This assignment is worth 4 credits towards the Fusion Laboratory module. You are required to write a short journal paper in the style of Physical Review Letters (though it doesn't need to be in two columns like PRL). Like PRL, you have a **4 page limit**. In this report you should

- As background, describe briefly the physics of plasma sheaths. You will need to read some background, for example lecture notes by R.Fitzpatrick `http://farside.ph.utexas.edu/teaching/plasma/lectures/node41.html` and many plasma textbooks

- Use your code to investigate how the ion velocity and flux into the wall depends on parameters in the model. You should do **one** of the following:

  1. Use the code from assignment 3 with varying collision length. What can you say about the ion velocity e.g. at small and large collision length

  2. A further modification to the code is to modify the ion continuity equation. If plasma is colliding with neutral atoms then it may be recombining or causing further ionisations. To model this, try writing the density equation as

  $$\frac{d}{dx}\left(n_i v_i\right) = R n_i \qquad \Rightarrow \frac{dn_i}{dx} = -\frac{n_i}{v_i}\frac{dv_i}{dx} + R n_i / v_i$$

  where R is a recombination rate and will usually be negative so that ions are lost going towards the wall.

  3. You can try a different modification to the model. Describe why your modification is reasonable, and study how it modifies the sheath.

- Can you relate the numerical results from the code to an analytical result?

- Discuss how your results could affect the accuracy of probes used to measure the plasma density, temperature, and flow.

You don't need to cover everything above, and it's more important to describe the physics and discuss the results than describe the code in detail. The mark scheme is below, and is entirely based on the report.

Category	Main criteria	%
Abstract	• Summarises main results • Brief and to the point • Guidline length 1-2 paragraph(s)	10%
Introduction	• Brief overview of literature • Motivates current study • Guidline length $\sim 1/2$ page	10%
Results	• Description of method appropriate for a paper. Give details of anything which you have done differently, and give references for widely known methods such as RK4 • Figures clearly presented. Legible labels and captions • Figures numbered and referenced in the text • Guidline length ~ 2 pages	20%
Discussion	• Summarises main findings • Discussion of the implications of your result • Relates results to literature and introduction • Guidline length $\sim 1/2 - 1$ page	20%
References	Statements of fact in text given references, preferably to a book or journal paper	20%
Structure and presentation	• Good use of English • Clear, legible layout • Each section is relevant to the next, and sections refer to each other where appropriate	20%