Residual Gas Ion Spectrometer v4

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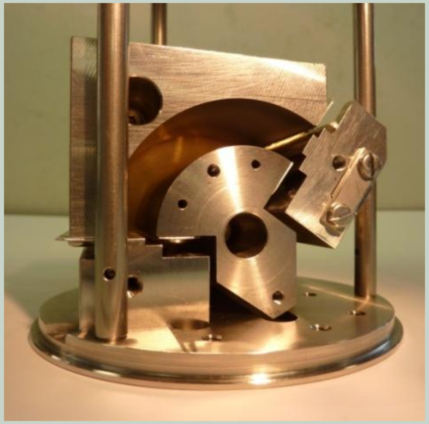

Residual Gas Ion Spectrometer v4 (RGIS4)

A design based closely on RGIS3 by R. Doelling, PSI

The RGIS4 will tell us the energy of the particles entering the instrument. It will be located in the drift vessel between LEBT solenoids 2 and 3.

The space charge decompensation electrode has shown that the beam is affected very quickly by the presence of a voltage and is slower to recover to its original state.

The time taken for the beam to recover is a function of the gas pressure around the beam and of the species of gas present.

For an uncompensated or partly compensated beam the RGIS4 should collect electrons produced by the FETS H^- beam. If the compensation exceeds 100% it should collect positive gas ions.

Understanding the factors affecting the beam recovery time could be particularly important to ESS and Fermilab who are both interested in chopping their beam in the LEBT.

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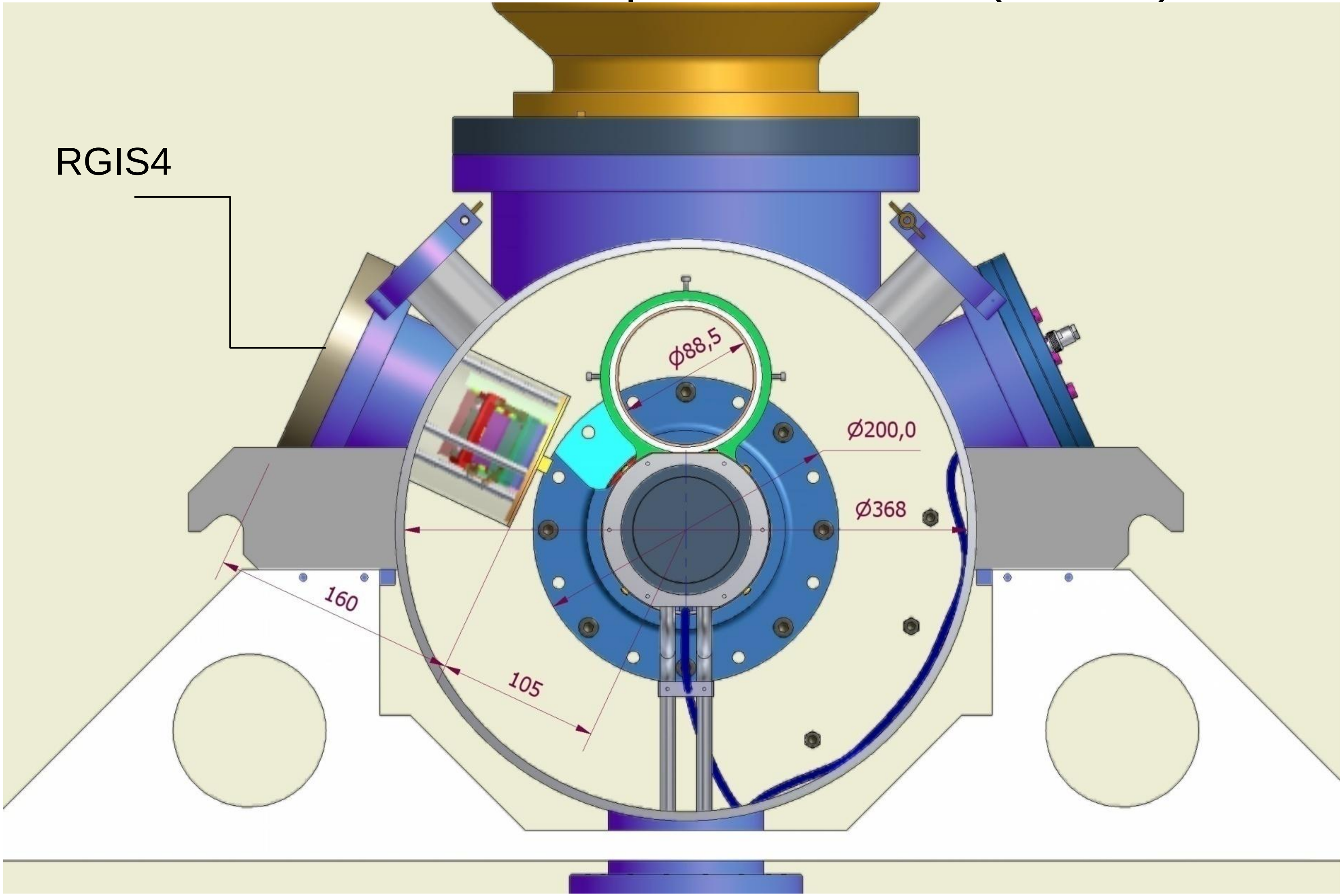

