Tactic in Notre-Dame

TRIUMF Annular Chamber for Tracking and Identification of Charged particles

Lothar Buchmann

Geography

York

$^{8}Li(\alpha,n)^{11}B$

r-process in entropy rich bubble of SNIIs starts out with nuclei disintegrated into nucleons, i.e. protons and neutrons. These recombine to form heavy elements with an excess of neutrons present. The mass 5 and 8 stability gaps have to be bypassed in the process.

Three possibilities: (i) 3 α process;

(ii) $\alpha(\alpha n, \gamma)^{9}Be$

(iii) $\alpha(t, \gamma)^{7}Li(n, \gamma)^{8}Li(\alpha, n)^{11}B$

$T_9 = 0.62$ Gamow peak: $E_{c.m.}$ =240 to 580 keV

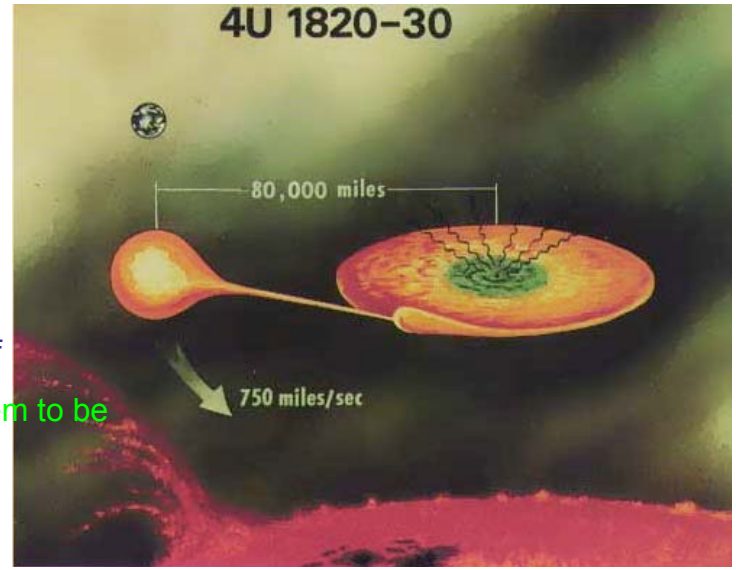
or E_{lab} = 90 to 220 keV/u

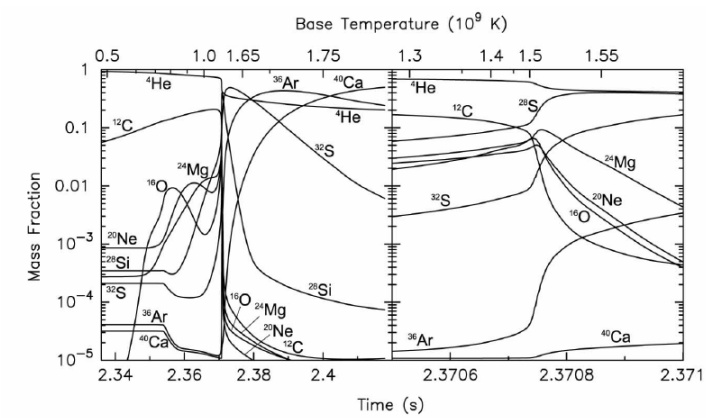
Lowest energy ISAC/TRIUMF: 120 keV/u

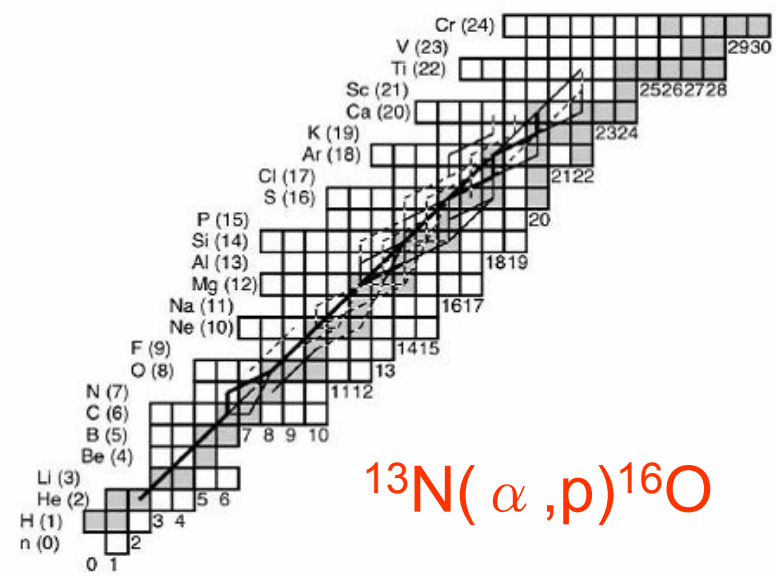
He-binary neutron stars

He white dwarf

He flashes seem to be observed







