Ion Feedback Suppression with MHSPs

(not entirely new ideas, originally developed for gas photomultipliers)

LCTPC Collaboration Meeting, March 26. 2012

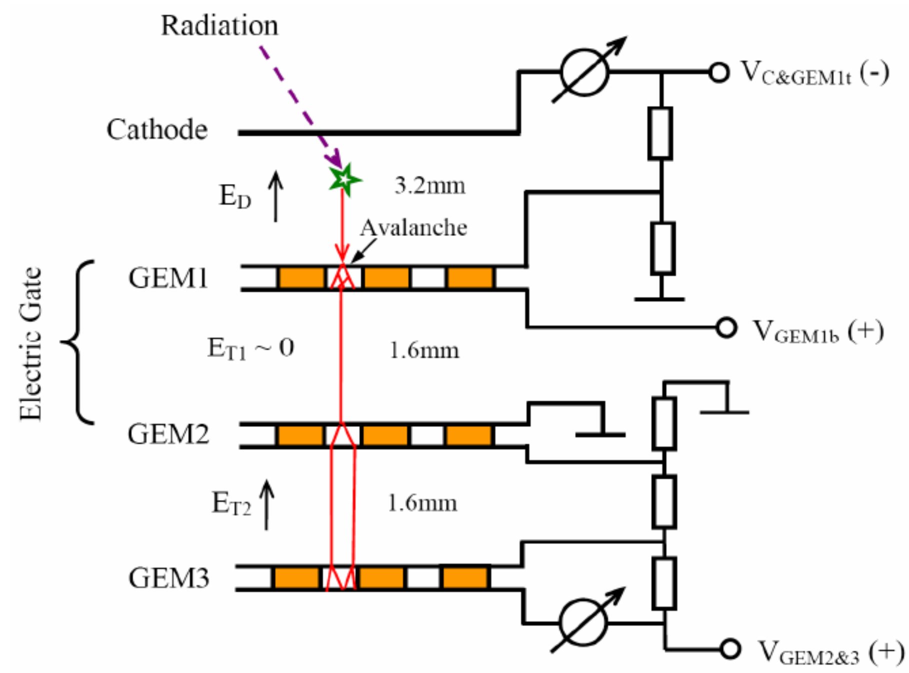
R. Diener, DESY

Definition

- Ion back flow:

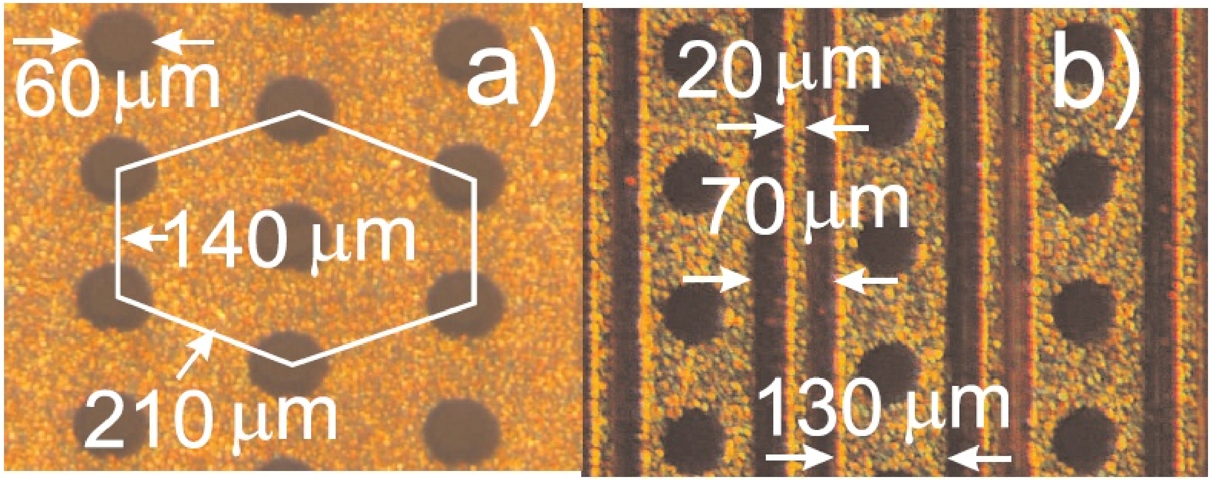
  $IBF = (I_C - I_{PI}) / I_A$

  I_C : cathode current
  I_{PI} : primary ionization current
  I_A : anode current

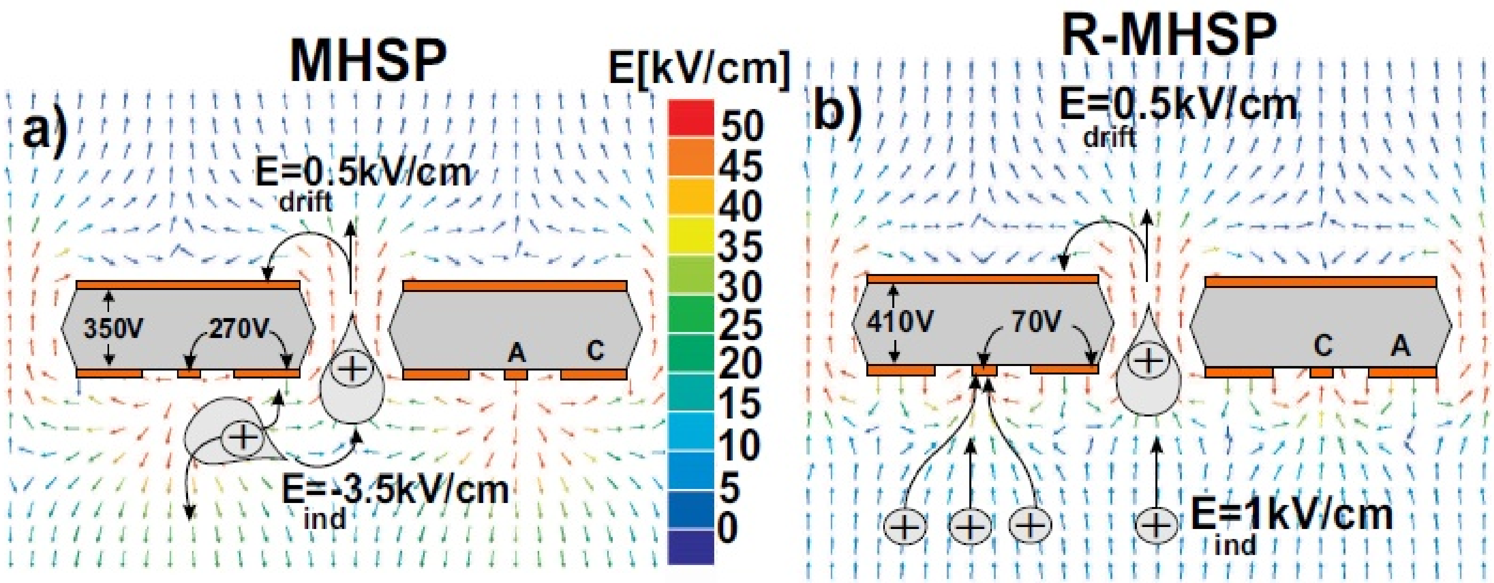


Micro-Hole & Strip Plates

- Micro-Hole & Strip Plates (MHSP): One side of a GEM with additional strips that can be run independently at different potential than the rest of the GEM



