

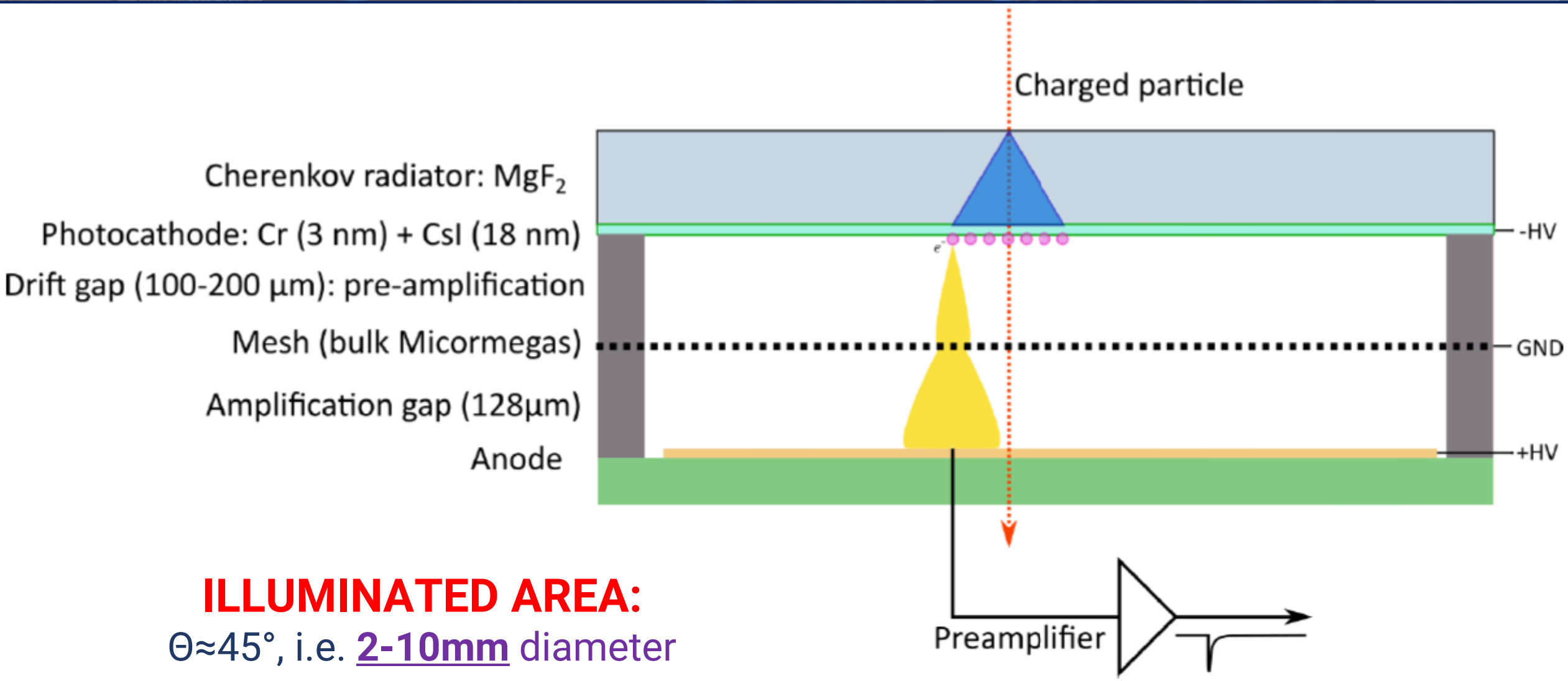
# Picosec Micromegas: a fast-timing MPGD for MIP detector in the Muon Collider detector

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*on behalf of the Muon Collider Physics and Detector working group*

