

# Capture Work Package

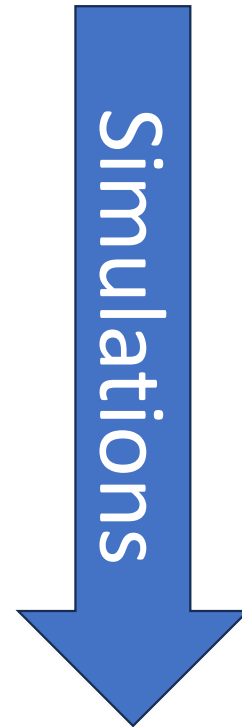
## PA2 PoP thoughts/discussion

Christopher Baker

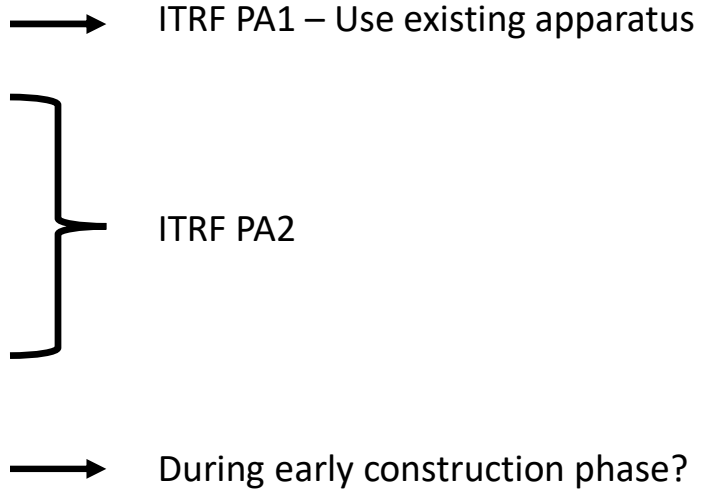
20<sup>th</sup> September 2023

# Original Plan

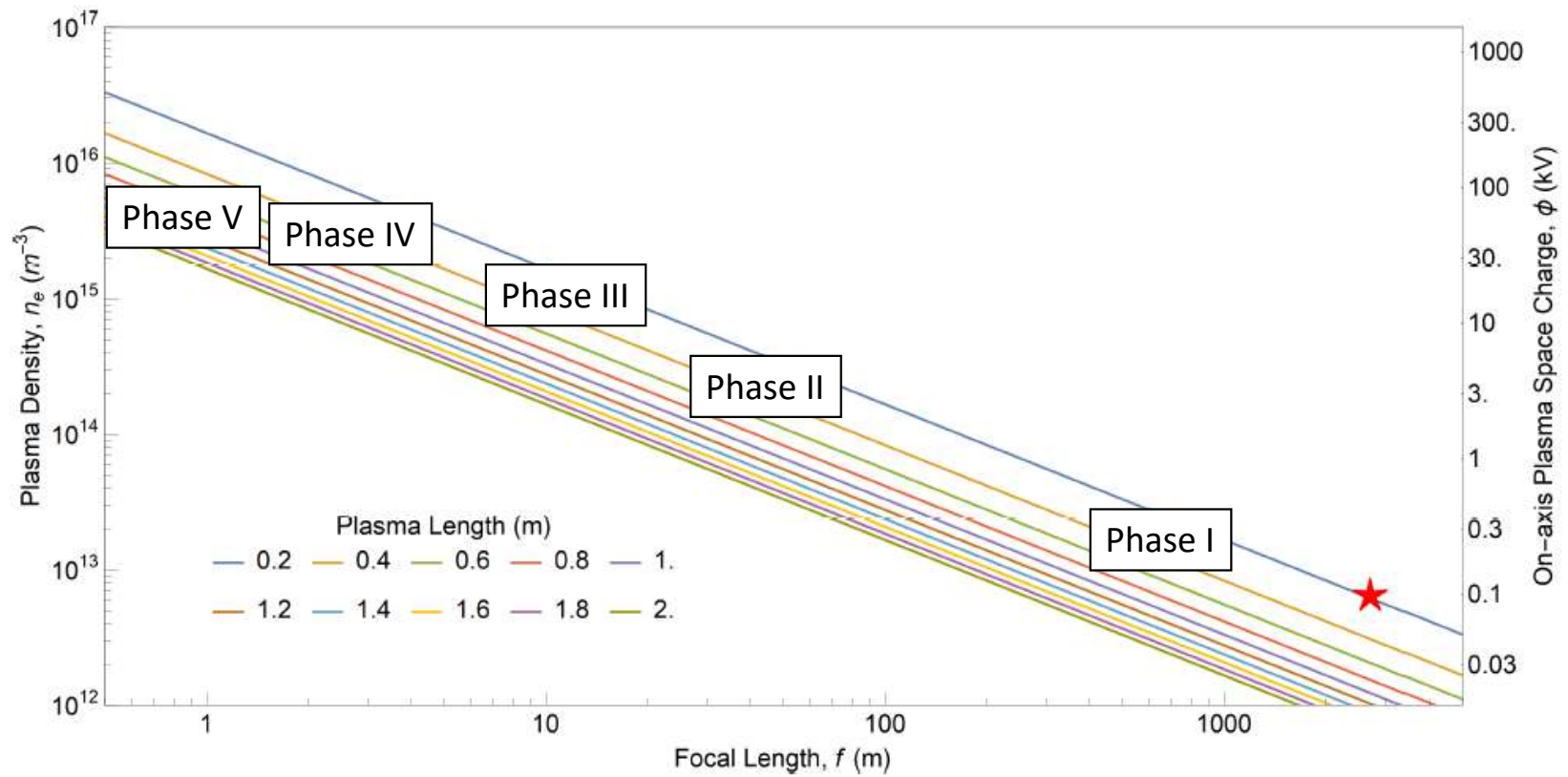
- Phase I
  - Upgrade Swansea Apparatus to 0.5-1 kV
- Phase II
  - Construct 2-5 kV testbench
- Phase III
  - Upgrade testbench to 10-20 kV
- Phase IV
  - Construct Gabor lens prototype at 50-65 kV
- Phase V
  - Construct Gabor lenses for use in beamline



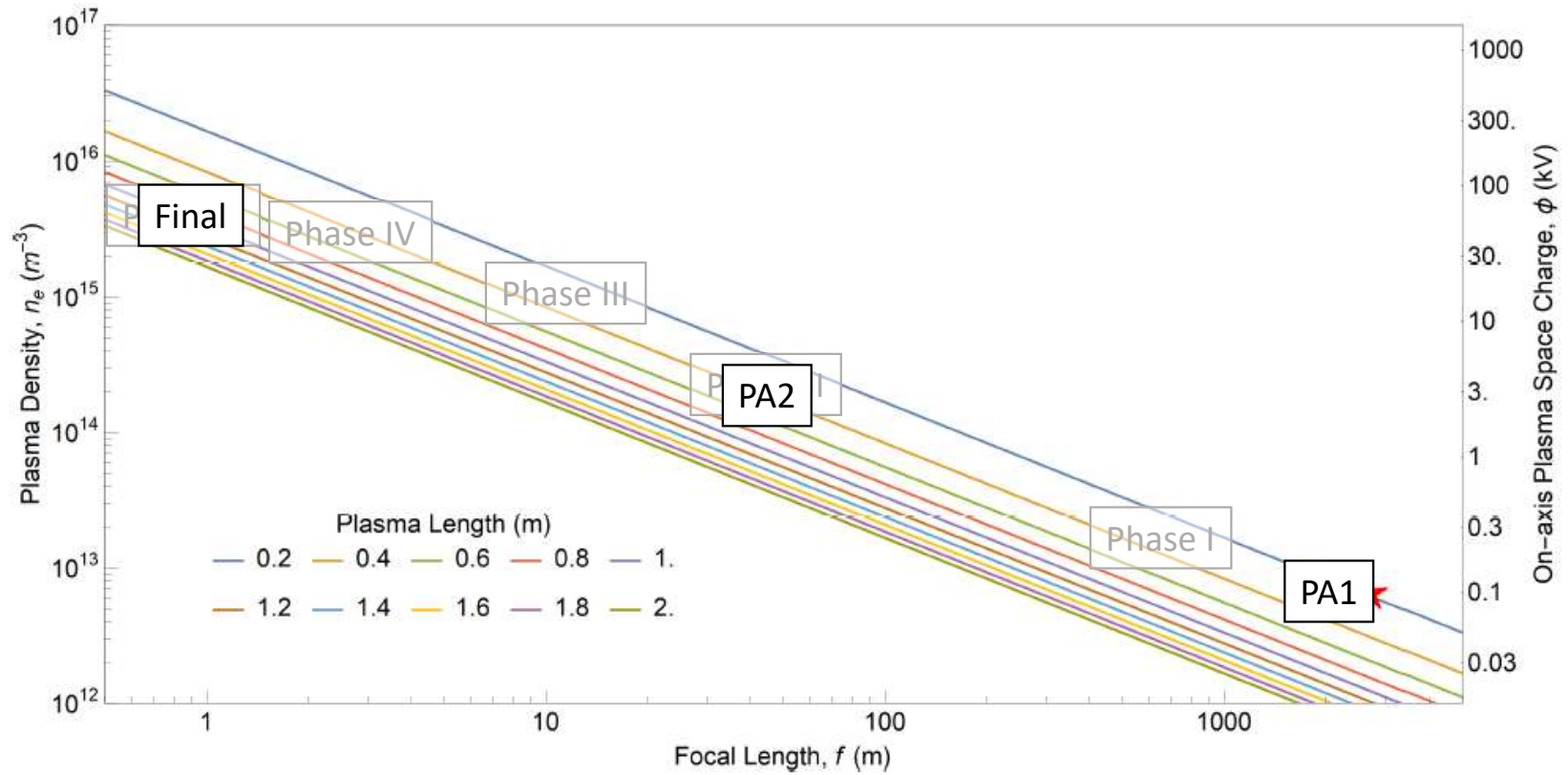
# Current Plan

- Phase I
    - ~~Upgrade Swansea Apparatus to 0.5-1 kV~~ → ITRF PA1 – Use existing apparatus
  - Phase II
    - Construct 2-5 kV testbench
  - Phase III
    - Upgrade testbench to 10-20 kV
  - Phase IV
    - Construct Gabor lens prototype at 50-65 kV → During early construction phase?
  - Phase V
    - Construct Gabor lenses for use in beamline
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# Graphical plan



# Graphical plan



# Recall specification & work elsewhere

- **Aymar *et al.*:**

Frontiers in Physics **08** 567738 (2020)

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**Proton and ion capture**

Beam divergence to be captured	50	mrad
Gabor lens effective length	0.857	m
Gabor lens length (end-flange to end-flange)	1.157	m
Gabor lens cathode radius	0.0365	m
Gabor lens maximum voltage	65	kV
Number of Gabor lenses	2	
Alternative technology: solenoid length	1.157	m
Alternative technology: solenoid max field strength	1.3	T

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- Each parameter largely achieved elsewhere

(See previous presentations)

- Lengths >1 m
- Radii >3 cm
- Density > $10^{15} \text{ m}^{-3}$
- Lifetime >days
- Space Charge >kV
- Low B-fields <1 T

# PA2 Timeline

- 0 – 12 months
  - Testbench construction
- 13 – 24/30 months
  - Study kV plasmas for PoP
- 30 – 36 months
  - PoP
  - Upgrade
- 37 – 48 months
  - Study >10 kV plasmas

Calendar Year	24	2025				2026				2027				2028			
Project Quarter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Apparatus Ordering	█																
Apparatus Delivery		█	█														
Apparatus Assembly			█	█													
Apparatus commissioning				█													
Study Length dependence					█												
Study B-field dependence						█											
Study Density dependence							█										
Study Radii dependence								█									
Combine studies									█								
Test PoP plasma										█							
Disassemble & ship apparatus											█						
Reassemble & commissioning												█					
PoP experiments													█				
Disassemble & ship apparatus														█			
Upgrade															█		
Commission upgrades																█	
Study Length dependence																	
Study B-field dependence																	
Study Density dependence																	
Study Radii dependence																	
Combine studies																	
Final Plasma lens design																	
Simulations	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	

# PoP Plasma suggestions

- Limit capture efficiency (i.e. radius)
  - 0.5 cm
- Limit expected lifetime
  - 10s seconds
  - Low duty cycle efficiency
- Accept higher **B**-field
  - 0.15 – 0.2 T
- Limit no. of plasma lenses
  - 1 (or 2) plasmas



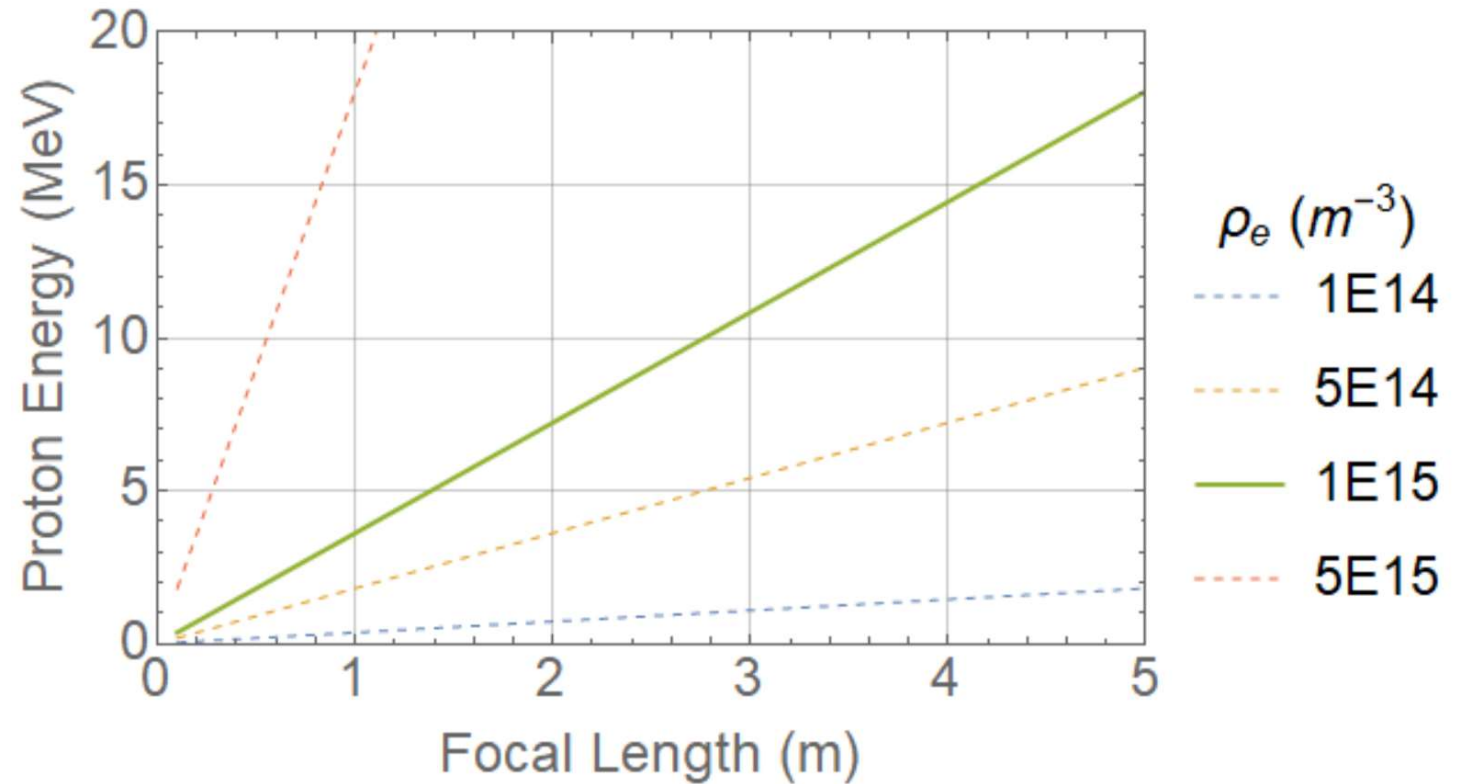
## PoP Plasma suggestions

- Limit capture efficiency (i.e. radius)
  - 0.5 cm
- Limit expected lifetime
  - 10s seconds
  - Low duty
- Acceleration
- Limiting lenses
  - 1 m

**Proton Energy (as low as possible)**  
**Beamline focal length**

# PoP Plasma - proposal

- $r = 0.5$  cm
- $L = 0.8$  m
- $Br < 2\%$
- $\phi \sim 800$  V
- $V \sim 2$  kV



Discuss...