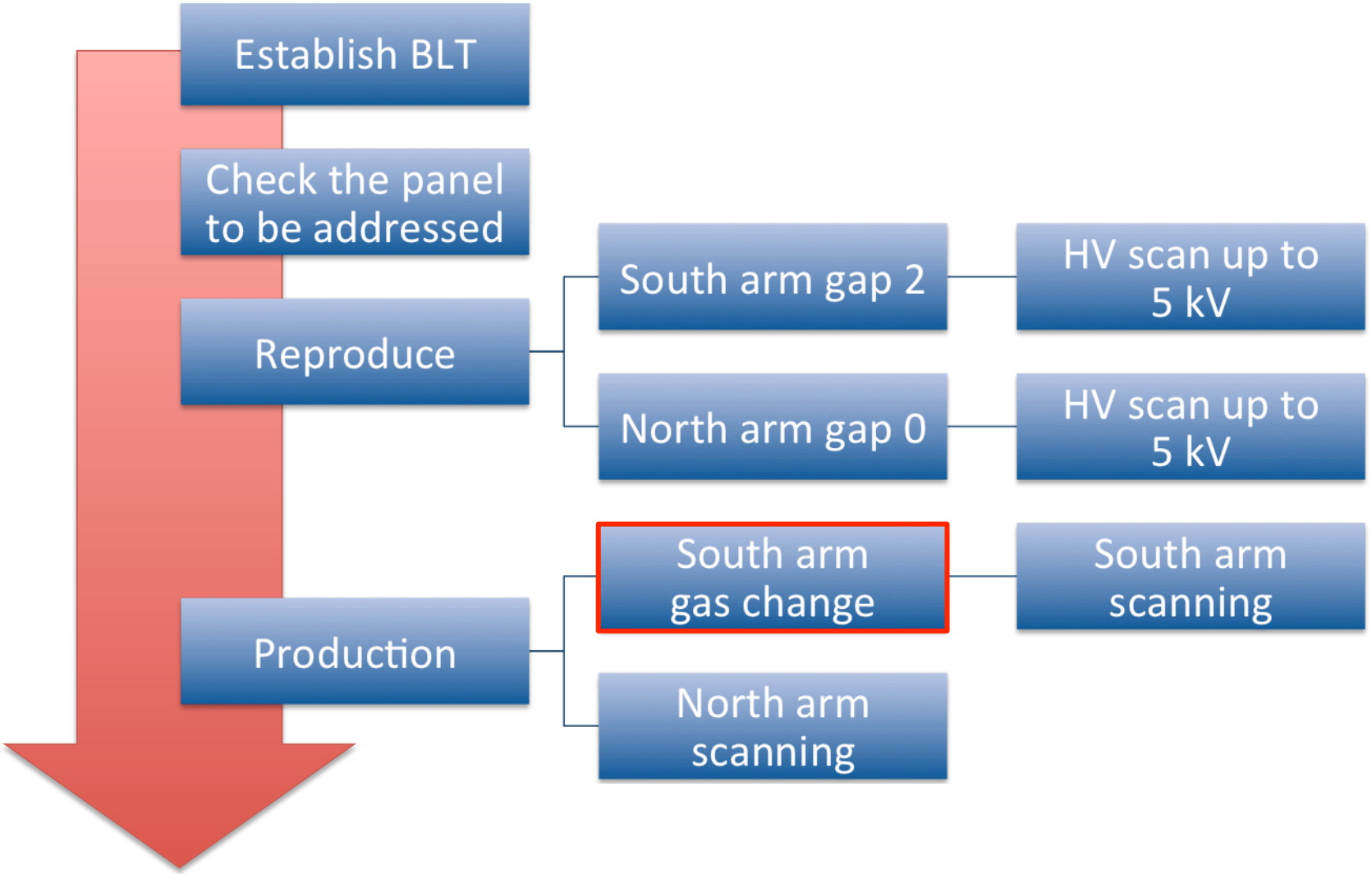
- Because of the extra current, the Veff gets lower
- Working voltage is just shifted to right
- Still narrow plateau
- Is the rate response still same as 1997 measurement?




