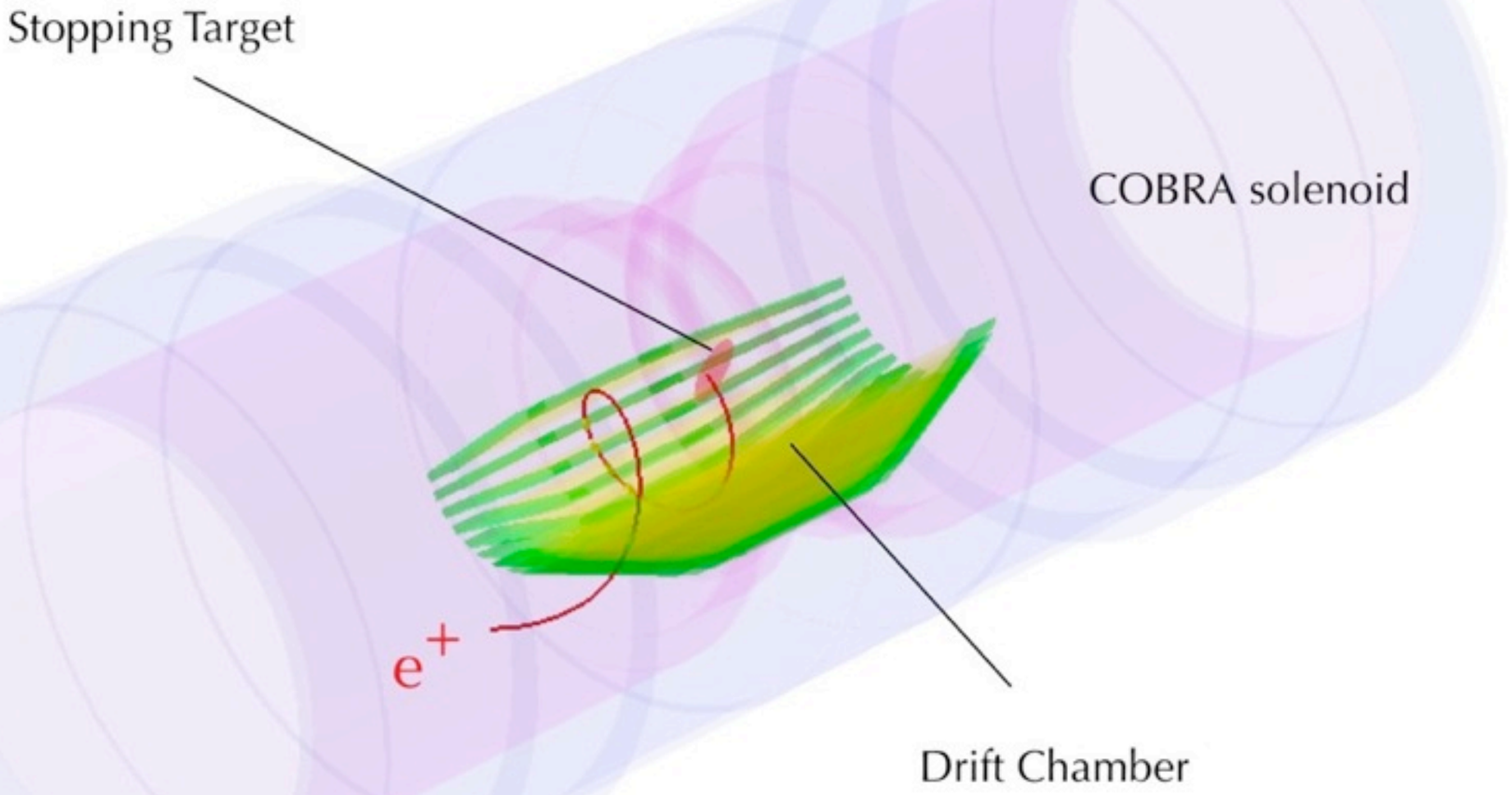

MEG実験2008 陽電子スペクトロメータ

西口 創 ／ KEK素核研,　他 MEG コラボレーション

JPS Spring Meeting, 27-30/Mar./2009, Rikkyo University

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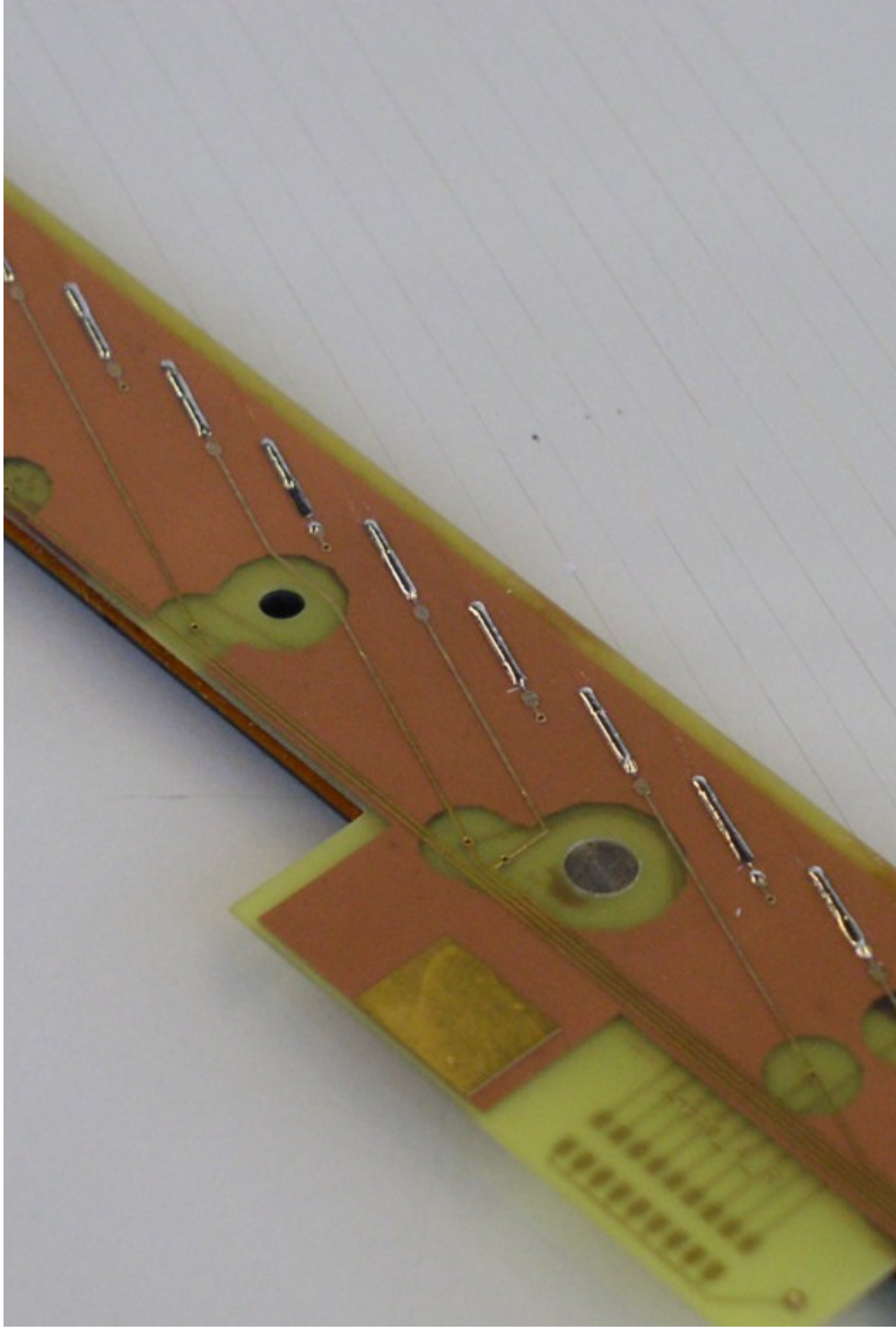
- MEG e^+ spectrometer
- MEG Drift Chamber
- Run2007 and Run2008
- Problems
- Prospects
- Conclusion



Requirements for Positron Spectrometer

- **Very high counting rate**
  - the most intense DC muon beam in the world
  - muon stopping rate : 3×10^7 muon/sec

→ Special B-field

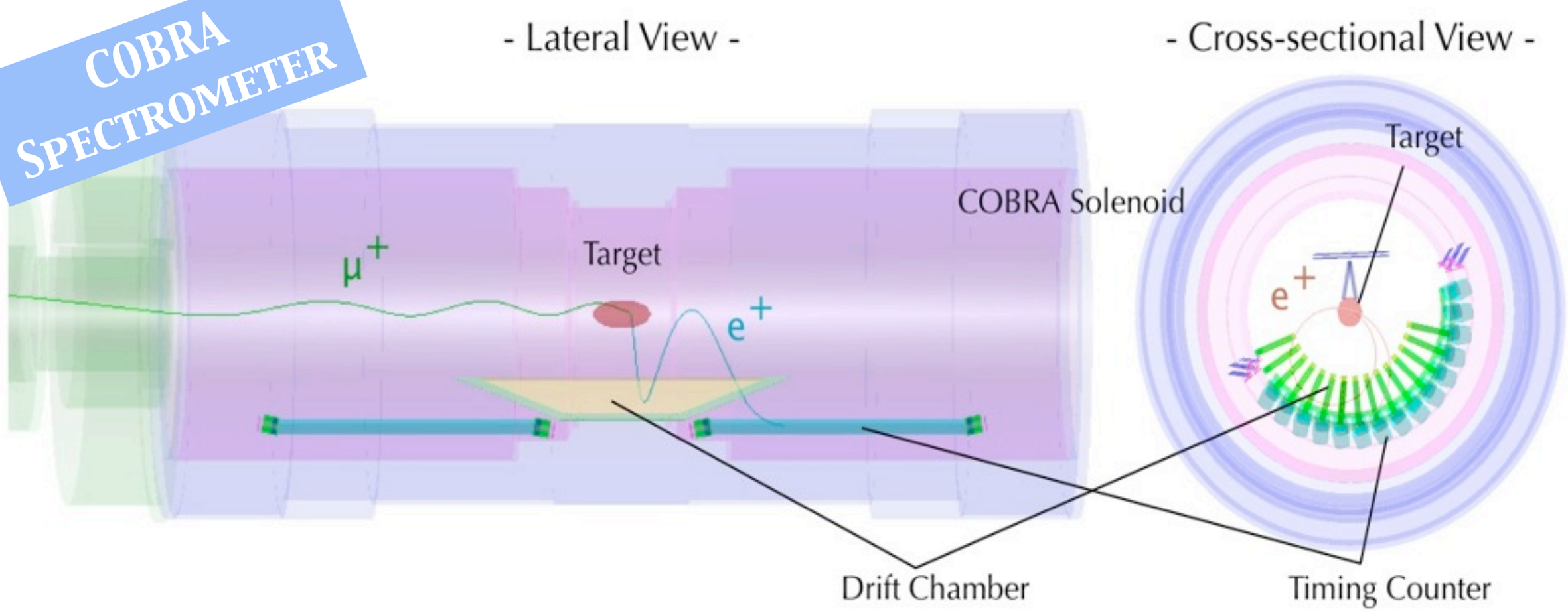
- **Good momentum/position/timing resolution**
  - aiming excellent sensitivity
  - <1% momentum resolution, 500μm position resolution for both direction(r,z) and 40 ps timing resolution

- **Low-mass material**
  - 52.8MeV/c positron can be affected by multiple Coulomb scattering easily
  - γ background generation should be suppressed as much as possible

→ new sensitive & light DC

MEG Positron Spectrometer

COBRA SPECTROMETER



Solenoid

superconducting solenoid
gradient B-field (0.5-1.7 T)
very thin conductor and
cryostat wall ($0.2X_0$)

