

November test beam results

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Within the MAMMA collaboration

Arizona, **Athens(U, NTU, Demokritos)**, Brookhaven,
CERN, Harvard, Istanbul, Naples, **CEA Saclay**, Seattle, USTC Hefei,
South Carolina, St. Petersburg, Shandong, Stony Brook,
Thessaloniki

Shuoxing Wu / CEA Saclay, USTC Hefei

Outline:

- Spark current-voltage monitoring.
- Spark rate.
- Efficiency and spatial resolution.

Test beam set up:

- Telescope:

3 X-Y detectors(10 x 10 cm²) manufactured at Saclay

- Aim: Test different resistive films detectors manufactured by Rui De Oliveira at CERN and compare behaviour to non-resistive detectors

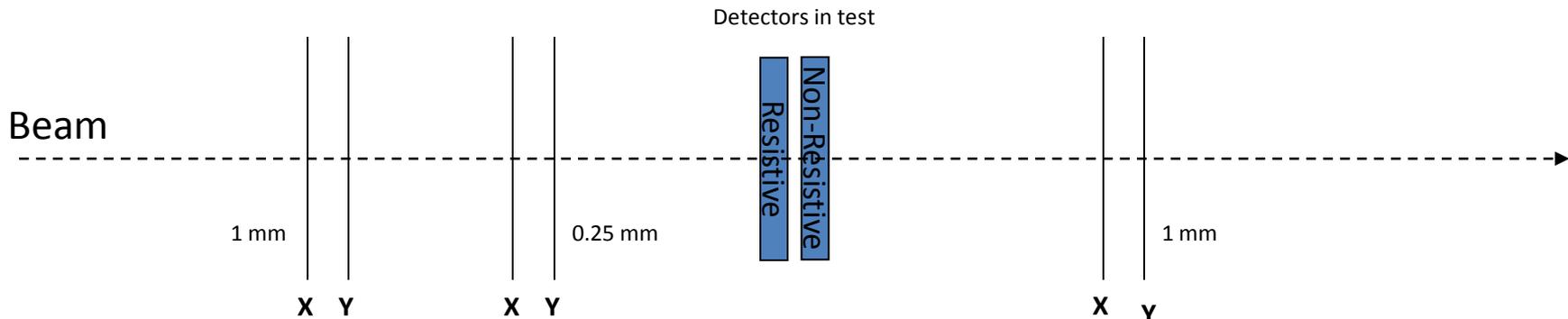
- Electronics: GASSIPLEX

- DAQ: realised by Demokritos

- Gas: 95%Ar + 3% CF₄ + 2% isobutane



SPS-H6
120 Gev π^+



Tested detectors:

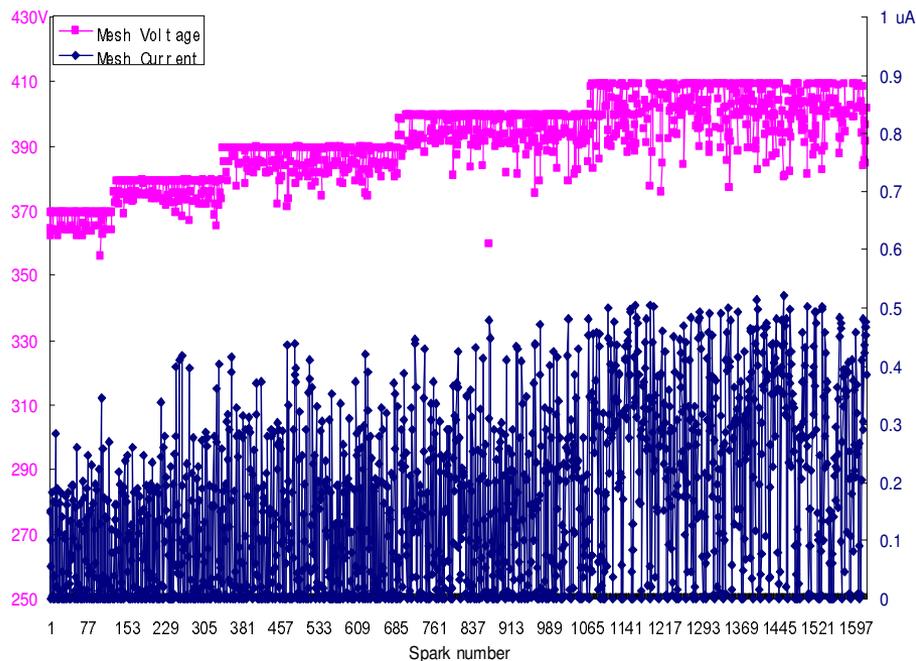
Standard bulk detectors; Resistive coating detectors; Segmented mesh detector

Summary of tested detectors:

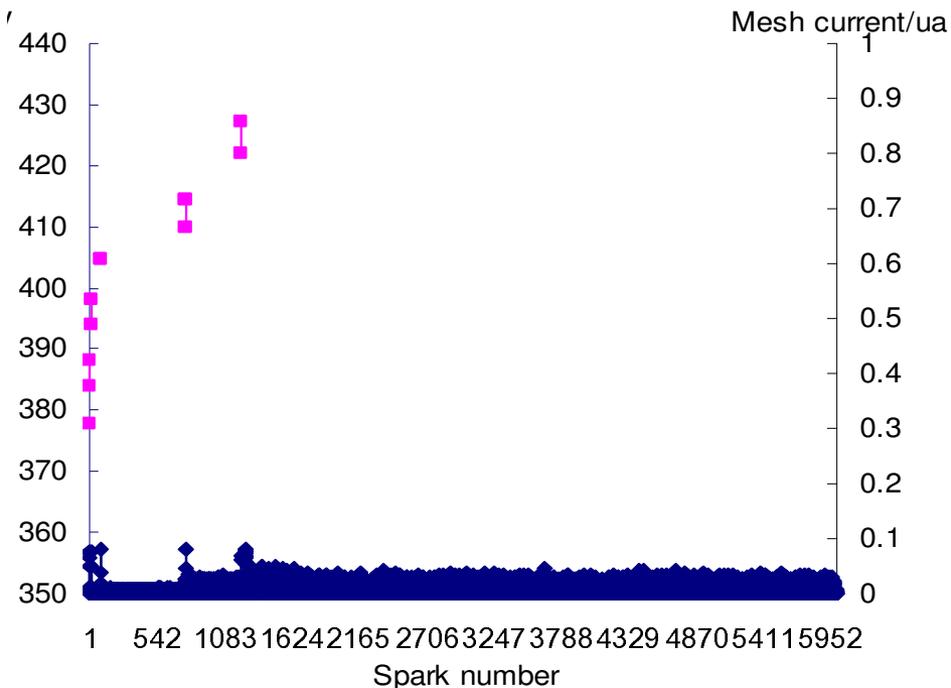
Type	Name	Properties:
Standard bulk:	SLHC3	1mm pitch
	SLHC2	2mm pitch
Resistive coating:	R3&R4	2mm, 2M Ω /□, kapton+insulator
	R5	2mm, 250M Ω /□, resistive paste
	R6	1mm, 400K Ω /□, resistive strip
	R7	0.5mm, tens of K Ω /□, resistive pad
Segmented mesh	S1	1mm pitch, 8 segmentations

Different sparking behaviors of standard and resistive detector:

Standard SLHC2 (2mm) (@10KHz):



R6(1mm,400k Ω /□ resistive strip) (@10KHz):



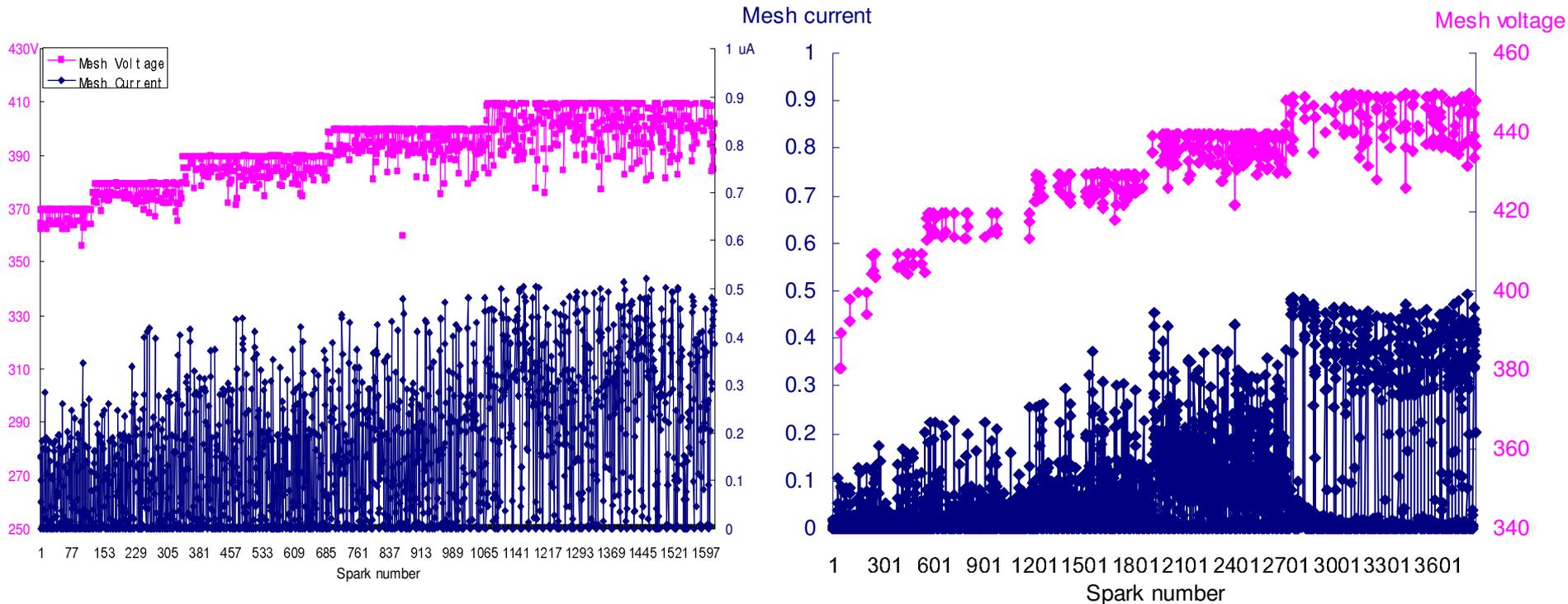
SLHC2: HV=400 V (Gain \sim 3000): current when sparking $< 0.4 \mu\text{A}$
voltage drop $< 5\%$

