TEST of the HADES LH2 target at the Orsay tandem (6-8 january 2014)

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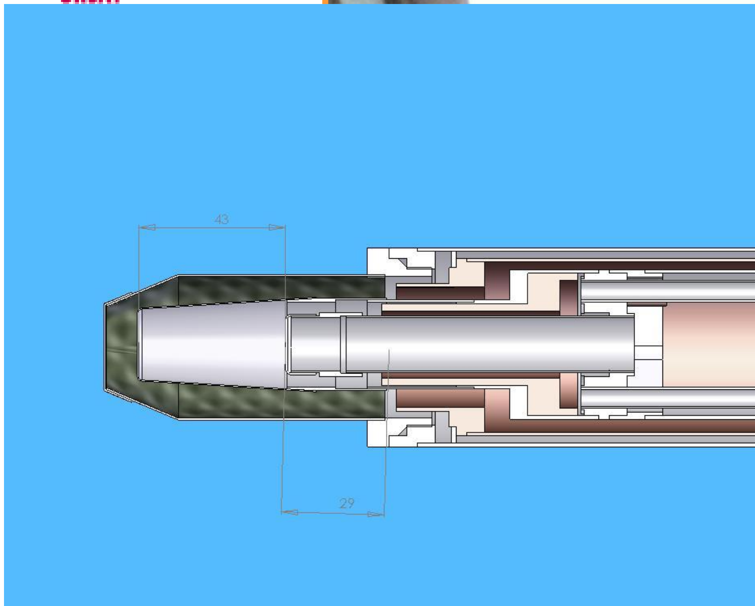
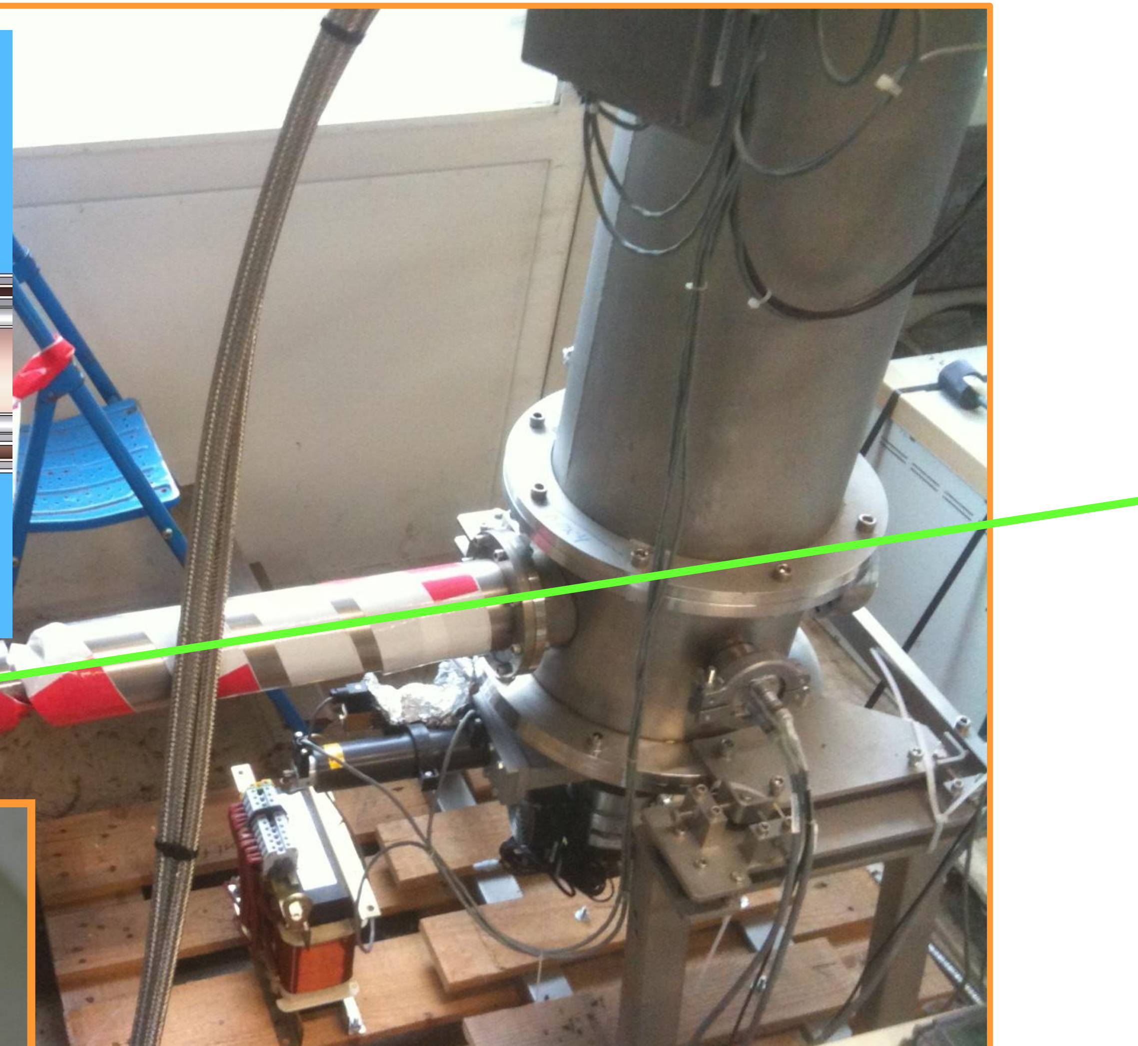
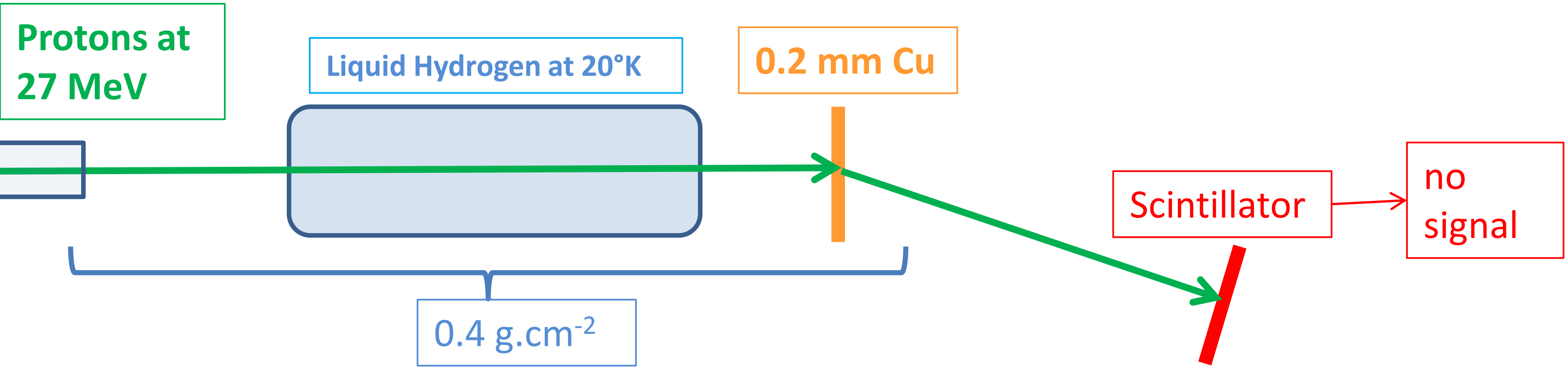
The HADES LH_2 target