## Expected Features of the New Gas Mixture

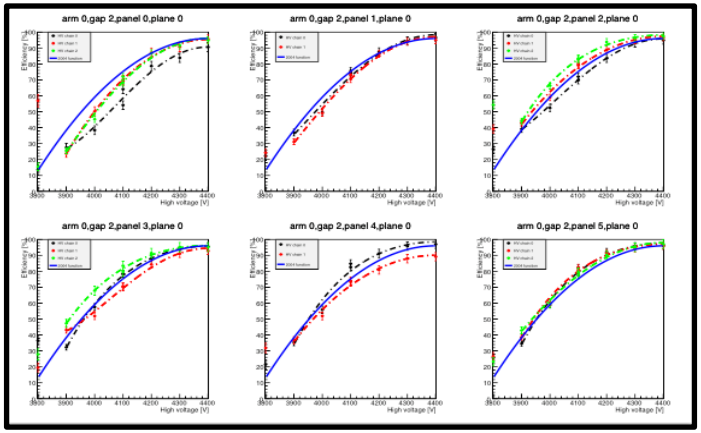
- SF6 will be added (0.5-5%) – Plan to scan upto 5000V
- More broaden region of plateau
- Working voltage around 5000V

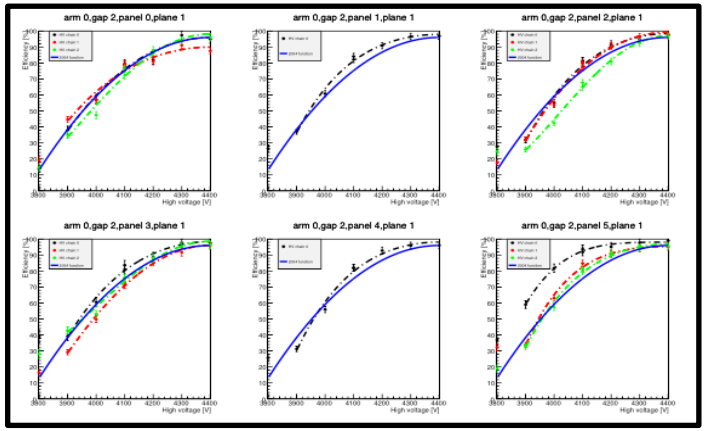
# Run Plan

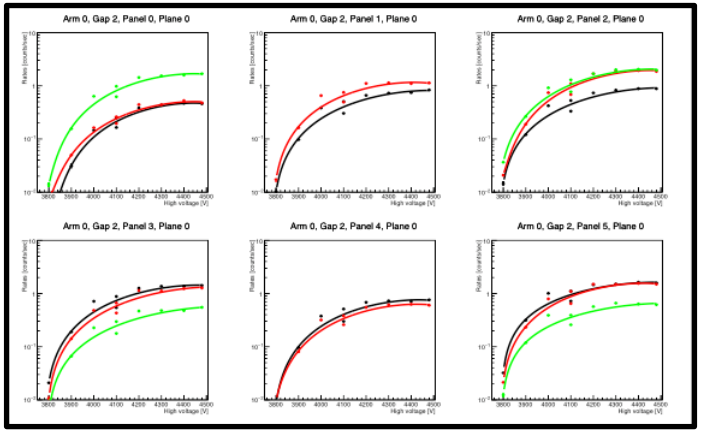

Establish BLT
Check the panel to be addressed
Reproduce
South arm gap 2
HV scan up to 5 kV
North arm gap 0
HV scan up to 5 kV
Production
South arm gas change
South arm scanning
North arm scanning

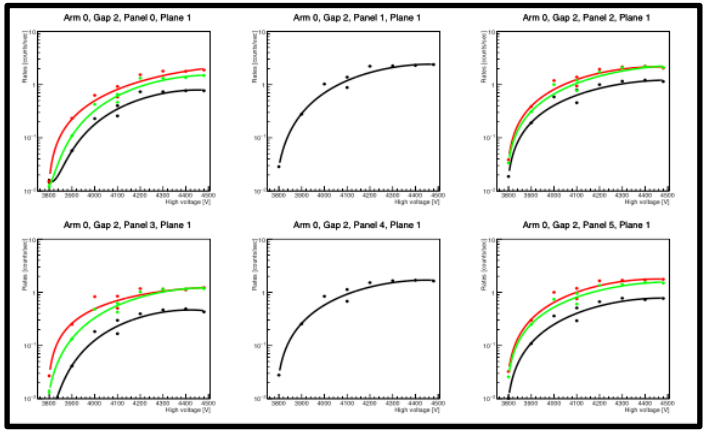
# Current Status

- South arm gap 2 and the North arm gap 0 shows best status



# Reproduce Previous Result

- Test status of MUID
- Reproduce 2014 July result
  - For south arm gap 2, north arm gap 0
    - Best status during the previous test
  - 3 points : 4000V, 4400V, 4480V
  - nroads==1
  - About 2 hours to be reproduced