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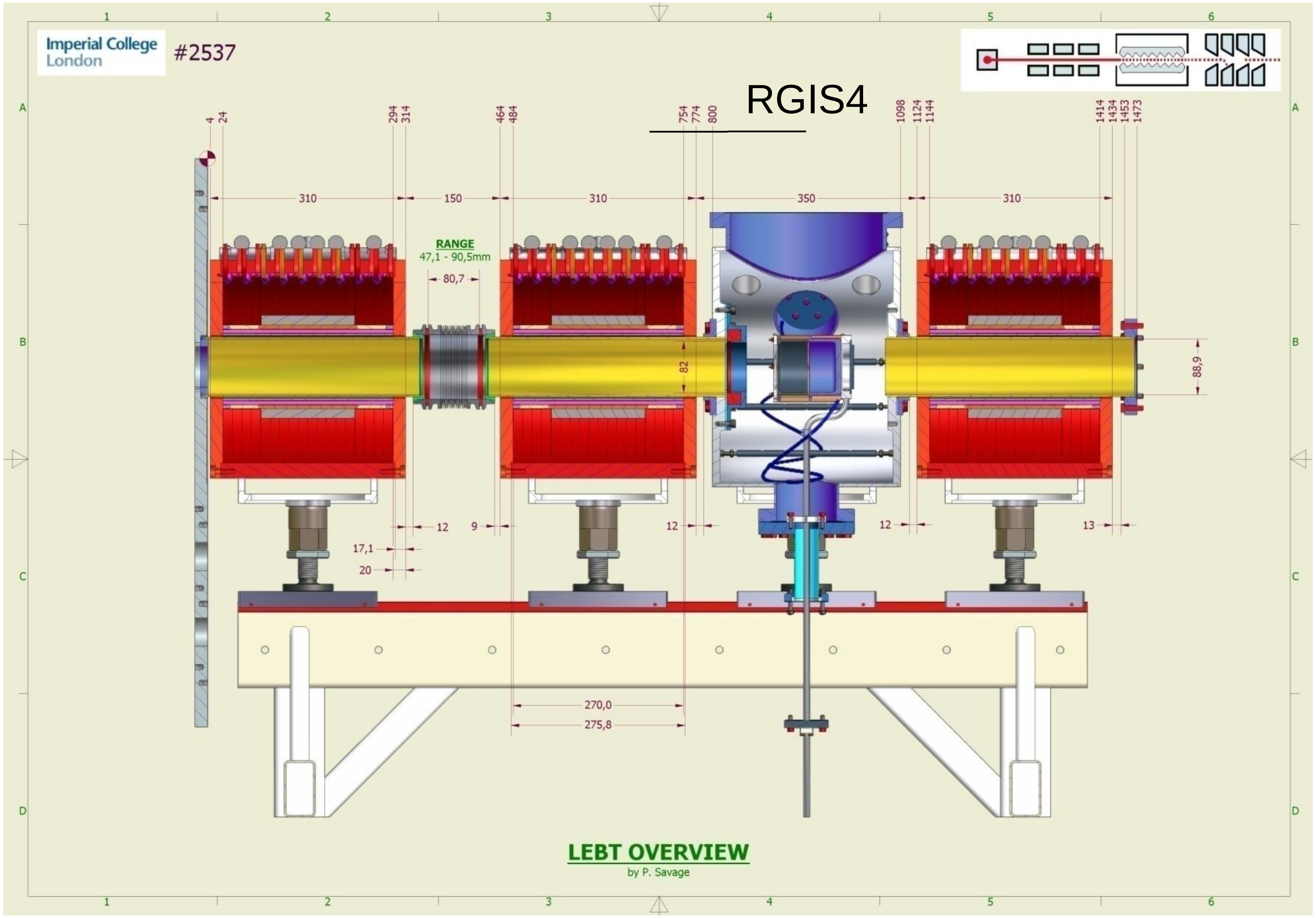

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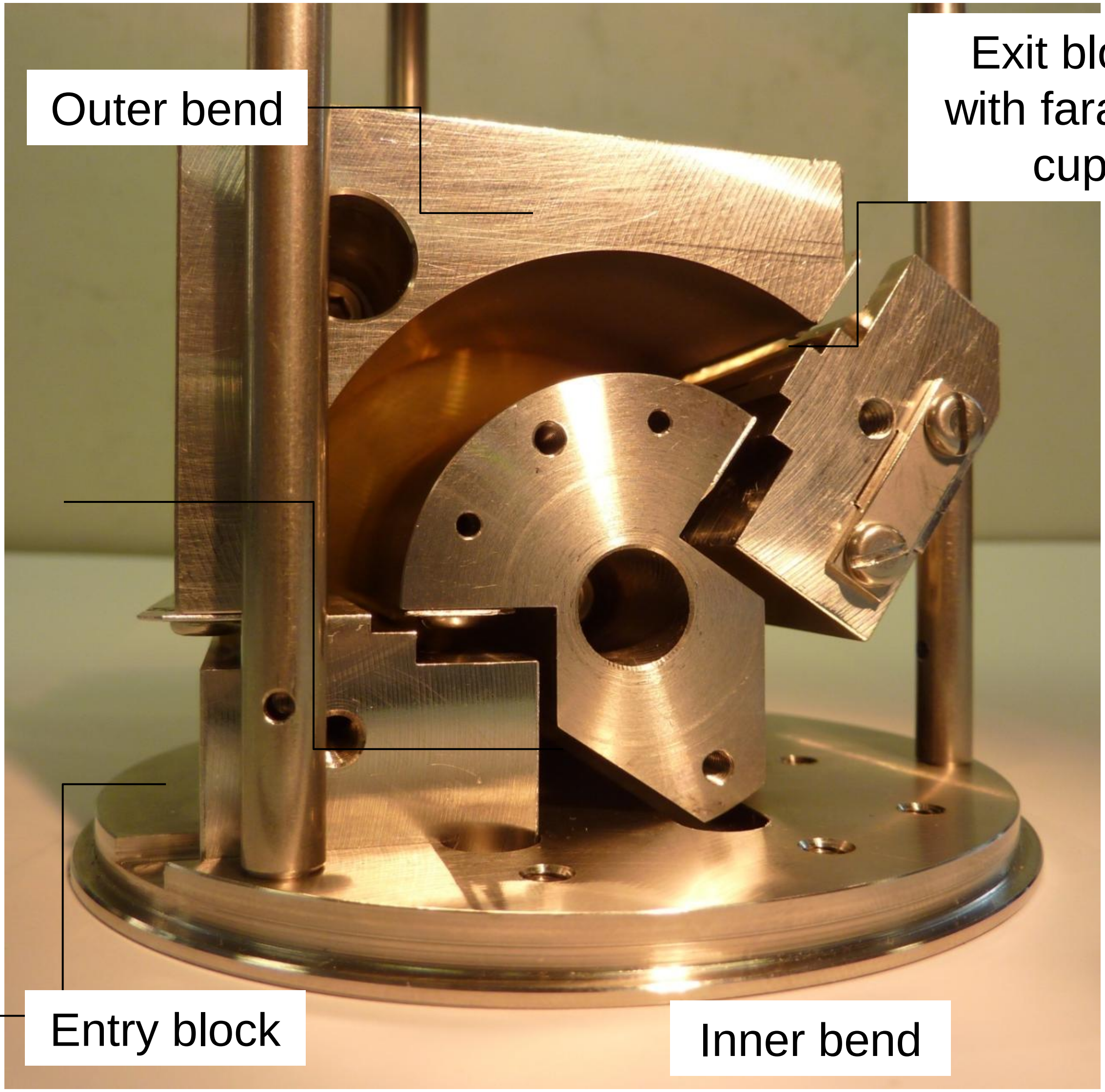