IFD Workshop, Bari 17-19 Oct

# Picosec Micromegas concept

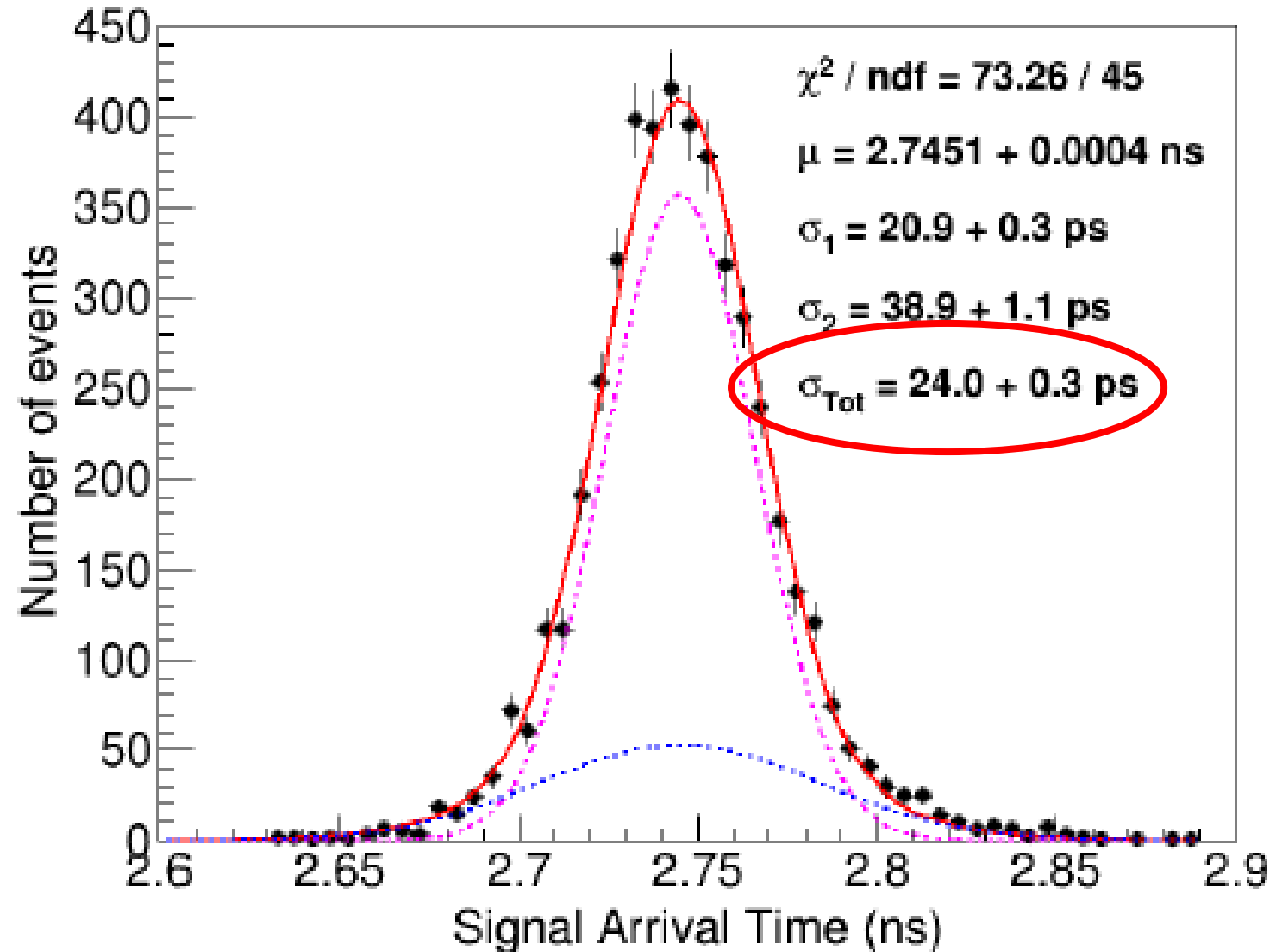


# Picosec Micromegas concept

[Bortfeldt, J., et al. "PICOSEC: Charged particle timing at sub-25 picosecond precision with a Micromegas based detector." \*Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment\* 903 \(2018\): 317-325.](#)

**BASELINE DETECTOR**  
**24ps of time resolution!**

**Proved on multiple test beams!**



[C.Aime - Muon detectors performance](#)  
[I.Vai - R&D studies on muon detector](#)

