$^{12}C+^{12}C$ reactions at astrophysical energies: Tests of target behaviour under beam bombardment

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$^{12}C+^{12}C$ reactions in stars:

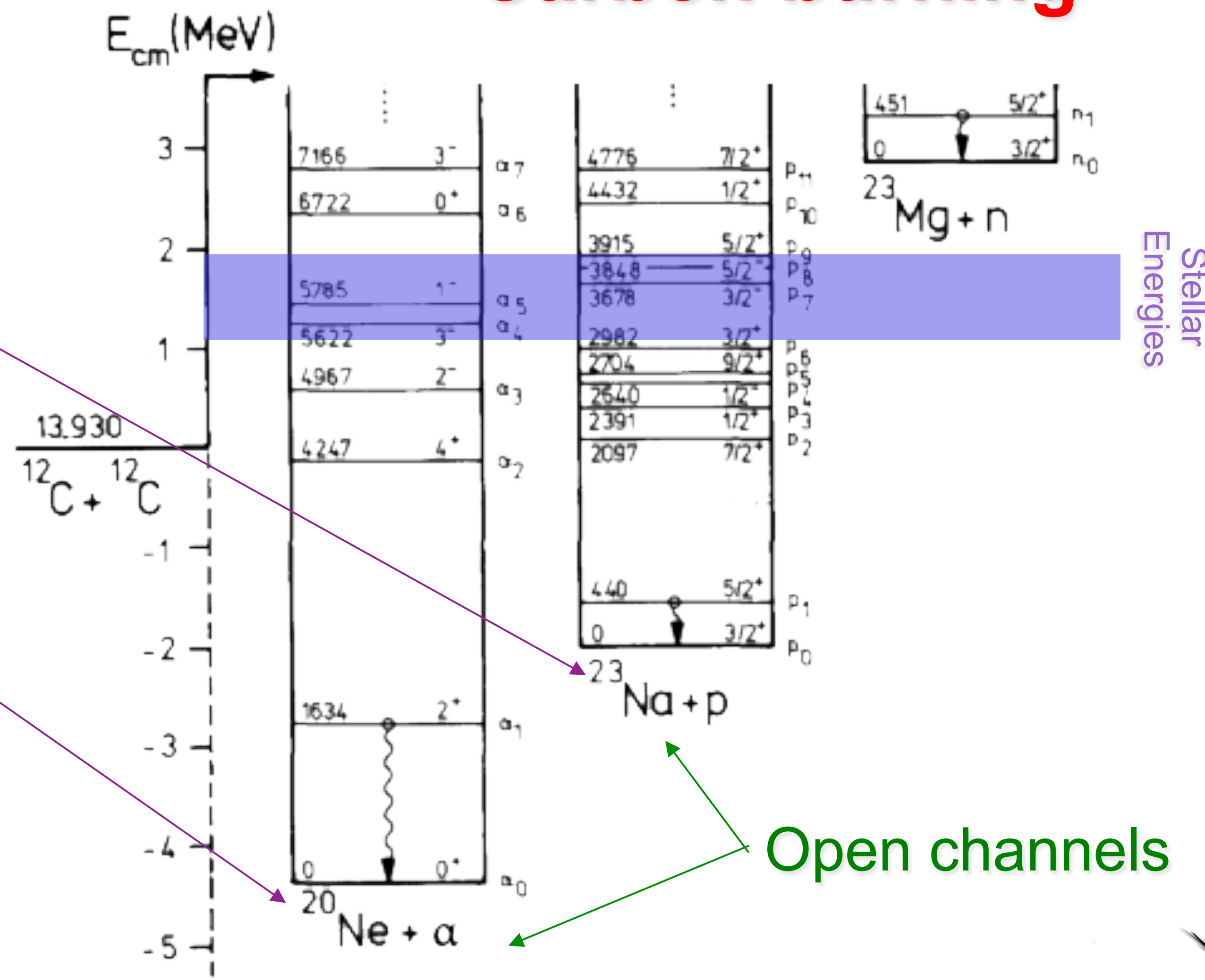
Temperature = 5×10^{8} K

Energy range E= 1.5 ± 0.3 MeV

