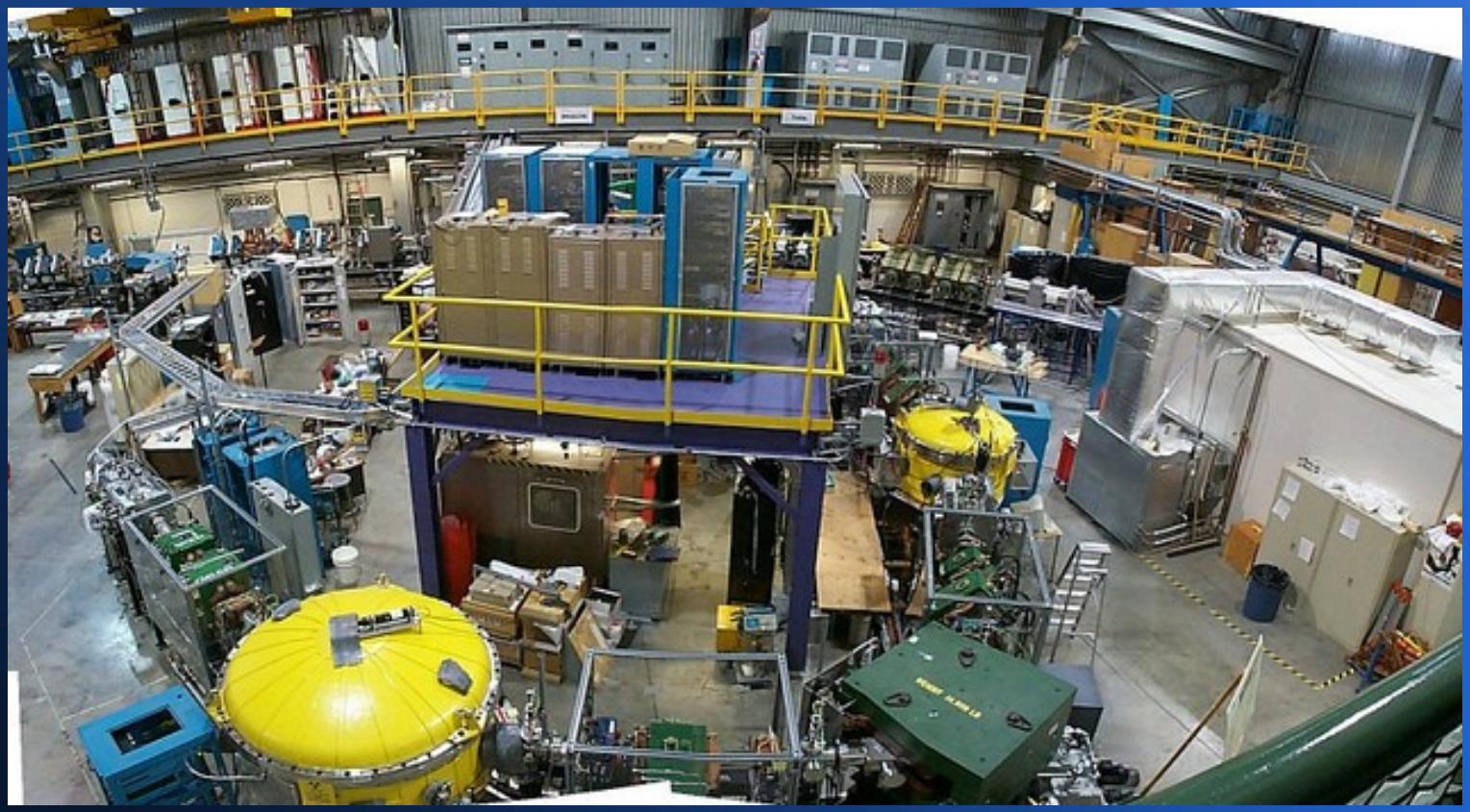
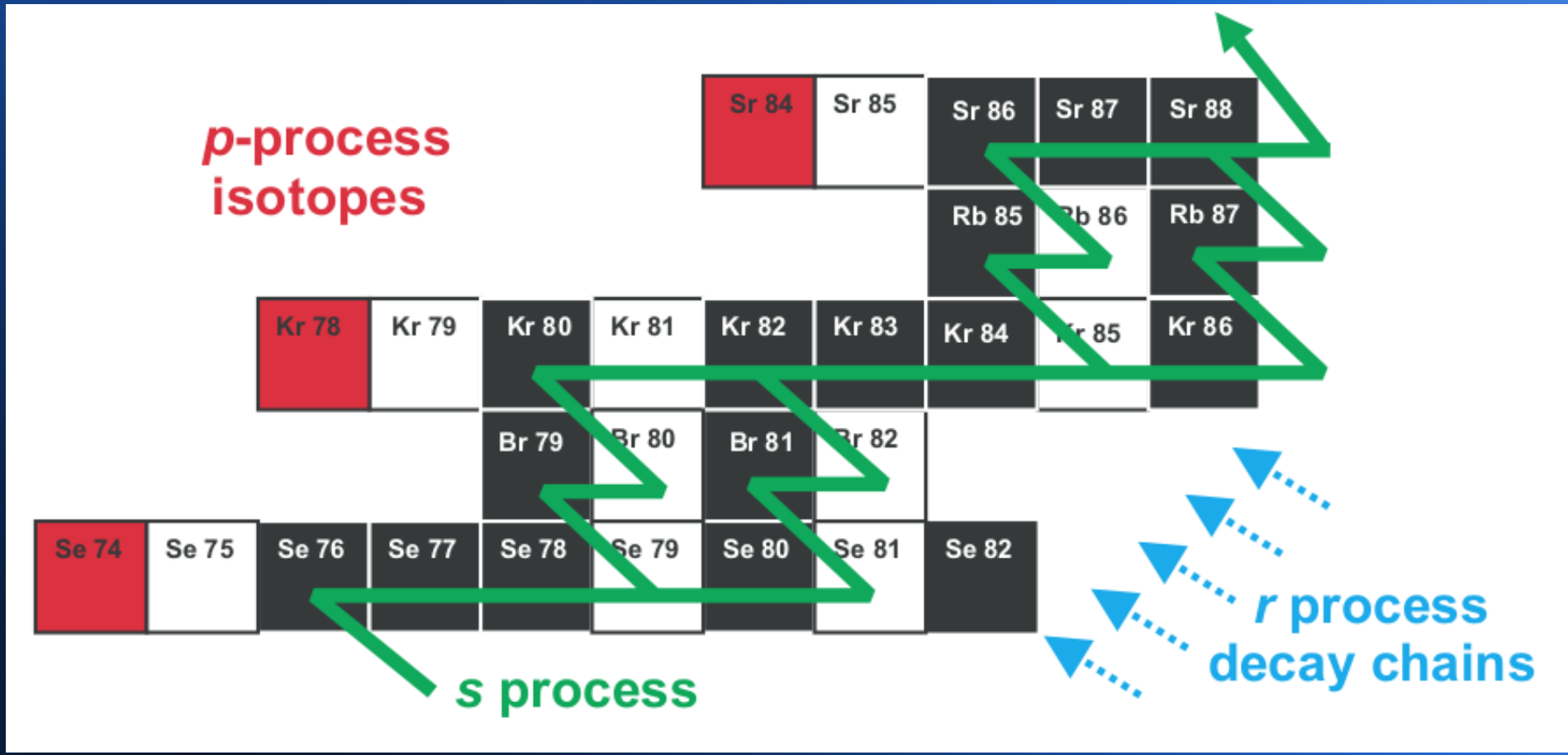
$^{76}Se(\alpha,\gamma)^{80}Kr$ at DRAGON