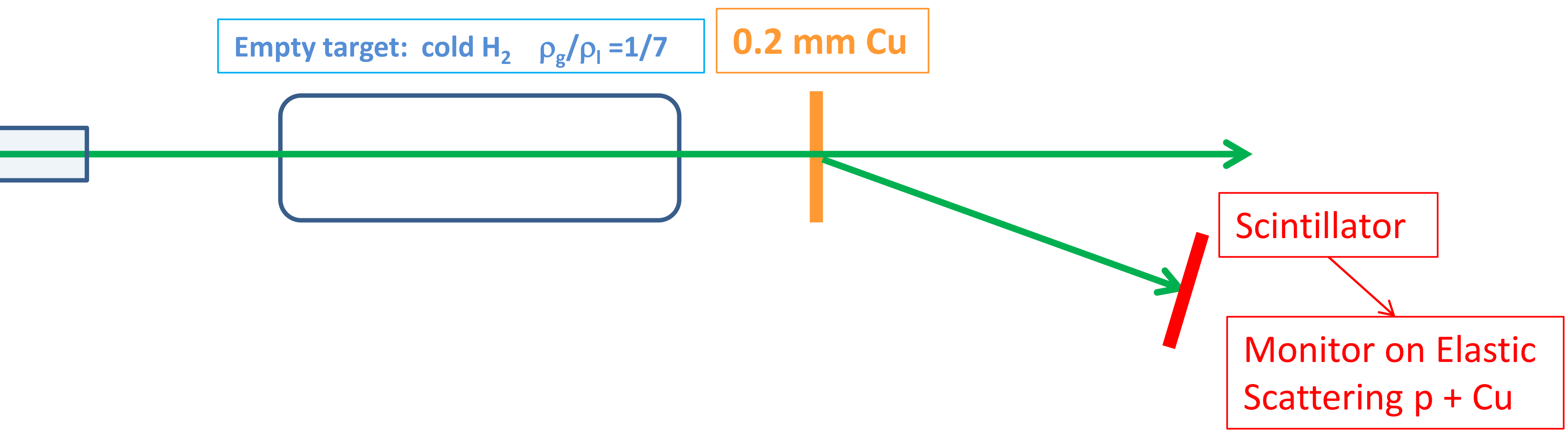




Measurement principle



Range of 27 MeV protons = 0.335 g.cm^{-2}
Hydrogen thickness: 0.330 g.cm^{-2}



Brief reminder on cross section

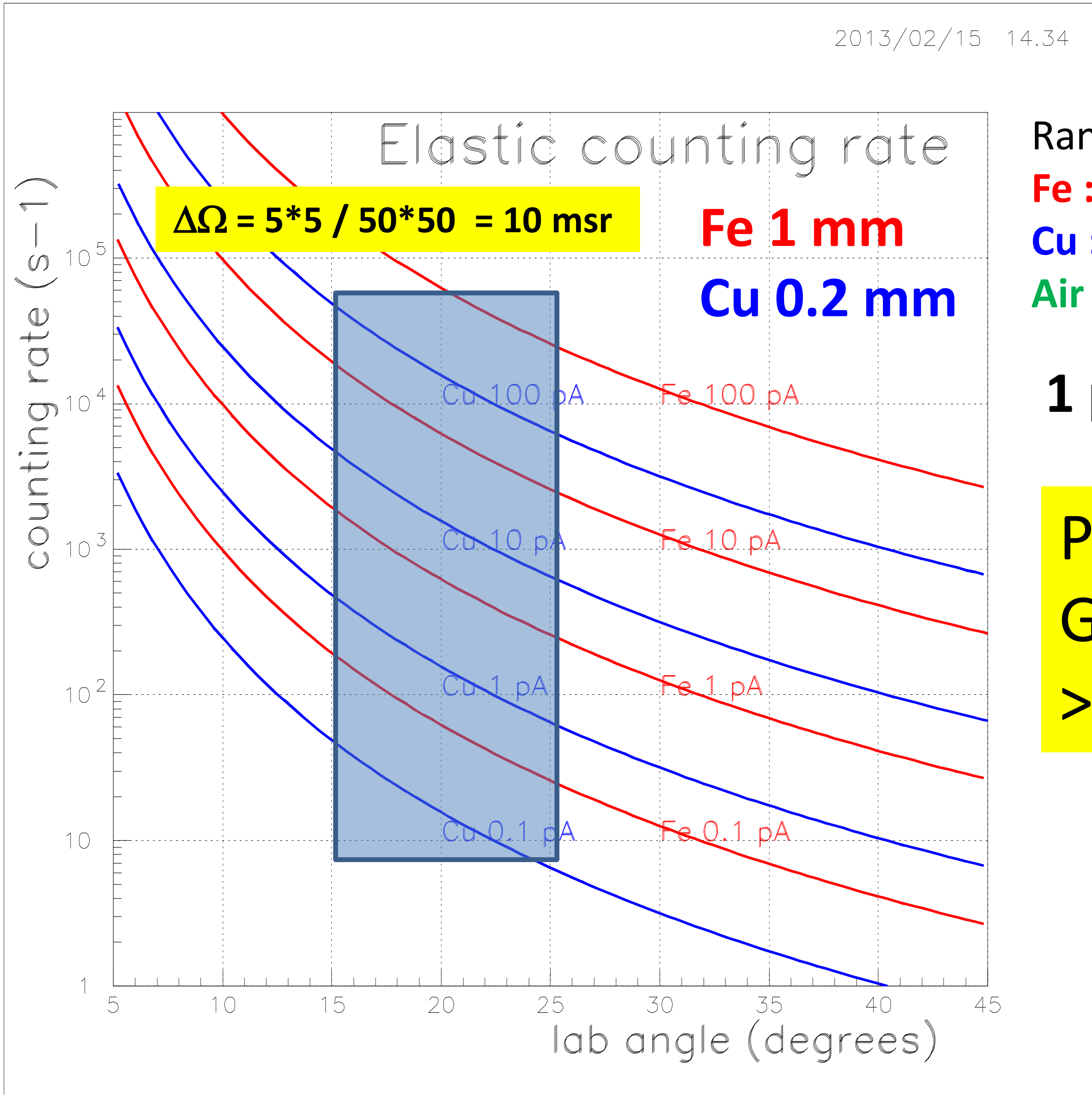
Dominance of Coulomb scattering

$$\frac{d\sigma}{d\Omega} = \left(\frac{Z_1 Z_2 e^2}{4 E_0}\right)^2 \sin^{-4}\left(\frac{\theta}{2}\right)$$

For 28 MeV proton on a 0.2 mm thick copper target,
Z_1=1 , Z_2=29 E_0=28 MeV

→ $d\sigma/d\Omega = 1.4 / \sin^4(\theta/2)$ mb/sr

Counting rates



Range p de 27 MeV

Fe : 1.44 mm

Cu : 1.33 mm

Air : 6.5 m (dE/dx = 2.5 MeV/m)