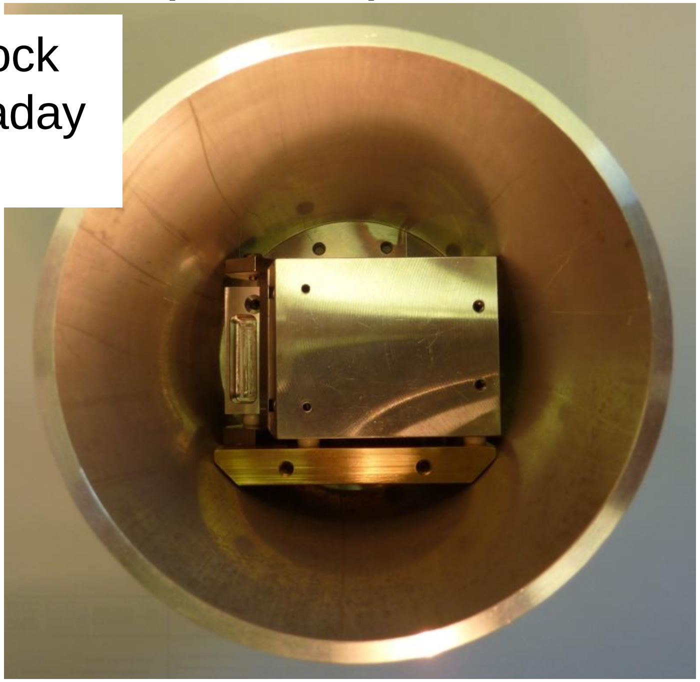

One of the design goals was to make the RGIS4 from available materials. This has resulted in a the mix of materials used, e.g. a brass back plate and an aluminium outer tube.

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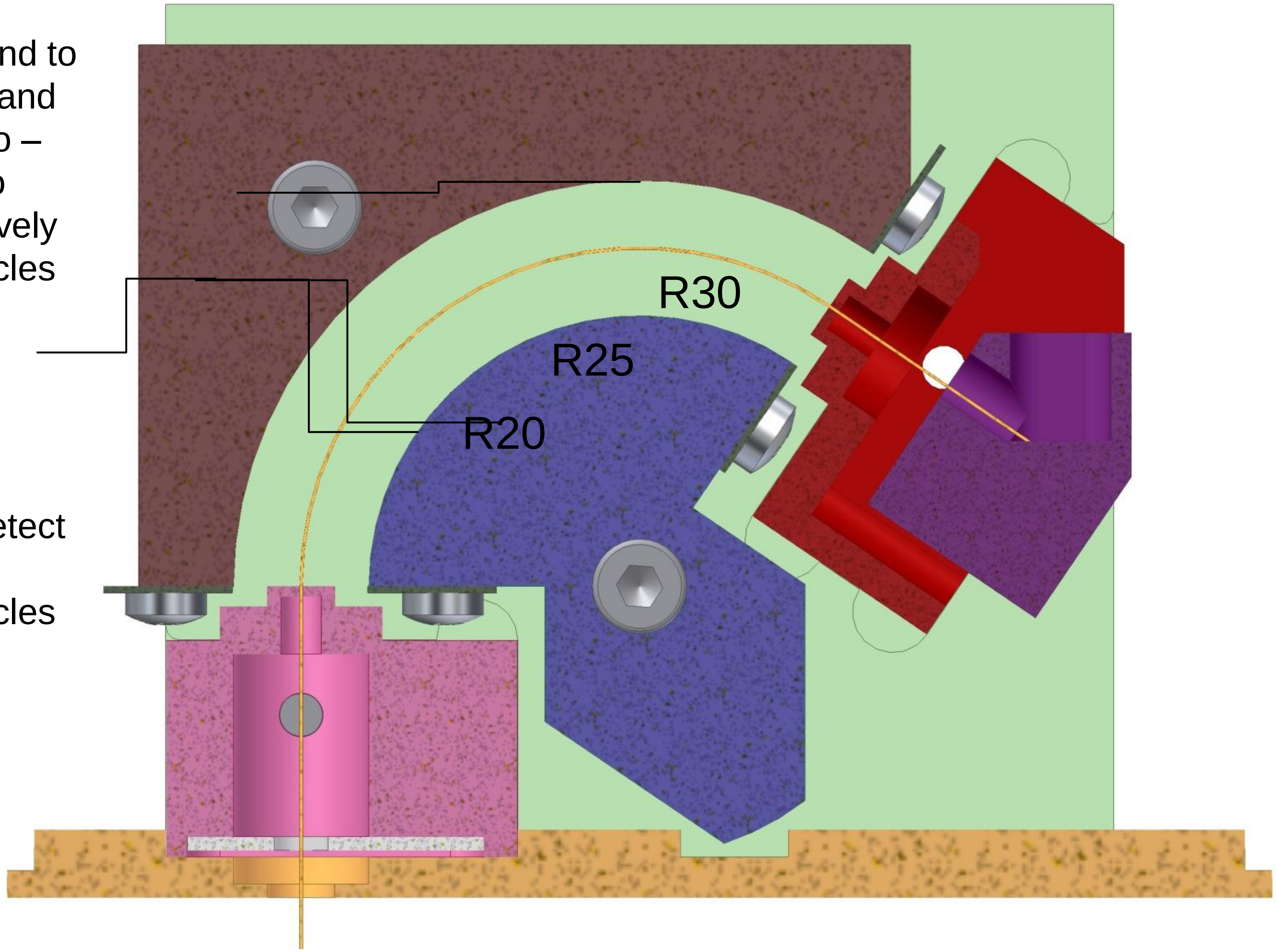
Residual Gas Ion Spectrometer v4 (RGIS4)

