AS 712 – Fall 2016

Class Project - Topics/Ideas

The goal of this exercise is for you to understand the practical applications of radiation theory. Pick a topic that is of interest to you and relevant for your future research while keeping in mind that the exercise should also help you understand the concepts of radiation theory more comprehensively.

You need to clearly describe the topic/problem, its relevance, what you learnt, and detailed description of associated calculations or derivations. This means you will be required to derive the formula or in-between steps that are needed for your chosen topic. All the handouts given in the class, online reading material and books cited in your syllabus are at your disposal. It would also be good if you can use some relevant journal papers to include in your project. Remember to include references to any material that you have used to complete your project.

In addition to the above material, feel free to use the following online book for any of your projects:

Stellar Atmospheres & Radiative Transfer by Alex de Koter available as a PDF here:

http://manasvita.com/filetree/teaching.php

For each topic, you are allowed to work in partnership with only one other person with the exception of topic # 6 where up to 3 people can work in partnership. In any case, each of you are required to submit your *own* 3-4 page report written in LaTeX. I am happy to help with any questions you might have with getting started with LaTeX. You can find lots of information related to LaTeX on Google &/or you can use the following link to guide you through the entire process:

https://tobi.oetiker.ch/lshort/lshort.pdf

Topics:

1. *Line Blanketing*
   This phenomenon is particularly noticeable in cool stars and is related to the metallicity of a star. Describe the process in detail, coming up with relevant figures, spectra, and/or equations to explain it and show its relevance to other astrophysical systems, if at all.

2. *Primary sources of opacity that remove stellar photons from a beam*
   Discuss four main sources of opacity that can strip a beam off its photons. Give relevant material (figures, equations, etc.) to support your discussion and put it in the context of what has been covered in the class in terms of radiation theory.

3. *Limb Darkening*
   This is an optical effect that is seen in stars, including the Sun. Its understanding is what led to the development of radiation transfer theory. Describing the process in detail, come up with a simple model to calculate the limb darkening of the Sun and present your result in the form of a graph.

4. *Geometrical Optics Limit*
   We had skipped this section in Chapter 2 of R&L. Go through that section and explain what this Limit is while investigating the areas where it is applicable. Give complete and relevant details to corroborate your findings.

5. *Eddington – Barbier Approximation and the average optical depth of 2/3 in stellar atmospheres*
   Explain what this approximation is and what it's used for. Describe other astrophysical systems where this approximation might be applicable. In the case of stellar atmospheres, show how the average optical depth of 2/3 is obtained.

6. *Non-relativistic and relativistic Bremsstrahlung processes*
   Chapter 5 of R&L will be skipped in the interest of time. Go through this chapter, its derivations, and its associated problems. Present your report containing the summary of the chapter, its physical implications on astrophysical situations, and solutions to its problems.

7. *Baade-Wesselink Method*
   It is a distance determination method for stellar objects. Describing the method in detail, explain the applicability of this method to other kinds of astrophysical systems. Give few relevant examples to demonstrate the applicability of this method and briefly discuss its limitations, if any.

8. *Investigating the need for correction to the HI optically thin approximation*
   Most observers of HI assume that it is optically thin. However, in some extragalactic (and Galactic) systems, this may not be the case. Investigate systems where HI becomes optically thick while addressing relevant questions, such as what is the magnitude of the correction required to account for this approximation, etc.?