R6: HV=390 V (Gain \sim 3000): current when sparking $< 0.08 \mu\text{A}$
voltage drop $< 0.5\%$

Sparking behavior of resistive detector R3:

Standard SLHC2 (2mm) (@10KHz):

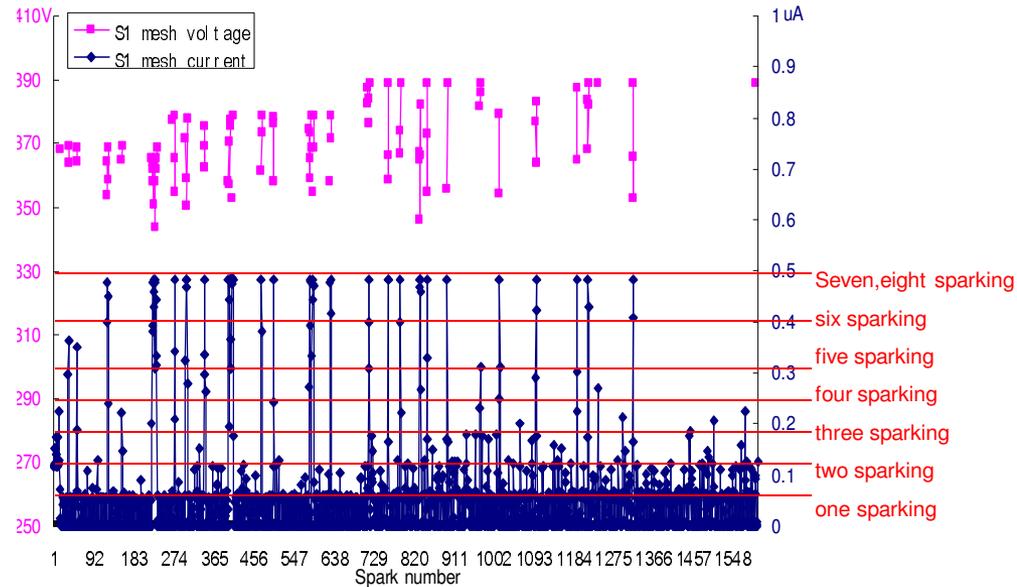
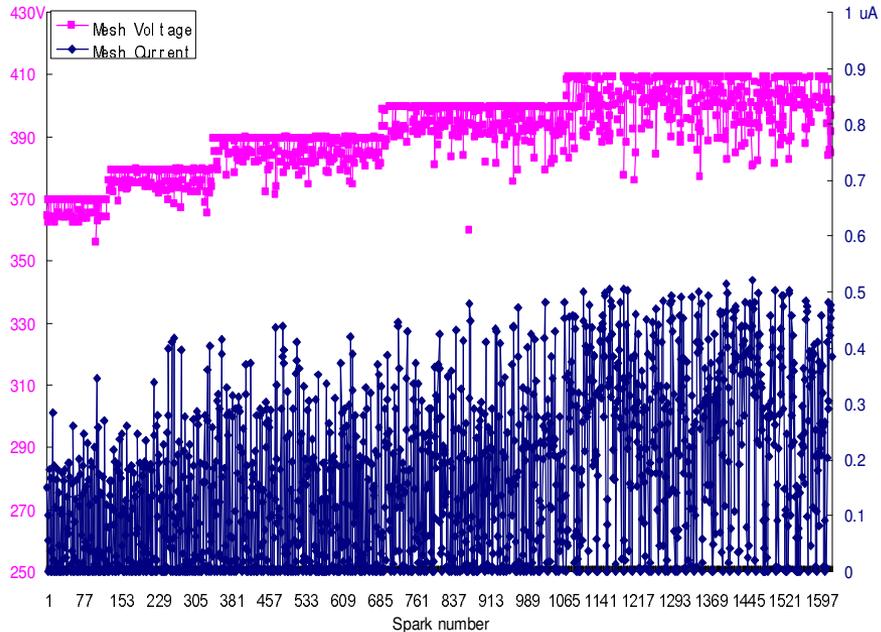
Resistive R3(2mm,2M Ω /□) (@10KHz):



SLHC2: HV=400 V (Gain \sim 3000): current when sparking < 0.4 μ A
voltage drop < 5%

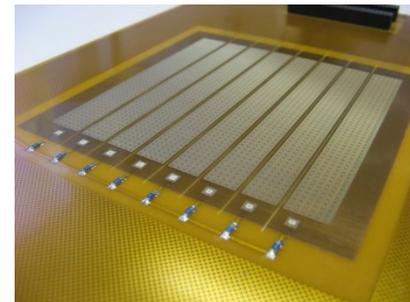
R3: HV=410 V (Gain \sim 3000): current when sparking < 0.2 μ A
voltage drop < 2%

Sparking behavior of S1:

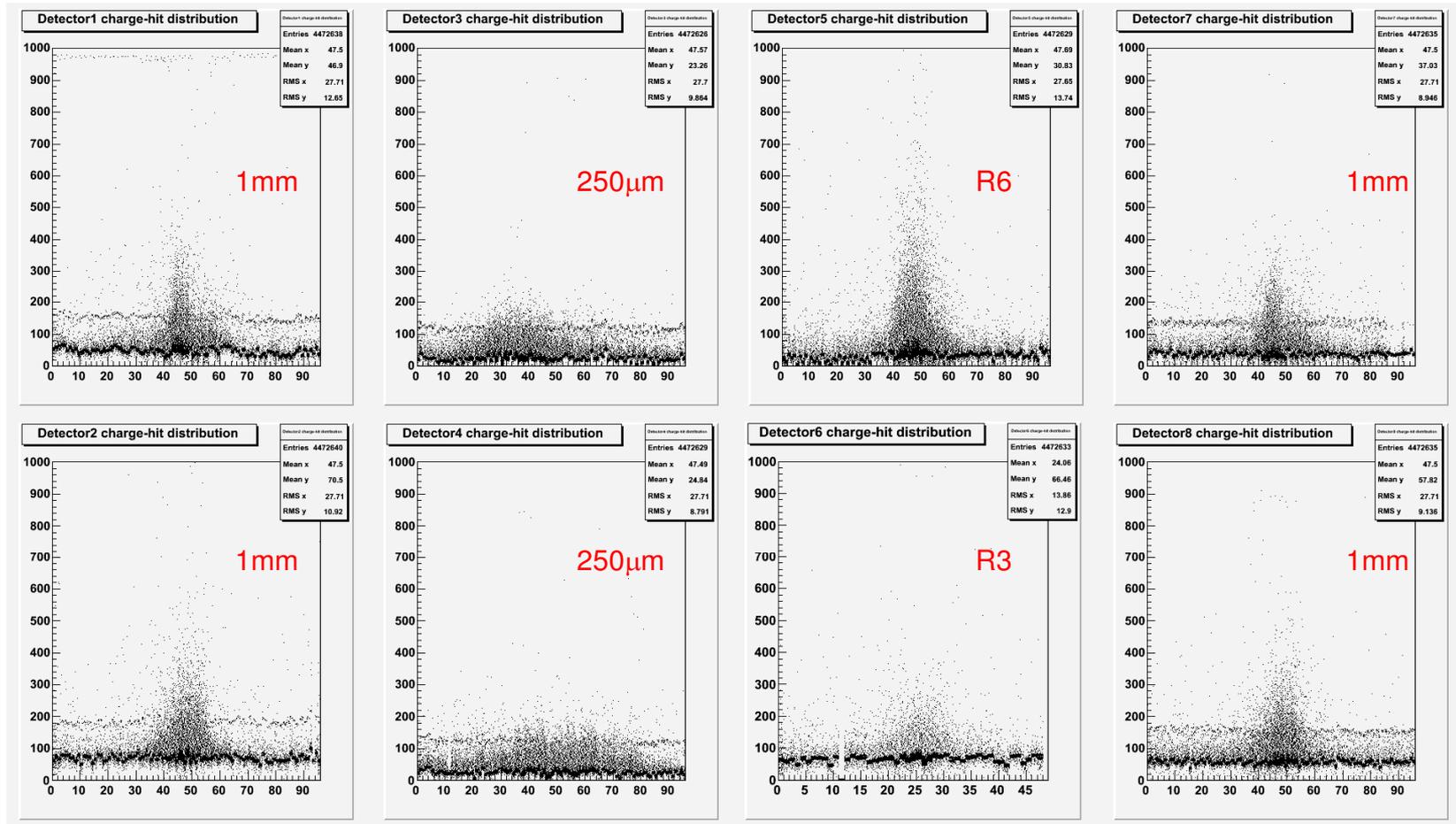


Standard bulk: SLHC2

S1:



Charge vs. channel number:

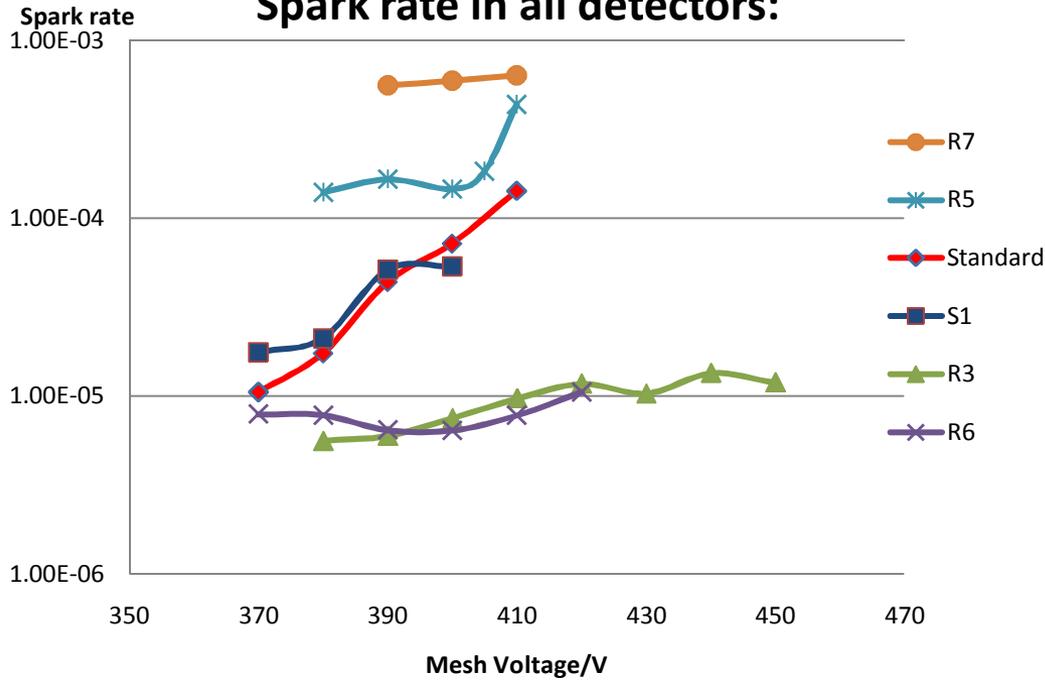


Pedestal shift in standard MM (telescope) due to sparks.

No pedestal shift in resistive detectors (R3&R6).

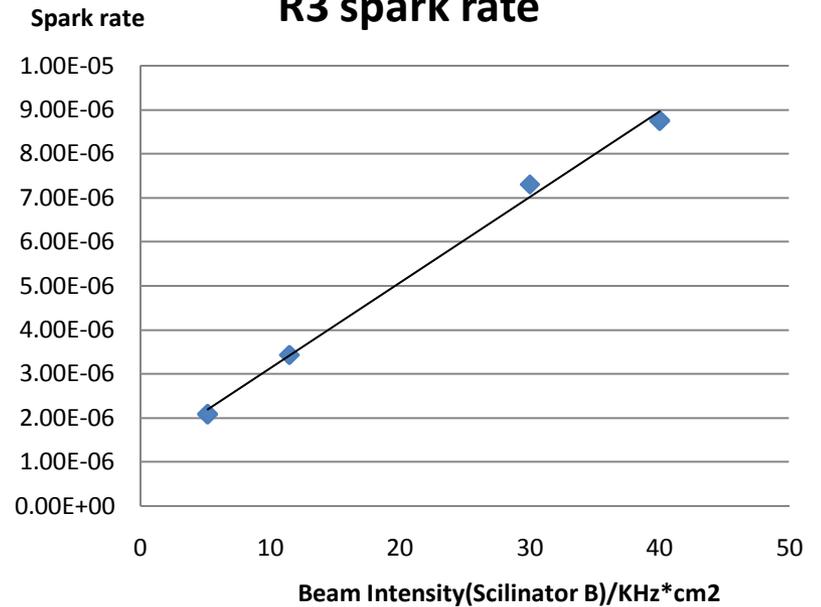
Spark rate vs mesh voltage and beam intensity:

Spark rate in all detectors:



R3(2mm, 2M Ω /□):

R3 spark rate

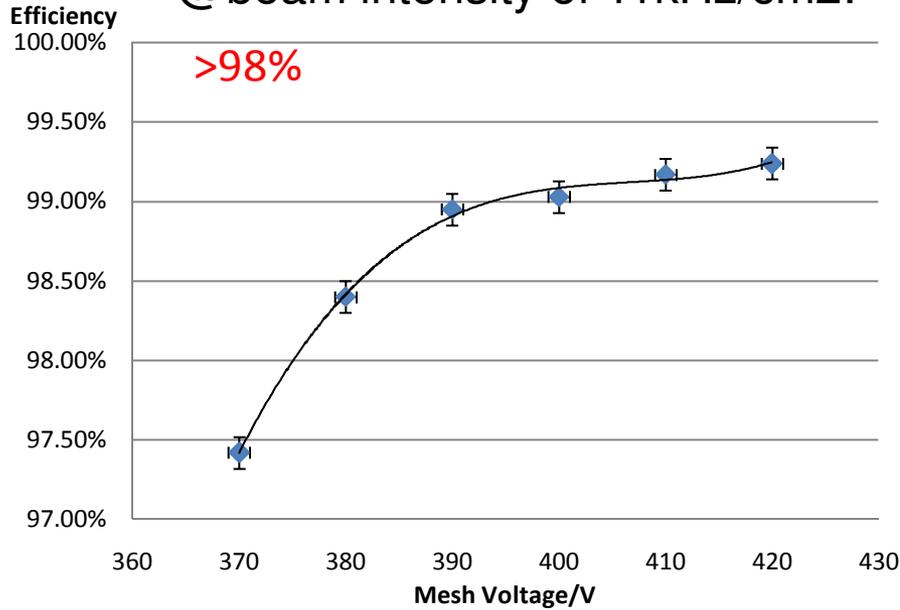


Detector performance at same gas gain (~3000):