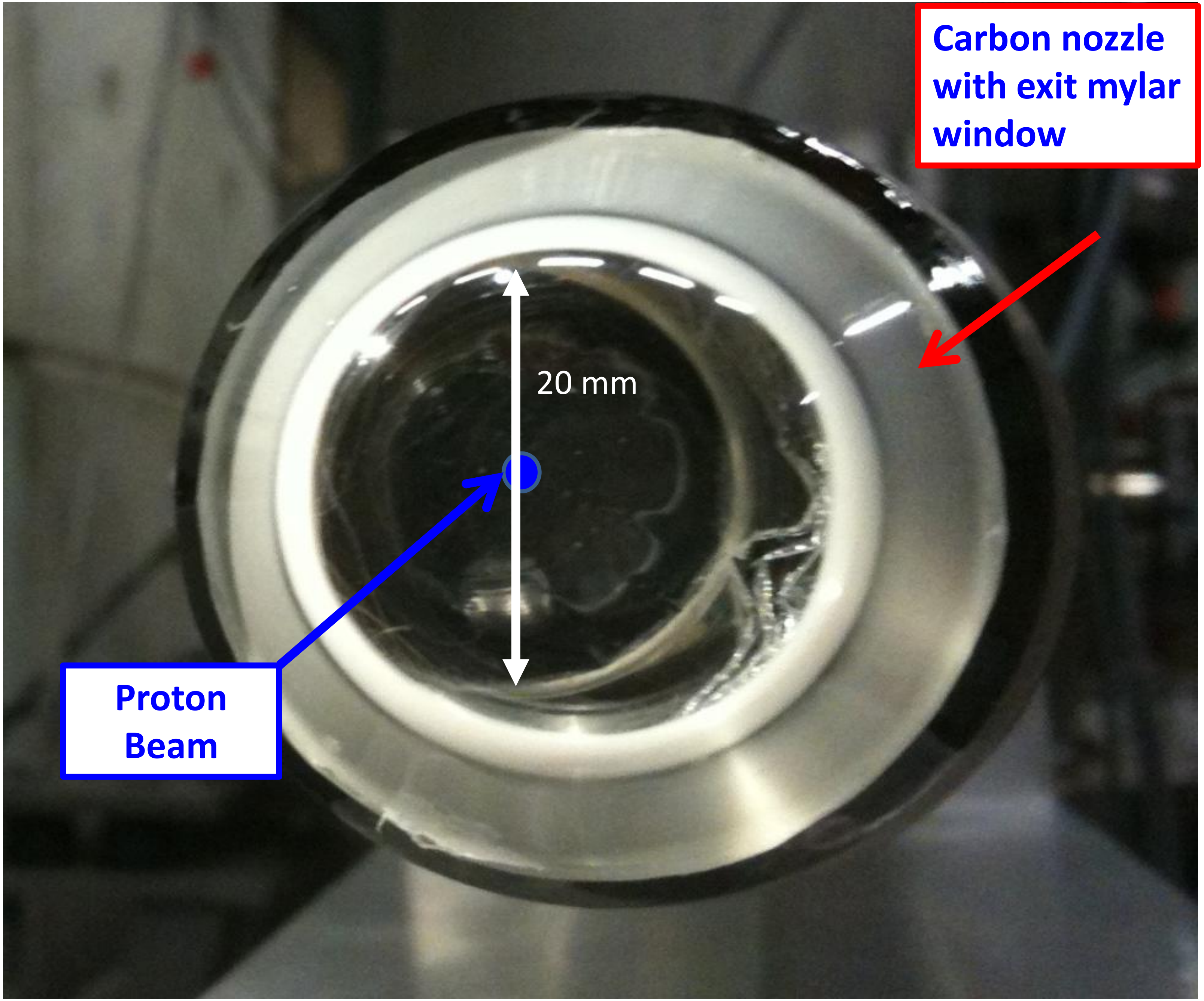
1 pA = 6 10^6 protons.s^{-1}

Pion incident flux at GSI:

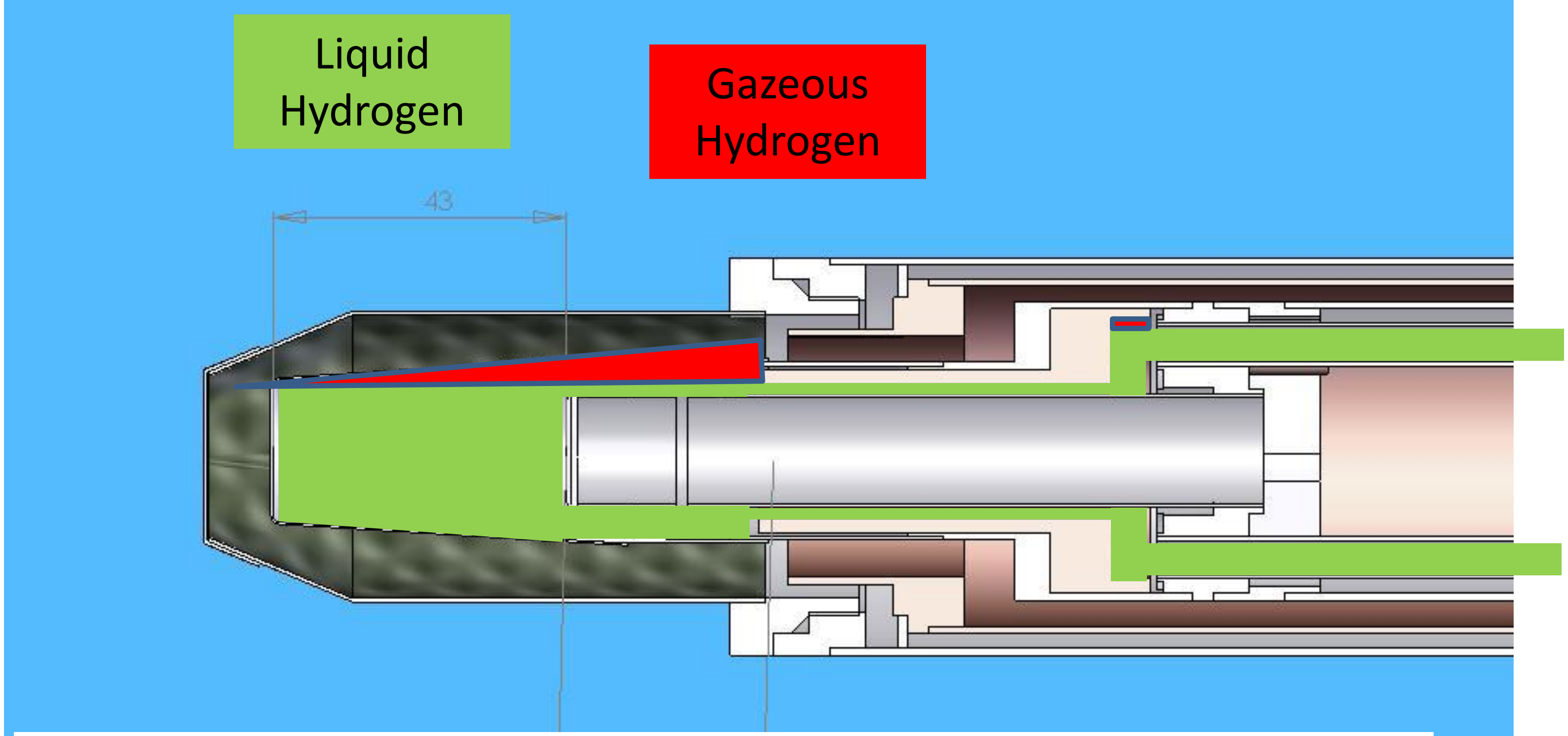
> 10^6 s^{-1} = 0.17 pA

News from december 2013

- Target installed on the tandem beam line in week 48 and 49
  - Connection to the tandem vacuum OK
  - Alignment of the target on the beam axis
  - Slight shift observed between target center and carbon nozzle (~2-3 mm)
- Test during week 50 (on the tandem site)
  - Everything seems OK; stability at P=1000 mbar (as in july?)
  - Target turned off on 13/12
- Restart on 16/12
  - Problems when running at 1000 mb
    - Target empty-full fluctuations over short timescales (a few s to minutes)
    - Down to 300 mbar, then to 500 mbar
  - Stable situation from tuesday 16:00 up to Wednesday 9:00 at 500 mbar
  - Wednesday 9:30: back to 1000 mbar → Empty-full oscillation phenomena show up again
  - Wednesday 10:30 , down to 500 mbar ; no stable condition
  - Wednesday 11:00 down to 300 mbar for a few minutes then back to 500 mb → target gets stable and full!


Carbon nozzle
with exit mylar
window
20 mm
Proton
Beam

Why do we have bubbles ?



Small bubbles are continuously produced , as a result of heat transfer through the Carbon envelope. They contribute to the formation of a sizeable bubble (~1 cm^3). This bubble has to be evacuated from time to time.

