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**APPLICATION FOR CONFIRMATION OF STATUS AS A STUDENT**

**FOR THE DEGREE OF DOCTOR OF PHILOSOPHY**

**(Mathematical, Physical & Life Sciences Division only)**

***Staff notice:*** *This form contains personal data and may contain sensitive information. Please ensure that downloaded or printed copies are stored securely. Please retain information only for as long as you need it and then dispose of it confidentially. Further advice about handling student data can be found here: (*[*https://academic.admin.ox.ac.uk/student-data*](https://academic.admin.ox.ac.uk/student-data)*).*

*Students are reminded that there is a checklist available on the MPLS Graduate School website to help prepare for Confirmation of Status:* [*https://www.mpls.ox.ac.uk/graduate-school/information-for-postgraduate-research-students/progression*](https://www.mpls.ox.ac.uk/graduate-school/information-for-postgraduate-research-students/progression)

*This form and any subject-specific supporting documentation required should be sent to your departmental contact.*

*(please refer to* [*www.ox.ac.uk/students/academic/guidance/graduate/contacts/*](http://www.ox.ac.uk/students/academic/guidance/graduate/contacts/) *for contact details)*.

*Please complete SECTION 1, SECTION 2 and SECTION 3, and then ensure that SECTION 4 and SECTION 5 are completed by your supervisor and college. You should make sure that you are aware of the maximum fee liability you will incur in your proposed new status, and consult your college or Graduate Studies Assistant if in doubt.*

*Students who require adjustments to the assessment arrangements for Confirmation of Status due to disability, under Section 6 of the General Regulations for Research Degrees* (<https://examregs.admin.ox.ac.uk/Contents>)*, should also complete the GSO.19 Application for Adjustment to Assessment Arrangements form available at:* [*https://www.ox.ac.uk/students/academic/guidance/graduate/progression*](https://www.ox.ac.uk/students/academic/guidance/graduate/progression)*. Guidance for Directors of Graduate Studies on such adjustments is available in Annex C of the Policy and Guidance on Research Degrees at* [*https://academic.admin.ox.ac.uk/research-degrees*](https://academic.admin.ox.ac.uk/research-degrees)*.*

*Please use* ***BLOCK CAPITALS*** *(unless typed), and refer to the current edition of the Examination Regulations, or departmental or divisional guidance notes or handbooks that you have received, where full details of the relevant confirmation requirements are given.*

**SECTION 1 –** Declaration of consent *(to be signed by the student)*

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| I understand that the information and any materials that I supply in support of this application will be processed by the University in accordance with the Student Privacy Policy <https://compliance.admin.ox.ac.uk/student-privacy-policy>. I consent to my information being used for the purposes of this application. | | |
| **I consent to disclosure within the above limits** | | ☑   **Yes**           ❑   **No** |
| **Signature of Student:** |  | |

**SECTION 2 –** to be completed by the student. Please use **BLOCK CAPITALS** (unless typed)**.**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Surname: | Cookman | | | | | | Title (Mr/Mrs/Miss/Ms/etc.): | | Mr | |
| First Name (in full): | Daniel | | | | | | Student Number: | | 1293820 | |
| College/Hall: | Christ Church | | Faculty/Department: | | | | Physics | | | |
| Address for Communication: | | | | | | | | | | |
| 58 Marston Street  Oxford  OX4 1JU | | | | | | | | | | |
| Telephone Number: | 07964810118 | | Email Address: | | daniel.cookman@physics.ox.ac.uk | | | | | |
| Term Transferred to D.Phil. Status: | | | Trinity term 2020 | | | | | | | |
|  | | | | | | | | | | |
| Title of thesis proposed or branch of study: | | ***NOTE:*** *For students admitted in or after October 2007(please tick box); I am aware that I must deposit a digital copy of my thesis following successful completion of my degree, and am aware of copyright issues* (<http://www.bodleian.ox.ac.uk/ora/oxford_etheses>*)* | | | | | | | | ☑ |
| Studies of optical scattering and first measurement of the solar neutrino oscillation parameters in the SNO+ detector | | | | | | | | | | |
| Initial term of entry to course: | Michaelmas 2019 | | | **OFFICE USE ONLY** | | Final Term: | |  | | |

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| Signature: |  | Date: | 19/01/2022 |

**RESEARCH ETHICS APPROVAL *(Please tick one box only)***

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| ☑ | I confirm that no human participants were involved and no personal data was used in my research and therefore ethical approval was not required. |
| ❑ | I confirm that my completed CUREC1/1A was approved by the appropriate REC. |
| ❑ | I confirm that my completed CUREC2 (or NHS REC or OXTREC application) was approved by the appropriate REC. |

