

Setup of a low intensity configuration for extracted beams at CNAO

M. Marafini, R. Mirabelli, V. Patera, A. Sarti, A. Sciubba, G. Traini

INFN Roma 1 & Univ. La Sapienza, Centro Fermi

G. Battistoni, Y. Dong, I. Mattei, S. Valle

INFN & Univ. Milano

M Pullia, S. Savazzi

CNAO

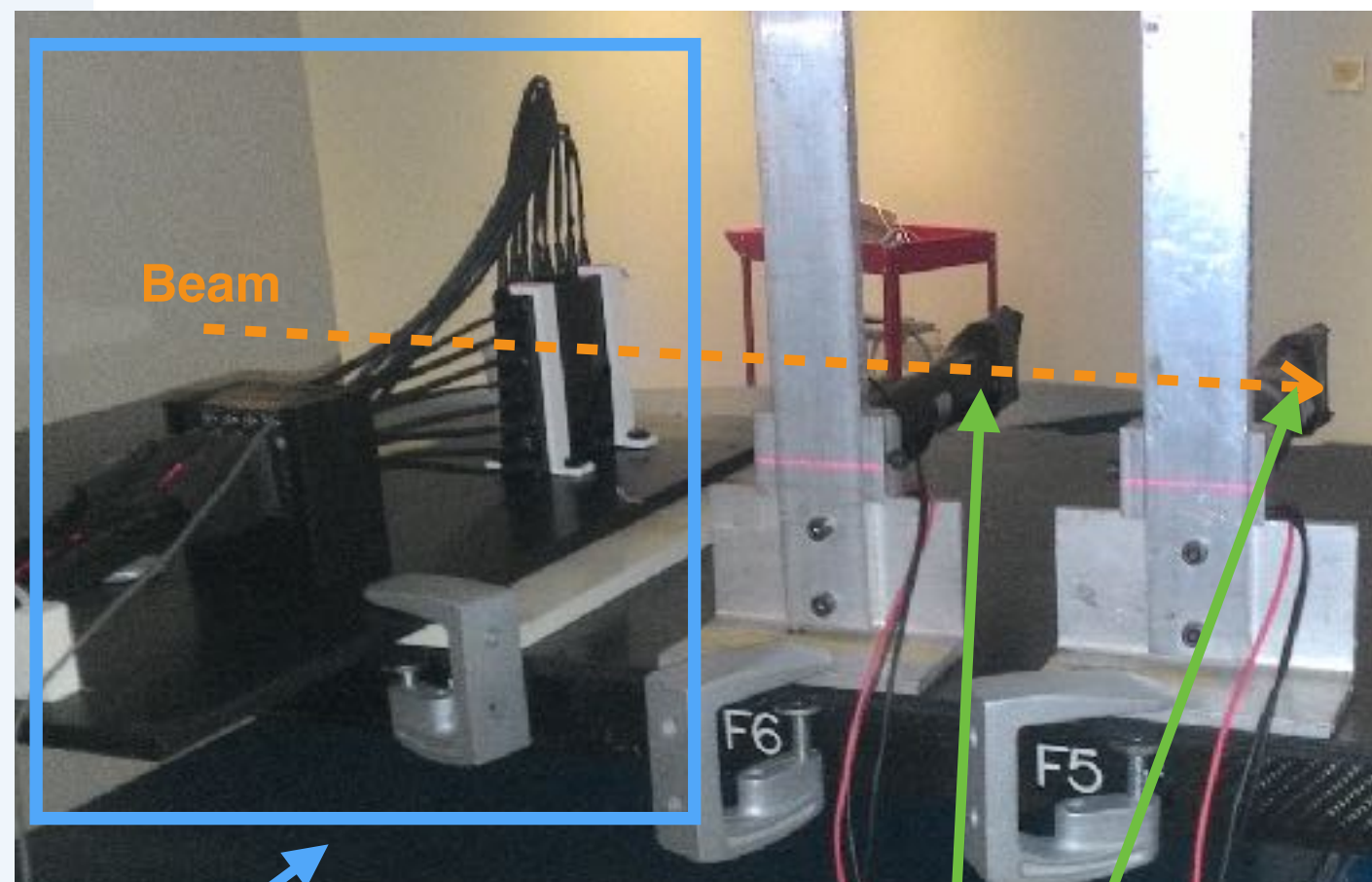
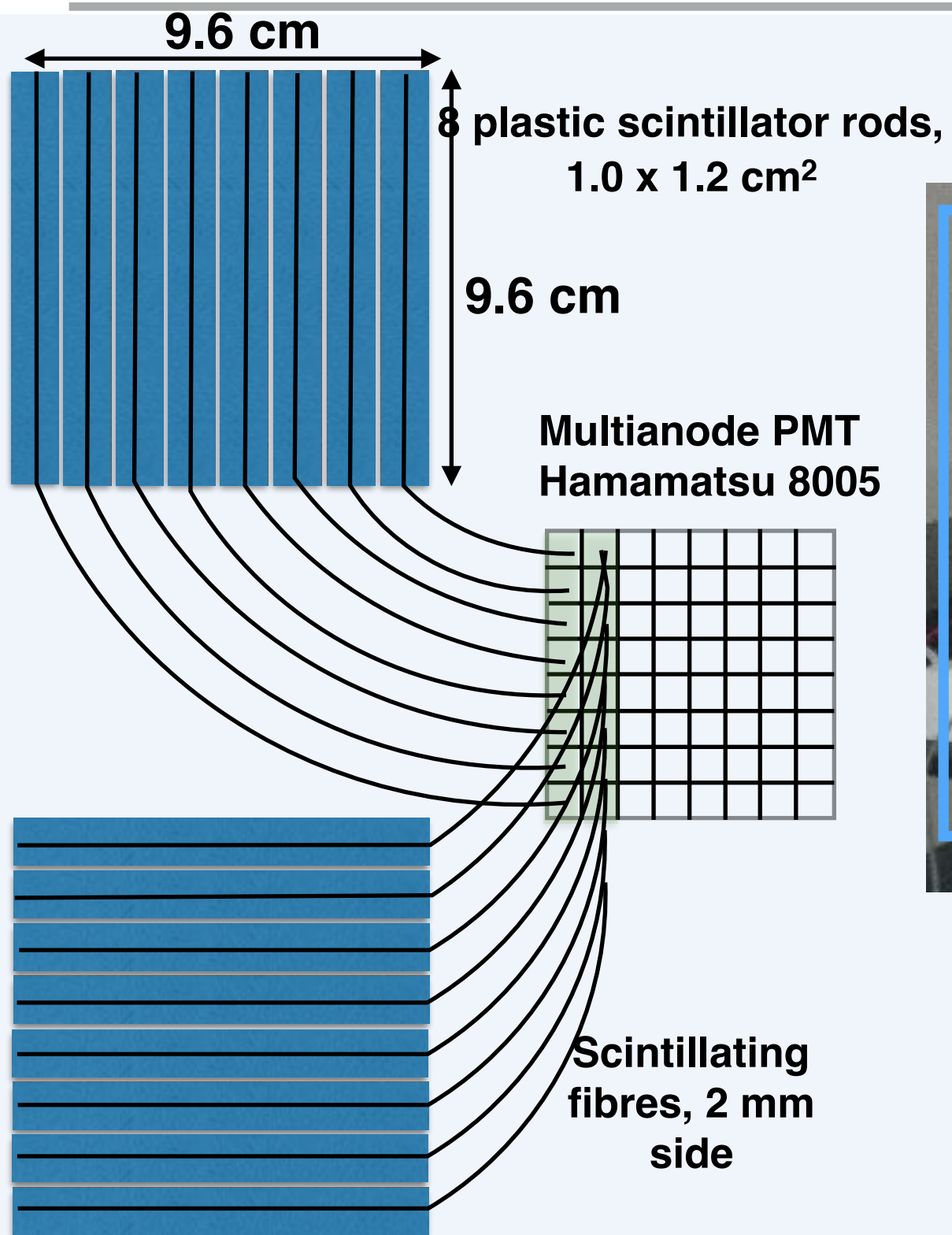
Motivations

- ▶ **The present Dose Delivery System is able to steer the beam for intensities above $\sim 10^6$ particles/s**
- ▶ **For some applications like detector tests, some nuclear physics experiments (see FOOT exp.) a low intensity ($10^3 - 10^4$ particles/s) is required**

The idea...

