Time Domain Astronomy 7016ASTPHY

Case Study Coursework 2020/2021

This piece of coursework is worth 25% of the total marks for the Time Domain module. It is therefore expected that you will spend $\sim$25% of your time working on the module carrying out this exercise.

The aim of this piece of course work is to study in detail **one** particular time-domain astronomy phenomenon that is not fully covered within the course. You will be expected to assess the current understanding of your chosen phenomenon's properties and explain how this understanding has been achieved. Where applicable, you should pay particular attention to multi-wavelength, and even multi-messenger, time-domain studies of these objects, particularly within the past decade. Your report should include all techniques employed and the *physics* that they probe.

Many (but certainly not all) of the suggested phenomena have published observations across the majority, if not all, of the electromagnetic wavelength range. You should attempt to find the most recent literature on every aspect of your chosen phenomenon, since in many cases our understanding has improved enormously in the last few years.

You should also look into the different types of observations which can be carried out. For example, long-term monitoring over periods of many years yields very different information from fast photometry, which aims to detect changes in fractions of a second. Different instruments have different capabilities in terms of angular resolution, spectral resolution, field of view and sensitivity, and these factors radically affect the types of measurements which are made with them.

This project will be assessed by a written report and is worth 25% of the final module mark. The report should be *absolutely no more than* 2500 words of text, which excludes full references and illustrations as appropriate. References to and discussion of papers published in research journals and review articles is required (the bibliography is not included in the word count). Please note this is an upper limit of length, the appropriate length should be judged by the student and based on the chosen topic.

IMPORTANT: Your work **must** be submitted **anonymously**. As such, your name, or your student ID number, or any other identifiable information should not appear anywhere within the submitted document, the filename of the submitted document, or the meta data of the submitted document. Any work that breaches the anonymity of the assessment risks not being marked.

Projects are to be conducted individually and reports will consist of original work.

We strongly encourage the use of LaTeX for the production of your reports, and recommend the free web-based LaTeX editor Overleaf: `https://www.overleaf.com`. To assist further, we have created a template for Case Study submissions on Overleaf that you may choose to use, indeed, we would recommend that you do use this. Additional information is available on Canvas.

See the attached sheets for a selection of report topics and a breakdown of the mark scheme that will be used to assess the work.

Submission deadline: 23:59 (BST/UTC+1) Friday 9$^{\text{th}}$ April 2021.

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Case Study Coursework 2020/2021 — Report Topics

Your report should be about a **single** astrophysical, **time-domain**, *phenomenon* (not a single example from your chosen phenomenon) from the following list:

- AM Canum Venaticorum Variables
- Dwarf Novae
- Fast Radio Bursts
- Gravitational Wave Electromagnetic Counterparts
- Luminous Red Novae
- Neutrinos
- Tidal Disruption Events
- X-ray Binaries

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Case Study Coursework 2020/2021 — Mark Scheme

Student: ____________________ Marker: ____________________

Physics content **/ 5**

Clear descriptions of observable phenomena and how they relate to physical processes.

Discussion **/ 5**

Cross-waveband information (i.e. how observations at different wavelengths relate to each other; where relevant) and general understanding.

Completeness **/ 5**

Comprehensive background research, completeness of wavelength coverage, etc.

Presentation **/ 5**

Length, style, clarity, quality and relevance of figures.

References **/ 5**

Comprehensive survey of sources, including research papers.

TOTAL **/ 25**

Case Study Coursework 2020/2021 — Marking Descriptors

The Marking Descriptors for this assignment are as follows:

Marks in the range 90% — 100%

Candidates will demonstrate a comprehensive understanding of a wide range of physical laws and the ability to apply them to develop mathematical models or, in the context of a project, in diverse areas of physics. Answers will be logically structured and directly relevant to the question or problem and demonstrate a mature ability to communicate physical arguments and an understanding of relevant current issues where appropriate. Solutions to numerical questions or measurements made will clearly and concisely identify the relevant physical principles and demonstrate a high level of analytical ability and numerical accuracy.

Marks in the range 80% — 89%

Candidates will demonstrate a comprehensive understanding of a range of physical laws and the ability to apply them to develop mathematical models or, in the context of a project, in diverse areas of physics. Answers will be logically structured and directly relevant to the question or problem and demonstrate a well-developed ability to communicate physical arguments. Solutions to numerical questions or measurements made will clearly identify the relevant physical principles and demonstrate analytical competence and a high level of numerical accuracy.

Marks in the range 70% — 79%

Candidates will demonstrate a comprehensive understanding of fundamental physical laws and the ability to apply them to develop mathematical models or, in the context of a project, in diverse areas of physics. Answers will be logically structured and directly relevant to the question or problem and demonstrate an ability to communicate physical arguments. Solutions to numerical questions or measurements made will clearly identify the relevant physical principles and demonstrate a high level of numerical accuracy.

