Collaboration meeting
27 April 2022
WP1.3 - Capture

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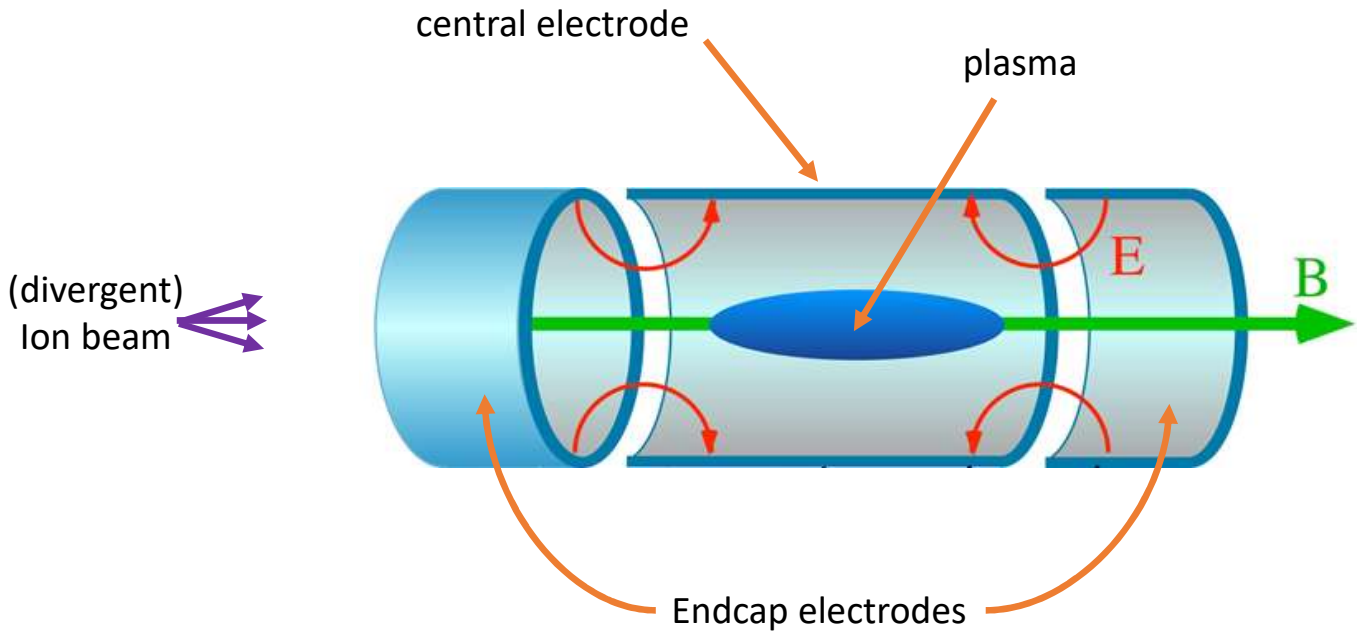
Gabor lens – basic overview



Discharge vs. Non-neutral plasma apparatus

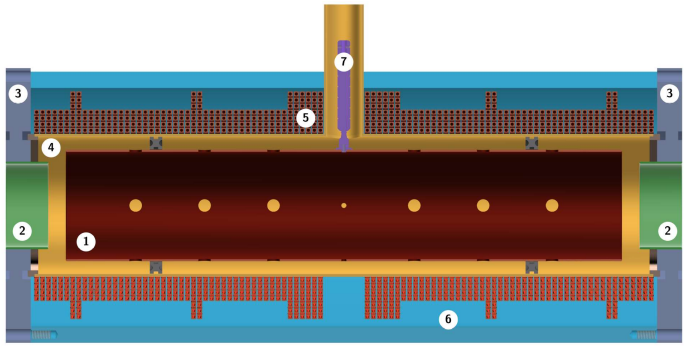
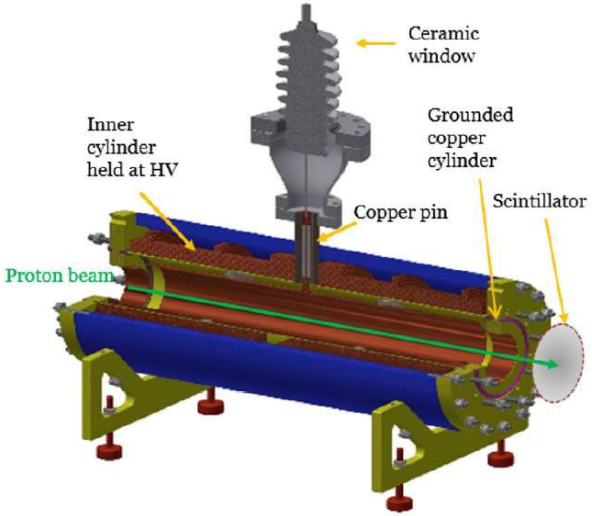


Figure 1. Internal structure of the IC Gabor lens viewed in longitudinal cross-section. The main components are: 1-central anode, 2-end electrodes, 3-end flanges, 4-vacuum tube, 5-pancake coils, 6-outer tube, 7-high-voltage feed-through.



Appl. Sci. **11** 4357 (2021)
Proc. IPAC2016 TUPMY024

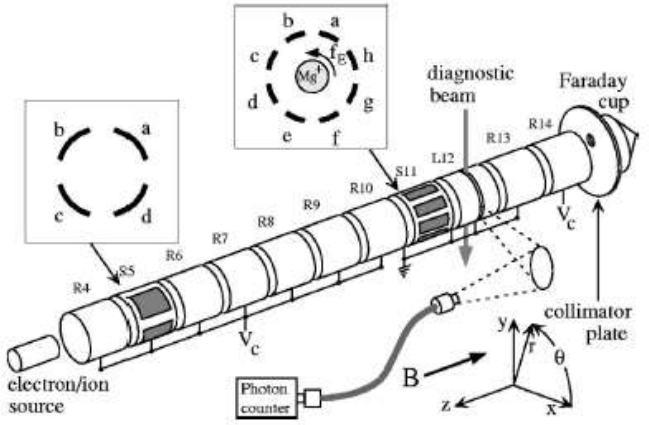
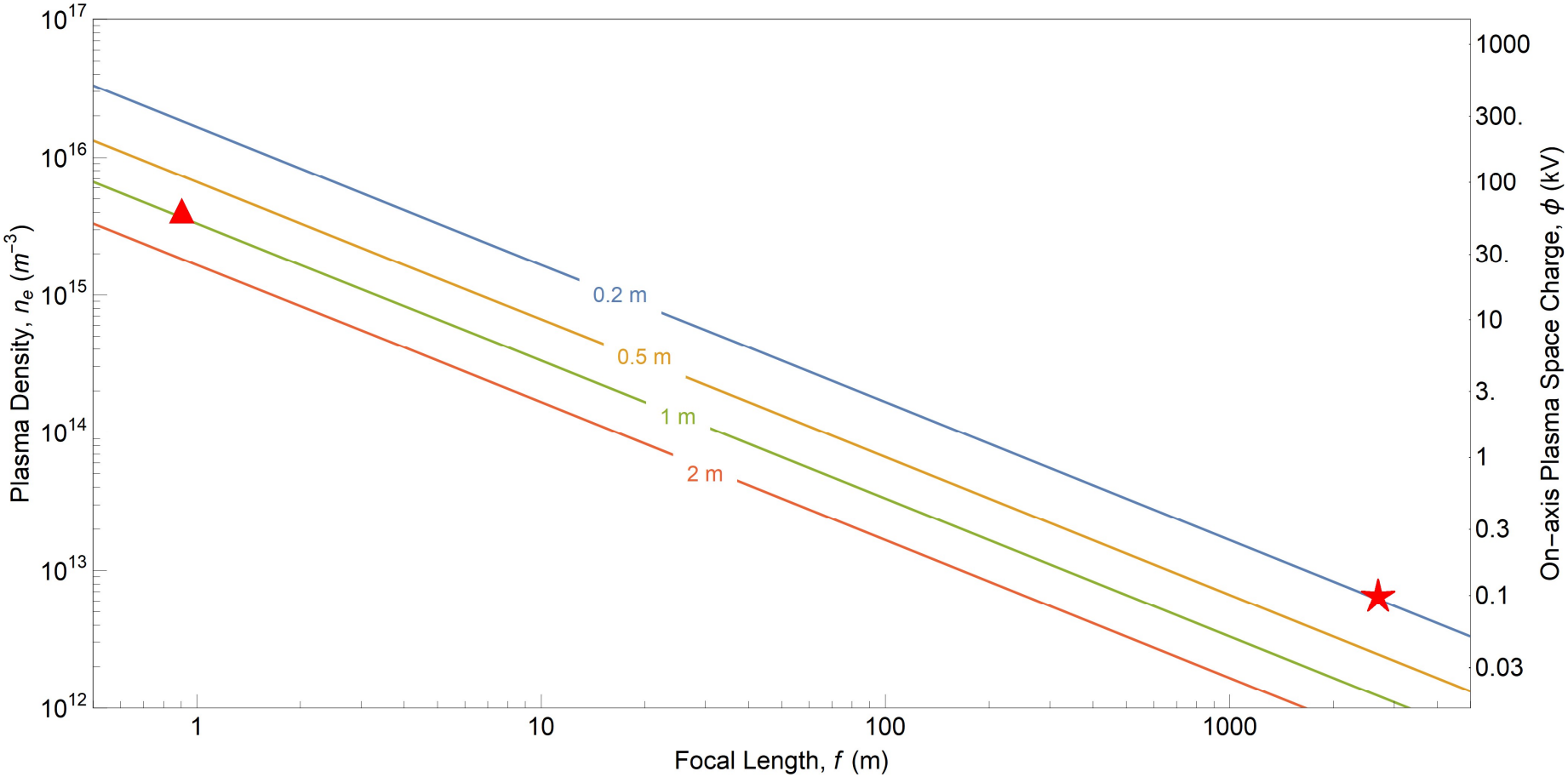


FIG. 1. Schematic of the IV Penning–Malmberg trap used for electron and ion plasma experiments. Electrons are typically confined in the region S5 →S11; Mg^+ ions (shown) are typically confined in the region S11→R13. A laser diagnostic is used for ion plasmas; a collimator plate and Faraday cup diagnostic is used for electron plasmas. Azimuthally-dependent modes are driven and detected with sectored rings (S5 and S11).

Phys. Plasmas **7** 2776 (2000)

Non-neutral plasma lens parameter-space plot



Original programme

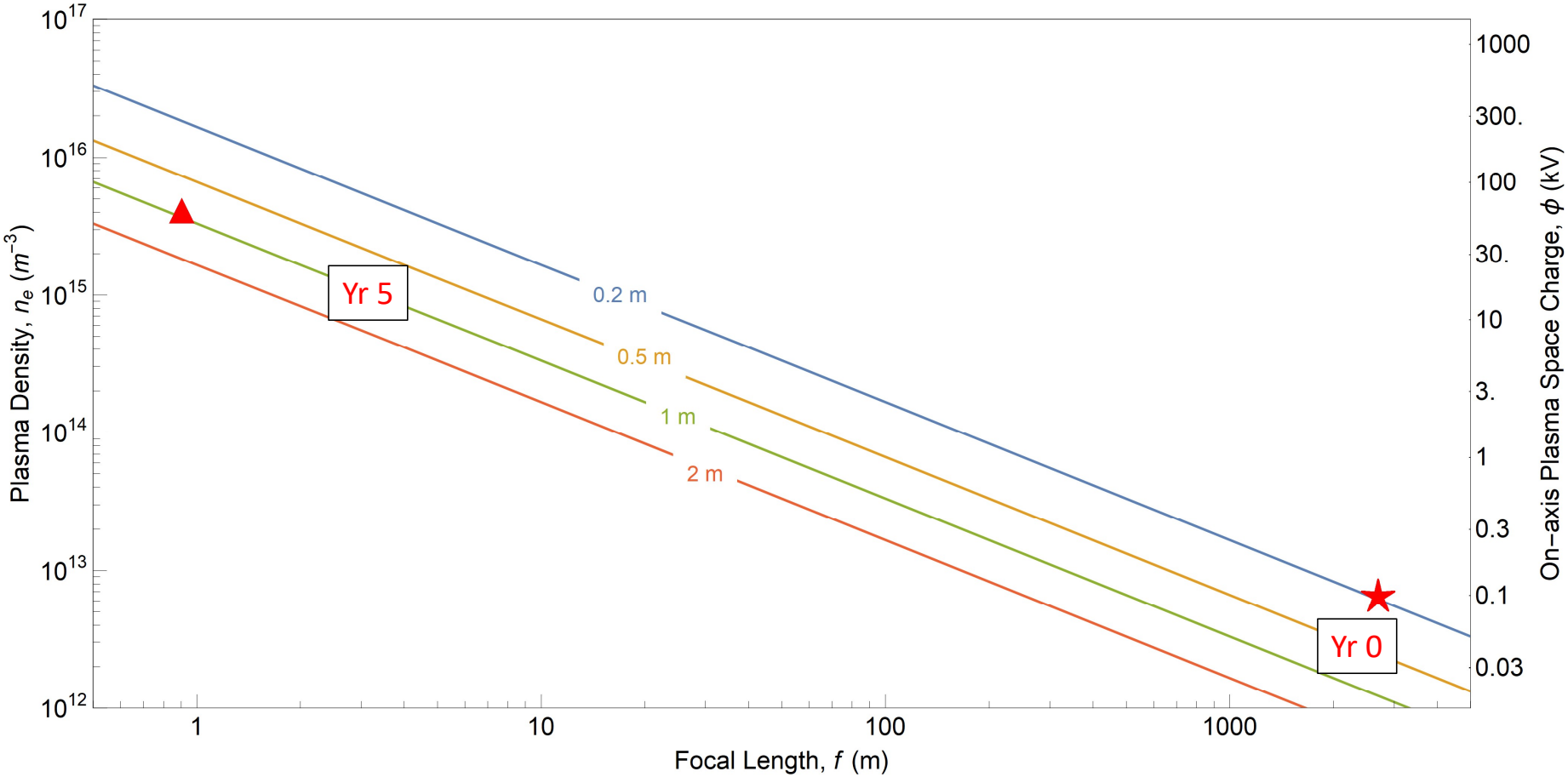
- Parallel streams:
  - Years 1-2
    - Upgrade Swansea apparatus to operate at higher voltages
      - Study parameters to guide new design (hardware cost vs. specification options)
    - Validate simulations with higher voltages
      - Study parameters to guide new design
    - Design, order, assemble new testbench
  - Years 3-5
    - Testbench
      - Commission – months 24-30
      - Systematically study several plasma parameters (density, length, radius, etc.) – months 30-54
    - Numerically study plasma produced & those beyond apparatus capabilities
    - Interface with ion source & validate simulations – months 54-60
    - Finalise ‘final’ Gabor lens design – months 57-60

New programme

- Parallel streams:
  - Years 1-2
    - Use Swansea apparatus to study a plasma parameter (radii)
    - Numerically study experimentally produced plasma & testbench configurations
    - Design new testbench
  - Years 3-5
    - Testbench
      - Order & assemble – months 24-36
      - Commission – months 36-39
      - Systematically study several plasma parameters (density, length, radius, etc.) – months 40-54
    - Numerically study plasma produced & those beyond apparatus capabilities
    - Interface with ion source & validate simulations – months 54-60
    - Finalise ‘final’ Gabor lens design – months 57-60


Year 1
Year 2
Year 3
Year 4
Year 5
Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4
Upgrade Swansea Apparatus
Study plasma in Swansea apparatus
Study test bench hardware options with plasma
Simulations - Validate
Simulations - Study
Test bench - design
Test bench - ordering
Test bench - assembly
Test bench - commissioning
Test bench - Plasma study
Source interface
Original plan
ITRF reprofiled plan

Non-neutral plasma lens parameter-space plot



Proposed Costs

	Original	New
Year 1-2 – FTE	10.5	2.5
Year 1-2 – Cost	£1.8M	£0.4M
Year 3-5 – FTE	16.5	25
Year 3-5 – Cost	£2M	£4M
Total FTE	27	27.5
Total Cost	£3.8M	£4.4M

Above exclude costed risks

Critical changes

- Years 1 & 2
  - Junior researcher
  - Limited PI/supervisor time
  - No dedicated technical support
  - Heavily reliant on pre-existing expertise (& apparatus) from existing projects
    - Not guaranteed
- Years 3, 4 & 5
  - Additional PDRA required
  - Additional PI/supervisor time
  - Additional technical support
- Equipment
  - Removal of ‘off-the-shelf’ apparatus testing
  - Removal of an intermediate step
  - Increased bespoke designs outsourced

Milestones / Objectives

Year	
0.5	Validate plasma simulations with existing Swansea experimental set-up
1.5	Progress report of large diameter plasma experiments and simulations
2	Next generation plasma lens testbench design
3	Progress report of standalone plasma apparatus build and commissioning
4	Progress report of large particle number plasma experiments and simulations
5	Ion focussing results & final plasma lens design

Questions?