MCP Godparents Meeting

Oct 4, 2010

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Outline

- **Accomplishments** to date
- **Status** of your work on the project now
- Your view of **future** work
- Problems, challenges you either face now or foresee in the future

OPTION YEAR 2: Large Batch

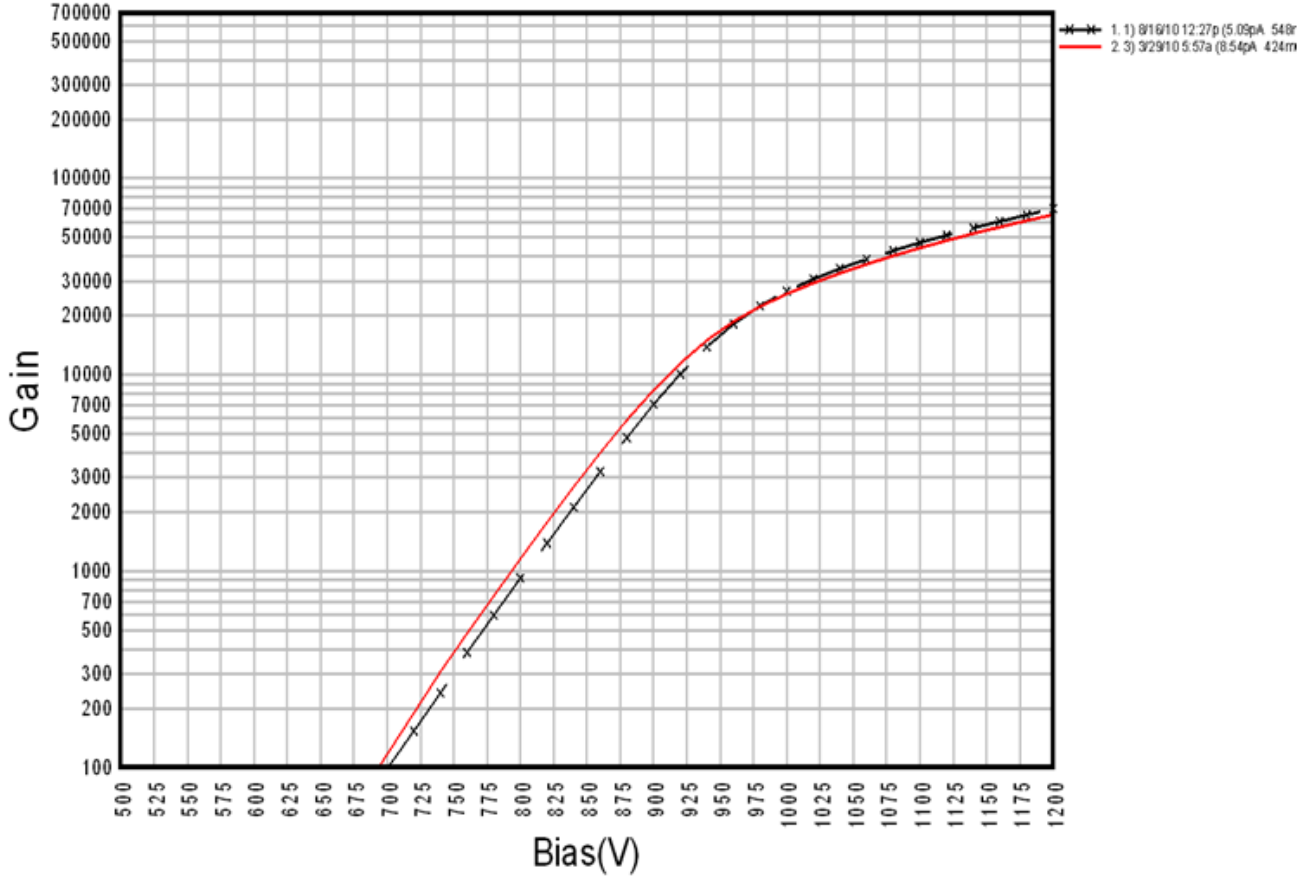
- Objective: To understand & document the problems & solutions functionalizing large surface area batches (limited by capacity of ALD process tool) of small format GCA substrates (33mm OD; 20um pore diameter; 8 degrees bias; 60:1 L:D 2)
- Work Plan Detail:
  - Uniformity tests of batch processing of small form factor AAO or capillary glass substrate MCPs
    - Resistive film (R2) and emissive film (D2) processes on Argonne-supplied 33mm dia AAO and/or glass capillary plates resulting in resistance optimization at 500 MΩ for the specified geometry. Other sizes and geometries of the same (non-testable) substrate may be added to meet the area goals, commensurate with the capability of the Arradiance tools.
      - A progressive sequence of at least 3 runs with a quantity of non-testable plates to simulate the 65-square meter area of the 8”-square design MCP’s, with six or more 33mm active, testable plates per batch to measure uniformity of resistance and gain on each plate and from plate-to-plate.
      - Perform measurements of resistance, gain and uniformity of the testable plates in each run between each of the above runs.
      - Write a report on the problems encountered with large-area functionalizing , and the evolution of solutions/