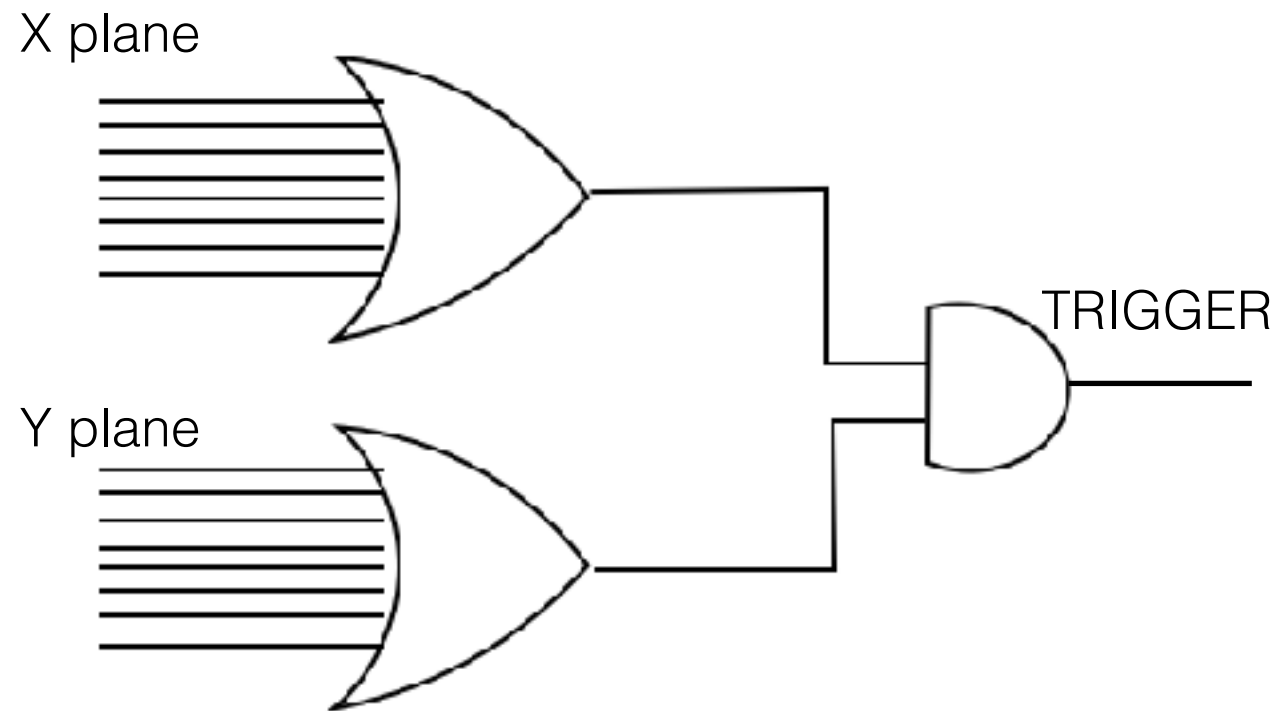
- ➔ **how can we help the CNAO accelerator staff to find a setting in order to reach low beam intensities ($\sim$ kHz)?**
- ➔ **A dedicated detector, capable to count the incoming ions and to monitor the beam position in the x-y plane, has been developed (Roma - SBAI)**