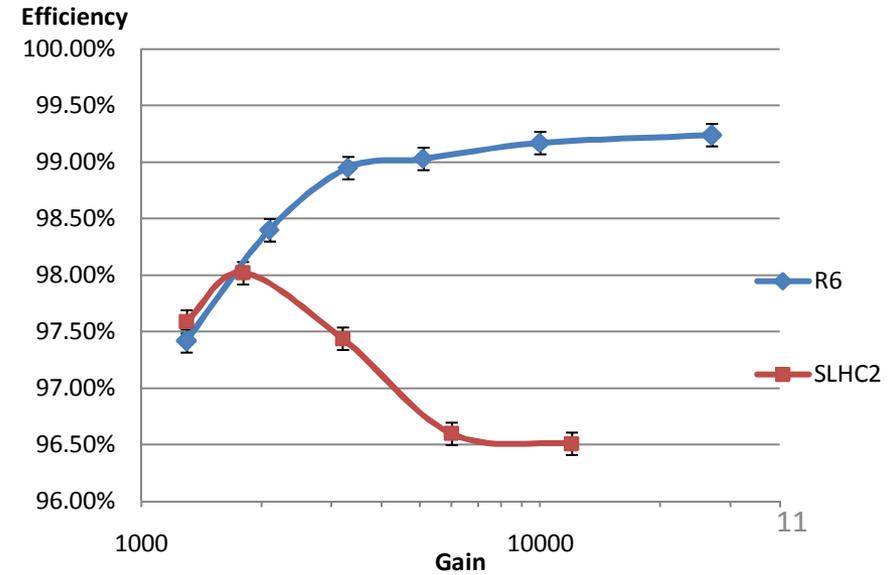
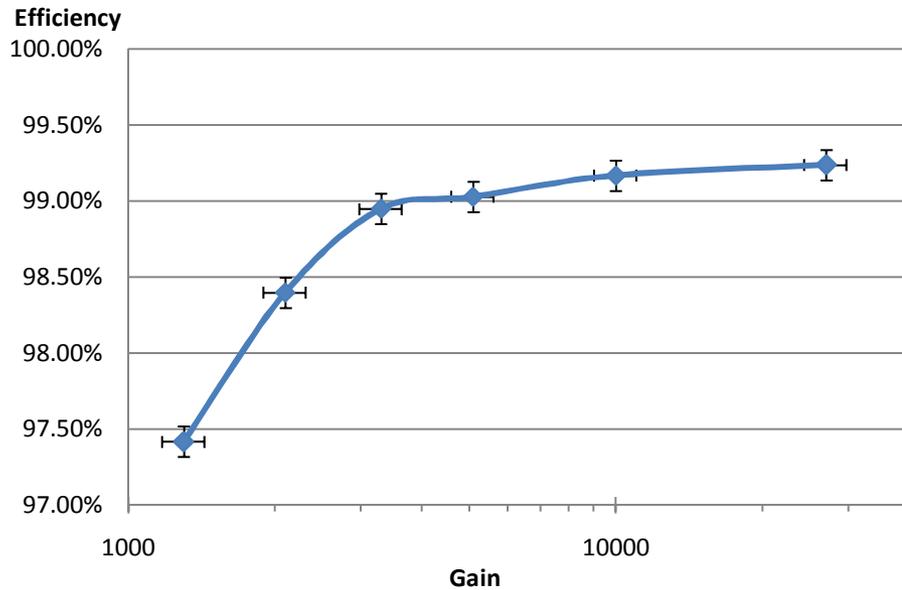
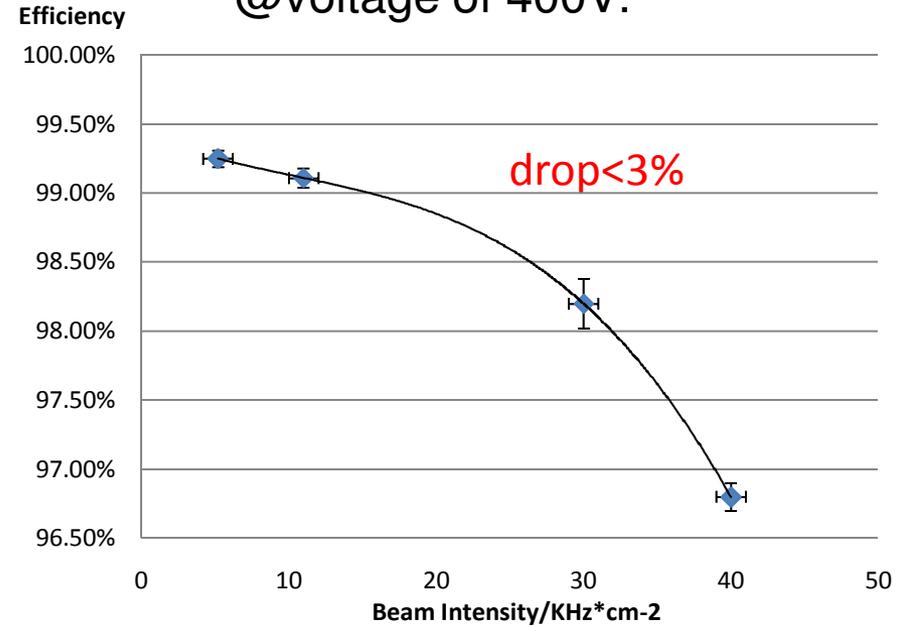
Detector	type	Spark rate	Spark current / μA	Voltage drop
SLHC2	standard	$7 \cdot 10^{-5}$	0.4	5%
R3	2 M Ω / \square resistive kapton	$9.6 \cdot 10^{-6}$	0.2	2%
R6	400K Ω / \square resistive strip	$6.4 \cdot 10^{-6}$	0.08	0.5%
R5	250 M Ω / \square resistive paste	$1.6 \cdot 10^{-4}$	0.1	1.5%
R7	tens of K Ω / \square resistive pad	$5.9 \cdot 10^{-4}$	0.35	4.5%

R6 (1mm, 400K Ω /□) efficiency :

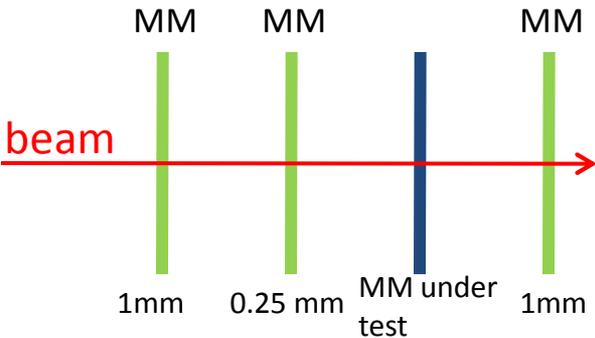
@beam intensity of 11kHz/cm²:



@voltage of 400V:



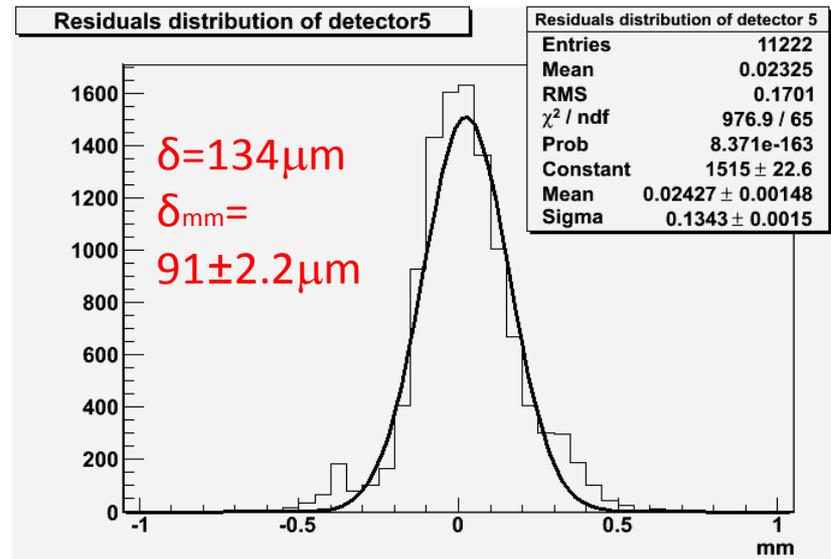
Resolution:



- Residuals of MM cluster position and extrapolated track from MM telescope:
- Convolution of:
 - Intrinsic MM resolution
 - Track resolution (extrapolated)
 - Multiple scattering
 } $\sim 98\mu\text{m}$

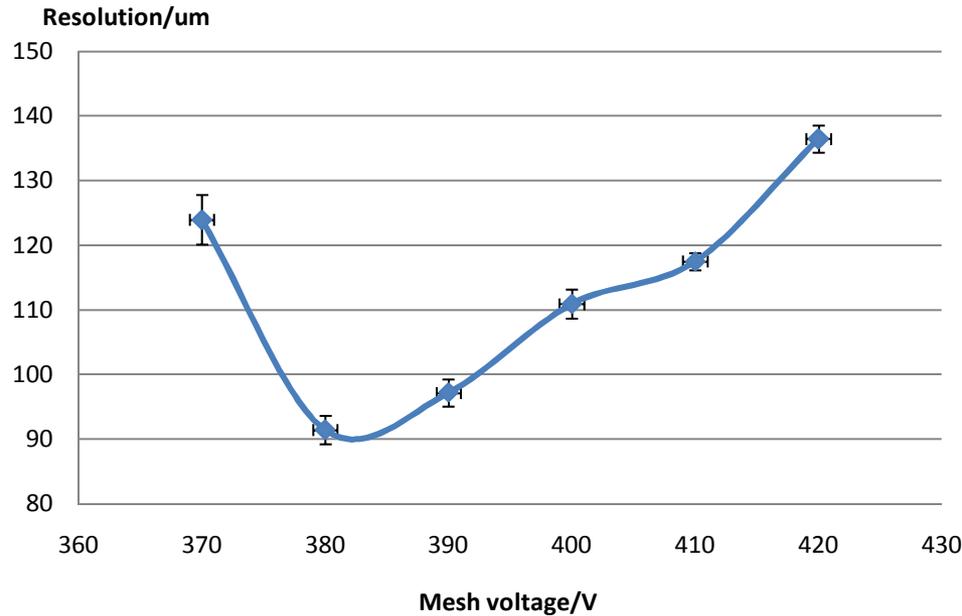
R6(1mm pitch, 400k Ω / \square)

$$\delta_{mm} = \sqrt{134^2 - 98^2} \mu\text{m} = 91\mu\text{m} \pm 2.2\mu\text{m}$$