OPTION YEAR 2: Large Batch - Deliverables

- Initial report and test data of all results from the first run of the study of problems and solutions achieving uniformity in a high surface area production process of resistance and gain on small format (33mm) AAO and/or glass capillary substrates of pre-determined geometry.
- At least 6 active testable 33mm Argonne-supplied substrates [AAO or GCA per schedule below] per run coated in a high surface area environment (total of at least 18).
- Final report and test data of all results from the study of problems and solutions achieving uniformity in a high surface area production process of resistance and gain on small format (33mm) AAO and/or glass capillary substrates of pre-determined geometry

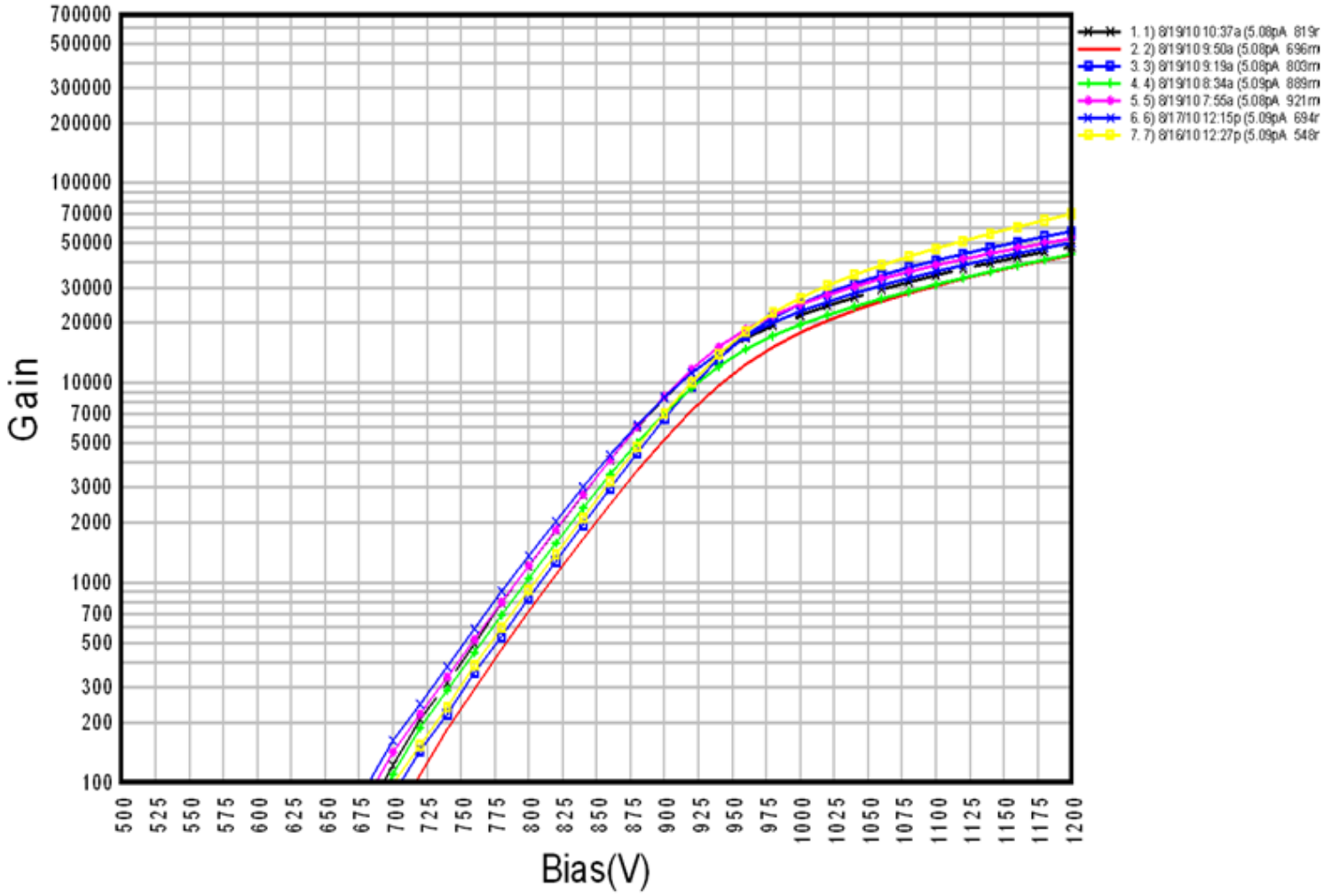
OPTION YEAR 2: Large Batch - Results

- Arradiance GEM R2D2 ALD process equipment 33mm capacity is 14 plates / batch. MCP surface area of approximately 1.88 m^2 as compared to 5.1 m^2 for the 8”x8” LAPD MCP device.
- Target lots (single testable device run with 13 “dummy” MCP plates). MCP met the target 500 MΩ resistance with nominal gain behavior.



