PICOSEC

Reports and Plans

Outline

- Beam Telescope
- T0-reference
- Multipad
- Different Micromegas
- Photocathodes
- Futur plans

August 2018

- Large MCP (40 mm diameter) + 12 Channel Oscilloscope
  - ➡ 3 Pads Multipad in parallel with full overlapping MCP
- Multipad uniformity studies
  - ➡Cividec and Ortec amps has been used
- New large chamber by Saclay
  - ➡ Tested but design problems
- Microbulk and Thinmesh
  - ➡ Possible alternative to Bulk ?!
- Doublemesh in reflection and transmission mode
- Test of different Photocathodes
  - ➡DLC, Nano Diamond and Secondary Emitter

Beam Telescope

New position of the set-up: upstream of Goliath

MCP-PMT
T0 - Reference

UV reference measurements performed to complete MCP—PMT t0-reference studies

Photoefficiency of

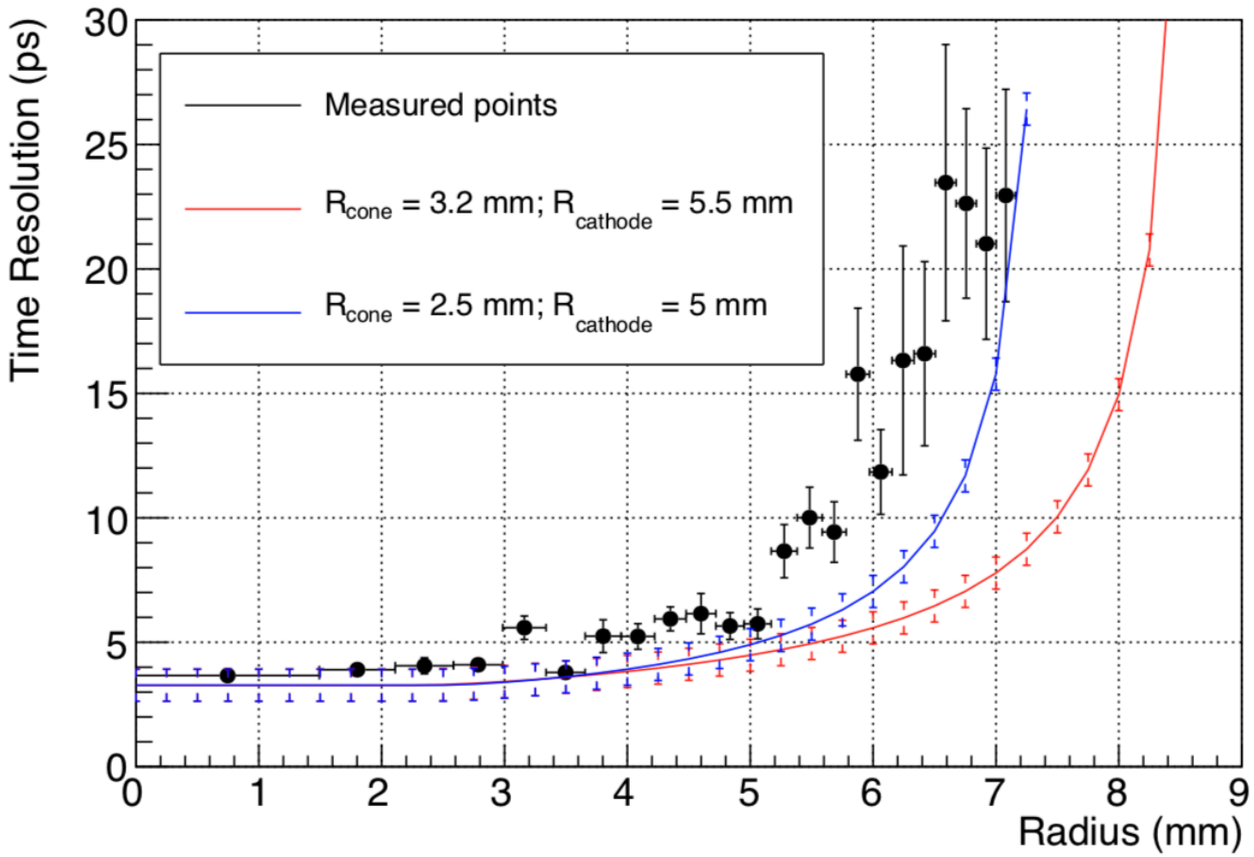
$$N_{\text{p.e.}} = 58.22 \pm 11.45 \, \frac{\text{p.e.}}{\mu}$$

has been measured for a full Cherenkov cone.