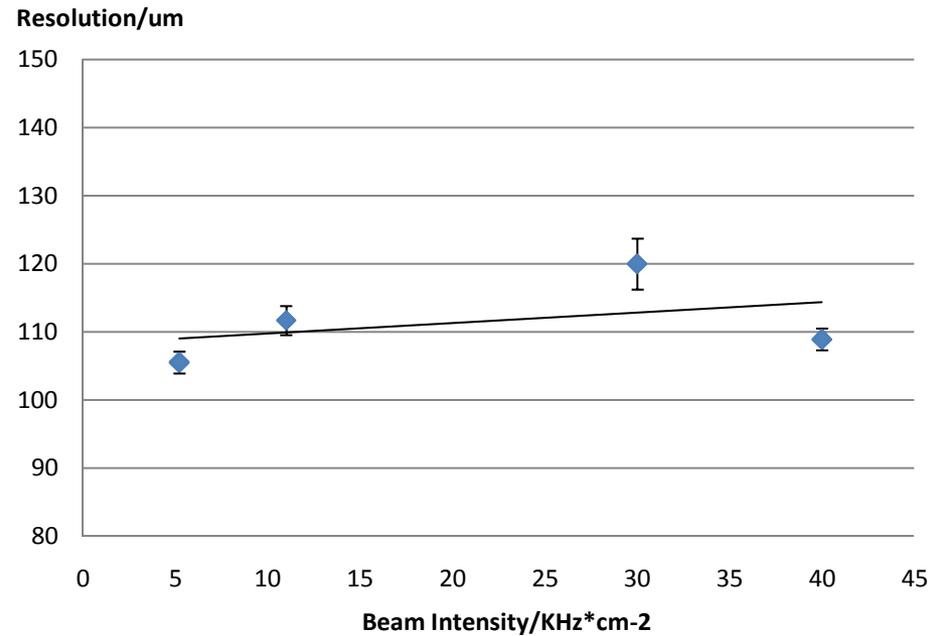


R6(1mm 400k Ω / \square resistive strip) resolution vs mesh voltage and beam intensity:

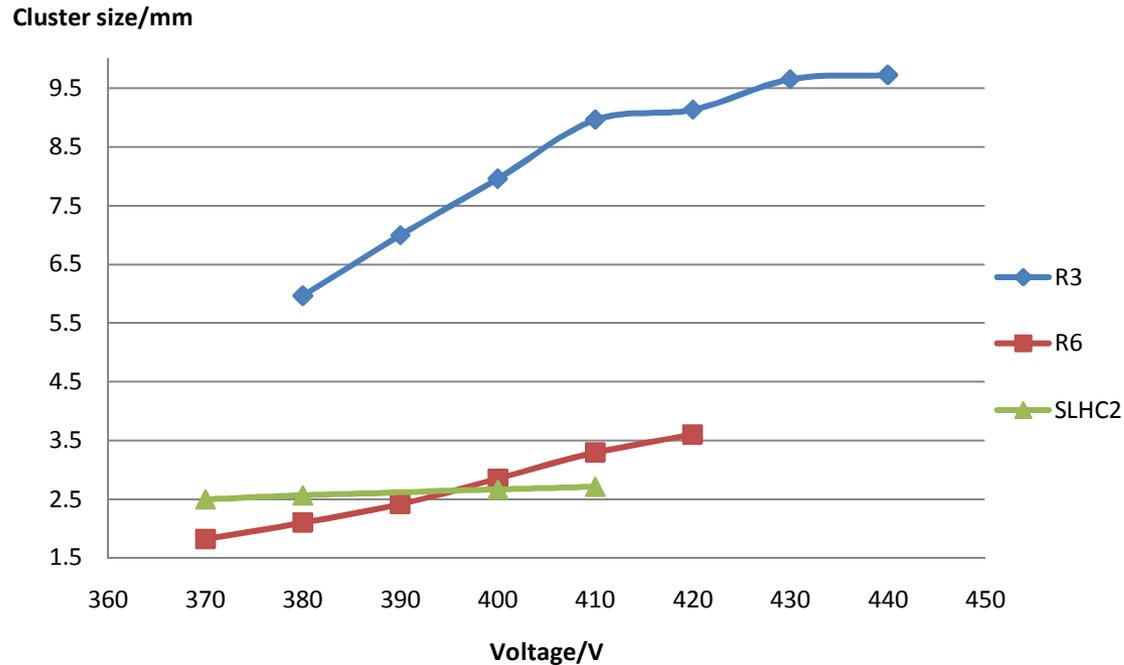
Mesh voltage:



Beam intensity:



Cluster size (mean of distribution) :



R3 : 2mm , 2 M Ω / \square Resistive kapton +insulator

R6 : 1mm , 400 k Ω / \square Resistive strip

SLHC2: 2mm standard bulk

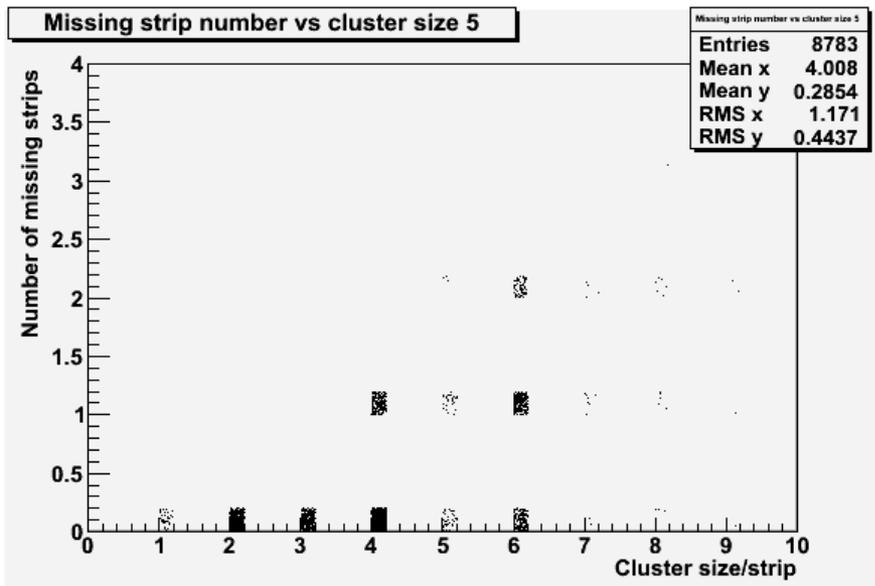
Conclusion and outlook:

- Resistive coating is a successful method to reduce the micromegas spark rate and limit the change in mesh voltage and current.
- Good spatial resolution $< 100\mu\text{m}$ can be reached with a resistive strip coating detector of 1mm pitch.
- High efficiency ($> 98\%$) can be achieved with resistive strip coating micromegas detector, and efficiency drops less than 3% when increasing the beam intensity from 5KHz to 40KHz . R6 can operate at high gain up to 30000 without losing efficiency.
- R&D and studies will continue inside the MAMMA collaboration

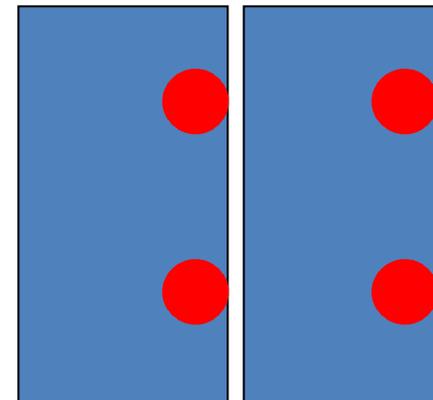
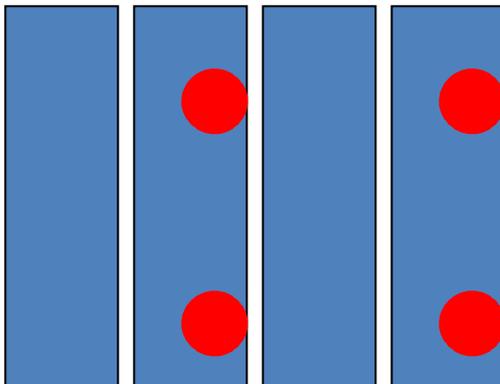
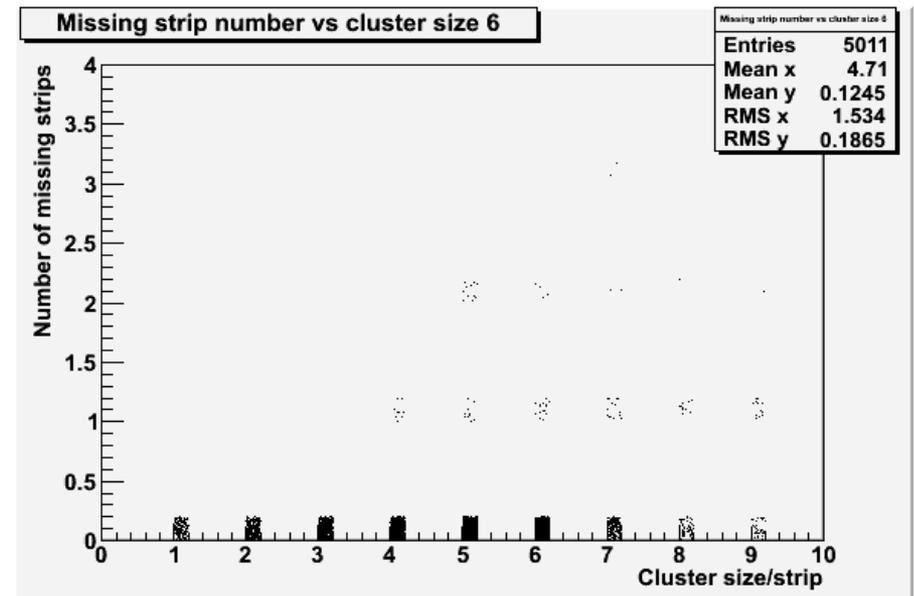
Back up slides