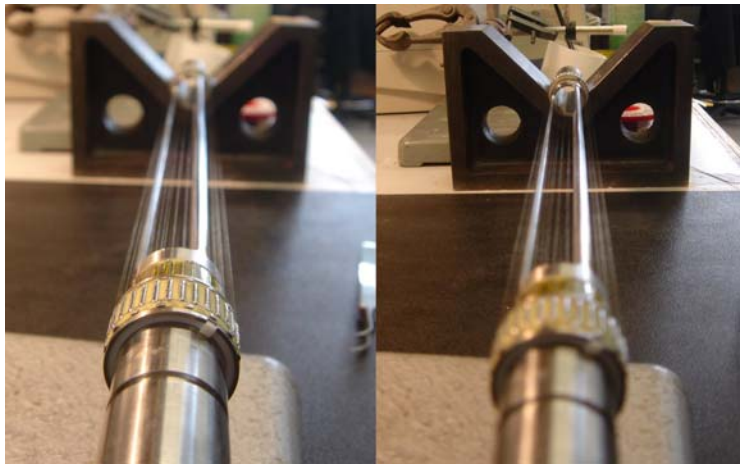
$^{13}N(\alpha,p)^{16}O$

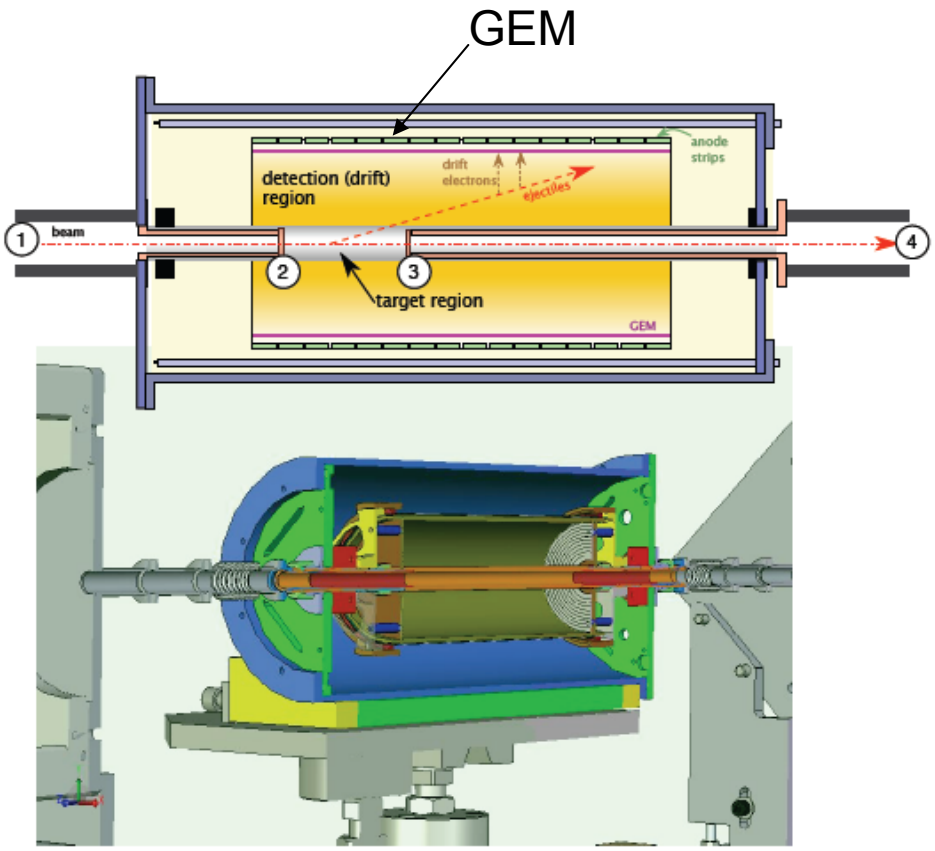
S1162

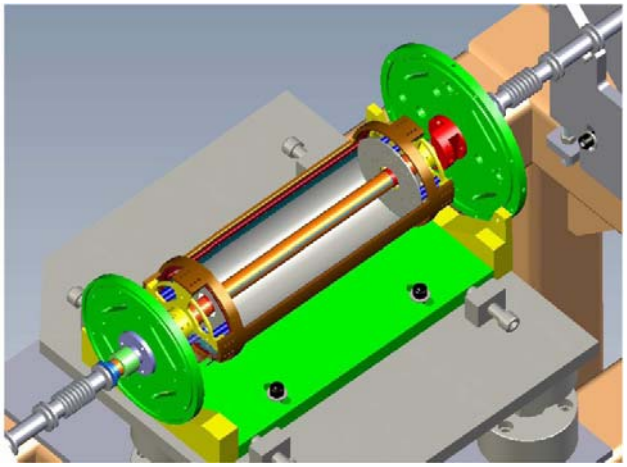
The ND laboratory

There are focusing issues at our position, as quads are too far.
Beam was collimated down.

TACTIC-principle/images



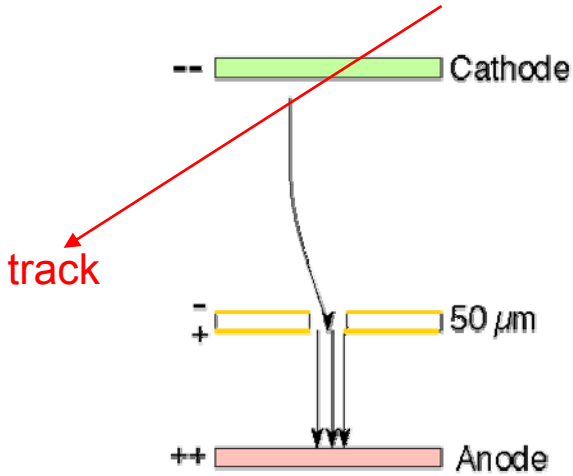


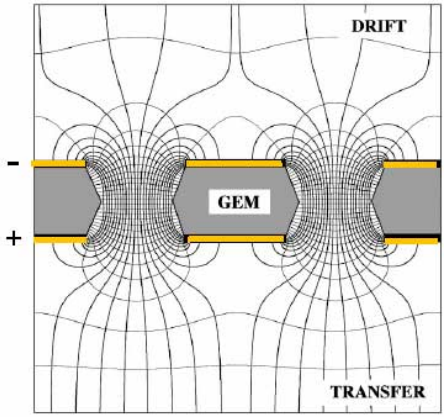


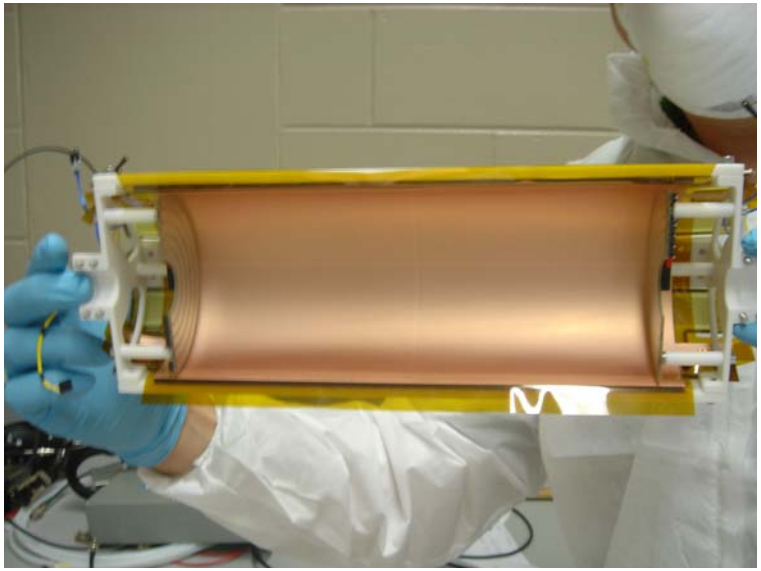
What’s going on?

