Muons, Inc.

Argonne NATIONAL LABORATORY

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Psec Collaboration Meeting

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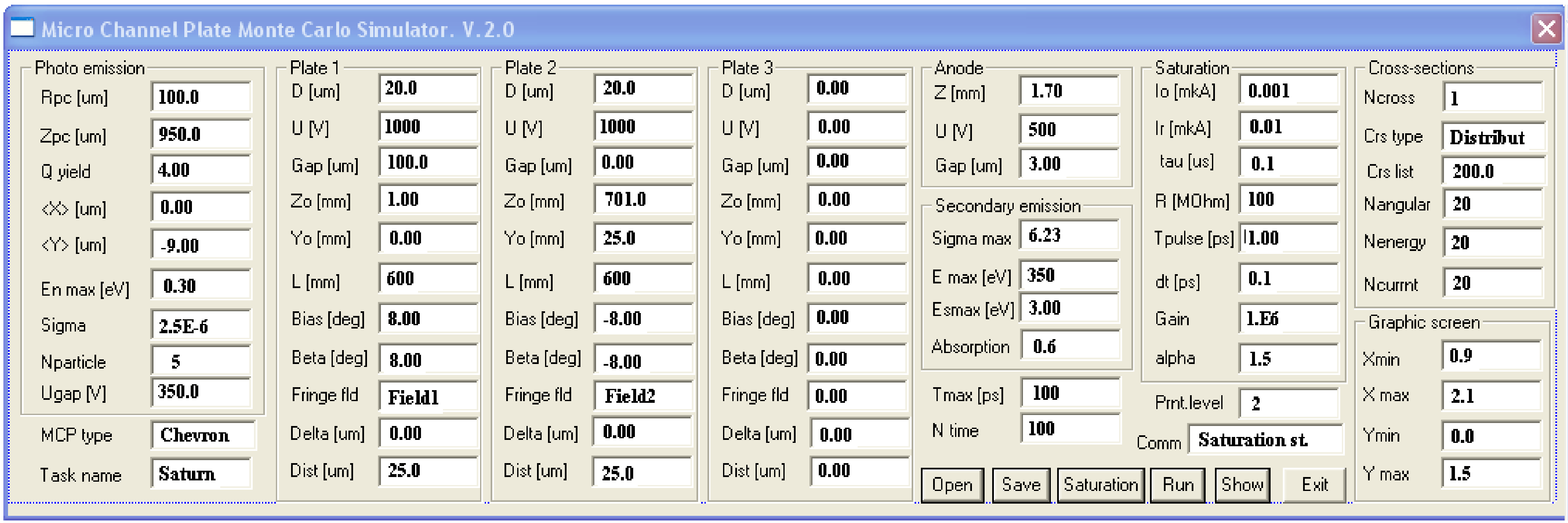
Computer code “Monte Carlo Simulator”, Windows Ver.2.0

The code MCS is full 3D simulator with friendly user’s interface and graphical post-processor. Numerical models include the angular, energy and spatial distributions for photo- and secondary emitters, fringe fields, saturation effects and other features representing different multi-layer materials. It can evaluate all parameters of realistic MCP devices: gain, transit time spread, angular, energy and spatial distributions of photo- and secondary electrons in pre defined cross-sections. Typical CPU-time for simulation of 1 million particles is 5 to 15 minutes at desktop or laptop computer with 1.8GHz CPU.