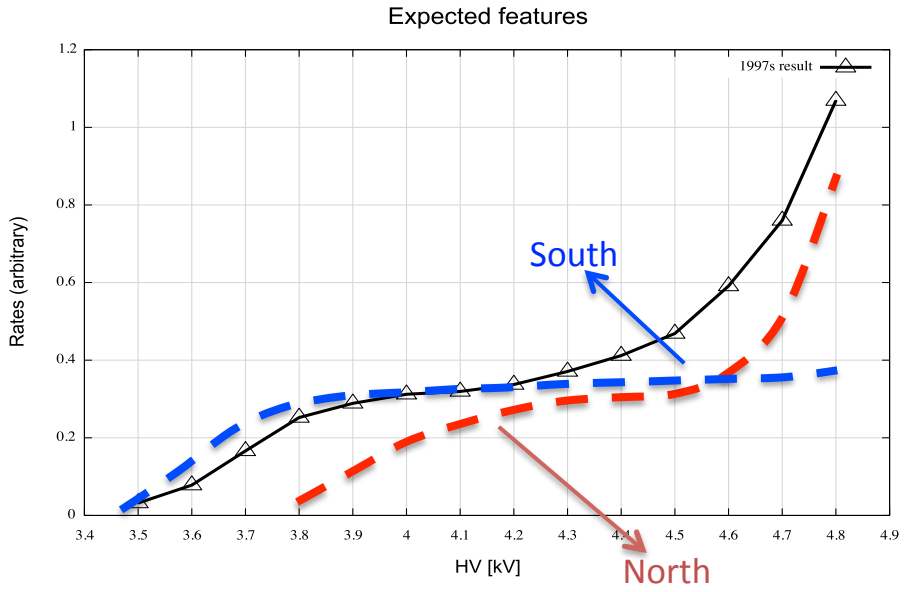
# Scanning up to 5 kV

- For the South arm gap 2, North arm gap 0
  - Could be done at the same time : Standalone run
- For 3% error statistical production in 4400V
  - Need 1100 hits per a HV chain
- 3k trigger rate (~1Hz road construction)
- 3.3M triggering per a run @ 18 min

| HV | 4500 | 4600 | 4700 | 4800 | 4900 | 5000 | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| rate | 1 | 1 | 1 | 1 | 1.1 | 1.3 | | | |
| time | 18m | 18m | 18m | 18m | 18m | 15m | | | 2h |
| Trig# | 3.3M | 3.3M | 3.3M | 3.3M | 3.3M | 3.3M | | | |

# Production Run for Every Gaps

- Change the gas mixture of the south arm
- Exclude gap in interest from the BLT
- North arm with the present gas
- South arm with the new gas mixture
- Keep on record “Good Run list”
- Total 35 hours to get finish
  - North/south could be use standalone




| HV | 3900 | 4000 | 4100 | 4200 | 4300 | 4400 | 4500 | 4600 | 4700 | 4800 | 4900 | 5000 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| rate | 0.2 | 0.3 | 0.5 | 0.8 | 0.9 | 1 | 1 | 1 | 1 | 1 | 1.1 | 1.3 | |
| time | 100m | 62m | 36m | 25m | 25m | 18m | 18m | 18m | 18m | 18m | 18m | 15m | 6.5h |
| Trig# | 17.2M | 11M | 6.6M | 4.3M | 3.8M | 3.3M | 3.3M | 3.3M | 3.3M | 3.3M | 3.3M | 3.3M | |

# Total Time Estimate

- Check the panels to be addressed : 6 h (?)
  - North arm gap 2
- Reproduction run : 2 h
- Scanning up to 5kV for single gap : 2 h
- Gas change : 48 h
- Production run : 35 h
  - Include time for change the BLT cable
  - Gap in interest will be excluded from the triggering system (same as July, 2014)
- It is estimated about 6-7 days