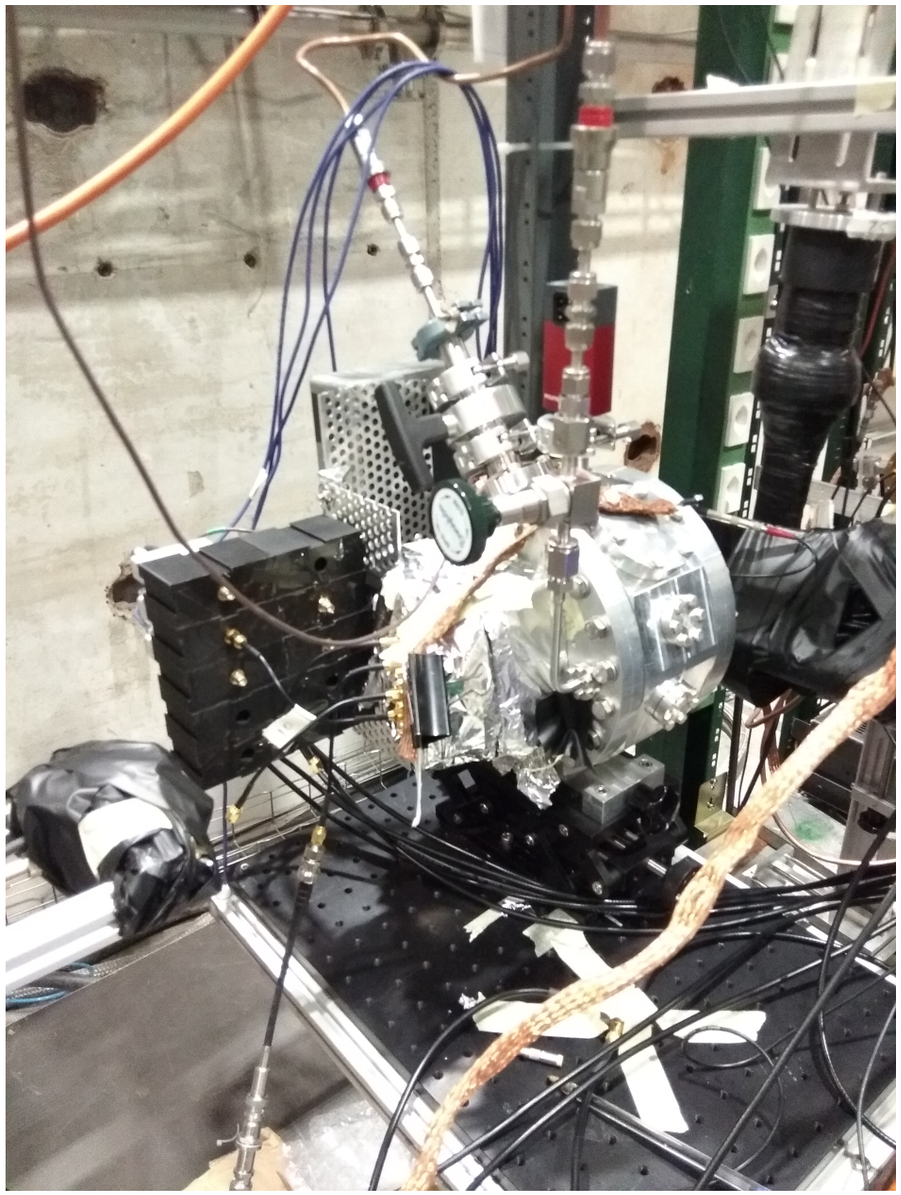
This leads to a time resolution of

$$\sigma_{\text{MCP}} \approx \frac{\sigma_{\text{TTS}}}{\sqrt{N_{\text{p.e.}}}} \qquad \sigma_{\text{MCP}} = 3.28 \pm 0.64 \, \text{ps}$$

Theoretical spatial distribution can be compared with the measured one.