Number of missing strips in cluster:

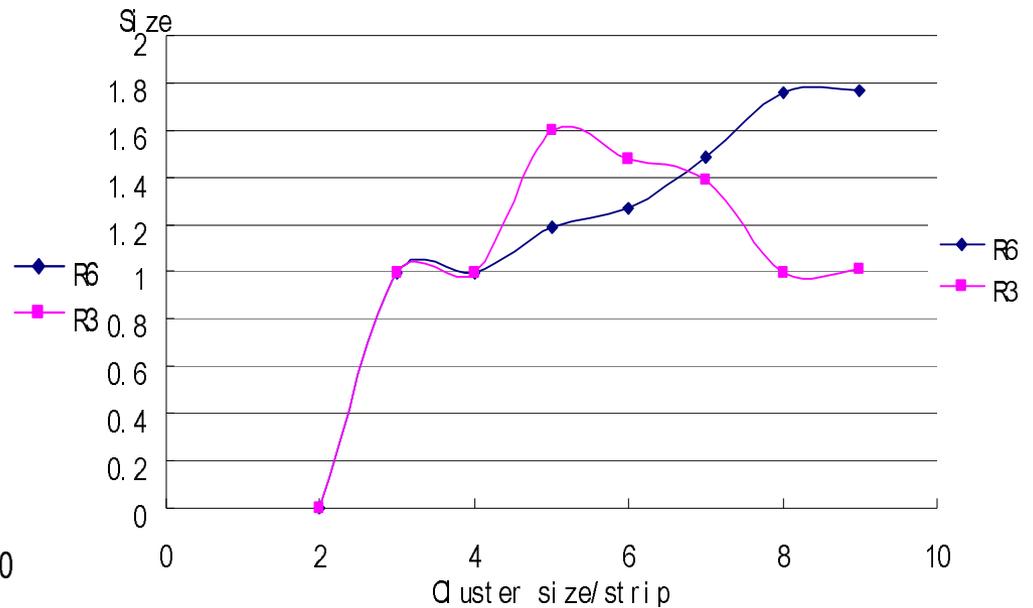
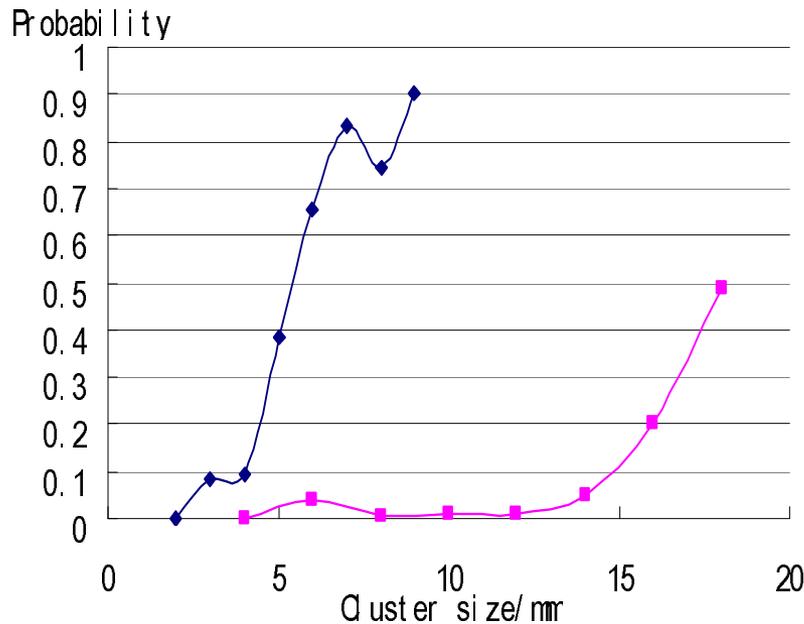
R6(1mm, 400 K Ω / \square):



R3(2mm, 2 m Ω / \square):

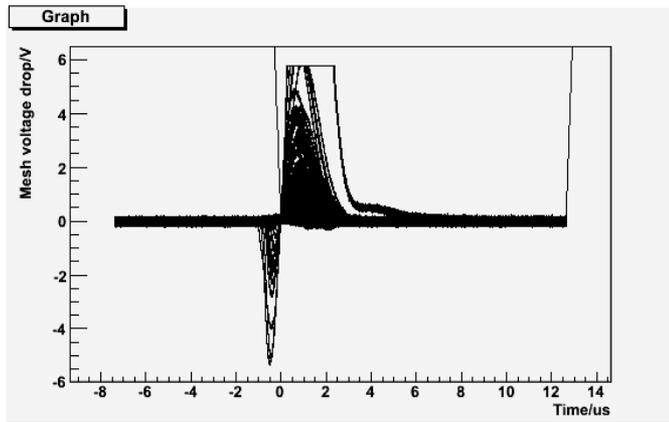


Probability to have missing strips in cluster and number of missing strips:

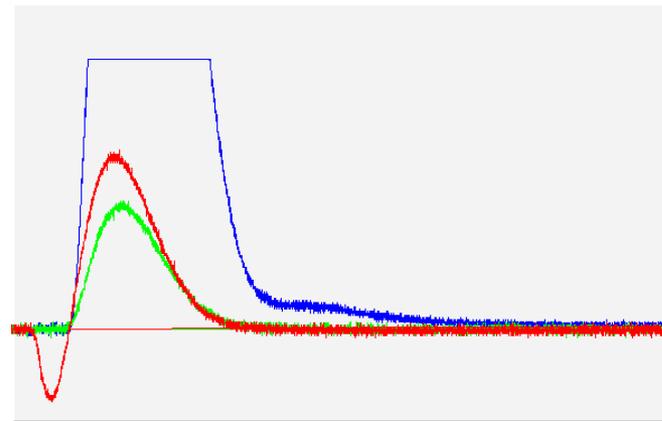


Sparks in R7 (few tens of $k\Omega/\square$ Resistive pads):

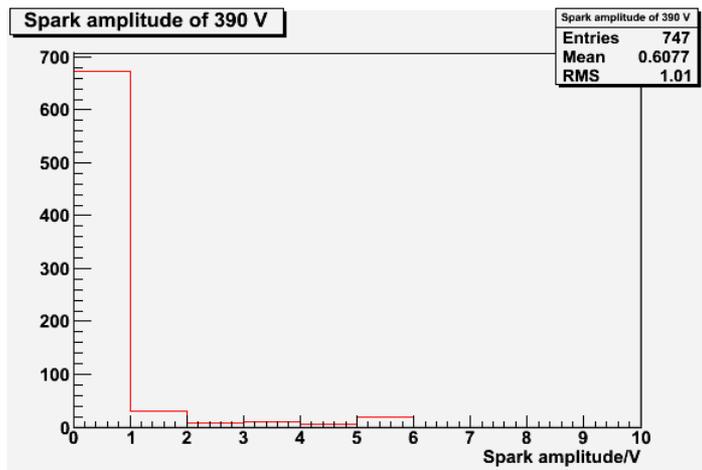
All the 'sparks' in R7:



Three 'spark' type:

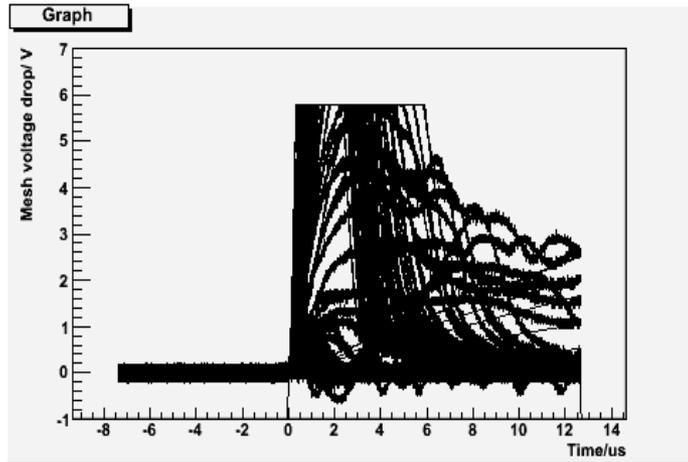


'Spark' amplitude distribution:

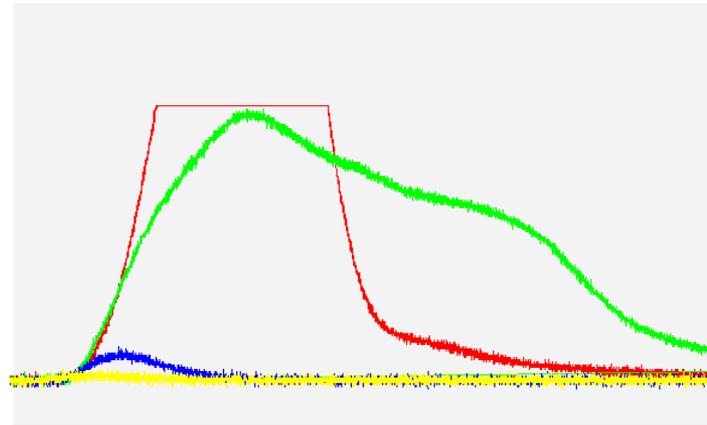


Sparks in R5 (250 M Ω /□ Resistive kapton):