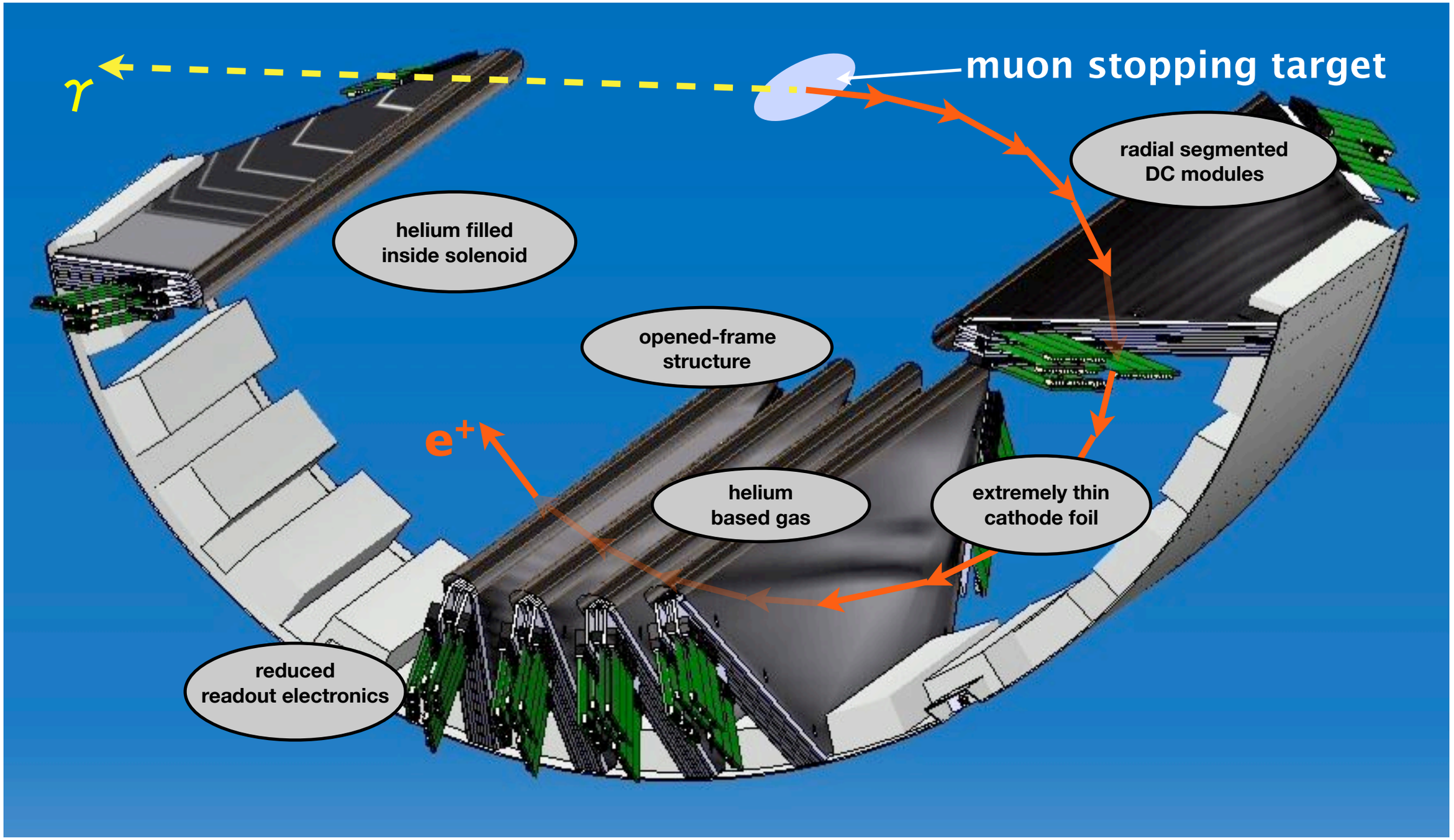
Drift Chamber

segmented radially (16 sectors)
helium:ethane (50:50)
opened-frame
very thin cathode foil with pads

Timing Counter

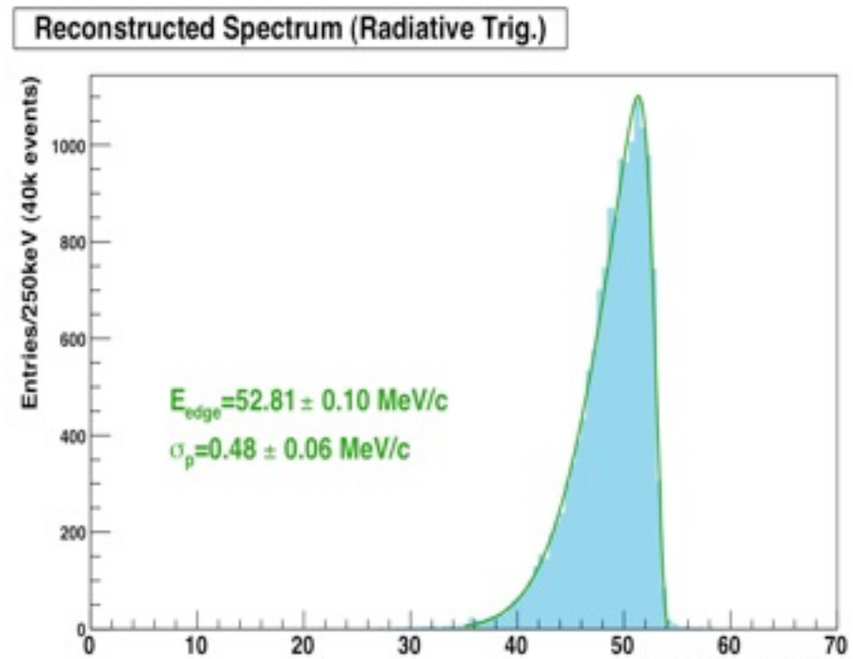
2-layers of scintillators
- scintillator bars (outer)
- scintillator fibres (inner)

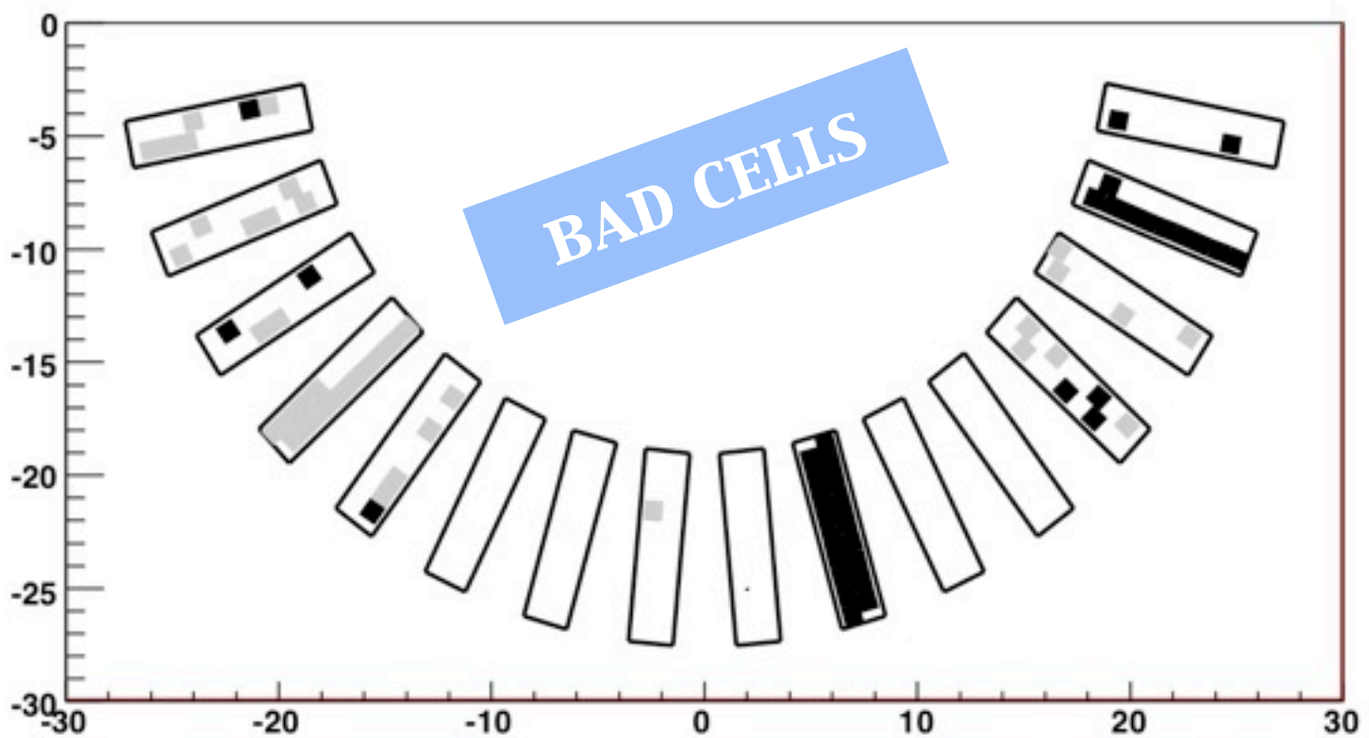
MEG Drift Chamber



Engineering Run 2007

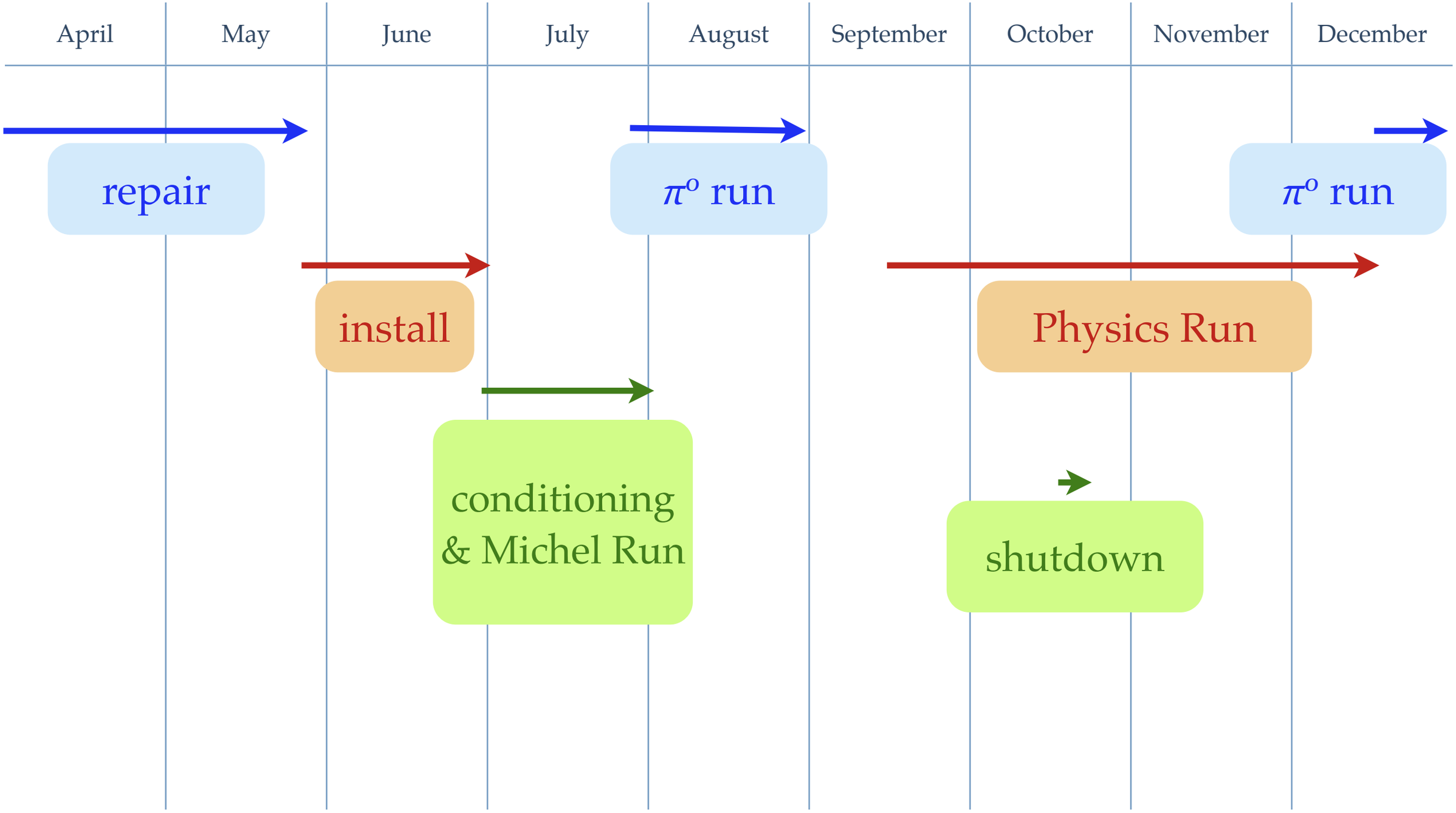
- (1) DAQ Check, (2) Conditioning with Final Beam Intensity, (3) Establish the Slow Control, (4) Establish the Calibration Procedure
- Major Problems:
  - **Discharge** : by helium
  - **Disconnection** : at patch panel of end cap