Carbon burning

Q = 2.24 MeV

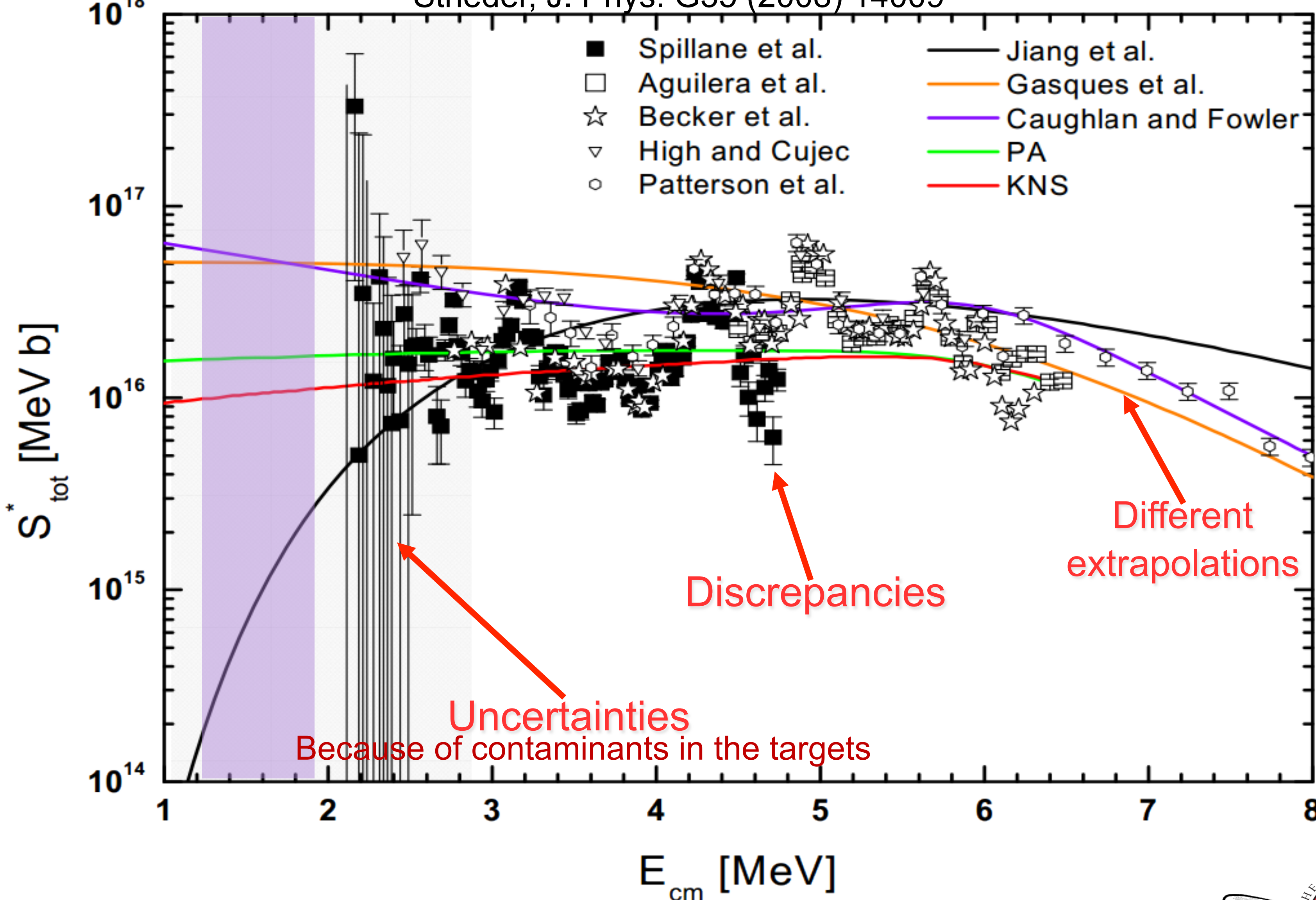
Q = 4.62 MeV



Open channels

Previous works

Strieder, J. Phys. G35 (2008) 14009



Previous works showed:
Higher temperature → less contamination

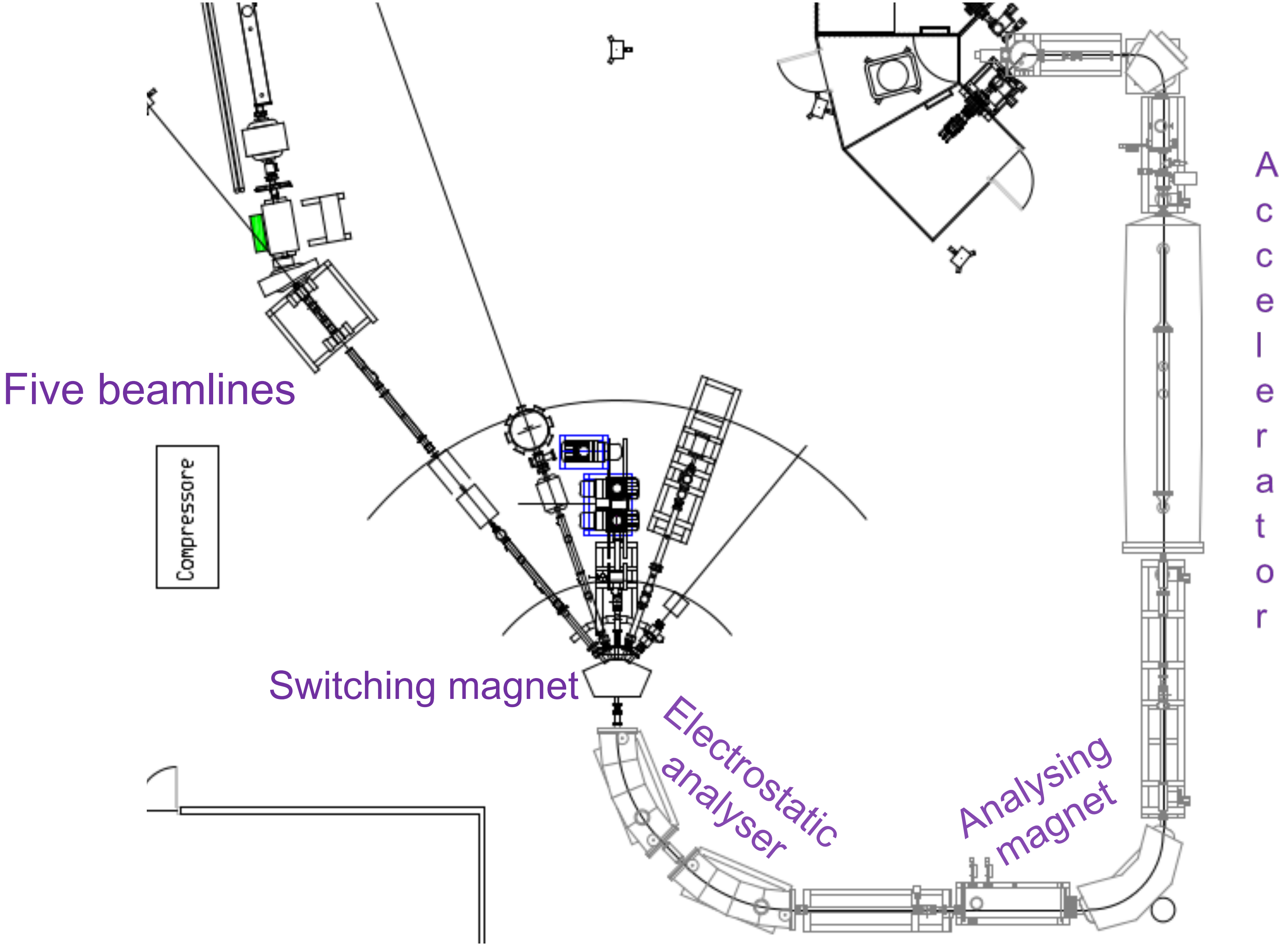
Kettner et al., 1980
Barron-Palos et al., 2006
Spillane et al., 2007

No quantitative study

Aims of our project

- Heat up target with beam
- Map target temperature using a thermocamera
- Quantitative study of target behaviour under beam bombardment
- Targets with ultra low H content (HOPG, diamonds)
- Pyrolytic and natural graphite