Experimental setup

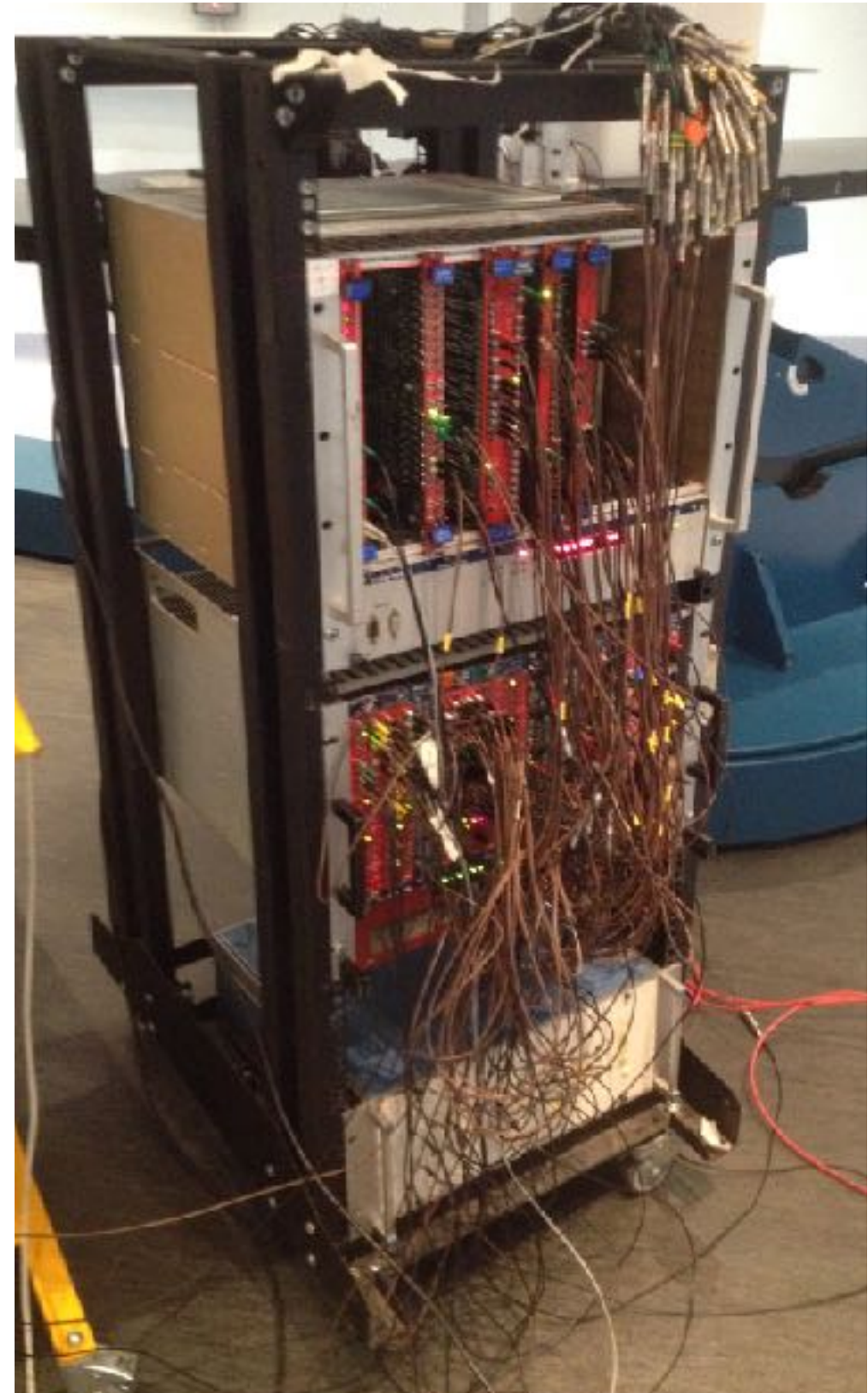


Plastic scintillators
5x5x5 cm³ for efficiency
measurement

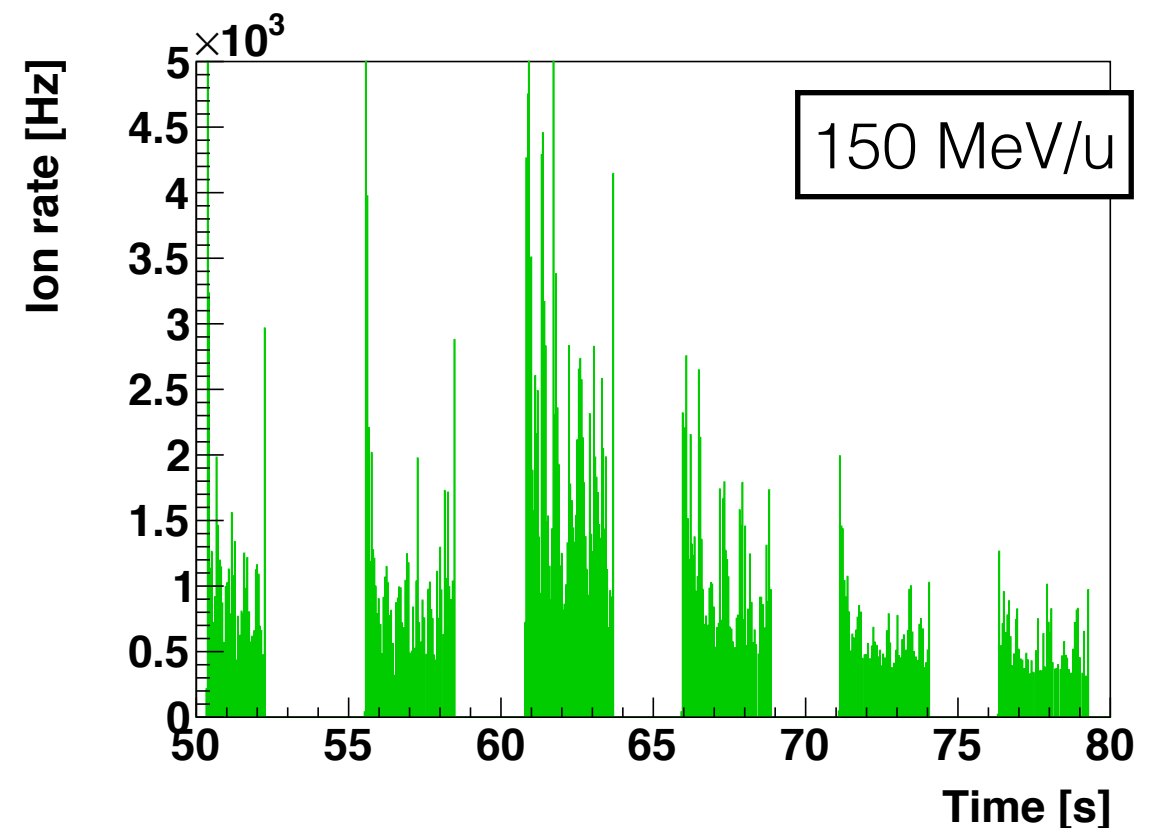
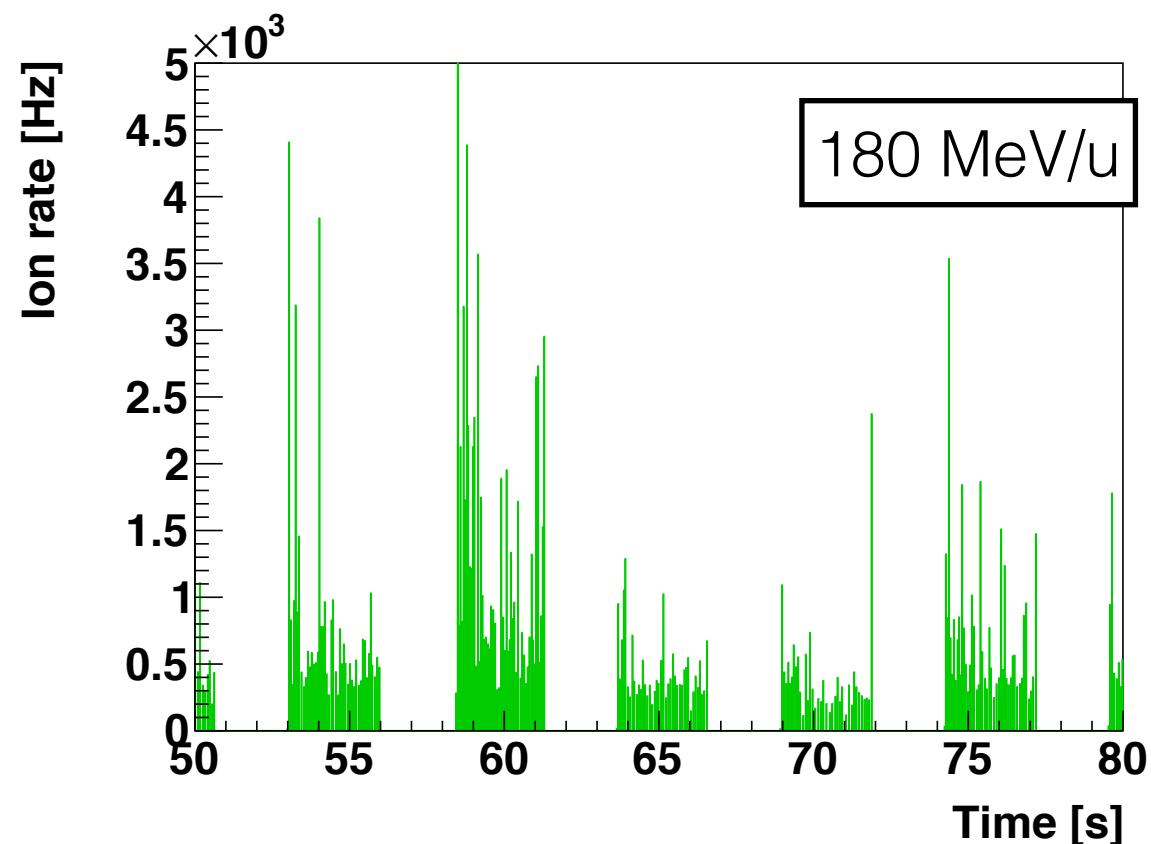
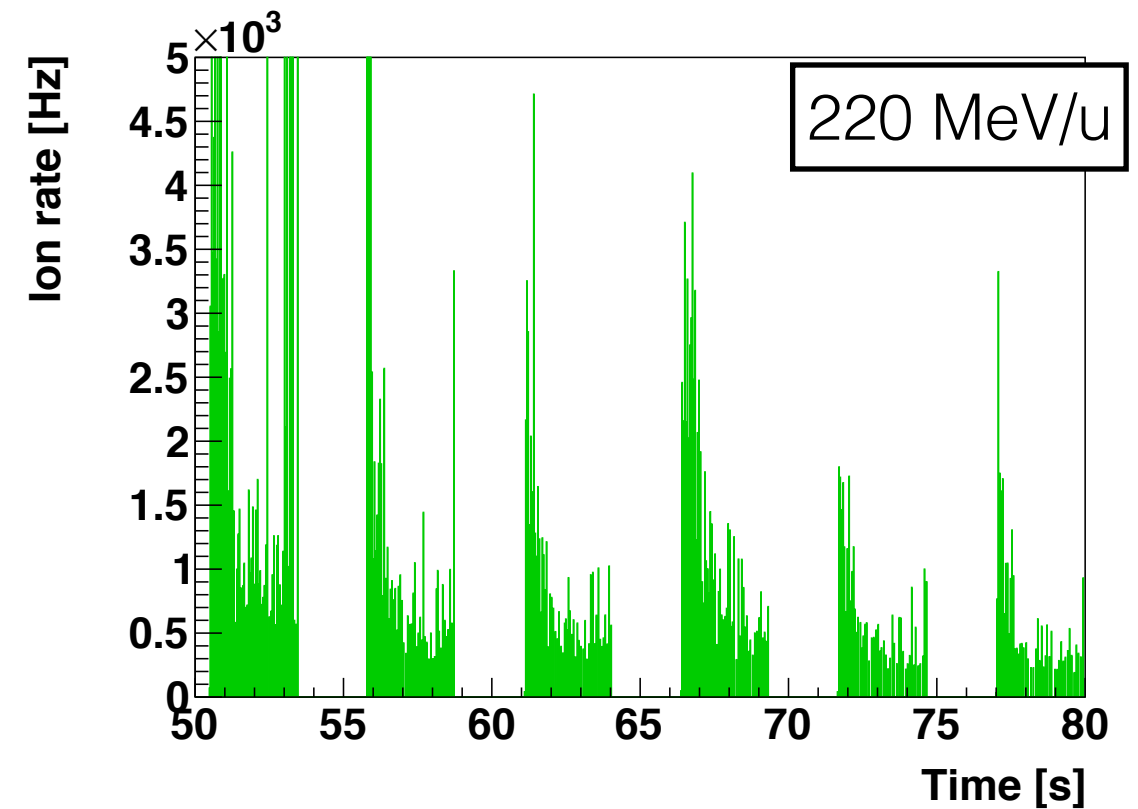