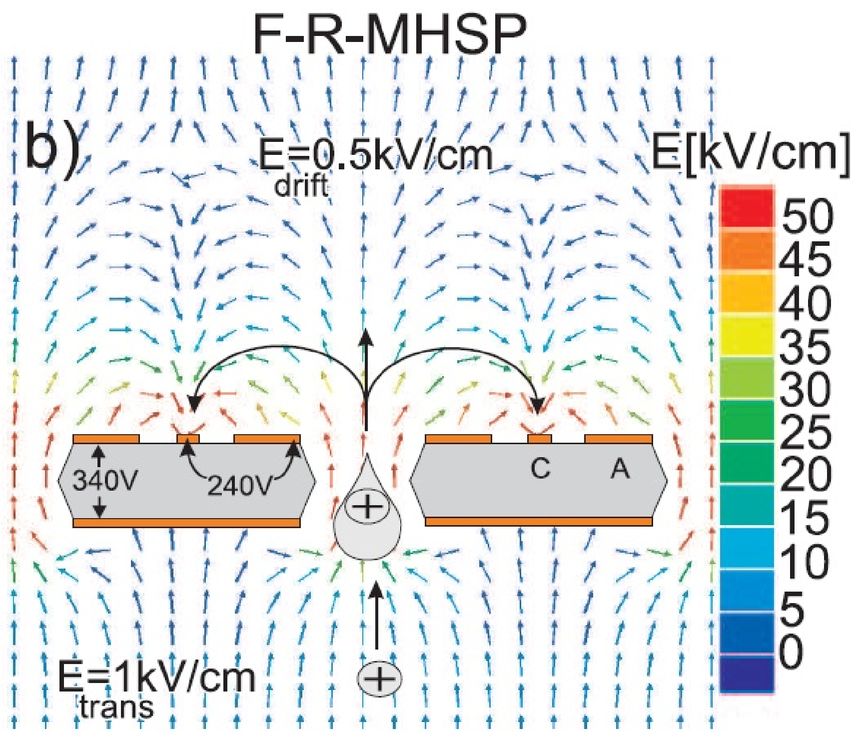
- Original idea: do additional amplification after the GEM hole
- Then: Reverse-bias to collect ions from previous amplif. stage (affects electron extraction, too!)

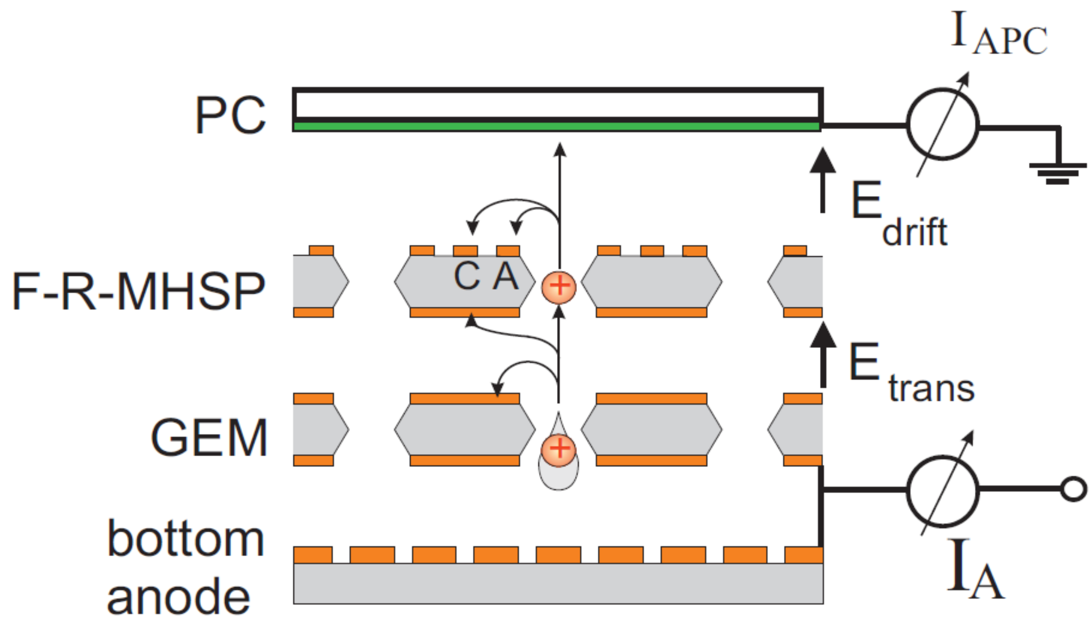


Micro-Hole & Strip Plates

A.V. Lyashenko et.al., 2007 JINST 2 P08004

- Next step towards better ion collection:
  "Flipped" Reversed-bias Micro-Hole & Strip Plates F-R-MHSP
- Catches also ions from 1st amplification stage

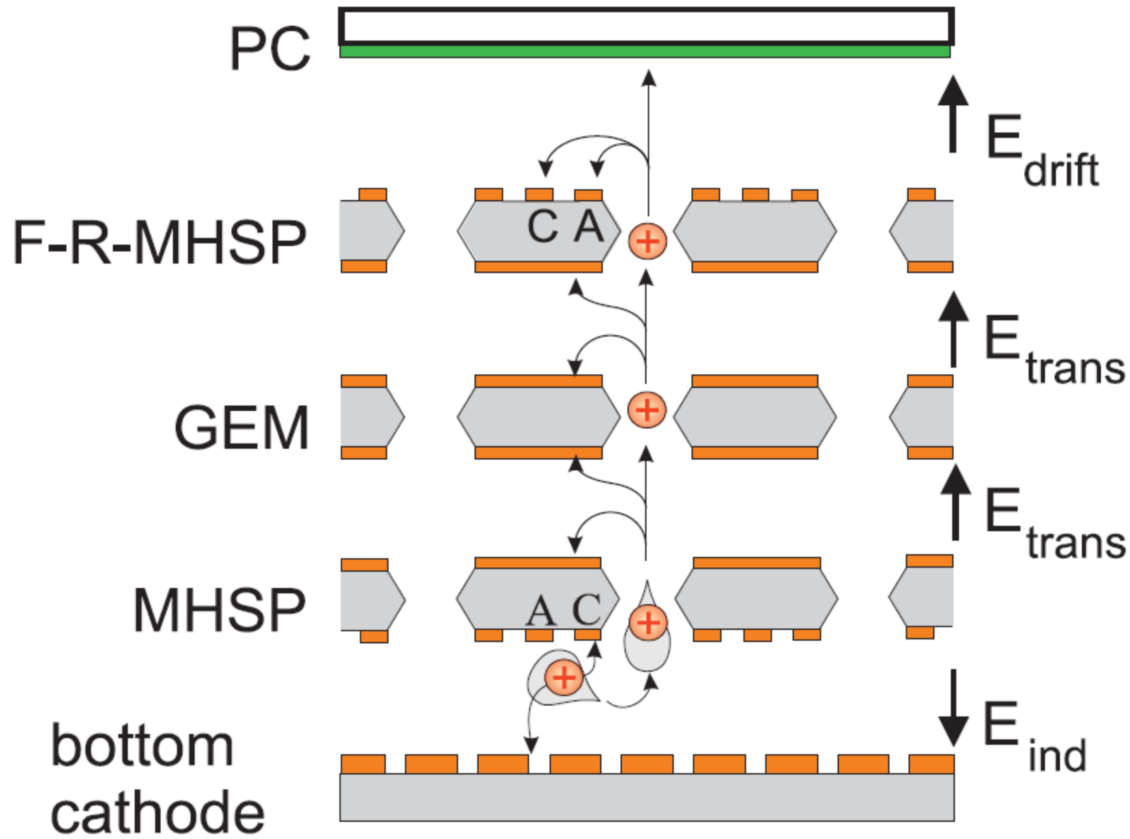




Micro-Hole & Strip Plates

A.V. Lyashenko et.al., 2007 JINST 2 P08004

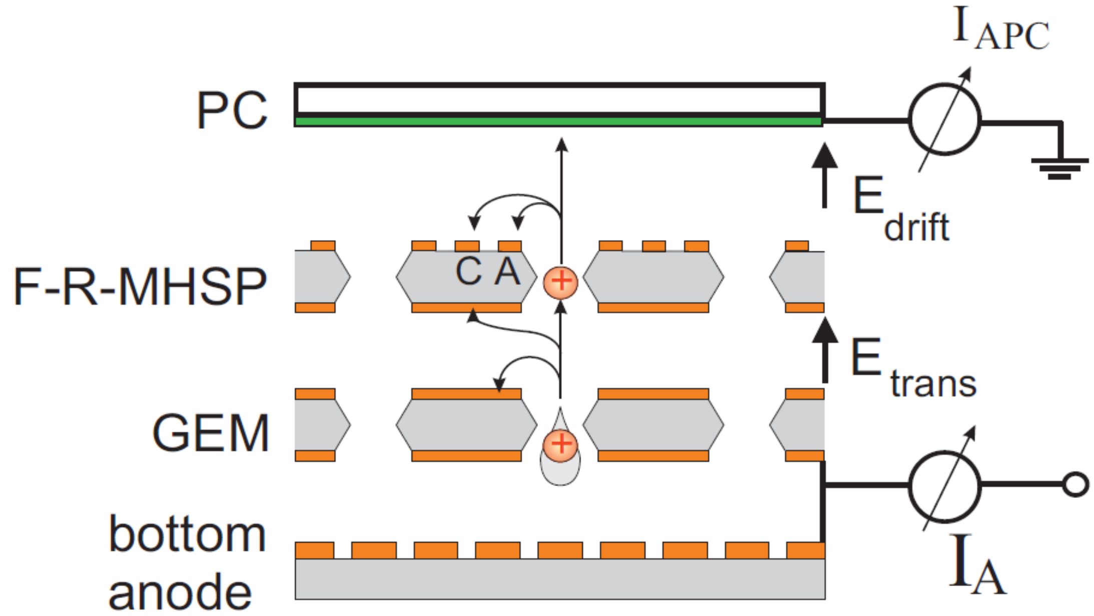
- Amplification setup: F-R-MHSP, GEM, MHSP
- 3 fold ion back-flow reduction by MHSP (closest to anode)
- F-R-MHSP on top:
  - same electron collection efficiency as normal GEM
  - 6-fold better ion back-flow suppression than GEM (2x better than R-MHSP)



- Total IBF value: ~1.5 10^{-4} at gain of 10^4 (drift field as in TPC ~200V/cm)
- Translates to:
  - less than 2 ions per avalanche electron drift back (8 for R-MHSP as first element)

Further Ideas

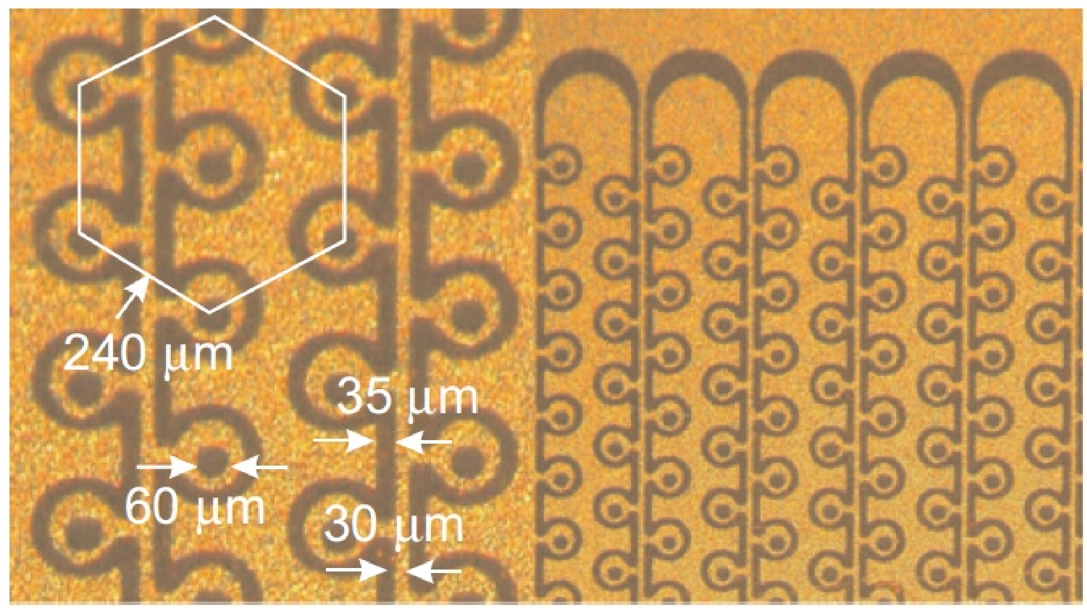
- Double sided R-MHSP



- Cobra GEMs

A.V. Lyashenko et.al., 2009 NIMA 598, P116-120

  - Result from 2008:
    - better ion suppresion
    - BUT only 20% electron collection efficiency!
  - Better with optimized pattern?



Conclusion

- Next steps:
  - Collect more information
  - CST/Garfield++ Simulations
  - Possible collaboration with TU Munich group (working on high rate TPCs) to measure properties