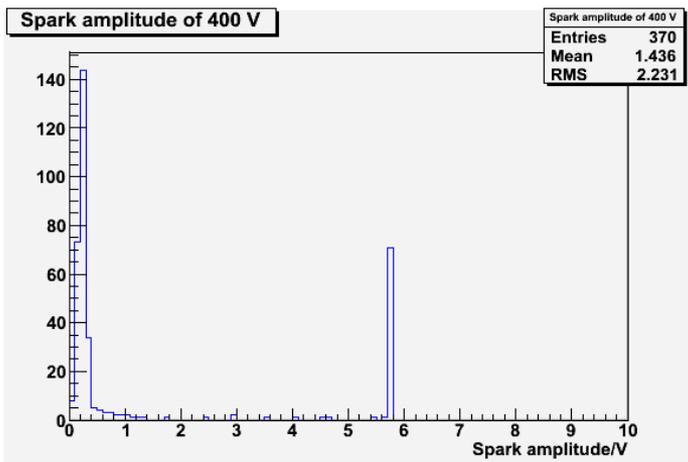
All the 'sparks' in R5:



Four 'spark' type:

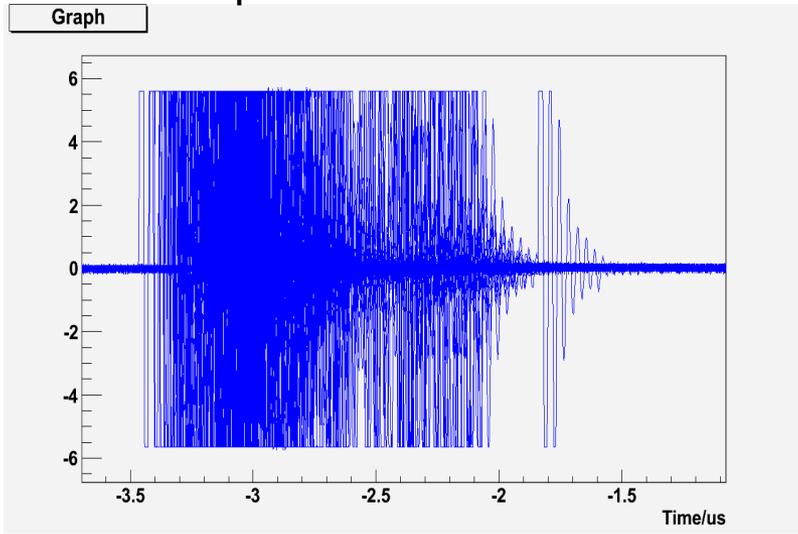


'Spark' amplitude distribution:

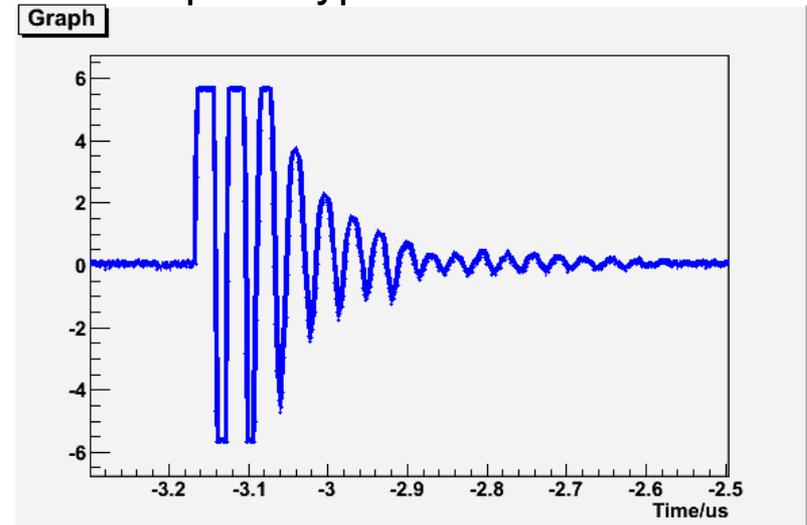


Sparks in SLHC2 (standard bulk):

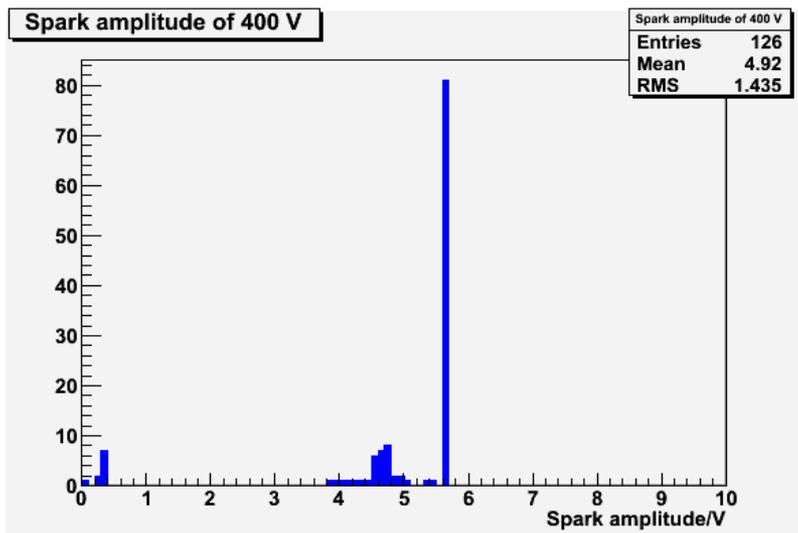
All the 'sparks' in SLHC2:



One 'spark' type:

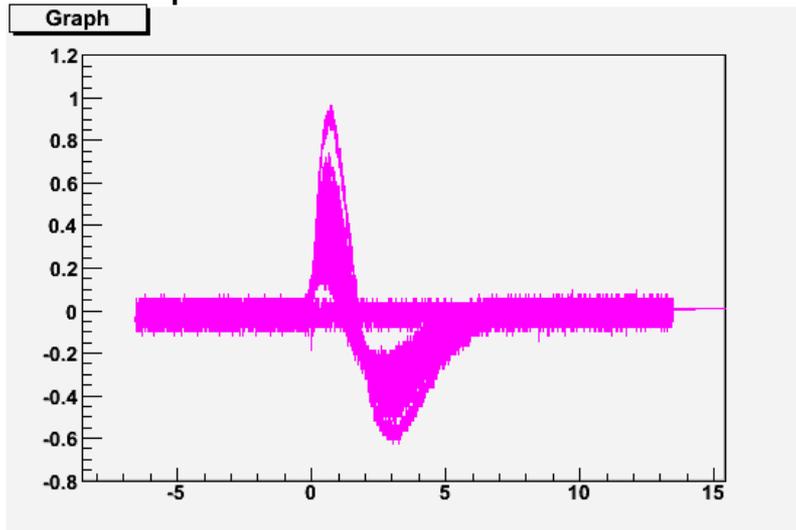


'Sparks' amplitude distribution:

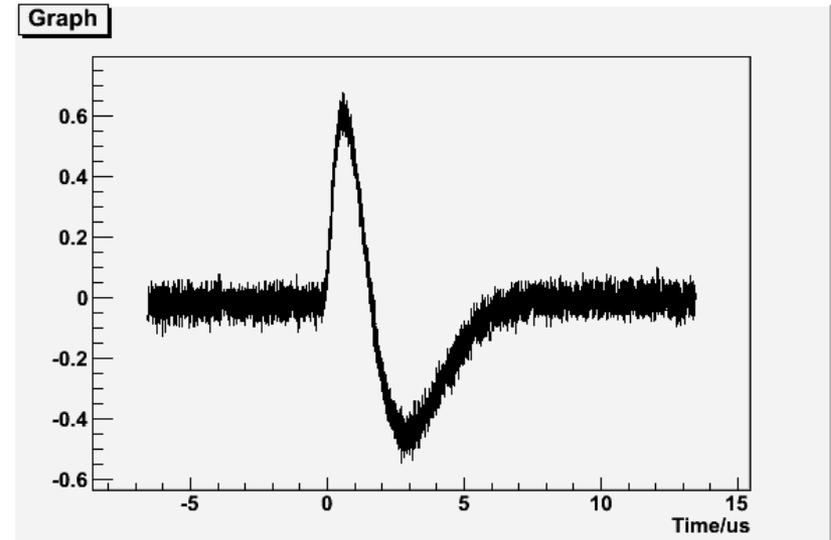


Sparks in R3(2 MΩ/□ resistive kapton):