Background

- Reaction relavent to the production of p-nuclei
- P-nuclei refers to the 35 proton rich nuclei that have a mass greater than ^{56}Fe
- These cannot be systhesized via the s- and r-processes
- The term p-process is commonly used to describe their production mechanism
- However its still not clear if this represents one or more processes

p-nuclei shielded from s- and r-process by stable isotopes

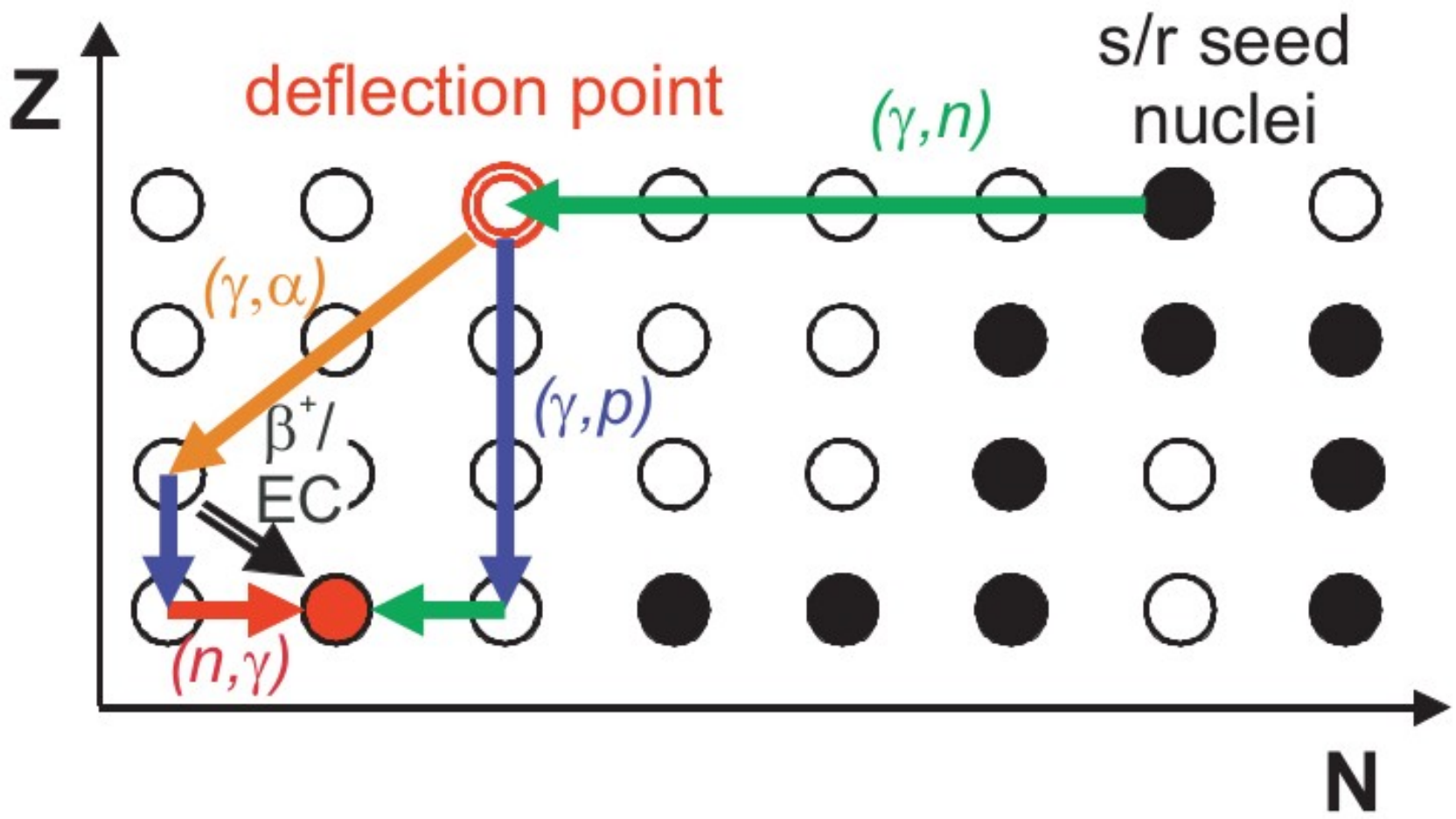


T. Rauscher *et al.*, Rep. Prog. Phys. 76 (2013) 066201

Background

- One scenario (γ-process) involves series of (γ,n) reactions on heavy nuclei
- One favoured site for γ-process is SN1a
- At specific branching points (γ,p) and/or (γ,α) reactions become dominant
- The rates of these reactions at the branching points have a large impact on p-nuclei abundance calculations