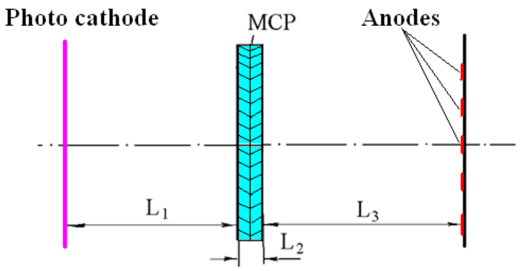
Integrated User's Interface



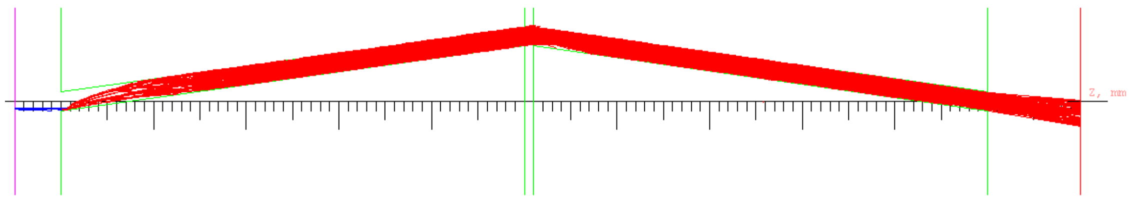
Using the Interface one can easily input/edit the data, run the problem, look at the graphical results, and repeat the computational cycle.

The effect of inter-plate gap variation

The normal way to reduce the saturation effects is to introduce the low-resistance layer coating the channel surface. Another way is to vary inter-plate gap of chevron pair or Z-stack in order to distribute the secondary electrons from one pore of 1-st plate to many channels of the 2-nd and 3-rd plates. By this way one can reduce the currents in each individual pore of last cascades, and keep the total gain.

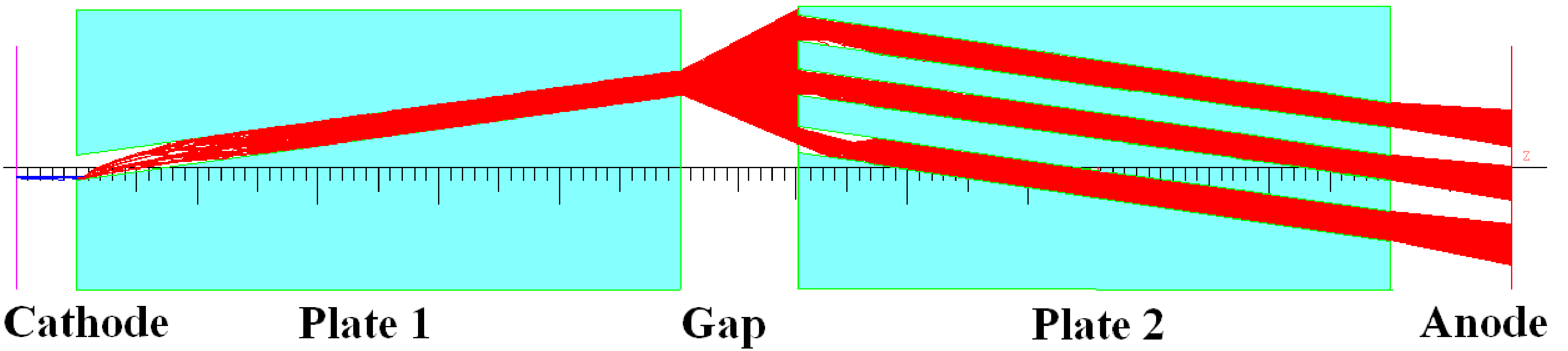


MCP amplifier sketch.



Small gap. Electrons from 1-st plate come to one pore of 2-nd plate. Gain M=1.2E6 for τ=1µs, and M=1.5E5 for τ=1ms. Blue – photo electrons; red – secondary electrons.

The effect of the gap variation (2)



Large gap. Electrons distributed to 3 pores of 2-nd plate. Gain M=3.4E6 for τ=1μs, and M=1.03E6 for τ=1ms.

MCP Specifications

Photocathode

direct photo-excitation on chrome electrode coating. No extraction voltage

Channel Plate Assembly

Voltage on MCP 1	800-1200 V
Gap Between MCPs	100 microns
Voltage across MCP Gap	none
Voltage on MCP 2	800-1200 V
MCP-Anode Gap	~8 mm
Volage on Anode Gap	800 V