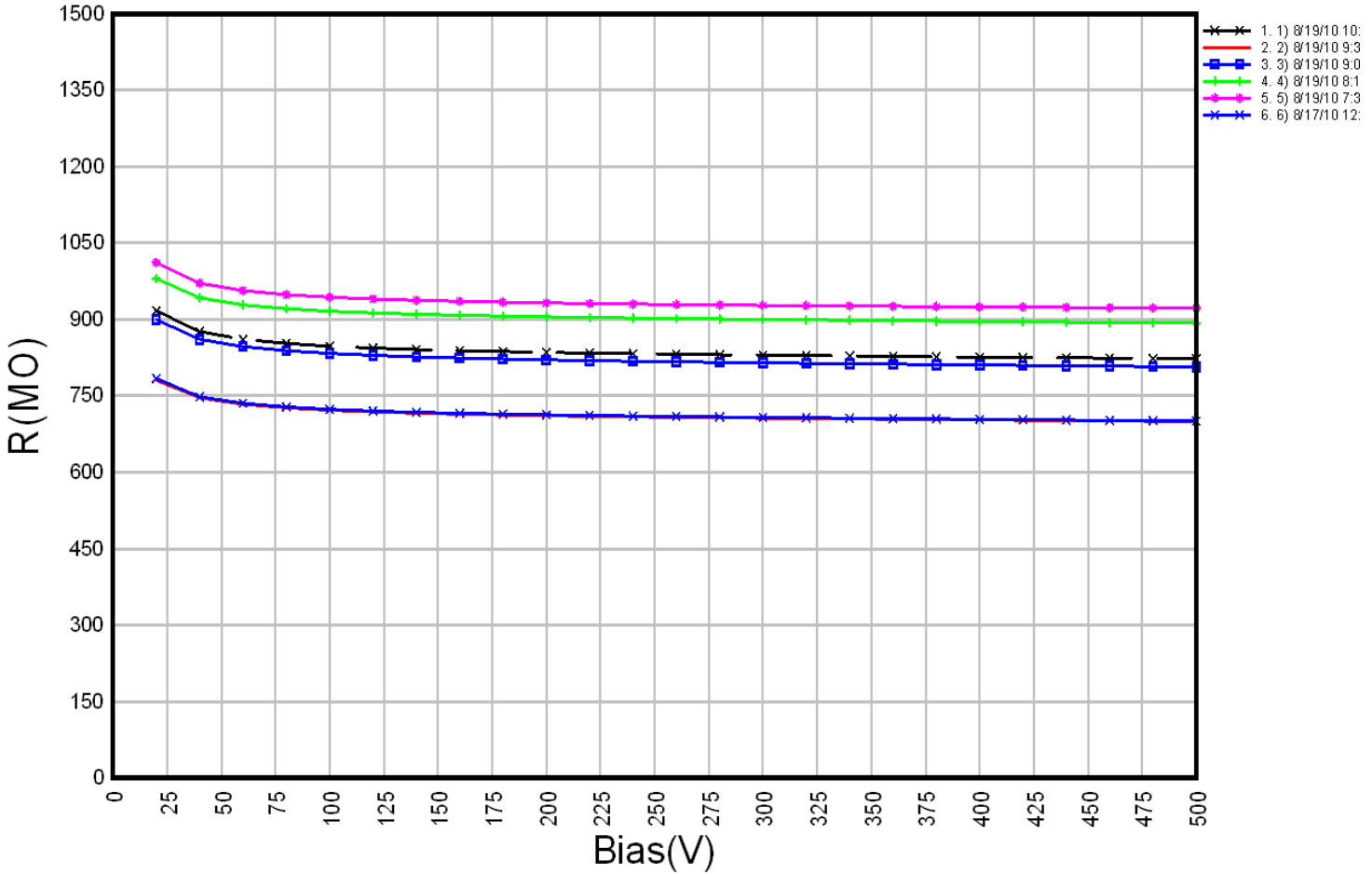
OPTION YEAR 2: Large Batch - Results

- 14 MCP wafers, 6 of which were testable



OPTION YEAR 2: Large Batch - Results

- Resistance demonstrated an offset from pilot run greater than 250 MΩ (average) with 1sigma of 100 MΩ.



OPTION YEAR 2: Large Batch – Next steps

- Plans for second uniformity run:
  - The resistance "offset" of the 6 wafer run from the pilot run will be studied using additional pilot runs to understand the root cause of the offset.
  - Several wafer pilot runs using 2 or 3 testable MCPs may be run to examine resistance uniformity as a function of chamber placement and ALD exposure and dose conditions.
  - Following this optimization the second uniformity run will be processed.