Tactic-GEM

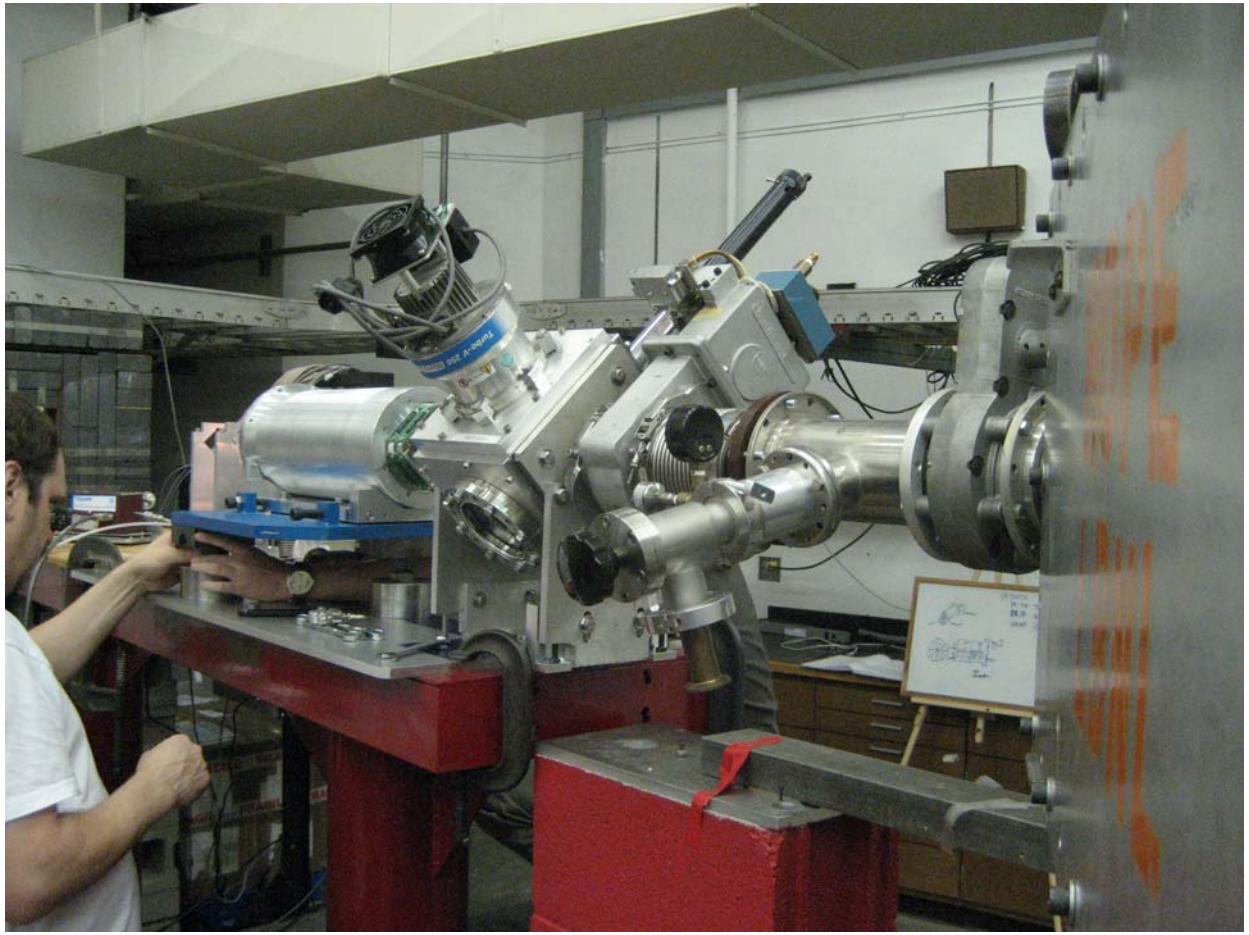
Gas Electron Multiplier





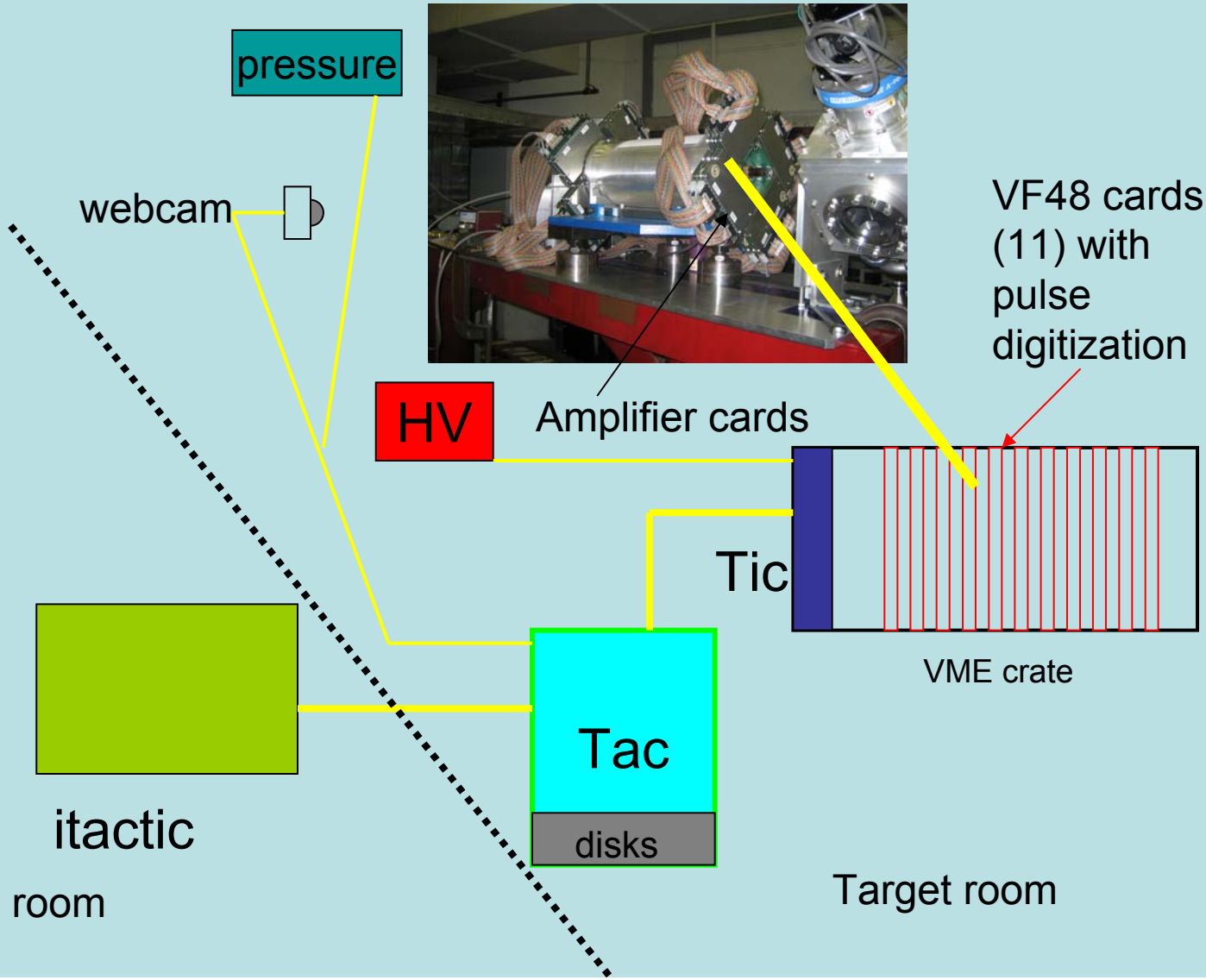


Tactic in ND

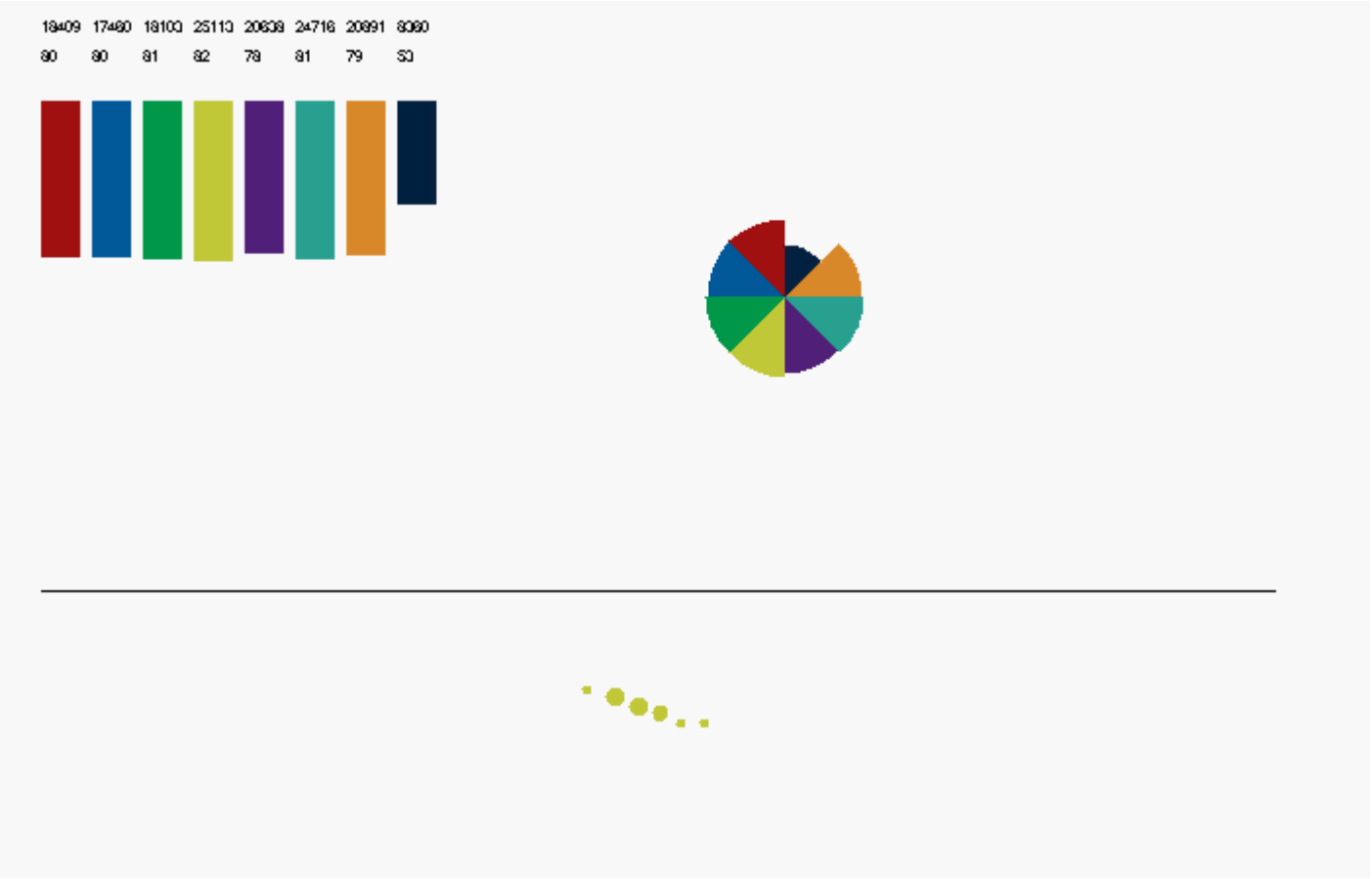


Two weeks of running separated by an off week. Running includes set-up.

Tactic-electronics



WWW-on-line display



TheTaclet

Toast→

Runs

We had runs at 5, 10, and 15 MeV employing the $^{10}B(\alpha,p_{0\text{-}3})^{13}C$ reaction with a ^{10}B beam on the active helium(90%)/CO_2(10%) target.

