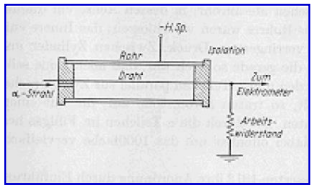


WP13 – TASK 13.2.5

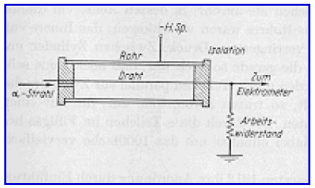
TASK 13.2.5

Development of high-gain MPGDs based on advanced THGEMs and hybrid MPGDs

TASK COORDINATOR: Silvia Dalla Torre

PARTICIPANTS: INFN - Trieste

HIGH-GAIN MPGDs

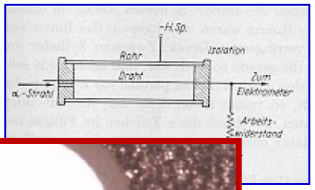


STATUS & PERSPECTIVES – 1

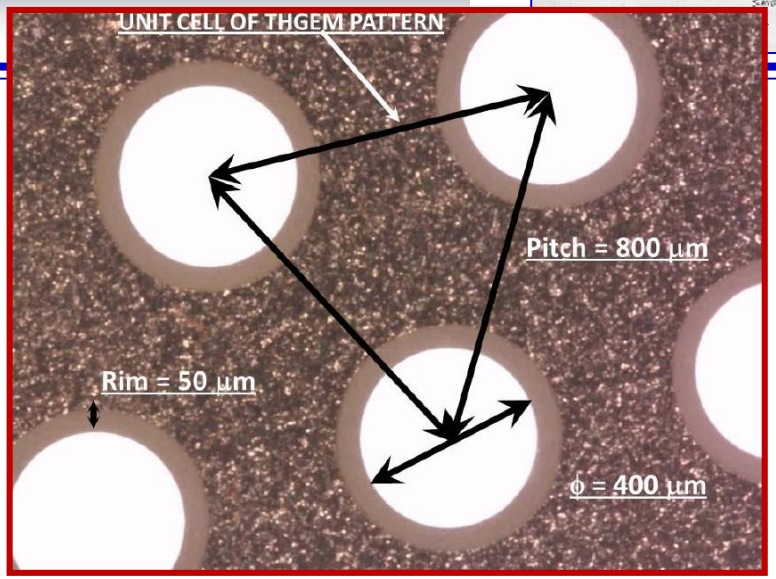
- **MPGD GAIN FIGURES IN RUNNING EXPERIMENTS**
  - MICROMEGAS trackers at COMPASS: G ~ 6400 (D Thers et al., NIMA 469 (2001) 133)
  - MICROMEGAS TPC R-O at T2K TPC: G ~ 1500 (N. Abgrall et al., NIMA 637 (2011) 25)
  - GEM trackers at COMPASS: G ~ 8000 (B. Ketzer, private comm.)
  - GEM trackers at LHCb: G ~ 4000 (M.Alfonsi NIMA 581 (2007) 283)
  - GEM trackers at TOTEM: G ~ 8000 (G. Catanesi, private comm.)
  - GEM photodetectors at Phenix HBD: G ~ 4000 (W. Anderson et al., NIMA 646 (2011) 35)

- **LARGER GAIN perspectives**
  - MPGDs with WELL-architectures, gain goals up to 10^5:
    - GEM based as in task 13.2.4 and in a CERN-BARI R&D
    - THGEM-based developed at Weizman
  - WP13-TASK 14.2.5 (this task), gain goal up to O(10^6):
    - By hybrid architectures (THGEM + MICROMEGAS) and improved THGEMs

