Laboratoire d'Annecy-le-Vieux
de Physique des Particules

SPLAM in LCDET
R&D 2013

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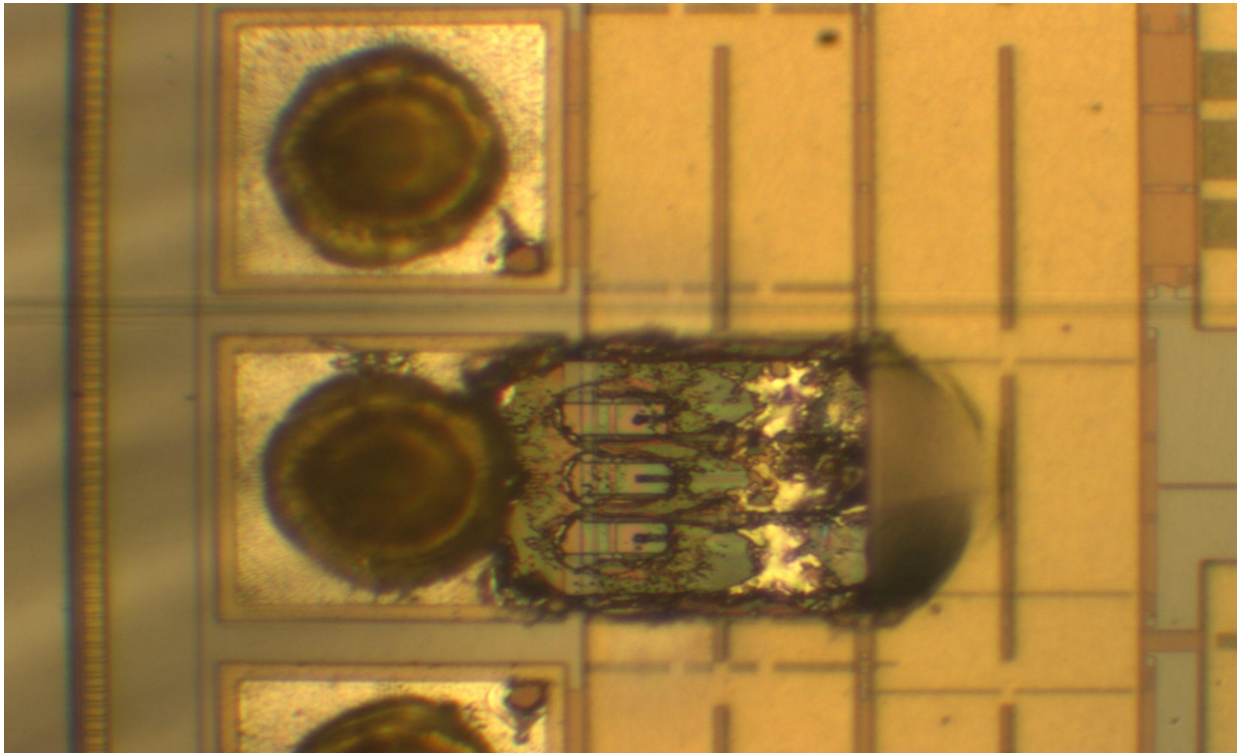
03/10/2012

Simulation model for discharges study in MPGD (µmegas)

Need to study discharges :
1)Understand physical mecanism of the discharges (energy released, dead time to recover voltage on the detector...)
2)Simulate electrical characteristics of a detector
3)Be able to design and optimise protection

in order to protect against that



Simulation model for discharges study in MPGD (μmegas)

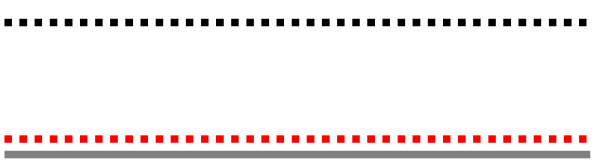
Configurations simulated

1 **Standard configuration :**

mesh

pad

gnd



2 **Capacitive configuration :**

mesh

upper pad

dielectric layer (12,5 μm Kapton)

pad

gnd

3 **Resistive configuration :**

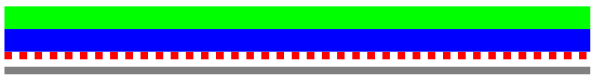
mesh

resistive layer

dielectric layer (75 μm FR4)

