China Scholarship Council – University Maastricht

PhD Programme Application form

Basic information

- To be filled in by the prospective UM supervisors -

1. Information on prospective UM supervisors and Promotor

1a. First Supervisor & Copromoter:

- Initial(s), first name, surname: Dr., Ian. G. M. Anthony
- Research group: M4i group on Imaging Instrumentation
- Address for correspondence:
  i.anthony@maastrichtuniversity.nl
  UNS 50, Universiteitssingel 50, 6229 ER Maastricht, Netherlands
- Telephone: +31 614709146
- E-mail: i.anthony@maastrichtuniversity.nl

1b. Second Supervisor & Promoter:

- Initial(s), first name, surname: Prof. Dr. Ron. M. A. Heeren
- Research group: M4i group on Biomolecular Imaging MS
- Address for correspondence:
  r.heeren@maastrichtuniversity.nl
  UNS 50, Universiteitssingel 50, 6229 ER Maastricht, Netherlands
- Telephone:
- E-mail: r.heeren@maastrichtuniversity.nl

2. Information on UM Faculty/ Department/ Institute/ School contact person:

When the application is granted by both the CSC and UM, the contact person is responsible for the practical arrangements (i.e. assistance in obtaining a visa, finding accommodation, etc.) of the visit of the PhD candidate:

- Initial(s), first name, surname: Sef Janssen
- Research group: FHML, M4i and MERLN
- Address for correspondence:
  UNS 40, Universiteitssingel 40, 6229 ER Maastricht, Netherlands
  sef.janssen@maastrichtuniversity.nl

- Telephone:
- E-mail: sef.janssen@maastrichtuniversity.nl

- To be filled in by the applicant if already known –

1. Information on the applicant

- Initial(s), first name, surname:
- Male/female:
- Current work address:

- Telephone:
- E-mail: WeChat:
- Private address:

2. Details of applicant's home university

Note! A separate letter of recommendation by the supervisor or faculty dean of the home university is required.

- Name of home university:
- Address:
- Telephone:
- E-mail:
- Website (if available):

3. Applicant's home university Master Thesis supervisor:

- Title(s), initial(s), first name, surname:
- Address for correspondence:

- Telephone:
- E-mail: WeChat:

4. Research field(s)

前沿技术 / Frontier Technologies

生物技术 / Biotechnology

基础研究 / Basic Research

Mass spectrometry
Instrumentation
Biomedical imaging
Electrical engineering
Data processing

5. Title of research plan for CSC-UM PhD Programme

Improving mass spectrometry imaging speed and spatial resolution through instrumental modifications and data analytics

6. Short summary of research plan (max. 250 words) (A full plan has to be submitted later)

Background: Mass spectrometry imaging (MSI) is a powerful technique that provides crucial chemical images that are relevant for medical diagnostics and biomedical research. For example, mass spectral images can be used for faster and more reliable medical diagnostics, such as cancer and chronic disease diagnosis, and more holistic understanding of biological systems, such as answering questions on inflammation and healing processes. Commercial, top-of-the-line MSI of biological tissues is relatively slow (less than 1,000 pixels s^{-1}) and has relatively poor spatial resolution (pixel sizes 5 μm or larger) when compared to optical microscopy. Improvements in MSI are needed by researchers and pathologists for easier comparison with existing optical microscopy data and workflows.

Study Objective: *This research will improve mass spectrometry imaging speed and spatial resolution through improved sample preparation, imaging mass spectrometer design and control, and/or data processing methods such as super resolution MSI techniques.* To perform this goal, three *unique* and beyond-state-of-the-art imaging mass spectrometers at the Maastricht Multimodal Molecular Imaging Institute (M4i) are available to be used to demonstrate improvements in speed and resolution. Use and successful alteration of these instruments requires 1) preparation of suitable samples and possible development of multimodal sample preparation techniques and methods; 2) optimized experimental design; 3) instrumental hardware and software changes; and 4) data processing and analysis demonstrating the improvements.

Expected results: The successful completion of this project would be a demonstrable, combined improvement of at least one order of magnitude of imaging speed and/or spatial resolution (e.g., 5x improvement in speed with 2x improvement in spatial resolution, or 10x improvement in speed) over 1,000 pixels s^{-1} and 5 μm pixel size. This improvement should be achieved without otherwise sacrificing molecular image contrast and sensitivity. If time permits, the improved imaging methods will be used in biomedically relevant studies to demonstrate not only technical improvements but also medical or research impact.

Requirements: one or more of the following: Mass spectrometry experience, chemical analysis instrumentation experience, programming experience, optical or electrical engineering experience, biomedical imaging experience

Group's performance:

H-Index: 54 ; number of publications 404.

Publications:

Mathew, A., Eijkel, G. B., **Anthony, I. G.,** Ellis, S. R., & **Heeren, R. M.** (2022). Characterization of microchannel plate detector response for the detection of native multiply charged high mass single ions in orthogonal-time-of-flight mass spectrometry using a Timepix detector. *Journal of Mass Spectrometry*, 57(4), e4820.

Vaysse, P. M., Demers, I., van den Hout, M. F., van de Worp, W., **Anthony, I. G.,** Baijens, L. W., Tan, B. I., Lacko, M. Vaassen, L. A., Mierlo, A. V., Langen, R. C., Speel, E. M., **Heeren, R. M.,** Siegel, T. P., & Kremer, B. (2022). Evaluation of the

Sensitivity of Metabolic Profiling by Rapid Evaporative Ionization Mass Spectrometry: Toward More Radical Oral Cavity Cancer Resections. *Analytical Chemistry*.

Barre, F., Rocha, B., Dewez, F., Towers, M., Murray, P., Claude, E., Cillero-Pastor, B., **Heeren, R. M.,** & Siegel, T. P. (2019). Faster raster matrix-assisted laser desorption/ionization mass spectrometry imaging of lipids at high lateral resolution. *International Journal of Mass Spectrometry*, 437, 38-48.

Ščupáková, K., Terzopoulos, V., Jain, S., Smeets, D., & **Heeren, R.** (2019). A patch-based super resolution algorithm for improving image resolution in clinical mass spectrometry. *Scientific reports*, 9(1), 1-11.

Anthony, I. G., Brantley, M. R., Gaw, C. A., Floyd, A. R., & Solouki, T. (2018). Vacuum ultraviolet spectroscopy and mass spectrometry: a tandem detection approach for improved identification of gas chromatography-eluting compounds. *Analytical Chemistry*, 90(7), 4878-4885.

7. Motivation for CSC-UM PhD application (max. 250 words)

The M4i group currently has two CSC students who are on-track to graduate and has one CSC student who has finished her dissertation and who is still working in the group as a post-doctoral research fellow. Our experiences with CSC students are that they have had good successes in the M4i working environment and are able to grow into successful researchers in the new environment.

Two letters are required, one from the student and one from the promotion team.

Applicant's Curriculum Vitae (if available)

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8. Personal details

Applicant
- Title(s), initial(s), first name, surname:

CSC-UM PhD programme start 1-9-2022

- Surname:
- Nationality: Chinese
- Date of Birth:
- Country and place of birth:

9. Master's degree (if applicable)

Note! Add a copy of your Master's degree to your application

University:
Faculty/discipline:
City and country:
Date:
Grade average:

Title Master’s thesis (if applicable):
Thesis grade: