Gas sTOF, or gastof

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UCLouvain

- Status:
  - simulations
  - tests
  - prototypes
- Next steps and plans

Why need sTOF?

Z-by-timing is crucial for running at high luminosity to kill (accidental) backgrounds, If δt=10 ps can be achieved for a proton ToF, then z-vertex resolution is 2 mm!

Note that already at $2x10^{33}$ a single-arm occupancy is about 3% -> probability of an accidental two-arm overlay is significant, ~0.1%; at the same time rapgap signature cannot be used and suppression by timing is a must!

Example: Inclusive vs. exclusive Higgs productions – We have to cope with 10000:1 ratio…

gastof: Basic idea

Consider gas Cerenkov as alternative/complementary solution:

- **Very simple and robust design**
- **Very thin and light detector - can be used before the tracking part**
- **(Very) radiation hard**
- **High energy threshold**

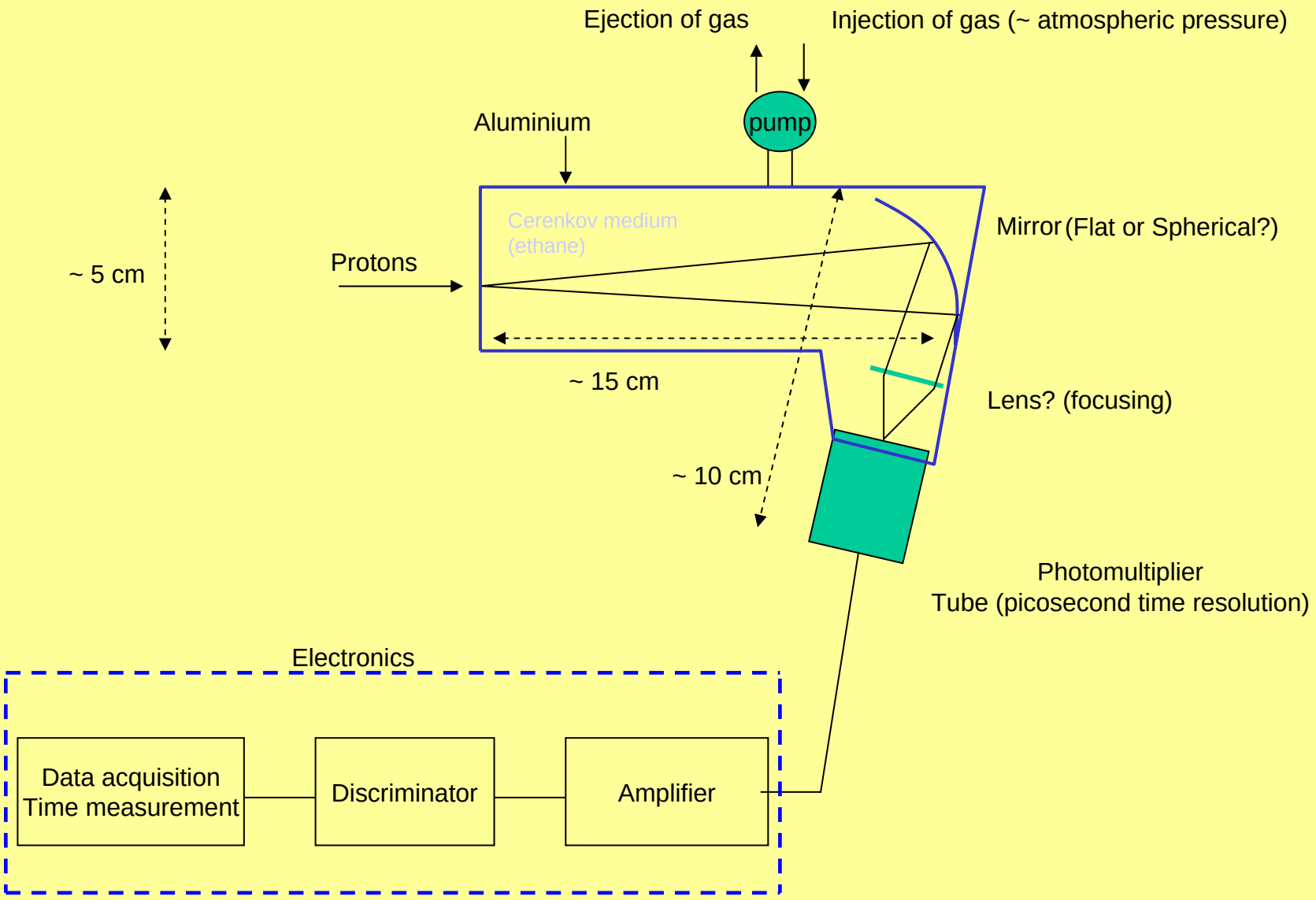
Basic formula: $N_{pe} \approx 100 \sin^2\theta_c \; L[cm]$

To estimate position sensitivity estimate average light spot radius ⟨r⟩, at radiator exit:

$$\langle r \rangle \approx 0.5 \, L \tan\theta_c \approx \sin\theta_c \; L/2$$

$$N_{pe} \approx 200 \, \langle r \rangle [cm] \; \sin\theta_c$$

gastof


Ejection of gas
Injection of gas (~ atmospheric pressure)
pump
Aluminium
~ 5 cm
Cerenkov medium
(ethane)
Protons
Mirror (Flat or Spherical?)
~ 15 cm
Lens? (focusing)
~ 10 cm
Photomultiplier
Tube (picosecond time resolution)
Electronics
Data acquisition
Time measurement
Discriminator
Amplifier

Status

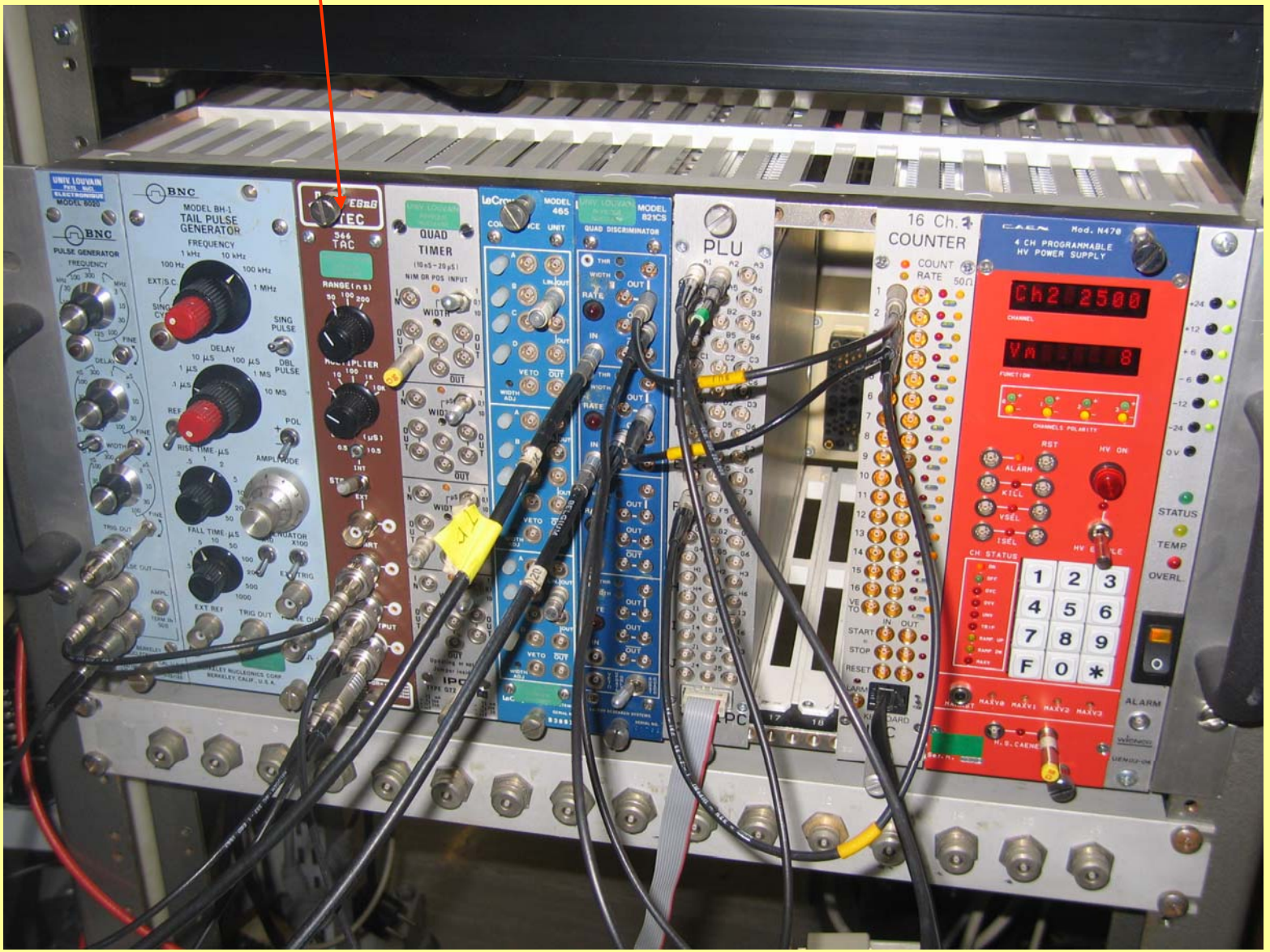
- **Tomek Pierzchała and Pierre Rodeghiero-made MC simulation of Cerenkov detector (ray tracing) - Gastof is really fast though has small number of photons**

- **We have ordered (or have) all electronics needed for tests, including two PMTs from Burle (Hamamatsu contacted); will receive mirror shortly**

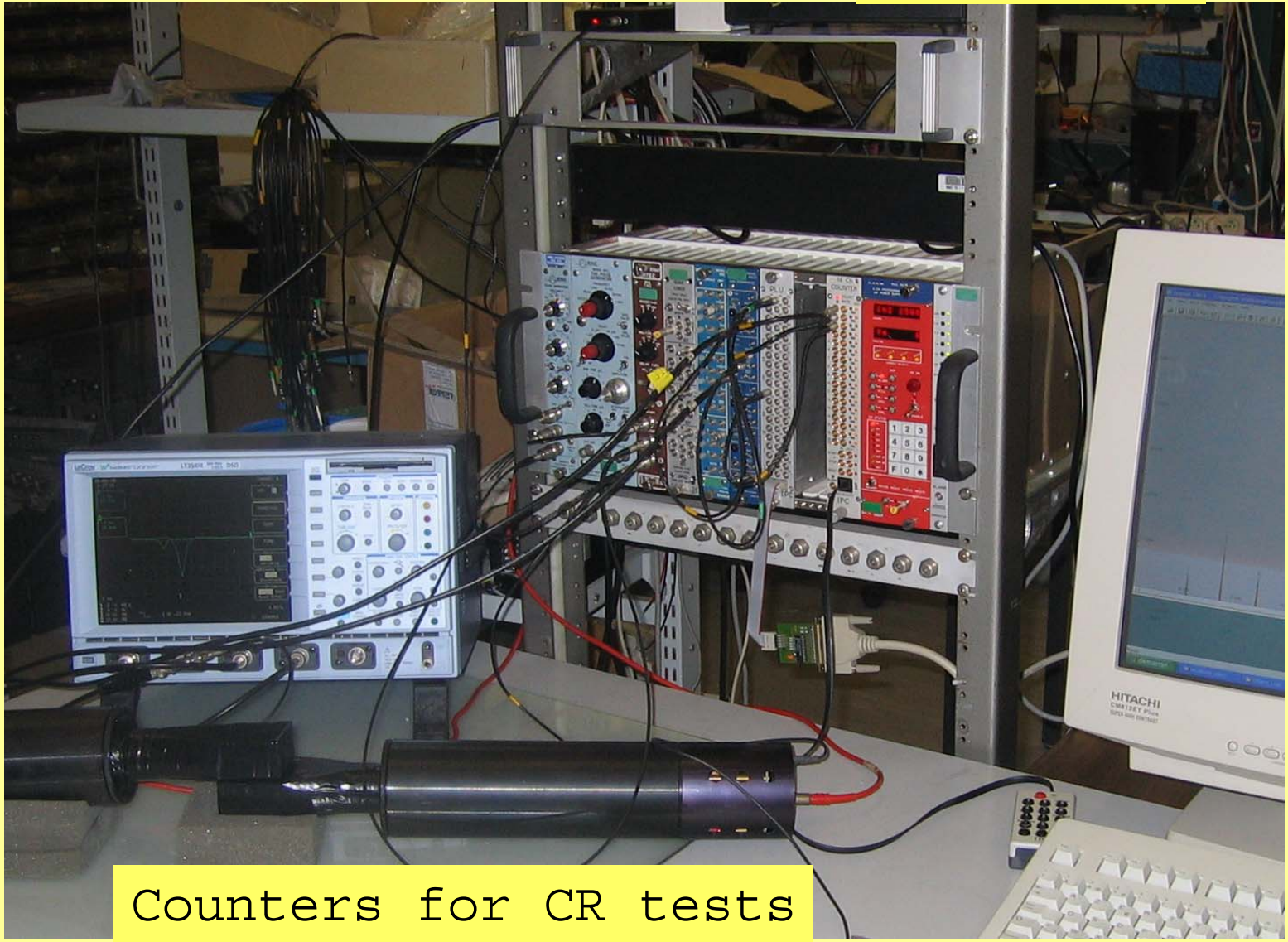
- **We aim at preparing a prototype for the beam tests in summer**

Test setup

TAC module (1 ch.) with σ_t <10 ps

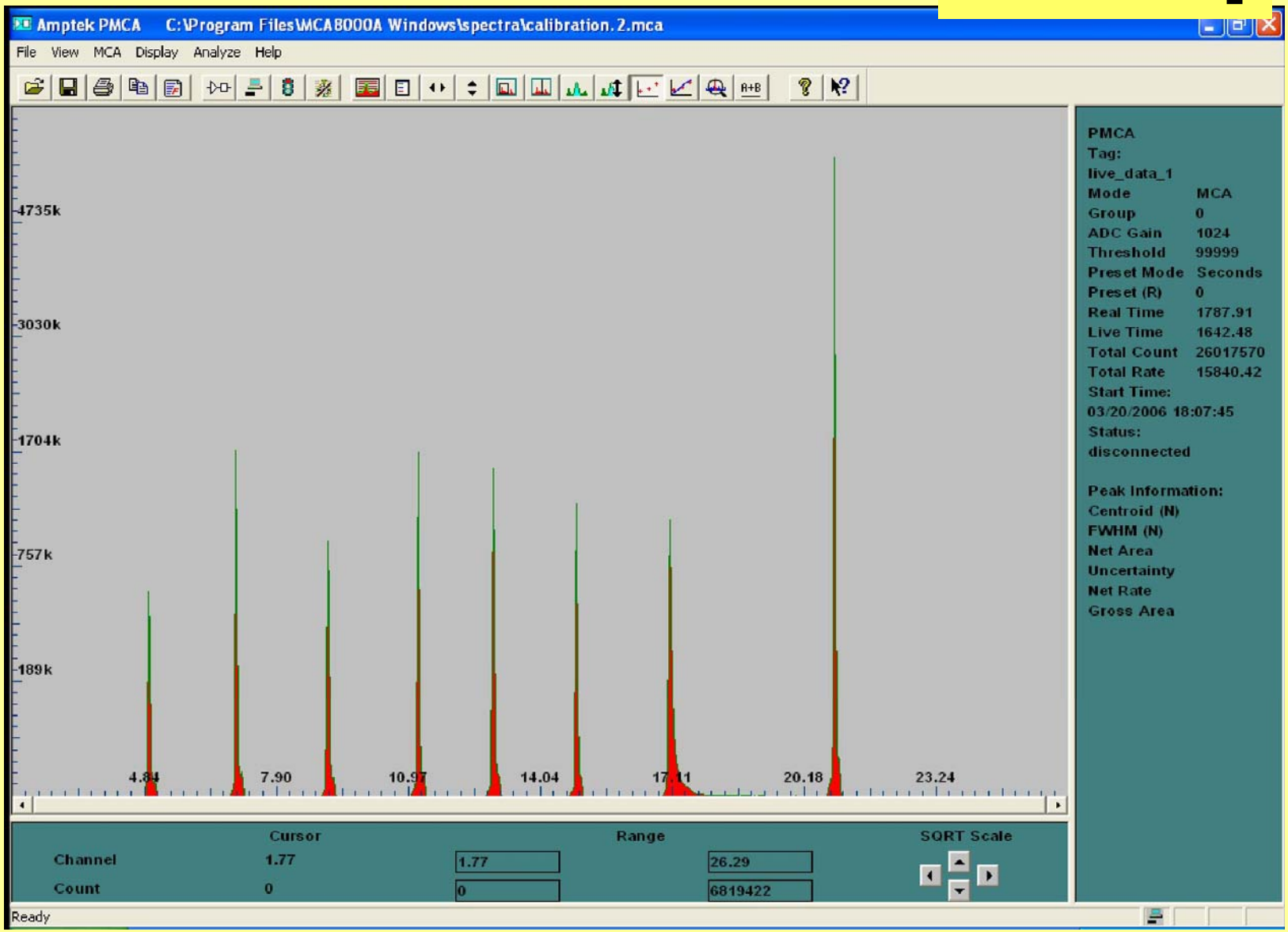


Test setup



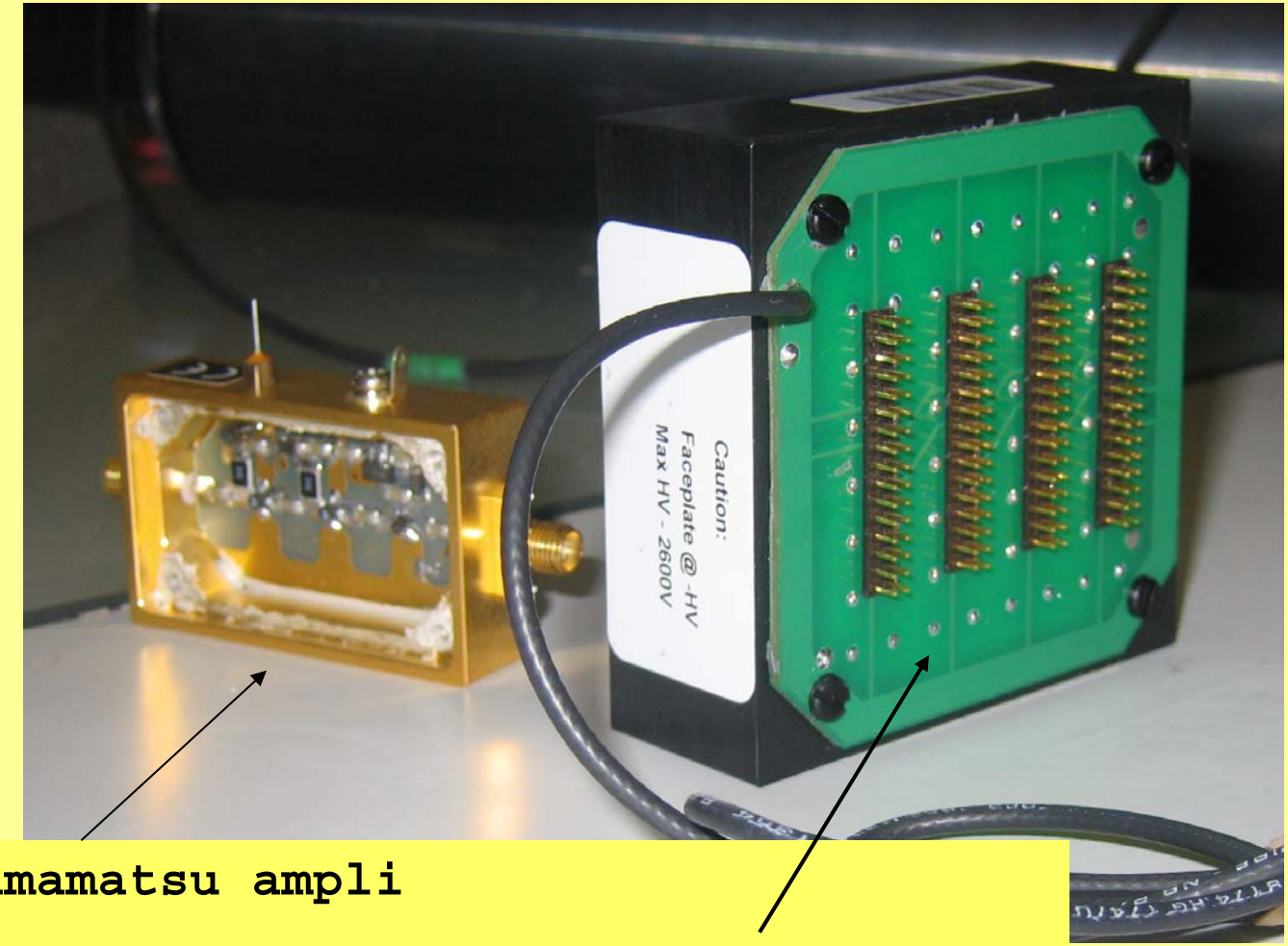
Counters for CR tests

Test setup



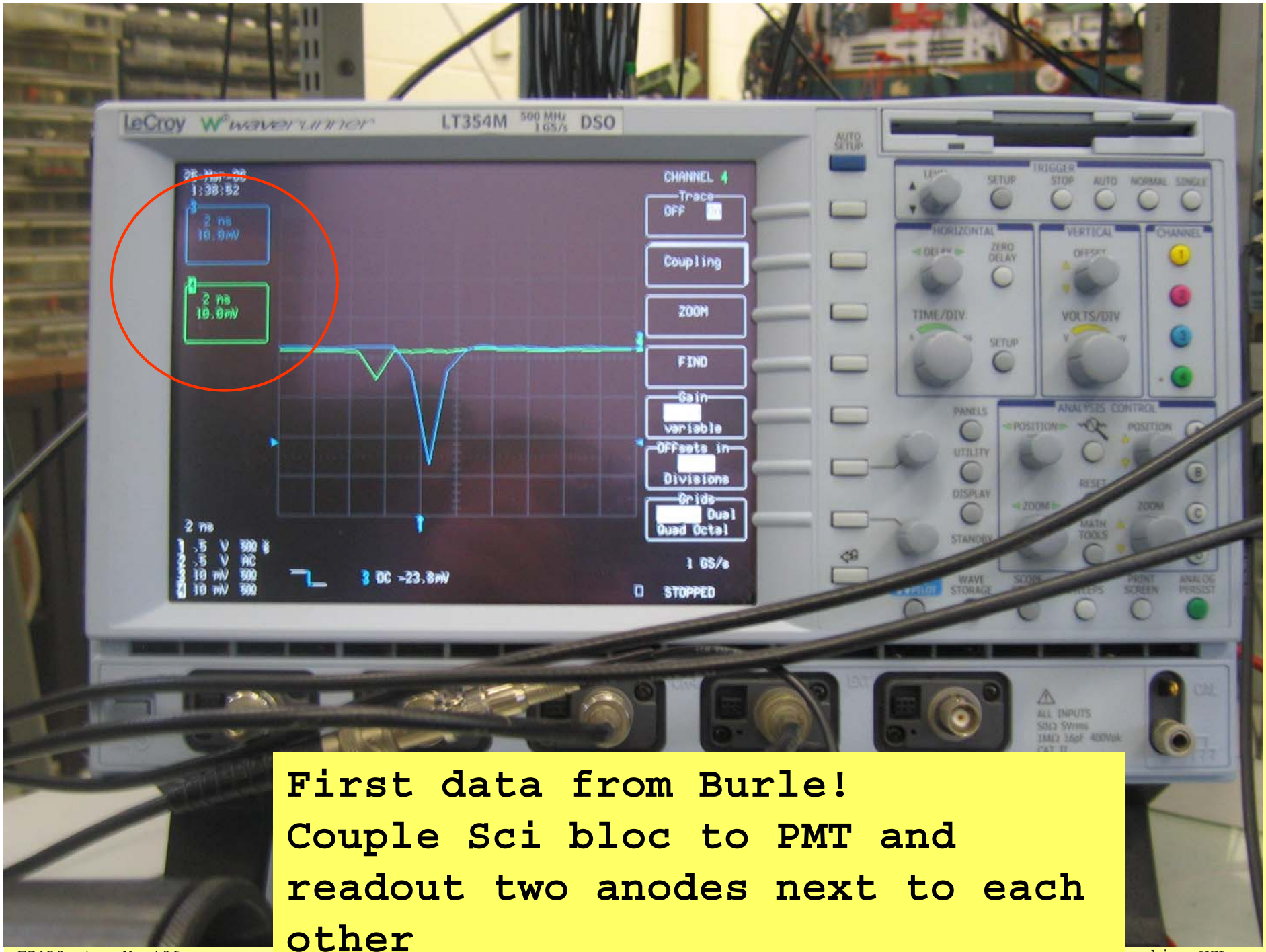
TAC module calibration confirms $\sigma_t \approx 10\,\mathrm{ps}$

Crucial components



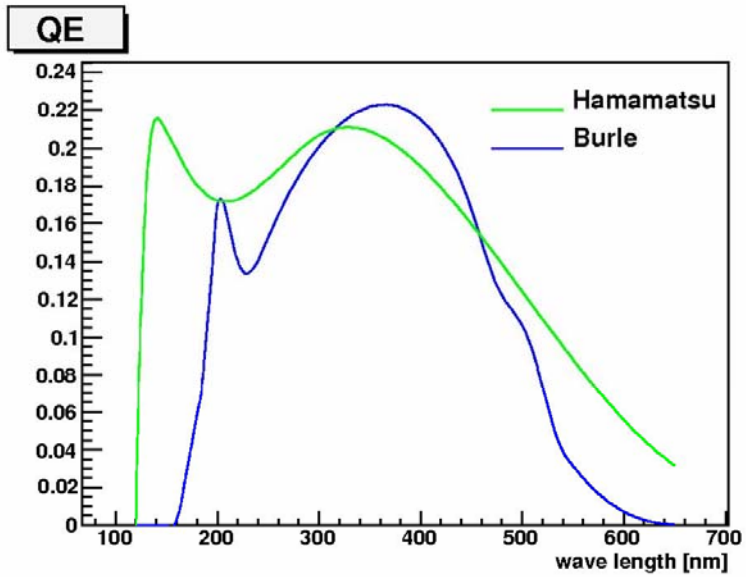
Fast Hamamatsu ampli

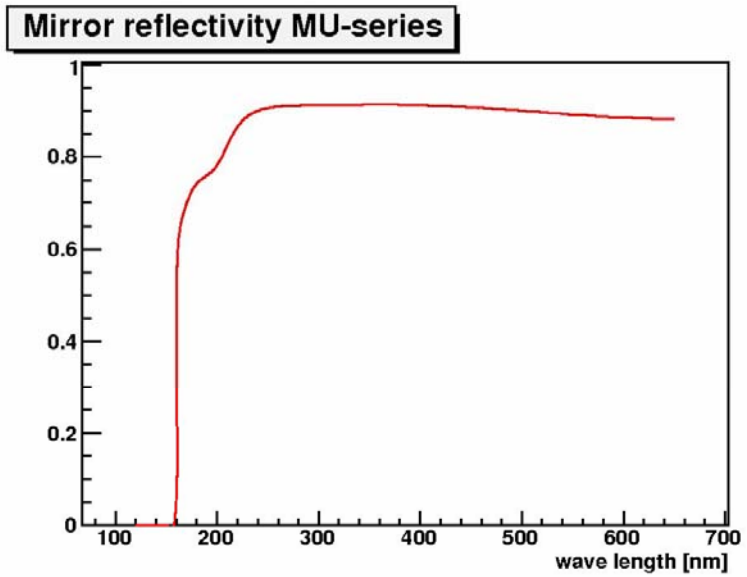
25 μm MCP-PMT from Burle with 8x8 anode

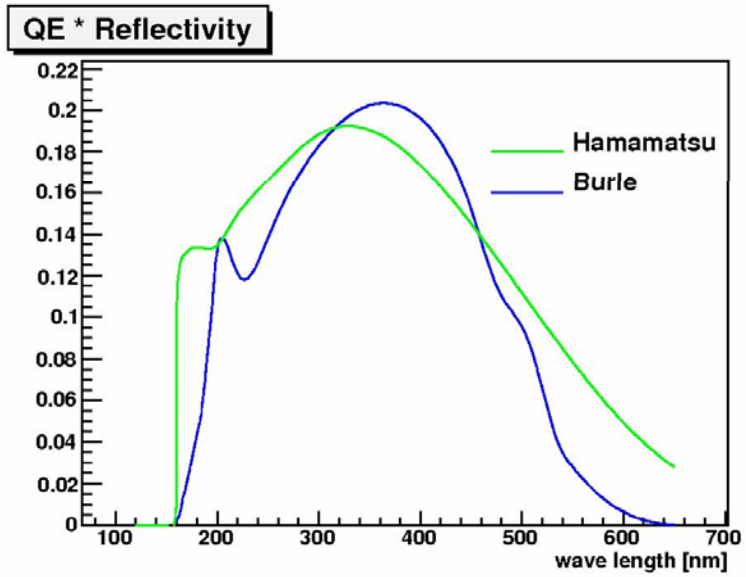


First data from Burle!
Couple Sci bloc to PMT and readout two anodes next to each other

Simulations with Burle

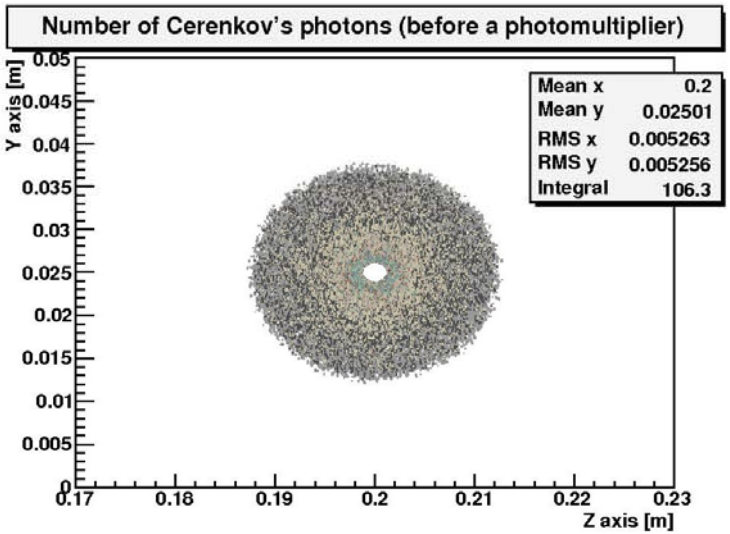


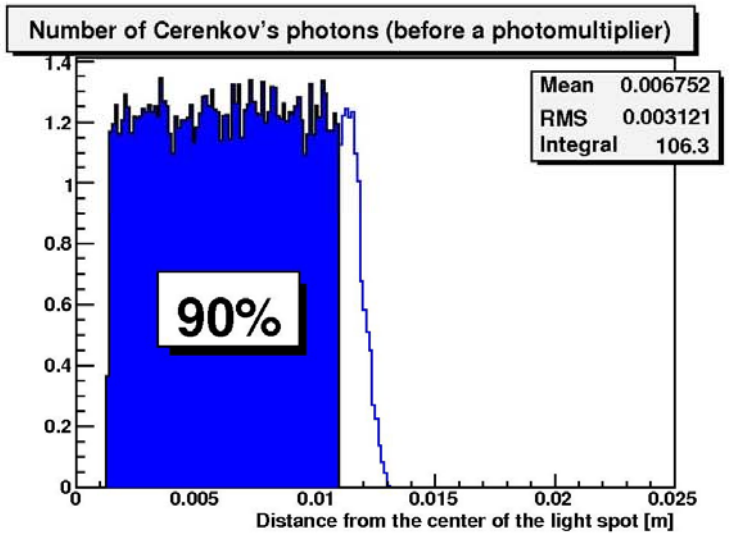


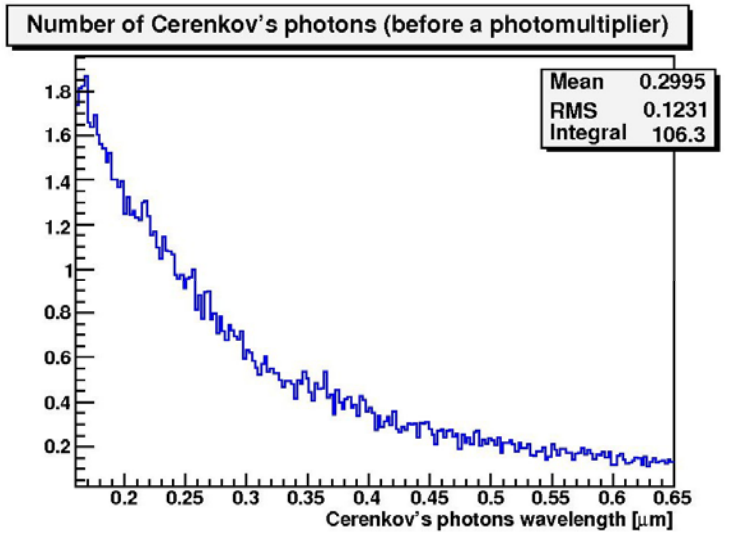


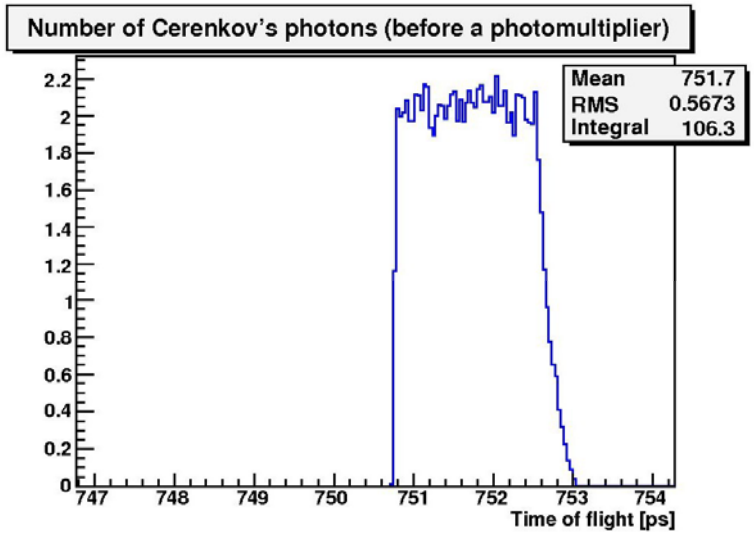
Still room for improvement:
- QE: ultra UV extension (Hamamatsu)
- Mirror: special MgF coating

Simulations with Burle (raytracing)



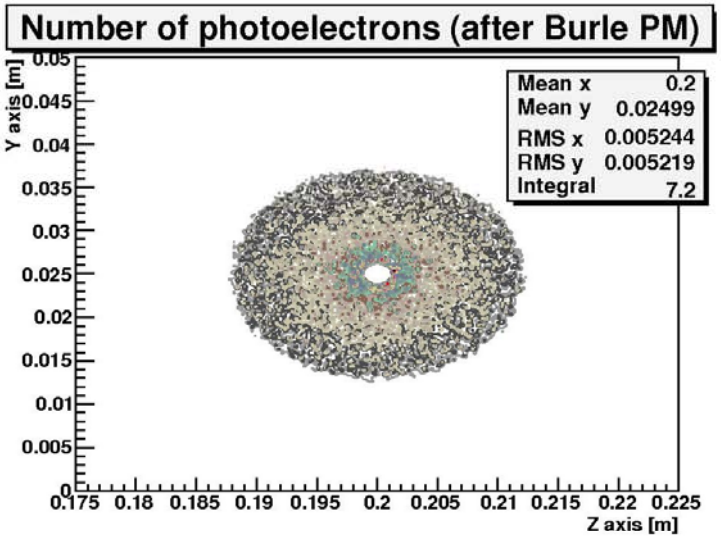


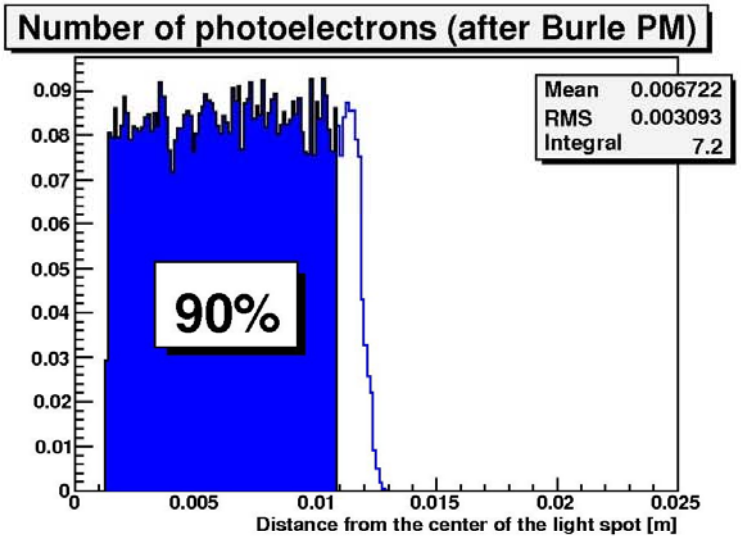


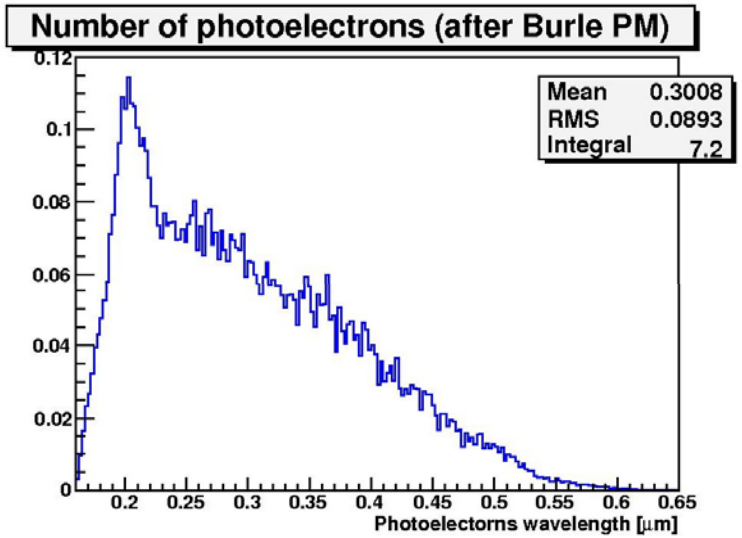


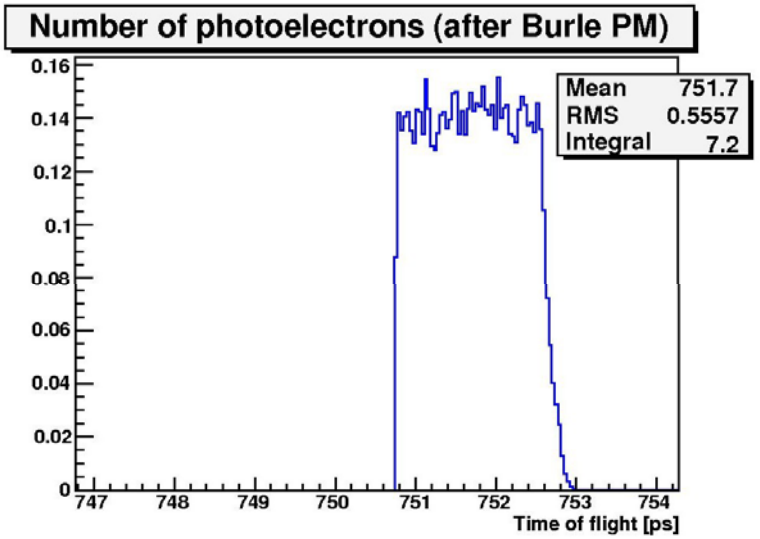
20cm of C_4F_{10} + Flat mirror + central proton

Simulations with Burle (raytracing)



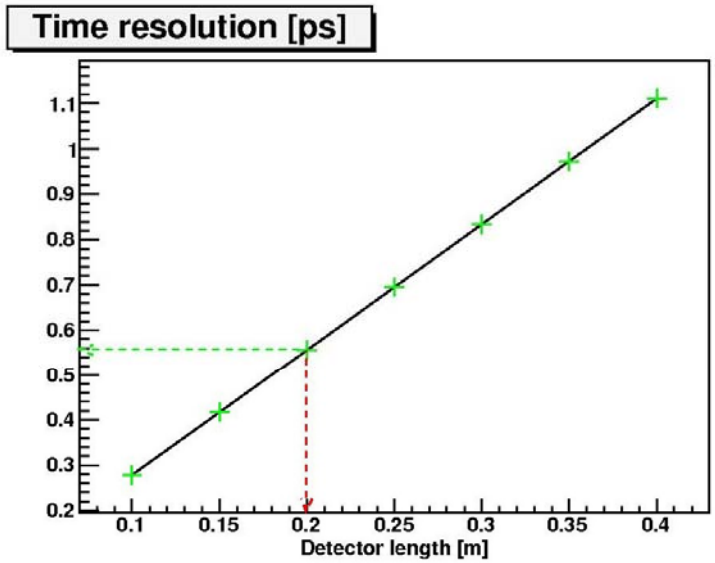


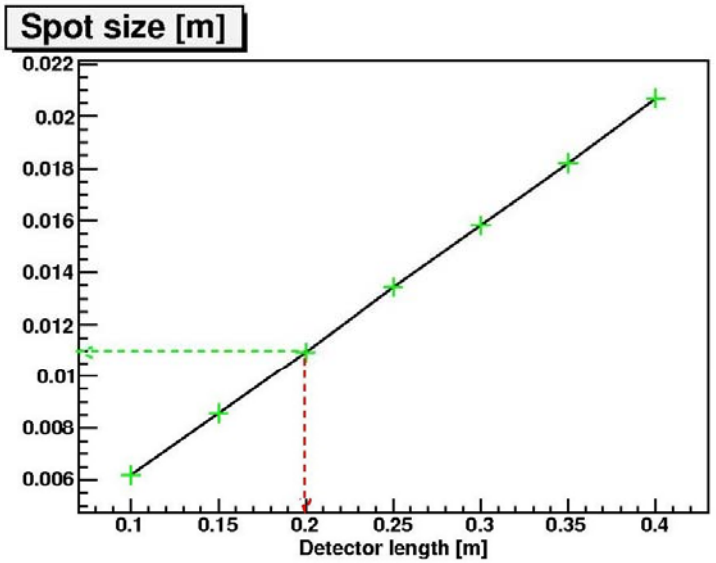


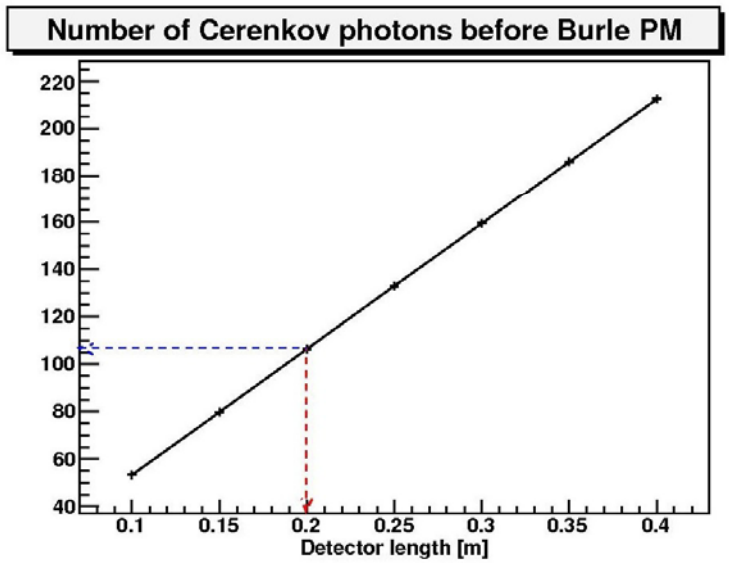


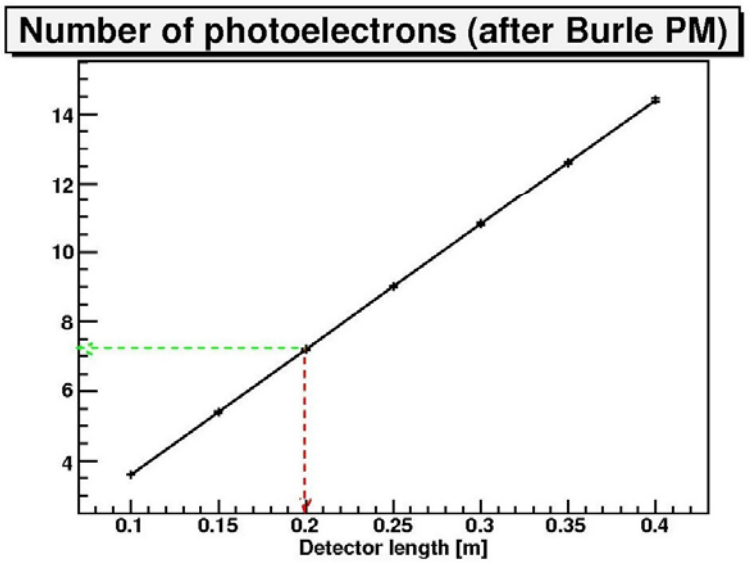
C_4F_{10} + Flat mirror + central protons

Simulations with Burle (raytracing)



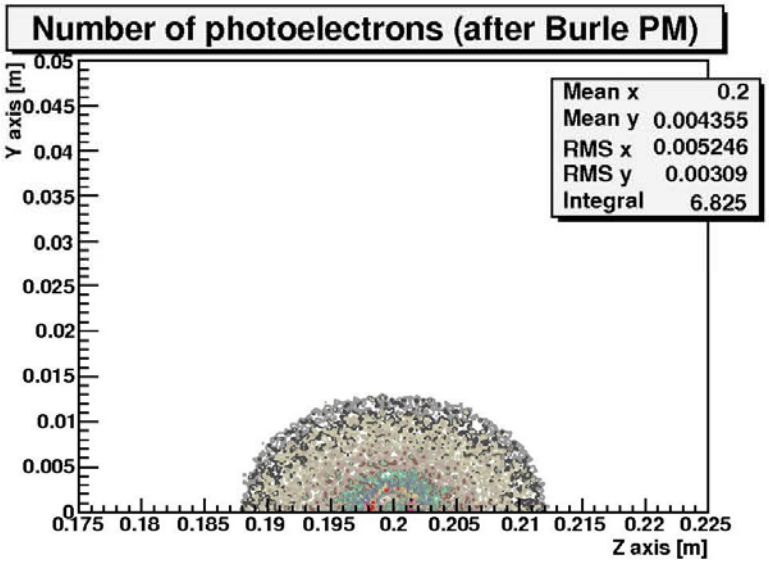


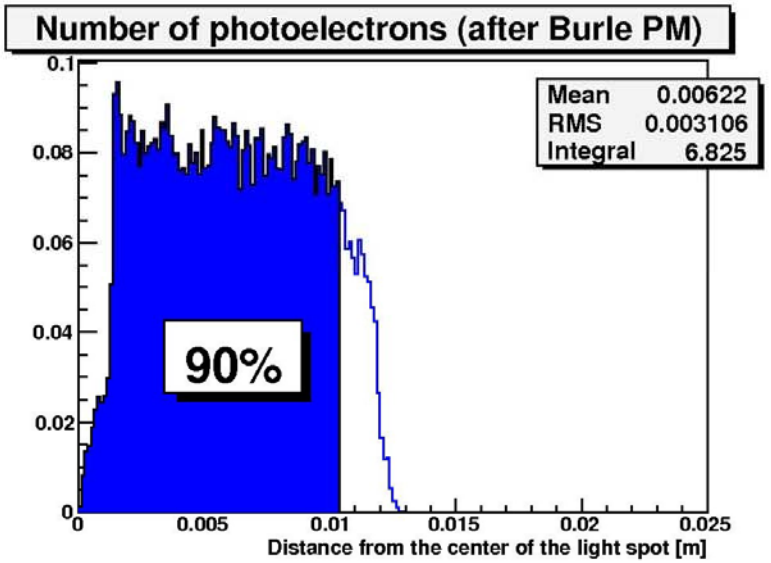


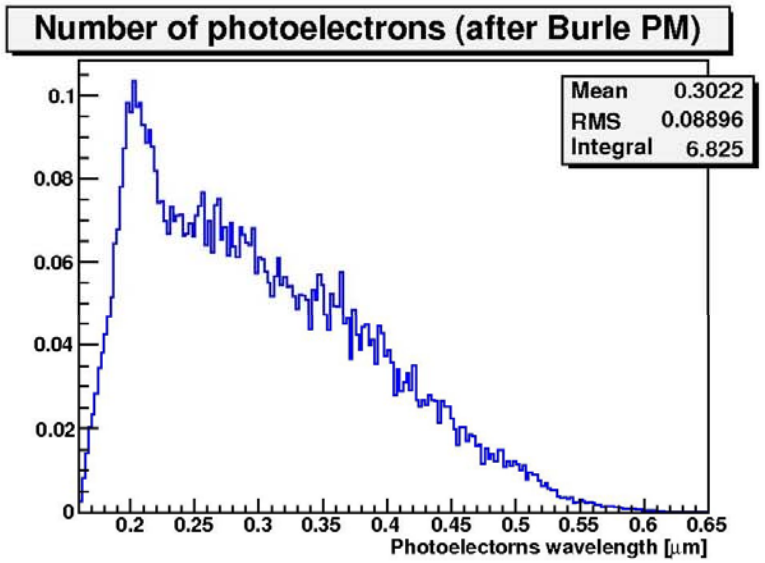


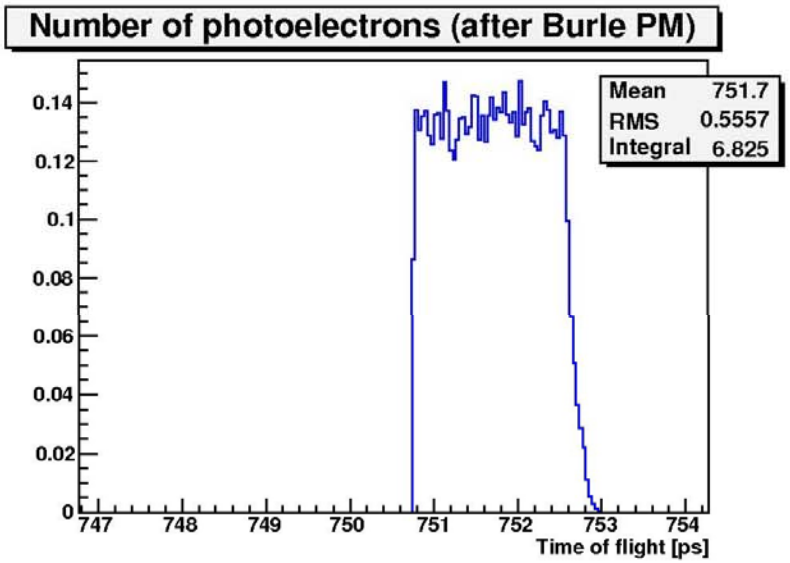
C_4F_{10} + Flat mirror + central protons

Simulations with Burle (raytracing)



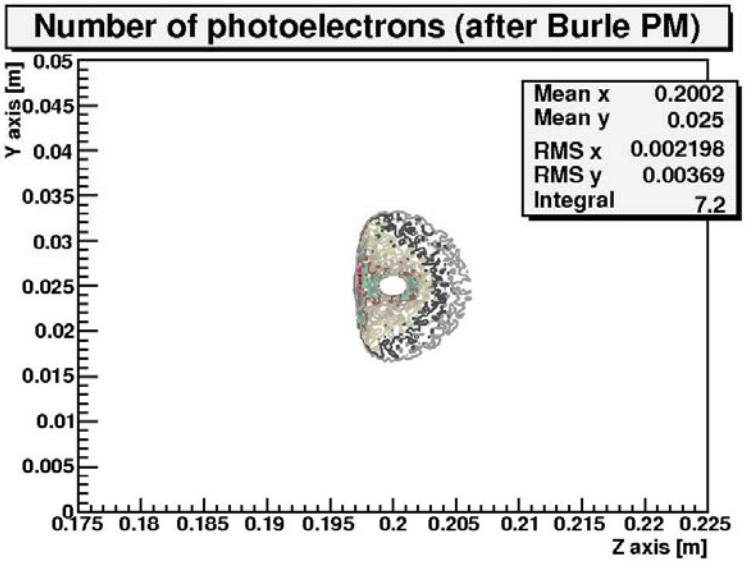


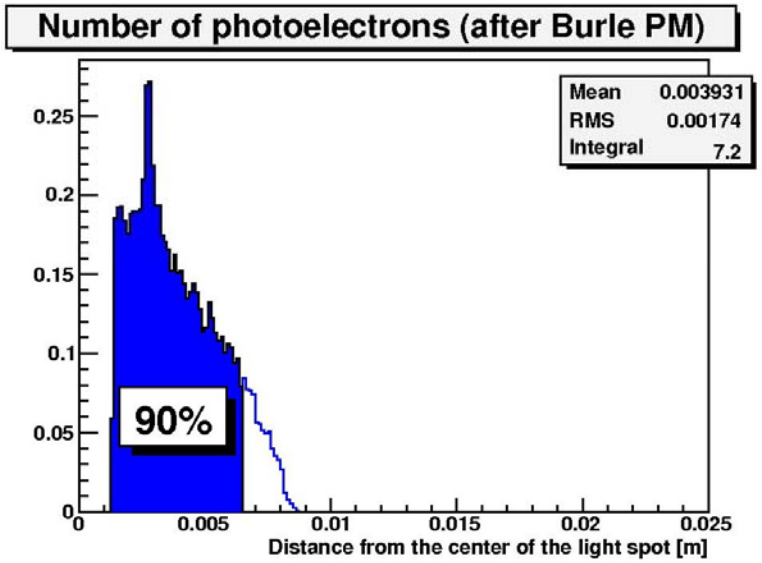


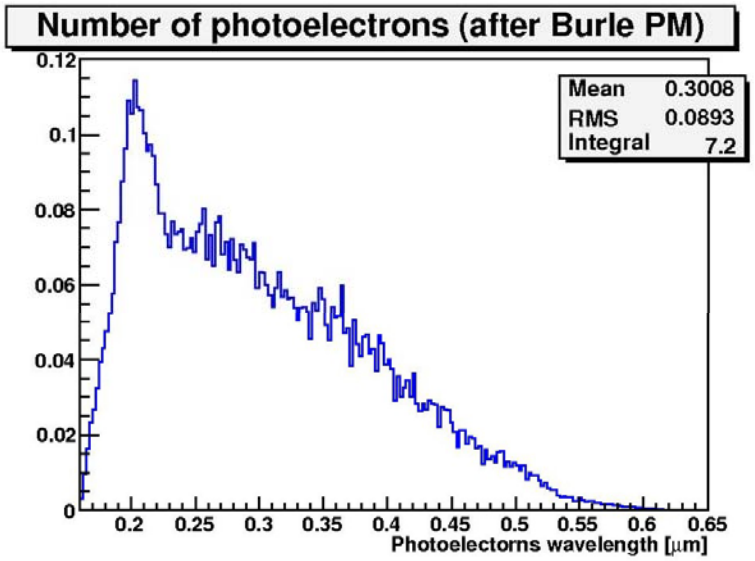


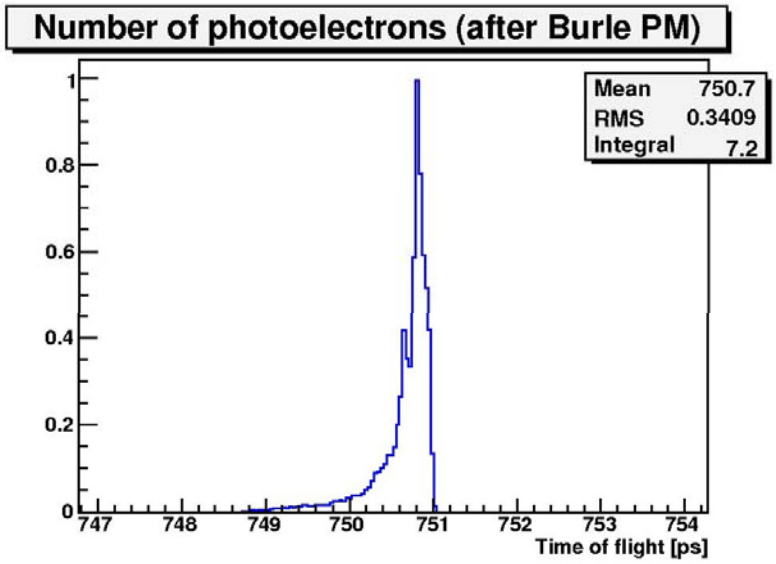
C_4F_{10} + Flat mirror + p 1mm from wall

Simulations with Burle (raytracing)



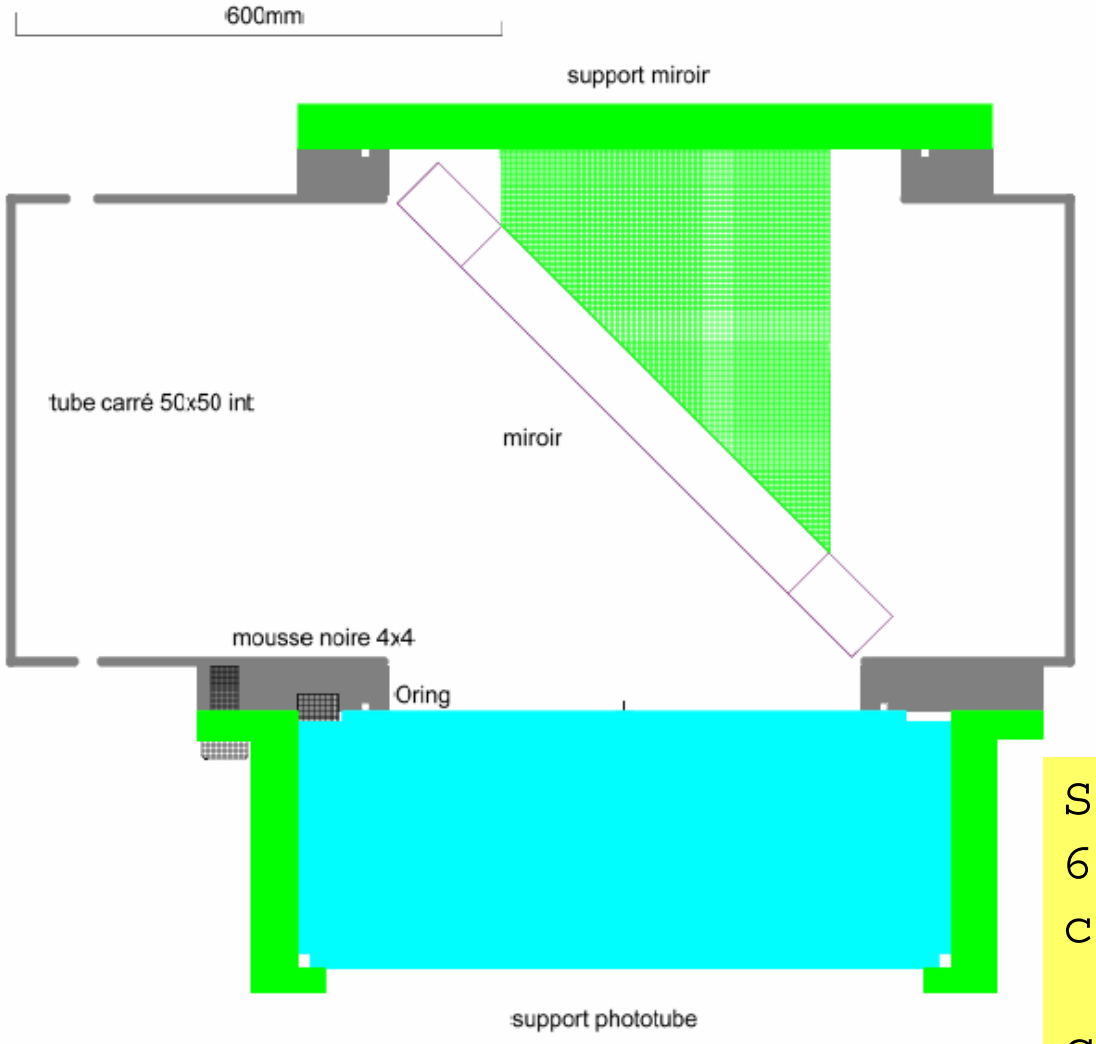






C_4F_{10} + spherical mirror + central p

Prototyping gastof



Start with air Cerenkov 60cm long and put to cosmic rays

Continue with 20-30cm long prototype using C_4F_{10} gas

Electronics for gastof

- PMT: Burle promised to provide 10 μm MCP, will contact Hamamatsu for 6 μm MCP

- Will use also CERN TDC for DAQ - one module ordered

- Need to discuss/study reference clock distribution for ToF in FP420

- Collaborate with Alberta

Prototyping gastof

- **A small team of 100% phd student + ~50% senior + >50% EE**

- **Funding requested for 2008**

- **Tentative schedule**
  - **March'06: we started to design mechanics, 2 MCP PMTs from Burle available we just started lab tests**
  - **Spring'06: prepare two prototypes for first beam tests/cosmic rays**
  - **Summer'06: first Tevatron beam tests data of gastof – high energy particles + response to secondaries from showering; will have a tracker in front?**