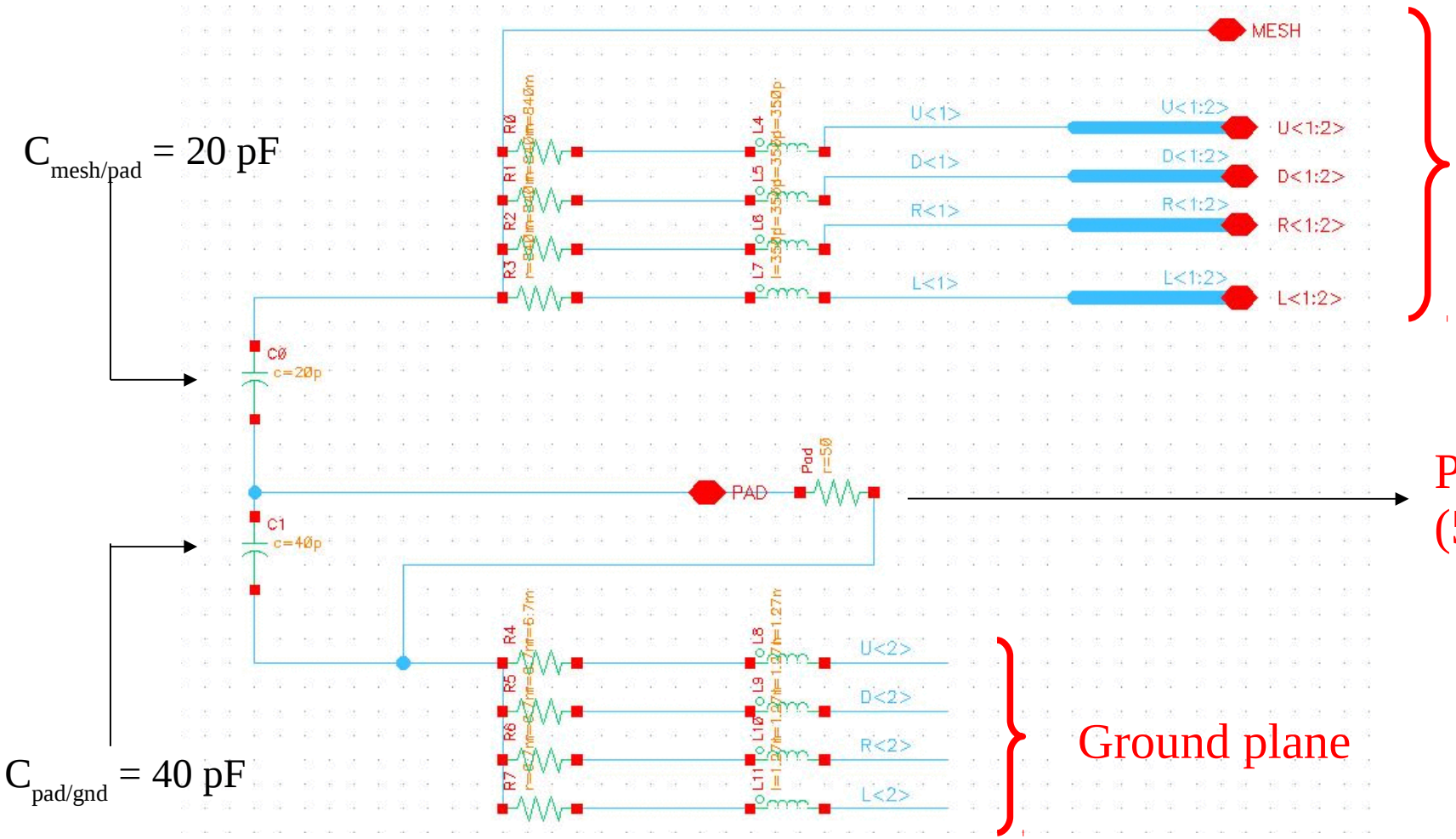
Pad

gnd



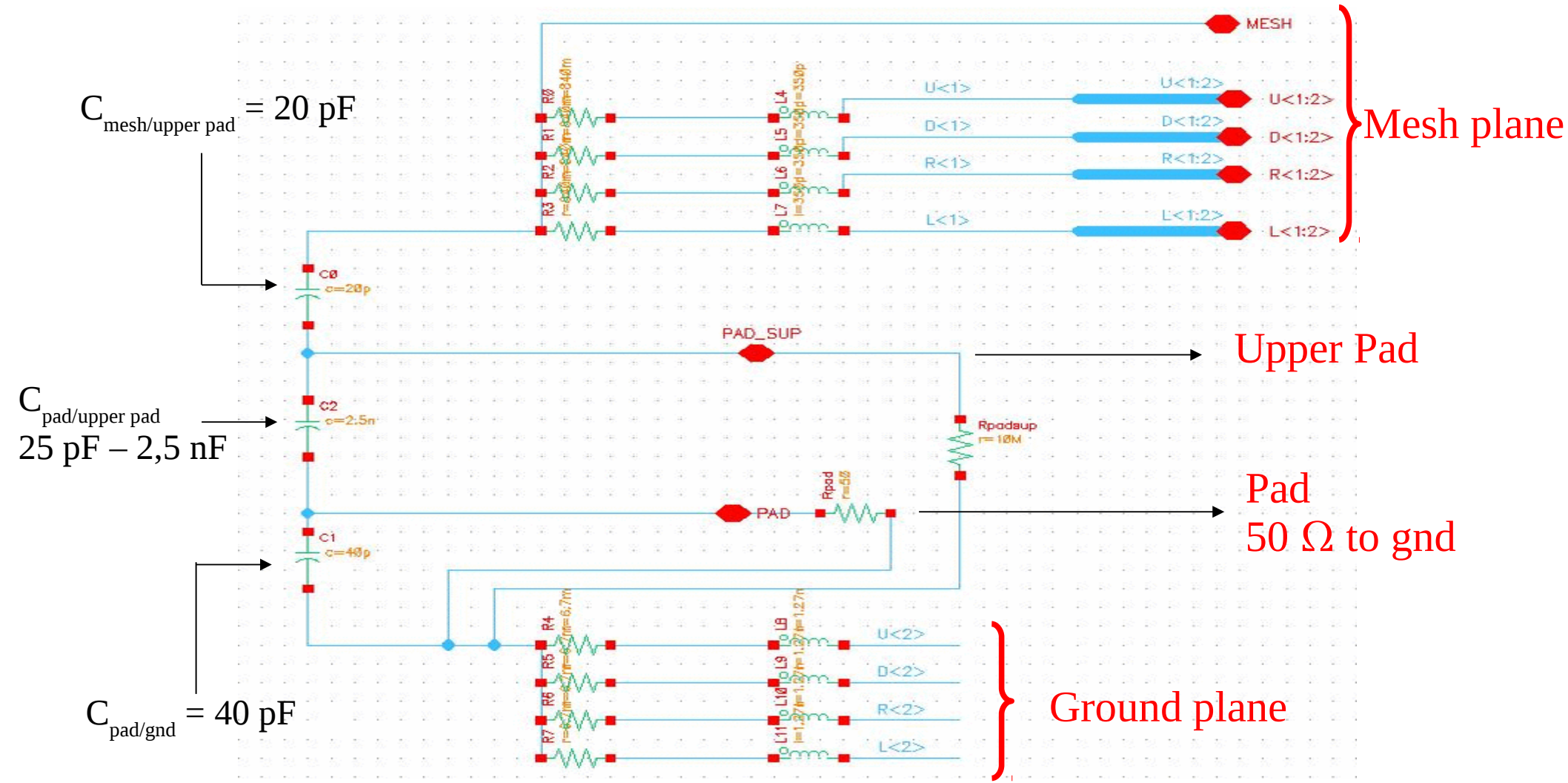
Simulation model for discharges study in MPGD (µmegas)

Elementary cell (1×1cm^2) standard configuration



Simulation model for discharges study in MPGD (µmegas)

