## APPLICATION FOR CMBSP-CSE JOINT PhD STUDENTSHIP

<table>
<thead>
<tr>
<th>Name</th>
<th>Department</th>
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<tbody>
<tr>
<td>Nigel Bannister</td>
<td>Department of Physics &amp; Astronomy (CSE)</td>
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<tr>
<td>Jeremy Prydal</td>
<td>Honorary Reader, Dept. Neuroscience, Psychology and Behaviour (CMBSP)</td>
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<tr>
<td>John LeQuesne</td>
<td>Department of Cancer Studies (CMBSP)</td>
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### Lead Applicant:
- **Nigel Bannister**
  - nb101@le.ac.uk
  - 1 current PhD student.

### Co-Applicant(s):
- **Jeremy Prydal** (2nd supervisor)
  - jp409@le.ac.uk
  - 0 PhD students
- **John LeQuesne** (3rd supervisor)
  - jlq2@le.ac.uk
  - 3 co-supervised PhD students

### Studentship Title:
- **Autofluorescence spectroscopy for the early and intraoperative diagnosis of eye, lung and skin tumors**

### Studentship Abstract:
The focus of the studentship is to develop technology for clinical applications of high resolution excitation wavelength resolved autofluorescence spectroscopy (EWRAS), including theory, instrumentation design, data processing, and practical demonstration. Beginning with a review of biological autofluorescence and related clinical techniques, the student will consider the key classes of cancerous and pre-cancerous tissue to be targeted, current methods of detection and diagnosis, and clinical requirements driving the system design.

Using existing prototypes and working with UoL team members and external collaborators, EWRAS signatures of priority targets will be investigated and EWRAS differentiation demonstrated (**publishable**). Experimental and theoretical work will be conducted to identify and implement optimisations for sensitivity & specificity to meet the clinical requirements. A key output will be the design of bronchoscopic, ophthalmic and laboratory/intraoperative instrument versions (**publishable**).

Innovative analytical techniques are an important aspect of the work. The student will review mathematical techniques, undertaking a comparative study of multivariate methods applied to EWRAS data obtained in the laboratory. Control algorithms will be developed to address the need for simple and efficient operation in the clinical setting (**publishable**).

Project aims include clinical demonstrations of the technology (ethics approval applications in preparation). Instrument performance and clinical “usability” will be assessed, and the control/analysis system will be evaluated (**publishable**). Backup plans exist should ethics approval timescales delay in-vivo work.

The studentship will end with a summary of project outcomes, identification of strengths and areas for development, and consideration of prospects for introduction in clinical practice (validation, commercialisation).

### Criteria Assessment:
| (1) Fit with College research themes | How does the application align to one of the Colleges’ strategic research themes? How does it contribute to the long-term development of the theme? The application is aligned with theme (iv): Life Sciences Interface, combining expertise in physics (instrumentation design, spectral data processing and analysis) and biology & medicine (biological processes, interpretation of autofluorescence signatures, clinical applications). The studentship is situated at the physics/biological science interface, and involves not only work with the identified supervisory team but also with collaborators in biology and clinical research groups beyond Leicester (including the Liverpool Ocular Oncology Research Group). Leads on new areas for the application of this technique will be pursued, opening the possibility of further expansion of the collaboration. Successful completion will result in post-doctoral research associate well suited to continue research at this interface. |
| (2) Fit with Department priorities | How does the application fit with departmental priorities? The project aligns with the Department of Physics & Astronomy’s desire to exploit techniques developed in its core research areas (astronomy, space science), for the public good. The project uses these technologies to further clinical diagnostic capabilities, and is part of a portfolio of projects currently being developed for use in hospitals and general practice. |
| (3) Support for inter-disciplinarity | How does the application support inter-disciplinarity between the colleges? The focus of the project is instrument and technique development for clinical applications; the student will be based in the Department of Physics & Astronomy. The opportunity suits a candidate with a physics background, though strong applicants from clinical science routes may be considered if they can demonstrate familiarity with optics and spectroscopic system design. The supervisory team includes members from both disciplines, ensuring the relevant support is available in technology development and clinical application. On completion, the student will have significant experience in both areas and will be well placed to pursue interdisciplinary research at postdoctoral level, strengthening the links between the colleges. This is a growing project. This application represents the next step in a collaboration which began in 2010 as a result of an informal conversation between Prydal and Bannister. Following preliminary work conducted in an undergraduate student project, the feasibility of our technique for the diagnosis of scleritis was published in 2014 (doi: 10.1136/bjophthalmol-2013-304086). The scope was then broadened to fluorescence spectroscopy, detecting microbiological agents responsible for sight-threatening corneal ulcers, for early detection and targeted treatment (Cornea, 2015, 34 (12) 1588-92). The success of this phase led the team to consider additional clinical applications. Discussions with LeQuesne suggested significant potential for lung cancer detection, and LeQuesne joined the project to provide leadership in this respect. The record of this project is therefore one of expansion, with new applications and external collaborators being identified. This studentship ensures that this will continue. |