

**University of St Andrews**  
**School of Physics and Astronomy**  
**Research Fellow – AR2528JM**  
**Further Particulars for Applicants**

**Physics and Astronomy**

The School of Physics and Astronomy has an internationally recognised set of research programmes in astrophysics, condensed-matter physics, and photonics. Detailed information provided by the groups can be accessed via the links above.

Around 30 academic staff work with approximately 50 research fellows and contract research staff, and about 55 PhD students. Our work is carried out in modern laboratories in St Andrews, as well as at major international research facilities in the UK and abroad.

The Nanophotonics Group (<https://nanophotonics.wp.st-andrews.ac.uk/>) explores the use of nanophotonics to push knowledge and devices in applications spanning optical communications, nonlinear optics and metrology. The group also has a track record of developing novel design and characterisation techniques. One of the key pillars within this work is the use of silicon Photonic crystal based devices for metrology applications, e.g. integrated displacement sensors and spectrometers. This research position is open to candidates with a strong PhD in photonics, with a proven background in experimental and/or theoretical optics and a strong interest in nanophotonics, demonstrated through journal and conference dissemination.

Photonic crystals are periodic structures that create bands and bandgaps for light, analogous to the electronic bandstructure of crystal materials. They allow light to be slowed down, stopped, collimated or dispersed, almost at will. Their major limitation to date is the scattering of light from disorder, i.e. deviations from the ideal crystal structures, for example, variations in the position of a hole/cylinder. Disordered photonics on the other hand uses exactly this scattering to realize devices, such as random laser or speckle spectrometers. In this project the two concepts will be combined, utilizing an underlying, but intentionally disordered Photonic crystal to control the scattering of light and enhance the performance of integrated spectrometers.

Dr Schulz is a world leading expert in photonic crystal devices and their interaction with disorder [*Optics Express* **18**, 27627 (2010) and *Sci. Rep.* **6**, 27037 (2016)]. Since establishing the nanophotonics group he has pushed the use of photonic crystals for metrology and spectrometer design [*Optics Lett* **43**, 4981 (2018) and *Nature Commun.* **11**, 2915 (2020)]. This project combines the understanding of the disorder in photonic crystals and its impact on light propagation with the application of on-chip spectrometers, to simultaneously achieve a small spectrometer footprint, high throughput and high resolution.

The applicant should have demonstrated experience in the design or the fabrication of integrated photonic devices, preferable photonic crystals and waveguides for the telecommunications wavelength range. Expertise in nanofabrication, and photonic device modelling, although not specifically integrated photonic devices, is also acceptable.

The contract is for an initial period of **2 years** with the ability to extend the contract for the full duration of the project funding (3 years) and is supported by an external funding body.

**The job description for this role is attached below.**

## Job Description

|                                    |   |
|------------------------------------|---|
| Job Title: Research Fellow         | Working Hours: 36.25 per week                             |
| School/Unit: Physics and Astronomy | Grade/Salary Range: Grade 6 / £33,797 - £36,914 per annum |
| Reporting to: Dr Sebastian Schulz  | Reference No: AR2528JM                                    |
| Job Family: Academic Research      | Start Date: 2 August 2020                                 |
| Duration of Post: <b>2 years</b>   |   |

## Main Purpose of Role

The Research Fellow will be required to design and fabricate photonic devices for integrated spectrometers.