Elementary cell (1×1cm²) capacitive configuration



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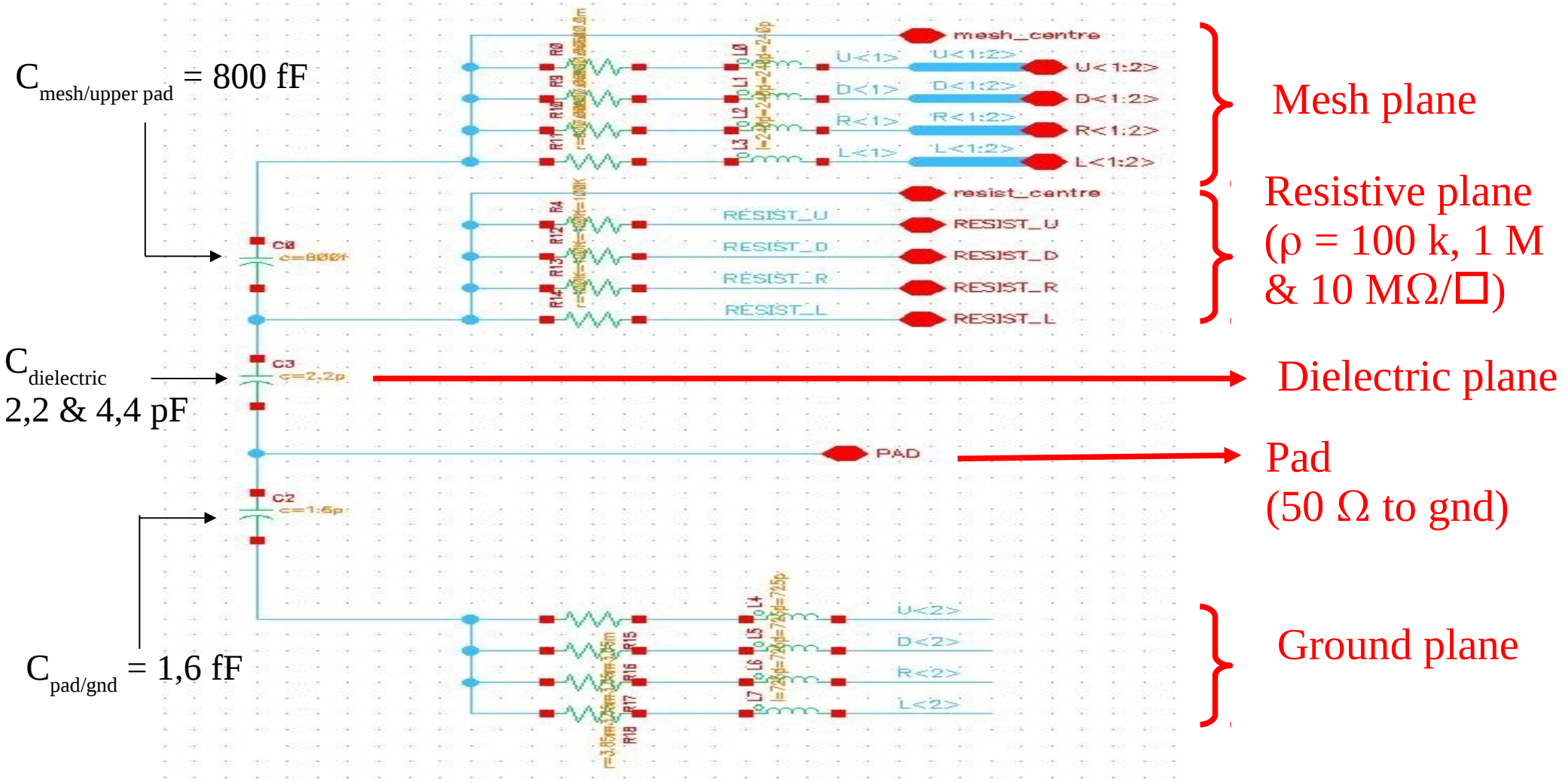
Simulation model for discharges study in MPGD (μmegas)

Elementary cell (2×2mm²) resistive configuration



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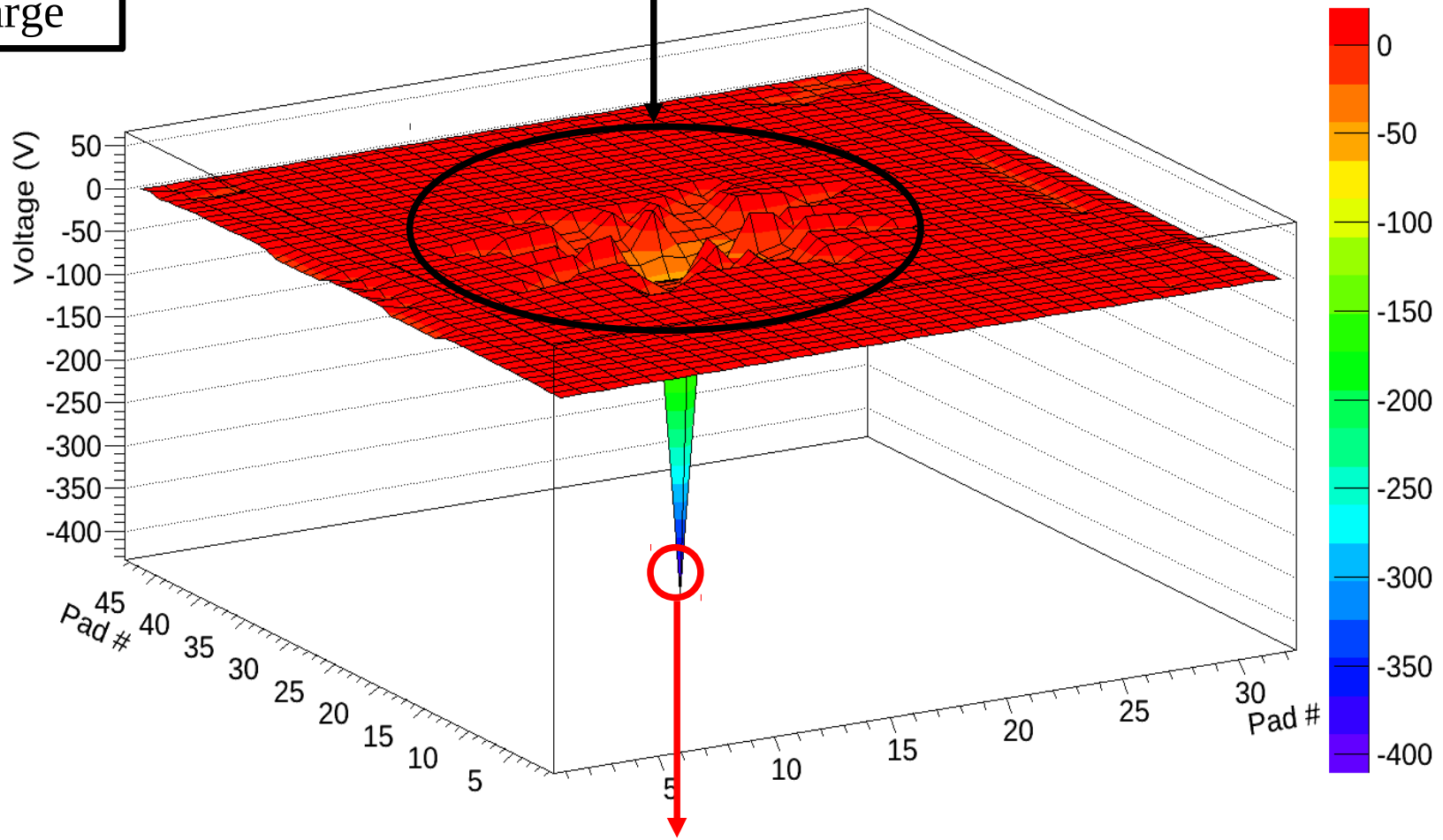
Simulation model for discharges study in MPGD (µmegas)