Set outer bend to +ve voltage and inner bend to –ve voltage to detect positively charge particles (in our case, residual gas ions)

Reverse the polarity to detect negatively charge particles (in our case, electrons)



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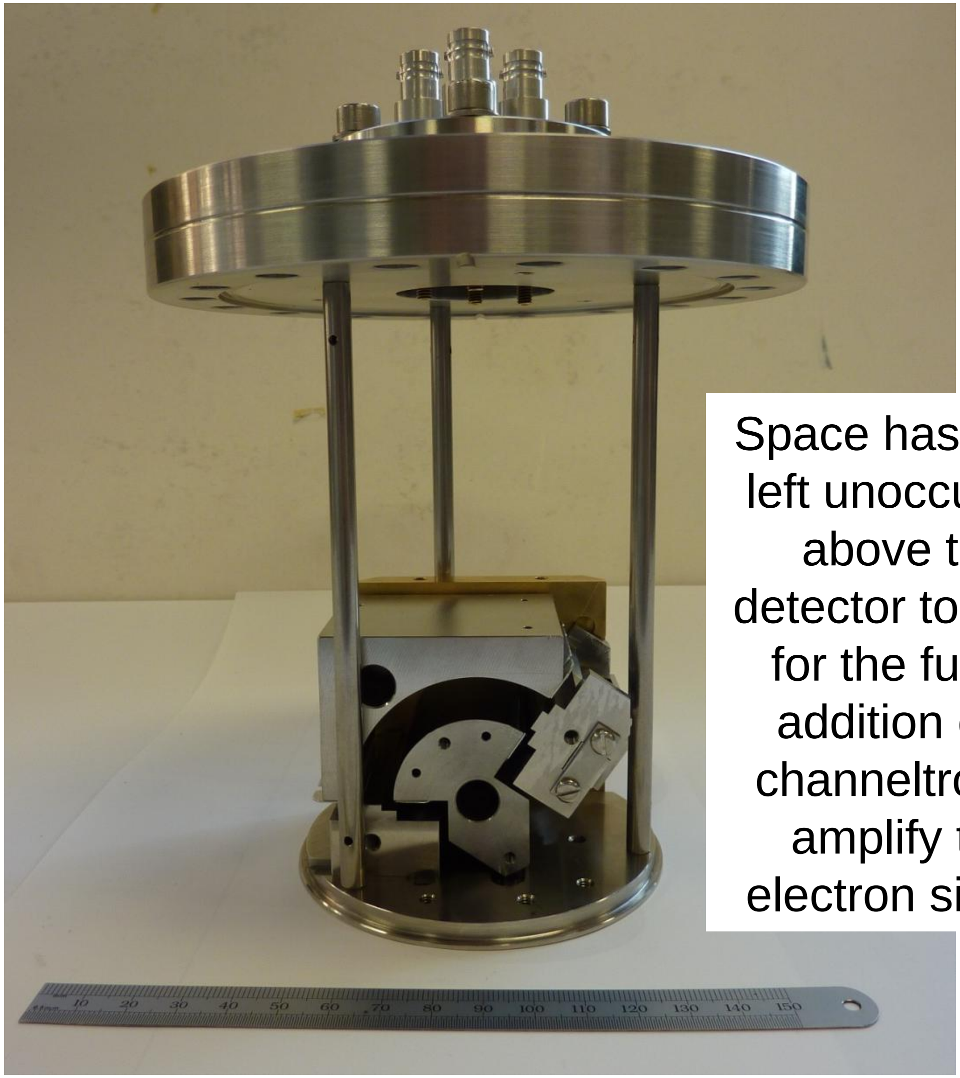
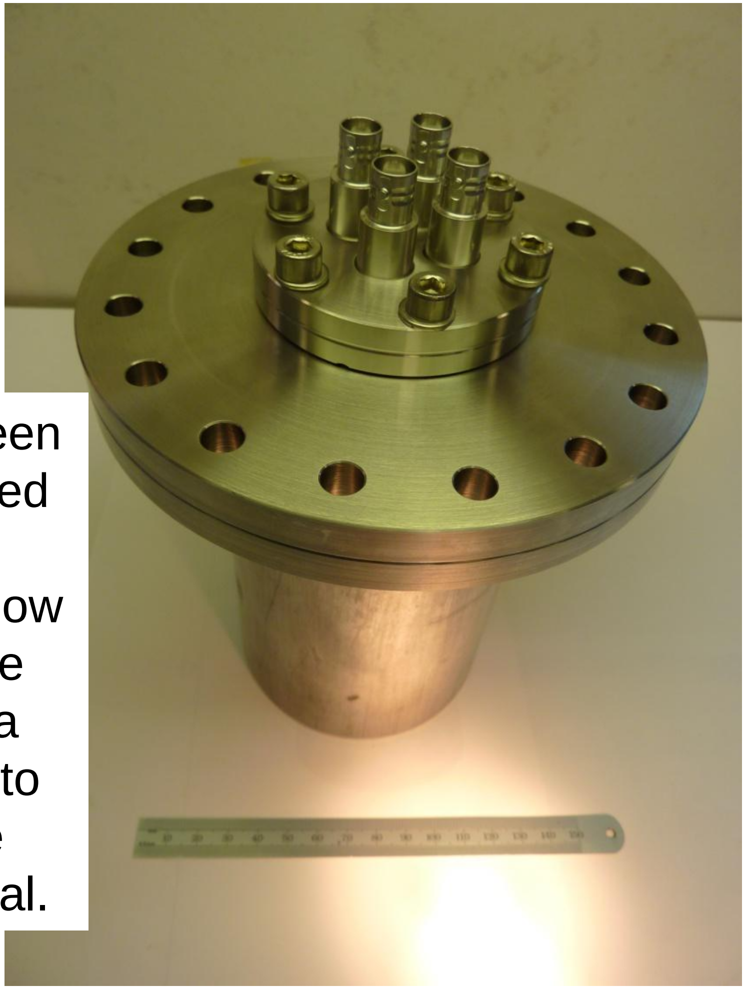