## Key Duties and Responsibilities

1. The key duty of the Research Fellow will be the development of disordered photonic crystal or quasicrystal devices for spectrometry applications. The candidate will have demonstrated expertise in the physics and applications of integrated photonic or similar devices. In particular, the candidate will have a solid understanding of the physics underpinning the propagation of light in uniform and periodic waveguide structures, including the impact of disorder and concepts such as cross-coupling and multiple scattering.
2. While applicants with either purely theoretical or experimental backgrounds are eligible, the fellow will be expected to focus on both the design and fabrication of the devices. Typical design tools include Finite-Difference Time-Domain codes (e.g. MEEP, Lumerical), plane-wave or Bloch mode expansion and waveguide solvers, (e.g. Lumerical Mode). The device fabrication will involve the use of advanced nanophotonics and nanolithography techniques, including Ebeam lithography, Reactive ion etching, sputtering, spin coating, wet etching, etc. and will rely on the facilities available in the School.
3. The candidate will also be required to characterise experimentally the optical properties of the designed and fabricated devices. The fellow will extend and adapt the existing set up through the addition of appropriate components to satisfy the requirements of the planned experiments.
4. The candidate will be required to perform speckle analysis using approaches such as principal component analysis, to link and optical output to the incident optical spectrum.
5. The project includes national and international collaborators and it is expected that the fellow will interact with these, including exchanging samples and data, preparing designs for external fabrication and visits to collaborators to gain first-hand experience of measurement setups and techniques.
6. It is expected that the fellow will work and collaborate with academic colleagues on areas of shared research interest.
7. It is expected that the fellow will independently and in collaboration with the rest of the research team analyse, interpret and write up results of the research. This will take the form of research reports, publications and contribution to conferences and workshops.

Please note that this job description is not exhaustive, and the role holder may be required to undertake other relevant duties commensurate with the grading of the post. Activities may be subject to amendment over time as the role develops and/or priorities and requirements evolve.

### Person Specification

This section details the attributes e.g. skills, knowledge/qualifications and competencies which are required in order to undertake the full remit of this post.

| Attributes   | Essential  | Desirable   | Means of Assessment<br>(i.e. application form, interview, test, presentation etc) |
|--|--|---|---|
| Education & Qualifications<br><br><i>(technical, professional, academic qualifications and training required)</i>  | PhD in subjects relevant to the topic including strong component of photonics.   | One or more years post-doctoral research experience   |   |
| Experience & Knowledge<br><br><i>(examples of specific experience and knowledge sought)</i>                        | Demonstrated expertise in the design, fabrication and/or characterisation of integrated photonic, nanophotonic or disordered photonic devices. | Experience in silicon photonic.<br><br>Working knowledge of disordered photonic devices or photonic crystal devices.<br><br>Nanofabrication, including electron beam lithography.<br><br>Design of photonic devices plane wave expansion, Bloch mode expansion, FDTD or equivalent tools.<br><br>Experimental characterisation of photonic crystal device, integrated photonic waveguides or disordered photonic devices. | Application, Publication record, Awards record, Presentation, Interview           |
| Competencies & Skills<br><br><i>(e.g. effective communication skills, initiative, flexibility, leadership etc)</i> | Strong communication and collaboration skills.   | Initiative and proactivity.   | Application, interview  |

|  |   |  |  |
|--|---|--|--|
|  | Track record of published papers commensurate with stage of career. |  |  |
|--|---|--|--|

**Essential Criteria** – requirements without which a candidate would not be able to undertake the full remit of the role. Applicants who have not clearly demonstrated in their application that they possess the essential requirements will normally be rejected at the short listing stage.

**Desirable Criteria** – requirements which would be useful for the candidate to hold. When short listing, these criteria will be considered when more than one applicant meets the essential requirements.

### Other Information

We encourage applicants to apply online at [www.vacancies.st-andrews.ac.uk/welcome.aspx](http://www.vacancies.st-andrews.ac.uk/welcome.aspx), however if you are unable to do this, please call +44 (0)1334 462571 for a paper application form.

For all applications, please quote ref: AR2528JM

The University is committed to equality for all, demonstrated through our working on diversity awards (ECU Athena SWAN/Race Charters; Carer Positive; LGBT Charter; and Stonewall). More details can be found at <http://www.st-andrews.ac.uk/hr/edi/diversityawards/>.

The University of St Andrews is a charity registered in Scotland (No SC013532).

### Obligations as an Employee

You have a duty to carry out your work in a safe manner in order not to endanger yourself or anyone else by your acts or omissions.