We ran a multitude of pressures and drift as well Gem voltages. The data rates have been varied widely and saturation effects have been observed.

ND sta(u)ff was very helpful.

It is possible to do accelerator physics without safety reports and technical reviews.

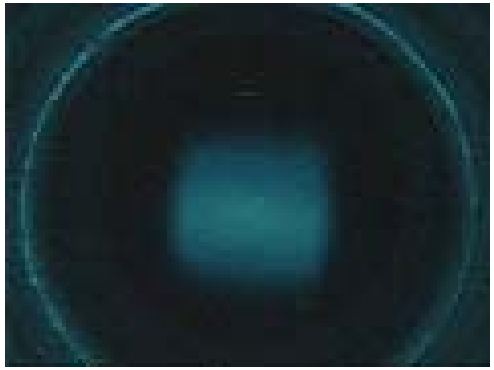
Experiences

1. Gems: (i) Gems are sensitive to dust, need clean handling. Can be sometimes recovered by movement, shaking. Dust in gas bottles seems to be an issue. (ii) The breakdown/destruction voltage for Gems is somewhere above 400 V across.
2. The raw data mode of the VF48 cards has an every 8th channel problem. The data rate could be higher. DMA mode is not yet developed. Unexplained front end crashes Following sector trigger a problem. We do the Vf48 debugging!
3. Beam/run experiences: We will install front Faraday cup and Pin diode to measure and tune better beam current. Never run beam through chamber without gas. Gatevalves too slow for window breakage, however slow vacuum rise before breakage observed, will interlock against it. With turbo on, helium leakage through windows is manageable.