HIGH-GAIN MPGDs

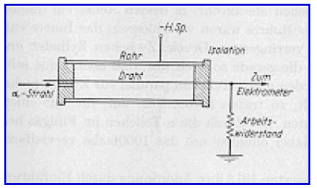


STATUS & PERSPECTIVES – 2

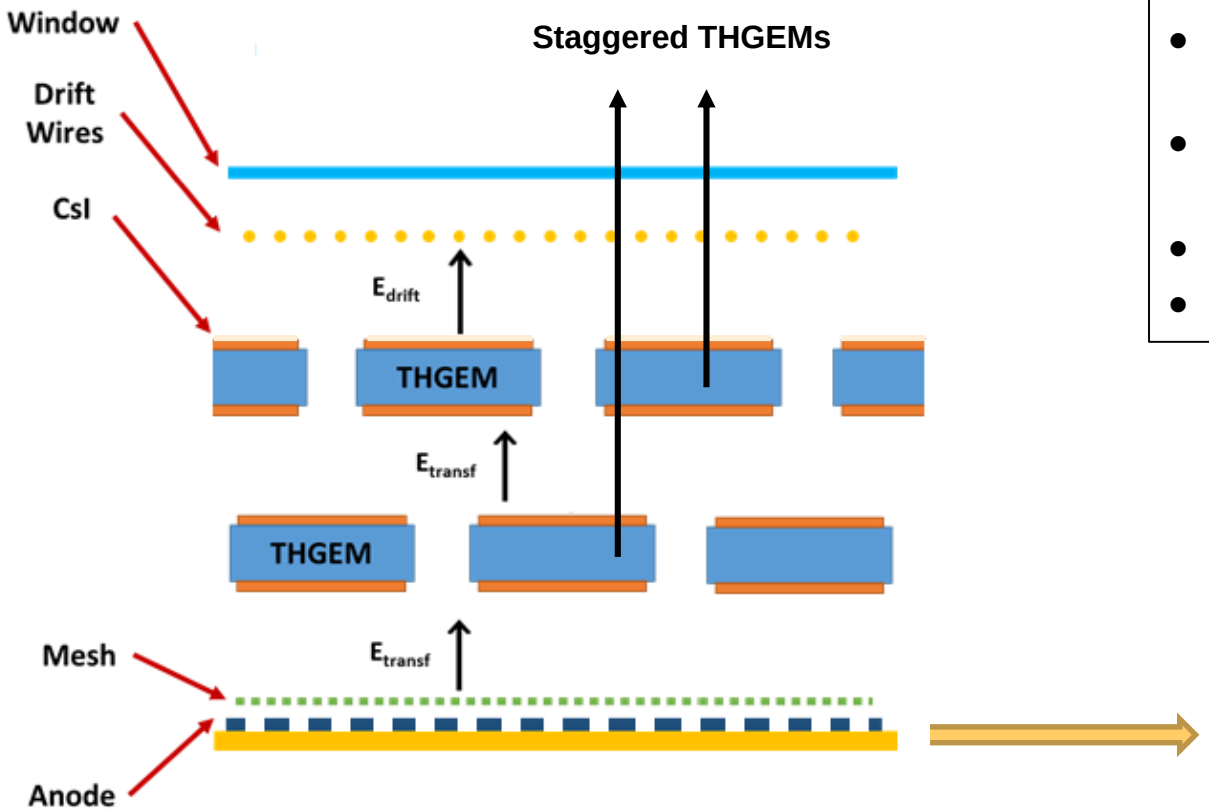


- **THGEMS (also called LEMs)**
  - introduced in // by different groups:
    - L. Periale et al., NIM A478 (2002) 377.
    - P. Jeanneret, PhD thesis, Neuchatel U., 2001.
    - P.S. Barbeau et al, IEEE NS50 (2003) 1285
    - **R. Chechik et al., NIMA 535 (2004) 303**
  - **deep studies of characterization & development by the Weizmann group**
  - **further characterization and engineering towards large size by the INFN-Trieste group:**
    - **Geometrical parameters, in particular the role of the rim**
    - **Advantages and limitations of the standard PCB approach**
    - **Polishing protocol to raise the discharge limit**
  - **Other approaches**
    - **glass GEMs by Photo Etchable Glass (University of Tokyo)**
  - **WP13-TASK 14.2.5 (this task), progress in THGEM technology**
    - **By improved production process and novel materials**

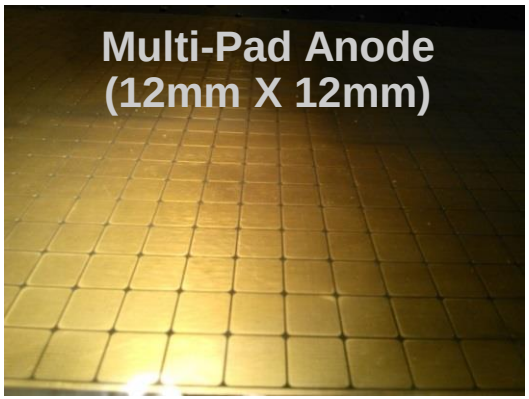
OUR APPROACH TO HIGH GAIN



Hybrid Detector (2 x THGEMs + Micromesh)

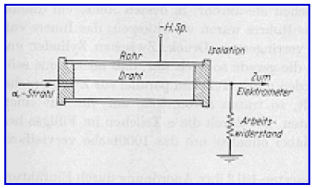


- Simple; robust; cheap;
- Signals → Electrons drift → $\sigma \approx 10\ ns$;
- Cascade → high gain, **present figure: $G \approx 10^5$ in beam**
- IBF $< 5\%$;
- Stability: time & high rates