Space has been left unoccupied above the detector to allow for the future addition of a channeltron to amplify the electron signal.

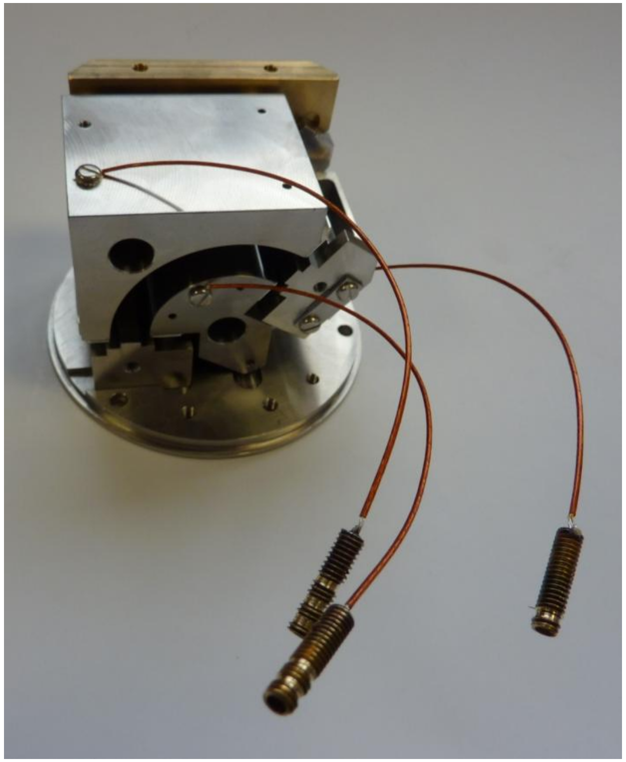


Residual Gas Ion Spectrometer v4 (RGIS4)