Standard setup ($C_{pad/gnd}$ = 40 pF)

Area influenced by the discharge



Voltage drop on discharge pad → (-410 V)

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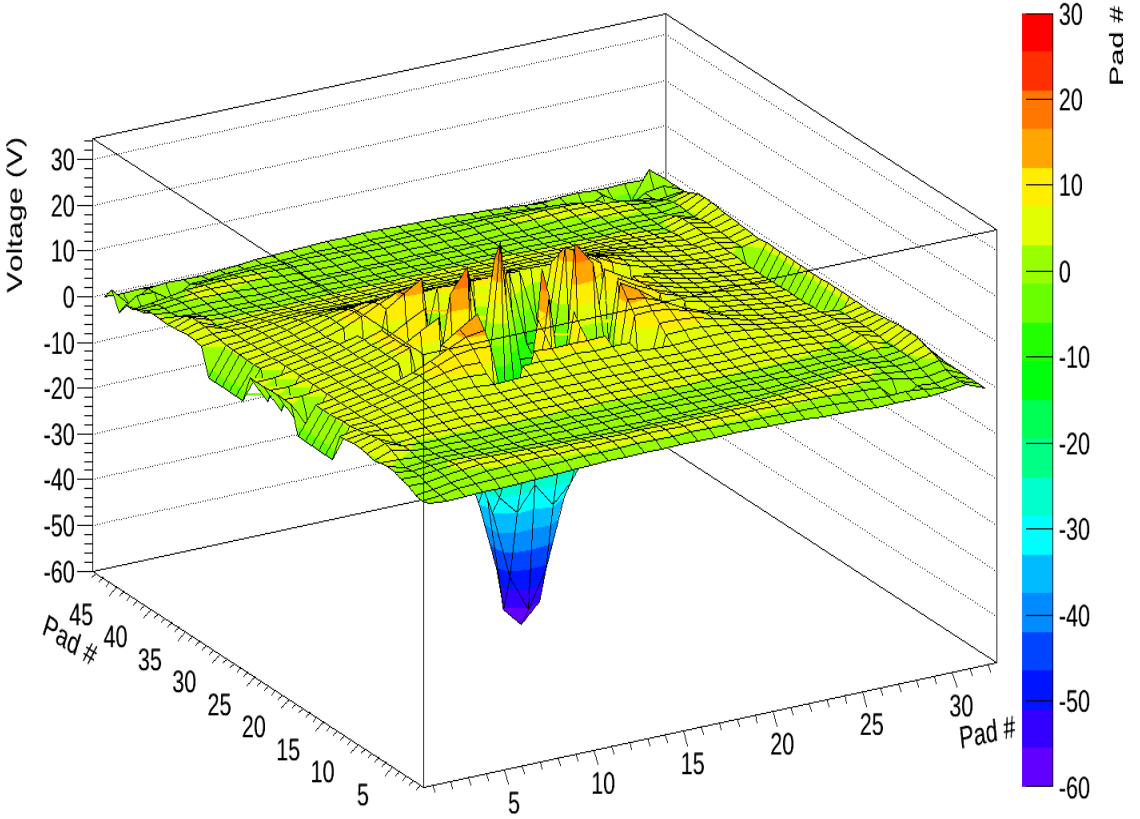
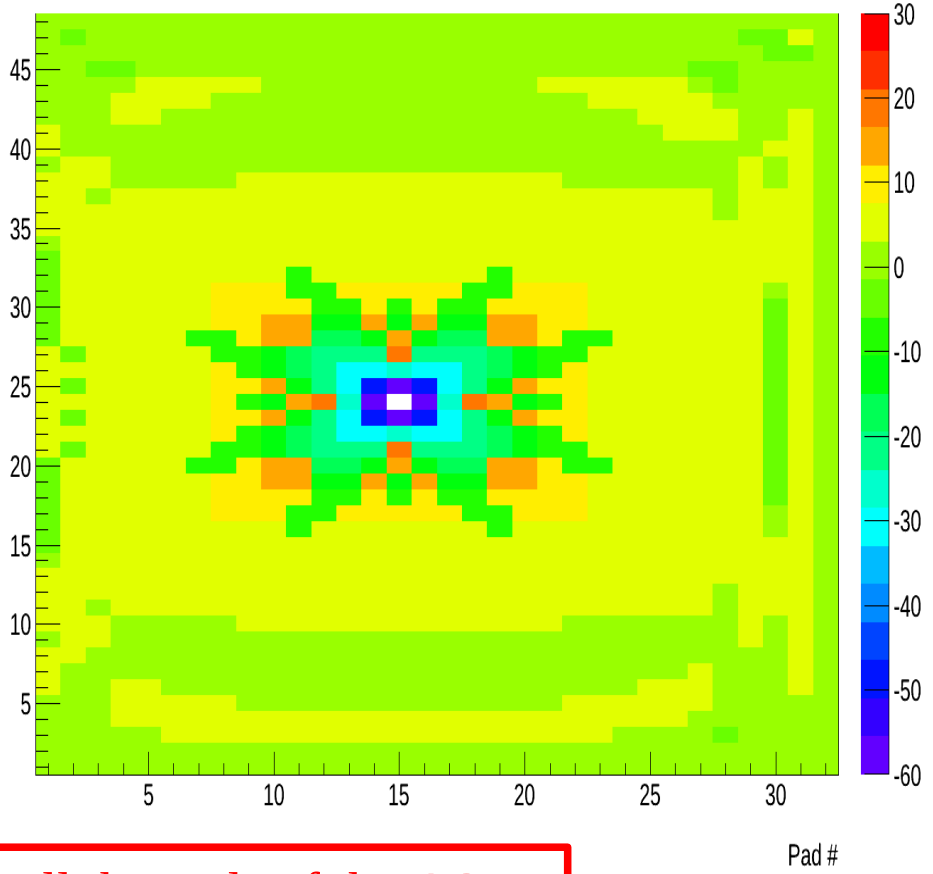
Simulation model for discharges study in MPGD (µmegas)