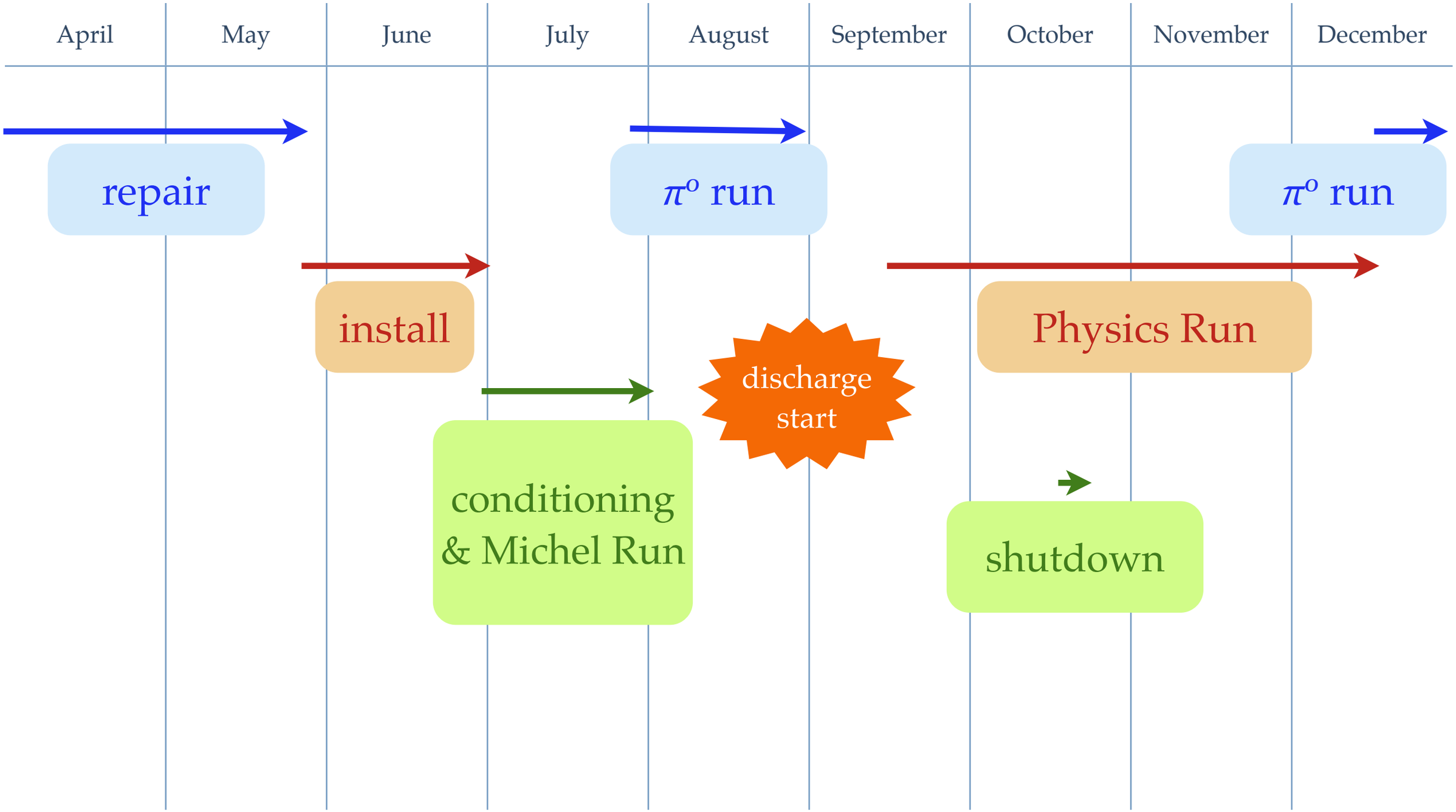


	track finding eff.	good tracking eff.	mom. resolution
Run 2007	85%	65.2%	0.9%
MC (full spec)	99%	97.5%	0.4-0.6 %

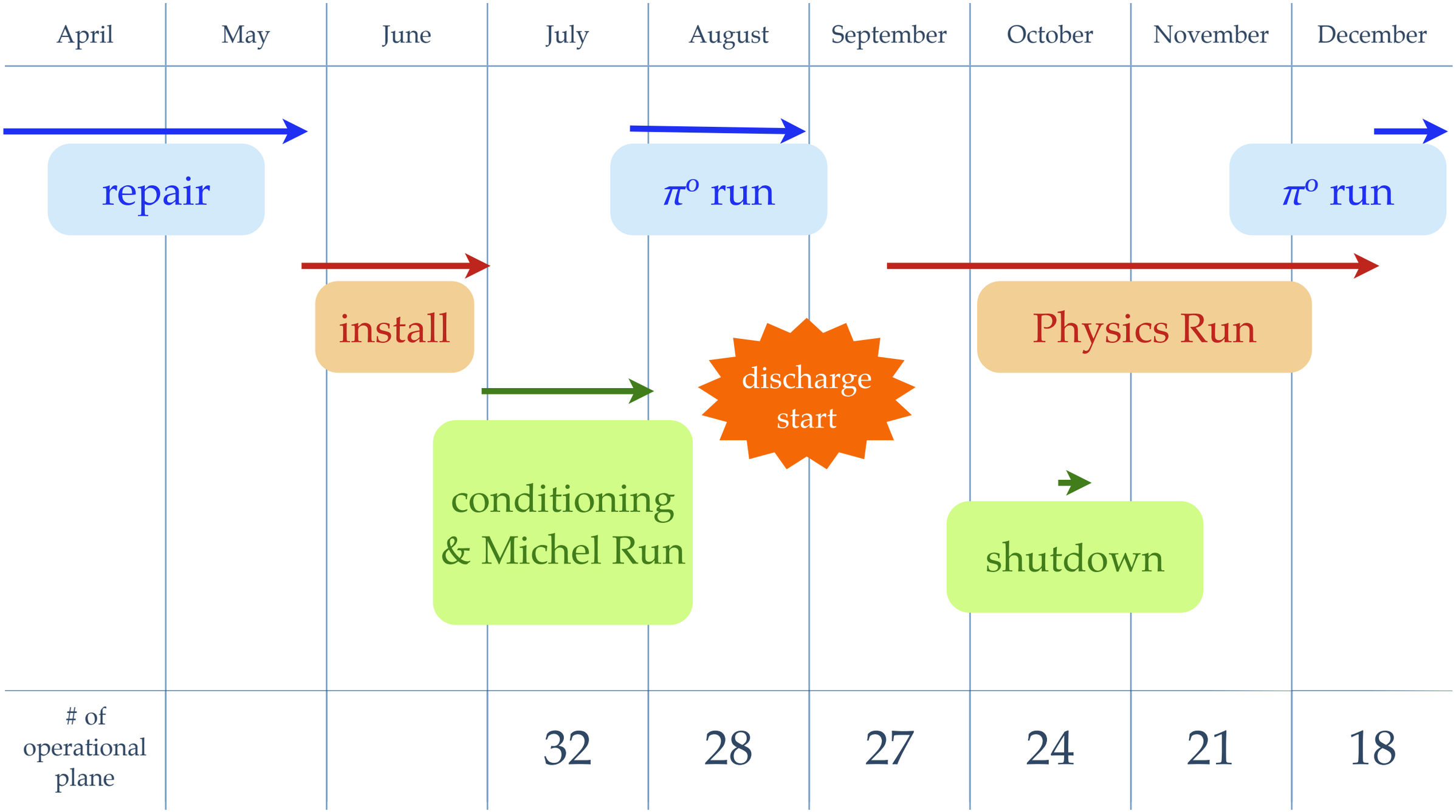
MEG DC Summary 2008



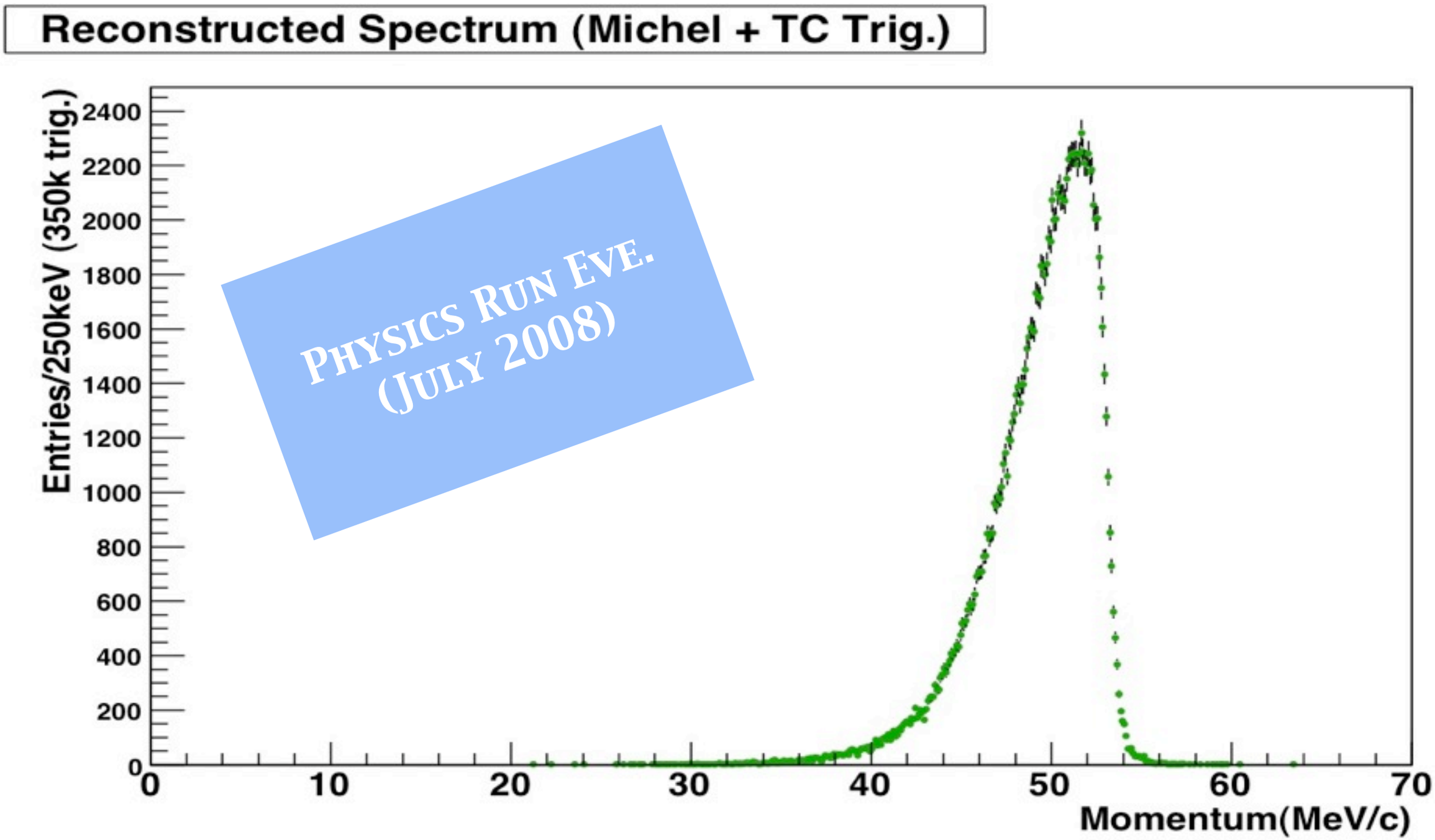
MEG DC Summary 2008



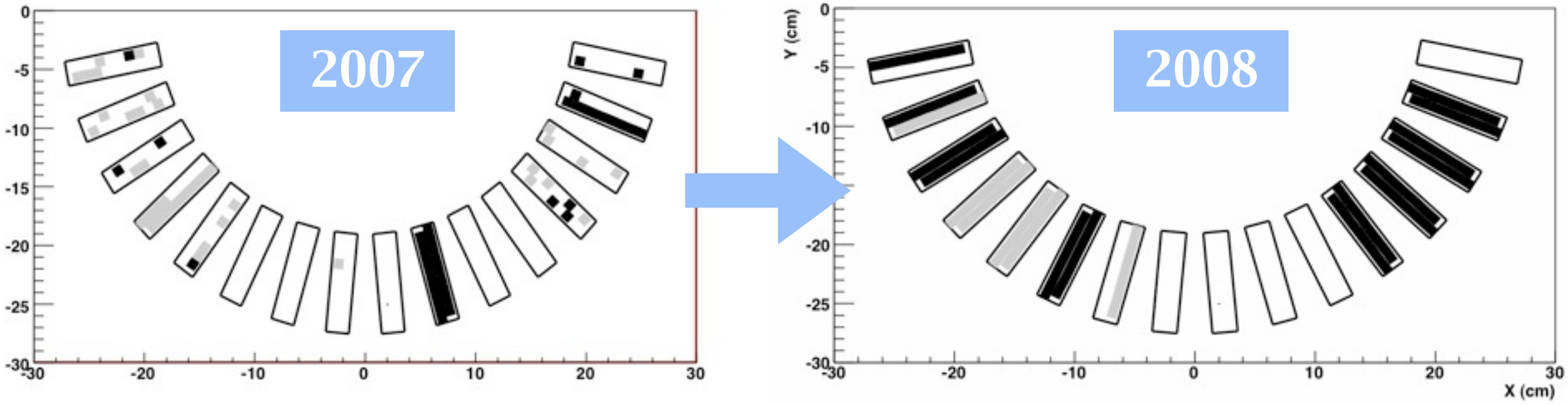
MEG DC Summary 2008



Momentum Spectrum (Michel, 2008)