Multipad



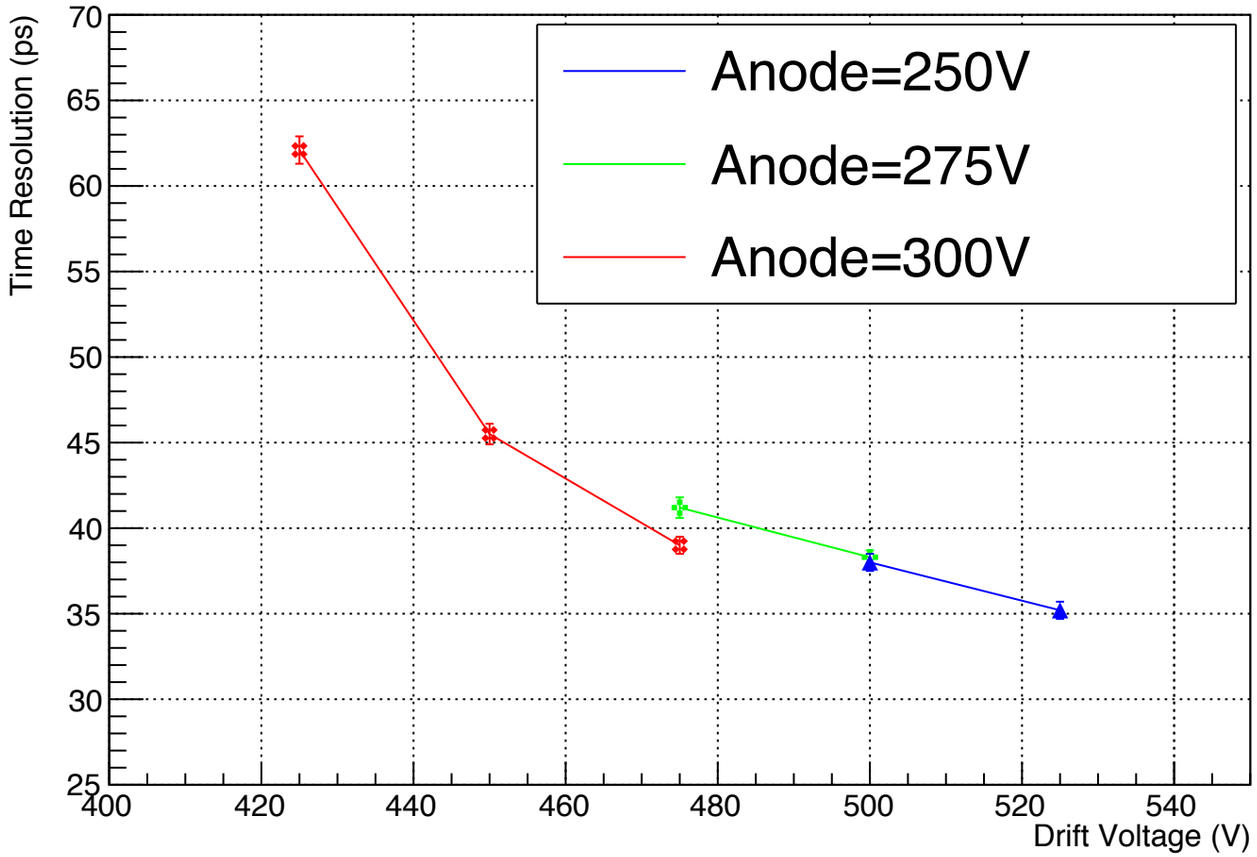
New Cividec mounting and shielding

12 - Channel oscilloscope used to measure up to three pads in parallel

Multipad

- 40 cm diameter MCP—PMT used to fully cover three consecutive pads
- Detector appeared instable, measurements up to +450 V / -350 V were possible
- A lot of Cividec broke down during sparks in the Multipad
- High statistics with 3 pads at +450 V / -350 V and the large MCP were measured
- (Tracking data necessary for analysing this runs)
- Uniformity measurements with UV light and Ortec charge sensing ampifier
- Muon measurements with several pads and Ortec amplifier