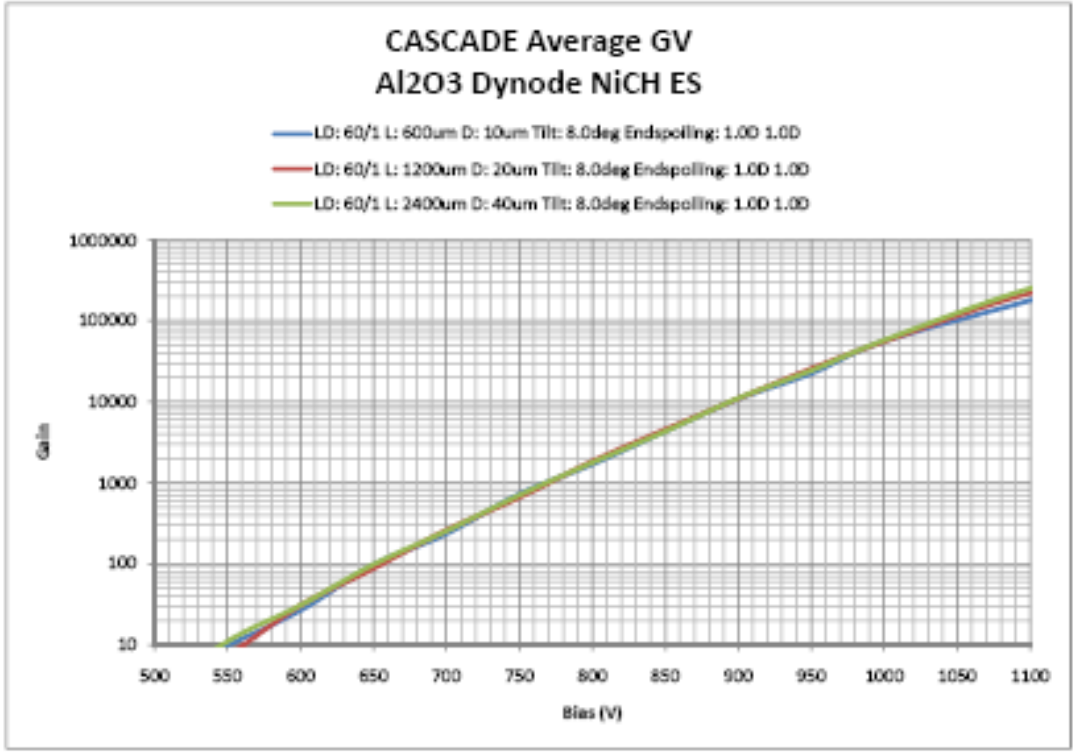
OPTION YEAR 2: Simulation

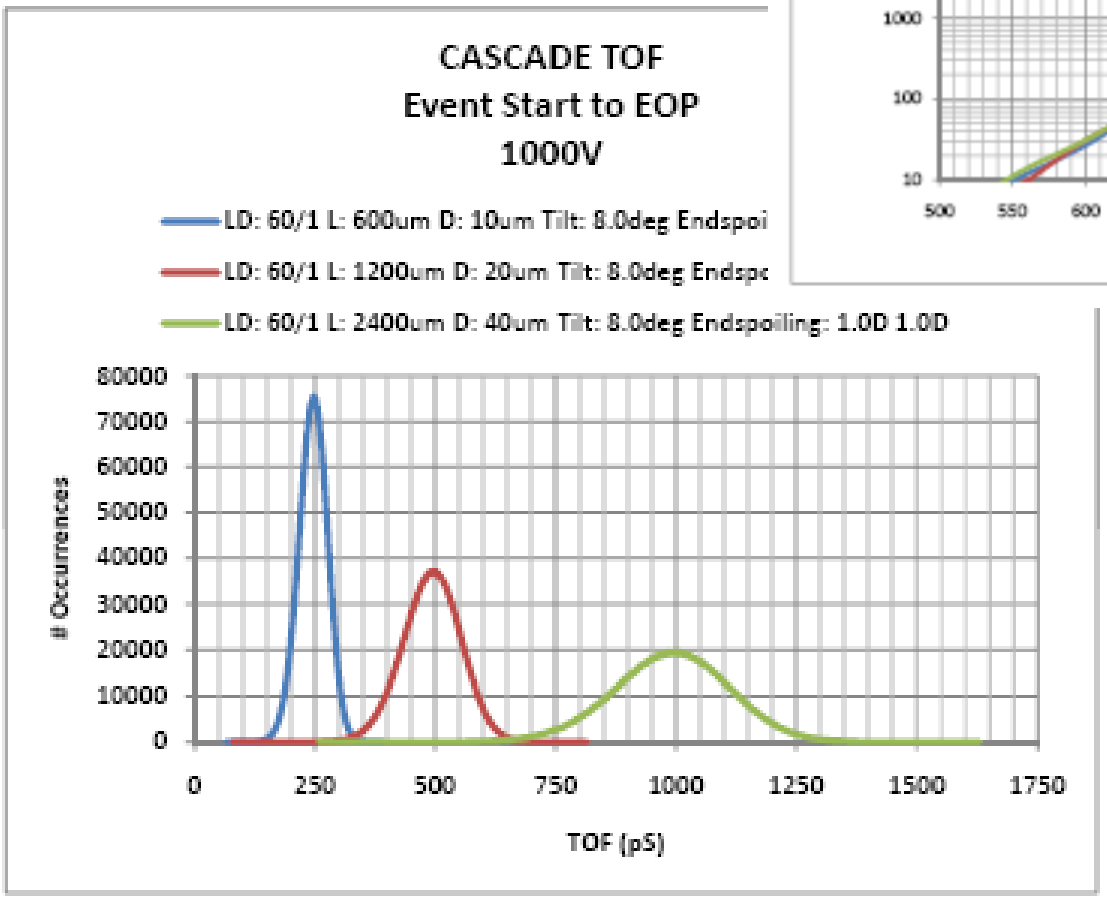
- Objective: To compare with and validate the simulation codes of Arradiance and the LAPPD collaboration for electron multiplication in microchannel pores. Work Plan
  - A simulation of the shower development in the default LAPPD 20-micron glass pore, with a comparison of gain, TTS, number of strikes, and angles and energies of selected strikes, to plates with the same parameters but with 10 and 40 micron p pores.
- Deliverable:
  - Final report and simulated data from the simulation study on the role of pore size.