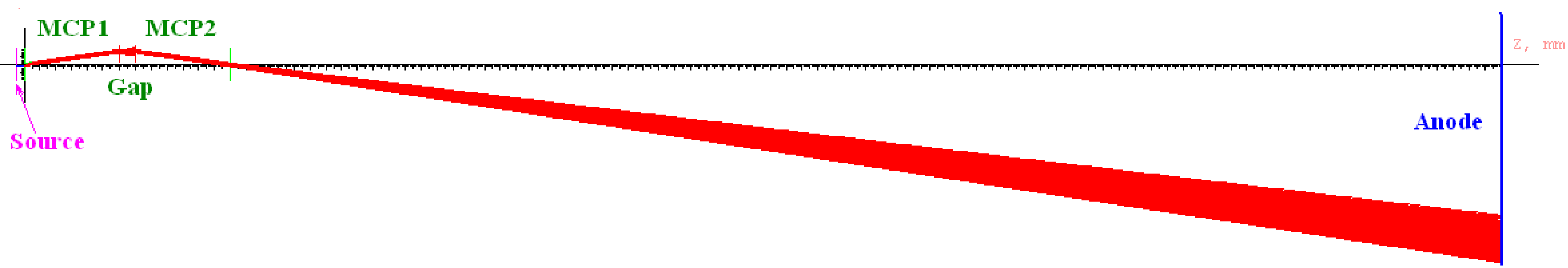
Channel Plates

MCP 72

pore diameter	thickness	L/D	open area ratio
20 micron	1.2 mm	60	60%
resistance	SEE material	bias angle	
1 GigaOhm	Al2O3	8 degrees	
electrode:	chrome layer on top of ALD		

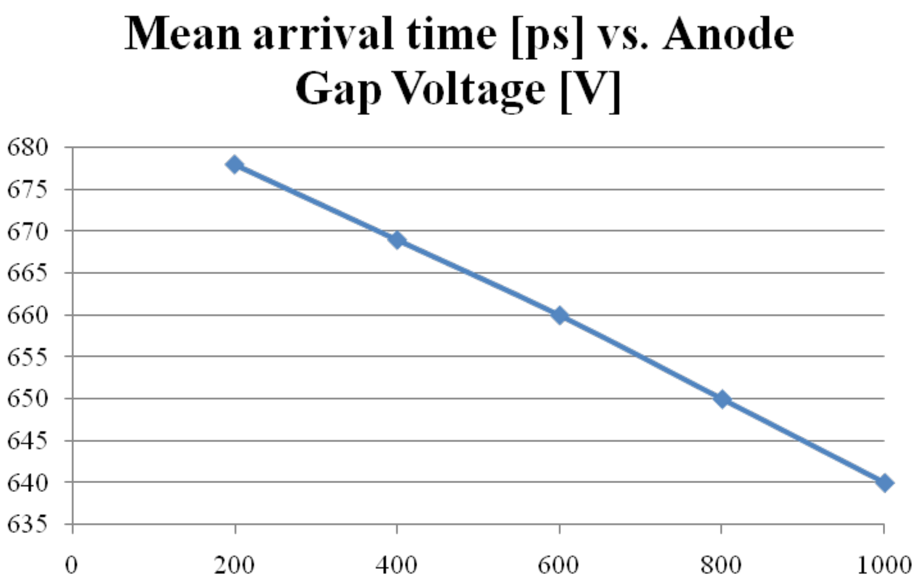
MCP 78

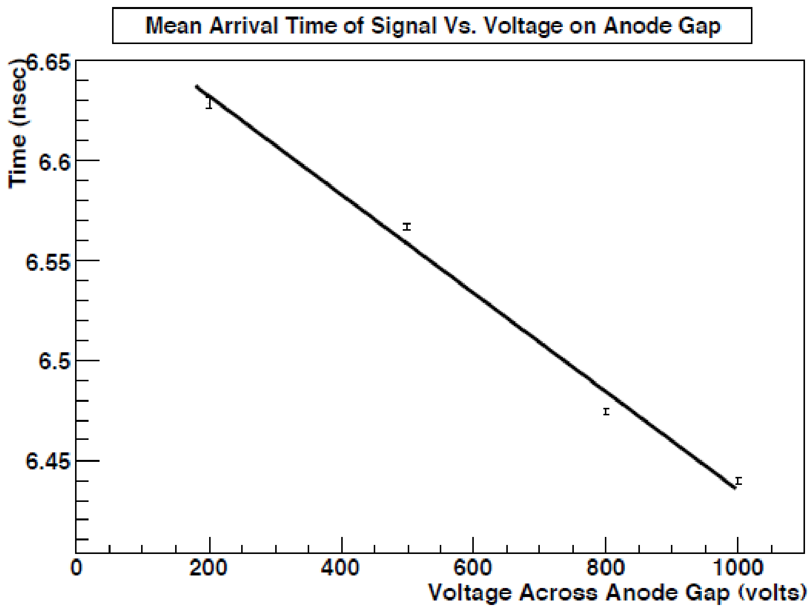
pore diameter	thickness	L/D	open area ratio
20 micron	1.2 mm	60	60%
resistance	SEE material	bias angle	
1 GigaOhm	Al2O3	8 degrees	
electrode:	chrome layer underneath ALD		