Muon collider collaboration meeting 11,14 Oct 2022

## Picosec+MPGD station proposed for the Muon endcap!

## Muon tracking and timing

### hadronic calorimeter

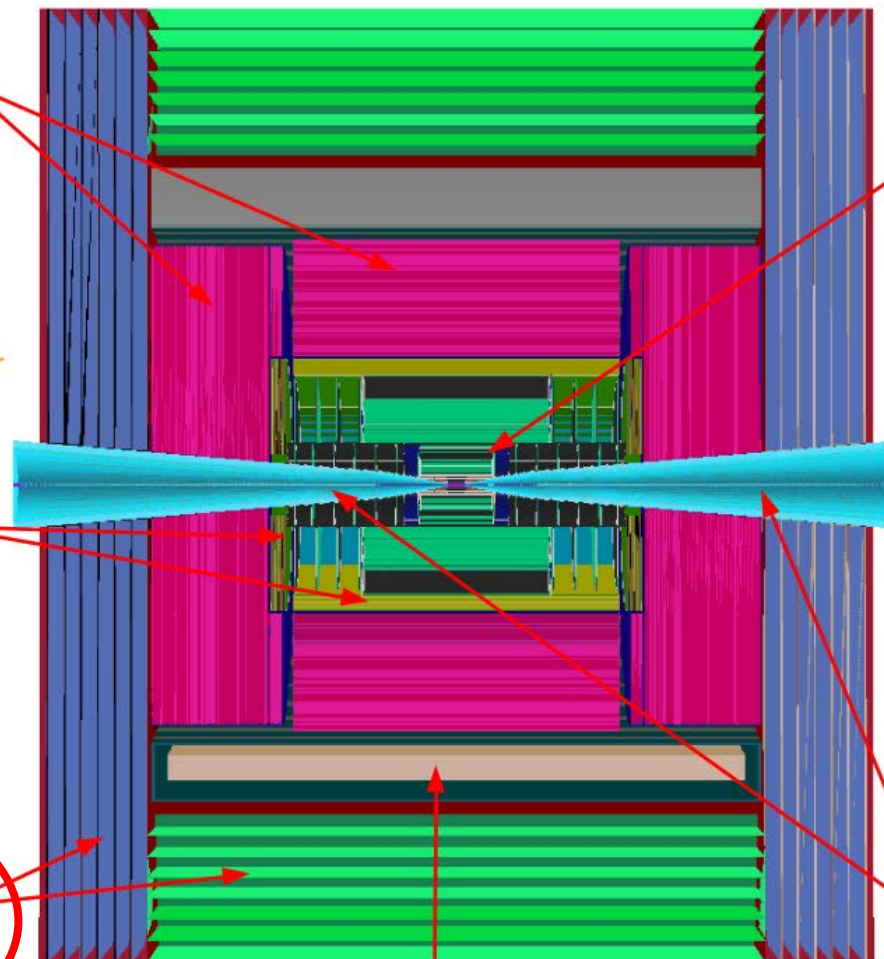
- 60 layers of 19-mm steel absorber + plastic scintillating tiles;
- 30x30 mm<sup>2</sup> cell size;
- 7.5  $\lambda_I$ .

### electromagnetic calorimeter

- 40 layers of 1.9-mm W absorber + silicon pad sensors;
- 5x5 mm<sup>2</sup> cell granularity;
- 22  $X_0$  + 1  $\lambda_I$ .