Standard setup ($C_{pad/gnd}$ = 40 pF)

3D plot



2D projection



The discharge propagates over all the pads of the ASU
Range of voltage drop for the others pads of the ASU :
-60 → +20 V(max : -60 V for 4 neighbors)

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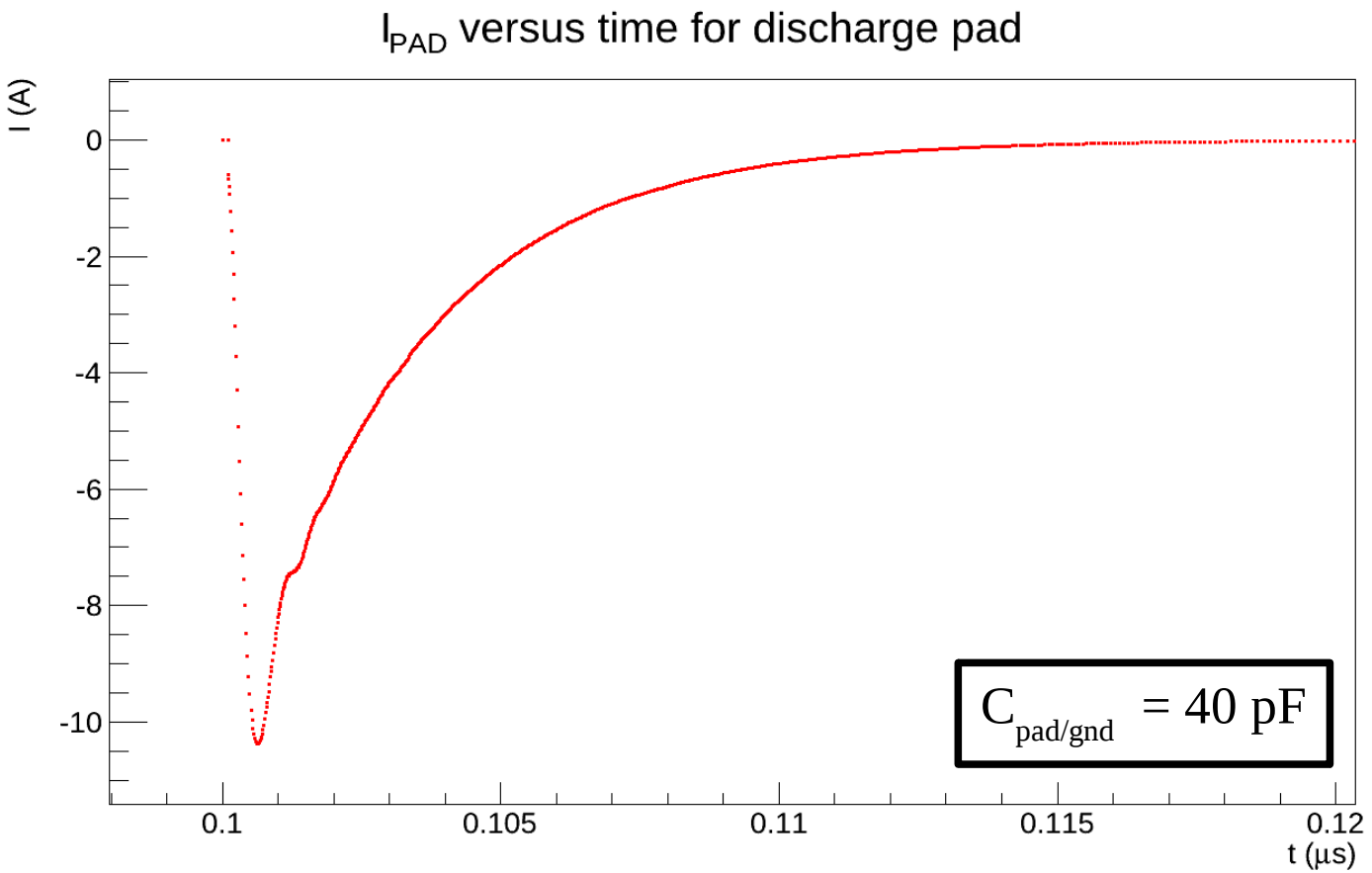
Simulation model for discharges study in MPGD (µmegas)