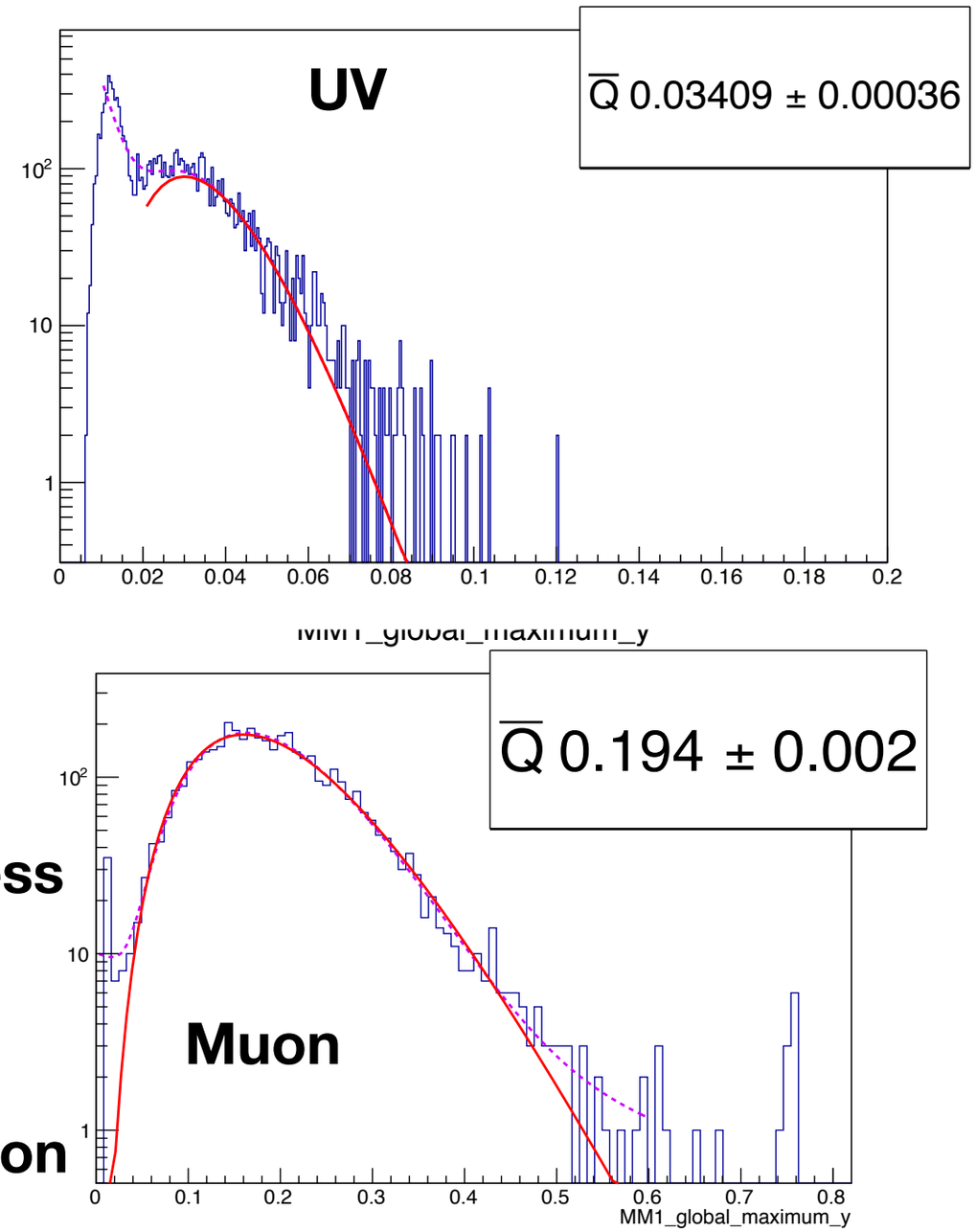
Thinmesh



Time resolution of up to 35 ps reached with CsI but less photoelectrons

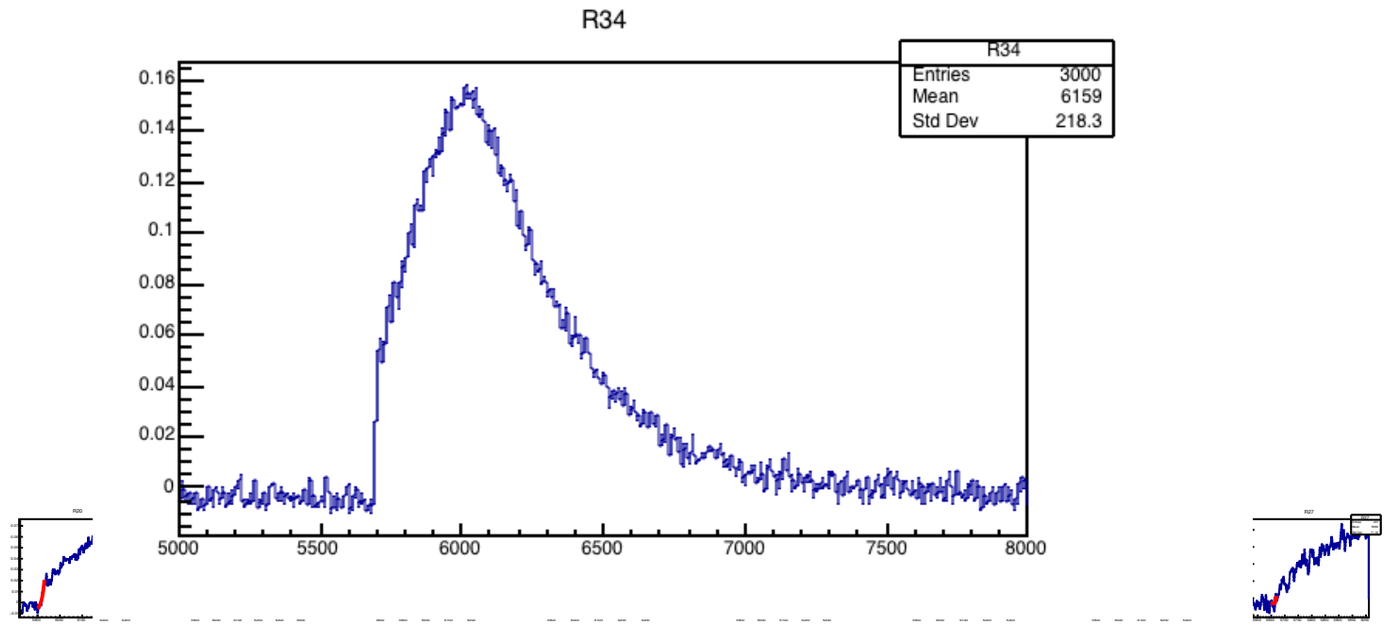
When time res. scales with sqrt of N.p.e.:
a resolution of around 25 ns is possible at 11 p.e./muon

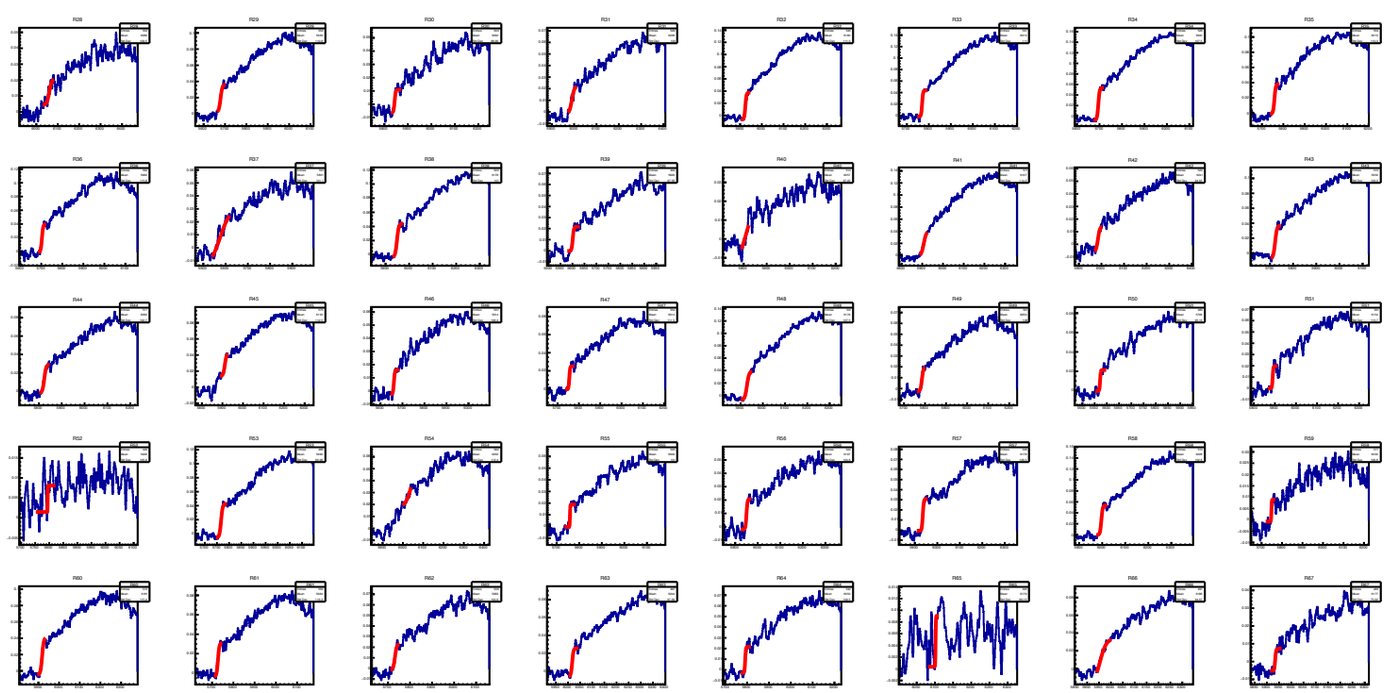
Q.E. of CsI only ~5.7 p.e./muon ?!