Illustration of γ-process



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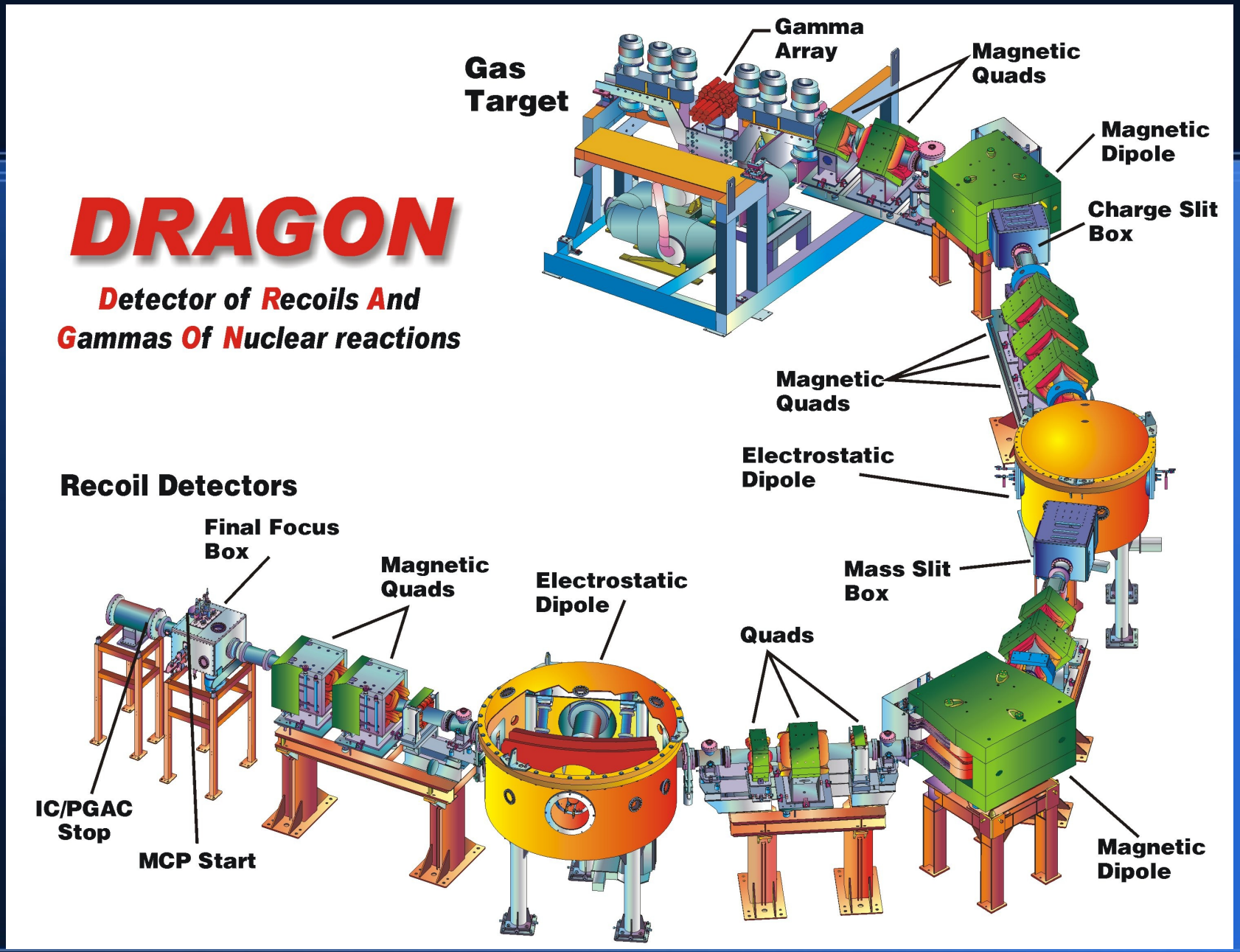
Background

- One of these branching point nuclei is ^{80}Kr
- The ratio of the reaction rates ^{80}Kr(γ,α)^{76}Se and ^{80}Kr(γ,p)^{79}Br is thus of great interest
- (even though neither isotope is a p-nucleus)
- We can use ^{76}Se(α,γ)^{80}Kr to infere the rate of ^{80}Kr(γ,α)^{76}Se
- Radiative capture allows us to exploit DRAGON's large background suppression
- This makes it feasible to measure the cross section at astrophysical energies


DRAGON
Detector of Recoils And
Gammas Of Nuclear reactions
Gas
Target
Gamma
Array
Magnetic
Quads
Magnetic
Dipole
Charge Slit
Box
Magnetic
Quads
Electrostatic
Dipole
Mass Slit
Box
Quads
Magnetic
Dipole
Recoil Detectors
Final Focus
Box
Magnetic
Quads
Electrostatic
Dipole
IC/PGAC
Stop
MCP Start

First Week

- Problem with DTL prevented beam delivery for first 3 days
- Received beam again on Wednesday
- Whilst tuning attenuated beam we found ED2 value to be noticably less than theoretical value (based on ED1)
- Lost beam for another 3 days
- Got beam back on Sunday at an increased intensity (2.1×10^{10} pps)

