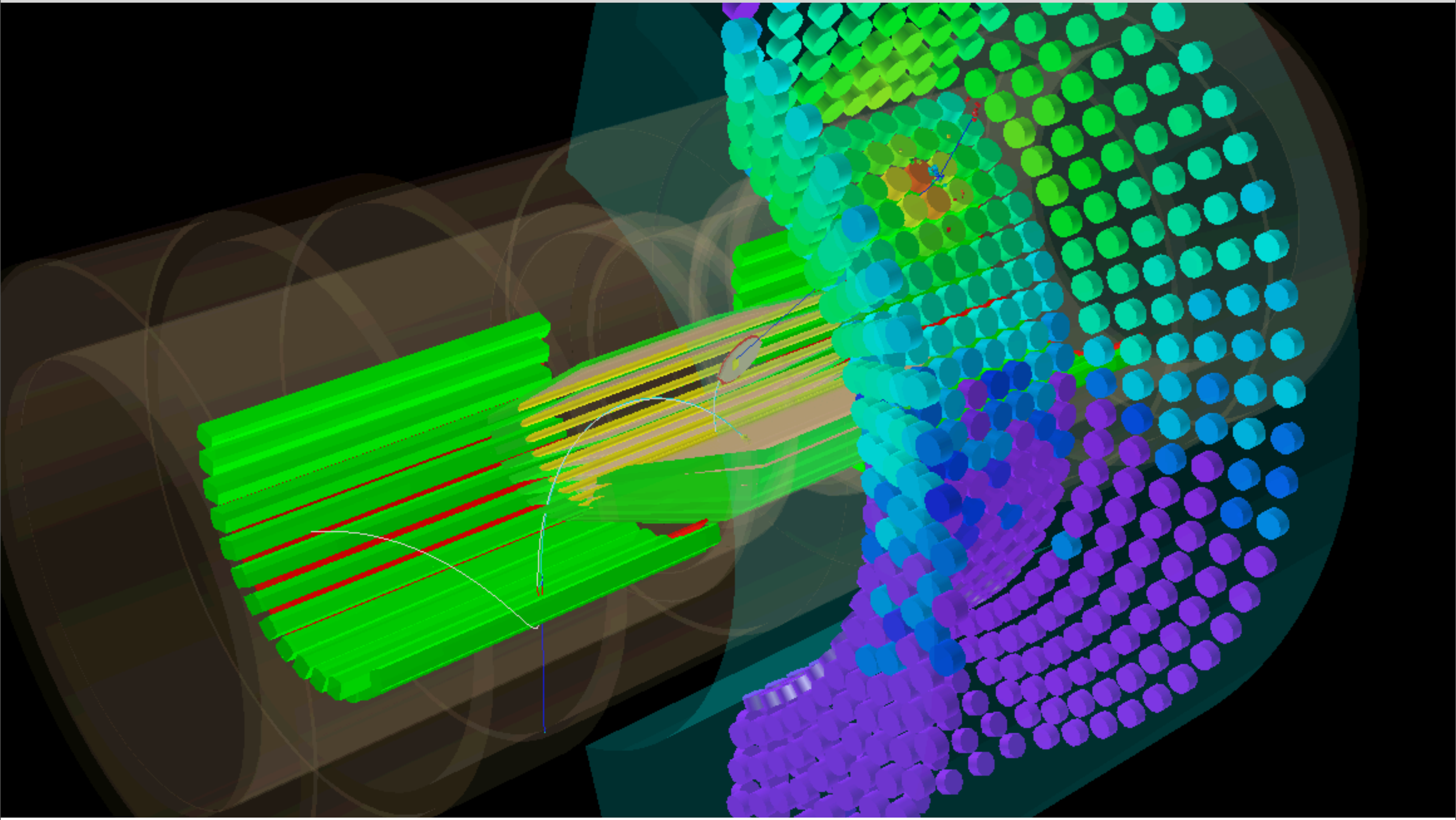

MEG Experiment in 2008

W. Ootani (ICEPP, University of Tokyo)
on behalf of the MEG collaboration

日本物理学会2008年秋季大会

2008年9月20日　山形大学小白川キャンパス

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- Run 2008
- Detector Performance
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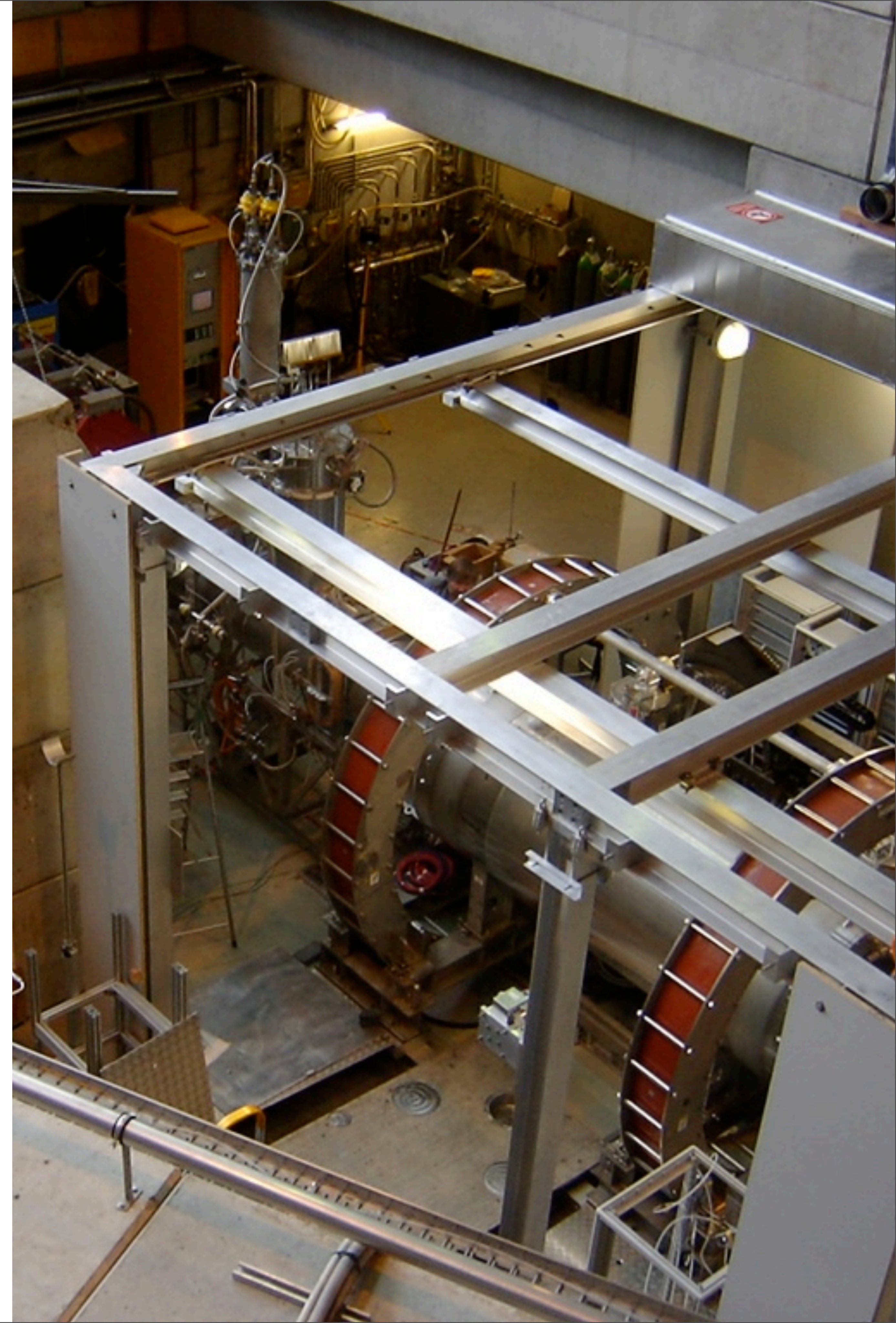
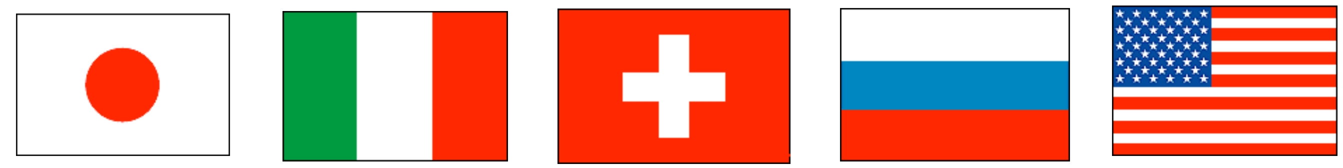


Introduction

MEG Collaboration



~65 physicists from 12 institutes in 5 countries

ICEPP, Univ. of Tokyo
X. Bai, Y. Hisamatsu, T. Iwamoto, K. Kaneko, T. Mori, H. Natori, H. Nishiguchi, Y. Nishimura, W. Ootani, R. Sawada, S. Yamashita, Y. Uchiyama
KEK
T. Haruyama, K. Kasami, A. Maki, Y. Makida, S. Mihara, A. Yamamoto
Waseda Univ.
T. Doke, J. Kikuchi, S. Suzuki, K. Terasawa

INFN and University of Pisa
A. Baldini, C. Bemporad, F. Cei, M. Grassi, D. Nicolò, A. Papa, R. Pazzi, F. Sergiampietri, G. Signorelli
INFN and Univ. of Genova
S. Dussoni, F. Gatti, R. Valle
INFN and Univ. of Pavia
G. Boca, P. W. Cattaneo, G. Cecchet, A. De Bari, R. Nardò, M. Rossella
INFN and Univ. of Roma I
A. Barchiesi, D. Zanello
INFN and Univ. of Lecce
M. Panareo

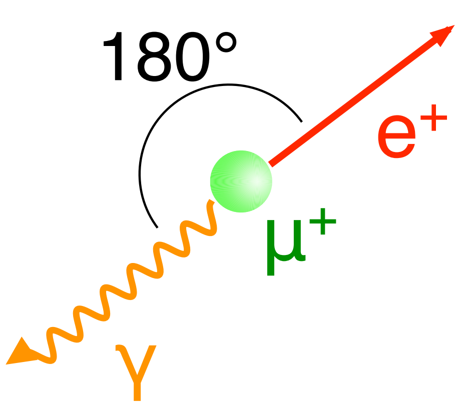
Paul Scherrer Institute
J. Egger, M. Hildebrandt, P.-R. Kettle, S. Ritt, M. Schneebeli

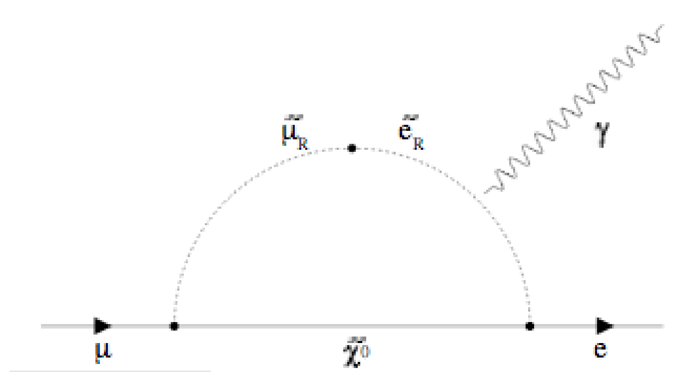
BINP Novosibirsk
L. M. Barkov, A. A. Grebenuk, D. N. Grigoriev, B. I. Khazin, N. M. Ryskulov
JINR Dubna
A. Korenchenko, N. Kravchuk, A. Moiseenko, D. Mzavia