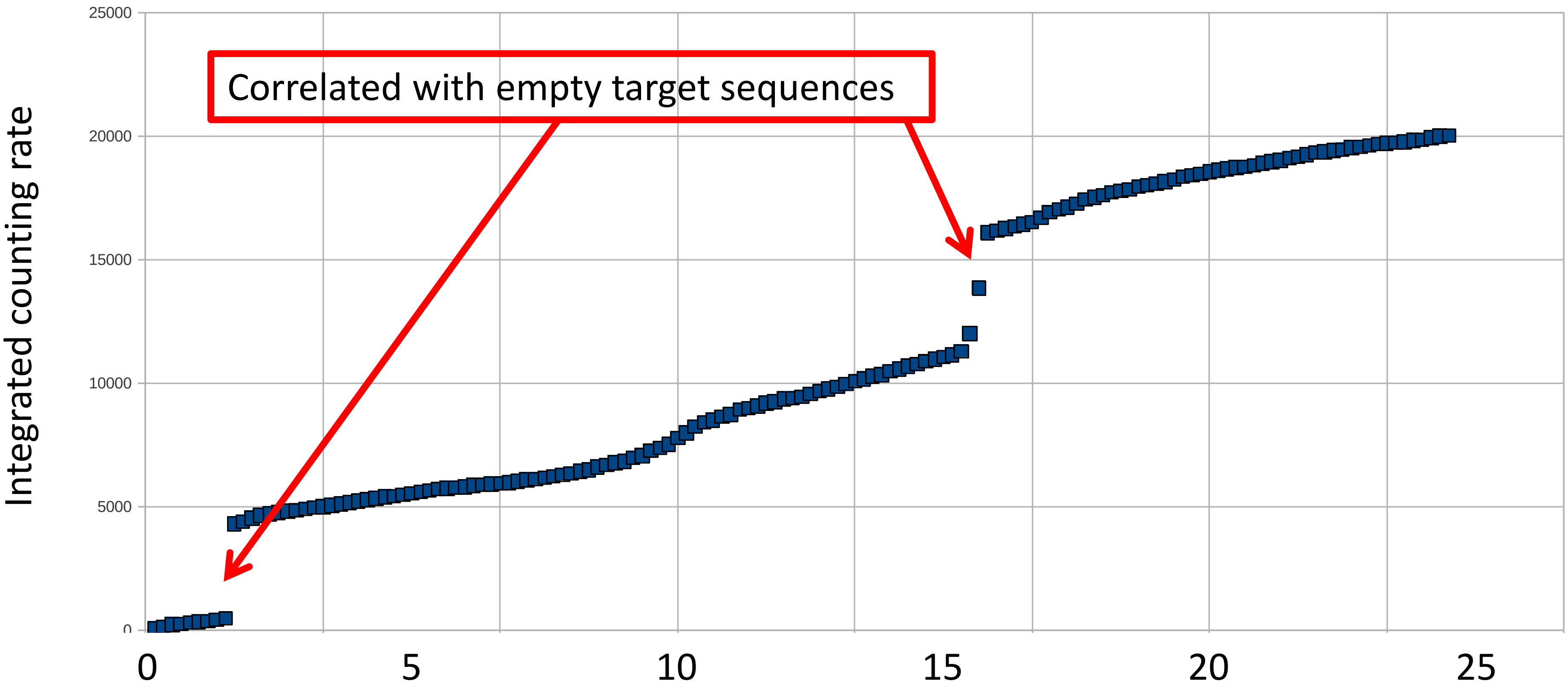
The LH2 target at the tandem beam line

Measurements at the tandem (6-8 january 2014)

- Proton beam at 25.8 MeV focused on the target and tuned to low intensity (10-60 pA)
- Test of the method
  - Cosmics rate : a few counts per second
  - Full target : a few hundred to 1000 per second (residual activation after beam irradiation)
  - Empty target: a few 1000 to 20000 per second