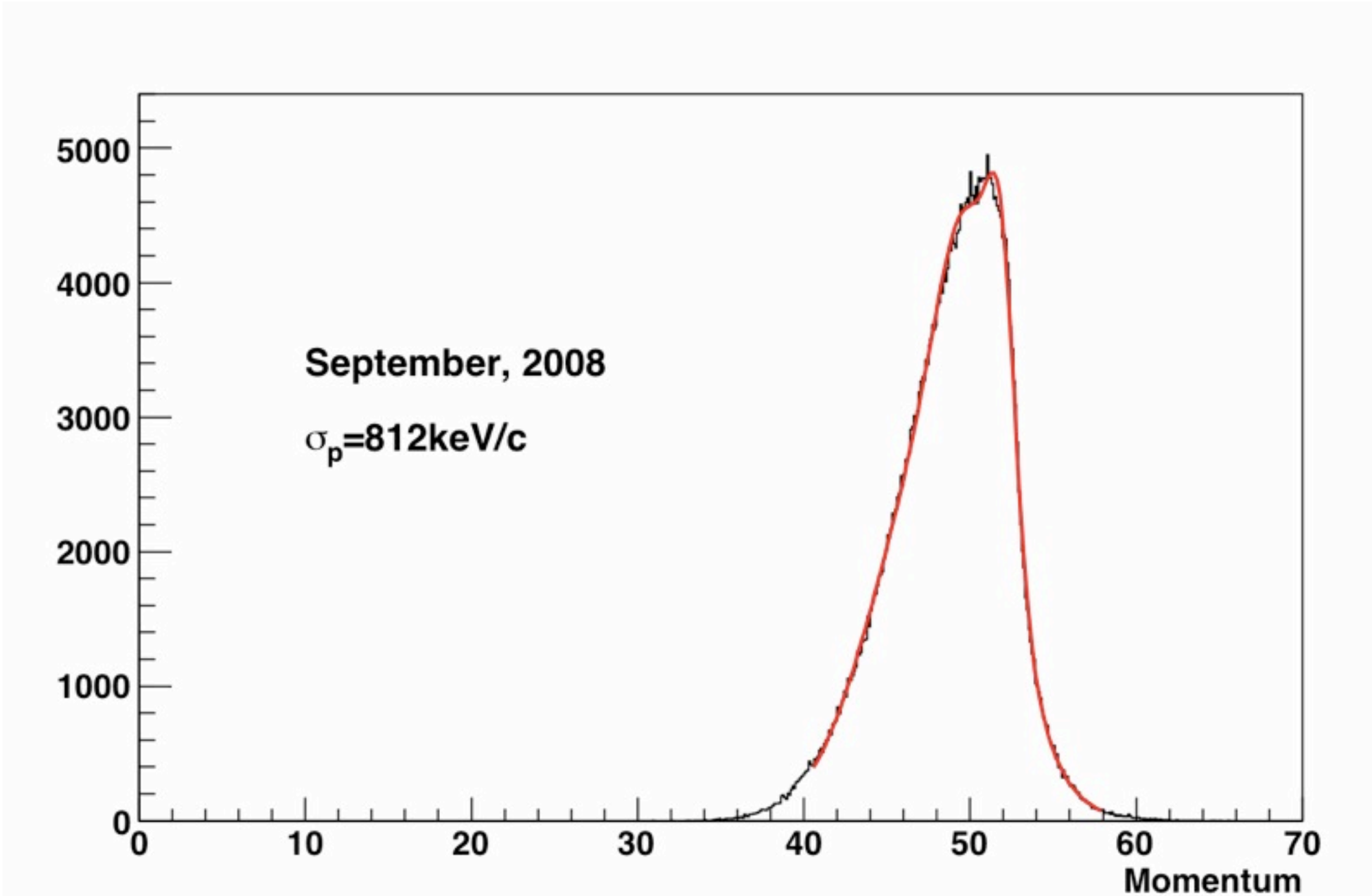


How has it been degrading ...



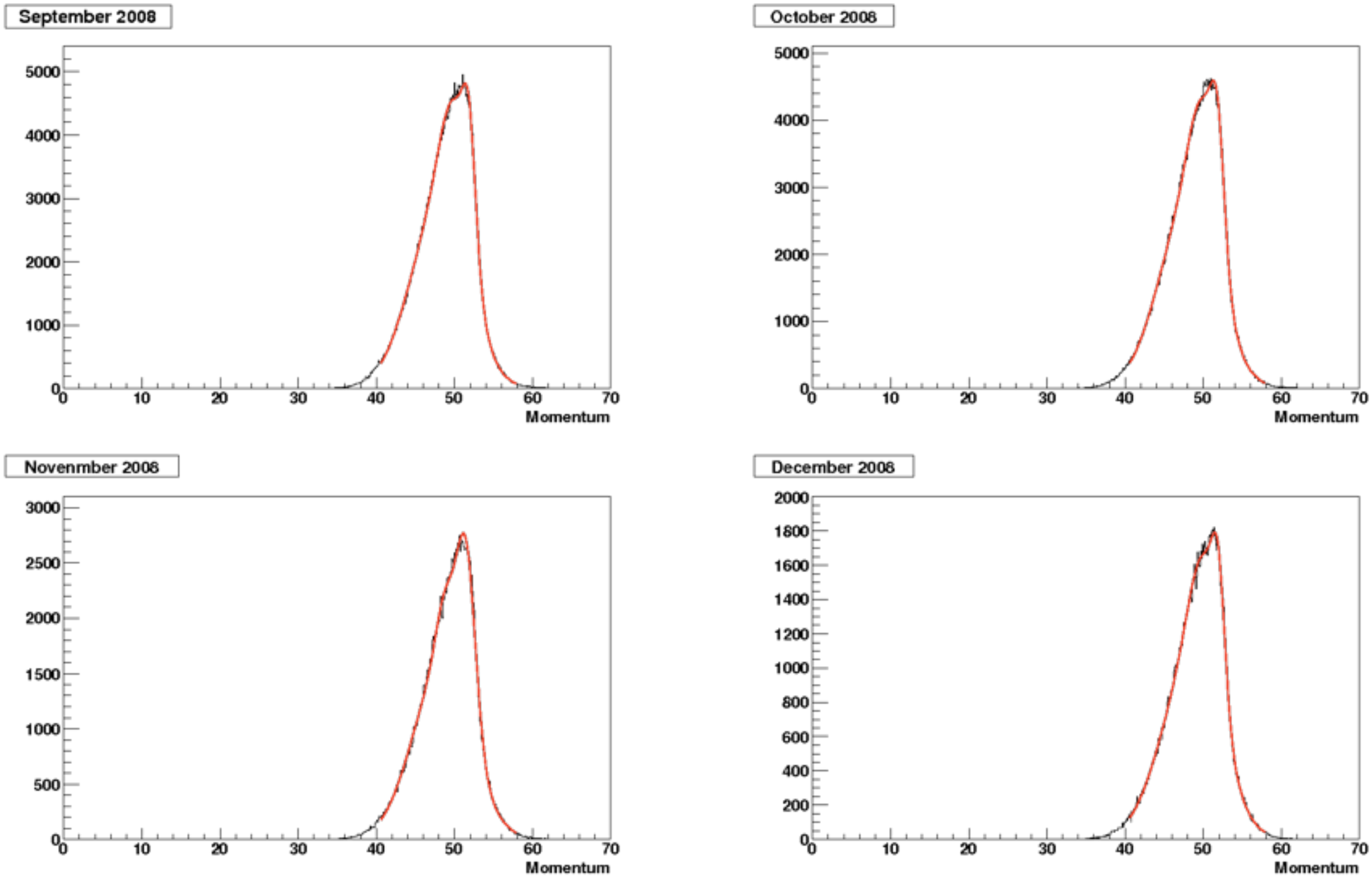
- HV is applied to each plane individually.
- Finally, 18 planes were operational, only 12 planes were working with nominal voltage...
- With tight cut, resolution deterioration is saturated.
- But, efficiency has been degrading dramatically...

Momentum Spectrum (MEG, 2008)



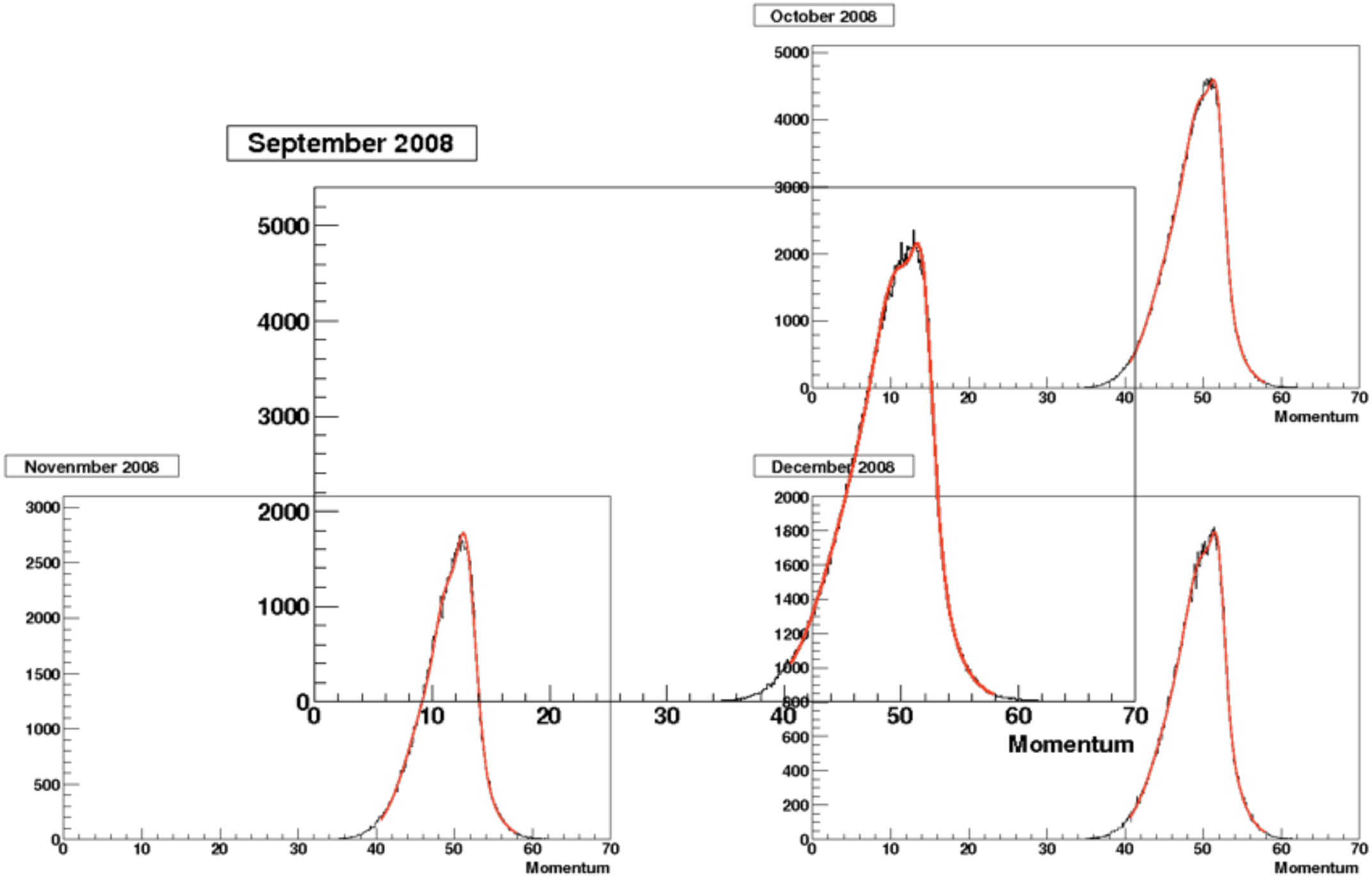
- Mom-Resolution is worse than 2007, due to missing planes, air doping, baseline noise.