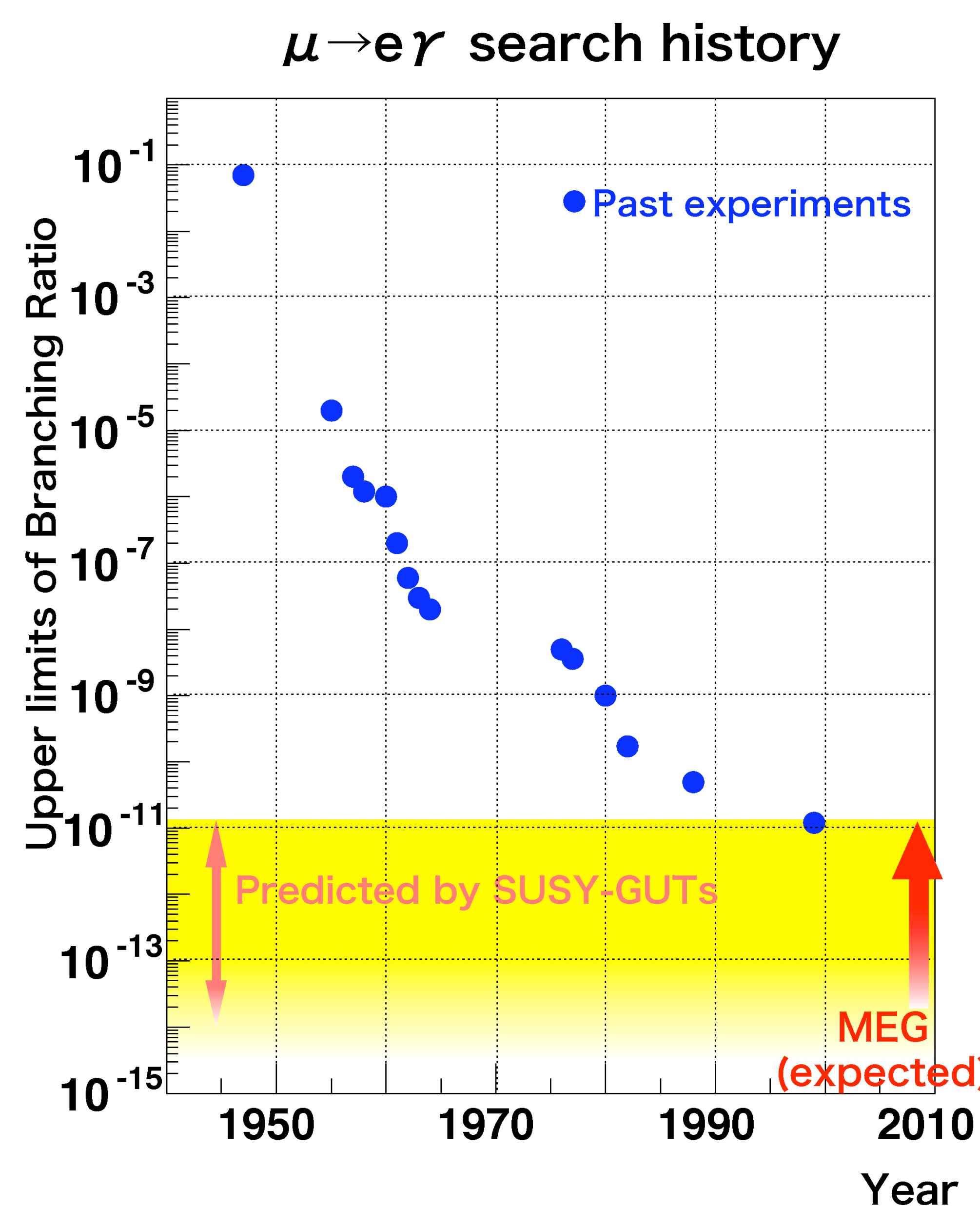
Univ. of California, Irvine
W. Molzon, M. Hebert, P. Huwe, J. Perry, V. Tumakov, F. Xiao, S. Yamada

What Is MEG?

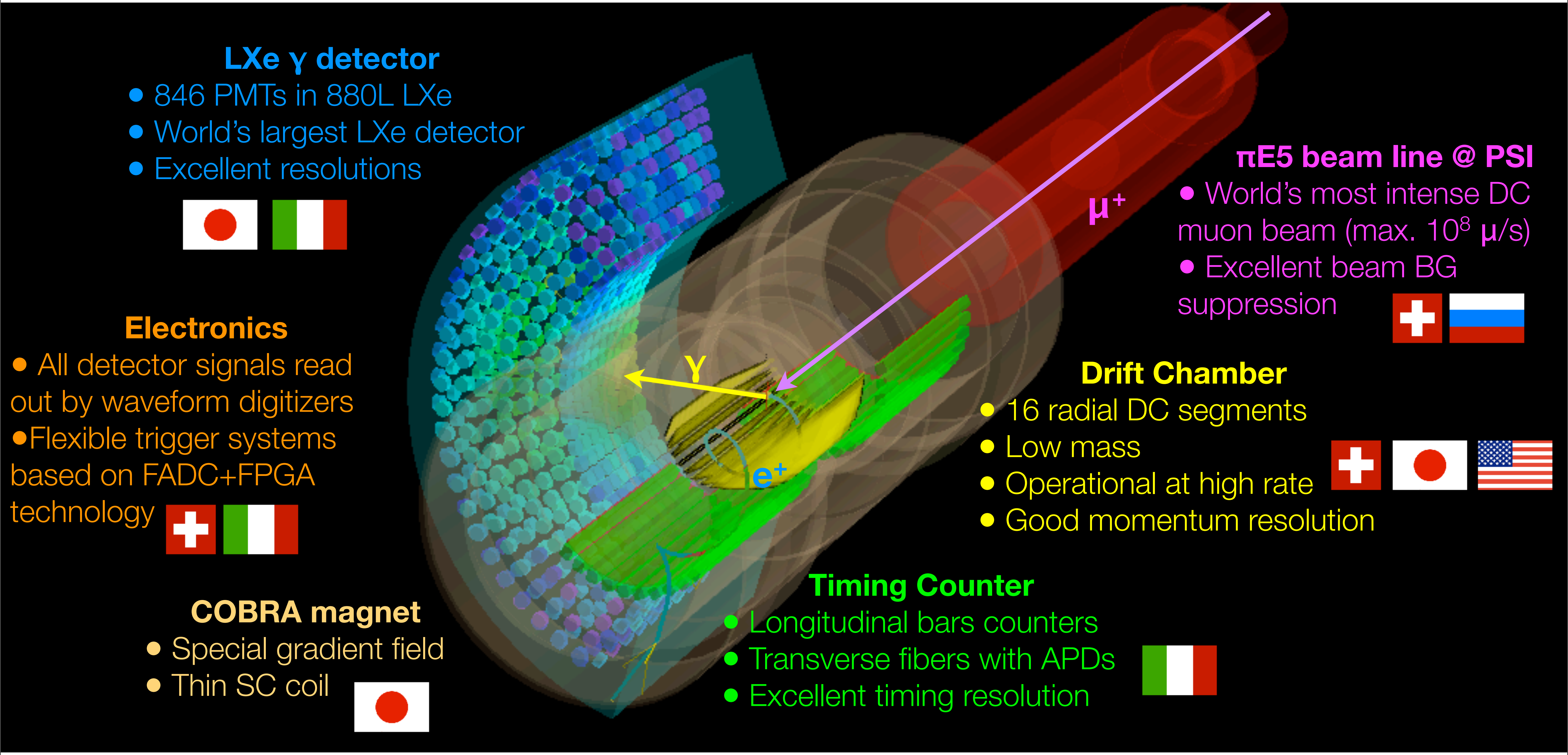
- MEG is an experiment to seek evidence for lepton flavor violating muon decay, μ→eγ.
- Target sensitivity ~ BR~10^{-13} improving the present limit by two orders of magnitude.
- Real chance to discover evidence of new physics beyond the SM such as SUSY-GUTs.