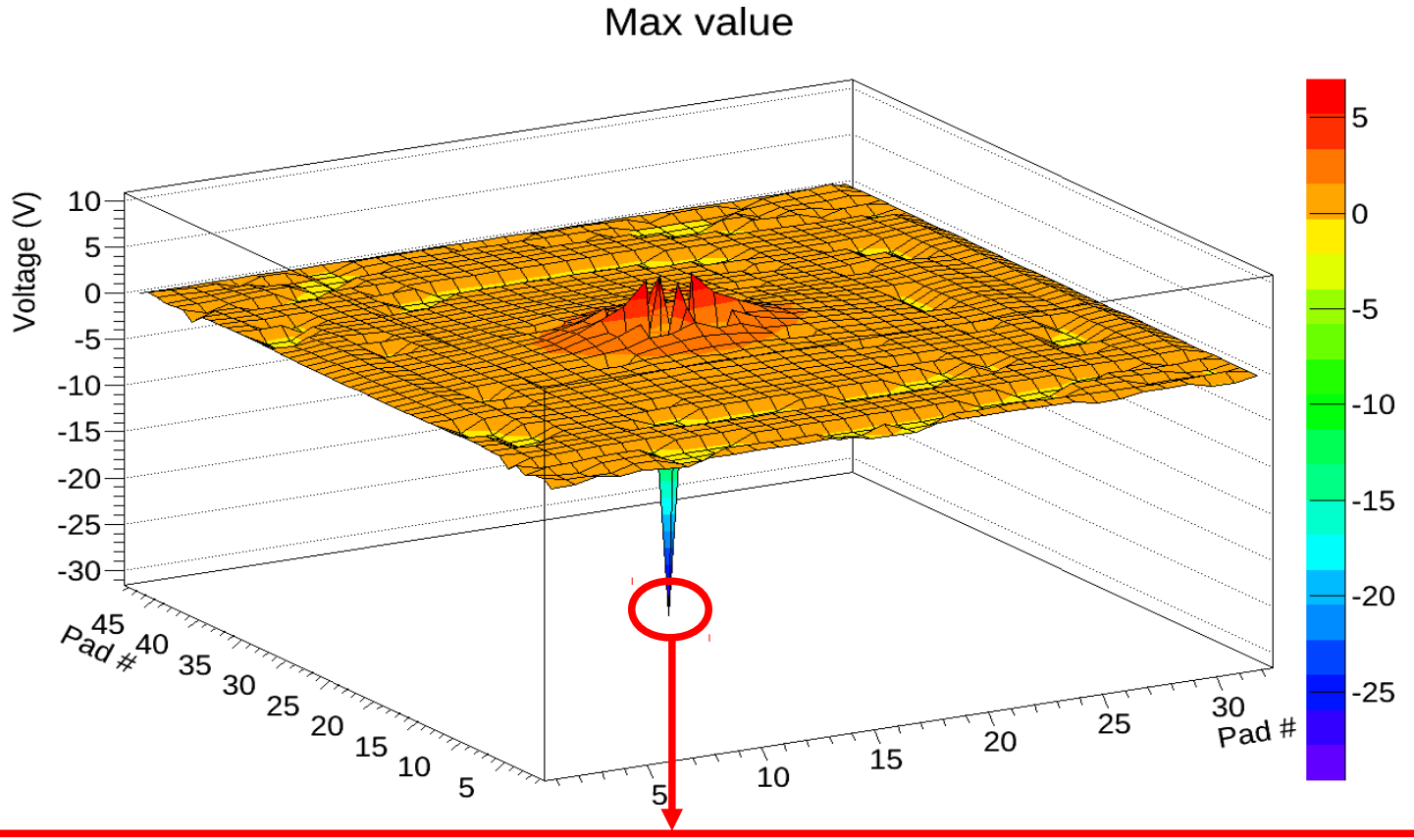
Standard setup ($C_{pad/gnd}$ = 40 pF)



@ $t_{discharge}$ = 100 ns I_{pad}max ≅ 10 A ⇒ destroy R/O electronic !!!

Simulation model for discharges study in MPGD (μmegas)

Resistive setup (Pads)



Voltage drop on discharge pad → (-30 V) much lower than standard setup (-410 V)

ρ = 1 MΩ/□ & $C_{resist/pad}$ = 2,2 pF

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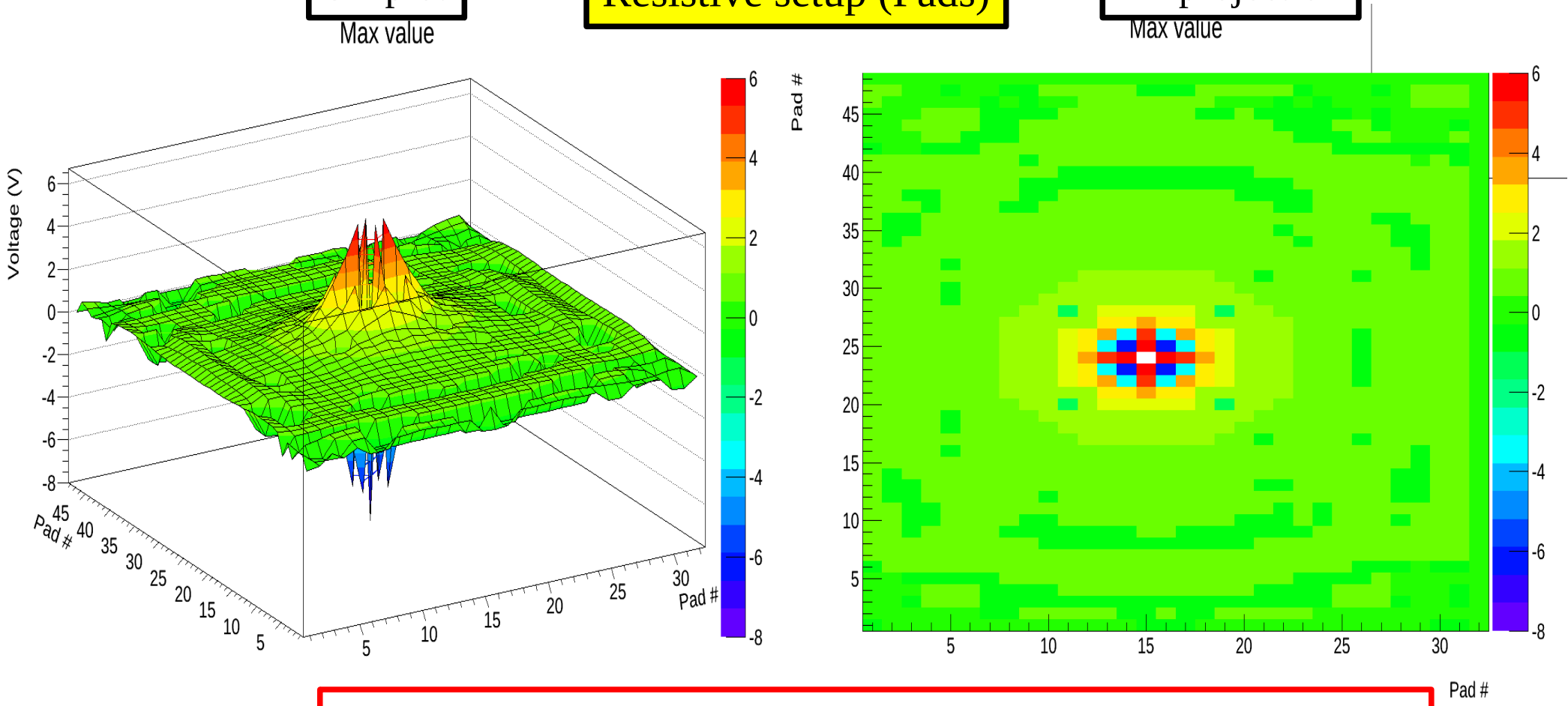
Simulation model for discharges study in MPGD (μmegas)