**RESEARCH INTEGRITY**

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| ***Students are reminded that they need to have completed the University’s online research integrity training. This should normally have been completed before applying for transfer of status, but must be completed before applying for confirmation of status.  The training is available at*** [***https://weblearn.ox.ac.uk/portal/hierarchy/skills/ricourses***](https://weblearn.ox.ac.uk/portal/hierarchy/skills/ricourses)  The University’s research integrity policies may be found here: <https://researchsupport.admin.ox.ac.uk/governance/integrity/policy>. The University takes seriously any concerns raised about research practice, and those found to have engaged in research misconduct may face disciplinary action. | | |  |
| I confirm that I have completed the online research integrity training and attach the emailed certificate of completion as evidence of this. [You do not need to provide this if it has already been provided at Transfer of Status.]  ***If you have not yet completed the training, please do so before submitting this form.*** | | ☑   Yes  ❑ n/a as I am on one of the  CDT programmes list below |  |
| Students on the following CDT programmes are not required to complete the online training, as the required training is already completed as part of the CDT programme:  Autonomous Intelligent Machines and Systems CDT  Inorganic Chemistry for Future Manufacturing (OxICFM) CDT  Future Propulsion and Power CDT  Modern Statistics and Statistical Machine Learning CDT | | |  |
| I confirm that I understand my responsibility to the principles of research integrity as set out in the University’s policies, in particular (delete any which do not apply): | | | |
| ☑  ☑  ☑  ☑  ☑  ☑ | Research data and records management (including data protection and information security)  Authorship and intellectual property  Plagiarism, copyright and proper referencing  Conflicts of interest (e.g. with respect to examining, recruitment, licences)  Health and safety (including fieldwork)  Research misconduct  ~~Human participants in research~~ *~~(cross out if not applicable)~~*  ~~Research involving animals~~ *~~(cross out if not applicable)~~* | | |

**SECTION 3** – to be completed by the student

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| **Progress report:** | | |
| **(i)** | **Please give a brief indication of the nature and progress of your research to date (please refer to any departmental or divisional guidance notes or handbooks that you have received for additional requirements):** | |
| I work on the SNO+ experiment, a neutrino experiment based in Canada whose flagship aim is the search for neutrinoless double-beta decay. My research is has two main components: studying the optical scattering properties of the detector using a laser calibration source (called “SMELLIE”), and developing an analysis to measure the neutrino solar oscillation parameters via solar Boron-8 neutrino events measured in the detector.  Much progress has been made by myself on the SMELLIE calibration system. After getting to grips with the existing hardware and software I have taken numerous sets of data over the past couple of years for analysis. Once SNO+ completed the filling of scintillator into the detector, I worked closely with colleague Jeff Lidgard to fully re-commission the calibration system, determining the new laser intensity set-points as a function of laser source, wavelength, and fibre. I have been also able to identify a distinctive “trigger-jitter” in one of the lasers. Furthermore, the entire SMELLIE analysis code-base has been fully re-written by myself, to be able to more robustly handle the variety of analyses that can be applied to SMELLIE data & simulation.  Critical to deriving scattering cross-sections from SMELLIE data is the angular intensity distributions of the emission fibres. I developed a new method to derive these “beam profiles” to much greater precision than was achieved previously through a maximum likelihood approach that combined multiple data sets. In addition, because the existing Monte Carlo generator that was used to simulate SMELLIE events was so slow as to be impractical for analysis, I created a new generator that reduced simulation times by multiple orders of magnitude.  As a critical part of calibrating the detector’s optics, I have been recently making a novel measurement of the extinction length of the scintillator within the detector as a function of wavelength. I have already been able to show to the collaboration that at a short wavelength, the extinction length is markedly shorter than what our earlier models expected. This work is on-going, but these early results appear to be in-line with other in-situ measurements.  Regarding my work on the solar analysis, I took over the project from a colleague who had made an initial background-free sensitivity study. After replicating their findings, I have been developing a new code-base to handle some of the major additions required for the analysis. I have been able to demonstrate the impact of a background-free study (realistic when looking only at data above a certain energy) when different Boron-8 solar neutrino flux constraints are considered. By taking the energy cut lower – and hence requiring consideration of backgrounds – the number of Boron-8 events used in the analysis will increase significantly, improving the quality of the parameter measurement. Work to handle these background processes via tagging and cuts is on-going. | | |
| **(ii)** | **Your proposed timetable for submission:** | |
| * Completing the scintillator-phase extinction length measurement – 2 months * Finalising parts of beam profiling (validation checks at short wavelengths, handle last fibre) – 1 month * Perform scattering analysis on water-phase data – 3 months * Perform first scattering analysis on scintillator-phase data – 3 months * SMELLIE hardware upgrade installation, if possible (requires extensive mine training beforehand) – 1 month * Solar oscillation analysis sensitivity study (tagging & cuts on backgrounds, handling expected rates & constraints correctly, look at systematics, consider impact of Te-loading) – 6 months * Solar analysis with scintillator data (apply analysis method described above onto as much scintillator data taken as possible. Handle data-specific issues, such as run selection, data cleaning, data-MC discrepancies) – 3 months | | |
| **Permission to submit thesis in an integrated format** | | |
| I wish to seek approval to submit my thesis in an integrated format (if permitted under [special regulations](https://examregs.admin.ox.ac.uk/Contents) | | ❑ **Yes** ❑ **No ☑** **N/A** |
| Please provide reason(s) for your request: N/A | | |