OPTION YEAR 2: Simulation - Summary of Results

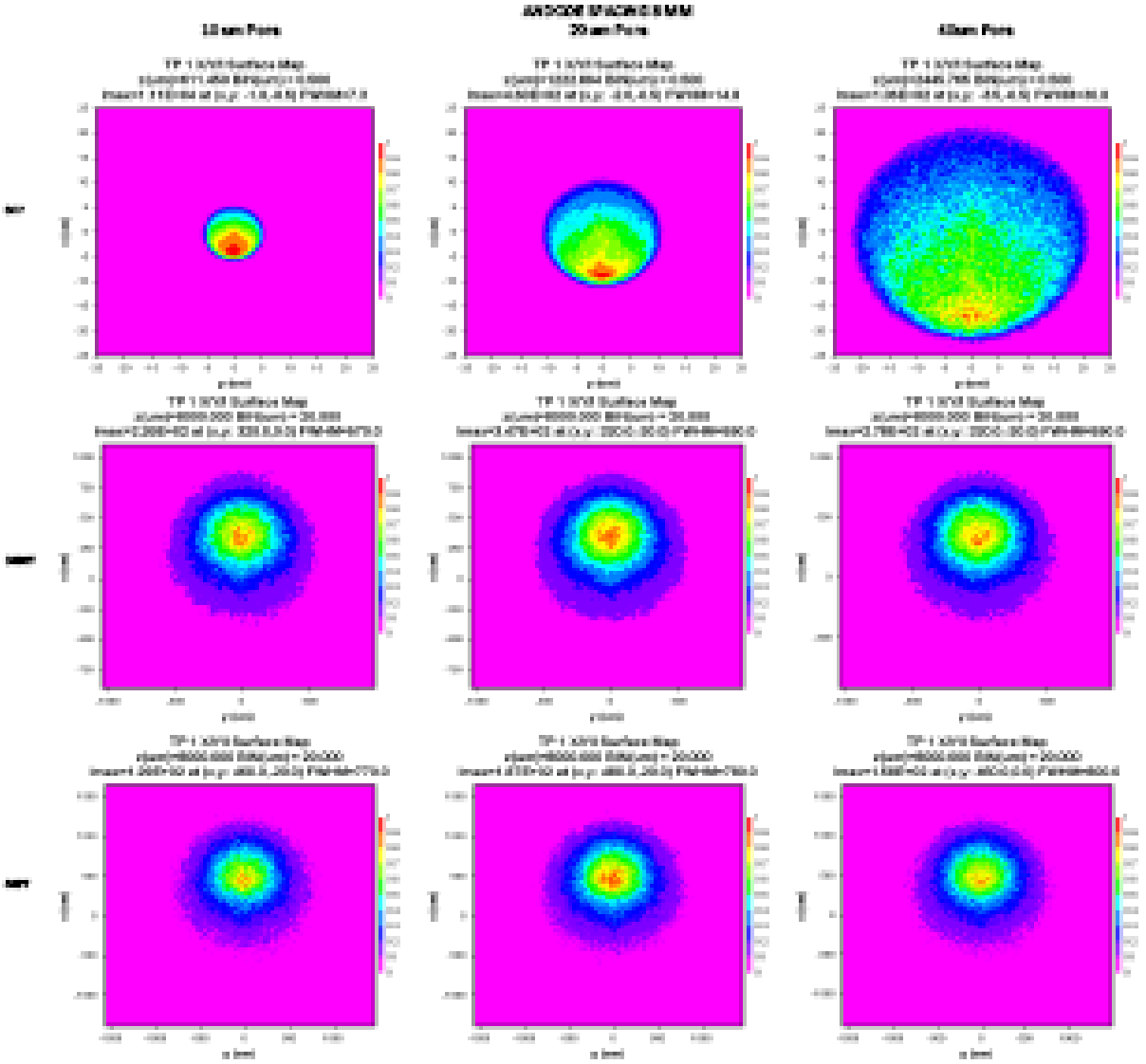
- The Transit Time Spread (TTS) changes dramatically between 10, 20 and 40 um pores:
- At the pore output:
  - TTS = 75 ps, 175 ps and 275 ps for 10, 20 and 40 um pores
- At the anode 8mm away with 1000V accelerating rear field
  - TTS = 200, 250 and 350 ps for 10, 20 and 40 um pores
- There is very little difference in performance of MCP/anode combination between 10, 20 and 40 um pores in terms of:
  - - output gain
  - - output kinetic energy of electrons
  - - output angular distributions
  - - charge footprint at the anode 8mm away from MCP

Simulation - Results





Simulation - Results



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