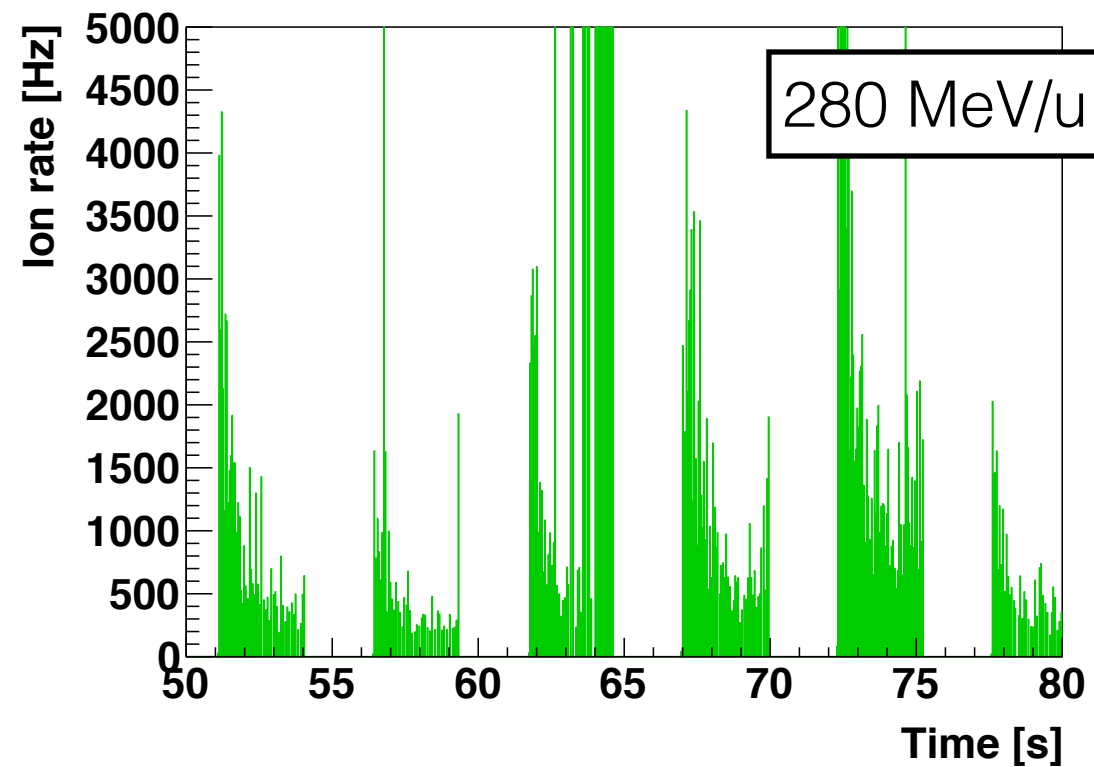
Trigger and DAQ



- ▶ **Trigger: coincidence between the X-Y planes. Fixed dead time of 30 ms**
- ▶ **VME-based data acquisition**
- ▶ **16 channels, multi-hit TDC V1290**
- ▶ **16 channels, QDC V792**
- ▶ **Scaler V560, V260**