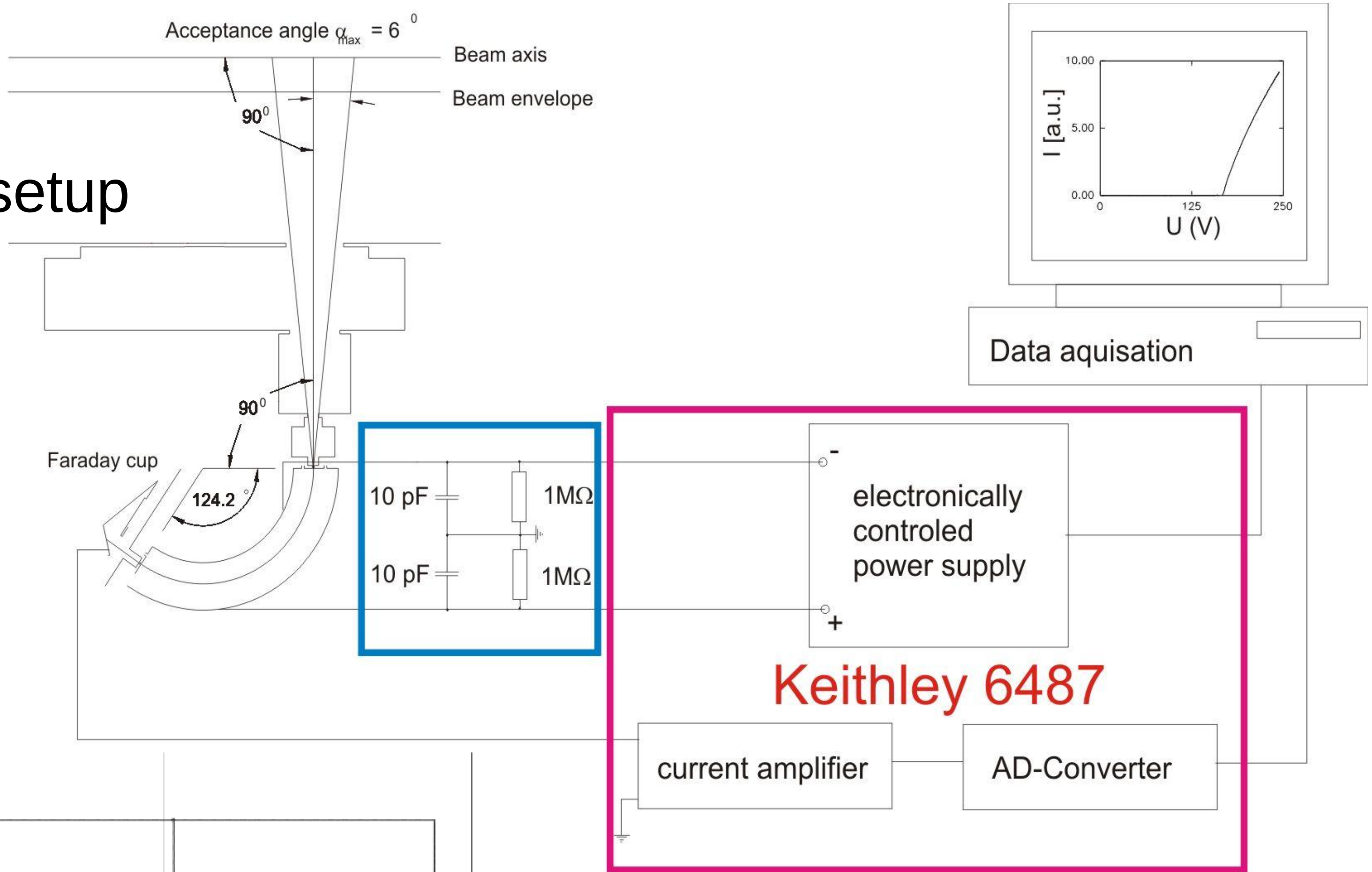
The air side BNCs have been labelled 1, 2, 3 and 4 and this corresponds to:

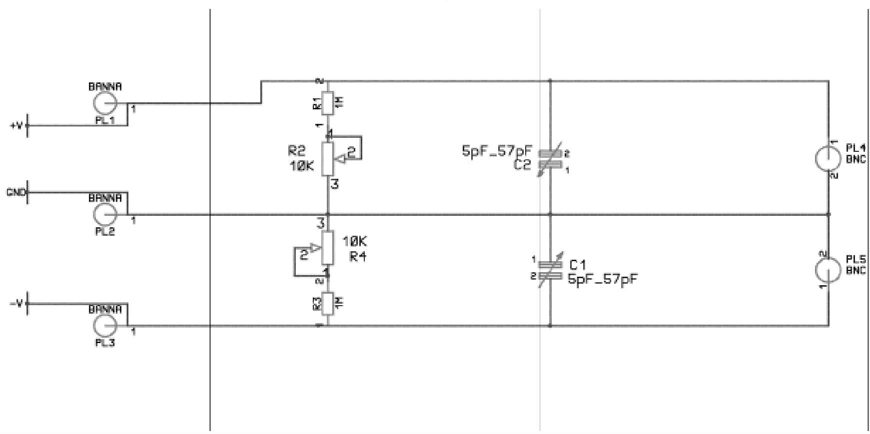
1) Faraday cup
2) Inner bend
3) Outer bend
4) Spare (unused).

Each brass connector that is soldered to the lead has the corresponding number of notches machined into it for identification on assembly.