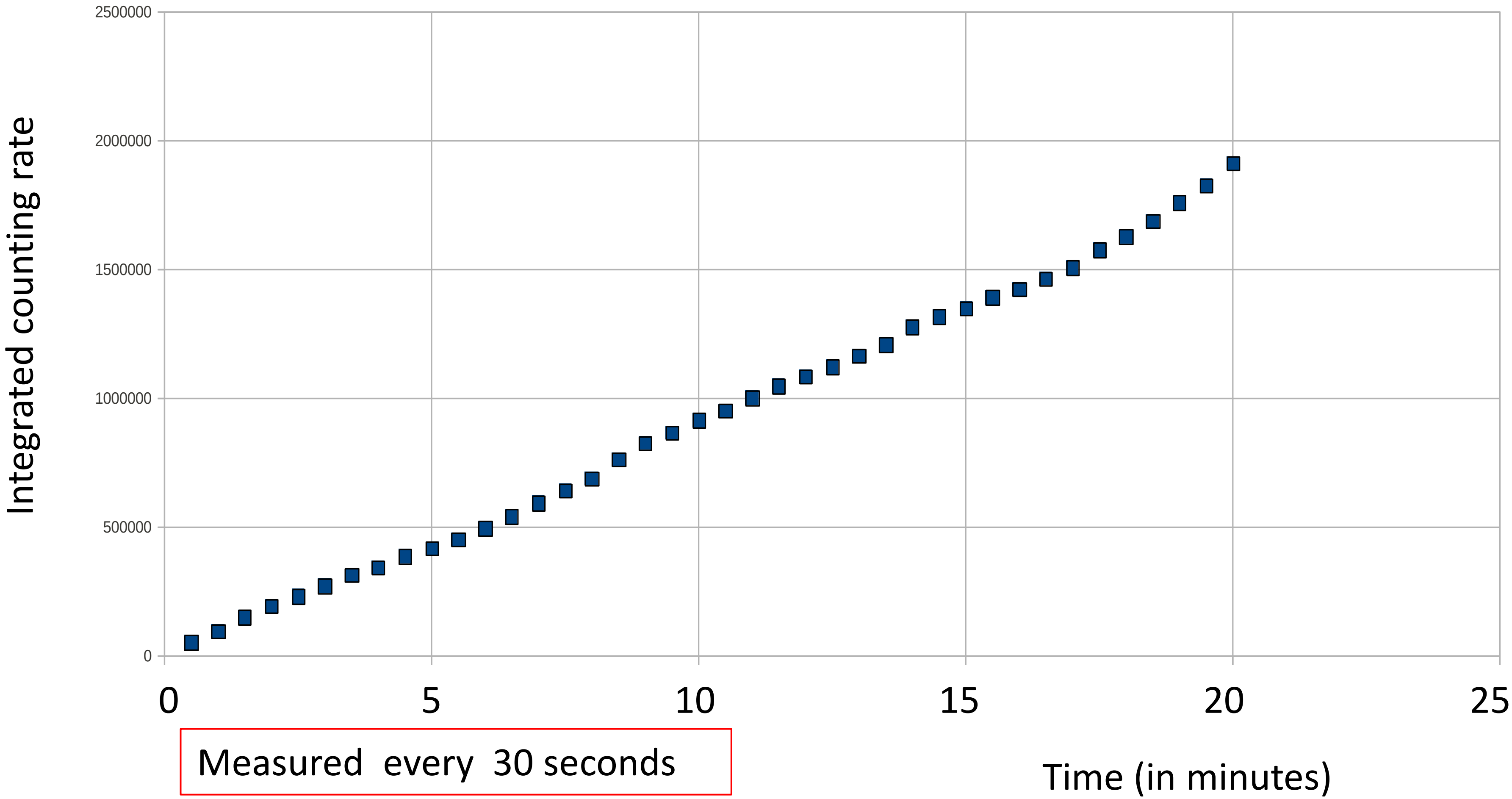
  and a 10 MeV 'signal' clearly seen on the scope, as expected
- Counting rate measurements at differents intensities and pressure

Integrated counting rate at 500 mbar, 10-20 pA



Measured every 10 seconds

Integrated counting rate at 300 mbar, 50 pA



Measured every 30 seconds

Main conclusions

- No possible working point could be found at 1000 mb (same situation as at GSI) with the carbon nozzle, contrary to what was 'observed' previously in our test room with the stainless steel nozzle
- Dissipated power = 1. 3 mW = 1000 times larger than in current HADES situation (6 10^6 protons per second at MIP)
- Empty target periods could be unambiguously detected by the proposed method
  - Empty target counting rates = calculated counting rates
  - Full target counting rates at least an order of magnitude lower
- At 300-350-400 mbar, a stable situation, with target full, could be found, not affected by the beam presence, over long periods (~1 hour)
- Ongoing investigations to understand the nature of the problem with experts.