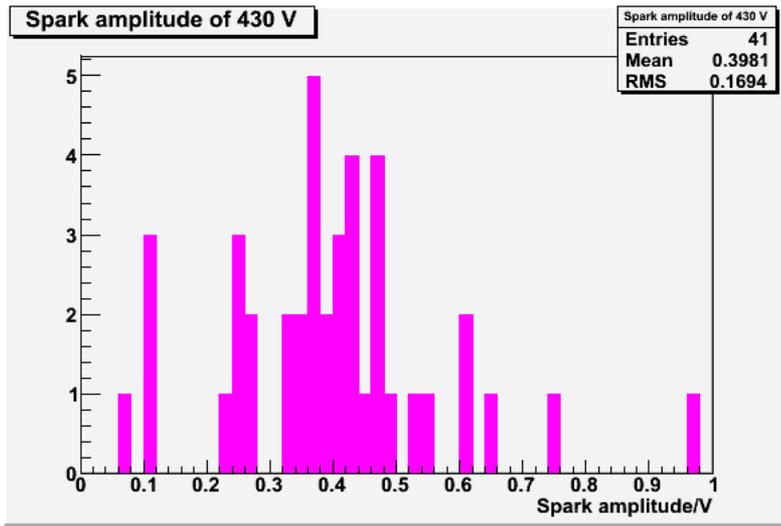
All 'sparks' in R3:



One 'spark' type:

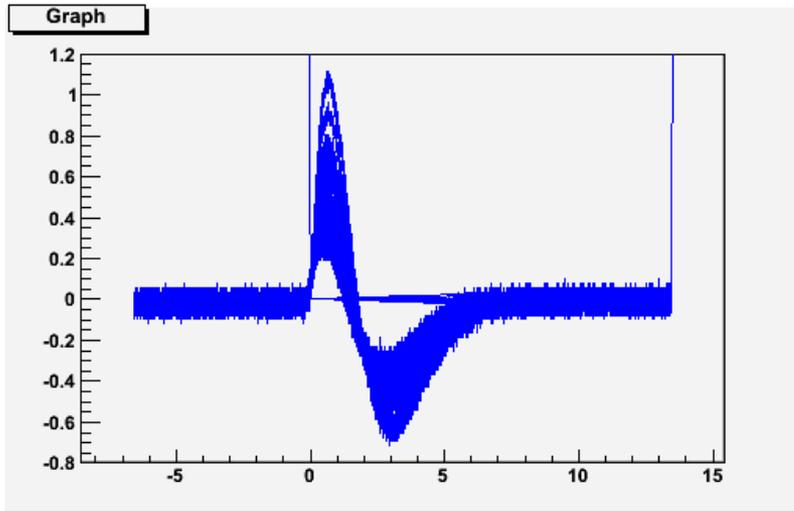


'sparks' amplitude distribution:

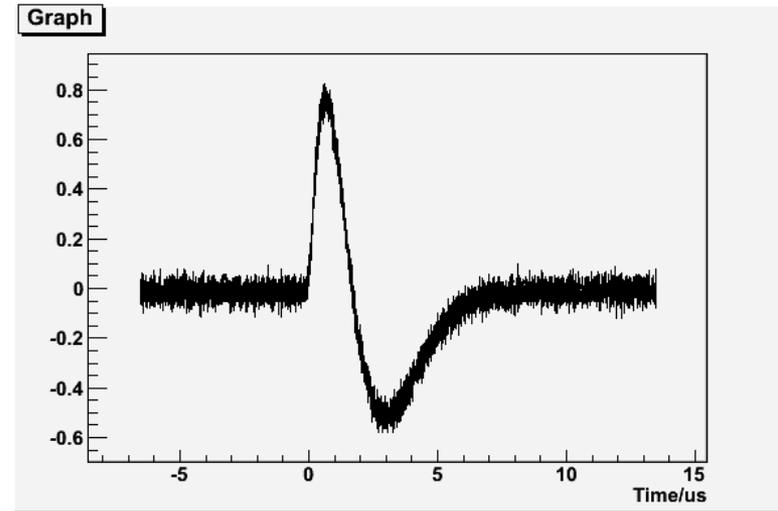


Sparks in R6(400 k Ω /□resistive strip):

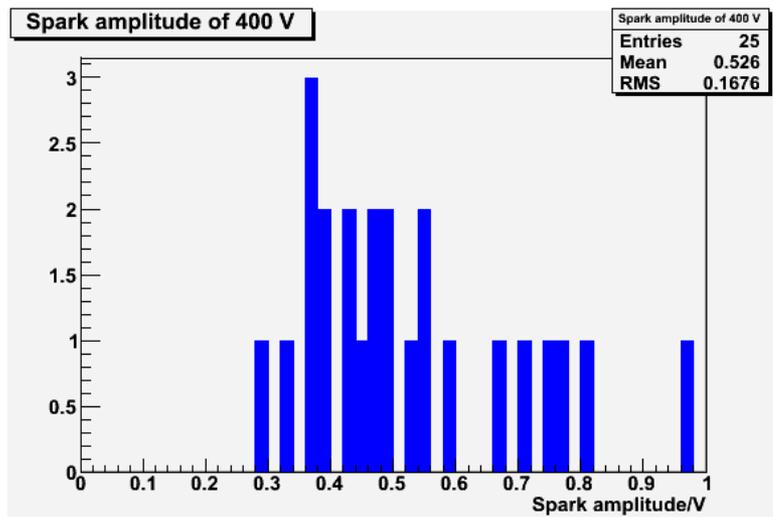
All 'sparks' in R6:



One 'spark' type:

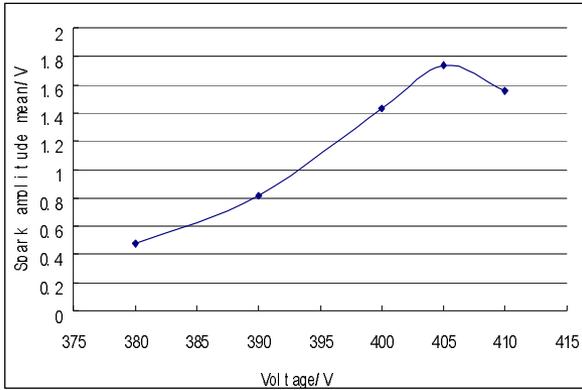


'sparks' amplitude distribution:

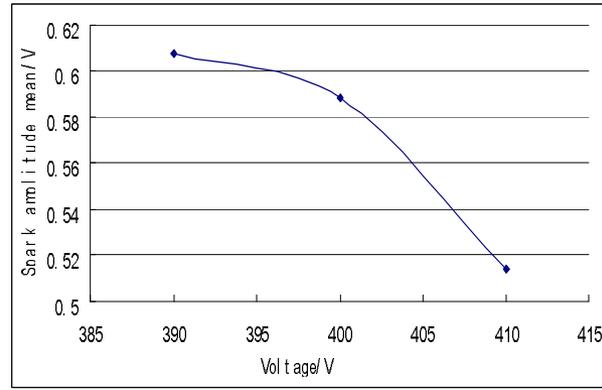


Spark amplitude vs voltage and beam intensity:

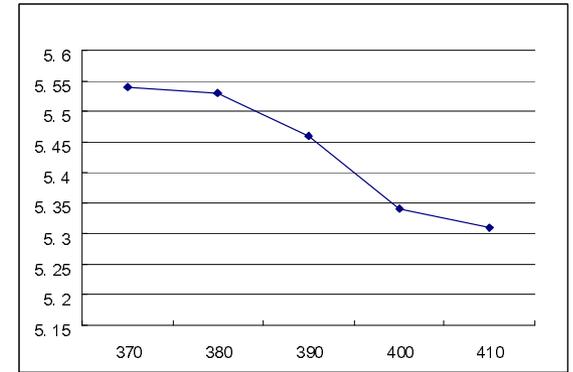
R5 vs voltage:



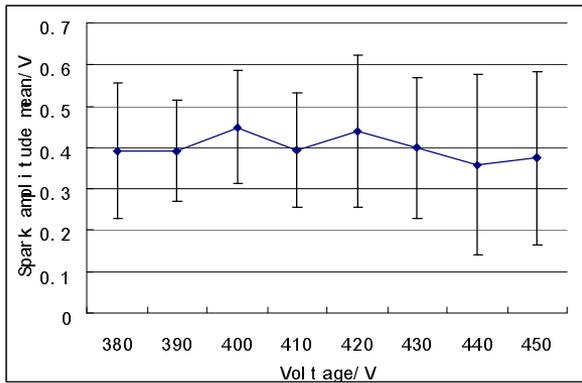
R7 vs voltage:



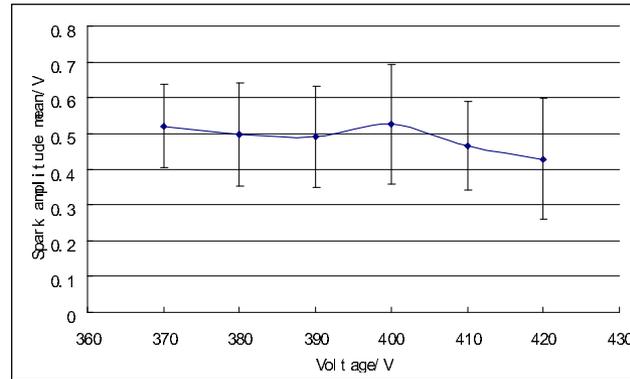
SLHC2 vs voltage:



R3 vs voltage:



R5 vs voltage:



R3 vs intensity:

