Resistive Micromegas for Sampling Calorimetry

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Calorimetry at future collider will be based on Particle Flow (PF)
→ highly segmented calorimeters (small pads, many layers)

Micromegas meets most of the technical and performance requirements (m²-size prototypes)...
...but sparking might result from dense shower ionisation (e.g. nuclear recoils, EM shower core)
→ spark suppression by means of resistive coatings

What resistive coating? Embedded resistor
Allows charge evacuation from top-to-bottom
→ no lateral charge dispersion
→ maintain calorimeter imaging capability

We observed:
● Full spark suppression in prototypes with R of 1-100 MΩ.
● Coupling between resistive/readout pad ~ 100%
● Still some issues with flatness (poor energy resolution)
Our resistive Micromegas efficiently suppresses sparks through local charge-up of the R-pad → What is the effect on the response?

It depends on the detector current (i.e. rate $\Phi$, primary charge $dE/dx$) and its time-constant $\tau$

**Case of high-rate tracking ($1/\Phi >> \tau$)**

Balance between charge ($\Phi$) & discharge ($\tau$)

Steady regime reached after $\tau$

**Case of low-rate calorimetry ($1/\Phi << \tau$)**

Pad mainly charges during event

Large $dE/dx$: last primary e- feel a reduced field

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We observed charge-up effects under high rates (10 MHz/mm²) and under high primary ionisation (2000 MIPs). They are on the percent level in both cases.

**Resistive Micromegas don't spark, have large dynamic range and withstand high-rates.**