Wire Chambers & Micromegas at Low Pressure for Beam Tracking

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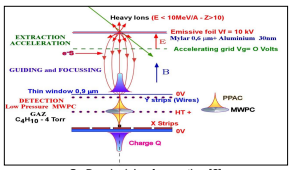
Motivation

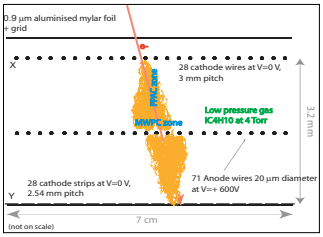
New facilities like FAIR at GSI or SPIRAL2 at GANIL, will provide radioactive ions beams at low energy (<10MeV/n). Such beams have generally a large emittance, which obliges the use of beam tracking detectors to reconstruct, for example, the exact impact of the nuclei on the target. Due to their thickness, classical detectors like CATs [1] would generate a lot of angular and energy straggling. One solution could be the Se-D (Secondary electron Detection) [2], a thin emissive foil in beam with a low pressure gaseous detector off-beam to detect the secondary electrons ejected from this foil.



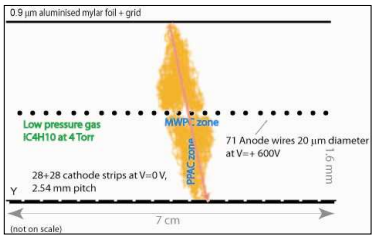
Se-D: principle of operation [2]

Detectors Prototypes

Since 2007, 3 prototypes of low pressure (6 mbar) gaseous detectors have been constructed with an active area of 7x7 cm^2: two wire chambers (a miniSe-D one dimension (MS1D) and a miniSe-D two dimensions (MS2D)) and one micromegas [3].

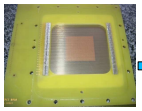


Structure of the MS1D

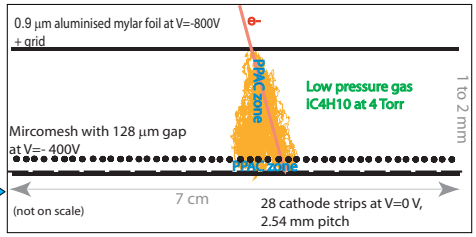


Structure of the MS2D

MS2D

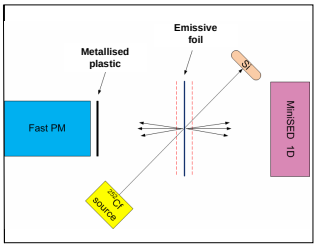


micromegas



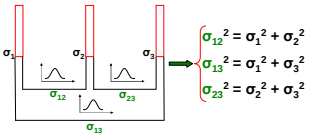
Structure of micromegas at low pressure

Test with ^{252}Cf source at CEA-Saclay



Experimental set-up in laboratory (CEA-Saclay) for measuring time resolution

- **2 detectors in coincidence: a silicon detector and a Se-D**
- **Time signals register with a MATACQ card [4]**
- **Analysis is done off-line**
- **A start time is defined using a constant fraction of the amplitude**
- **3 time differences between the 3 detectors give 3 time resolutions (σ_t)**

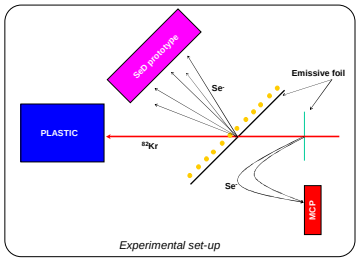


Results for light fission fragments

Detector prototype	HV	σ_t
MS1D	540V	90±30 ps
Micromegas (V_m 500V)	900V	190±35 ps

Beam test on CIME at GANIL

- **Beam: ^{82}Kr from CIME at 1.7 MeV/n from 10^3 to 10^6 pps/cm^2**
- **Emissive foil: Mylar+Al (130 µg/cm^2)**
- **No magnetic field to focalise the secondary electrons**
- **3 detectors in coincidence: an MCP, a Se-D and a collimated plastic**
- **Test of new electronics based on AFTER ASIC [5] to measure spatial resolution**

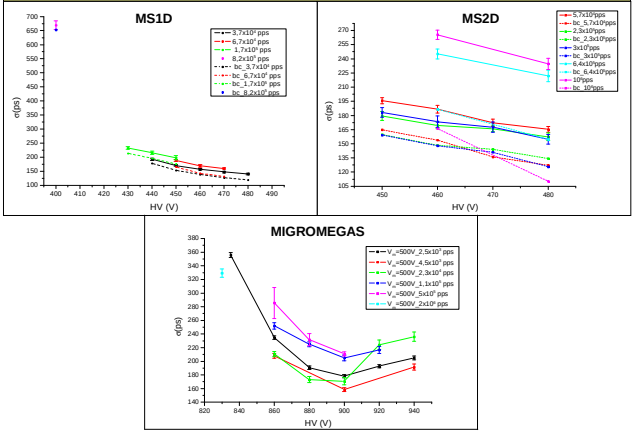


Experimental set-up

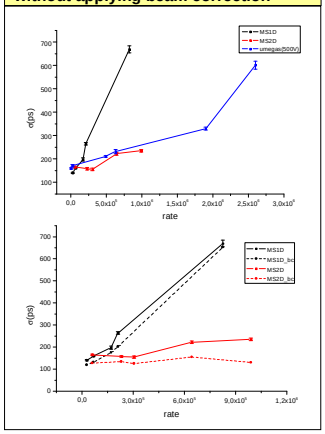
Spatial resolution results without magnetic field applied

	MS1D	MS2D(1)	µmegas
Dead layer+drift gaps(mm)	1.2+1.6+1.6	0+0.8+1.6	0+2.3
FWHM(mm) LC	3.5	3.3	1.9
FWHM(mm) HC	4.4	3.5	--

Time resolution versus polarisation voltage at different counting rates



Best time resolution obtained for each detector versus counting rate with and without applying beam correction



Conclusions & Outlooks

- **Spatial resolution: MS2D presents good results at low & high counting rates (LC and HC)**
- **Beam correction (bc) applied because of the beam shape for deconvolution of time resolution**
- **MS1D: degradation of σ_t when increasing the counting rate because of the limitation of HV**
- **Similar time resolution (σ_t) for MS1D and MS2D at LC but better performance for MS2D at HC.**
- **Micromegas shows good results and behaviour at HC (no bc was possible). Its σ_t is degraded at high voltage due to the spontaneous emission from the emissive foil.**
- **A new micromegas at low pressure prototype with 256 µm has to be tested**
- **After these results, a new prototype MS2D with a bigger active area (20x15 cm^2) will be constructed**

References:

[1] S. Ottini-Hustache et al., NIM A 431(1999)476-484

[2] A. Drouart et al., NIMA 579(2007)

[3] J. Pancin et al., JINST4:P12012 (2009)

[4] D. Breton et al., IEEE Trans. Nucl. Sci. 52 (2005)2853

[5] P. Baron et al., IEEE transaction on 55-3(2008)18

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