An example of the MCP simulation

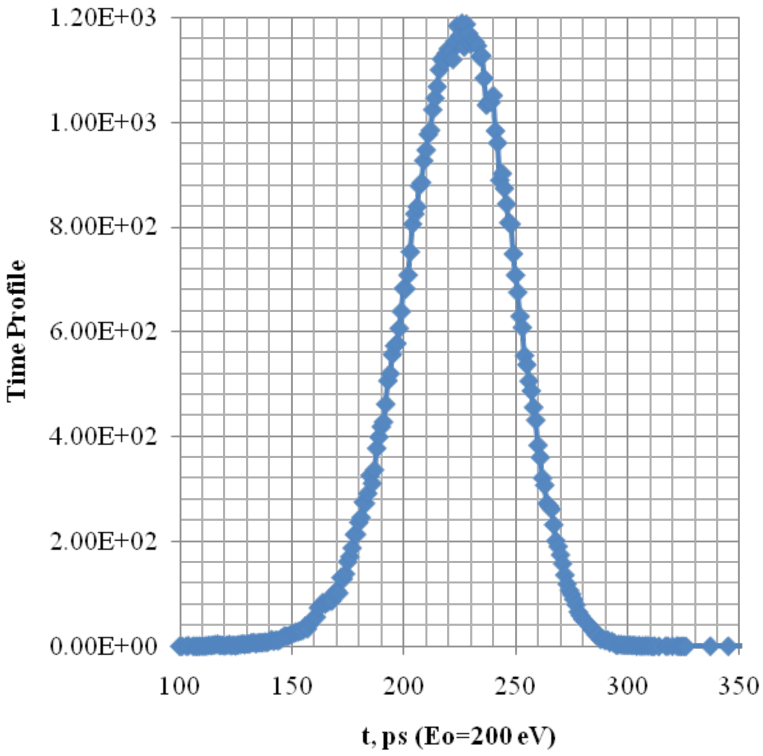
Simulation vs. experiment

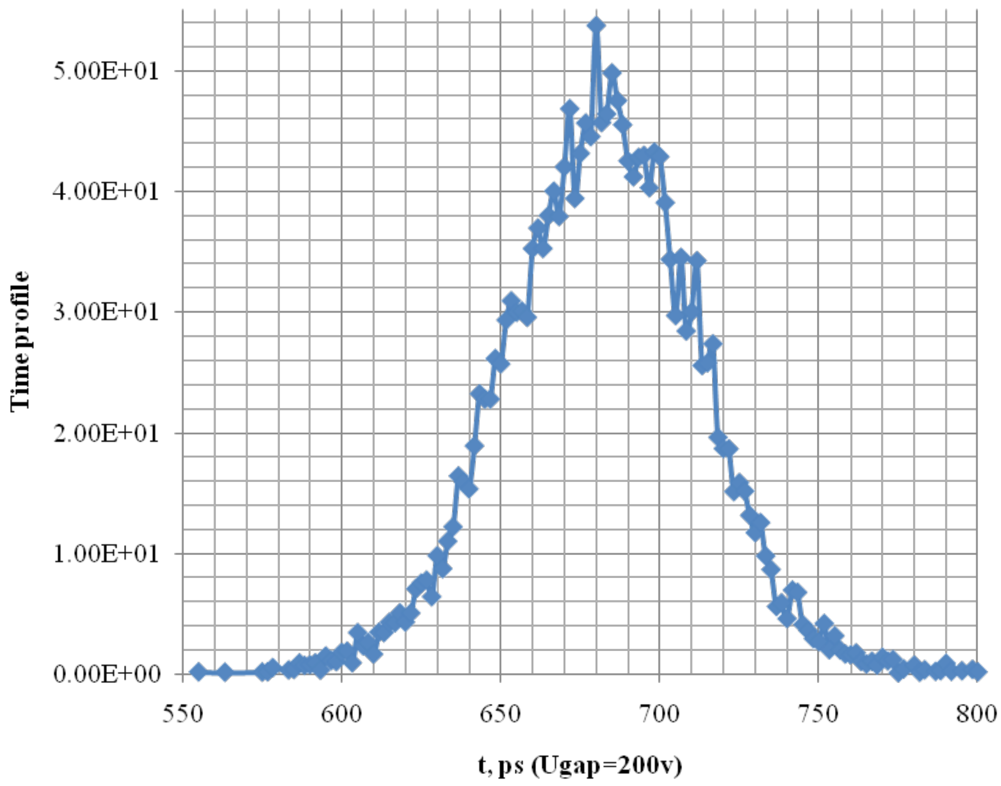




Simulations (left) & experiment (right) by M.Wetstein. Prorbable reasons for the diference are space charge effects or induced surface charges (saturation) .

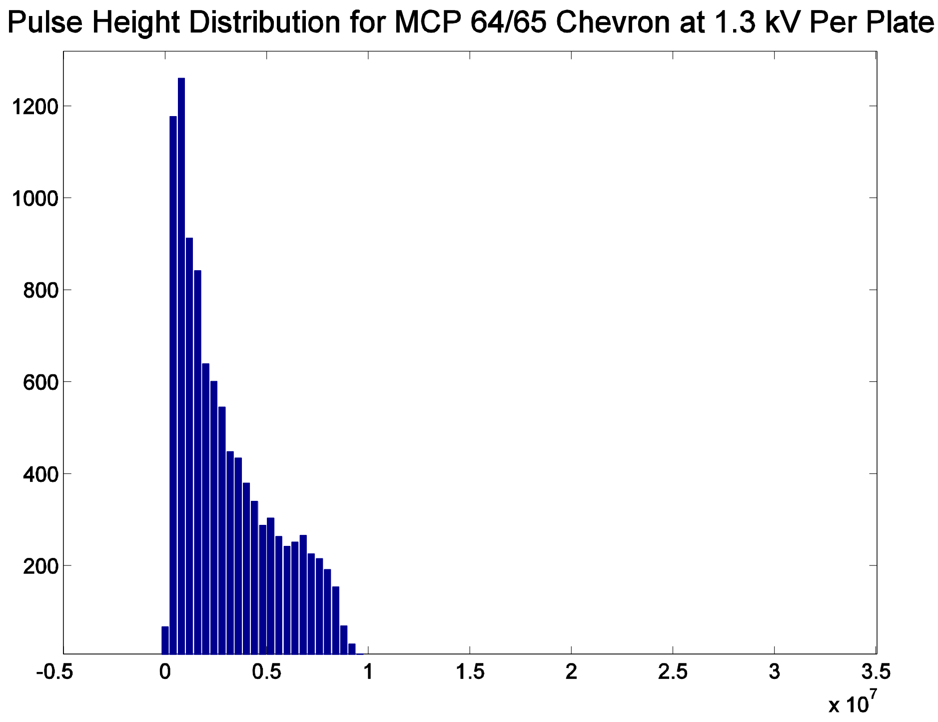
Evolution of the pulse shape





Time profiles for the pulse in the inter-plate gap (left) and at the anode (right)

Challenging problem for the future simulations



The experimental histogram shows the statistics of the gain distribution for a several thousand single photo electrons. In order to reproduce this statistics in simulations we should implement the parallel version of the code, because simulation of each event takes about 15 min. of CPU time.