Microbulk

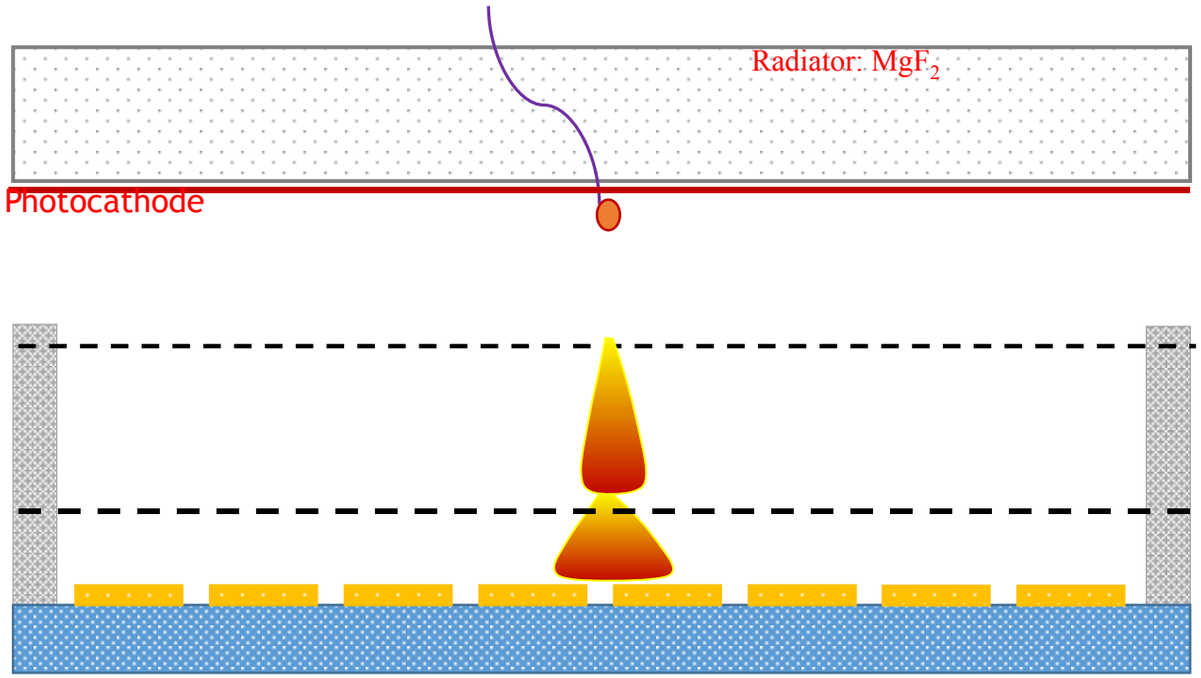
- **Different Waveform shape due to higher capacity of the mesh**
- **Observed signals similar to predicted simulations (see: „Modelling timing Micromegas“, D. Gonzalez-Diaz, F. Resnatti, CERN, 08/10/2015)**
- **Peak does not mark the end of the electron signal**
  - **New analysis algorithm necessary**