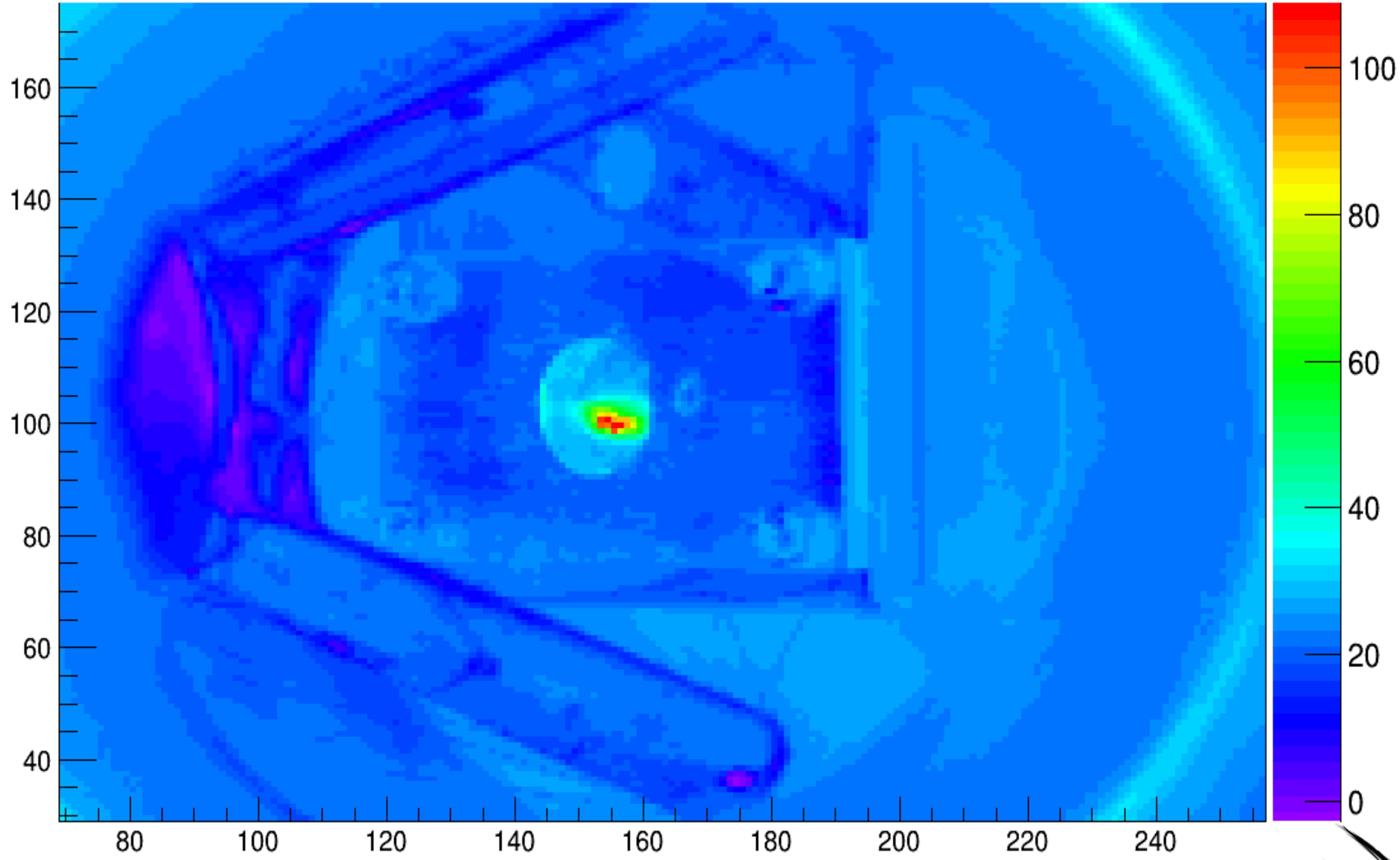
Laboratory CIRCE in Caserta, Italy



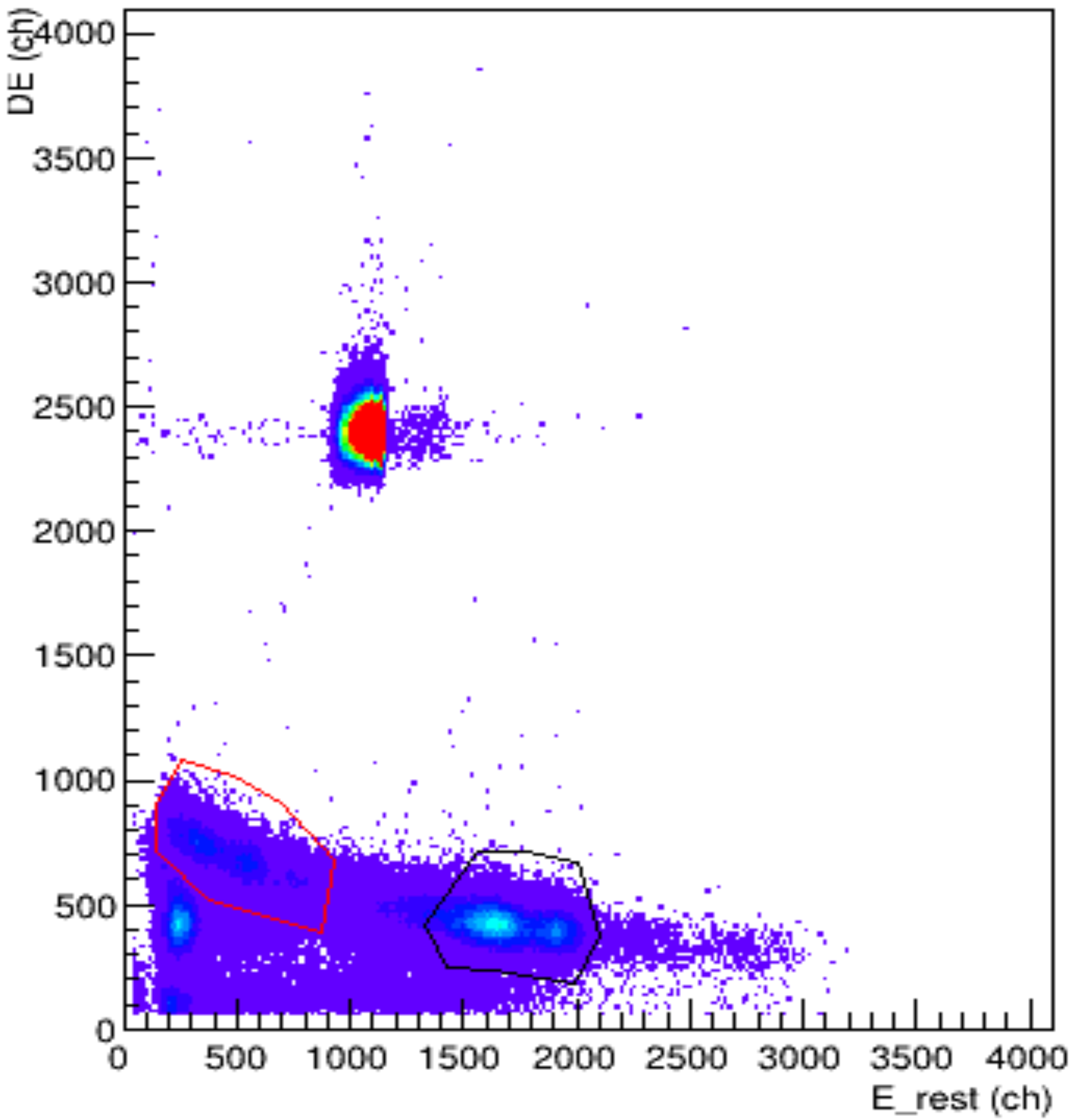
Target behaviour under beam bombardment

- ΔE-E Si detector
- NRA with C, O, N
- Thermocamera to map target temp.
- Water cooled targets
- QMS to monitor rest gas