Momentum Spectrum, continued



- Resolution Deterioration is saturated with tight cut. (~800keV/c)

Momentum Spectrum, continued



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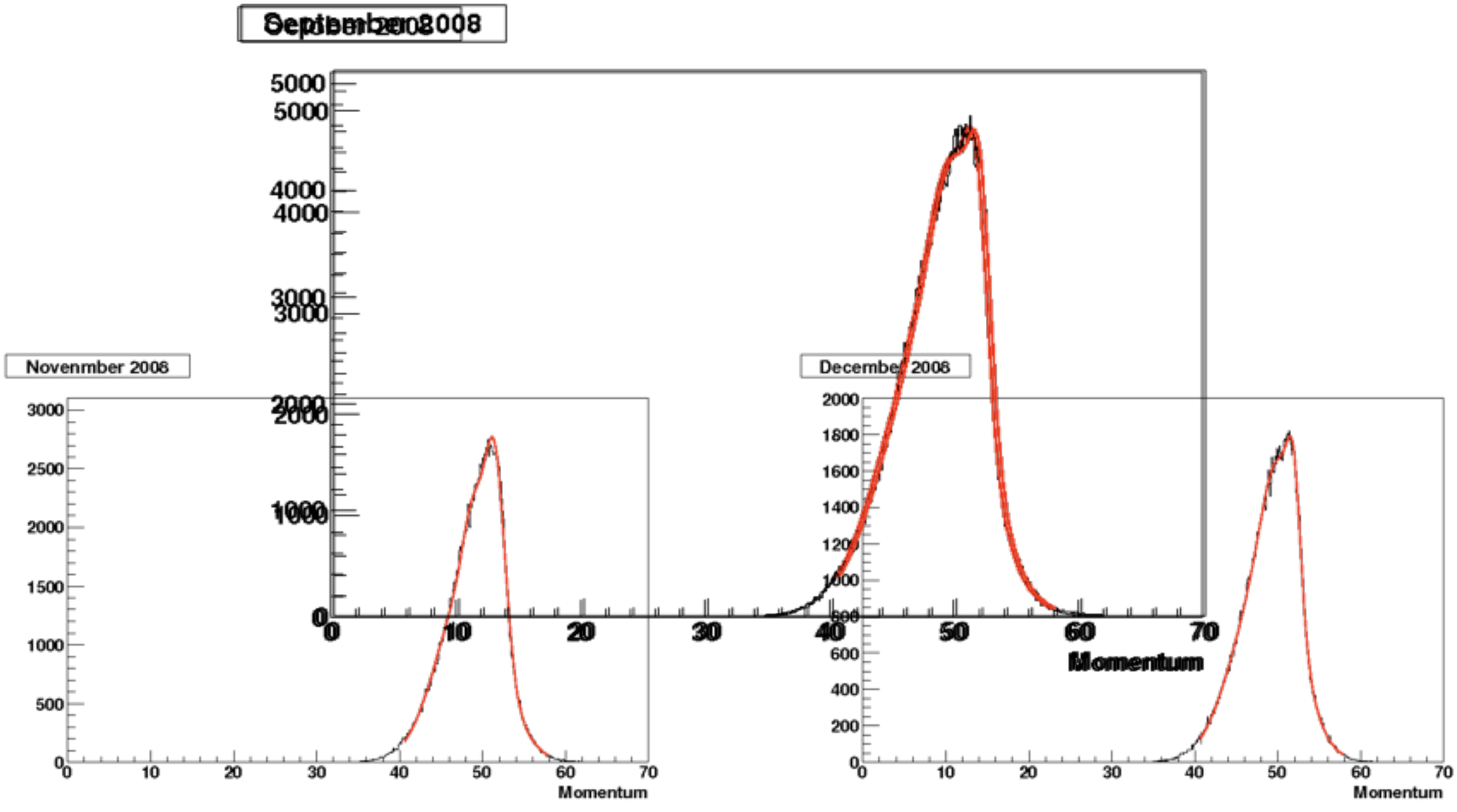

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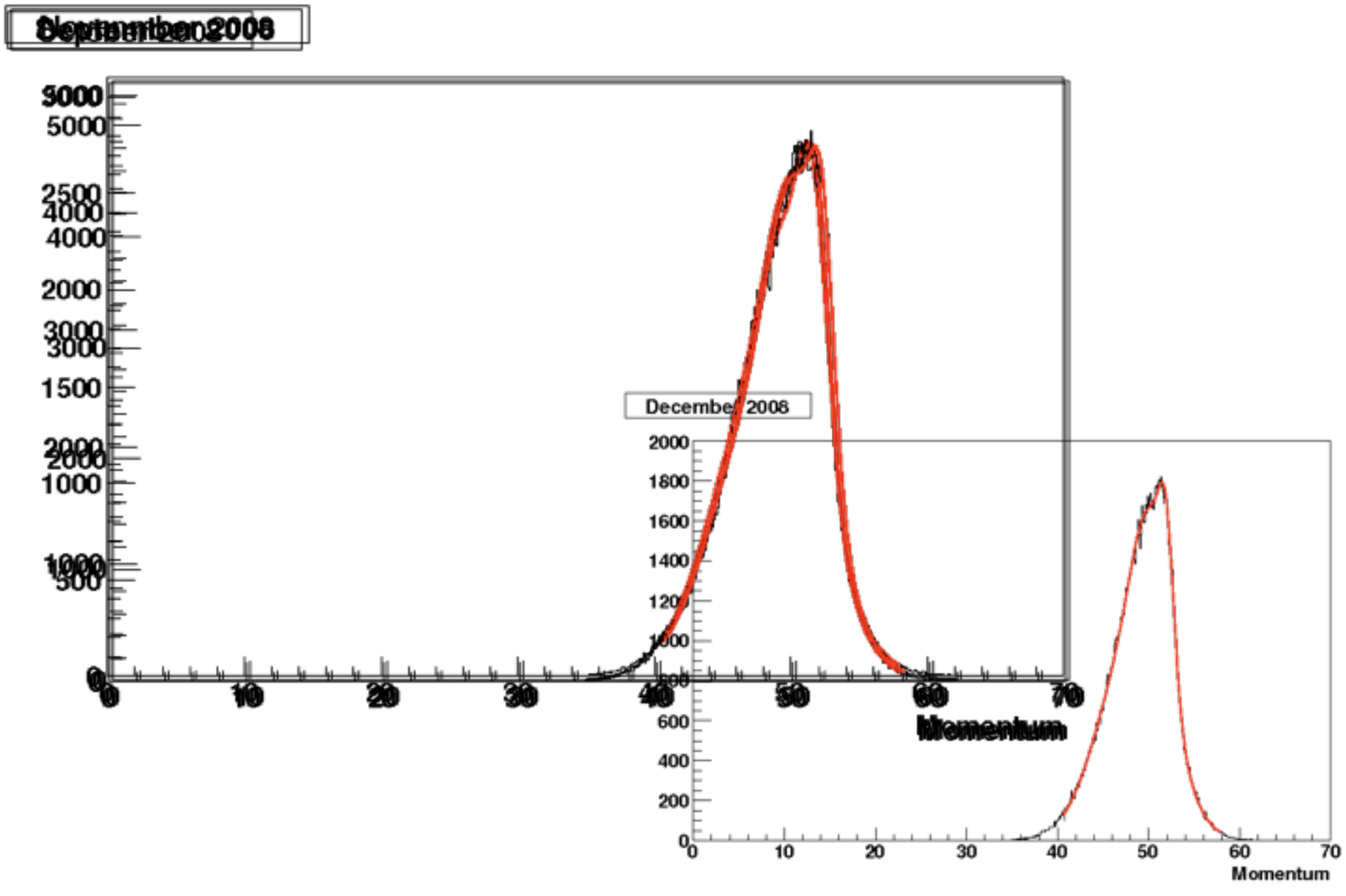
Momentum Spectrum, continued



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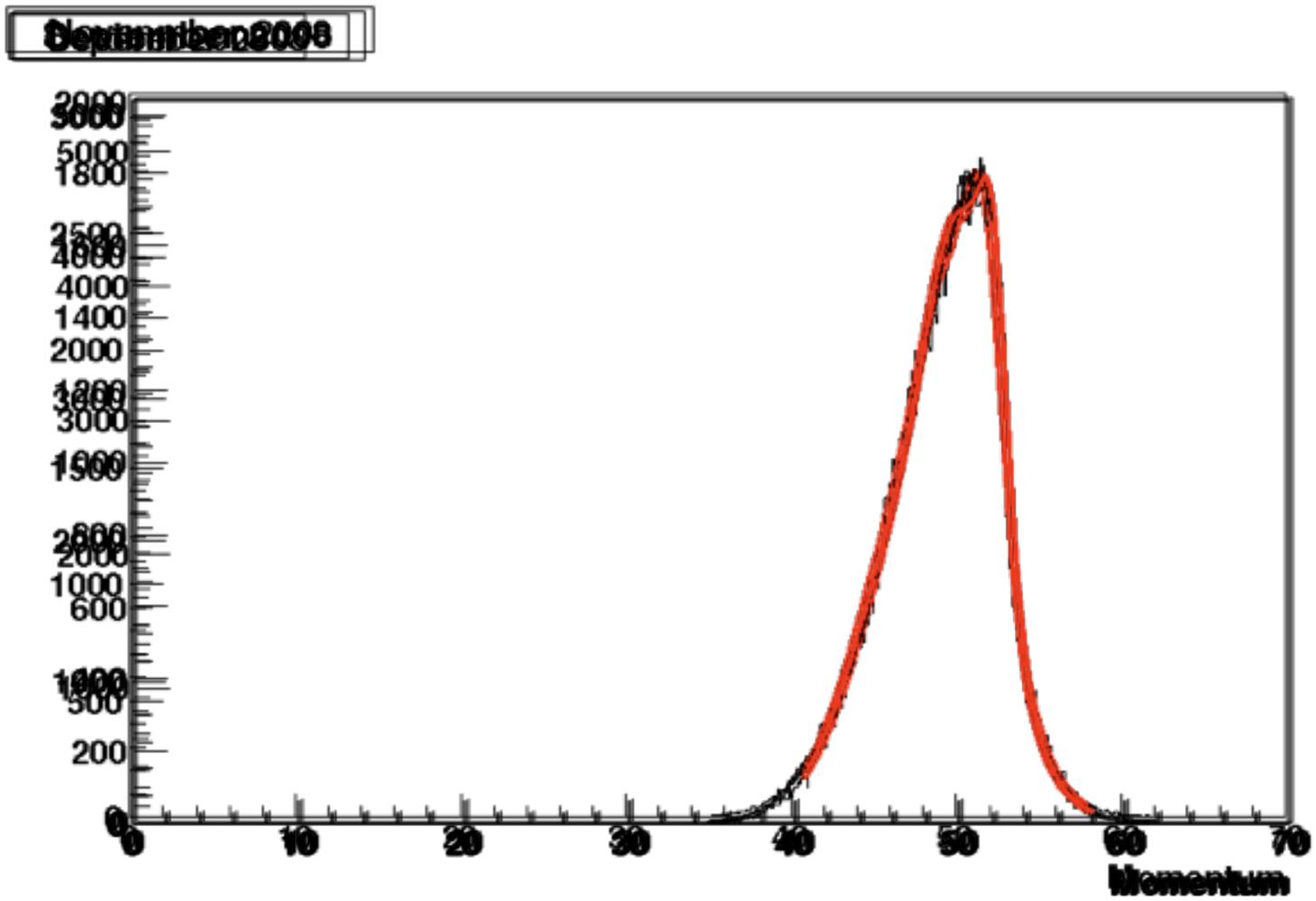

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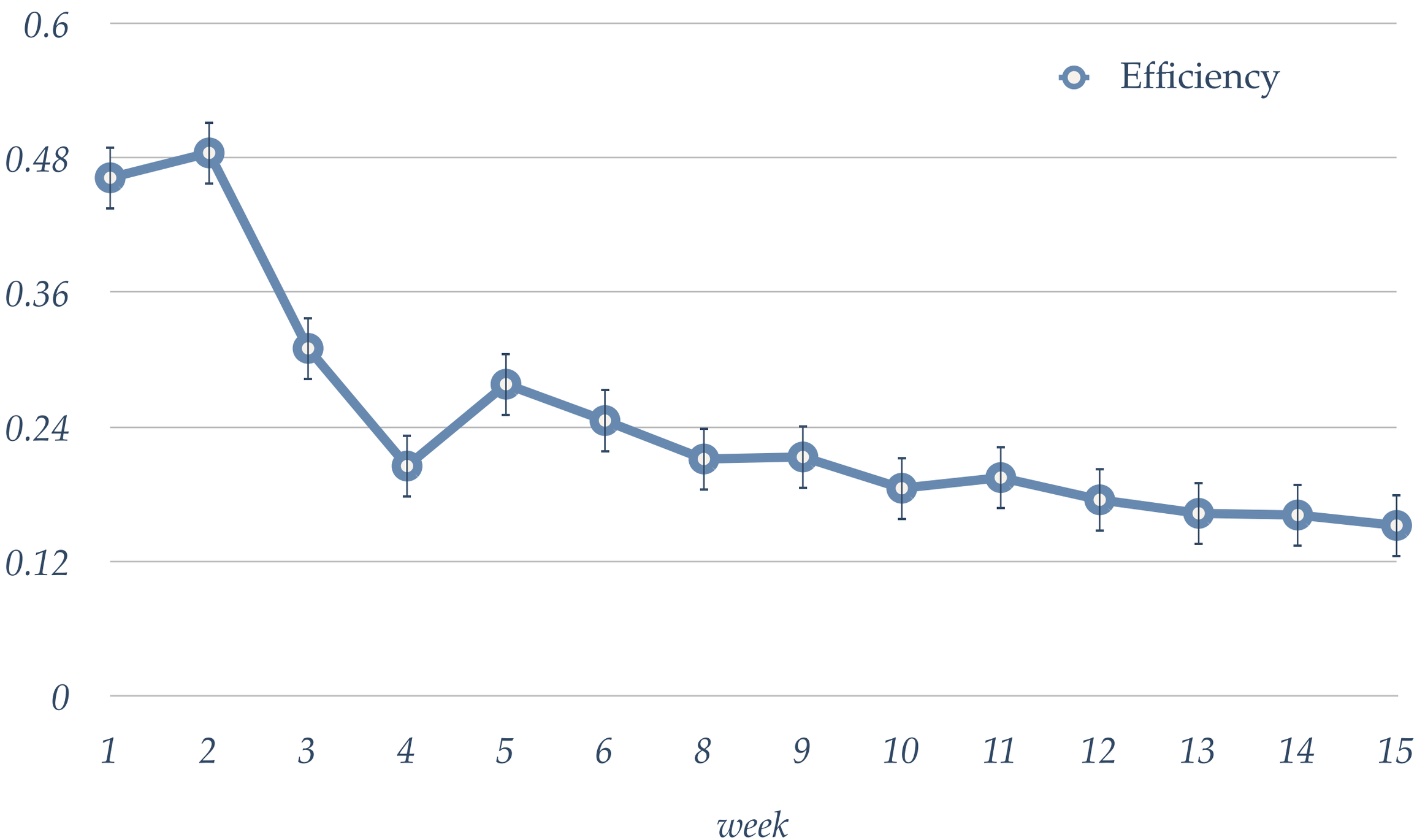
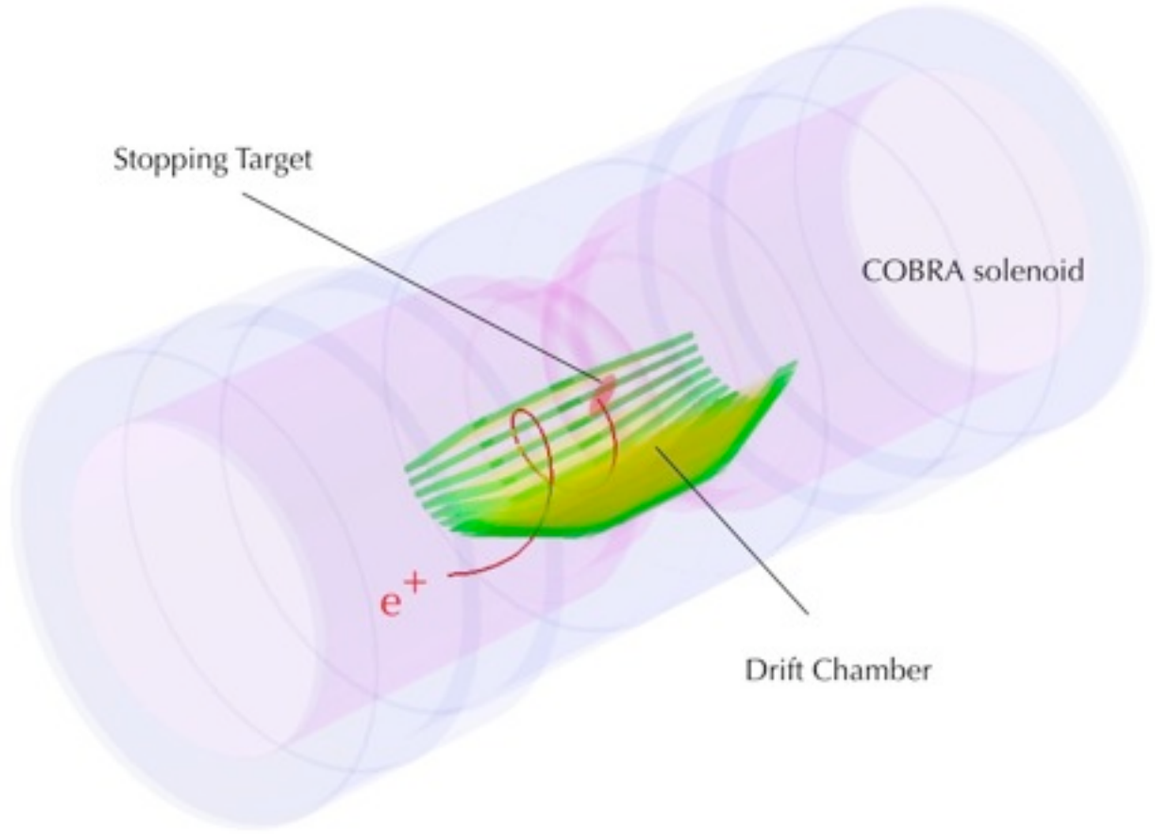
Spectrometer Efficiency

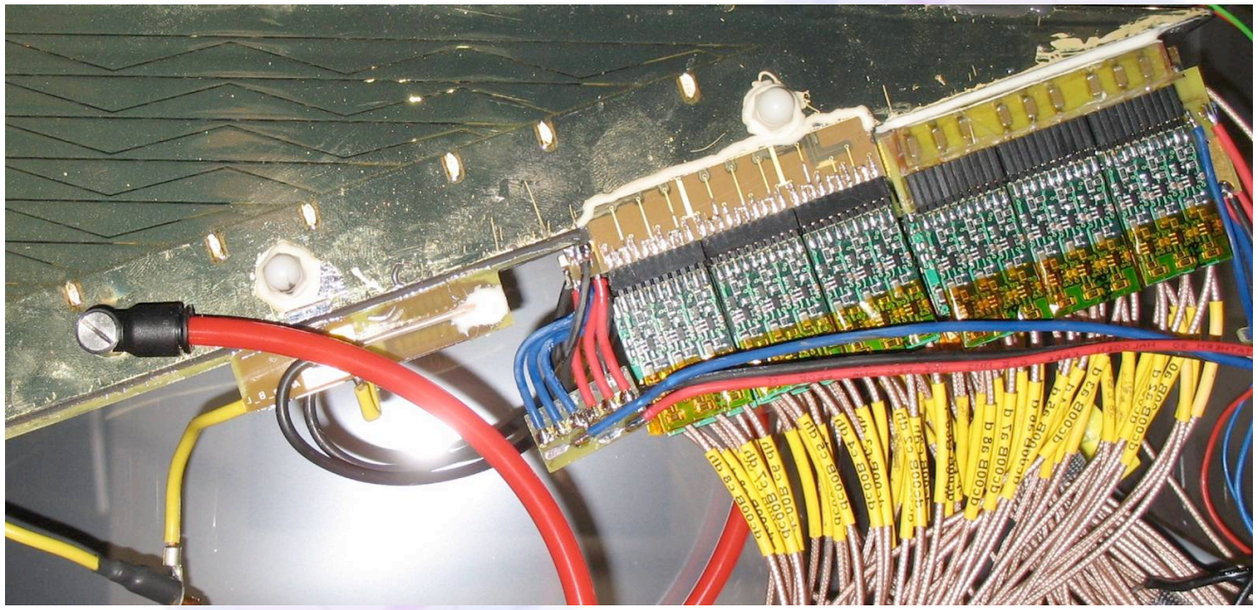


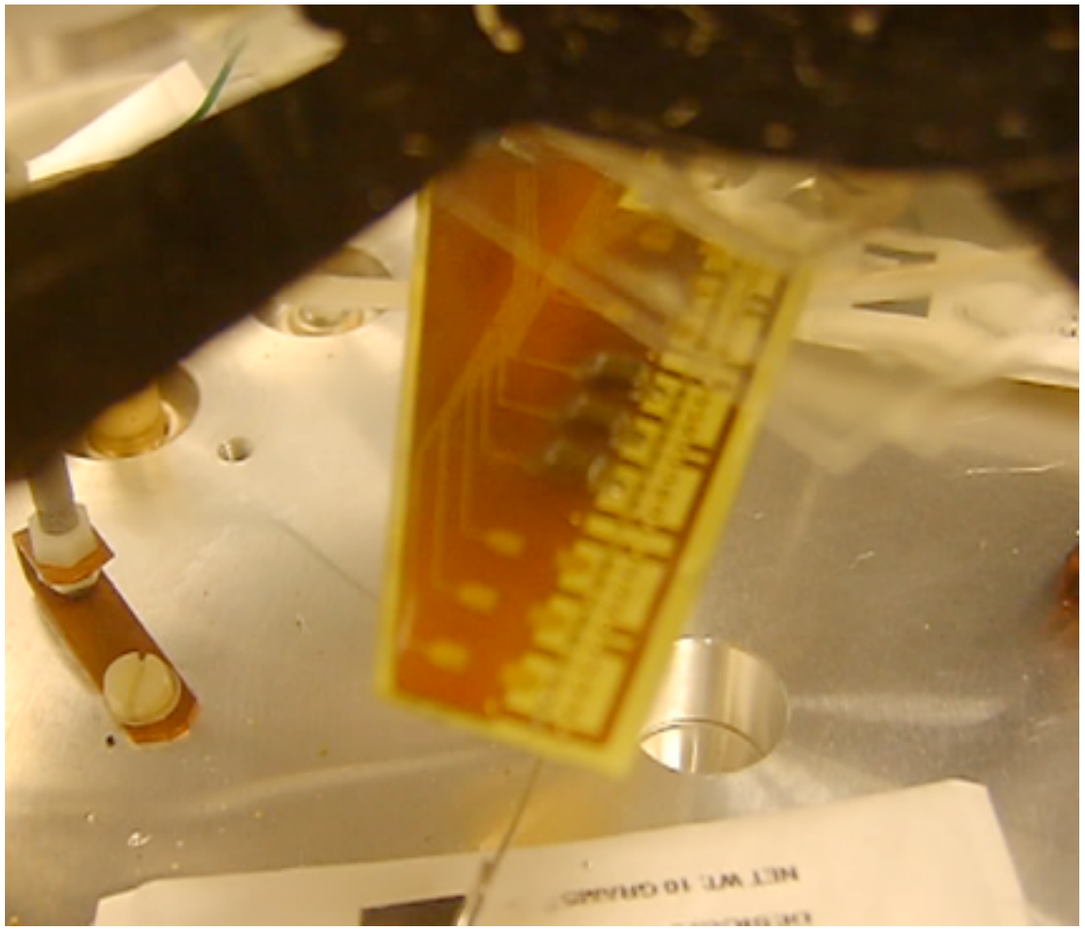
Discharges



- Inside COBRA is filled with pure helium, then DC-outside is exposed in helium atmosphere.
- HV-tracer-line is partially naked to helium in 2007, then discharged...
- We made the protection for helium in 2008 maintenance period, but...

Discharges





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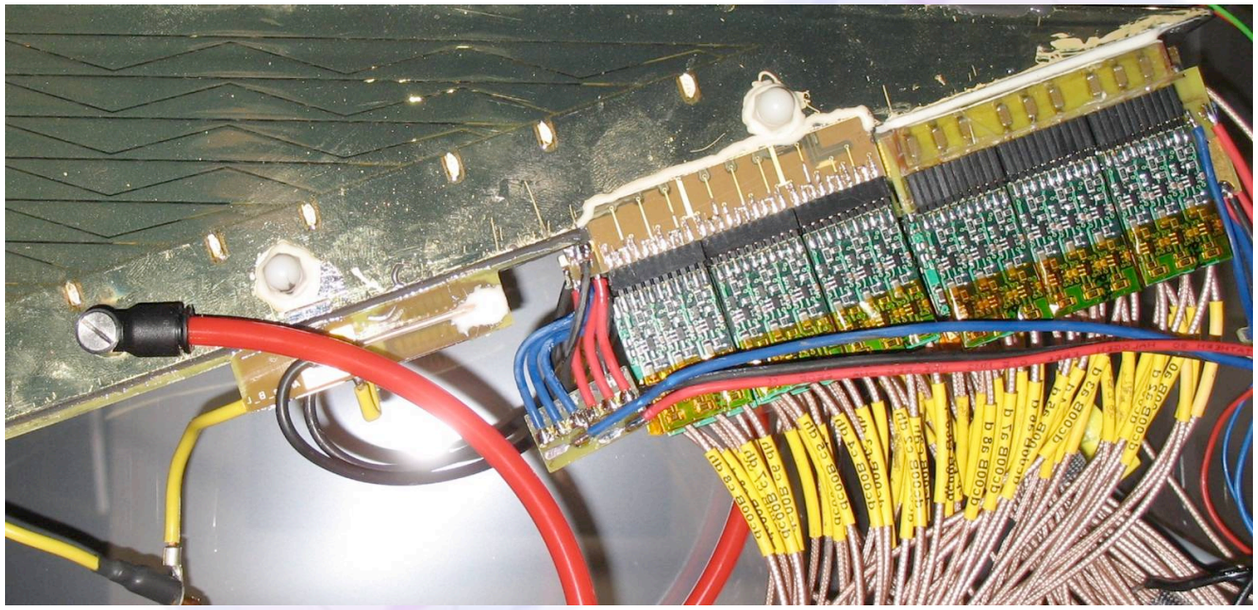

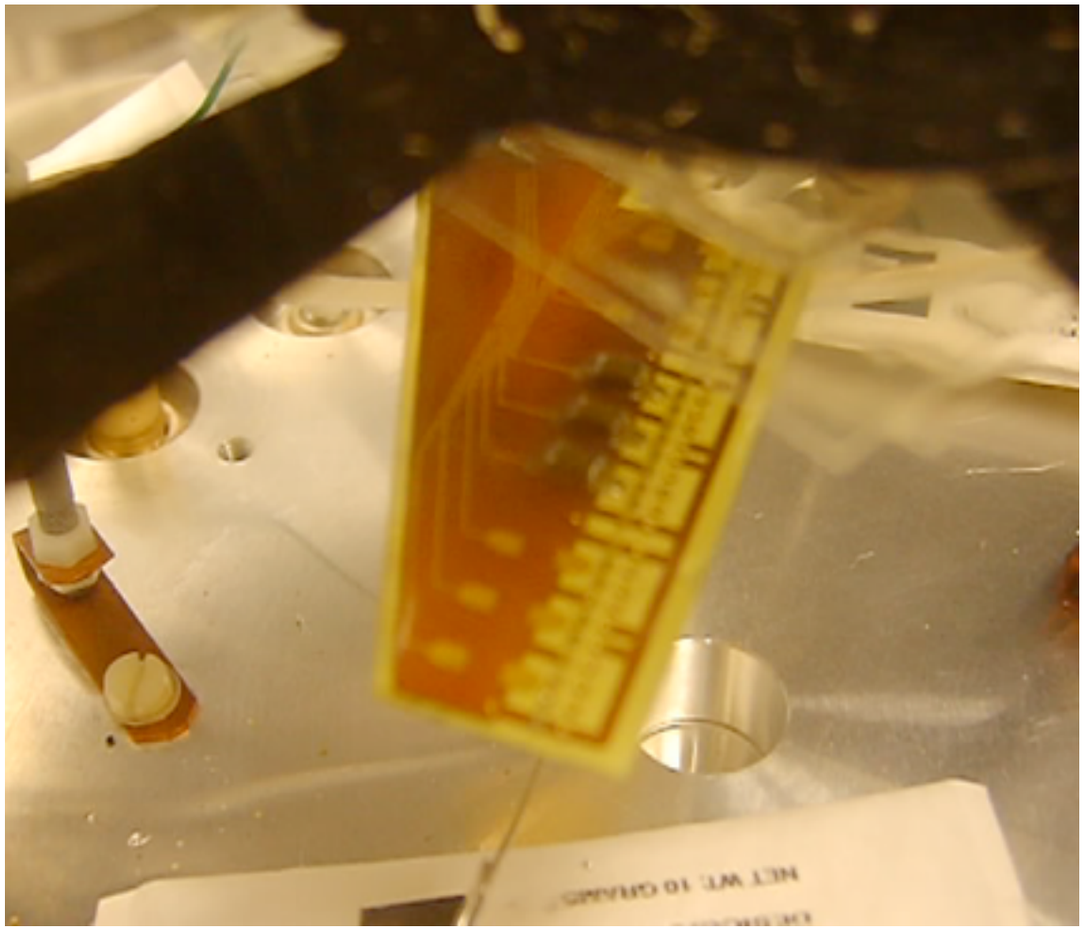

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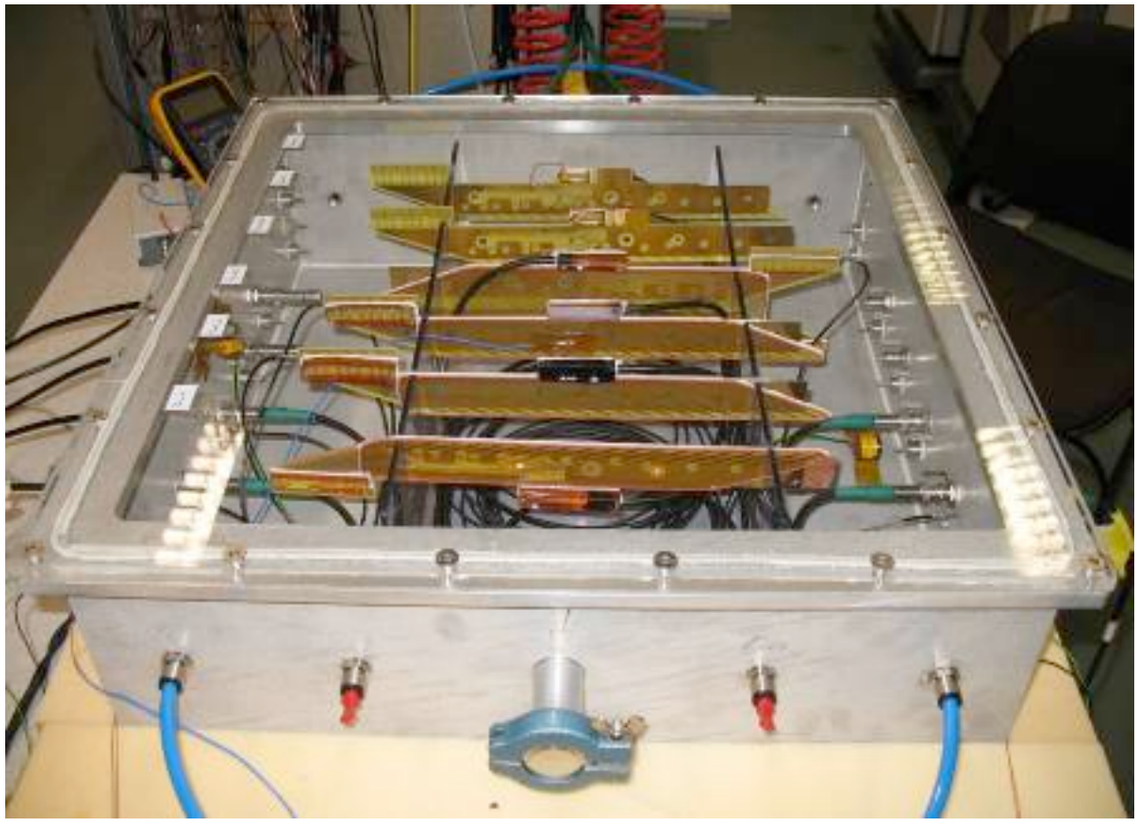
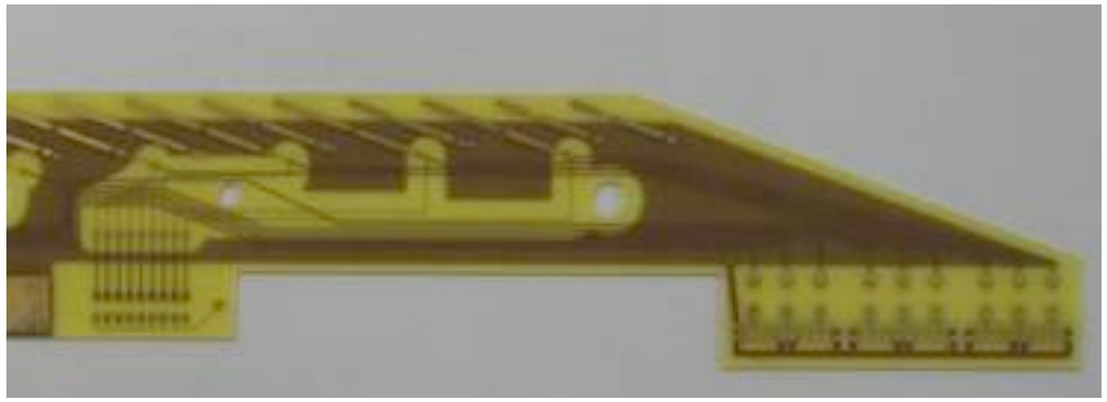
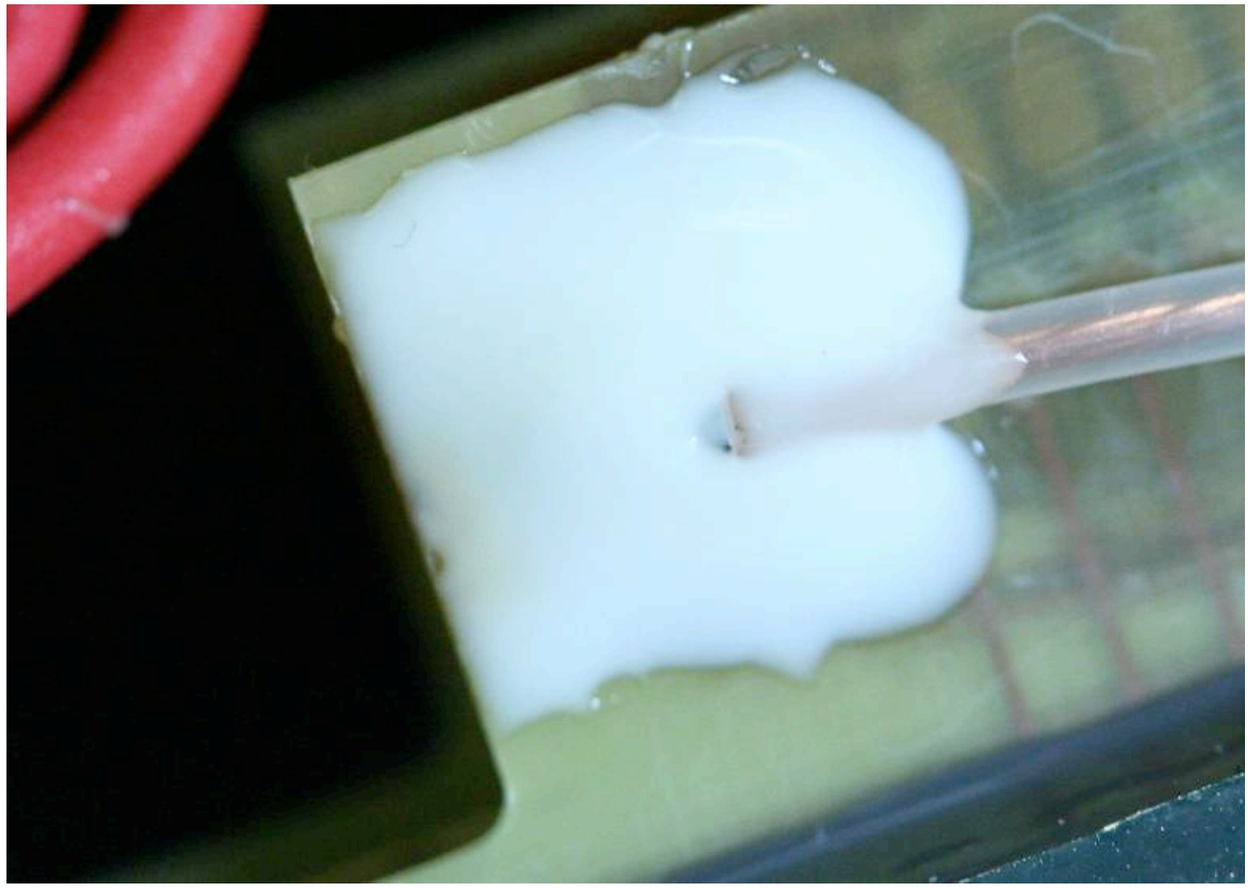
Discharge Studies





- More effective discharge protection is being developed in lab.
- Test Bench with helium, many protection ways are investigated.
- In parallel to that, investigation of actual module is underway.
- Final protection scheme is recently almost fixing.

Discharge Signature



- DC modules were uninstalled from COBRA solenoid, and is operating in Helium hat in lab.
- Each modules are under investigation.
- We found several discharge signature and candidates of the weak point.

Plan to *Re*-assemble

- Fix the protection scheme ASAP, then rebuild the first module in April.
- Start the long-term test in helium hat by the first module. In parallel, start reassemble all modules (incl. 5 spares).
  - Open module, Unmount the PCB boards, Install the new PCB, re-wire, and assemble again.
  - Reassembling will continue by ~August.
  - DC-activity Test will be performed in parallel to assembly.
- Aiming to reinstall/ready everything in beginning of September.

Conclusions

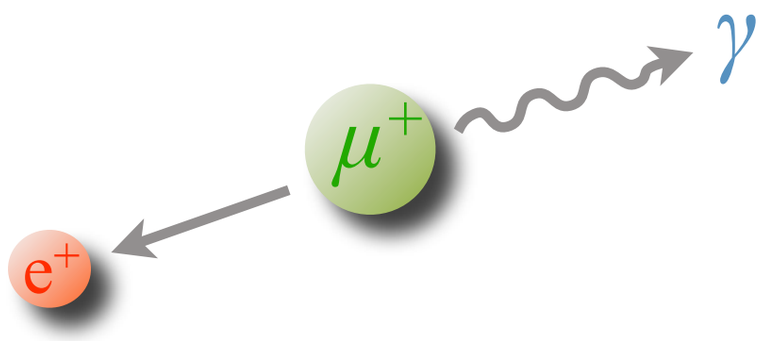
- MEG Positron Spectrometer ran for the first long-term experiment 2008.
- Unfortunately, several problems happened during the physics run, in particular, HV discharge problem.
- Due to discharge, DC system was operational partially, and thus the spectrometer performance was limited.
- Resolution deterioration was saturated, reconstruction efficiency was degrading continuously.

- Discharge study is finishing; now we are fixing the protection design.
- ALL DC will be reassembled in April-August.
- First DC module will be built ASAP, and long term test will be carried out in lab to confirm the new protection scheme.
- Spectrometer will be ready in September for the next physics run.

backups

Signature and Backgrounds

- Signal



- $E_e = E_\gamma = m_\mu/2 = 52.8\text{MeV}$
- $\theta = 180\text{deg.}$
- time coincidence

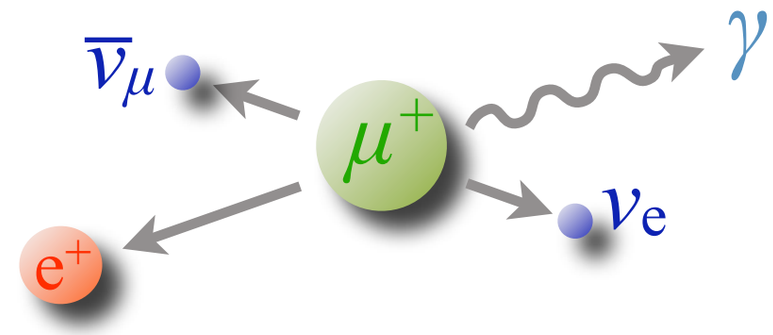
Clear 2-body kinematics

use μ^+ to avoid capture inside stopping target

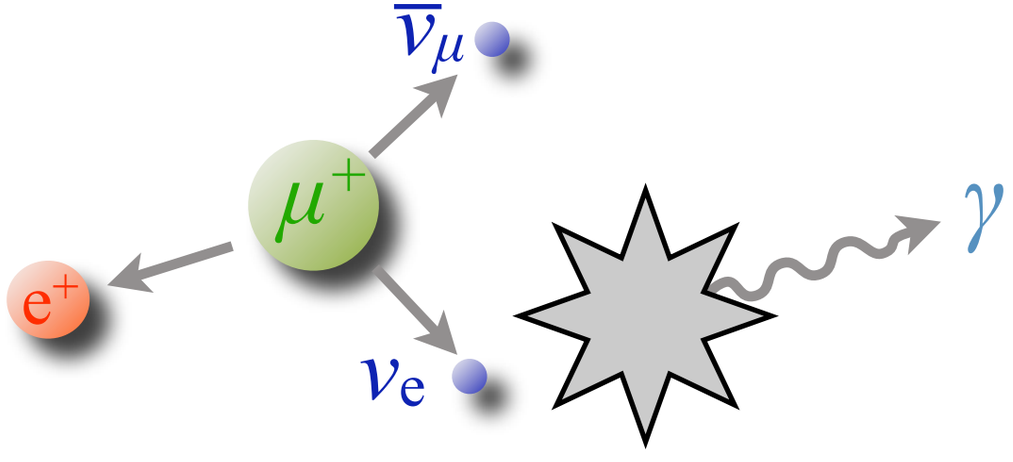
Background dominated by Accidental overlap

- lower muon beam rate is better
- DC muon beam is the best

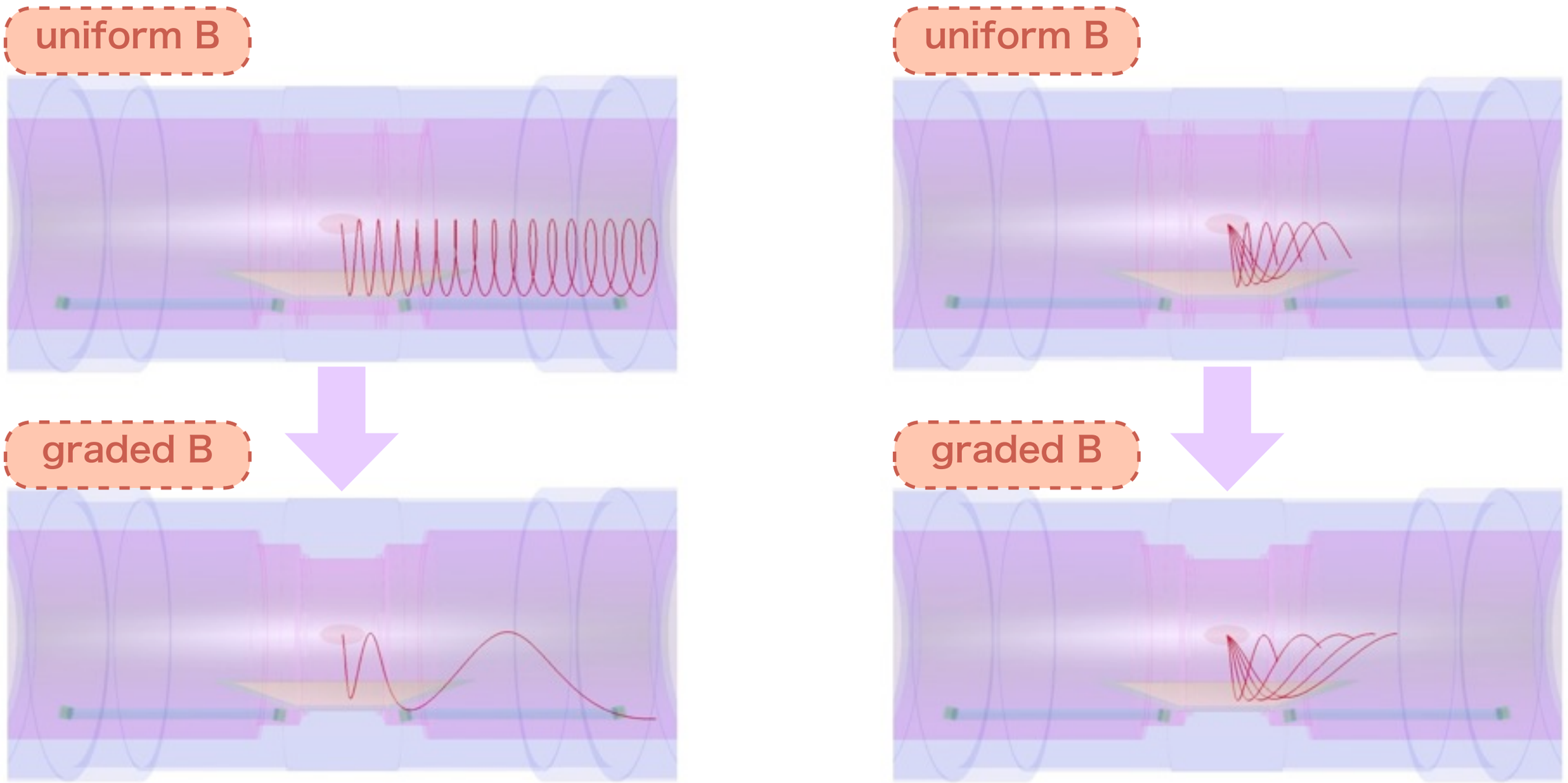
- Background
  - radiative muon decay



  - accidental overlap



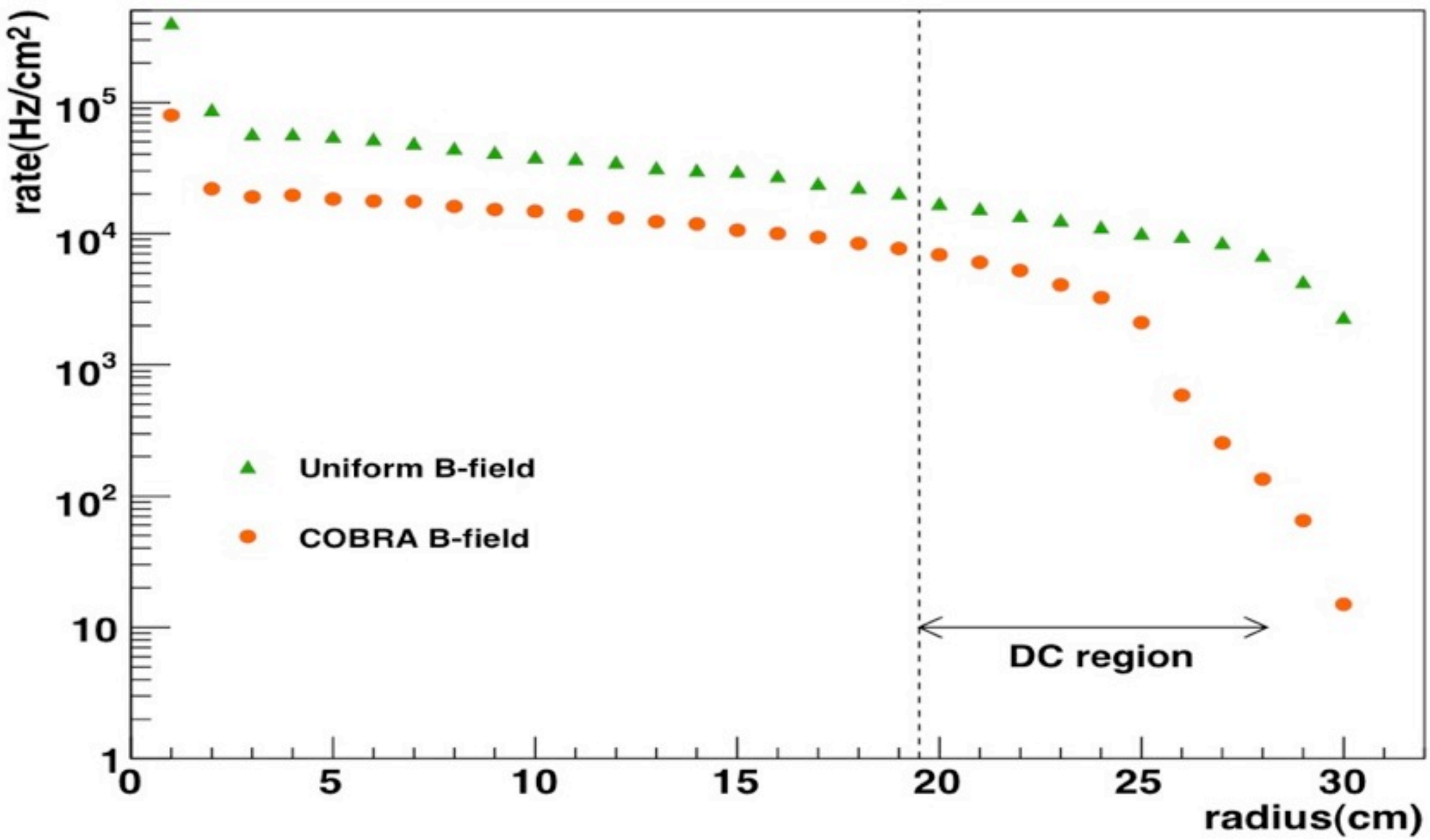
COBRA Solenoid



low energy e^+ quickly swept out

constant bending radius
independent of emission angles

Hit Rate in COBRA



MEG Drift Chamber