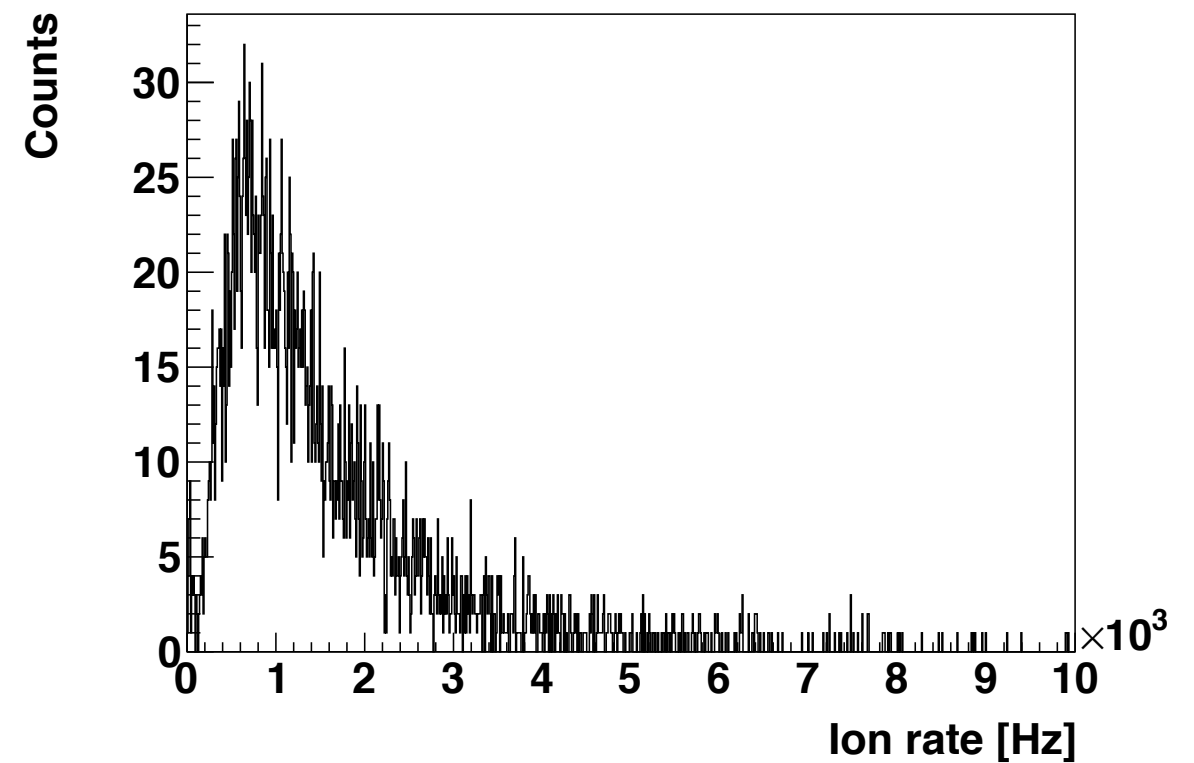
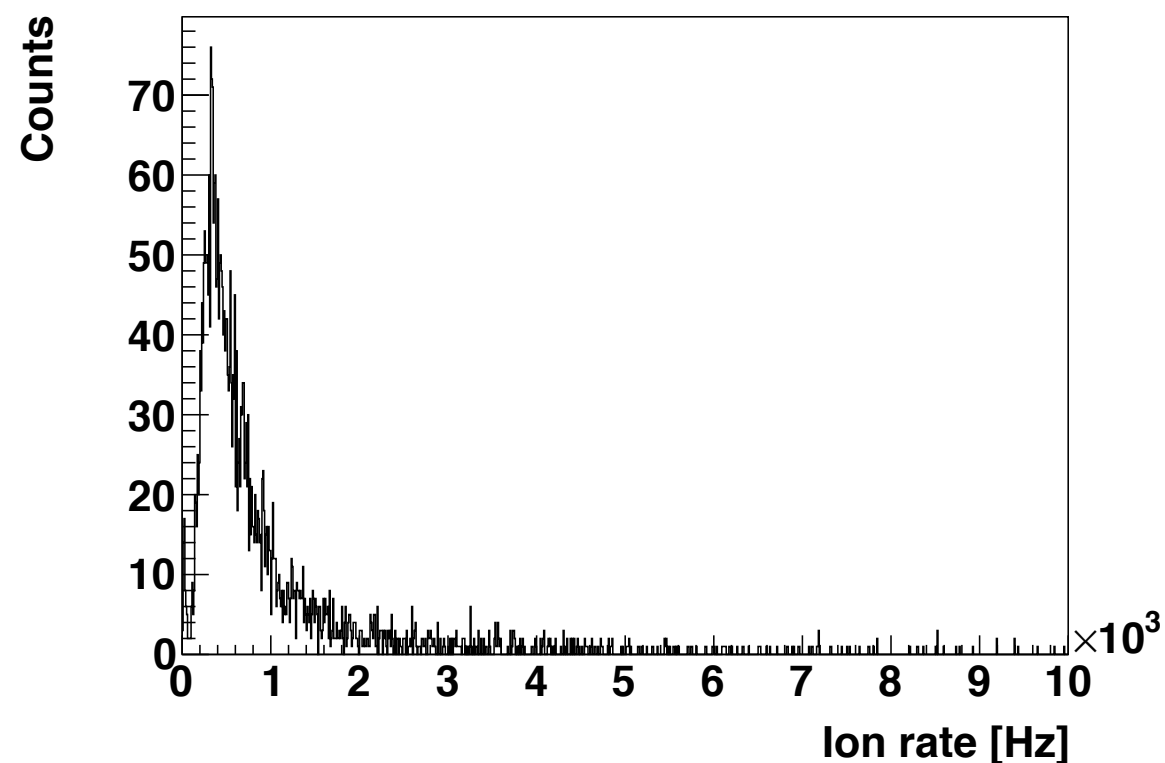
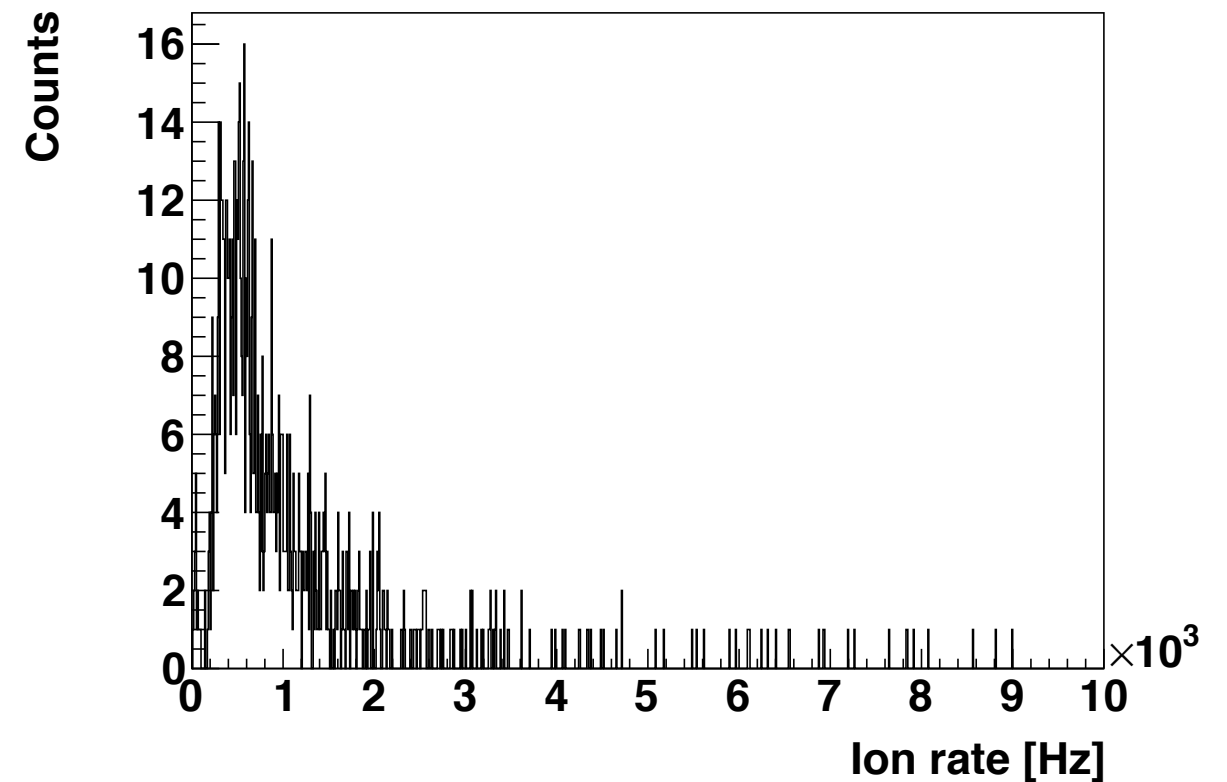
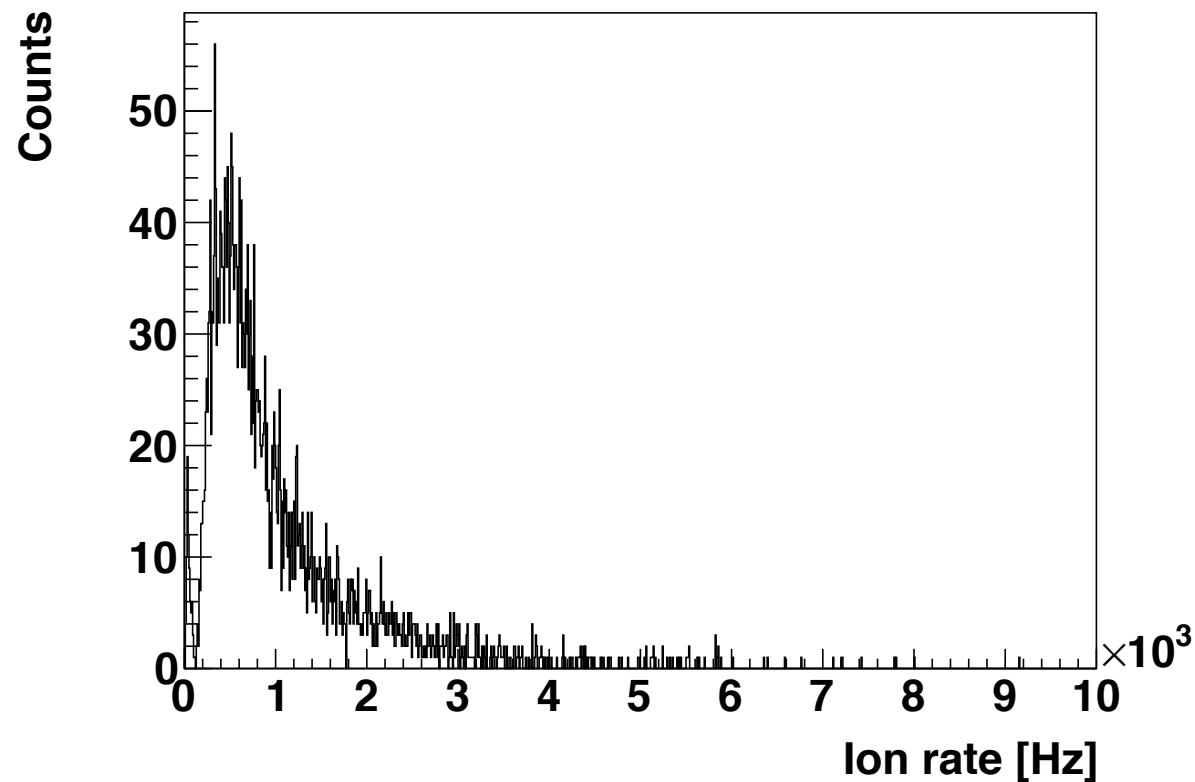