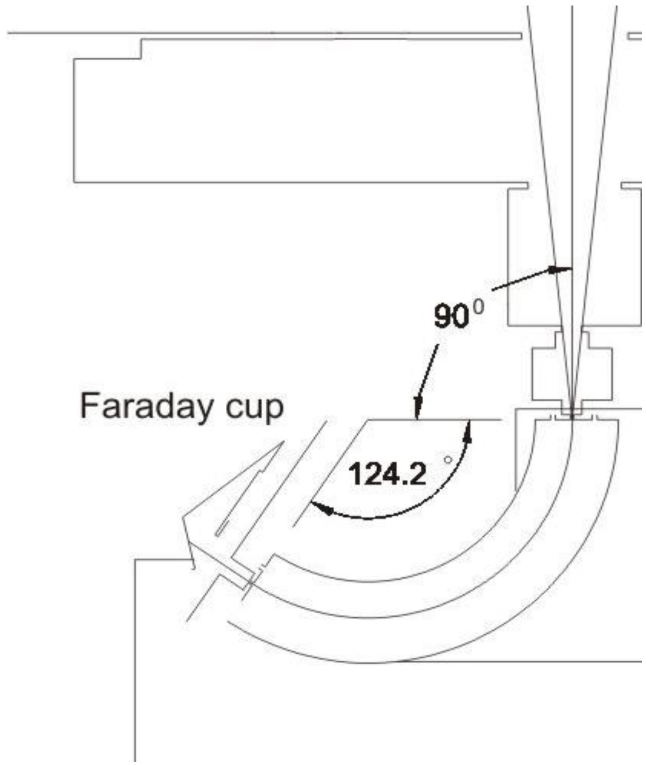


Wiring of experimental setup



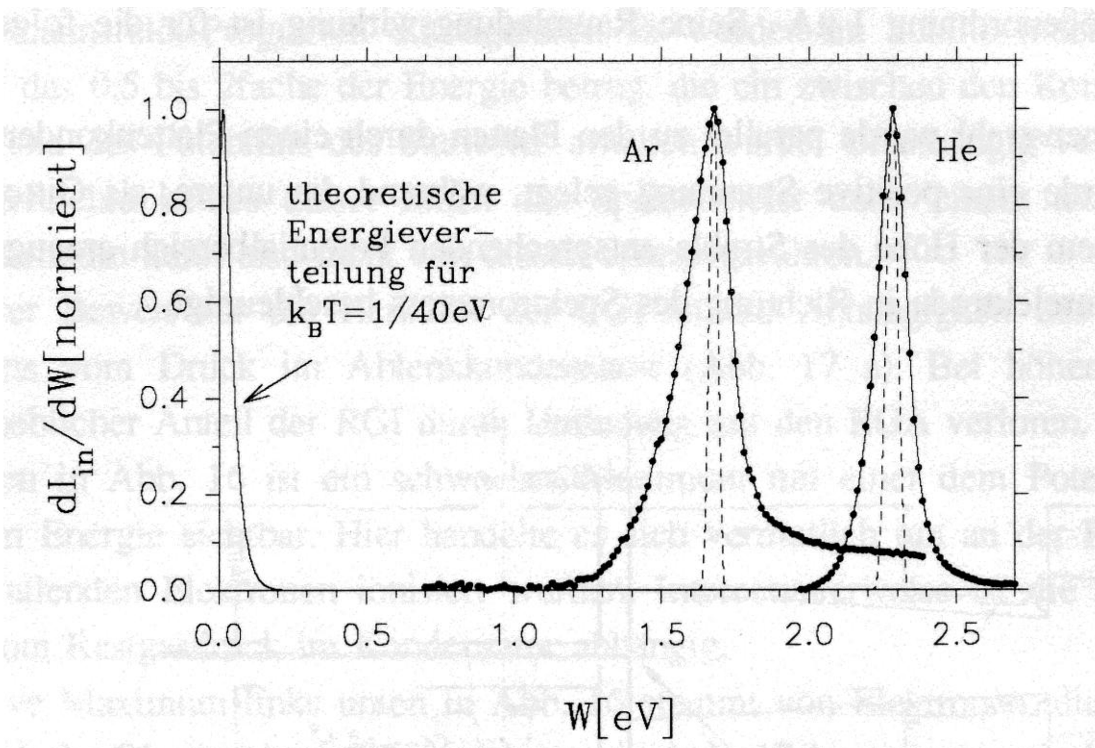


Relation between particles energies detected and voltage on electrodes



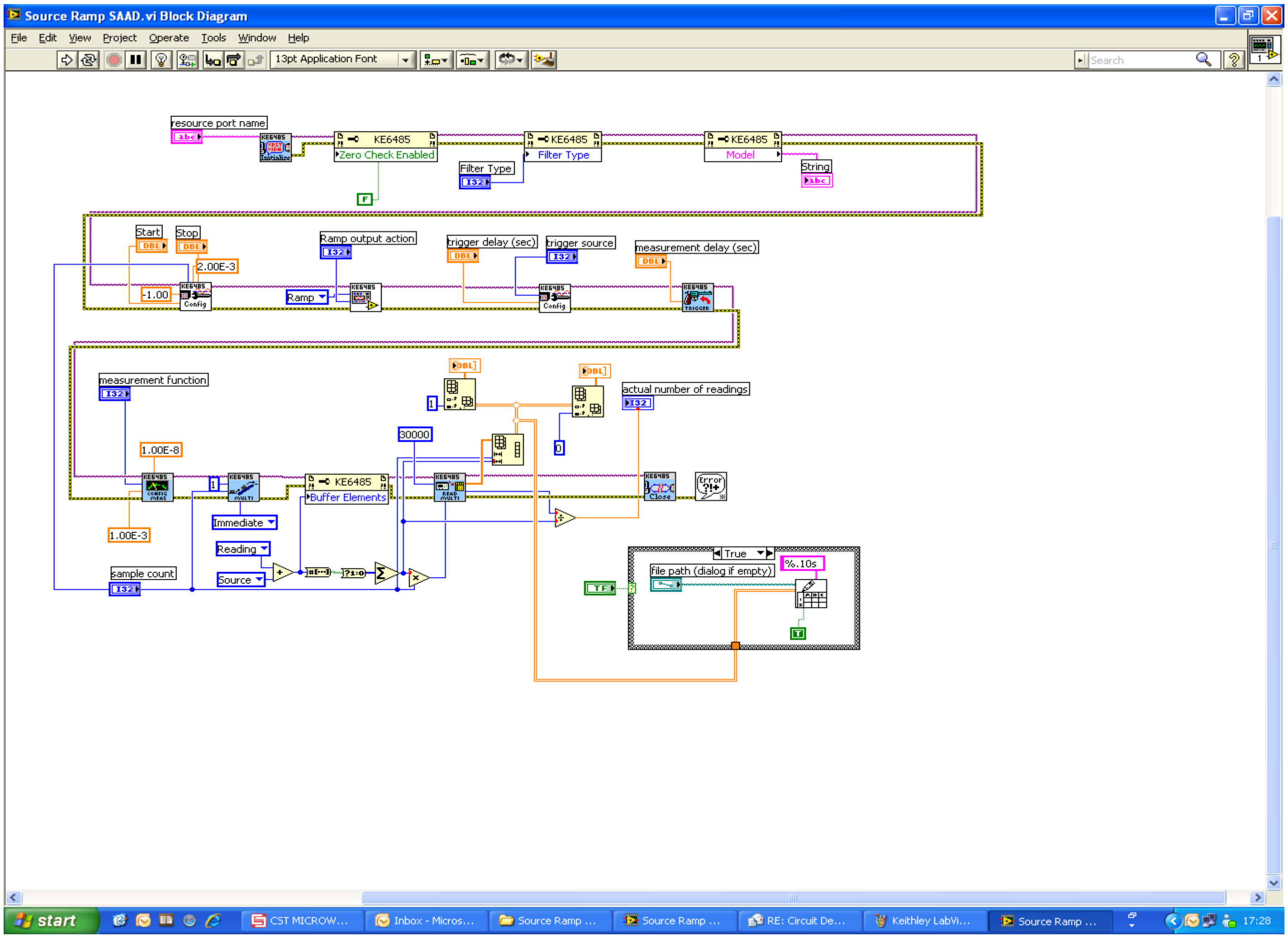
$$W_{particle} = \frac{q \cdot U_{spectrometer}}{2 \cdot \ln \frac{r_{out}}{r_{in}}} = 1.233 \cdot q \cdot U_{spectrometer}$$

Resolution of spectrometer and transfer function

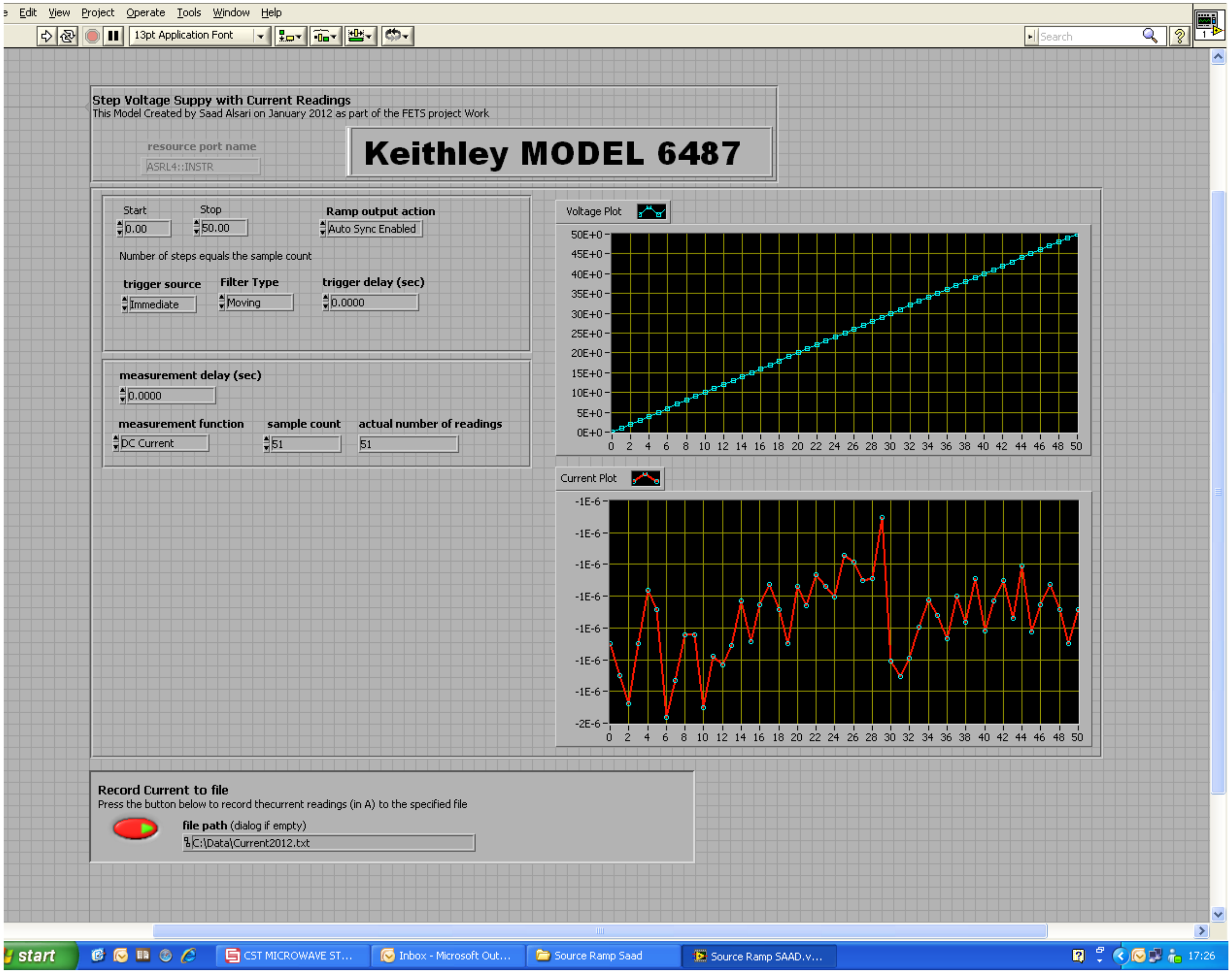


$$2 \cdot \Delta W_{particle} = W_{particle} \frac{d_{slit,in} + d_{slit,out}}{r_{slit}} = \pm 1{,}2\%$$

Keithey 6487 provides deflection voltage and ammeter and is controlled by a Labview code measurements



Labview code allows for automatic spectrometer measurements



Next steps

•Installation in FETS – vacuum test

•Installation of electronics (Keithley) first tests with beam

•Installation of decompensation electrode

•First set of compensation measurements (March ?)

•If Keithley ammeter is not sufficient

- Attach DDC 112 setup to FDC
- Upgrade to Channeltron

•Second set of compensation measurements (Mai)

•Can be used later in MEBT (different time structure)
•If CF 100 flange is available.