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Progress on the evaluation of the Gabor lens

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CCAP meeting 6th November 2018

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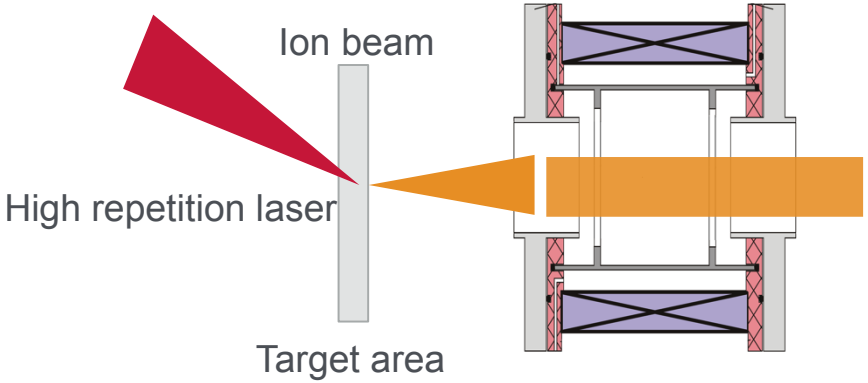
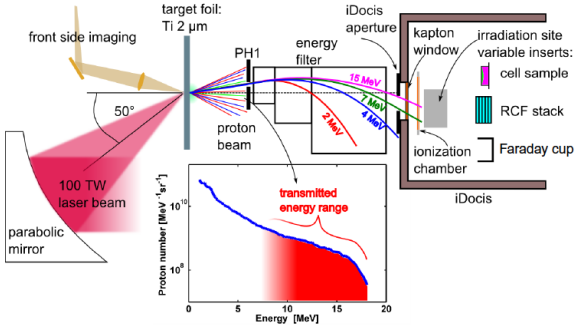
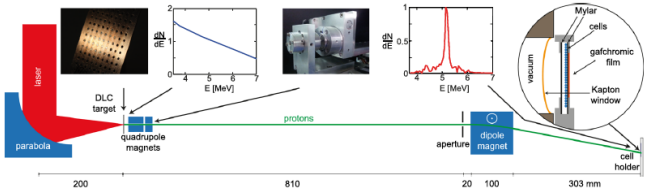
Aim: RBE facility at Imperial – first part of beam line



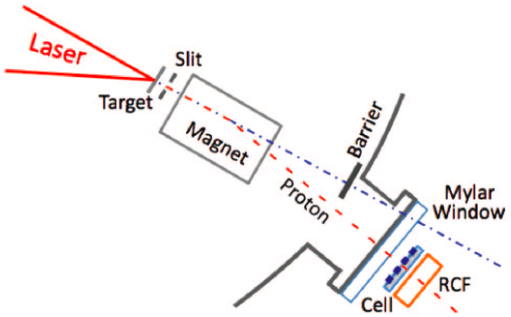
Beam capture



S.D. Kraft et al., Dresden (2010) [3]



J. Bin et al., Munich (2012) [1]



D. Doria et al., Belfast (2012) [2]

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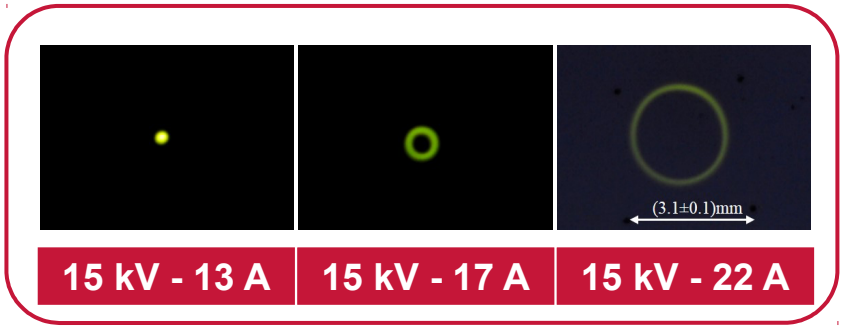
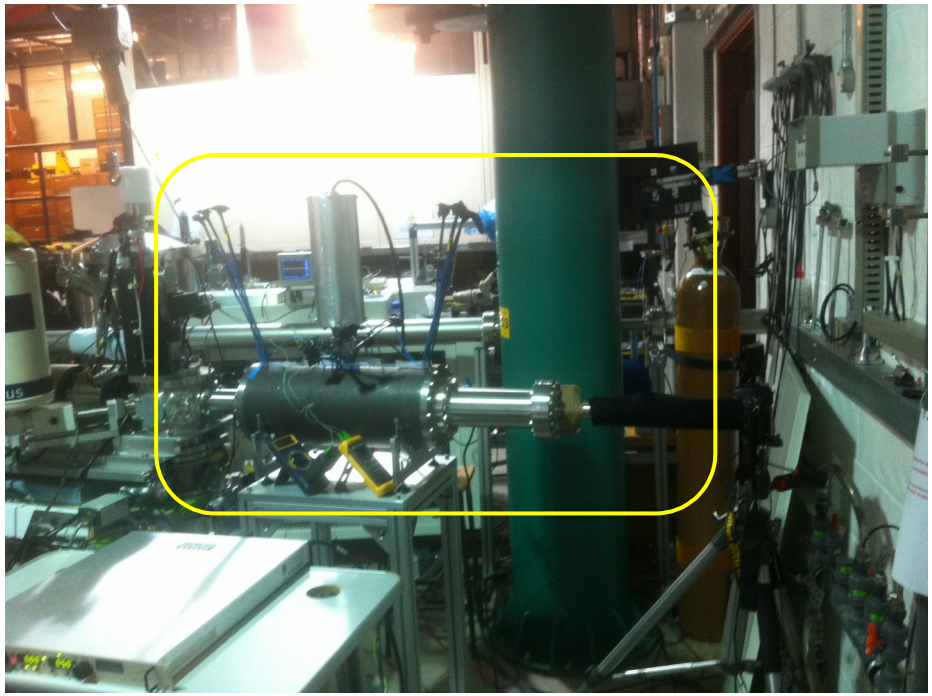
Main problem – lens shows no (or very little focussing but time varying deflection im ~circle

In November 2015 the lens was tested at the Ion Beam Centre of the University of Surrey with a 1 MeV proton beam. A YAG:Ce scintillator screen installed 0.5 m downstream of the lens was used to investigate the transversal beam properties for a large set of lens parameters.





Contrary to expectations, in all measurements rather than an focussing of the beam an ring shaped figure has been recorded the cause of which is unknown.

Investigations showed that no similar behaviour had been published before for such a setup

Various measures have been implemented since then to understand the cause of this behaviour.

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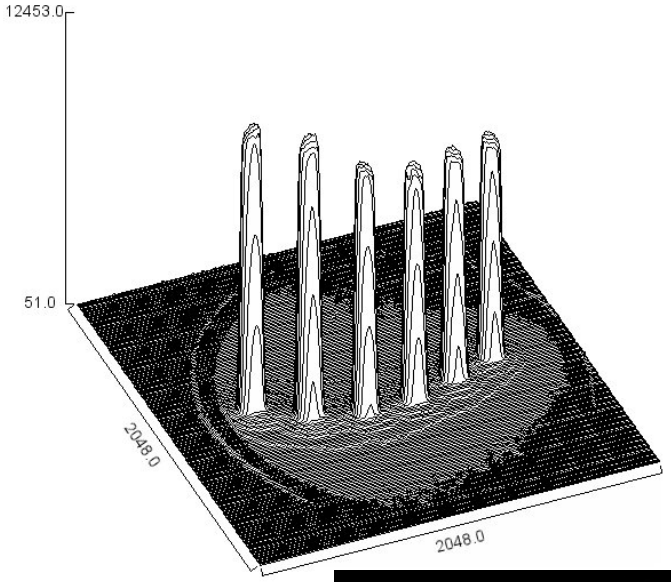
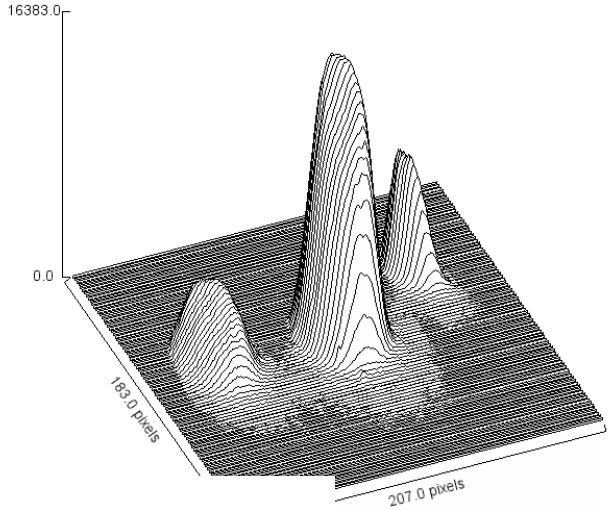
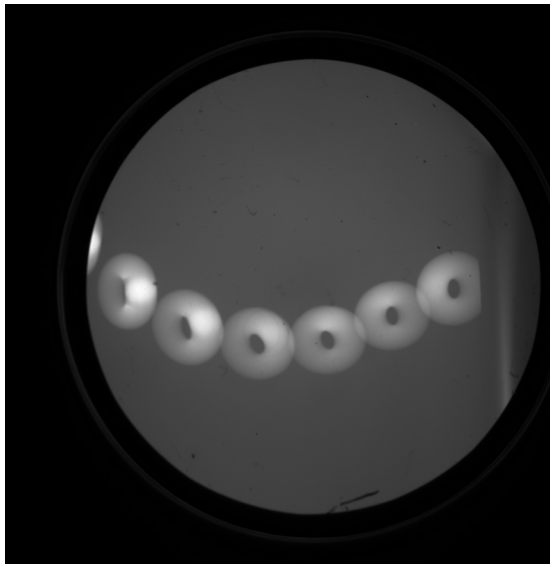
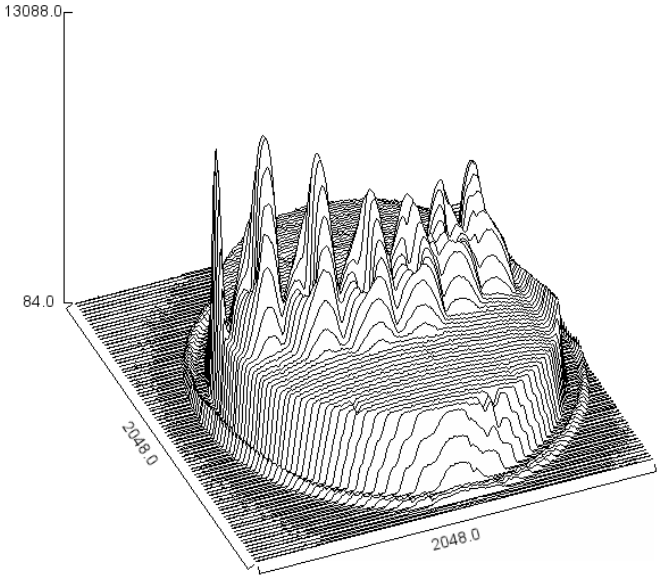
Latest results from Beam measurements – deflection ratio (x,y) is dependent of (radius)









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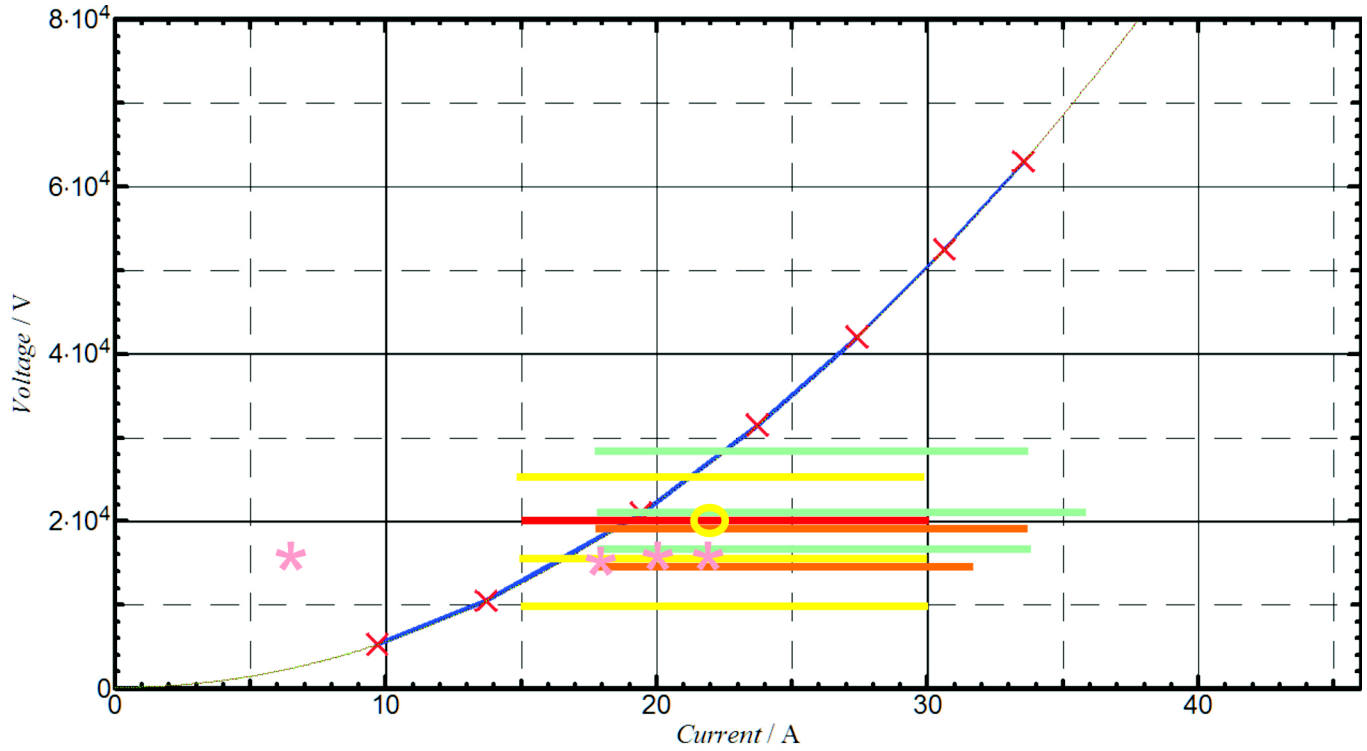
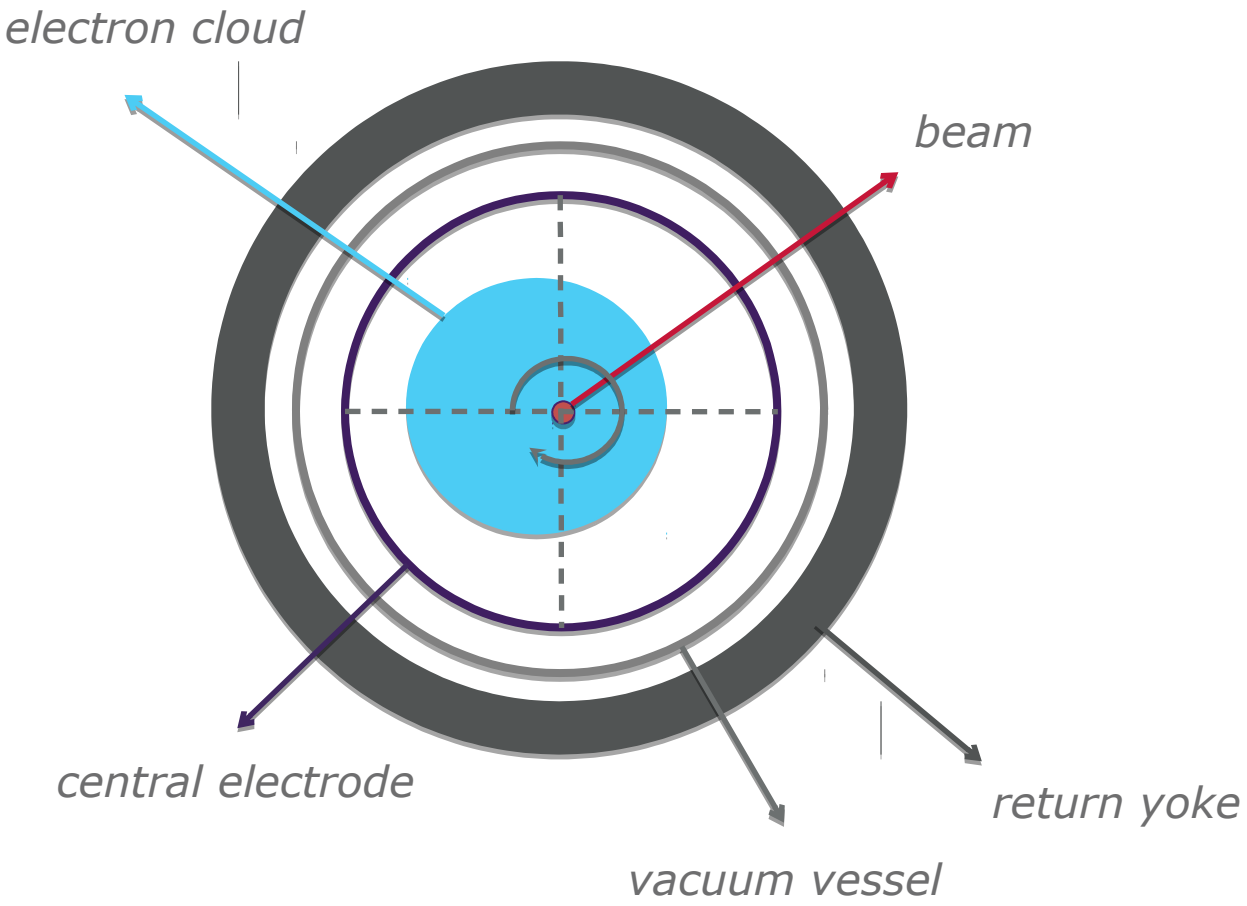
Parameter space for lens – not as it should be

- the working points for the space charge lens have been in plasma experiments at Imperial and at the Ion beam centre in Surrey is shown below. While the accessible extend increased in respect to first beam measurements it shows a certain unusual limitation.



Best assumption for the plasma density variations :

Hollow cloud rotates with ExB drift velocity around magnetic centre which is not the electric centre of the setup (f~10 – 200 MHz).



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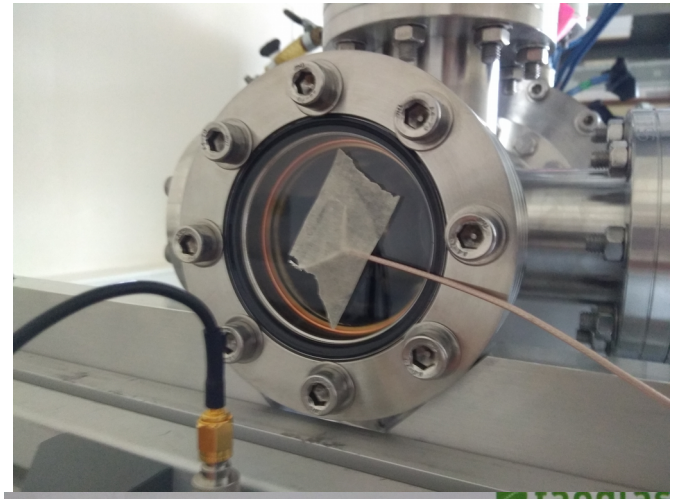
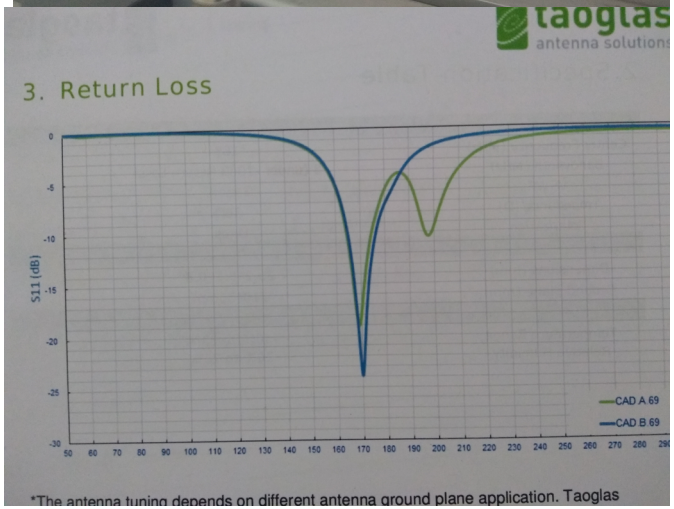
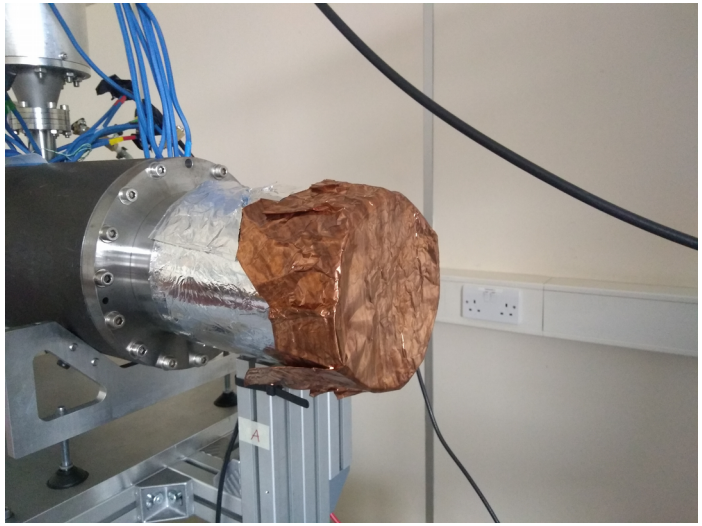
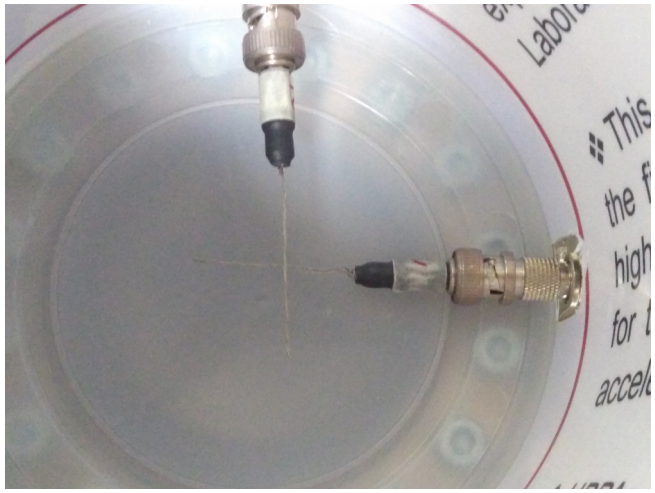
RF investigations - Moritz Sebald

- two types of antenna pairs have been characterized are used.









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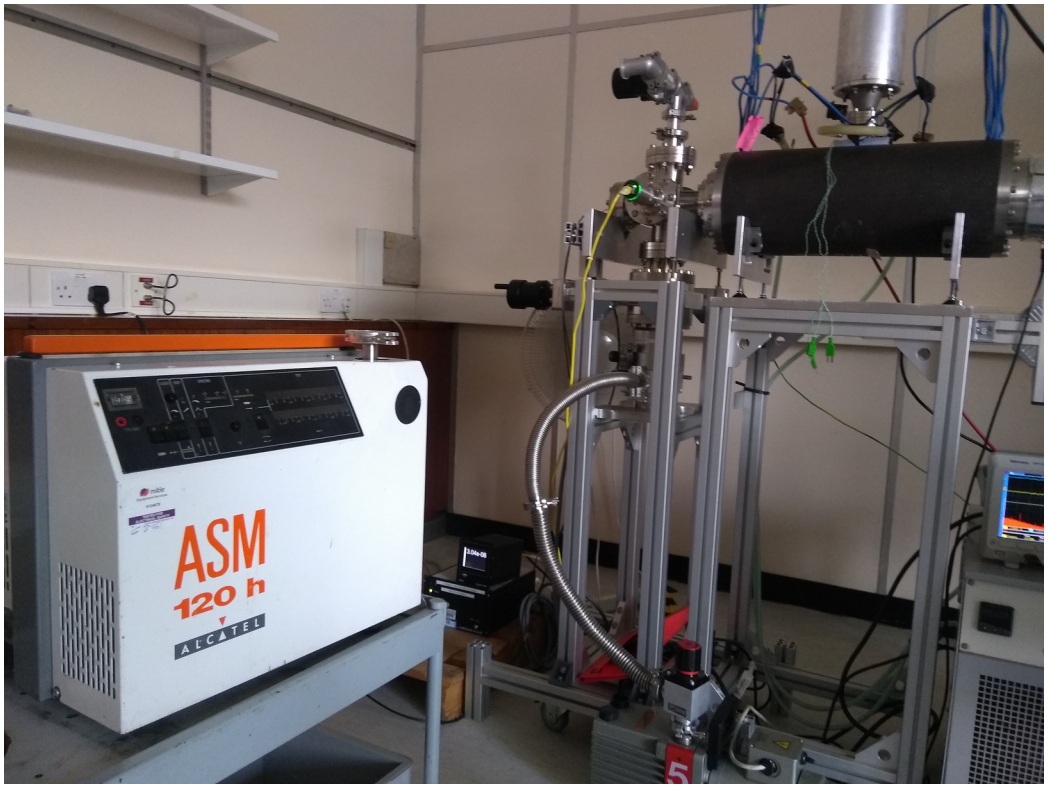
Leak testing at Gaborlens - identified possible position.

While the experimental setup showed a good base pressure of ~ $3*10^{-7}$ hPa before returning from Surrey since then this pressure has been constantly around $3*10^{-6}$ hPa.



Results :

- All parts of the external setup are free of significant leaks.

- External accessible flanges of the lens are free of significant leaks.

- The HV feed through and flanges of the lens show no significant leaks.

only the internal seals between vacuum vessel and endflanges showed an increase of Helium but temporal variation was extremely slow. See lens inspection plans.

Status and plans 1

- Investigate frequency of rotation of space charge cloud

  - using a RF antenna setup (10-200 MHz)
  -> started, first measurements showed no significant results, but measurements were first interrupted due to illness, later due to lab issues and finally the lens was put apart and analysed Further data from measurements are available but no analysed. Measurements will be repeated with spiral antenna when lens is reassembled.

  - using short pulse ion beam (laser driven) – after Lens rebuild

- Investigate the reasons for hollow lens filling / limited parameter space and influence of introduced changes to lens setup on experimental results. Additional use of alpha emitter considered. Update new lens design see later.

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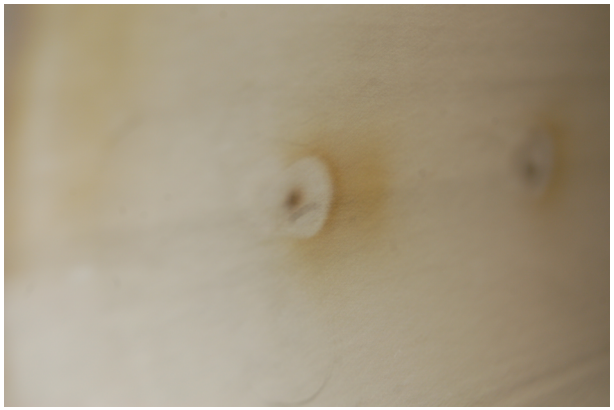
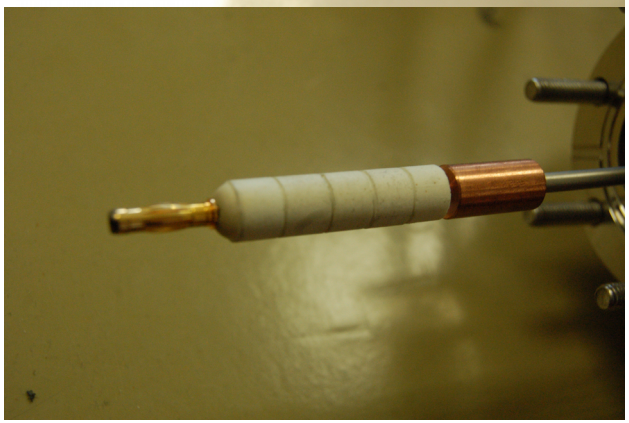
Status and plans 2

- Disassemble Lens and review internals Done





Main issues identified, all connected with dislocated discharges at endlanges, pumping holes and one pint at feedthrough. All will be part of first changes

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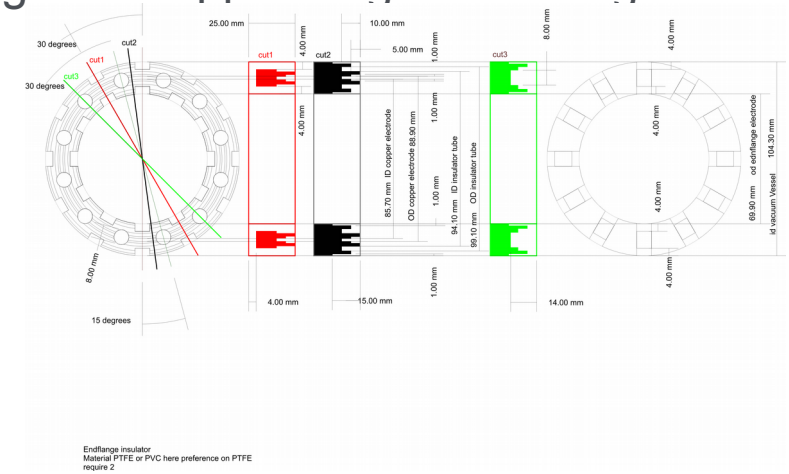
Status and plans 3

- make changes to end flanges of the lens (non magnetic) not priority in the moment

- make changes to HV electrode setup. Delayed due to engineering resources, finally drawings nearly finished and production started.
→ Use of insulators, main activity here,

* On end flanges to suppress gas discharge – material available, ->drawings finished



* On feed through to prevent break down above 35 kV, identified and solution available

Status and plans 4

- use electron emitter incorporated in new end flanges and / or additional access for diagnostics. In next step

- support coils from iron shell to reduce load on vacuum vessel, make access through shell from below for Helium. Drawings in progress, material available, part of first step.

- Rebuilt experimental setup with changes incorporated.
- upgrade pumping of experiment. Leak found and part of changes

- If required small model of alternative design ? New model will be closer in respect to old designs