**SECTION 4** – to be completed by the supervisor

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| Comments (please include a comment on the progress of the student’s research and the proposed timetable for submission). | | | | |
| In addition to the comments above, please tick **one** of the following options:   |  |  | | --- | --- | | ❑ | I have no concerns regarding this student’s readiness to apply to confirm status. | | ❑ | I have mild concerns regarding this student’s readiness to apply to confirm status, and have discussed these with the student. | | ❑ | I have serious concerns regarding this student’s readiness to apply to confirm status, and have discussed these with the student. | | | | | |
| I also support the student’s request to submit their thesis in an integrated format: | | | | ❑ **Yes** ❑ **No** ❑ **N/A** |
| Signature: |  | Date: |  | |
| Full Name: |  | | | |

**SECTION 5** – to be completed by the college’s Tutor for Graduates

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| I confirm that the college supports this application for confirmation of status as a student for the degree of D.Phil. | | | | |
| Signature: |  | | Date: |  |
| Full Name: |  | | | |
| Position (if not Tutor for Graduates): | |  | | |
| College Stamp: |  | | | |

**SECTION 6** – to be completed by the Director of Graduate Studies (or equivalent)

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| **Comments**: | | | | |
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| I approve for the student to submit their thesis in an integrated format. | | | | ❑ **Yes** ❑ **No** ❑ **N/A** |
| Signature of DGS (or equivalent): |  | Date: |  | |
| Full Name: |  | | | |

**NOTES**

Confirmation of D.Phil. status was introduced to give faculties and departments an opportunity to monitor the direction and progress of a D.Phil. student’s work in the period between transfer of status and submission of thesis. It is intended both to assess the progress of the research work and to support the work of a student and their supervisor(s) by ensuring that other members of the faculty or department with a responsibility for graduate students are aware of the state of the research in progress, and the likely timetable for submission.

While all candidates seeking confirmation of status are required to complete the form in full, further detailed requirements vary from subject to subject. You should find the specific requirements relating to your subject set out in the *Examination Regulations* or in the relevant departmental or divisional guidance notes or handbooks.

For candidates admitted to the status of Probationer Research Student, it is the University’s expectation that a D.Phil. thesis will be submitted within twelve terms (the work representing ‘what may reasonably expected of a capable and diligent student after three or at most four years of full-time study’). Candidates may apply for extensions of time beyond twelve terms, within a maximum of six further terms. Faculty/department boards or other committees will require such applications to include full explanation of the reasons for the request, as well as the support of the student’s supervisor and college. Approval of applications is not automatic, and most bodies will give not more, and may give less, than three terms’ extension at any one time. MPLS policy is to approve only one term at a time, unless there are exceptional circumstances.

Candidates who are in receipt of Research Council awards must ensure that they know the date by which they are expected to submit. It is essential for the award of studentships to future generations of graduate students that every effort is made to submit by this date, or, if there are good reasons for suspension of status or extensions of time, these are **always** approved by the Research Council concerned as well as by the faculty or department. Such approval is necessary within the required submission period **even if a student is no longer receiving financial support**.

**SUPPLEMENTARY INFORMATION TO BE PROVIDED BY THE STUDENT**

The University recognises that the identification of particular areas of skills training and development is a regular aspect of a student’s work with their supervisor(s). It regards confirmation of status as an appropriate point at which to ask the student, with the help of their supervisor(s), to:

* *record those subject-specific and personal and professional skills which the student has already acquired;*
* *identify any such skills which might require further development or refinement;*
* *note any other related activities, e.g. presentation of posters, attendance at conferences, etc., which have made a contribution to the development of the student’s work.*

In making this record available to confirmation assessors and to those responsible for approving applications for confirmation, the University does not wish to make this a formal aspect of the confirmation process, but to acknowledge the importance of such activities in a research student's training and to provide assessors and others with a fuller picture of an individual student’s progress. It also aims to help individual students cope with the increasing expectation on the part of research councils and other funding bodies that, in conjunction with their supervisor(s), they will maintain a record of such skills and achievements throughout the course of their career as a research student.