### muon detectors

- 7-barrel, 6-endcap RPC layers interleaved in the magnet's iron yoke;
- 30x30 mm<sup>2</sup> cell size.



superconducting solenoid (3.57T)

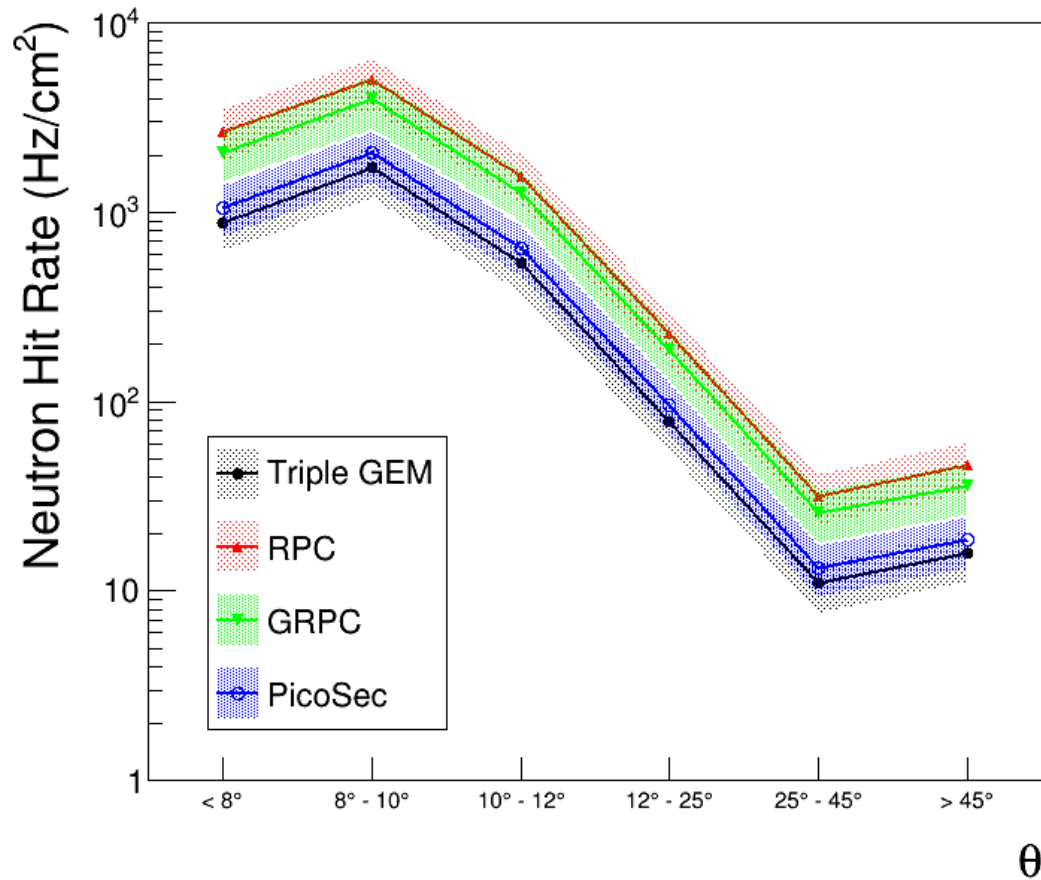
### tracking system

- Vertex Detector:**
  - double-sensor layers (4 barrel cylinders and 4+4 endcap disks);
  - 25x25  $\mu\text{m}^2$  pixel Si sensors.
- Inner Tracker:**
  - 3 barrel layers and 7+7 endcap disks;
  - 50  $\mu\text{m}$  x 1 mm macro-pixel Si sensors.
- Outer Tracker:**
  - 3 barrel layers and 4+4 endcap disks;
  - 50  $\mu\text{m}$  x 10 mm micro-strip Si sensors.