Carbon ion beam - Intensities vs time

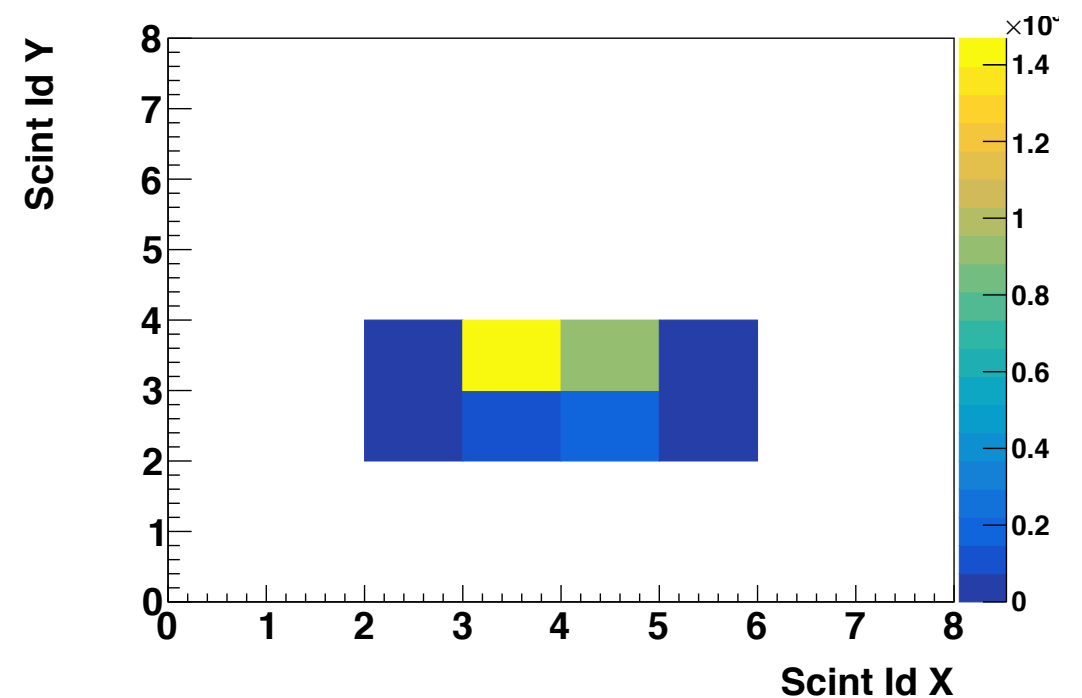
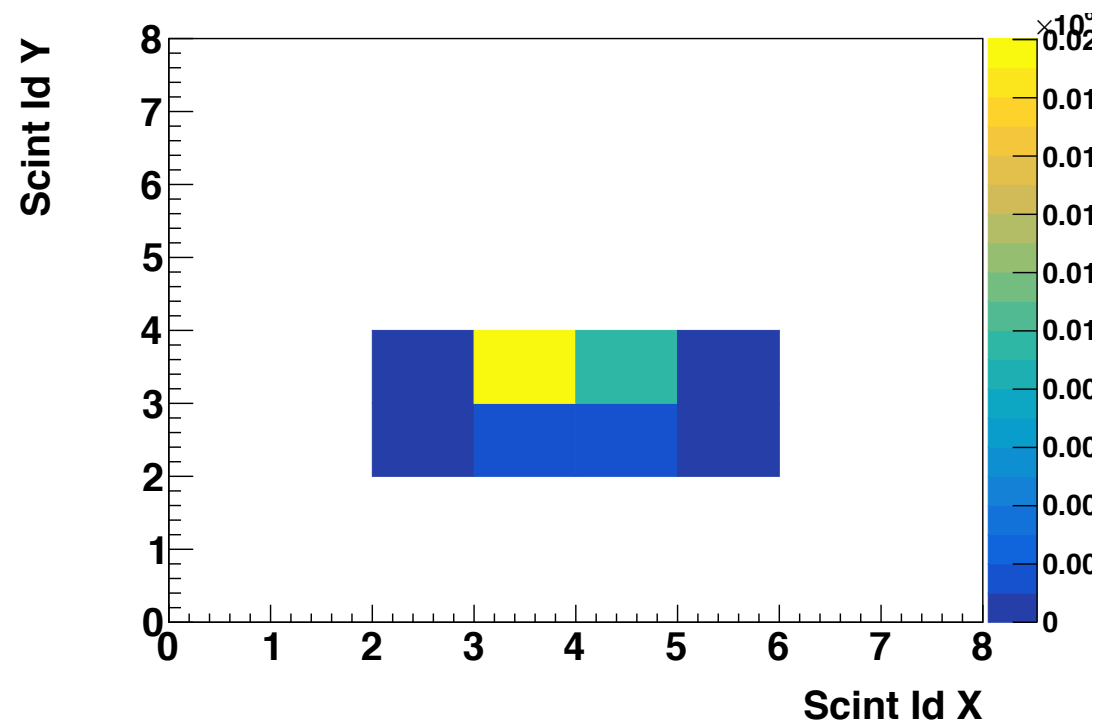
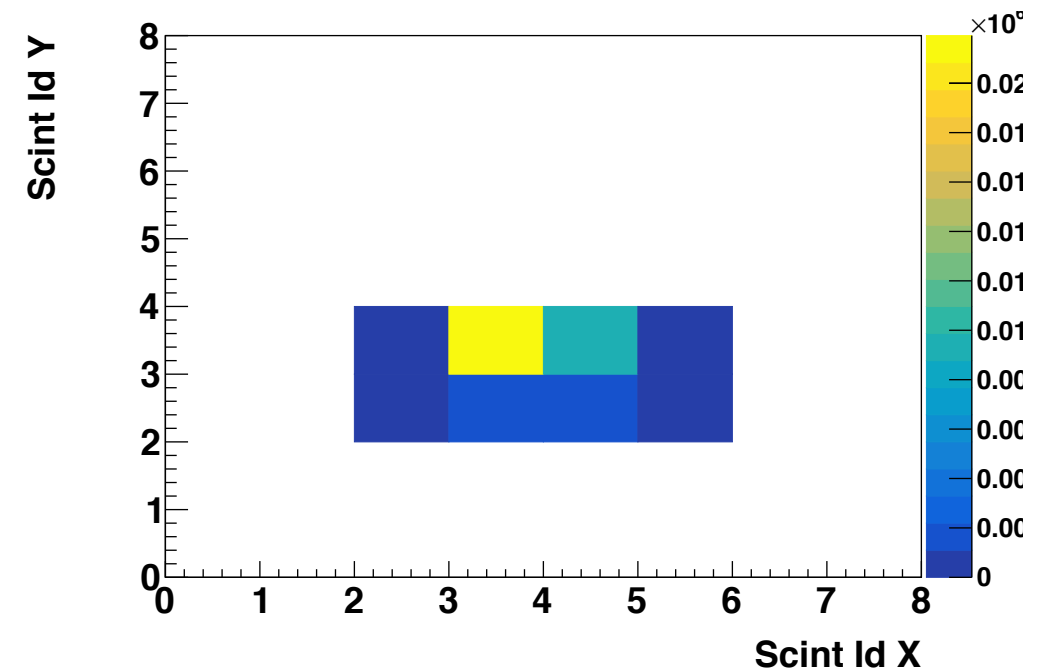
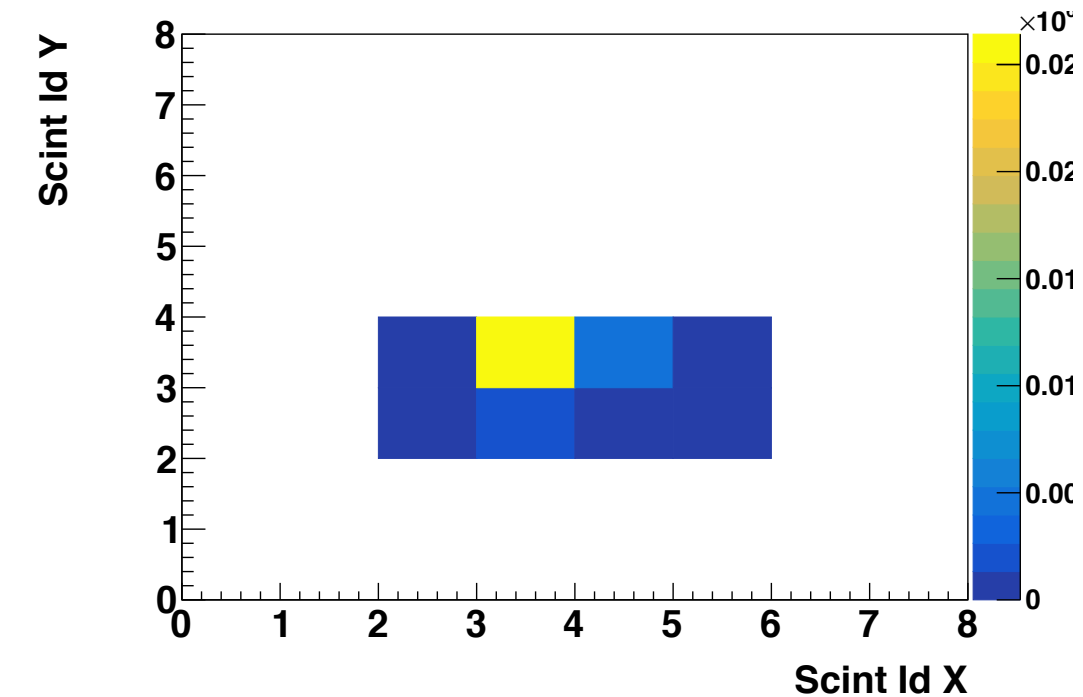