3D plot

Resistive setup (Pads)

2D projection



The discharge propagates over all the pads of the ASU
Range of voltage drop for the others pads of the ASU : -8 → +6 V

$\rho = 1\ M\Omega/\square$ & $C_{resist/pad} = 2{,}2\ pF$

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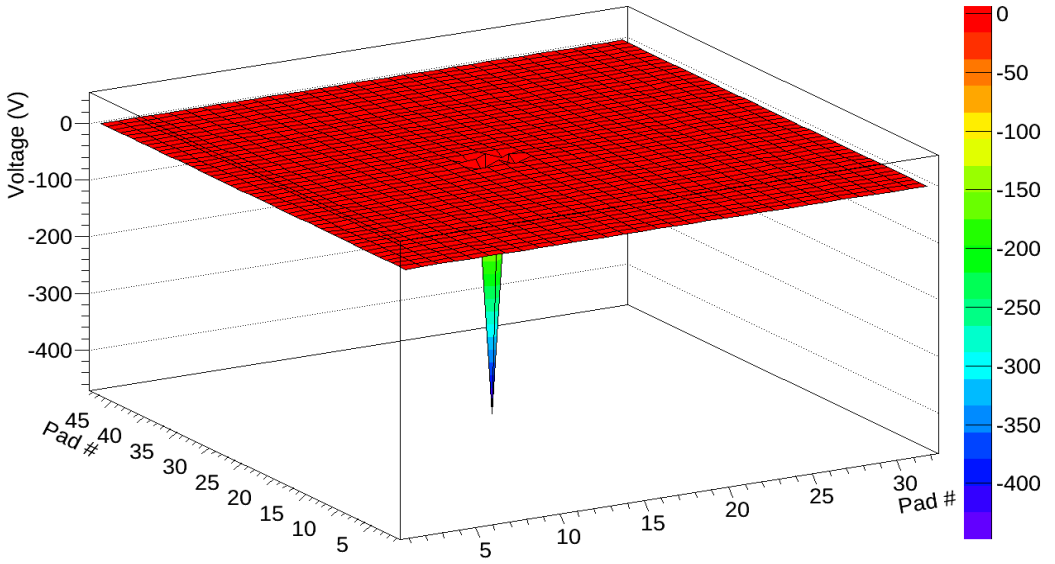
Simulation model for discharges study in MPGD (μmegas)

3D plot

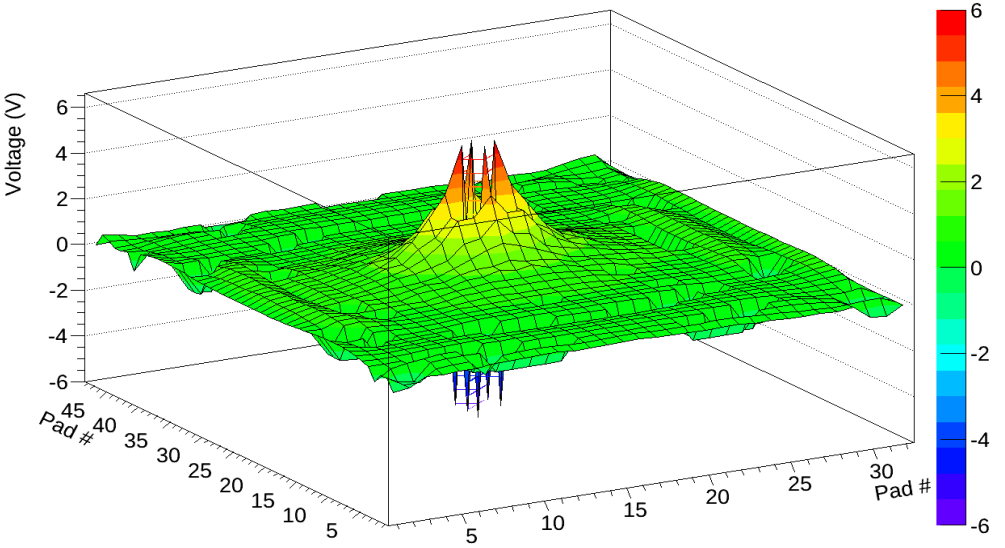
Max value



Resistive setup (Resistive layer)