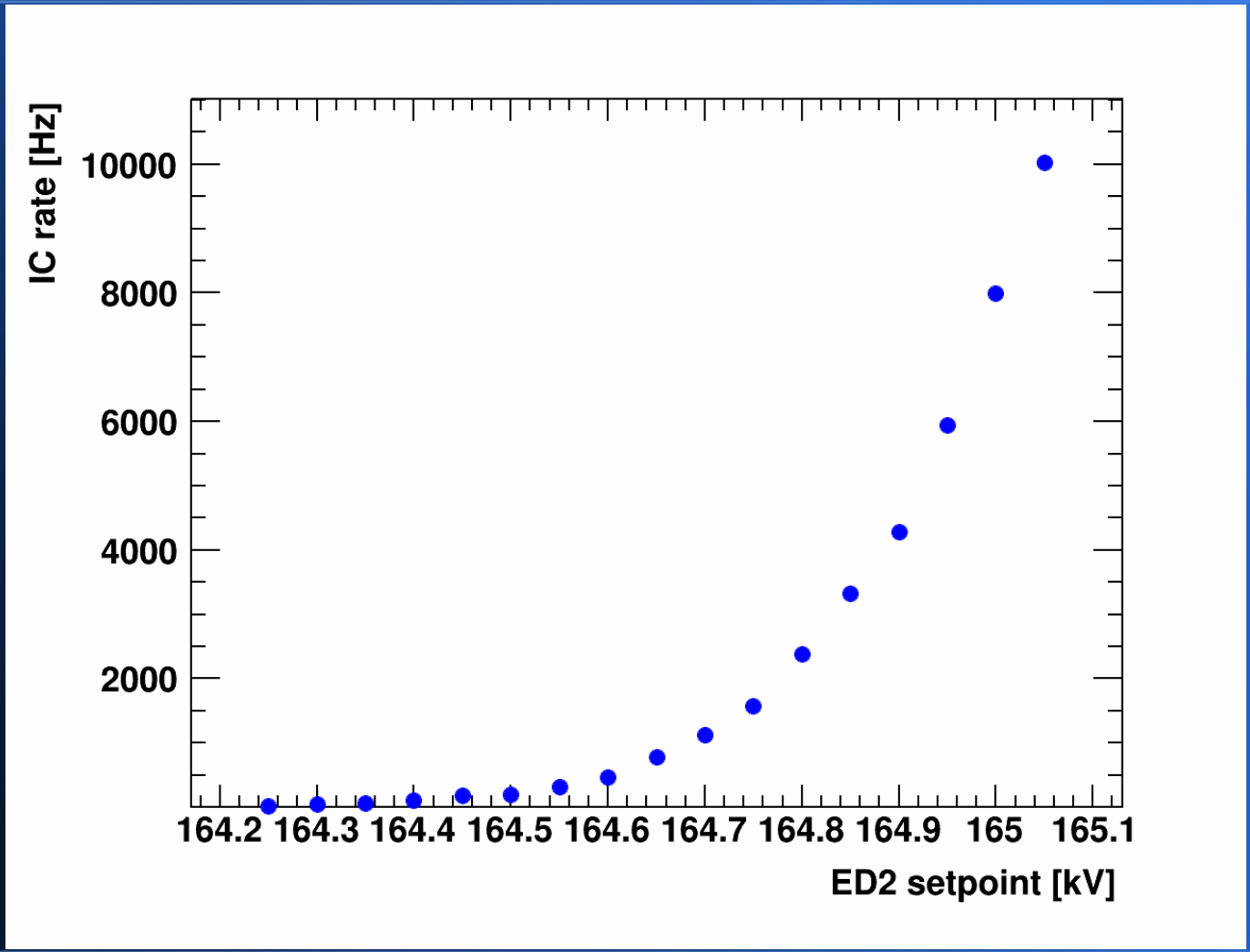
Second Week

- By second Thursday we still had no disernable recoil candidates
- NON-smoker rate gave 3-16 per shift (uncertainty from CSD)
- In order to test ED2 tune we asked ops for a beam energy corresponding to the recoils we were tuned for
- This yielded an ED2 voltage 3.64% lower than theory vs the 5.30% we saw beforehand (relative to ED1)
- Due to non linearity of field in response to applied voltage

