Gabor lens 5 year plan

2 postgrad years ,2 student years, 0.5 engineering years, 250k equip total.

Gabor lens – 1st iteration

This section includes work that can, in theory, start now

Work that will have tangible, guaranteed outputs – improve

Build

- high voltage tests
    - verify voltage hold off – requires engineered anode support. Test without magnets – essentially 'spot- knocking'
    - current monitoring – current return to power supply – low ohm link, or Rogowski probe.
        - dc
        - high bandwidth - oscilloscope.
    - optical emission
        - dc – quasi DC, camera.
            - high frame rate/gated?
        - high bandwidth – photo diode.
        - Side port?
- Vacuum
    - Turbo pumping.
    - NEG pump?
    - Calibrated 'leak' to simulate Laser target volume.
- magnet build and test
    - main coils
    - 'bucking' coils
    - Physical support and forces between magnets.
        - Modelling in CST.
        - 'Bucking' coils will experience high forces.

Diagnostics

- Alpha source.
    - Strathclyde possibly has suitable sealed source – possible to 'borrow' from labs avoiding 'increased Strathclyde inventory' which would be strongly resisted.
    - Requires
        - Fully sealed experimental area – formica type surfaces
        - Paperwork for all personnel involved
        - 'window' to form beam/sheet beam
    - Particle detector/tracker
        - Zinc sulphide coated window – camera – photodiode?
        - Other options – ICL?

- Low frequency RF to measure electron density
    - theoretical investigation – this is hard and requires multi-pass (~100) so a relatively high Q resonator would be needed – result would be a scalar output with no spatial resolution.
    - Possible ‘live’ diagnostic indicating lens ‘good – not good’

Gabor lens – 2nd generation

Electron source.

- In simple terms an electron gun on the cathode, outside the anode, providing a diverging ‘beam’ of electrons directed between the ‘bars’ of the anode.
    - Allows lens to ‘light’ without exceeding breakdown threshold between anode and cathode.
    - Electron insertion angle should be such that the ‘beam’ avoids the loss cone
    - Beam spread will be required to ‘fill’ lens?
    - 0.3m/ns, Gabor lens length ~1m, 100 round trips implies electron beam pulse of ~1us.

Mirror configuration – Investigation of alternative electron cloud confinement mechanism.

- Theoretical investigation
    - will enhancing the magnetic field at the ends of the device provide improved electron confinement?
    - We should expect a mirror trap to also confine the ions – if we strongly reduce the ion loss mechanism will we in fact reduce the charge imbalance and make the lens less powerful? Can we provide a method of extracting ions continually to maintain/enhance the charge imbalance in the mirror configuration? Mirrors do not conventionally have e-fields - this is an important distinction and may be sufficient to extract the ions. Should be amenable to calculation – sheath potential should be less than anode voltage.
- Practical – simulation experimental
    - Can we produce the required increased B field at the ends with a permanent magnet? Simulation – probably yes.
    - Electromagnet
        - Pulsed – definitely possible
        - DC – yes – will require active cooling but not too demanding.