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| **Supplementary Information to be provided by the student:** | |
| **A** | **Please describe briefly any subject specific research skills that you have developed or improved in the course of your time as a research student. For example, these might include: research methodology; data analysis and management; record keeping; bibliographical skills; presentation of research.** |
| Through a combination of 1st year taught courses and a pair of Summer Schools I attended, my theoretical understanding of particle physics has improved significantly. I have also read up on much of the relevant theory necessary for understanding both my scattering analysis and solar neutrino oscillation analysis work. I am now at a point where I can listen to seminars in my field and understand the content the vast majority of the time. This is also the case when it comes to detector technology – I understand now how the critical elements of particle detectors function, with a special focus on scintillator detectors. I now have a much greater understanding of how the electronics in a detector like SNO+ functions – I needed to know this to perform my calibration measurements by myself, and I am now a designated “Detector Expert” who is on-call to help diagnose problems whilst the detector is running.  I now have a strong grasp of the statistical analysis techniques commonly used in my field, including maximum likelihood estimation and Bayesian analysis. Carefully handling and analysing very large data sets is a core part of what my research involves. I am able to handle and propagate uncertainties throughout my work.  The programming and general software development skills required for my research have improved markedly – see (B) for some further details.  Keeping good records both in my lab book and on the computer is critical when working on the same projects for extended periods, and with others – I have to do this all the time.  I regularly present updates of my research to my collaborators at Working Group meetings, as well as Collaboration Meetings. I also was able to get a chance to present my work on the SMELLIE analysis at a poster session during the STFC Particle Physics Summer School.  On a daily basis I pay attention to the new pre-prints submitted to the ArXiv for experimental particle physics, and read any of the papers relevant to my research. I often pass on important papers of interest to my collaborators. | |
| **B** | **Please describe briefly any personal and professional skills in which you have received training or which you have enhanced during the course of your time as a research student. For example, these might include: time management; language skills; IT skills; team work; problem solving; presentation skills; teaching skills; career planning.** |
| The strongest professional skill that I have developed throughout my DPhil has been that of software development. I am now capable of writing quite large code-bases using both C++ and Python integrated together. Related to this, I have learned how to handle compiling C++ code with build tools including Make, CMake, and Scons. I know how to program using contemporary IDEs, which speed up the process of software development markedly. I can handle effective versioning control via Git/GitHub/GitLab both in situation for personal use, as well as working in teams both small and large. I have also learned how to write unit tests in both Python and C++. Some of these skills have been developed by taking dedicated afternoon courses on a specific subject; more generally, I have learned them first-hand through the large proportion of time in my DPhil spent programming.  As a member of an international scientific collaboration, team work is a critical skill I have been using. Whether it is the almost-daily assortment of Working Group meetings I go to and present at, or the software Pull Requests I help to create and/or review which will then get used by the whole collaboration, this skill is vital to the progress of our experiment.  Improving my time management is something I have also been working on – attempting to work on two different projects (SMELLIE calibration & solar analysis) simultaneously requires careful balancing! | |
| **C** | **Please identify any subject-specific or personal and professional skills in which you (and your supervisor(s)) foresee the need for further development or training.** |
| In the event I am able to go to SNOLAB in Canada to help perform hardware upgrades for the SMELLIE calibration system, I will need to undergo extensive mine safety training. | |
| **D** | **Please list any other activities which have contributed to the development of your work. For example, these might include courses attended, conference presentations given, publications, opportunities to undertake teaching etc**. |
| As part of my required training in Particle Physics, I have attended a large number of taught lectures in Oxford, as well as a Summer School for learning further theory. There, I attended a poster session to present my work on SMELLIE. In my own time, I attended a further Summer School called TRISEP, which focused much more on neutrino and dark matter theory. I have taken a number of afternoon courses on software development, including advanced C++ techniques, unit testing, using CMake, and continuous integration. I have also attended dozens of seminars, covering both experimental Particle Physics in my sub-field of neutrinos, but also more broadly, including a number of Theory talks and Machine Learning in Physics talks. I have now attended 3 SNO+ collaboration meetings, and remotely joined the Neutrino 2020 conference.  I have also spent two years teaching as a demonstrator in the undergraduate Physics Nuclear labs, helping students with their experiments which help teach both nuclear and particle physics. | |

GSO.14.MPLS (2) Updated Sept 2021 TQ