Second Week

- Decided to then run ED2 at 3.64% lower than theoretical value (165.05 V) and retuned to previous energy
- Leaky beam rate was huge (10 kHz) at this tune however & LT only 40%
- Leaky rate did decrease significantly with lower ED2 voltage however:

Second Week

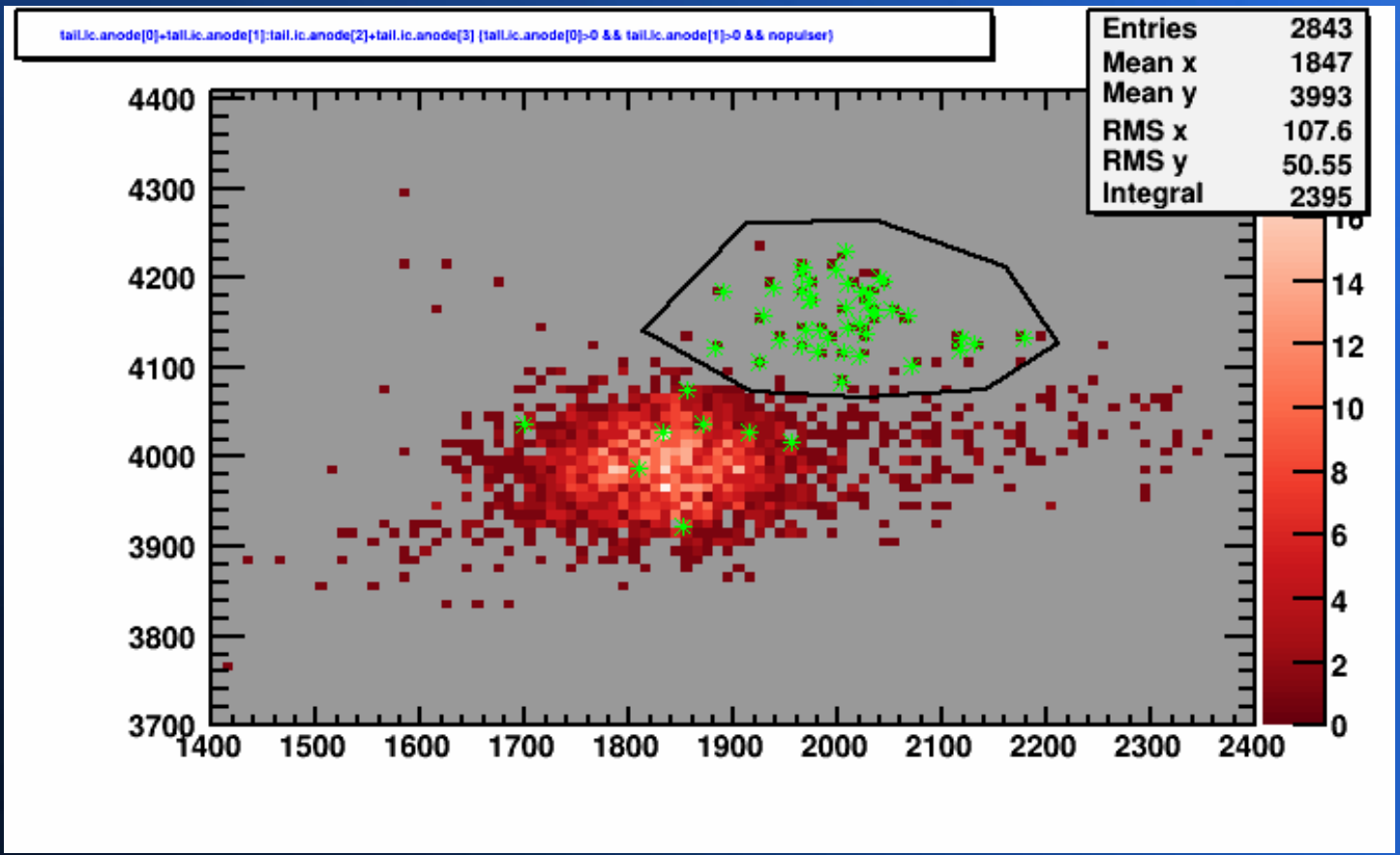

IC rate [Hz]
10000
8000
6000
4000
2000
164.2
164.3
164.4
164.5
164.6
164.7
164.8
164.9
165
165.1
ED2 setpoint [kV]