# Summary

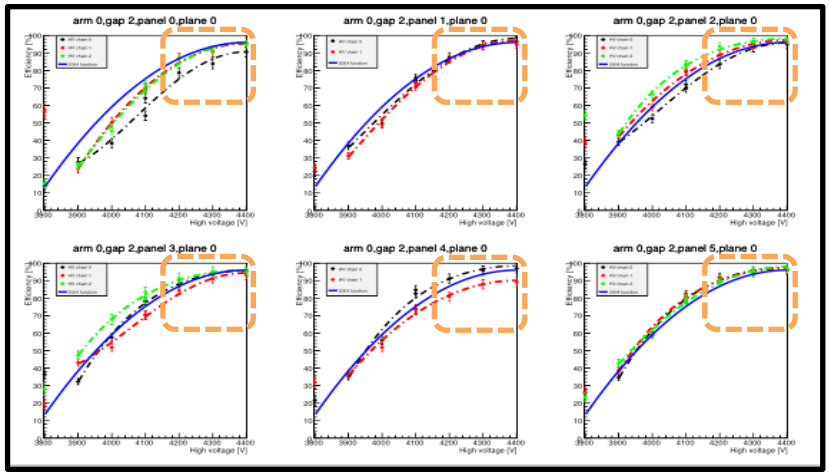
- MUID showed significant efficiency drop under recent high luminosity circumstances
- 2014 July HV scan result shows
  - Efficiency get worse than 2004 measurement
  - The plateau seems to be narrower than 2014. The fall off is closer to operating voltage
- Seek for possibility to operate MUID even higher voltage
- Seek for better gas mixture which provides wider plateau