Carbon ion beam - Intensity distributions

~90% efficiency has been measured, not applied in this analysis

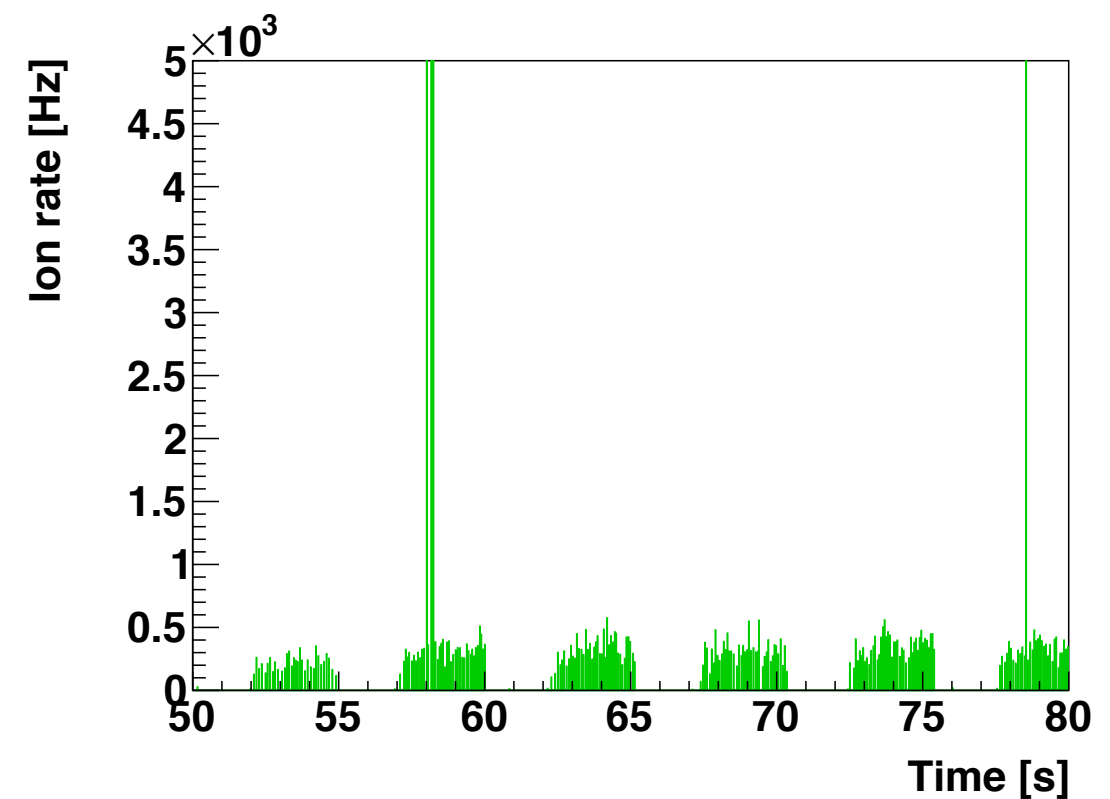
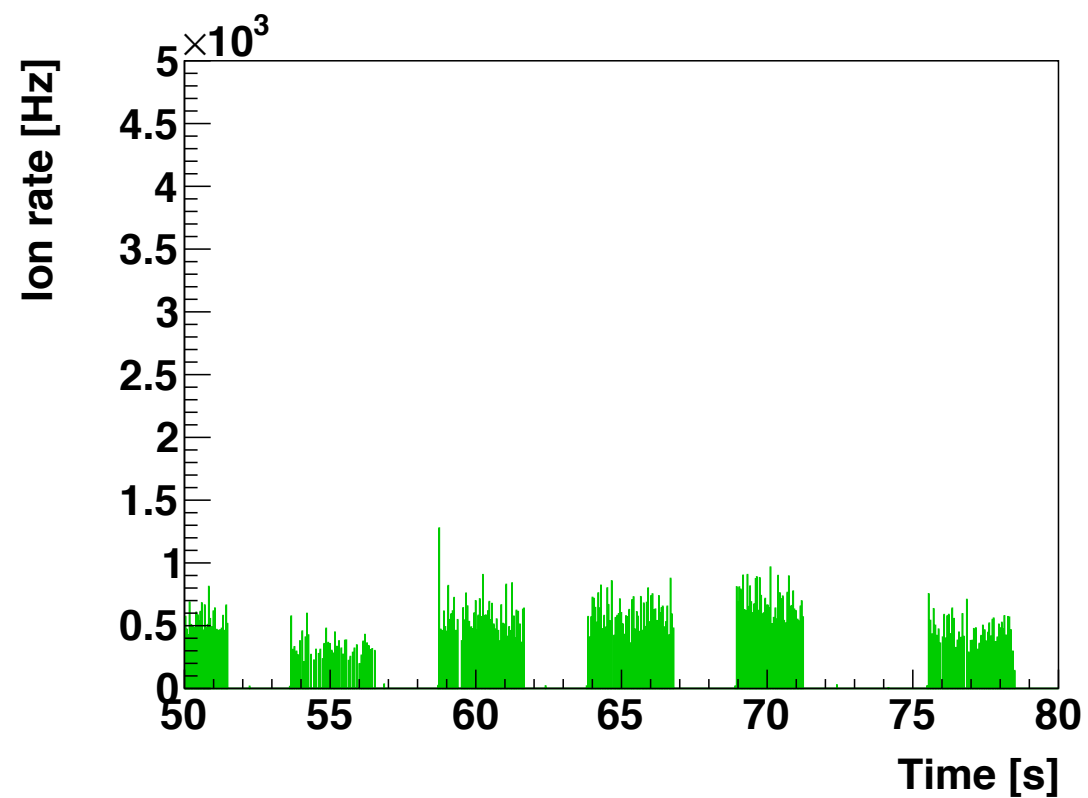
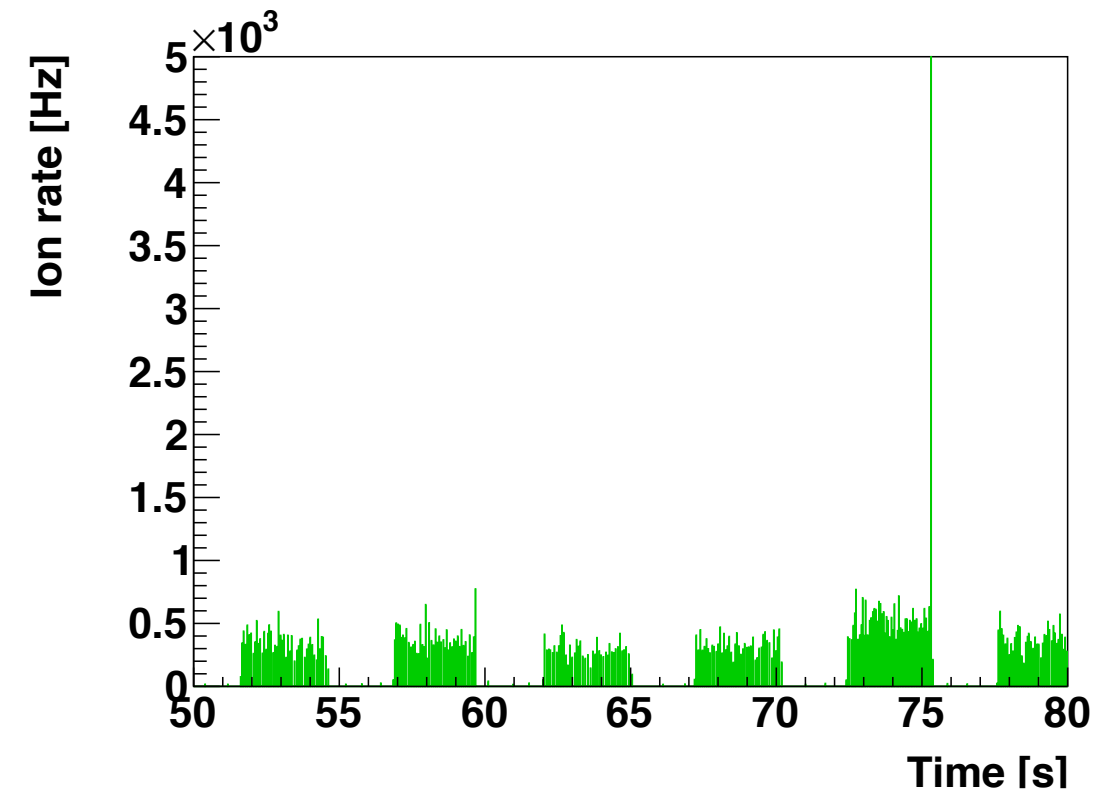
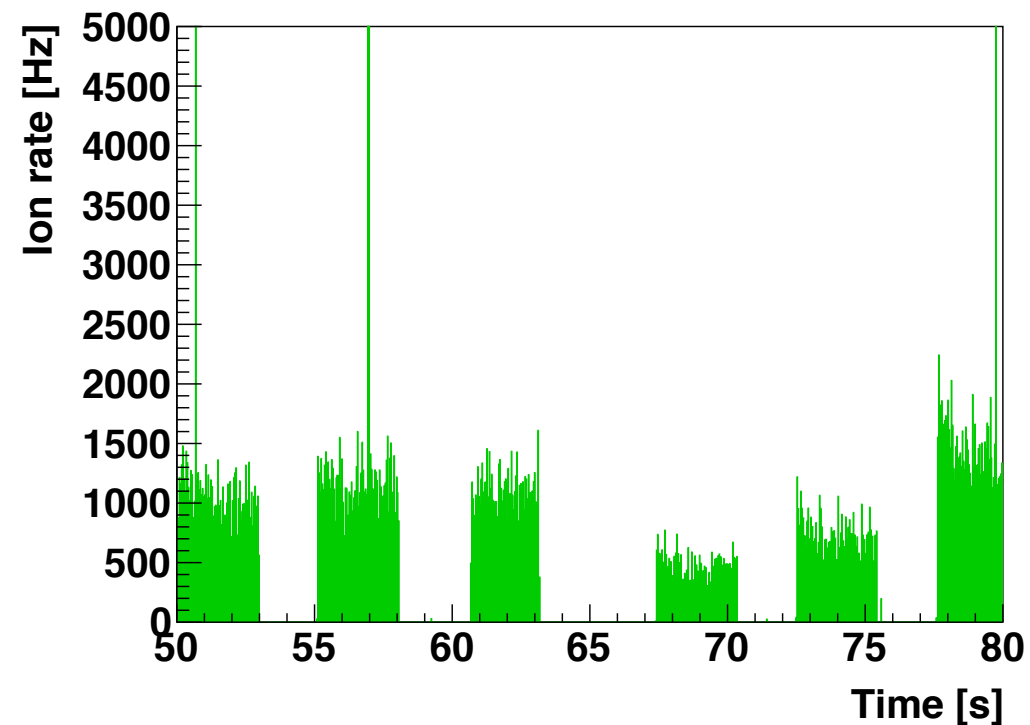