You are required to comply with the University health and safety policy as it relates to your work activities, and to take appropriate action in case of an emergency.

You are required to undertake the Information Security Essentials computer-based training course and adhere to its principles alongside related University Policy and Regulations.

You are responsible for applying the University's equality and diversity policies and principles in your own area of responsibility and in your general conduct.

You have a responsibility to promote high levels of customer care within your own area of work/activities.

You should be adaptable to change, and be willing to acquire new skills and knowledge as applicable to the needs of the role.

You may, with reasonable notice, be required to work within other Schools/Units within the University of St Andrews.

You have the responsibility to engage with the University's commitment to Environmental Sustainability in order to reduce its waste, energy consumption and carbon footprint.

### Who Are We? St Andrews At a Glance

Third oldest university in English speaking world

Consistently ranked [one of the UK's top five universities](#)

Award-winning [teaching quality and student experience](#)

Top in UK for [student satisfaction](#)

Research-intensive – ranked 14<sup>th</sup> in [UK Research Excellence Framework](#)

Athena Swann [Bronze Award holder](#)

[Strategy](#) founded on ambition to be World-Leading, Diverse, Global, Entrepreneurial and Socially Responsible.

Over 9000 students and 2500 staff

Highly international – over 45% of students and staff are from outwith the UK

A non-campus university, closely integrated with the ancient town of St Andrews

Top quality [sports](#), [music](#) and [nursery](#) facilities for staff and students

Committed to sustainability and a [pioneer of green energy solutions](#)

## The University & Town

Founded in the early 15th century, St Andrews is Scotland's first university and one of the oldest in the world.

Situated on the east coast of Scotland and framed by countryside, beaches and cliffs, [the town of St Andrews](#) was once the centre of the nation's political and religious life.

Today, it's a vibrant academic town with a distinctively cosmopolitan feel where students and university staff account for more than half of the local population.

The University of St Andrews is a diverse and international community of almost 12,000 students and staff, typically of over 140 nationalities. It has over 9000 students, just over 7,000 of them undergraduates, and employs approximately 2,500 staff - made up of c. 1,190 in the academic job families and c 1,350 in the non-academic job families.

Under the leadership of current [Principal Professor Sally Mapstone](#), the University's [Strategy \(2018-23\)](#) is to broaden its global influence, become more diverse and consolidate its long-held position amongst the top five universities in the UK.

The plan sets out St Andrews' ambitions to grow its international profile, champion diversity and inclusivity, expand its portfolio of world-leading research, develop stronger links with industry and embed a new culture of entrepreneurship among students and staff.

It also places social responsibility at its heart, with a pledge to manage growth in student numbers, foster a growing culture of sustainability and pursue a research and teaching agenda for the wider public good.

The University is one of Europe's most research-intensive seats of learning. In the [Research Excellence Framework \(REF\) 2014](#) it was ranked top in Scotland for quality of research output and one of the UK's top 20 research universities.

St Andrews is consistently held to be one of the United Kingdom's top five universities in university league tables compiled by [The Times and The Sunday Times](#), [The Guardian](#) and [The Complete University Guide](#).

It has frequently been rated the leading university in Scotland for [teaching quality and academic experience](#), and in the National Student Survey 2018/19 was [the leading mainstream UK university for student satisfaction](#).

In international and world rankings St Andrews scores highly for teaching quality, research, international outlook and citations. It is currently a World Top 100 institution in the [QS World University Rankings 2019](#).

St Andrews' reputation for teaching, research and student satisfaction make it one of the most sought-after destinations for prospective students from the UK, Europe and overseas.

The University typically averages 12 applications per place and has not offered Clearing places for over a decade. St Andrews has highly challenging academic entry requirements to attract only the most academically potent students in the Arts, Sciences, Medicine and Divinity.

St Andrews holds an Institutional [Athena SWAN Bronze Award](#), while the Schools of Biology, Physics & Astronomy and Psychology and Neuroscience have achieved [Athena SWAN Silver Awards](#).