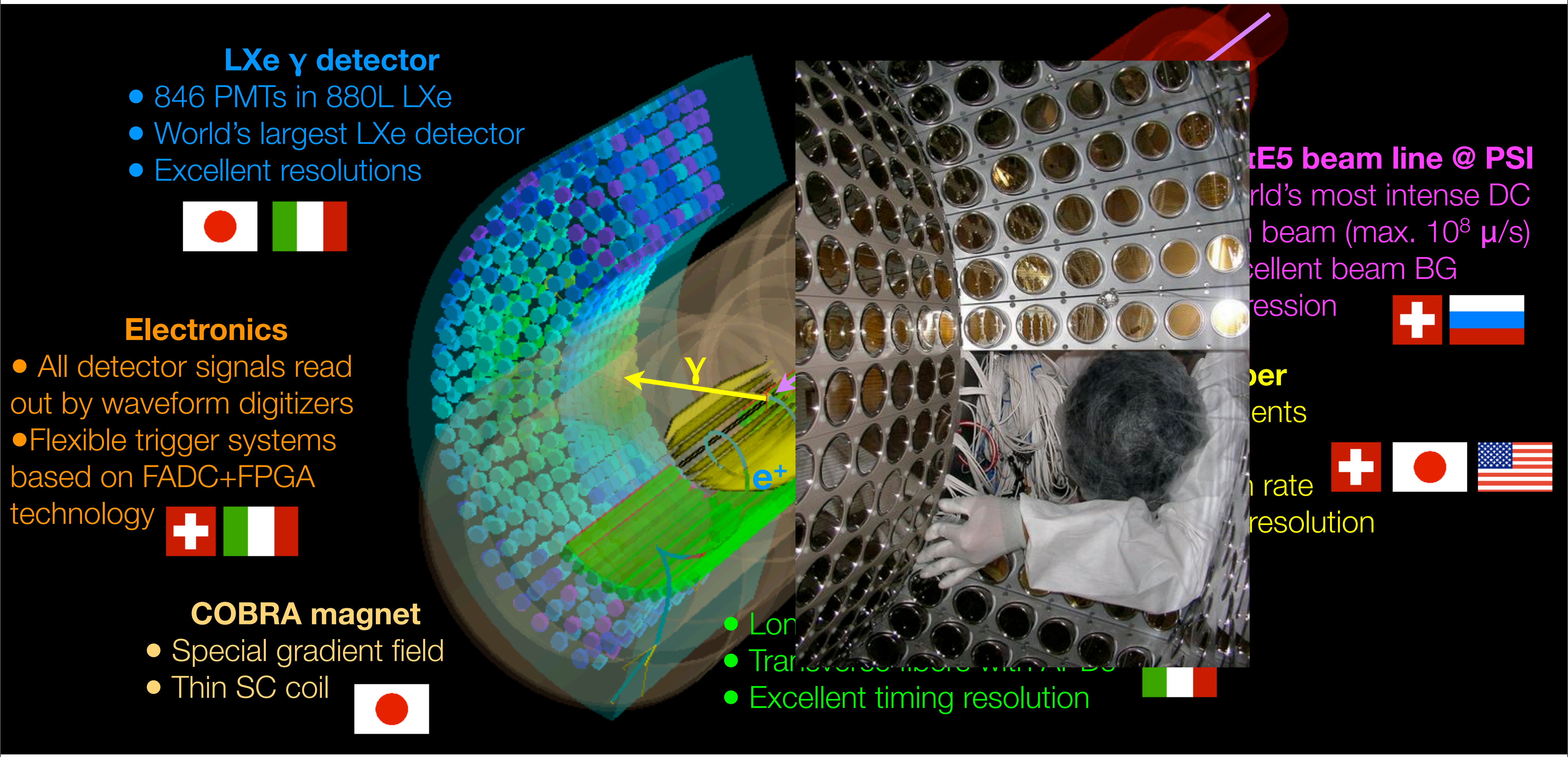




MEG Detector



MEG Detector



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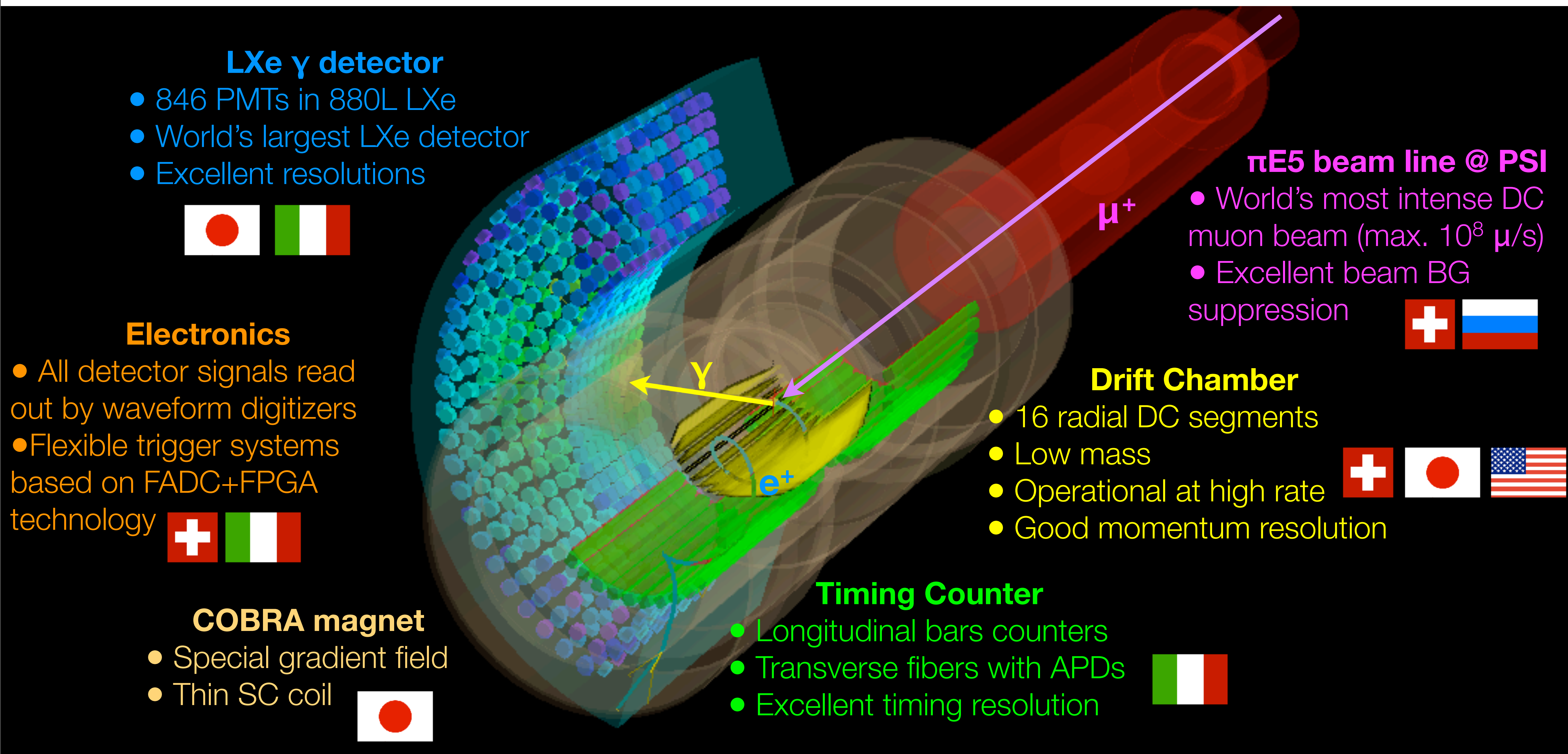
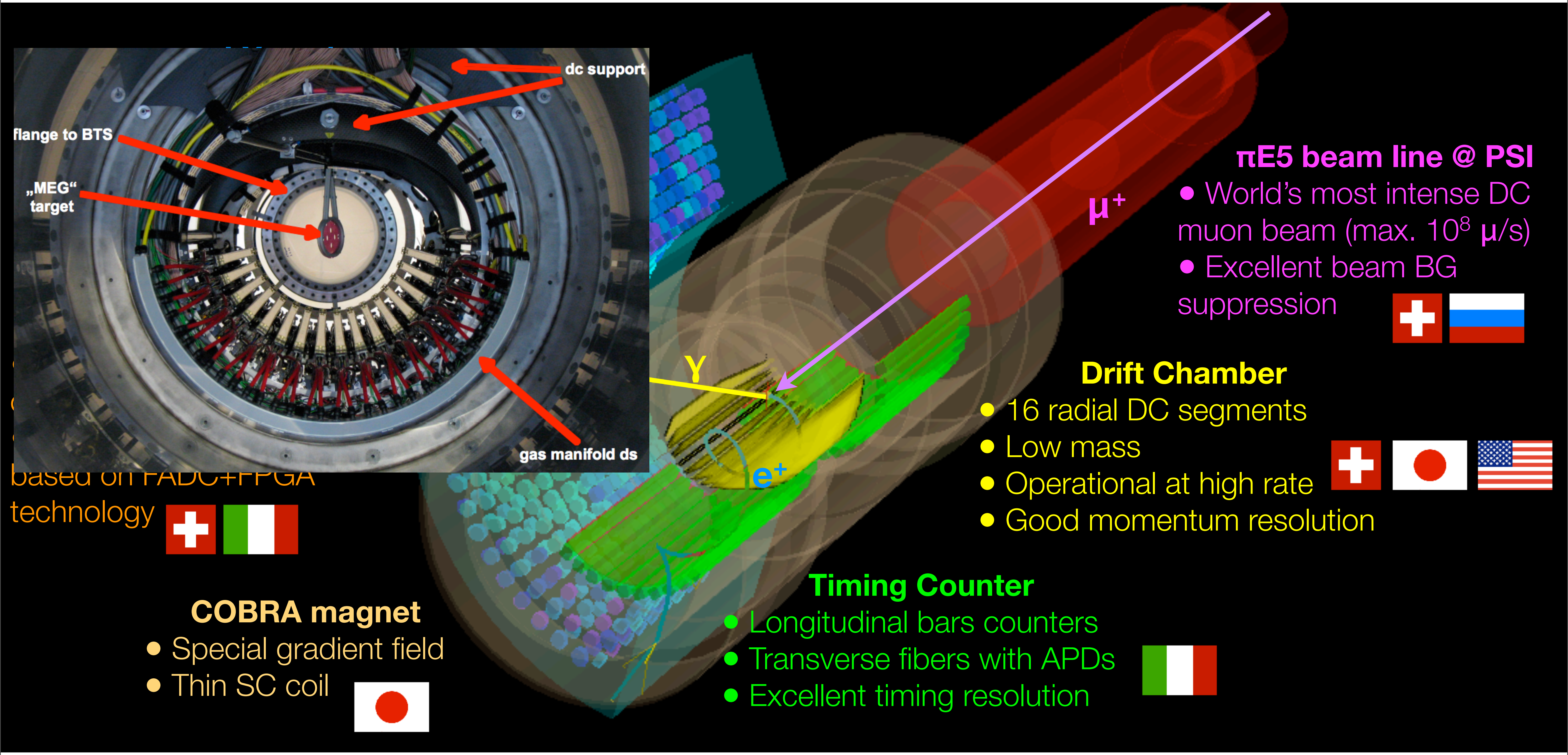
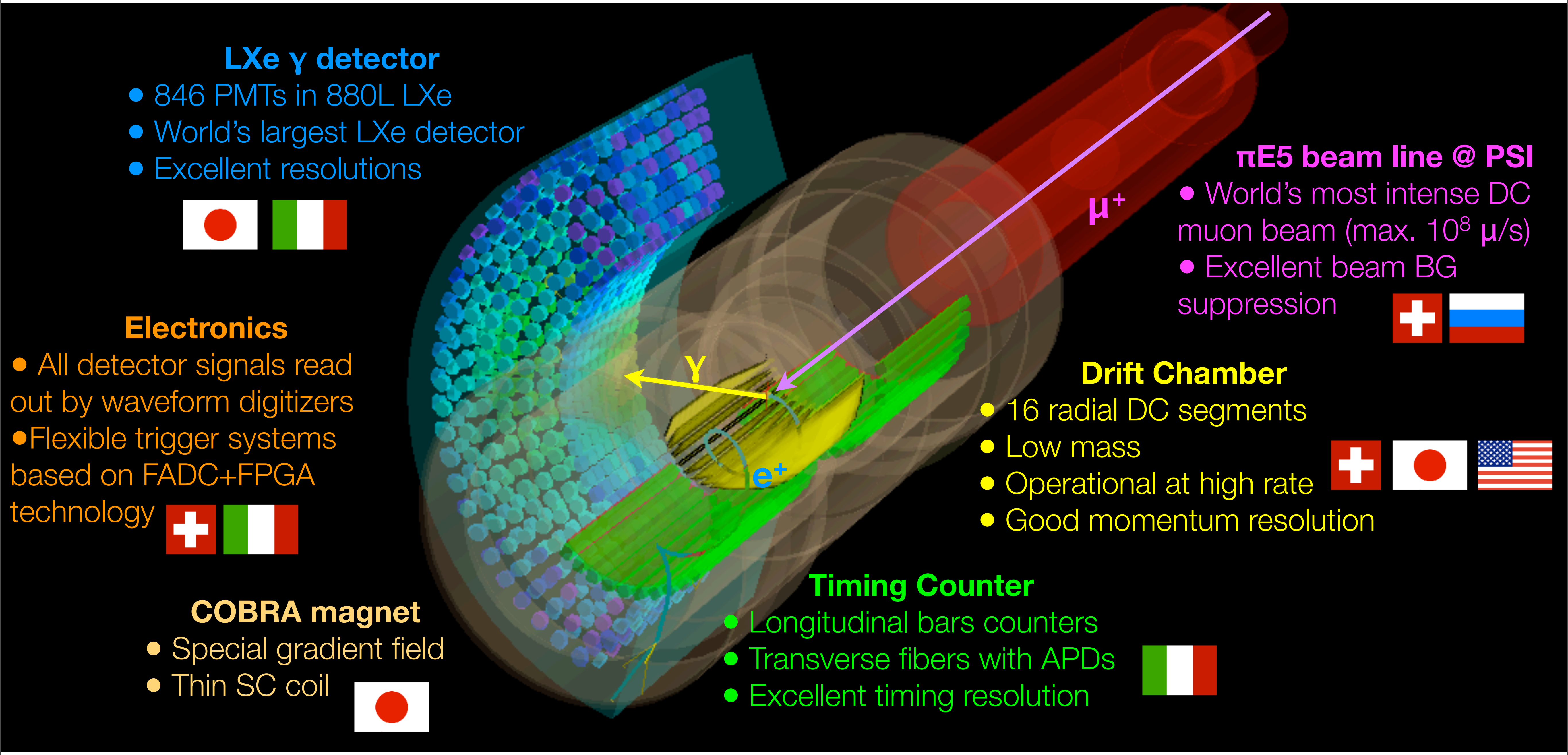


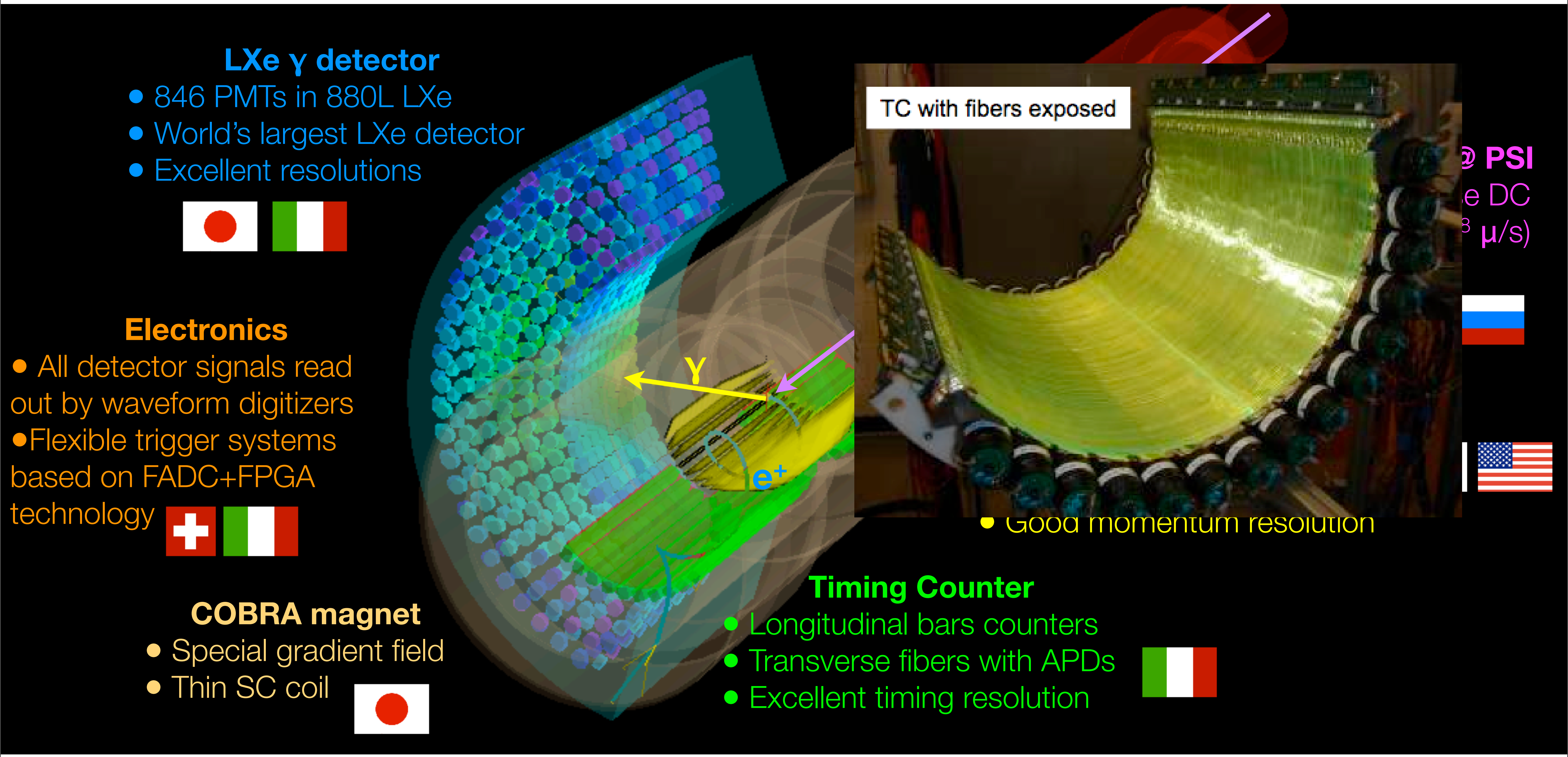
MEG Detector



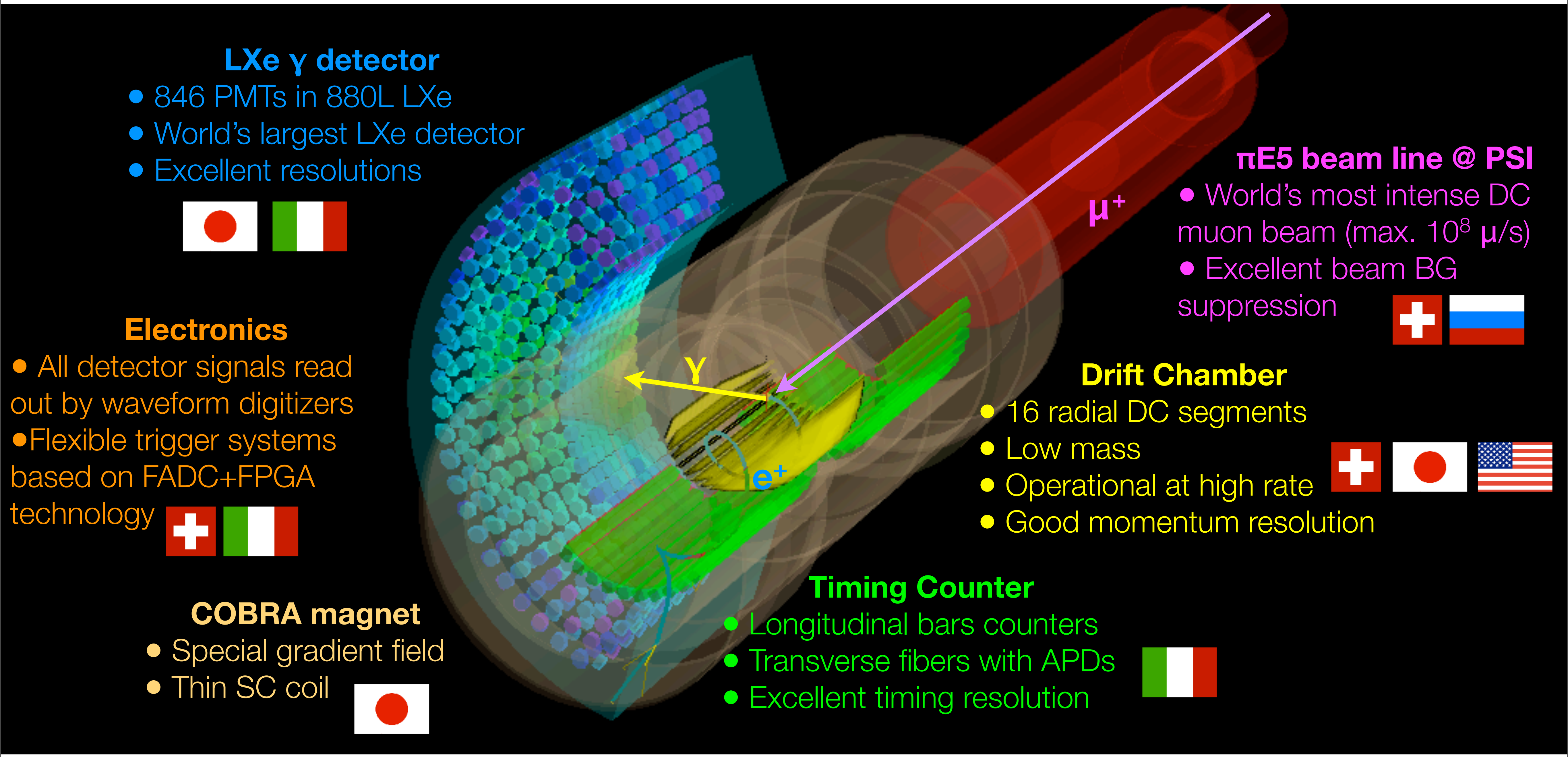
MEG Detector



MEG Detector



MEG Detector



Run 2008

What We Did Last Year

- Engineering run in 2007
  - All the main detector components assembled and operated.
  - $\mu \to e\gamma$ trigger worked at expected rate.
  - Test physics run (~1-2days)
- Issues
  - LXe γ-detector
    - Low light yield due to impurity in LXe
    - HV feedthrough problem
  - e^+ spectrometer
    - Some layers were not operational in drift chamber system
    - Fiber counters in the TOF detector system are missing.
  - ...

What's New in 2008

- Solved (partly) the problems we had last year.
- LXe detector
  - Light yield recovered by a factor of two!
  - Calibration in full acceptance using high energy γ from π^0 decay
  - Long term stability
- Drift chamber
  - Fixed non-operational layers last year
- Timing counter
  - Fiber counters operational
- π^0 Dalitz decay for relative timing bw/ LXe detector and timing counter
- Reduced electric noise

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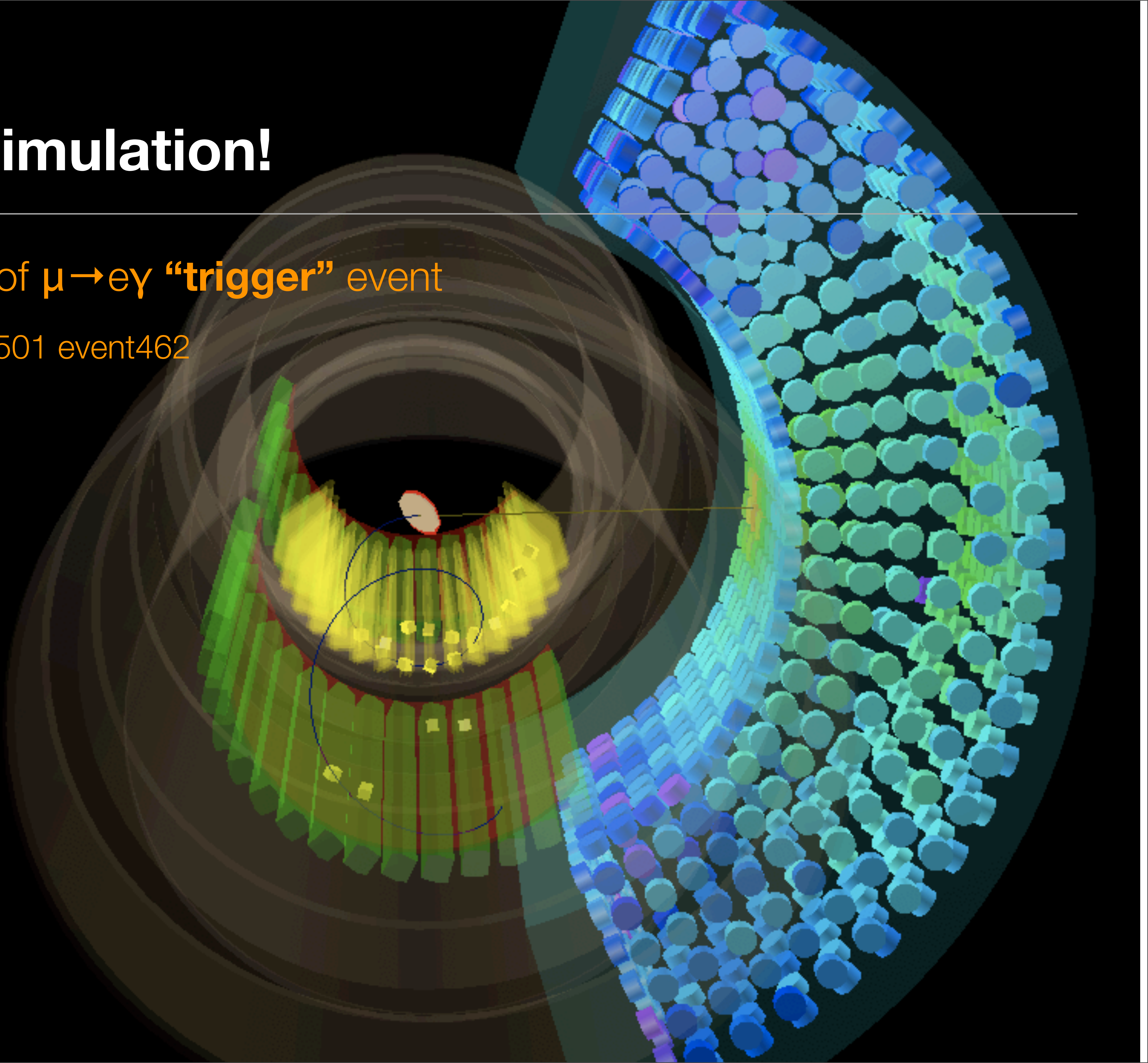
- Timing counter
  - Fiber counters operational
- π^0 Dalitz decay for relative timing bw/ LXe detector and timing counter
- Reduced electric noise

- **Started physics data production on Sep. 12th!**

Not a Simulation!

Example of μ→eγ **"trigger"** event

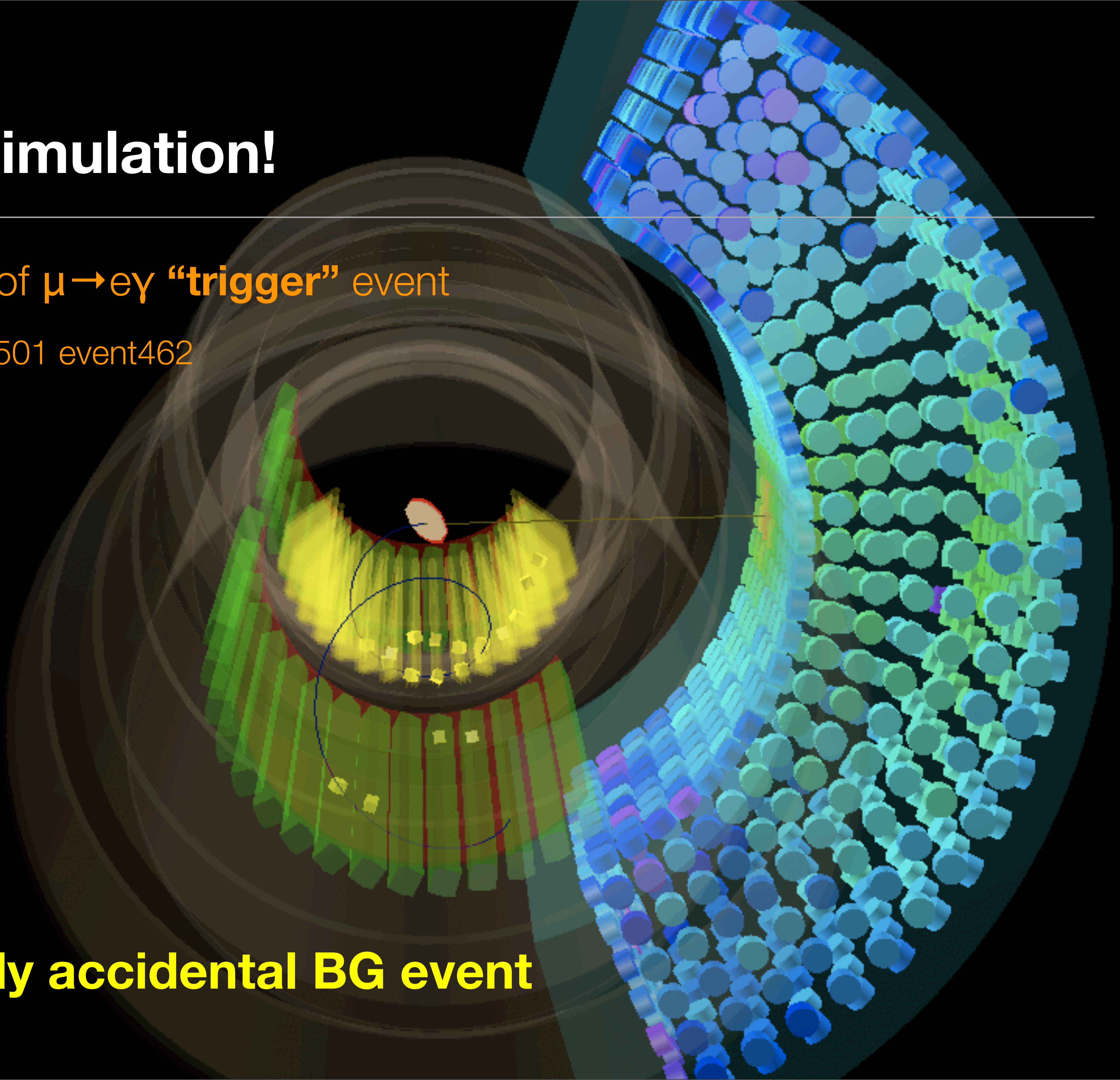
Run#24501 event462



Not a Simulation!

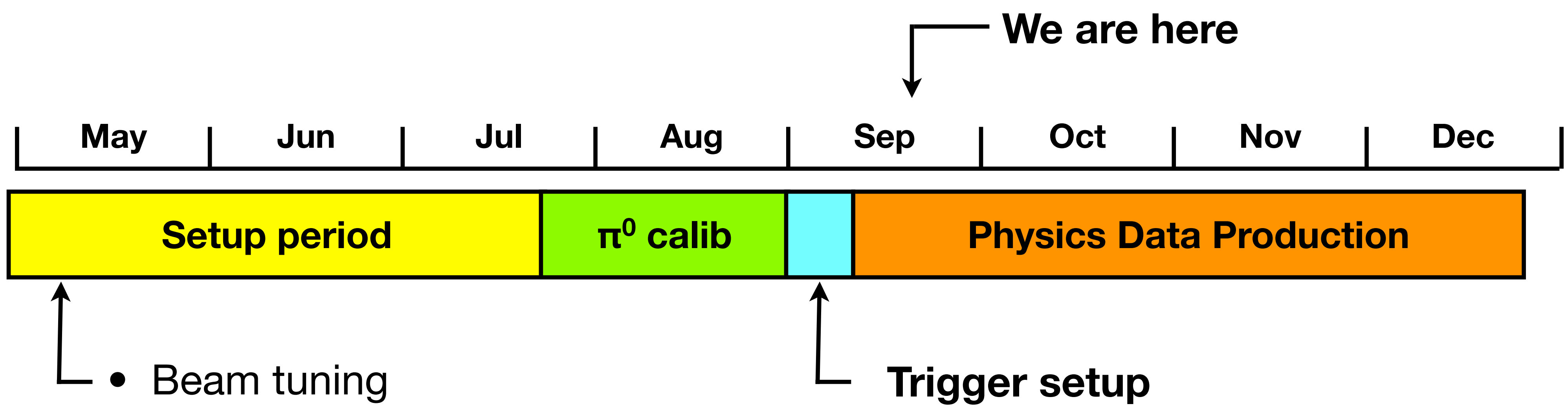
Example of $\mu \to e\gamma$ **“trigger”** event

Run#24501 event462



Most likely accidental BG event

Run Schedule 2008

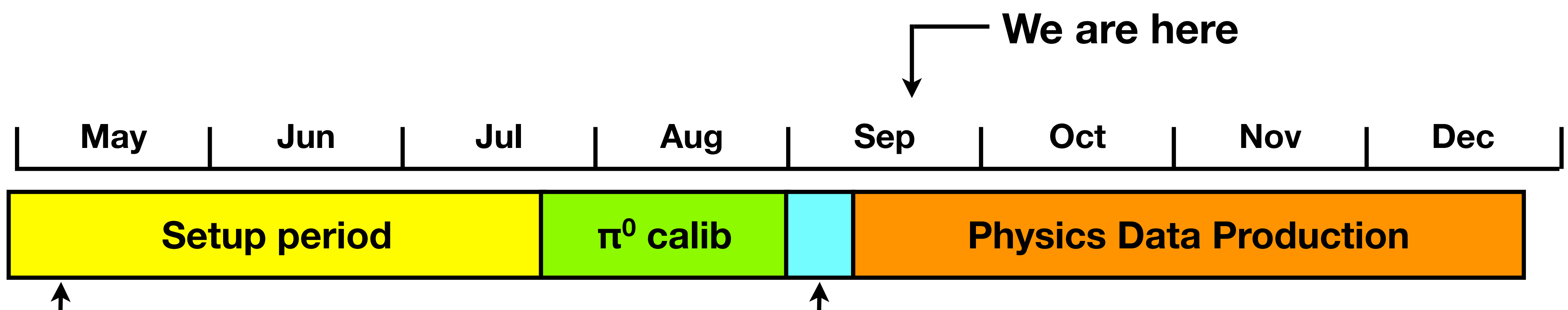


- Beam tuning
- Detector assembly
- Test and debugging
- LXe purification
- Electronics modification
- ...

Trigger setup

- Trigger setup
- Beam intensity study
- Single BG measurement

Run Schedule 2008



- Beam tuning
- Detector assembly
- Test and debugging
- LXe purification
- Electronics modification
- ...

Trigger setup

- Trigger setup
- Beam intensity study
- Single BG measurement

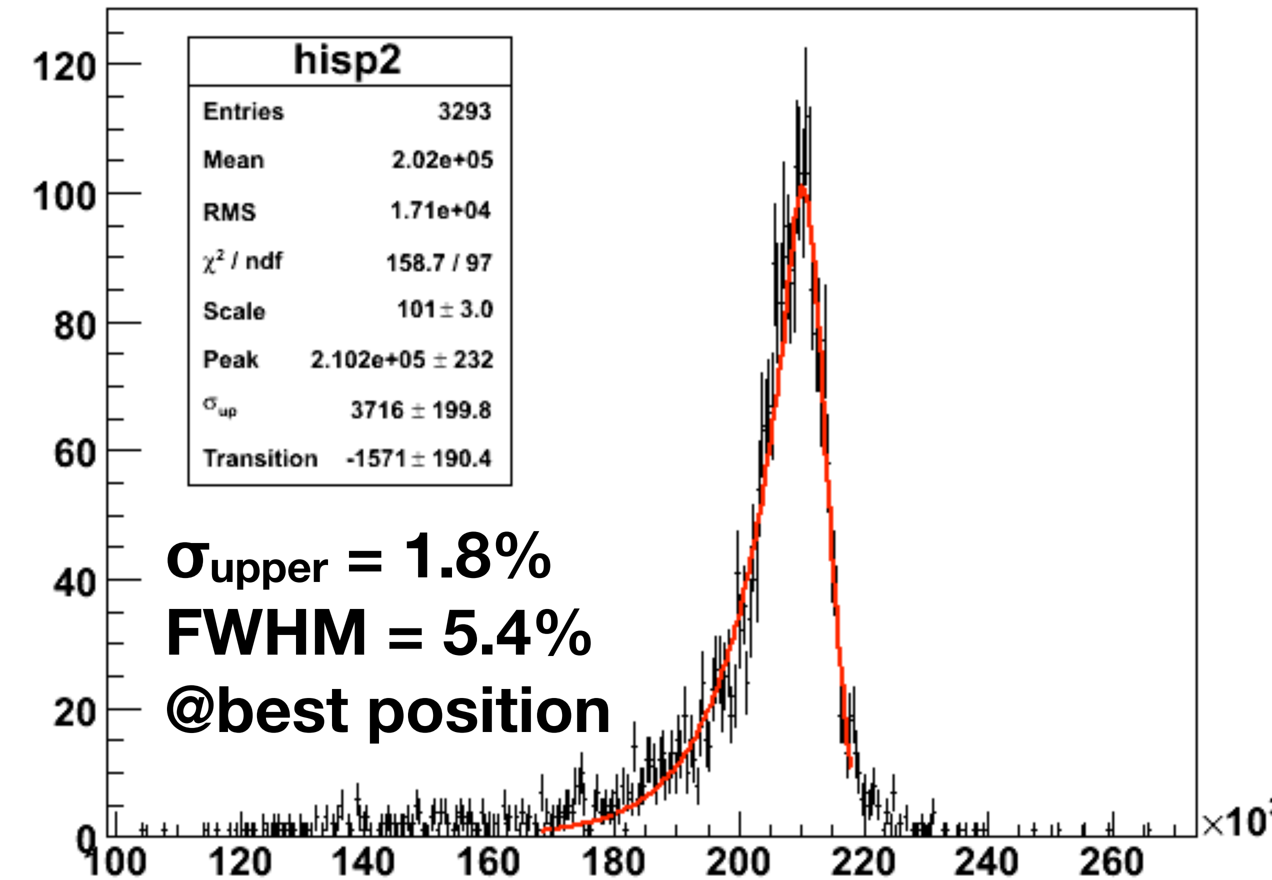
Goal of run 2008

- *First physics-data production (~12week)*
- *“Significant” physics result*

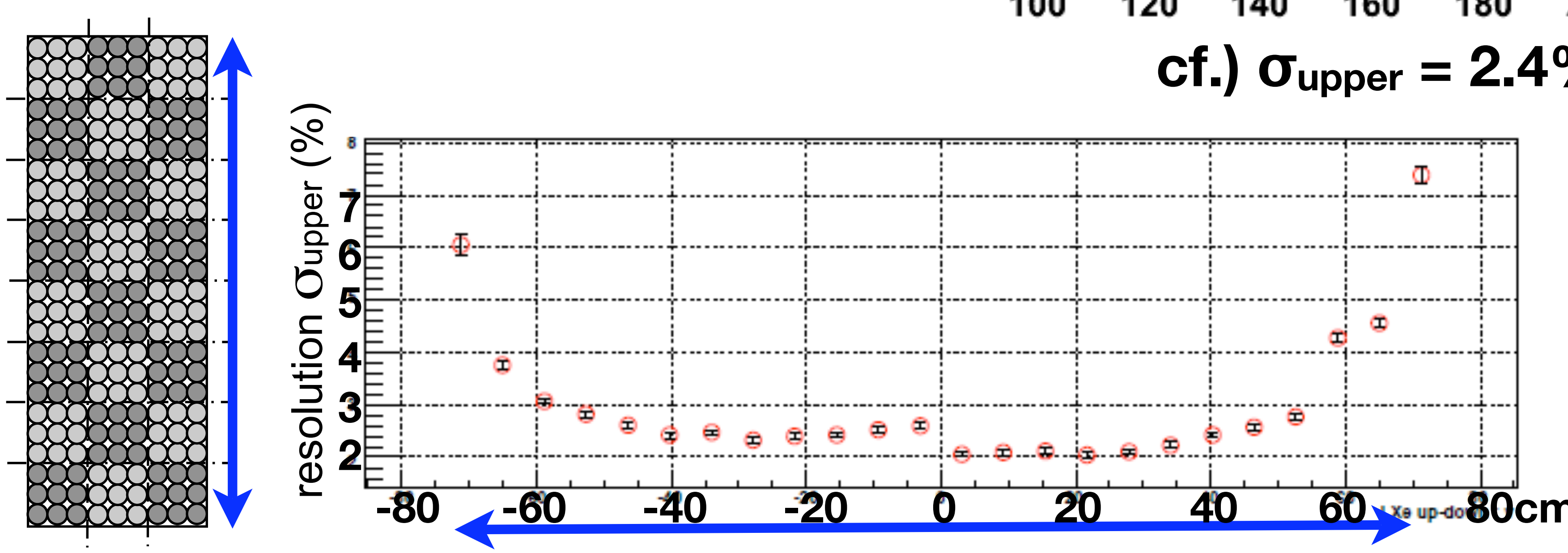
Detector Performance in 2008
(Preliminary results)

LXe: π^0 Calibration: Energy

- LXe detector calibrated **in full acceptance** with high-energy γ from π^0 decay
- Energy resolution for 55MeV-γ
- Systematic non-uniformity of detector response. Yet to be understood



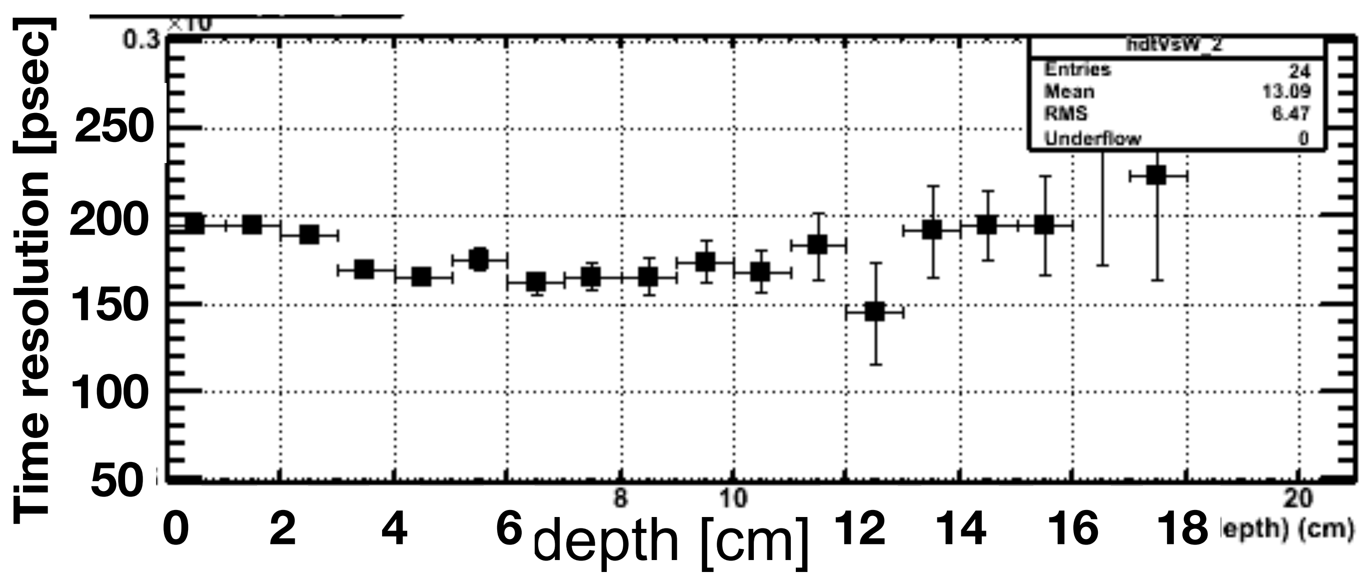
cf.) σ_{upper} = 2.4% (last year)



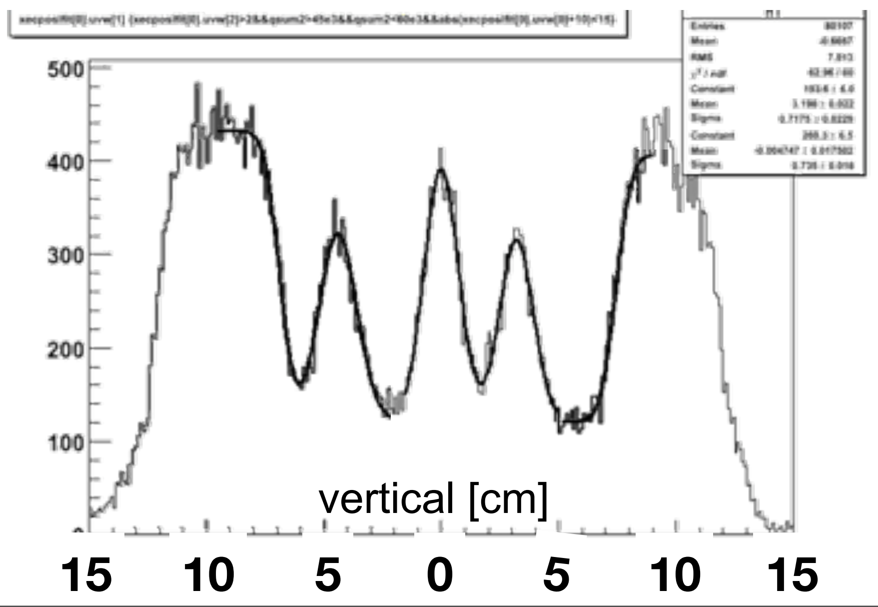
LXe π^0 Calibration: Timing & Position

- Timing resolution for 55MeV-γ
  - Relative time between LXe and timing counter with pre-shower converter
  - LXe timing resolution = 160ps - 70ps(timing counter) - 60ps(target)

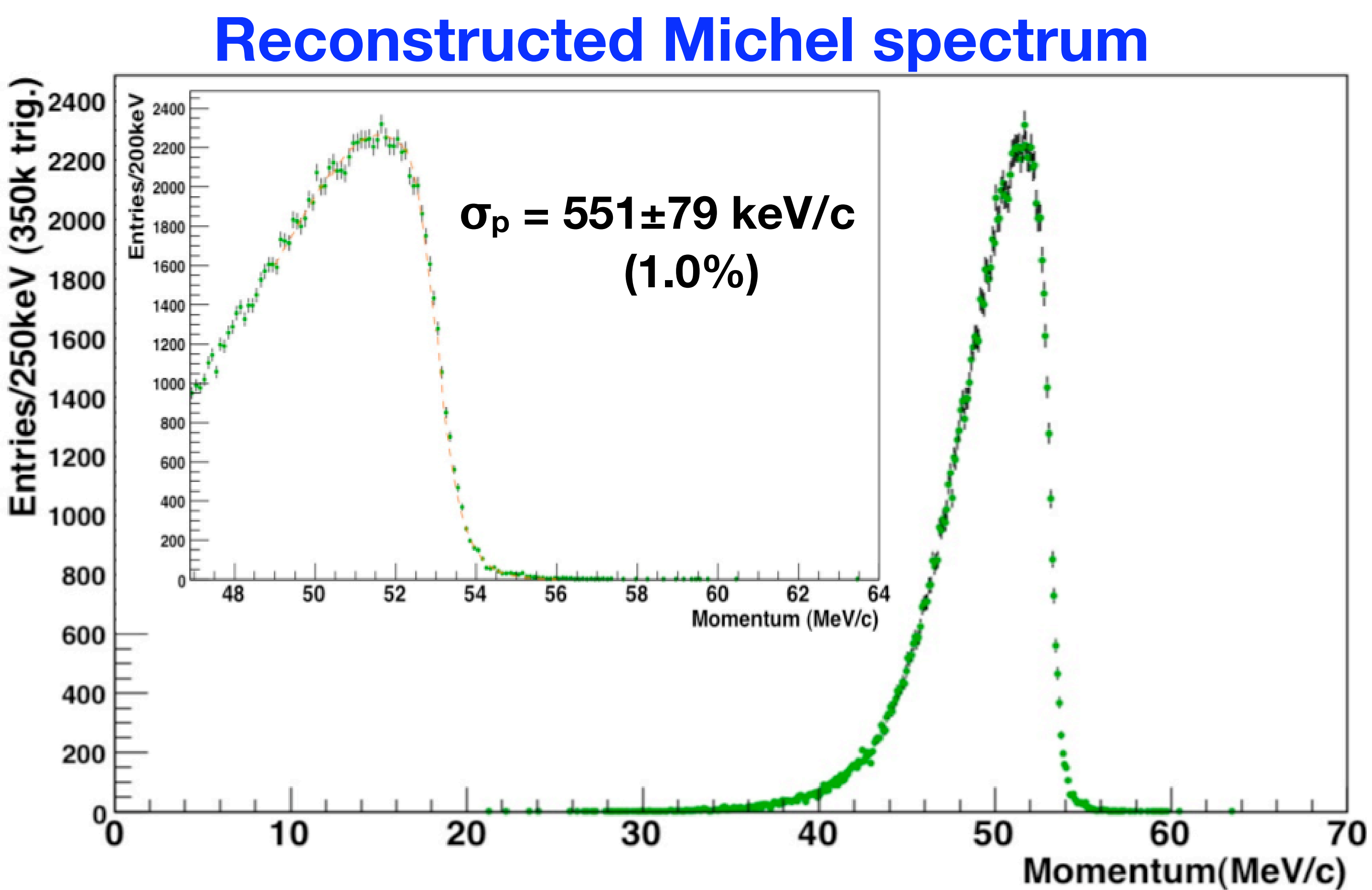
    = **130ps (σ)**

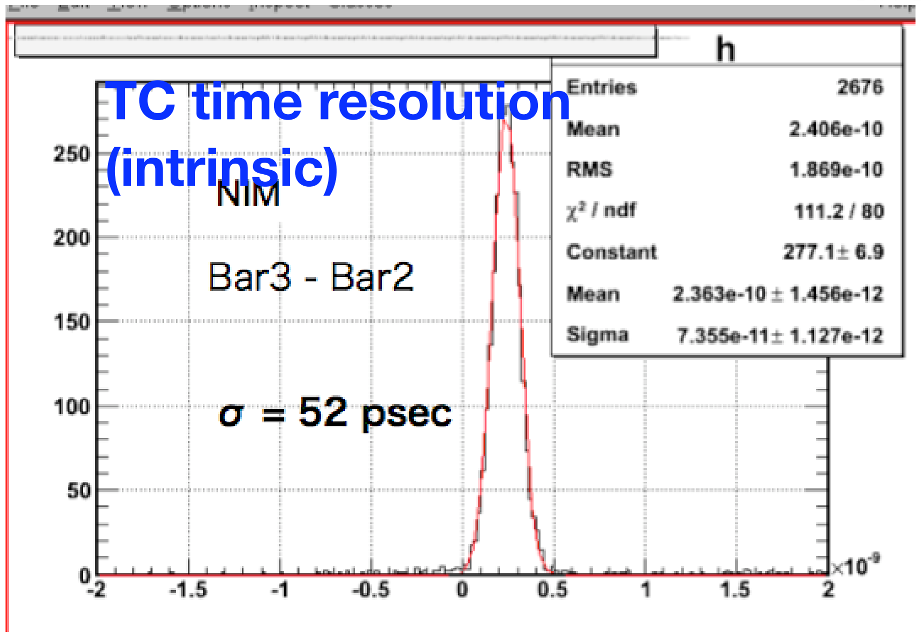


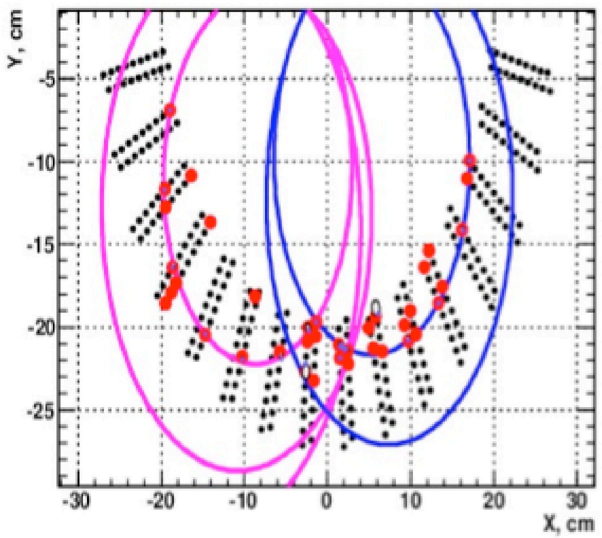
- Position resolution for 55MeV-γ
  - Shadows of lead collimator slits
  - LXe position resolution
    - **0.5cm (σ) @ edge**
    - 0.65cm (σ) @ slit (need further analysis)

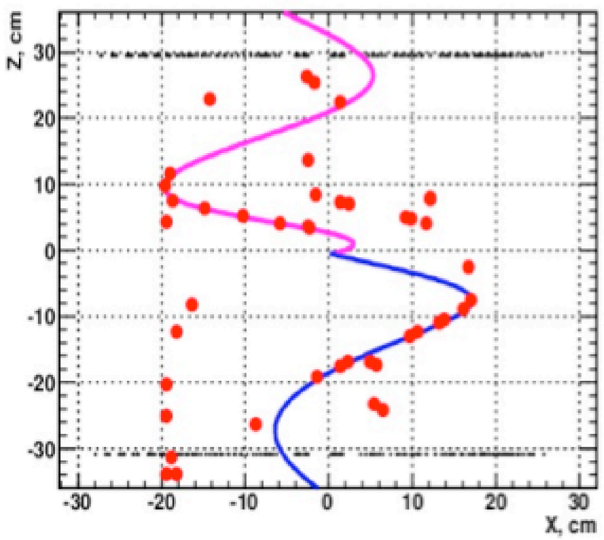


Positron Spectrometer









- **Calibration not yet completed**

Detector-Performance Summary

- **Very preliminary**
- Calibration not yet completed for 2008 data. Expected to be improved.

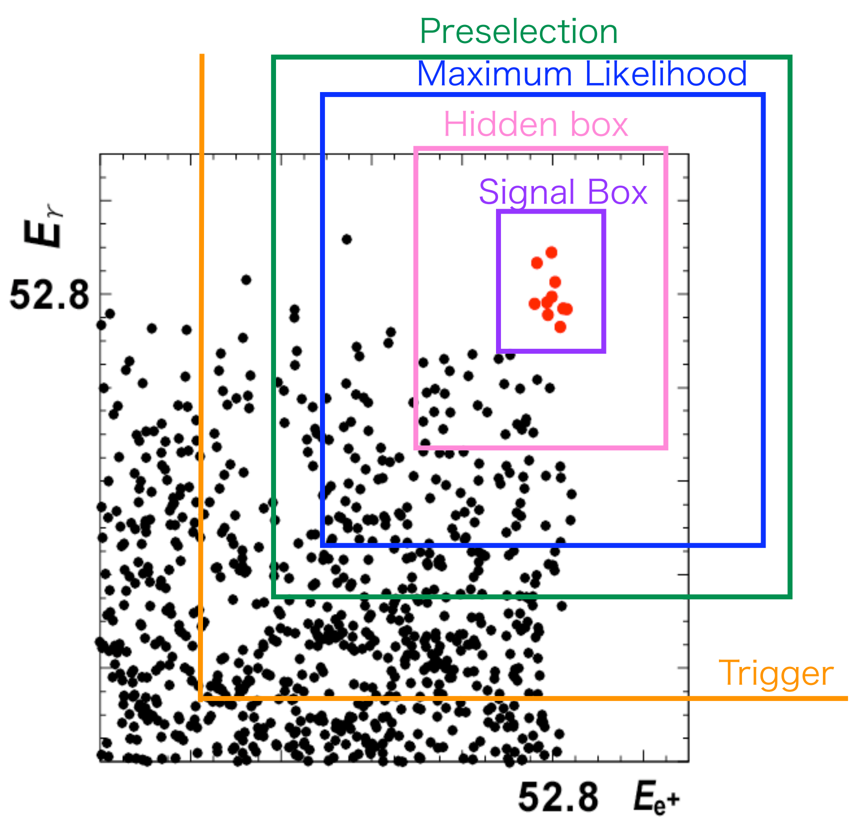
Resolution (FWHM)	2007	2008 preliminary
E_γ [%]	5.6	5.6
E_e [%]	2.2	2.4
$T_{e\gamma}$ [ns]	0.39	0.32
$\theta_{e\gamma}$ [mrad]	28.8	23.3

Preparation for Physics Analysis

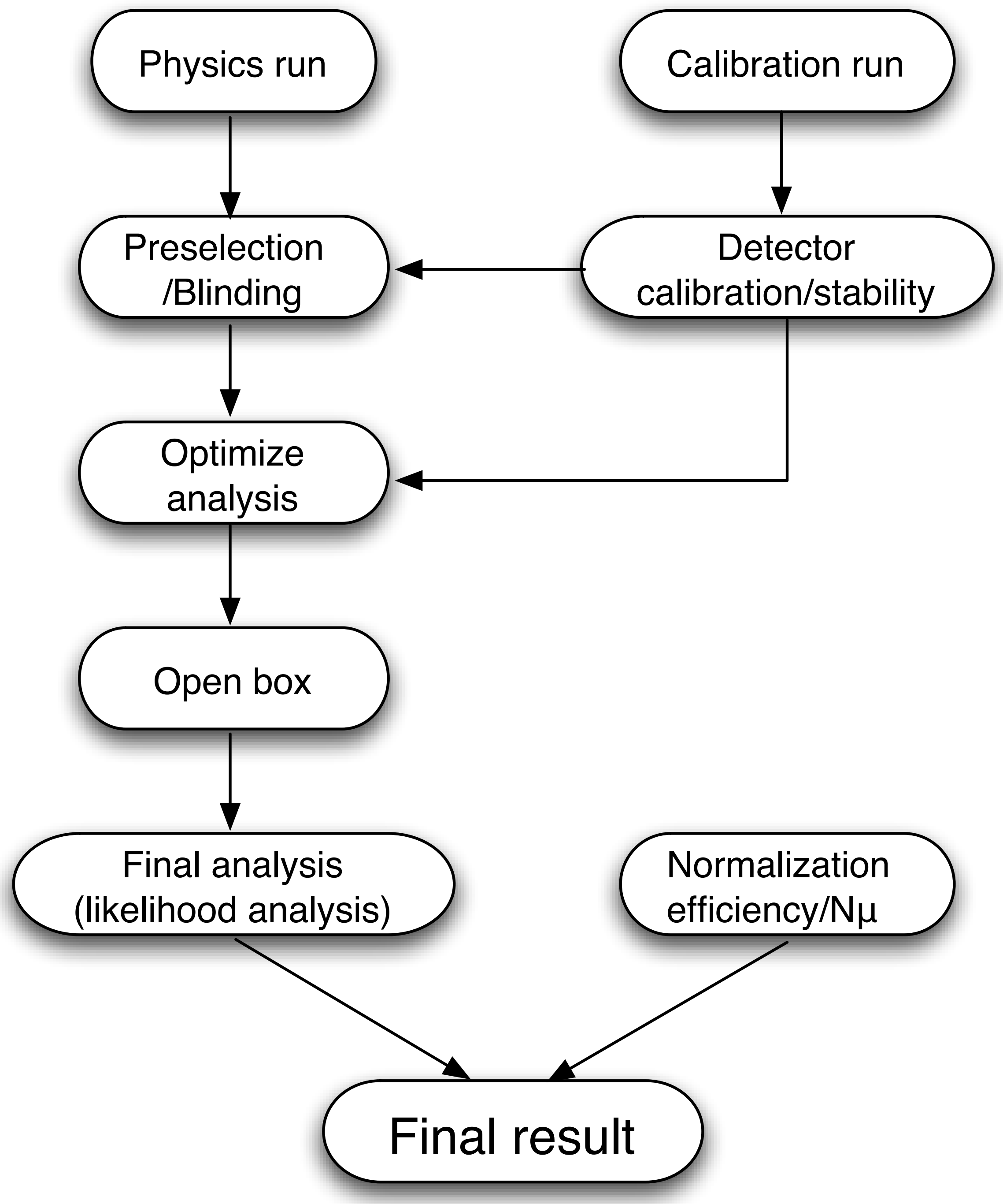
Physics Analysis

- Blind analysis: **Hidden signal box**
- **Maximum likelihood analysis**
- Preselection for data reduction and efficient analysis
- **Framework/tools are ready and being tested.**

Analysis Window Definition with MC data



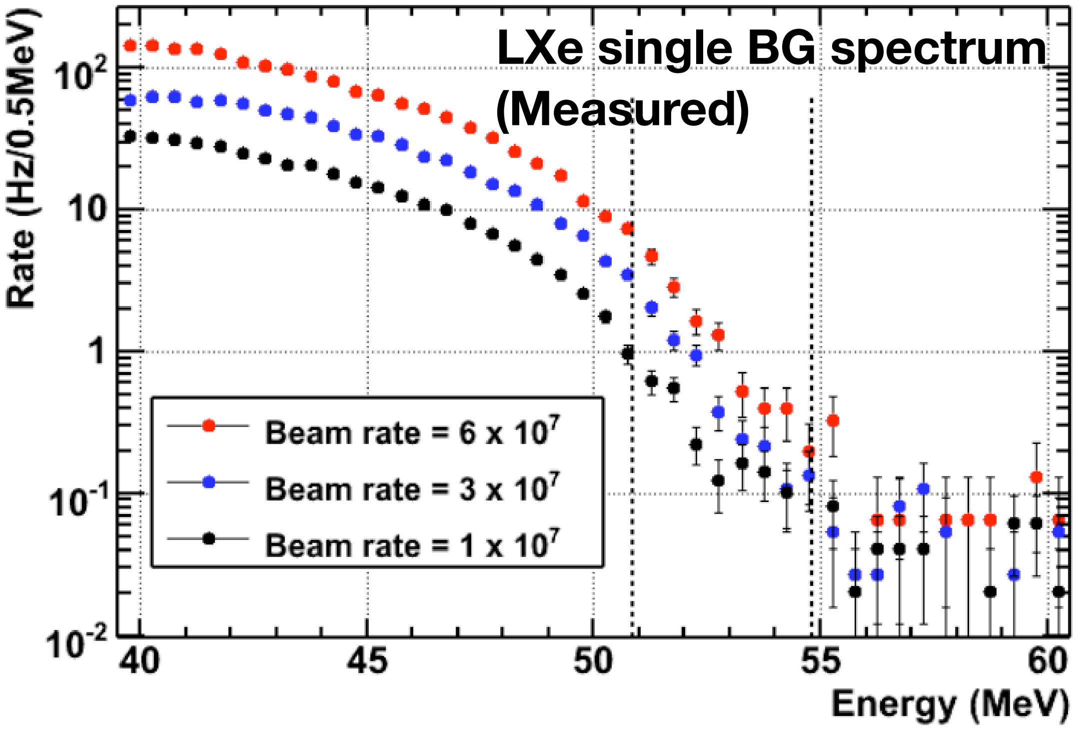
Planned analysis flow

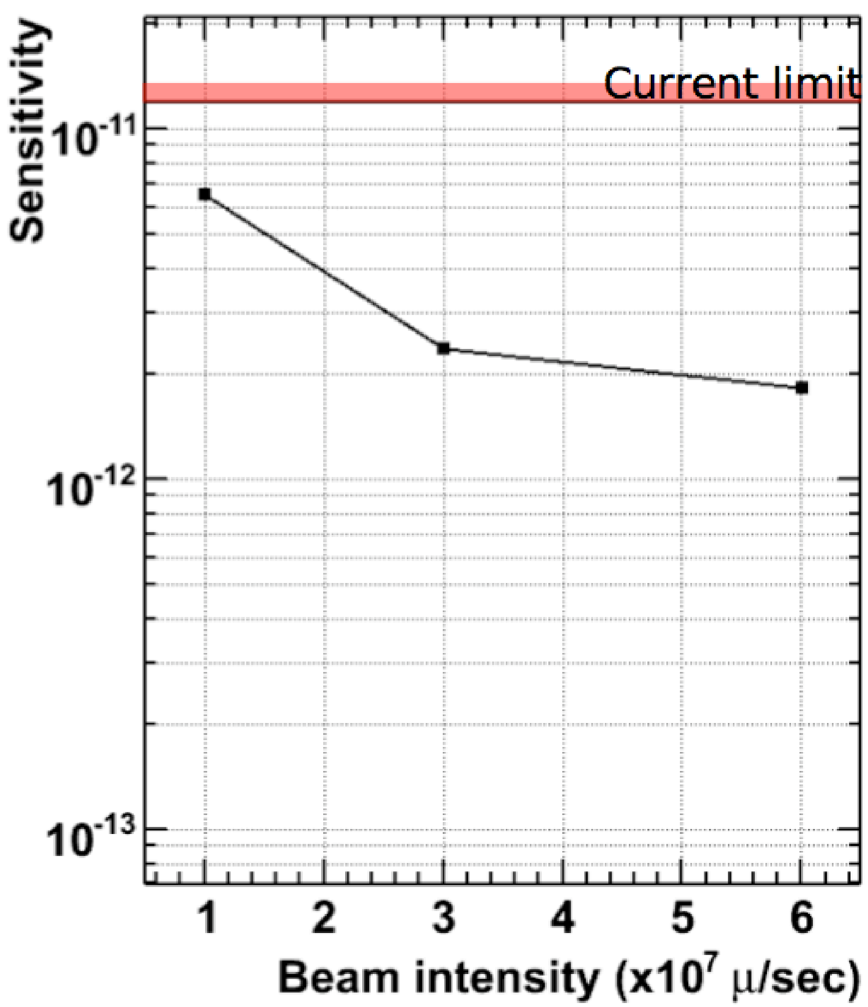


Sensitivity

How Far We Can Go This Year?

- Sensitivity as a function of beam intensity
  - **T = 12 weeks** (1week = 4×10^5s)
  - Measured resolutions (not optimized yet)
  - Measured LXe single BG rate





Beam intensity [μ^+/sec]	Single event sensitivity	Expected # of BG	Sensitivity
1×10^7	2.5×10^{-12}	0.04	6.5×10^{-12}
3×10^7	0.85×10^{-12}	0.30	2.6×10^{-12}
6×10^7	0.42×10^{-12}	1.32	1.8×10^{-12}

Experiment still BG-free up to 3×10^7 μ/sec

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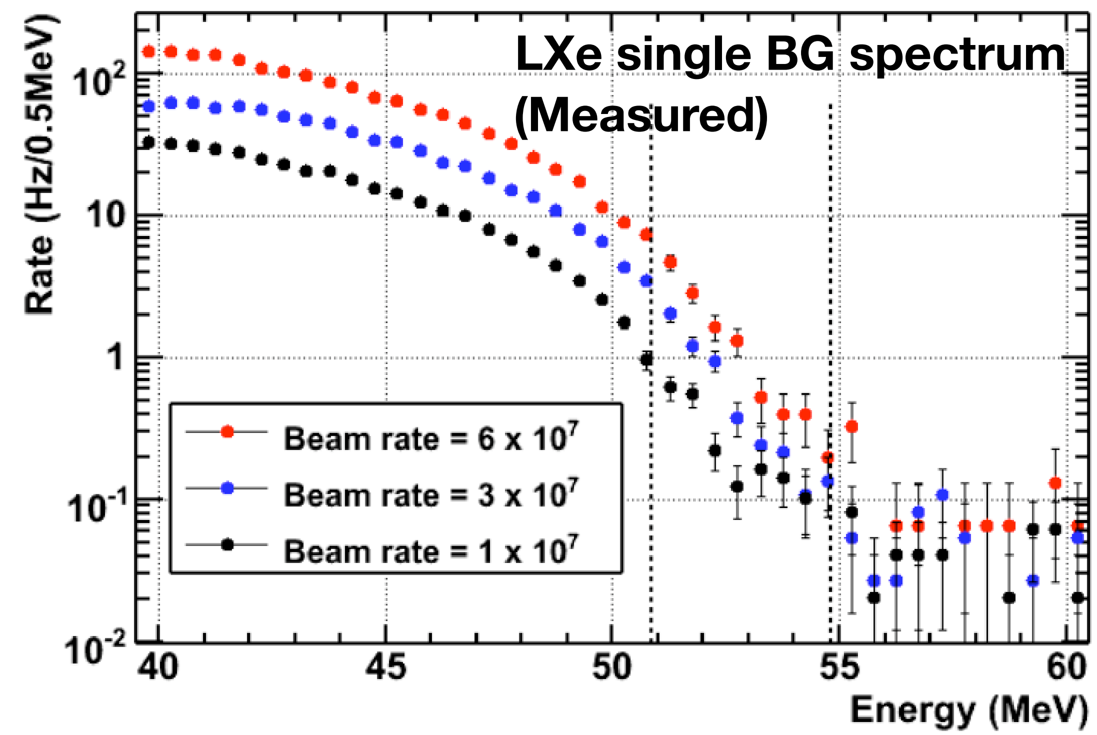

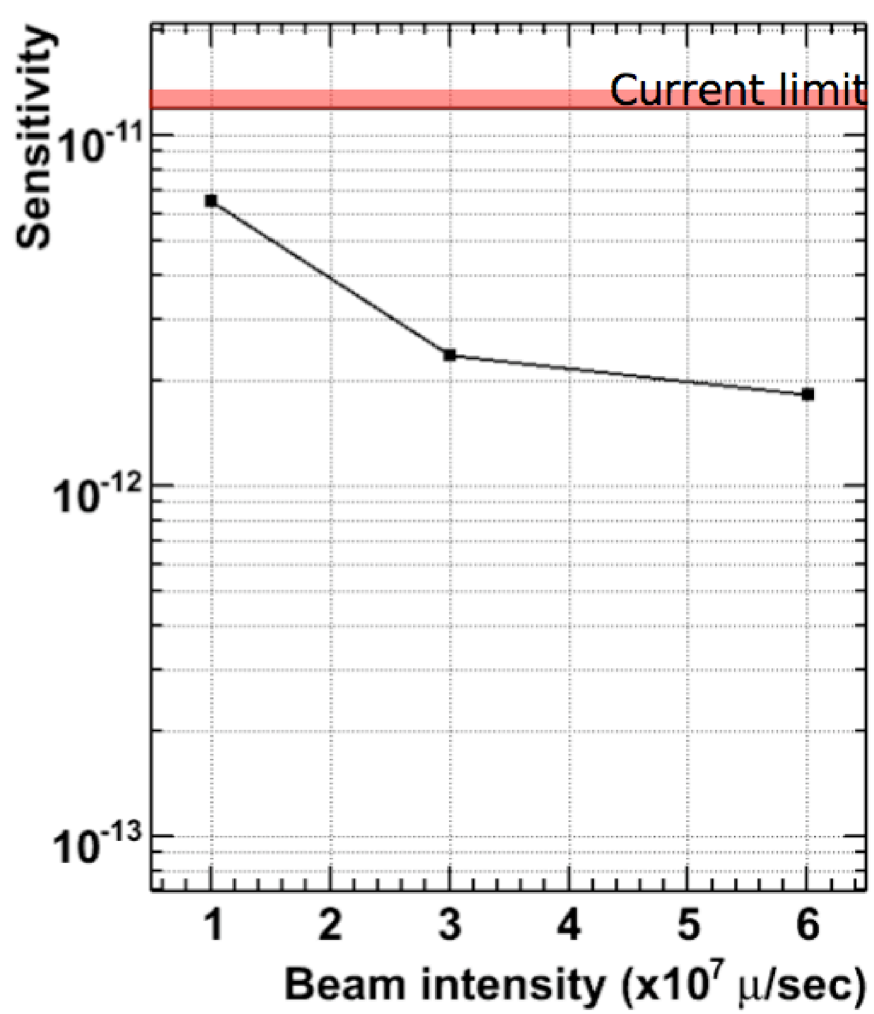

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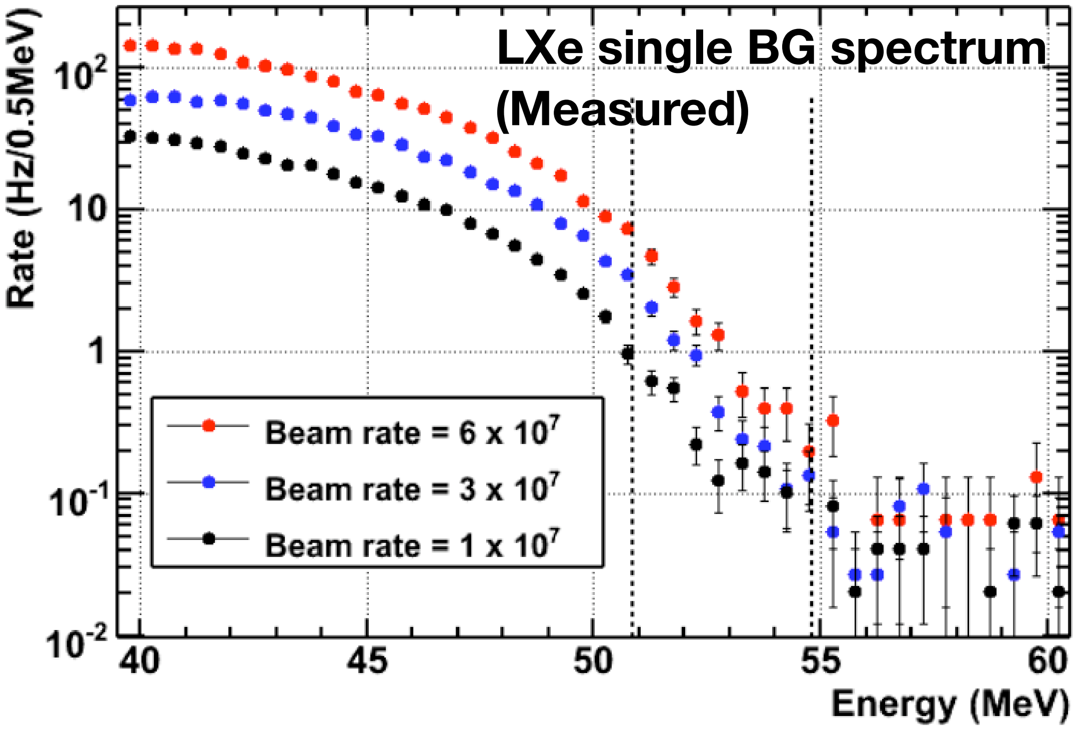
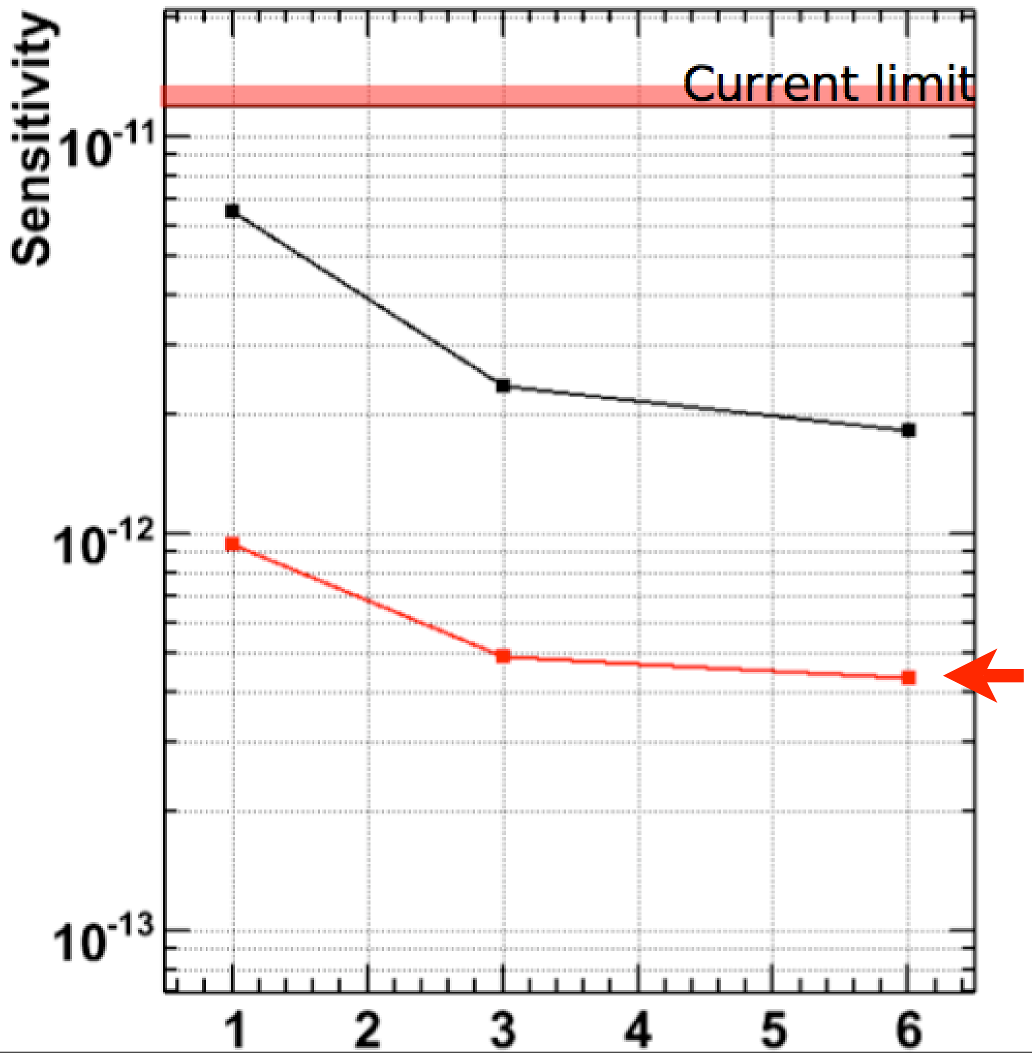
Experiment still BG-free up to 3×10^7 μ/sec

How about Next Year or Later?

- Sensitivity as a function of beam intensity
  - **T = 100 weeks** (1week = 4×10^5s)
  - Measured resolutions in 2008
  - Measured LXe single BG rate in 2008



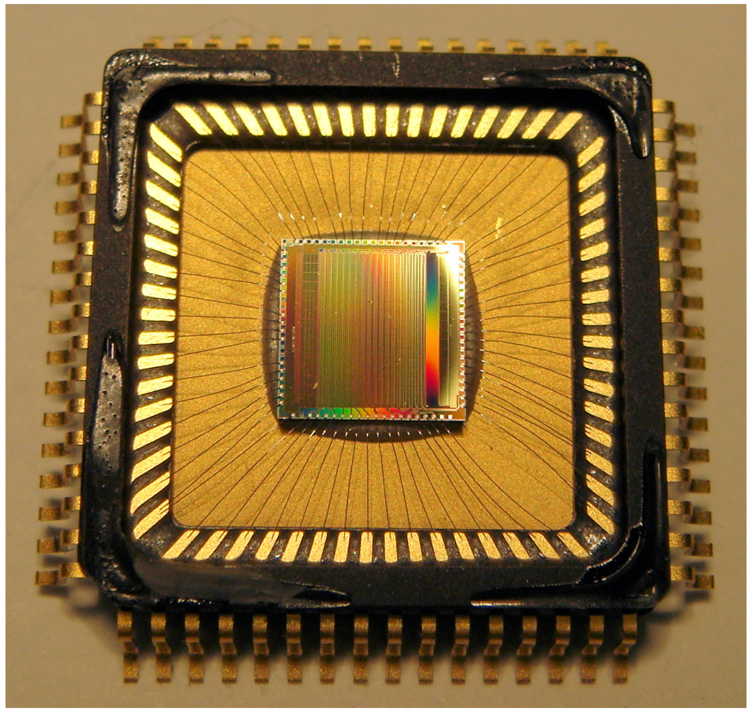


Beam intensity [μ^+/sec]	Single event sensitivity	Expected # of BG	Sensitivity
1×10^7	3.0×10^{-13}	0.30	9.4×10^{-13}
3×10^7	1.0×10^{-13}	2.46	4.9×10^{-13}
6×10^7	0.5×10^{-13}	10.9	4.3×10^{-13}

How about Next Year or Later?

- Some improvements in detector performance should be expected next year
  - Detector calibration not yet completed (even for this year's data)
  - New waveform digitizer (DRS4)
    - Better time synchronization over the chips
    - Better linearity
    - Supposed to arrive at Oct/Nov 2008
  - Further improvement of light yield in LXe?
  - Better reconstruction algorithm
    - Better resolution
    - Higher efficiency
    - Unfolding pileup events

New digitizer chip (DRS4)
Prototype



Summary

- All detectors assembled again and calibrated for run 2008.
- **We finally started physics-data production this month!**
- Detector performance is still to be optimized.
- Goal of run 2008
  - **Physics data production for ~12 weeks**
  - **Get the first but "significant" physics result.**

Conclusion

Hopefully first physics result by cherry-blossom season next year

(My personal hope)