Carbon ion beam - Spatial distribution

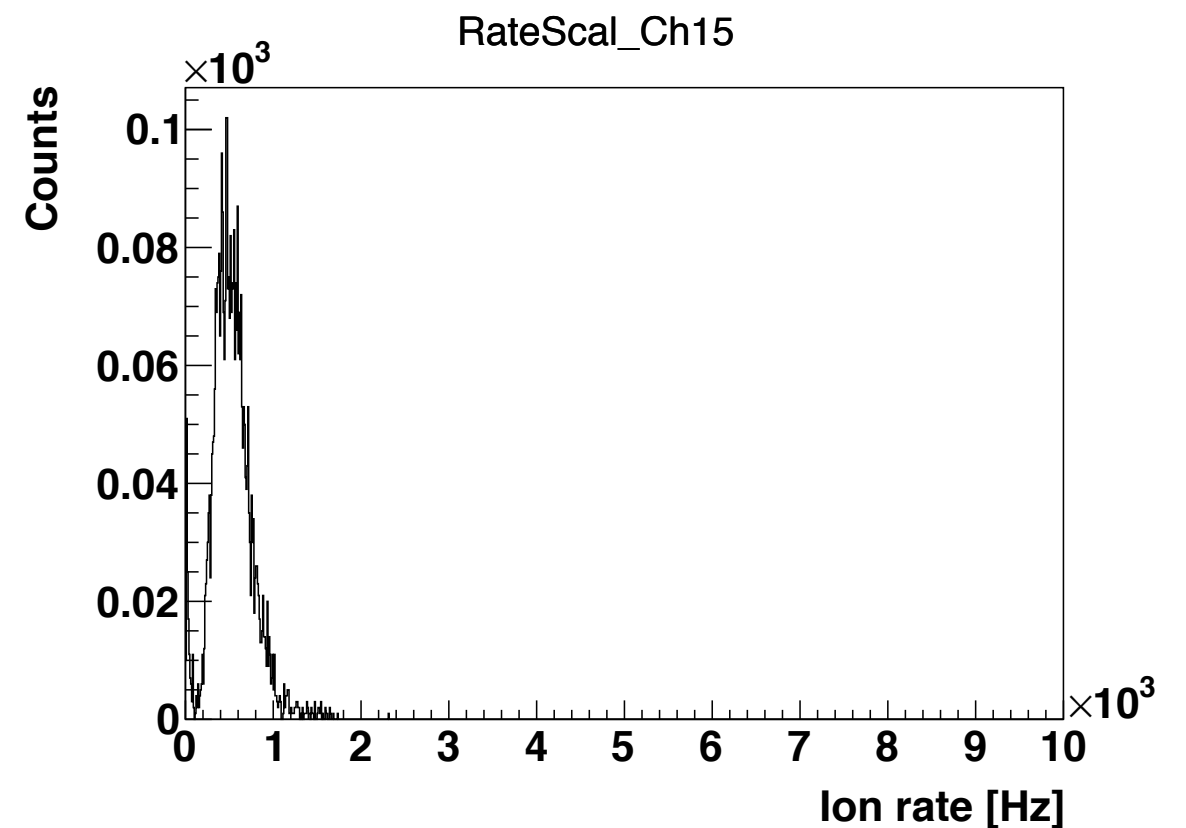
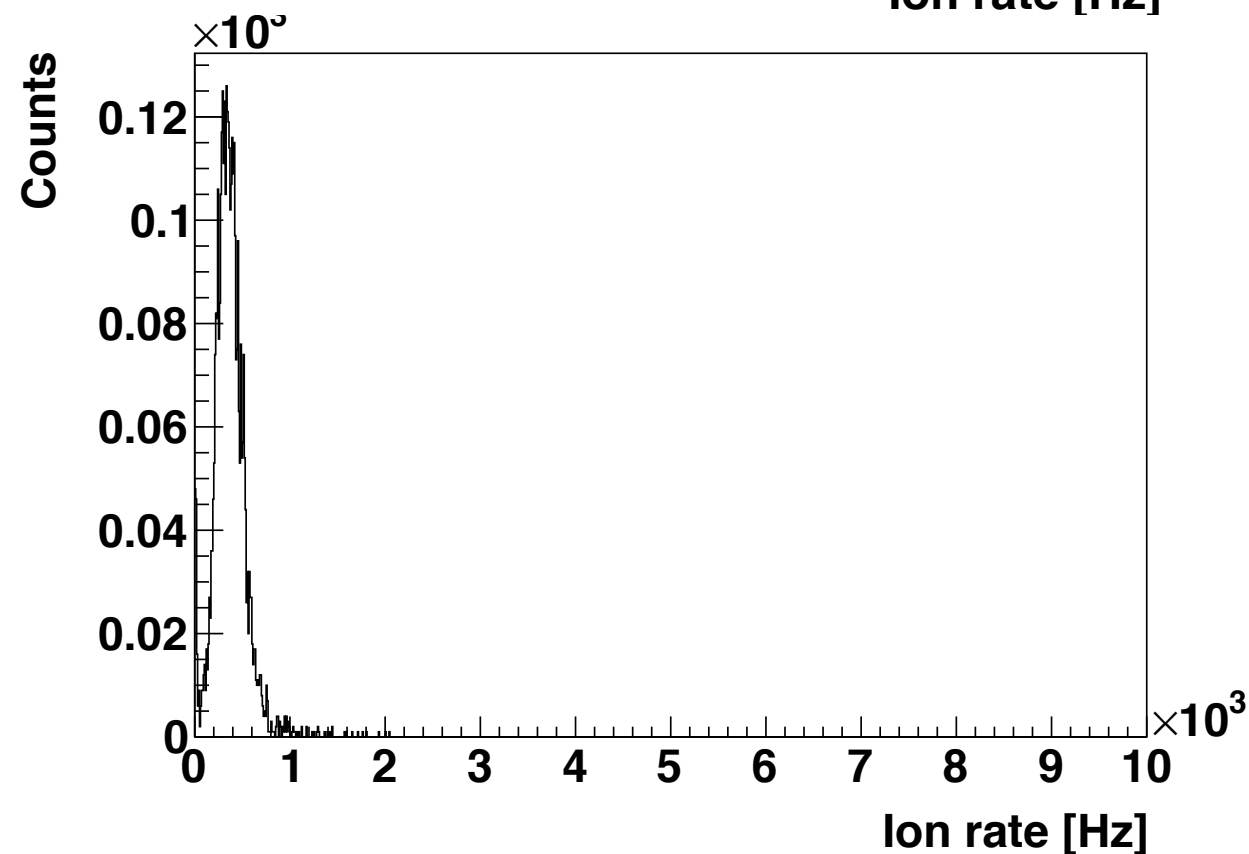
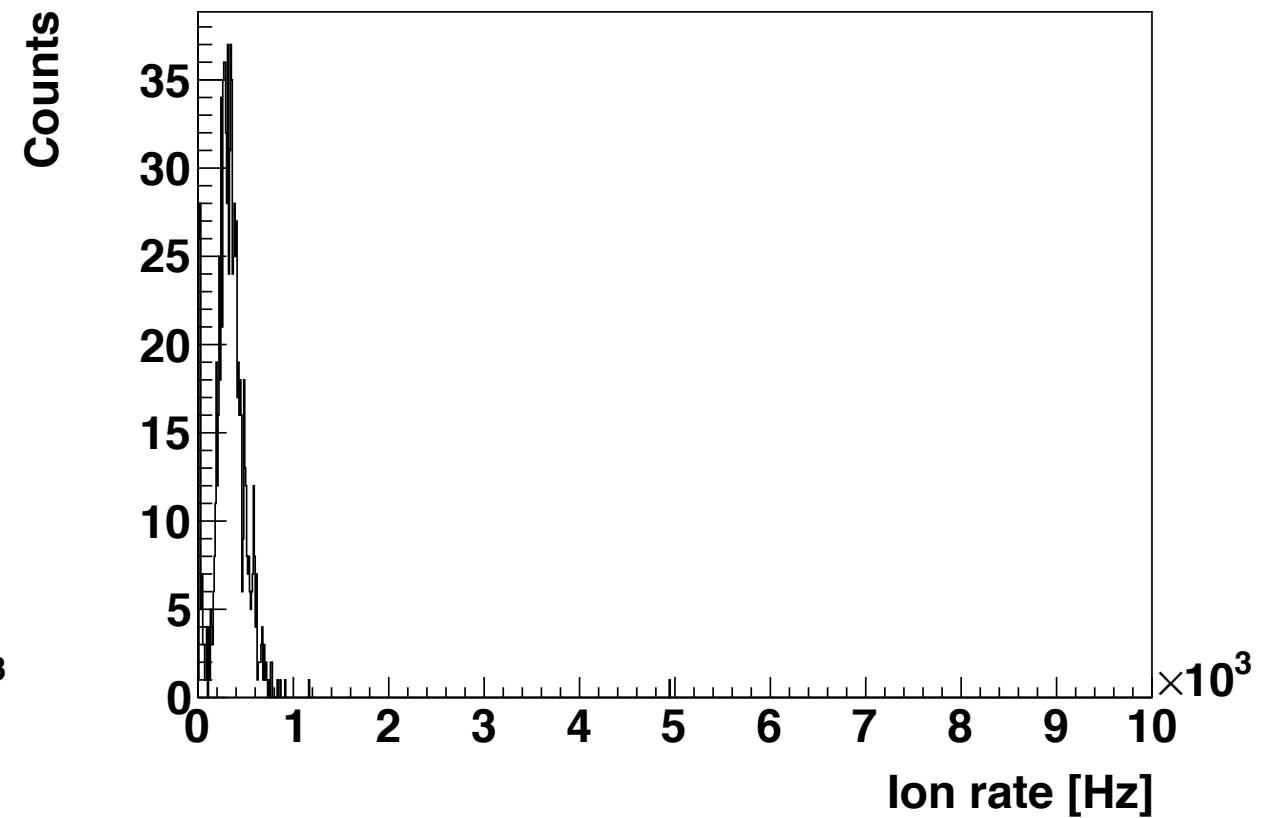
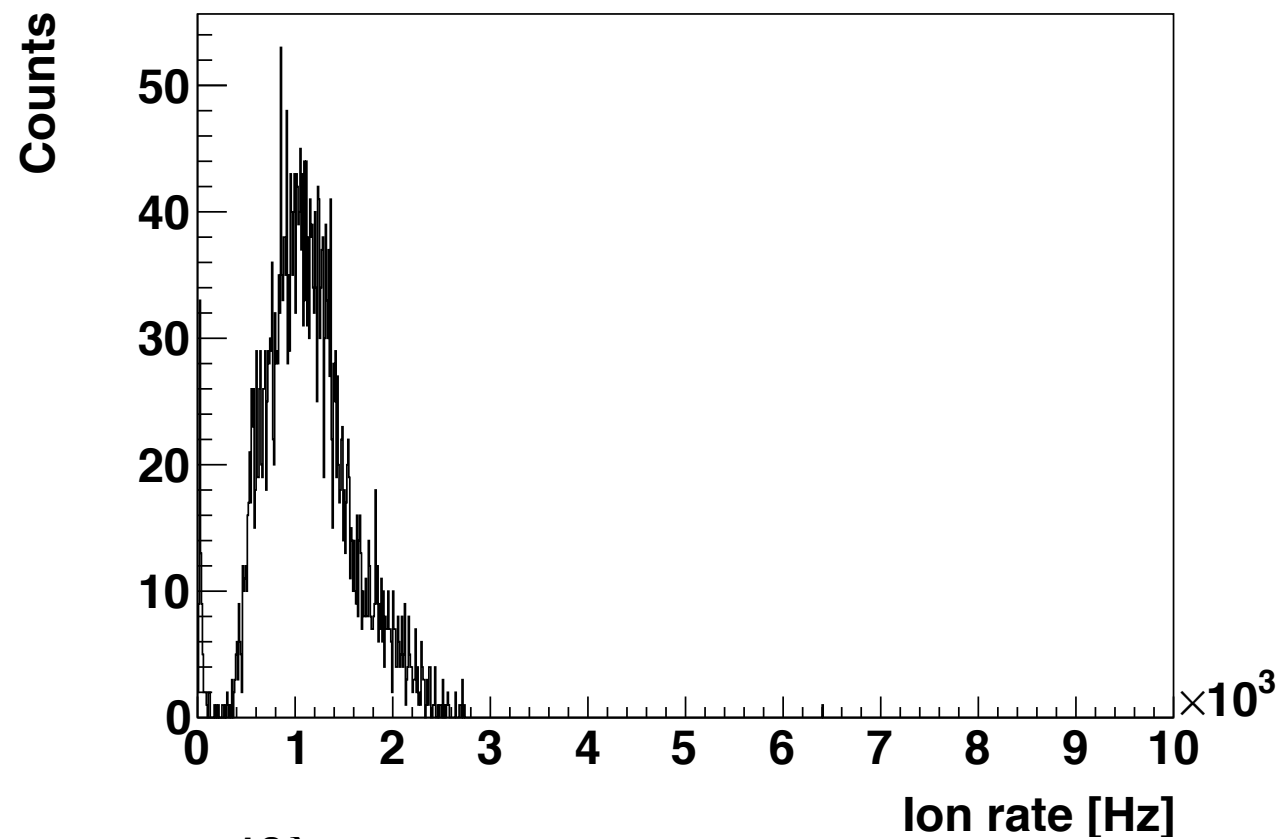


► No significant beam spot movement!

Proton beam - Intensities vs time



Proton beam - Intensity distribution



Conclusions

- ▶ **It was possible to reach beam intensities of the order of kHz at CNAO, both for Carbon ions and protons at different energies.**
- ▶ **The beam spot does not significantly change its position wrt the isocenter**
- ▶ **Such settings are reproducible. Tested for 2 different rooms (1 & 2)**
- ▶ **This configuration can be used also for the beam extracted in XPR**