Thesis Plan

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1 Titles

2 Chapters

2.1 Introduction

2.2 Experimental Review

2.3 Theoretical Review

2.4 Ball Pen Probe

This chapter will be a description of the design, modelling and experimental results from the ball pen probe. It will include the following work:

1. A description of the ball pen probe implementation on MAST

Completion status:	Ready for writeup
Time required:	N/A
Tasks:	Write up section

2. Present modelling work towards understanding the BPP collection mechanism

Completion status:	Finished analytics, need to solve numerically
Time required:	2 Weeks
Tasks:	Write integrator for I^+/I^- Complete analysis of probe impedance Attempt to compare probe impedance to experiment

3. Potential Profile measurements

Completion status:	Ready for writeup
Time required:	N/A
Tasks:	Write up section

4. Temperature profile measurements and assesment of BPP technique for measurement

Completion status:	Temperature profiles available Need to conduct assesment of α
Time required:	2 Weeks
Tasks:	Refine Thomson comparison Critically asses α

5. Radial electric field measurements

Completion status:	Figures available, awaiting comparison data
Time required:	2 Weeks
Tasks:	Compare BPP E-field to DBS and ECELESTE

6. Fluctuation measurements in shear layer region

Completion status:	Not yet started
Time required:	3 Weeks
Tasks:	Write PDF and moment calculator Perform analysis of PDF in shear layer

2.5 Two-Dimensional Blob Modelling

This chapter will provide a detailed introduction to 2D blob modelling followed by a description of the work carried out on the basic physics underlying 2D blob theory including the following:

1. Introduction to 2D blob simulations in intertially limited, sheath limited and coherent motion regime

Completion status:	Simulations ready Plots need refining
Time required:	$<$ 1 Week
Tasks:	Generate figures Write up section

2. Analytic comparison of inertially limited blobs/holes velocity including plasma background

Completion status:	Analytics complete, Simulations ready
Time required:	2 Weeks
Tasks:	Refine comparison plots Test blob/hole length scale velocity scaling

3. Effect of blob anisotropy on propagation dynamics

Completion status:	Inital simulations carried out
Time required:	2 Weeks
Tasks:	Test a range of anisotropy parameter Attempt comparison with analytic theory

4. Blob - Shear layer interaction

Completion status:	Code ready Need to develop length-scale based analytic work Need to prepare shear layer profile from expt Need to carry out simulations
Time required:	4 Weeks
Tasks:	Figure out analytic treatment Develop input from expt Carry out simulations

2.6 Three-Dimensional MAST Modelling

This chapter will be a description of 3D filament using Angus's work as a starting point. It will include the following work:

1. 3D filament simulations in a slab with the basic model as an introduction and to recreate Angus's work in MAST.

Completion status:	Started
Time required:	2 Weeks
Tasks:	Set up slab simulation with MAST parameters Run over a range of Δ and δ

2. 3D filament simulations in a slab with hot-ions

Completion status:	Initial work implementing hot ions complete Need to carry out simulations
Time required:	4 Weeks
Tasks:	Go through Angus drift wave work including effects of hot ions Complete symmetry breaking analysis determine parameters for simulations Run simulations

3. 3D filament simulations in a slab with parallel streaming

Completion status:	Parallel streaming implemented and under testing
Time required:	4 Weeks
Tasks:	Apply linear analysis to system Apply symmetry analysis to system Finish testing and carry out simulations

4. 3D flux tube simulations with the basic model

Completion status:	Nearly Completed
Time required:	$\sim$ 3 days
Tasks:	Re-run with shadowing Write up section

5. 3D flux tube simulatations with the full isothermal model

Completion status:	Not yet started
Time required:	4 Weeks
Tasks:	Finish stability checking of hot-ion parallel streaming model Decide on correct starting conditions Carry out simulations

6. 3D slab simulations with divertor tilt boundary conditions

Completion status:	Not yet started
Time required:	4 Weeks
Tasks:	Implement Loizu boundary conditions in BOUT++ Carry out simulations varying δ

7. 3D full SOL simulations with the full isothermal model and divertor plate tilt

Completion status:	Started on grid generator
Time required:	4 Weeks
Tasks:	Continue to develop FWA grid generator Carry out simulations in a realistic scenario

2.7 Three-Dimensional MAST-Upgrade Modelling

This chapter will extend the results of the previous chapter to the case of the MAST-U Super-X diverter geometry. In particular it will address the effect of an extended connection length on filament dynamics. It will include:

1. An investigation in 2D of the effect of increased connection length on the transition from inertially limited to sheath limited blob dynamics

Completion status:	Code ready Need to set up and run simulation scans
Time required:	1 Week
Tasks:	Run Simulations Review sheath-limited theory for analytic comparison

2. 3D SXD flux tube simulations over a parameter scan

Completion status:	Grid needs developing Code ready Simulations need carrying out
Time required:	4 Weeks
Tasks:	Generate grid with suitable resolution in divertor region Run flux-tube simulation for different psi in SXD geometry

3. Full SOL SXD simulations

Completion status:	Grid generator started Simulations need carrying out
Time required:	4 Weeks
Tasks:	Continue to develop FWA grid generator Carry out simulations in a realistic scenario

2.8 Zero-Dimensional Predictive Modelling

2.9 Conclusions

2.10 References

2.11 Appendix: The BOUT++ Code