Experiences

4. E-field end cap resistor chain manufacturing.

5. Tried scintillator at backend:



KF flange

Got blind spot after a while.

6. Window sleeve test, under analysis.

Equipment status

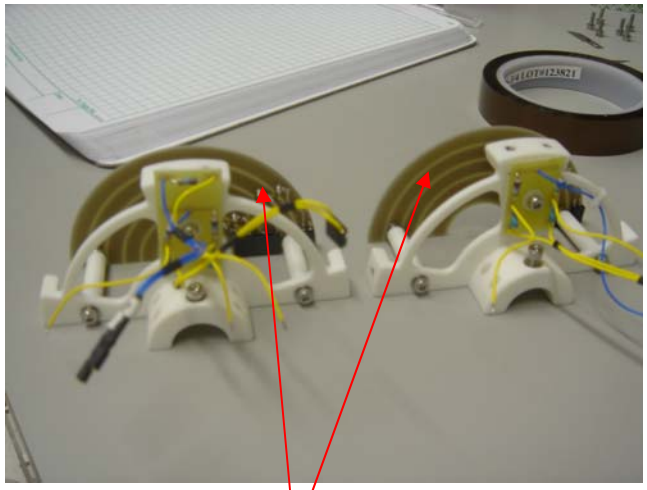
1. Most equipment left behind in Notre Dame for January run, including DAQ computer Tac that is on the net in ND.
2. Data backed on two external disks taken to TRIUMF and York, now backed onto TRIUMF computers.
3. Tactic and some frontend electronics in York for α-tests.
4. Computer, disks, TRIUMF frontend computer back to TRIUMF.

Analysis and Development

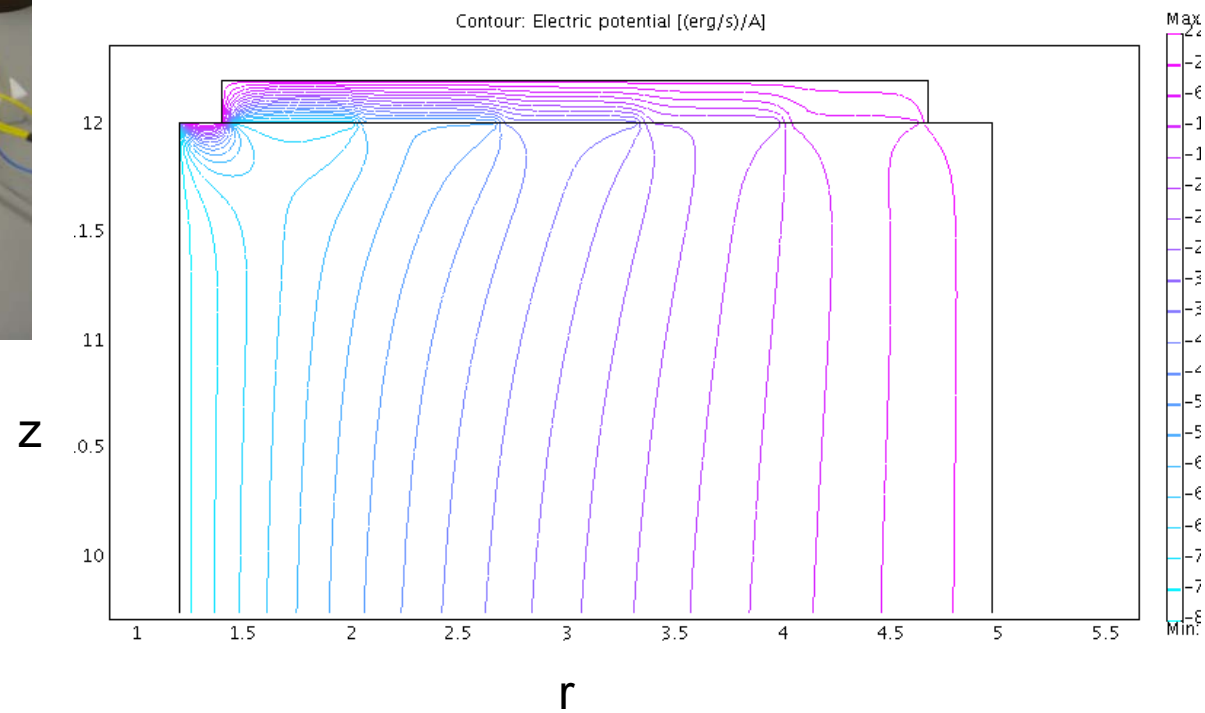
1. NIM trigger electronic is being thought out.
2. High voltage distribution box is being redeveloped to allow independent setting of drift and GEM (amplification) voltage.
3. VF48 problem hopefully soon corrected.
4. Development of DMA readout.
5. Computer hang up???? VME crate? Cooling?