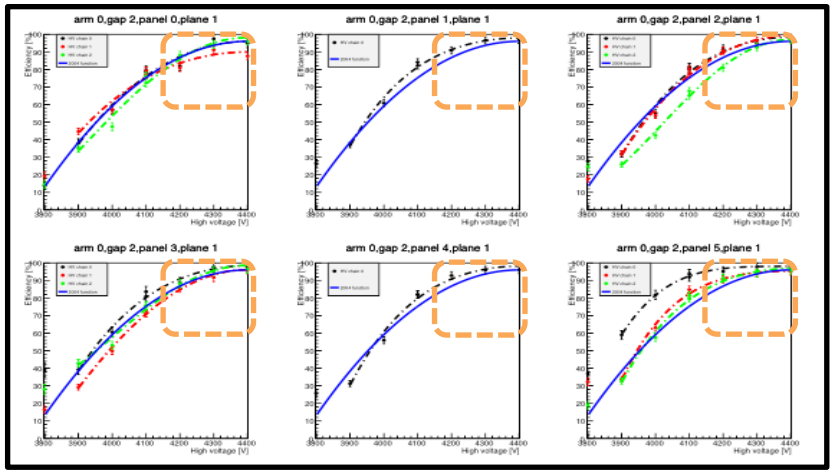
# THANK YOU

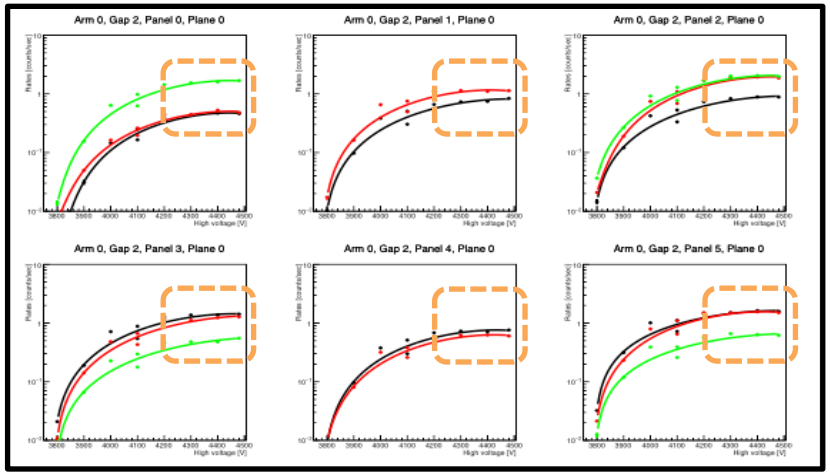
# Outline

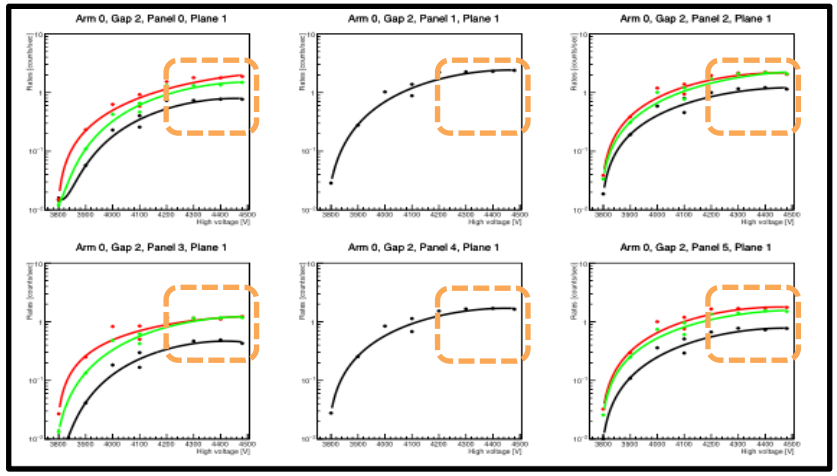
- High luminosity situations
  - Found efficiency drop
    - Caused by current limiting resistor : cannot changed
  - Found data driven and HV method efficiency result shows difference
    - 2014 July, try to change equation of HV method
    - Find efficiency drop rapidly
      - Also caused by current limiting resistor : voltage holding
      - Working voltage is unsuitable
        - » Change the working voltage
        - » Change the gas mixture

# Target HV Region to Reproduce



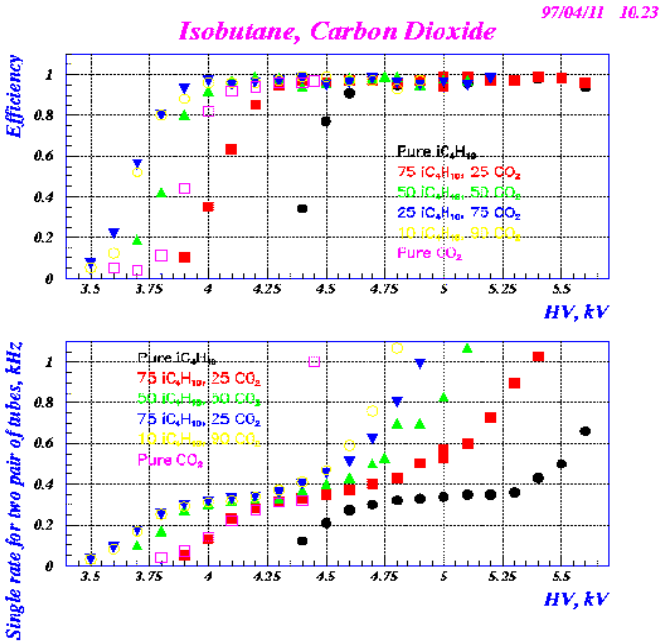



# Check Out Run Time Scale

- For one gap
- nroads==1
- Efficiency ~ 100%




| HV | 4000 | 4100 | 4200 | 4300 | 4400 | 4500 | 4600 | 4700 | 4800 | 4900 | 5000 | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| rate | 0.3 | 0.5 | 0.8 | 0.9 | 1 | 1 | 1 | 1 | 1 | 1.1 | 1.3 | | |
| time | 62m | 36m | 25m | 25m | 18m | 18m | 18m | 18m | 18m | 18m | 15m | | 4h |
| Trig# | 11M | 6.6M | 4.3M | 3.8M | 3.3M | 3.3M | 3.3M | 3.3M | 3.3M | 3.3M | 3.3M | | |

# Advise from the Nov 21th meeting

- To use isobutane gas
  - Make lower the flow rate
  - Higher the ratio
- Make voltage push up
  - w/o change of the gas mixture
  - Test should have to done before we change gas mixture.
- Photon quencher
  - Excited CO2 gas -> emit photon -> need quencher gas