### shielding nozzles

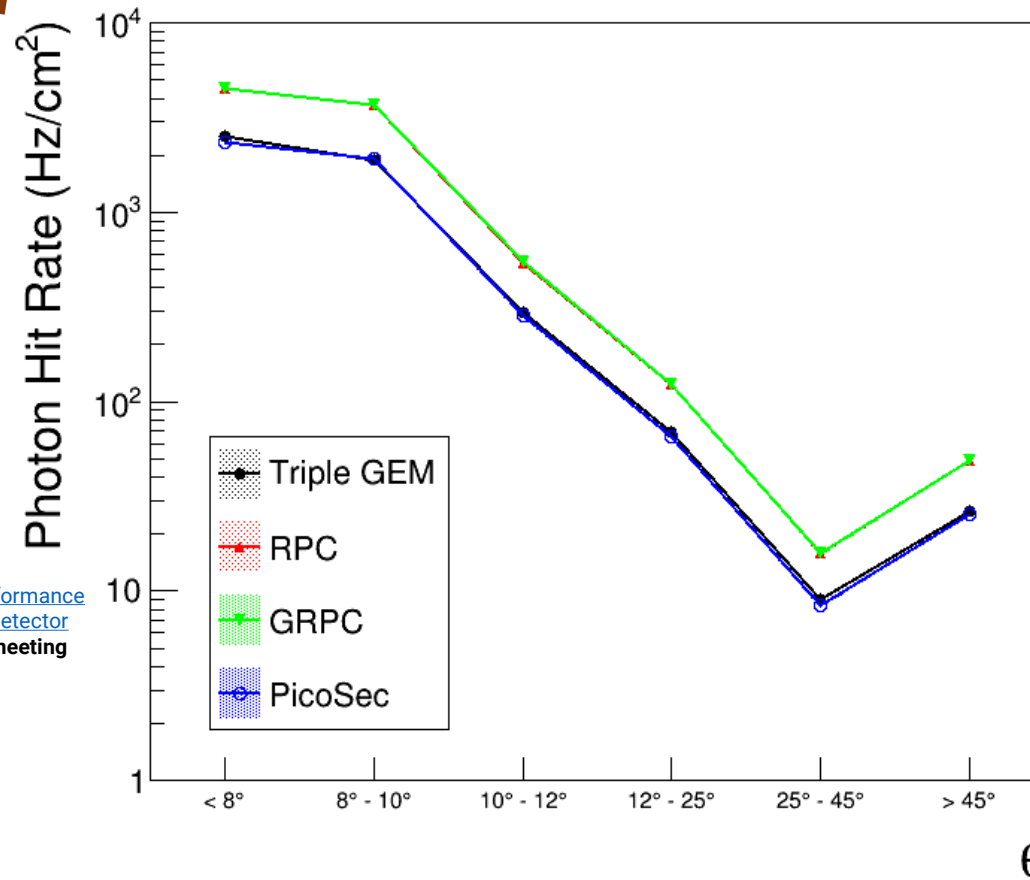
- Tungsten cones + borated polyethylene cladding.