Second Week

- Ran at slightly lower voltage (164.30 V) as a result (3.97% lower vs. 3.64%)
- The next morning we saw clear signs of multiple recoil events:

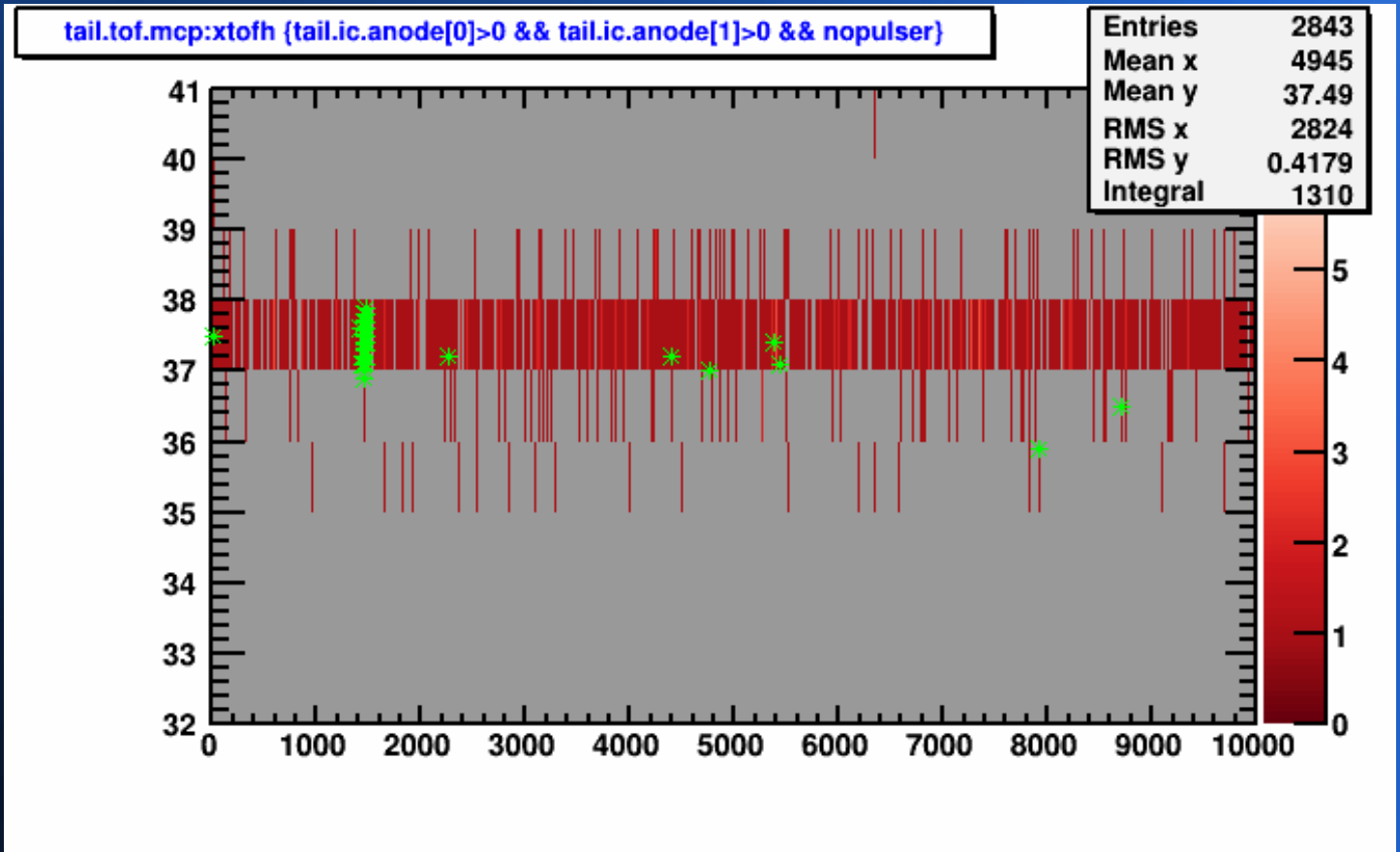
Second Week

- IC01 vs IC23:



Second Week

- Separator TOF vs MCP TOF:



Second Week

- By Saturday decided we had enough good recoil candidates to do energy change
- Faced same problems with leaky rate so stepped down ED2 voltage to compensate
- Also observed recoil candidates at new energy
- Handed beam back to ops on following Monday

Preliminary Results