Field and Drift time analysis

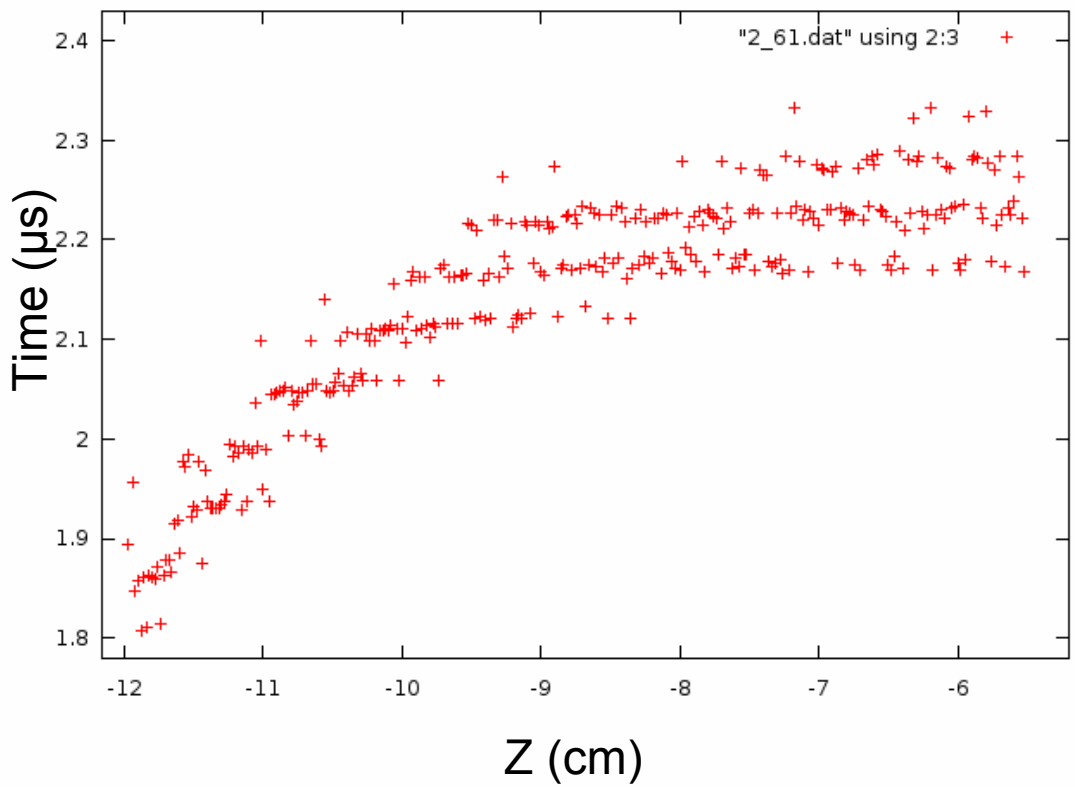
Femlab analysis of real voltages (resistors) applied showed that voltages on endcap rings were wrong (linear not logarithmic, manufacture error).



Endcap rings



Garfield and Drifttimes



r=2.61 cm

Effect of endcaps on wrong potential

Corrections built in: tracks straightened out!

GEANT4 simulations

Toast →

Analysis of tracks

1. Track reconstruction into dead zone
2. Collection of total energy

TACTIC future measurements

0. $^{10}B(\alpha, p\ d\ n)$

0.5 ɣ-ray detection capability

1. $^{8}Li(\alpha, n)^{11}B$
2. $^{7}Be(p,p(p'))^{7}Be$ higher stopping capability
3. $^{7}Li(^{3}He, \alpha)^{6}Li$ separate outer and inner volume (tritium?)
4. $^{12}C+^{12}C$ high intensity on windowless gas target
5. Children of TACTIC: (i) in solenoid chamber: $^{13}C+\alpha$, (ii) high energy light particle detection on outside.