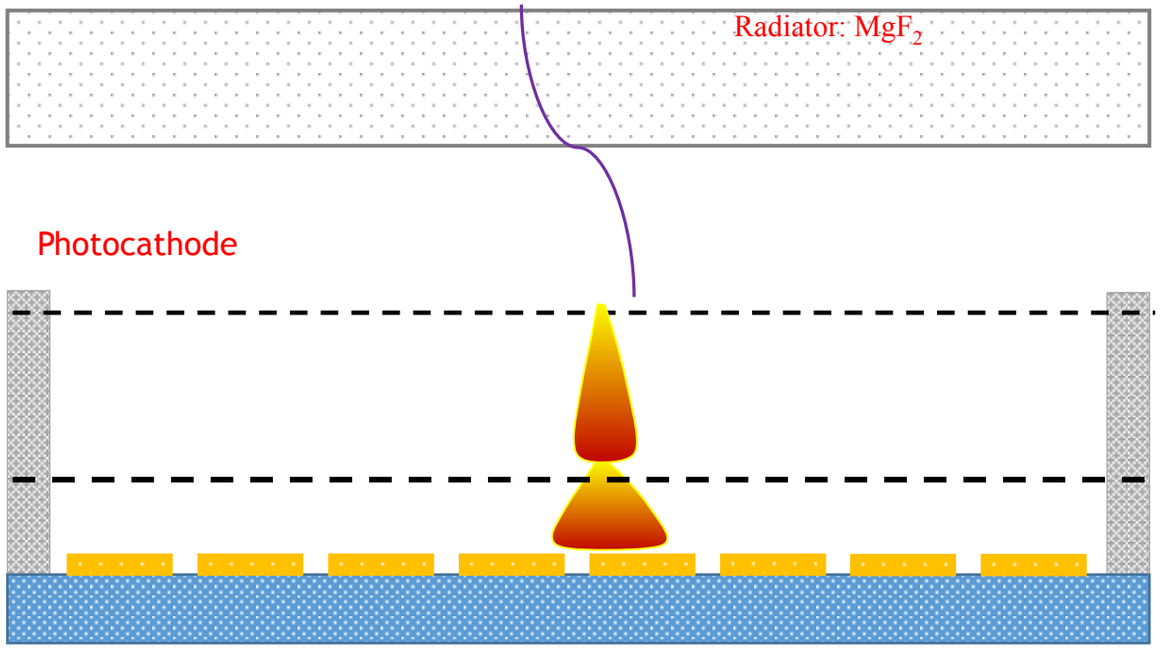
Doublemesh

Two types of Double mesh Micromegas (DMM) detector



Transmission Type

- Triple cascading avalanche
- Low IBF
- higher gain, more stable



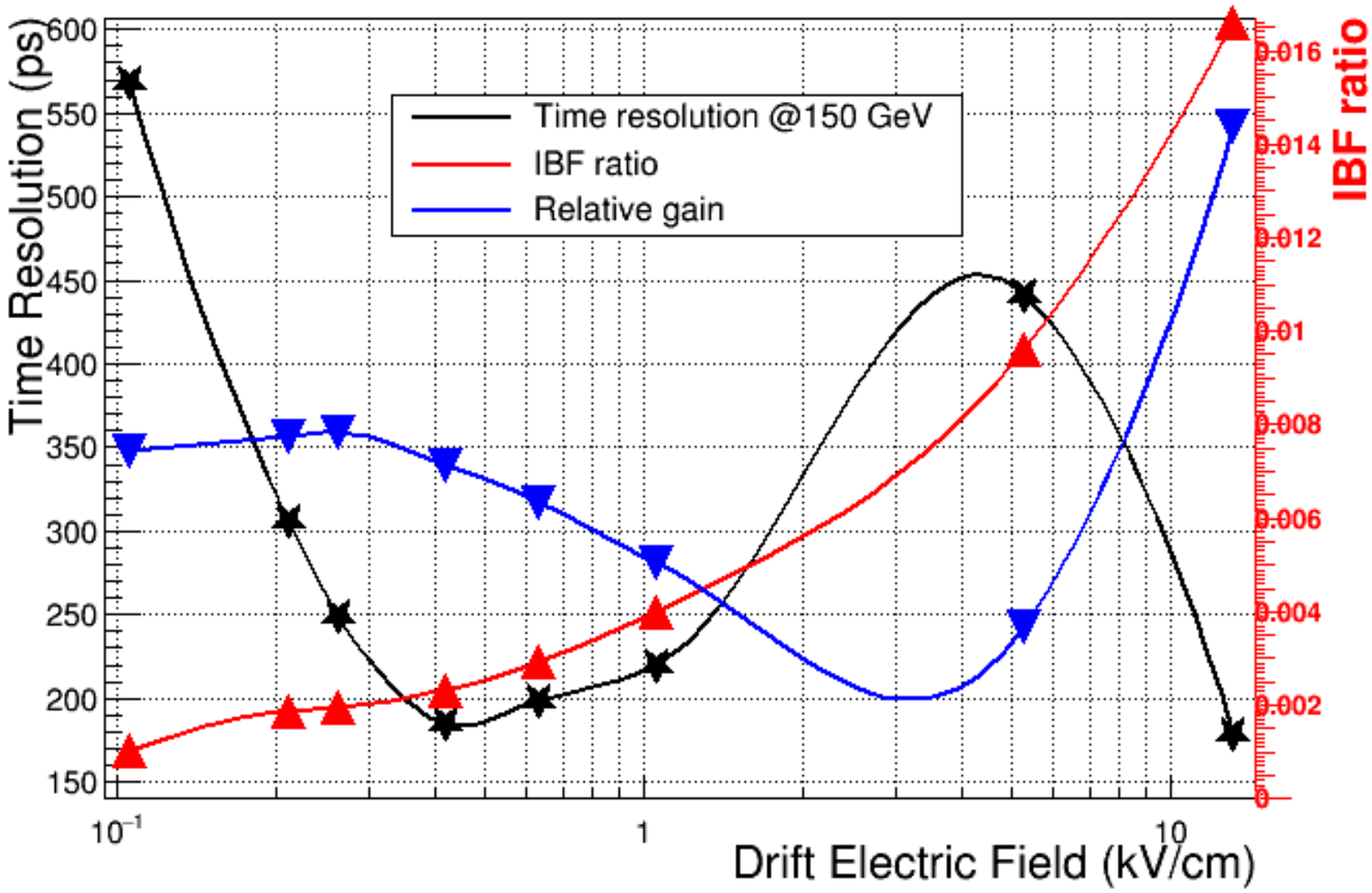
Reflection Type

- Higher QE
- Better time resolution
- Photocathode blind to IBF

Transmission DMM

April beam tests results

3mm MgF2 + 5nm Cr & 18nm CsI



- Fixed: mesh_up: 42.5 kV/cm, mesh_bottom: GND, Anode: 36kV/cm
- Time resolution reached **180 ps** & IBF **3.5‰** at: -433V, -425V, 0, +360V
- The best time resolution reached **~80 ps** at different voltage

Reflective DMM

No Results at present

Reflection Type:

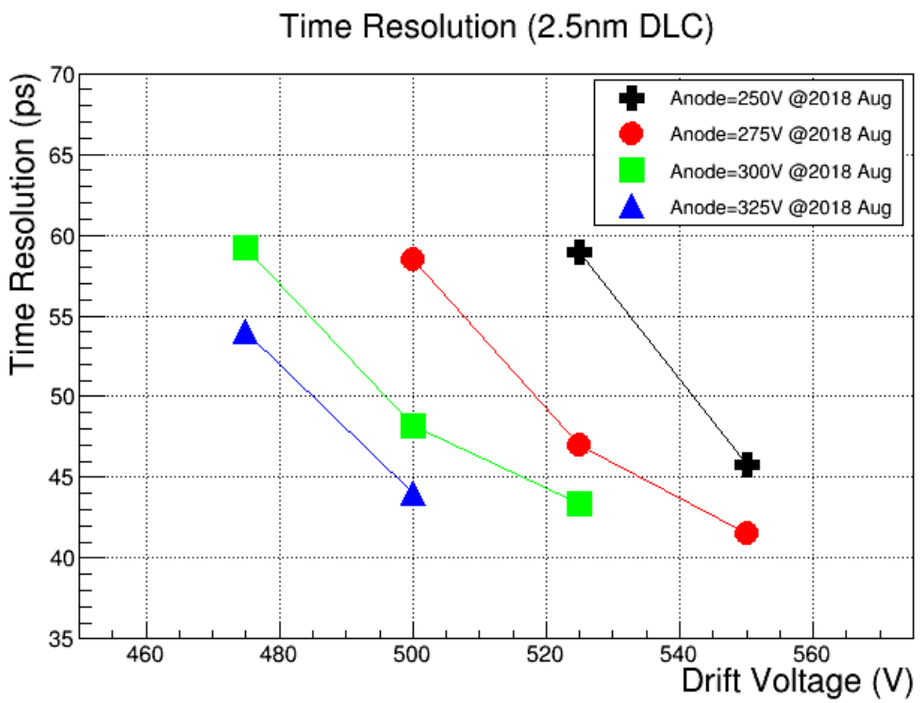
- **In August beam test first muon signals were observed**
- **Some signal amplitudes were very high(>3 V), but most of them are low.**
- **Detection efficiency is not very high**
- **For UV lamp run, we can get good single photoelectron distribution**
- **Still have some problems of CsI deposition on the mesh**

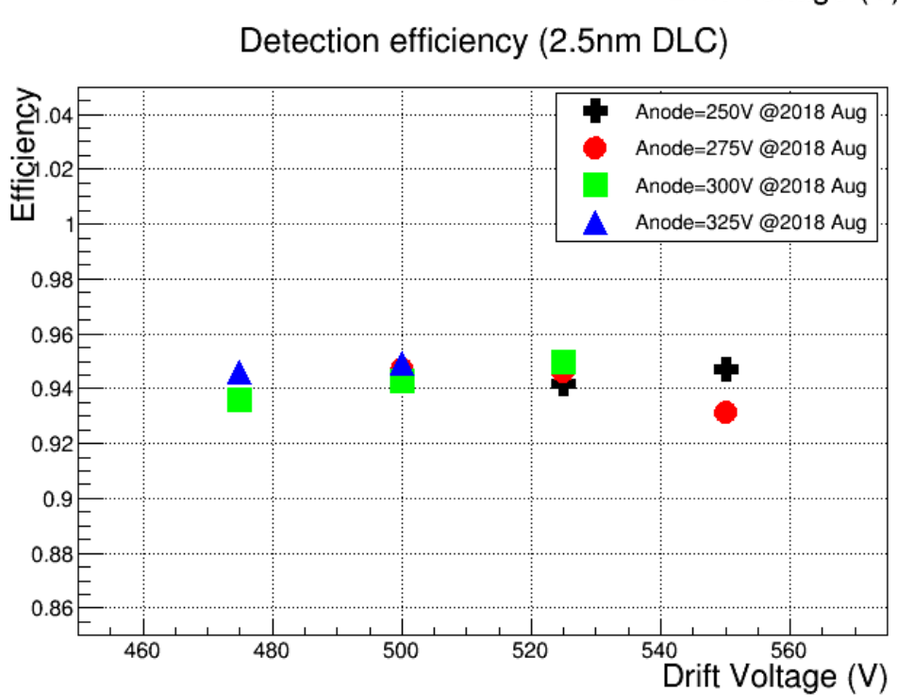
Photocathode

- **2.5 nm DLC promising time resolution up to 42 ps**
- **Results repeatable in independent samples and Measurements**
- **Addtitional tests with heating treatment under N2 and H2**
- **Additional aging tests under pions**

- **Nano seeding 5 nm ~ 1.68 p.e./muon -> 64 ps**
- **30 nm DLC -> 105 ps**
- **Boron doped nano diamonds -> pending**
- **Diamond secondary emitter -> pending**

Thickness of DLC film (nm)	Npe/per muon	Detection efficiency for muons
1	Bad	Bad
2.5	3.7	97%
5	3.4	94%
7.5	2.2	70%
10	1.7	68%
5 nm Cr + 18 nm CsI	7.4	100%





Future plans for 2018/19

- **Continuing measurements with different DLC photocathodes**
- **Ageing studies of promising DLC samples**
- **Optimize the coating of the CsI on the DMM Mesh**
- **Optimize structure of transmission type DMM**
- **Progress in the development of the larger Picosec chamber**
  - **1 cm Bulk and Microbulk ready**
  - **2 cm and larger in development (with segmented readout)**
- **(Embedded) electronic necessary for segmented readout**

- **DLC and S.E. Production at USTC and CEA**
- **New cosmic muons bench at Saclay**
- **Asset chamber at CERN**
- **At least 6 weeks of Laser time at Saclay**