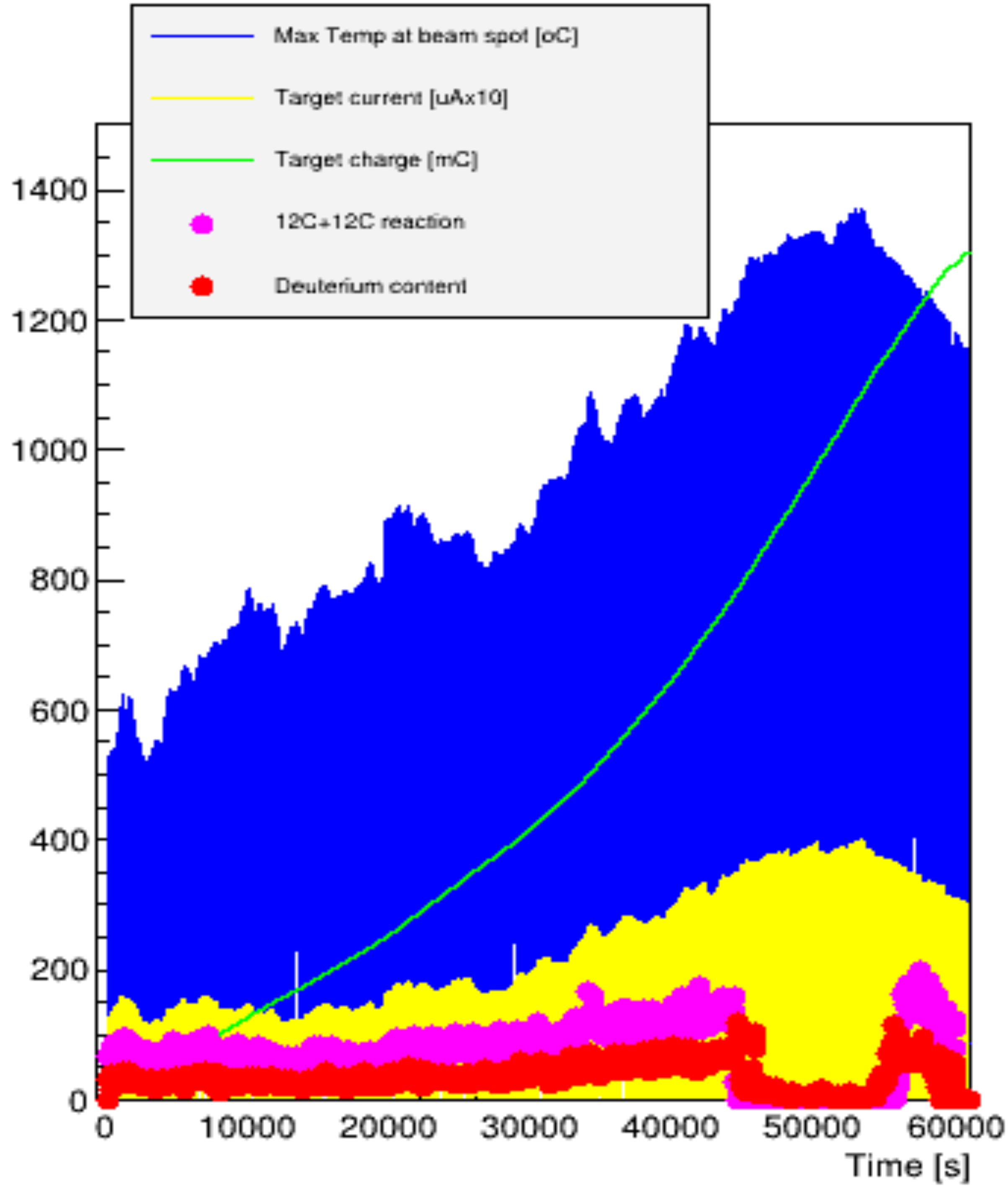
Map temperature



$^{12}C^{+3}$ Beam E=8MeV HOPG

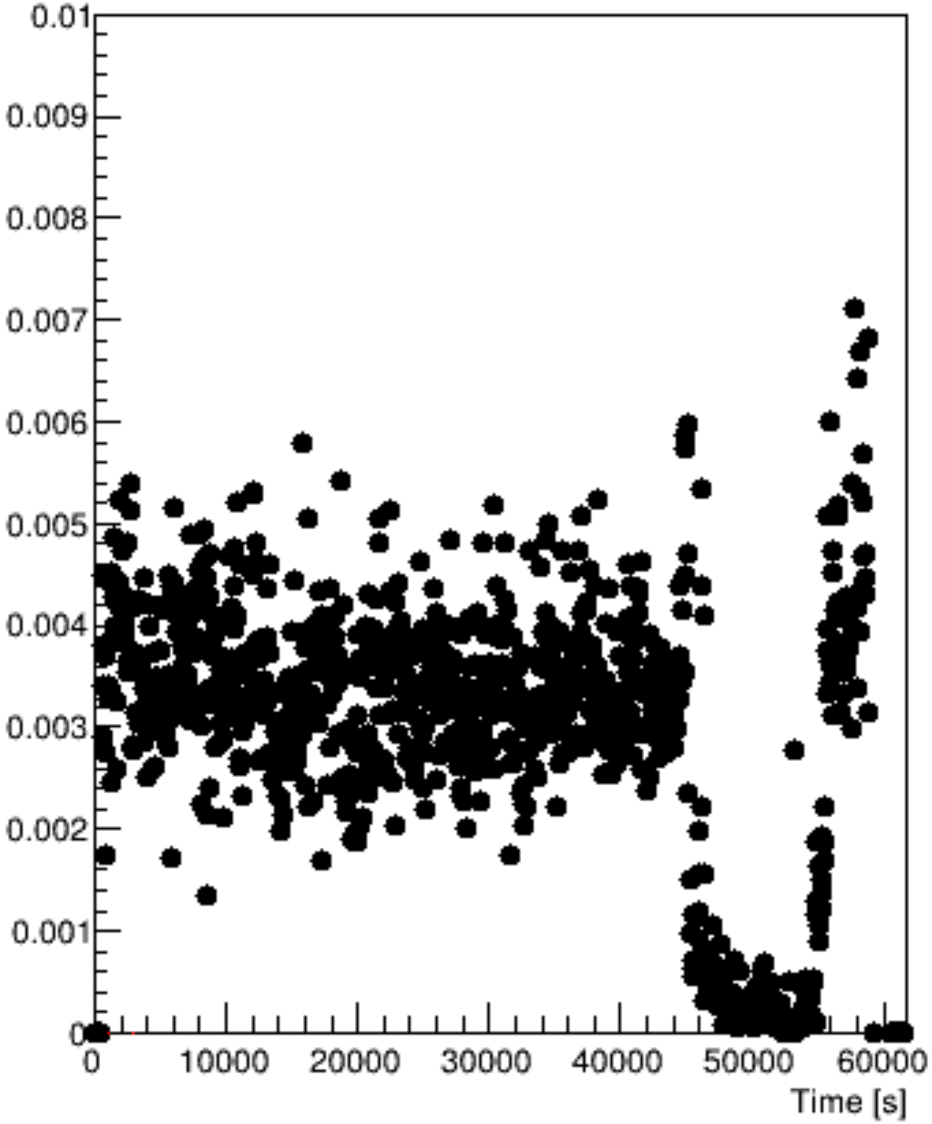


$^{12}C^{+3}$ Beam E=8MeV HOPG

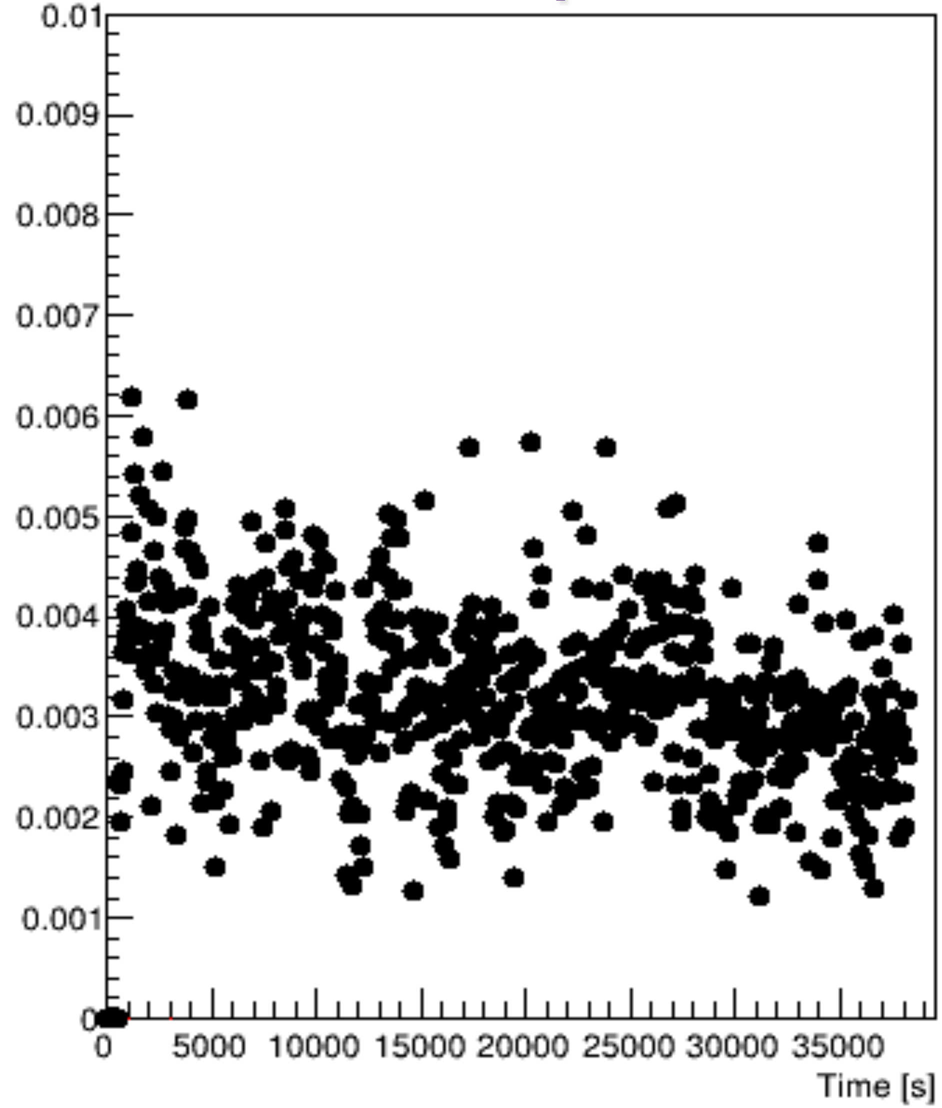


Normalized deuterium content

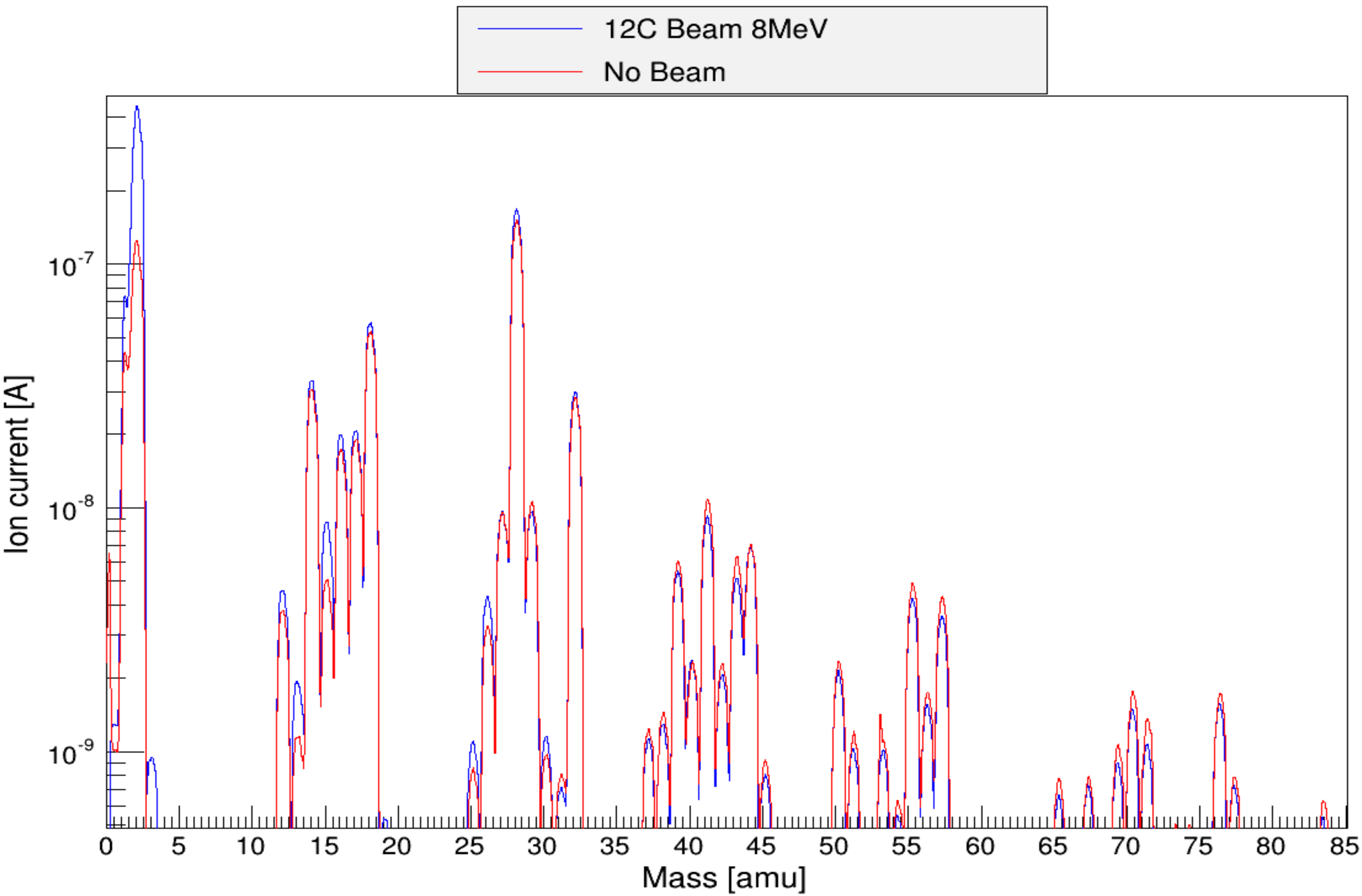
HOPG



Natural Graphite



QMS information



Summary

- Final aim → measure 12C+12C
- Key limitation → contaminants in targets
- Increase temperature → decrease contaminants
- Quantitative study of target behaviour under beam bombardment
- Designed setup provides temperature map of the target, normalized H content and rest gas composition
- Detector problems at high temperatures
- No difference in deuterium content → something is wrong!
- Improvements → N "aquarium" and water cooled flange

Thank you!

$S^*(E)=S(E)\exp(-gE)$

g=constant related to nuclear separation
Usually $g=0.43\ MeV^{-1}$

Theoretical models:
PA->proximity adiabatic potential (non resonant behaviour)
KNS->Krappe-Nix-Sierck potential (non resonant behaviour)
Jing-> based on hidrance behaviour