Marks in the range 60% — 69%

Candidates will demonstrate a sound understanding of fundamental physical laws and their use in developing mathematical models or their application in the context of a project. Answers will be logically presented, but with some omissions and irrelevant material. Solutions to numerical questions or measurements made will use the relevant physical principles and achieve a good level of accuracy.

Marks in the range 50% — 59%

Candidates will display an understanding of fundamental physical laws and their use in developing mathematical models or their application in the context of a problem. Answers will be based mainly on teaching inputs, with omissions and irrelevant material indicating a deficiency in overall understanding. Solutions to numerical questions will demonstrate an ability in numerical manipulation but may contain errors of argument and incomplete calculations. Measurements made in the context of a project will be succinct but may contain some errors.

Marks in the range 40% — 49%

Candidates will display an adequate knowledge of fundamental physical laws and an appreciation of their use in developing mathematical models or their application in the context of a problem. Answers will be based on teaching inputs, with signicant omissions and irrelevant material, and will lack logical structure with little evidence of overview of the subject. Solutions to numerical questions will demonstrate a limited ability in numerical manipulation and will include errors of argument and incomplete and inaccurate calculations. Measurements made in the context of a project will be adequate but may contain some errors and deficiencies.

Marks in the range 35% — 39%

Candidates will display a limited knowledge of fundamental physical laws and a limited appreciation of their use in developing physical models or their application in the context of a project. Answers will be based on teaching inputs, with significant omissions and irrelevant material, and will lack logical structure with little evidence of understanding or overview of the subject. Solutions to numerical questions will demonstrate a very limited ability in numerical manipulation and will include serious errors of argument and incomplete and inaccurate calculations. Measurements made in the context of a project will be adequate but may contain some errors and deficiencies.

Marks in the range 30% — 34%

Candidates will display an inadequate knowledge of fundamental physical laws and little appreciation of their use in developing physical models or their application in the context of a project. Answers will be based on a confused presentation of teaching inputs, with serious omissions and irrelevant material, and will lack logical structure with little evidence of understanding or no overview of the subject. Solutions to numerical questions or measurements made in a project will be incomplete and may contain errors and deficiencies.

Marks in the range 20% — 29%

Candidates will display an inadequate knowledge of fundamental physical laws and lack appreciation of their use in developing physical models or their application in the context of a project. Answers will be based on a confused presentation of teaching inputs, with serious omissions and irrelevant material, and will lack logical structure with no evidence of understanding or overview of the subject. Solutions to numerical questions or measurements made in a project will be incomplete and will contain significant errors and deficiencies.

Marks in the range 10% — 19%

Candidates will display little knowledge of fundamental physical laws and no appreciation of their use in developing physical models or their application in the context of a project. Answers will be confused and fragmentary and will lack logical structure with no evidence of understanding or overview of the subject. Solutions to numerical questions or measurements made in a project will be incomplete and will contain significant errors and serious deficiencies.

Marks in the range 0% — 9%

Candidates will display very little knowledge of fundamental physical laws and no appreciation of their use in developing physical models or their application in the context of a project. Answers will be confused and fragmentary with no logical structure or evidence of understanding. Solutions to numerical questions or measurements made in a project will be fragmentary and will contain serious errors and deficiencies.

Case Study Coursework 2020/2021 — Useful Resources

The following list of resources should assist the research needed for your coursework.

SAO/NASA Astrophysics Data System (ADS)

`https://ui.adsabs.harvard.edu`

This searches for journal papers by particular authors or about particular objects. You may need to access ADS from a LJMU networked computer (e.g. using the 'Off Campus' tools) in order to have access to the latest issues of many journals (alternatively you can use the 'Athens' service to authenticate using your LJMU credentials). This is because LJMU are registered subscribers to the journals. ADS provides effectively a complete library of all astrophysics publications (over 10 million records). The main astrophysics subject journals are: The Astrophysical Journal (ApJ), The Astronomical Journal (AJ), Astronomy and Astrophysics (A&A), Monthly Notices of the Royal Astronomical Society (MNRAS).

NASA/IPAC Extragalactic Database (NED)

`https://ned.ipac.caltech.edu`

A superb facility for finding out all measured properties of any extragalactic object, which can be specified by name or position. It will provide a full list of references for journal papers about each object.

CDS Set of Identifications, Measurements and Bibliography for Astrophysical Data (SIMBAD)

`http://simbad.u-strasbg.fr/simbad`

Doesn't contain as much information on extragalactic objects as NED but covers the majority of Galactic and Local Group objects.

NASA SkyView Virtual Observatory

`http://skyview.gsfc.nasa.gov`

Useful for obtaining images (although not very pretty ones. . .) of your target objects, since it includes the entire Digitised Optical Sky Survey, and it recognises names such as M87, Coma Cluster, etc. Also contains multi-wavelength data, e.g., X-ray and radio maps.