Muon Collider 1.5 TeV - Neutron Hit Rate vs  $\theta$



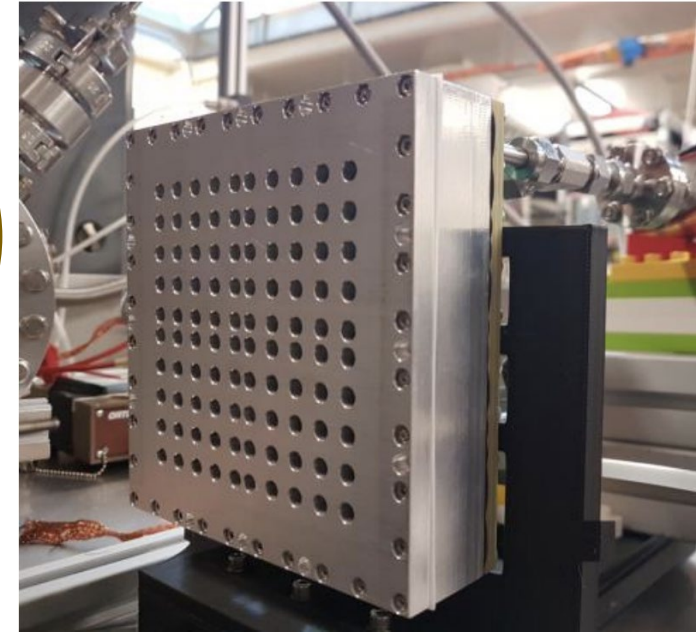
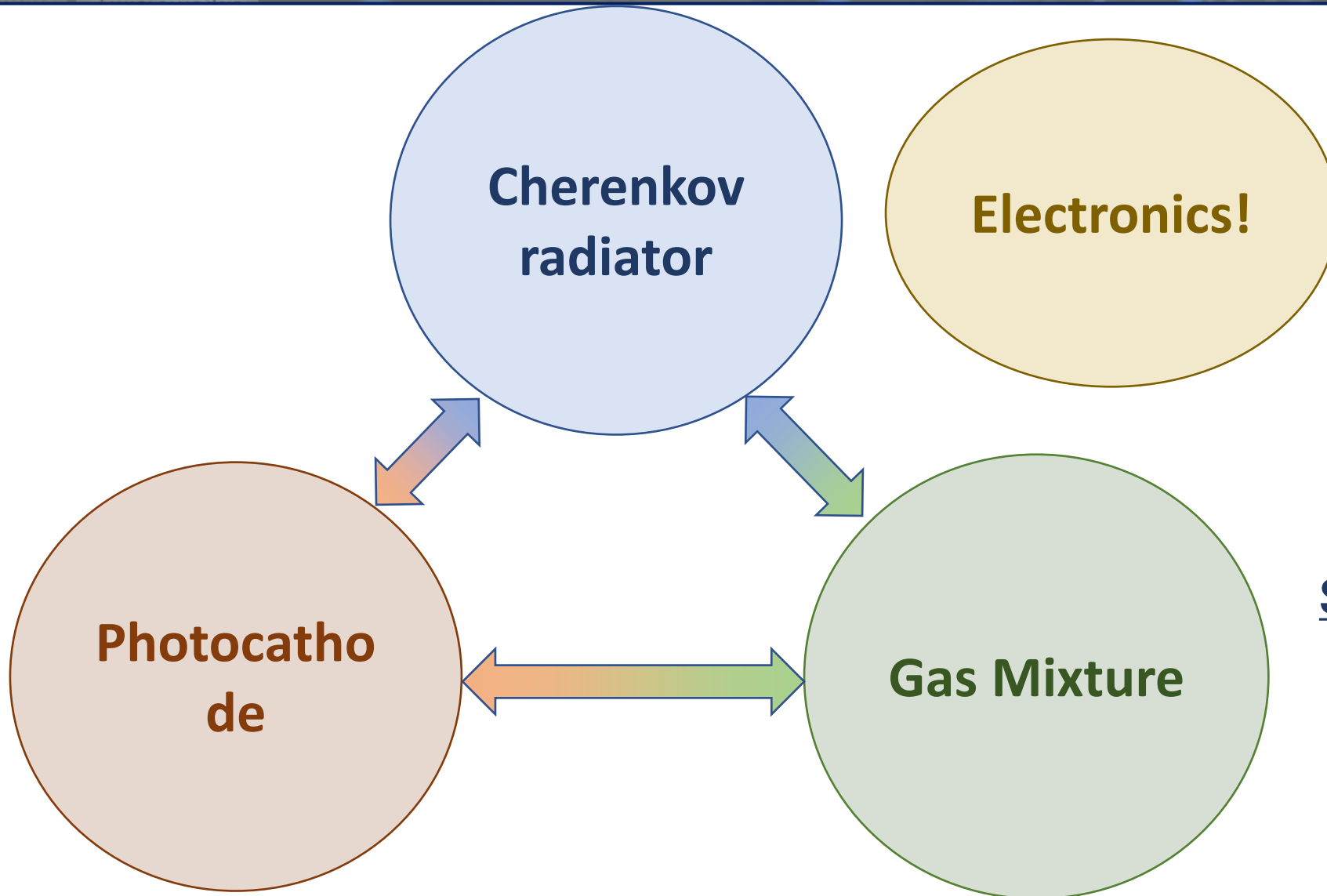
**Simulated Hit rate**

Muon Collider 1.5 TeV - Photon Hit Rate vs  $\theta$



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Picosec can operate in high-rate environments and give timing information with higher precision wrt other technologies  
**POTENTIALLY**



**Still, a lot of work to do!**

**BASELINE DETECTOR  
engineered up to a  
10x10!!!**