

The University of Birmingham
Registry - Academic Services

DOCTORAL REPORT FORM
PART ONE: INDEPENDENT REPORT ON THESIS
(A JOINT REPORT IS NOT ACCEPTABLE)

Independent Report normally 500 words which should address the following.

- a) Was the nature and purpose of the research made clear and was this substantially achieved?
- b) To what extent does the thesis demonstrate that the candidate has an adequate understanding of the subject and knowledge of the literature? Is there coverage of recent and relevant literature in the field of study which shows critical appraisal and an original synthesis?
- c) Has the candidate chosen the appropriate methodology for the study? Is the methodology then used effectively? Are the findings interpreted in a valid way?
- d) What evidence is there of independent critical and analytical skills, and the ability to evaluate evidence?
- e) Is there an understanding of the theoretical field associated with the study? Is the linkage and balance between practical investigation and theory satisfactory?
- f) Are the arguments put forward in an appropriate and coherent form?
- g) To what extent does the thesis show evidence of originality and make a contribution to knowledge? Does it contain matter suitable for publication in whole or in part in a learned journal or the equivalent?
- h) What is your view of the overall quality of the research described in the thesis?
- i) Is the synopsis an adequate summary of the work presented?
- j) Is the thesis clearly written and presented? Is the style and structure of the thesis satisfactory?

This is a very well written and comprehensive thesis that presents a series of novel investigations that address key questions related to both our ability to forecast and characterise space weather effects, as well as to identify the underlying physical processes that drive the activity. Two of these studies have already been published in peer reviewed journals and the remainder of the work is definitely, in my opinion, of publishable quality. It makes a significant and new contribution to the field

Three linked projects are presented, the first including a feasibility study of using an existing network of ground-based muon detectors in order to detect the secondary particles associated with solar cosmic rays. This includes a range of different simulations that allow the author to convincingly identify the reasons why the existing instrumentation is unable to successfully achieve this, and then to propose some relatively simple modifications that have been implemented and undergone initial testing. An initial comparison with neutron monitor data has provided encouraging agreement between the data sets.

The second project (already published) explores the link between galactic cosmic ray modulation and the solar cycle, exploring the time lag between GCR intensity and sunspot number for 4 solar cycles. While the anti-correlation between GCR intensity and sunspot number is well known, significant differences are seen between odd and even cycles, and open questions relating to cycle 24 remain. This study provides a more comprehensive study of cycle 24 data, as well as comparative modelling of the hysteresis plots for cycles 20-24. The published work is supplemented with an analysis of the muon data, linking this work to chapters 2 and 3.

This study is then expanded with an analysis of the characteristics of the solar mean magnetic field, the origins of which remain controversial. A careful analysis of high temporal resolution data is undertaken, and the results examined quantitatively for consistency with other datasets and numerical and analytical models. This analysis and interpretation provide convincing evidence that the source is active regions and magnetic flux concentrations, in contrast to many previous studies. Finally, a search for magnetic signatures of Rossby waves is conducted, motivated by recent reports of their existence. Again the analysis is careful and considered, and supported by modelling and consistency with other data sources.

The whole thesis demonstrates a thorough, careful and logical approach to the research, coupled with a high level of critical thinking in the evaluation and interpretation of the results. The writing is very clear and there are very few typographical errors. The thesis is well structured, figures are high quality and well captioned and referencing is thorough.

Continue on a separate sheet if necessary.

Please return this part BEFORE the Oral, (keeping a copy for yourself) to Research Student Administration via e-mail to pgrstudentrecords@contacts.bham.ac.uk.

Date Of Oral (please insert)	14/5/21
An oral examination is compulsory for a doctoral thesis	

Examiner	Name (Block Capitals)	Signature (if sending by e-mail insert "by e-mail")	Date
External	SARAH MATTHEWS	By email	12/5/21