Double THGEM: t = 0.4 mm; p = 0.8 mm; h = 0.4 mm

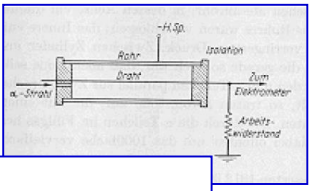
APPLICATIONS



- **Large gain-values**
  - facilitate the detection of signals when the initial charge is modest, in particular in case of single photon detection where a single photoelectron must be detected
  - make it possible the use of simple, digital read-out systems, making affordable both from the point of view of the costs and from that of the simplicity
    - large detection systems and
    - applications beyond fundamental research.

- **Another relevant feature is the use, as first multiplier, of a rigid element, namely the THGEM substrate:**
  - this element is the ideal substrate of converting layers, as required both for photon detection and neutron detection.

PLANNING



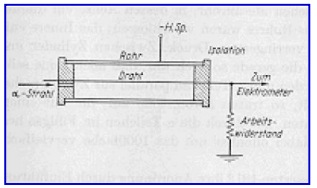
- **1st YEAR**
  - ACTIVITY: Detailed characterization of the discharge sources in the hybrid MPGD architecture and discharge propagation in the hybrid MPGD architecture
  - MILESTONE: ready to publish the obtained results, M12
- **2nd YEAR**
  - ACTIVITY: New candidate materials for THGEM substrate and improved production techniques are qualified by THGEM prototyping.
  - MILESTONE: **MS13.4**, Qualification of the new candidate materials for THGEM substrate, M26, Report to StCom

OFFICIAL MILESTONE

- **3rd YEAR**
  - ACTIVITY: The qualification of the new candidate materials for the high-gain performance of hybrid MPGDs is demonstrated by small size prototyping. Resistive MICROMEGAS will be employed
  - MILESTONE: M36, ready to publish the obtained results
- **4th YEAR**
  - ACTIVITY: An engineered large-size high-gain hybrid MPGD prototype is realised and validated by laboratory and test-beam measurements
  - MILESTONE: **D13.5**, Prototype of a large-size high-gain MPGD (a large-size fully engineered and validated prototype of the a high-gain MPGD), M44, DEM

OFFICIAL DELIVERABLE

1st YEAR ACTIVITY

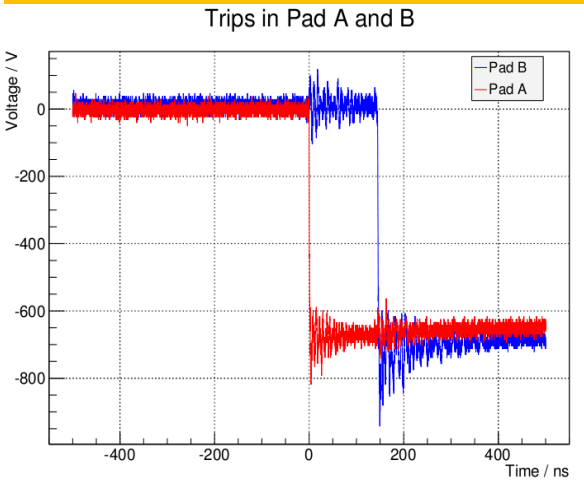


- **1st YEAR**
  - **ACTIVITY:** Detailed characterization of the discharge sources in the hybrid MPGD architecture and discharge propagation in the hybrid MPGD architecture

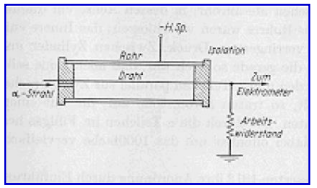
- **It includes:**
  - **Discharges in MM related to HV and gain**
  - **Propagation of discharges within the MM**
  - **Discharges in THGEM related to HV and gain**
  - **Propagation of discharges from a THGEM layer to the next one**
  - **Propagation of discharges between MICROMEGAS and THGEMS in a hybrid architecture**

- **Studies already started !**

Time and space correlation of trips in MICROMEGAS



COMPLEMENTARY RESOURCES



- **STAFF PERSONNEL from INFN**
  - 6 scientists at 20% over the four years of the AIDA2020 project
  - 2 units of technical personnel at 25% over the four years of the AIDA2020 project

- **Financial resources from INFN**
  - A 4-year project dedicated to R&D items in the MPGD sector is being submitted to INFN
  - It includes the high-gain hybrid MPGD task