3D plot

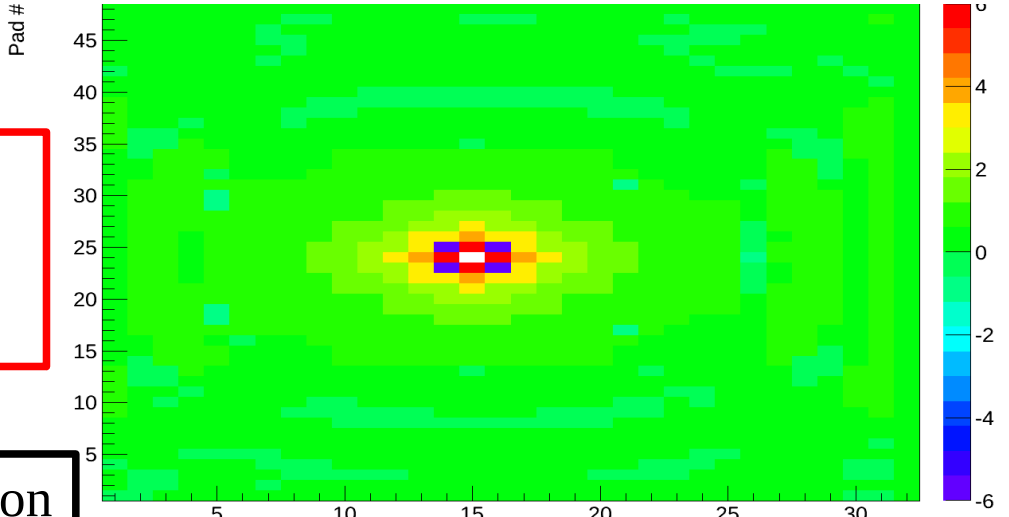
Max value



Resistive layer → -400 V (discharge pad)
but max voltage -8 V ≤ voltage drop ≤ 6V
for the discharge area

$\rho = 1\ M\Omega/\square$ & $C_{resist/pad} = 2{,}2\ pF$

2D projection



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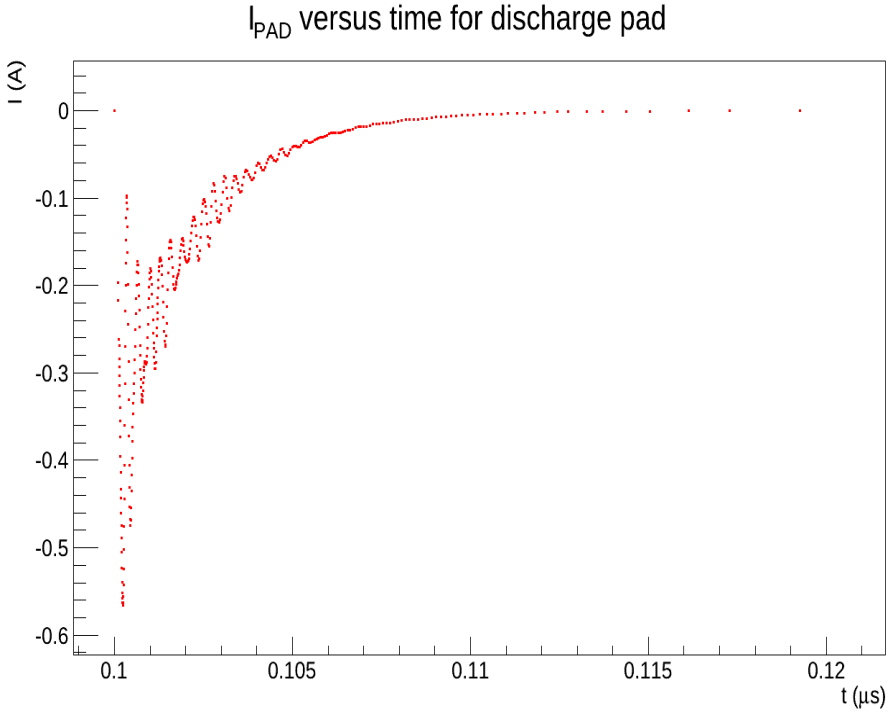
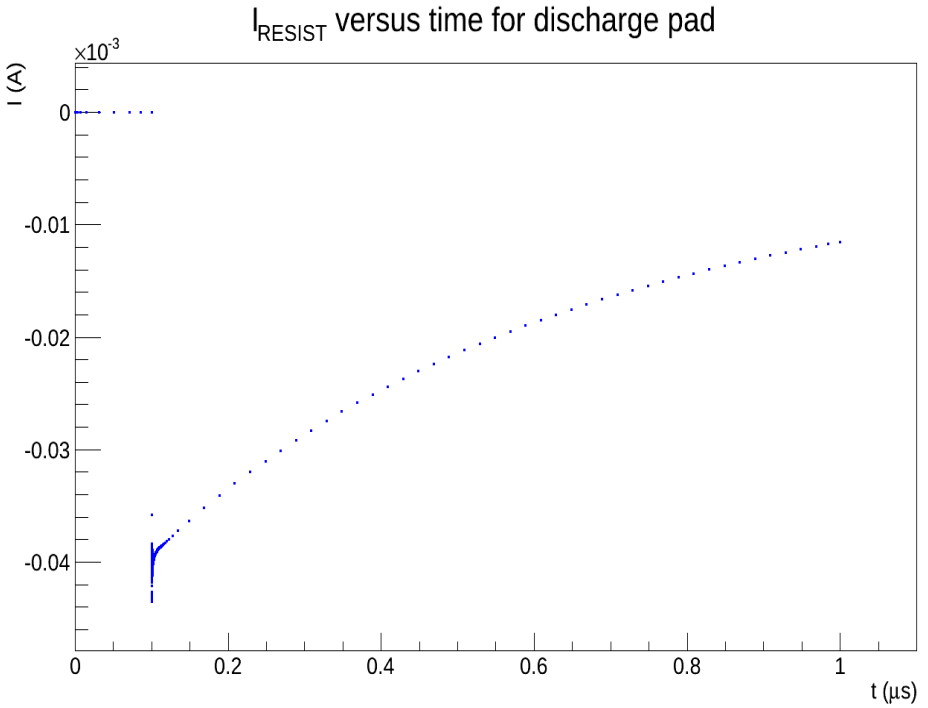
Simulation model for discharges study in MPGD (µmegas)

Resistive setup (Current)





I_{pad} (~ 550 mA) much lower than standard configuration (~ 10 A) !!!

ρ = 1 MΩ/□ & $C_{resist/pad}$ = 2,2 pF

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Conclusion

1)**Standard setup** : high voltage drop (-400 V) for the pad associated with a high I_{pad} (~ 10 A) → risk for R/O electronics

2)**Resistive setup** : "reasonable" voltage drop for the pad (-30 V) with a much lower I_{pad} (~ 0,5 A).

3)**Up to now the resistive solution is the best one but need to be tested under real conditions** : Full ASU tested with X-ray gun and α source (@ CERN ??)

Validate the simulation : voltage drop, the time propagation over the ASU, the optimal value of resistivity

4)**Another test ongoing** : test 6 different ways of protection (diodes)