

**Profile of a Female Scientist: An Interview with
Ruby Raheem
By Jennifer Kruschwitz**

Ruby Raheem

Meeting brilliant people striving to make long-lasting contributions to the field of optics as well as the science-education community, has been a regular occurrence since my affiliation with the Optical Society of America (OSA). So when OSA asked me to interview and profile a few of the Society's female student members for the MWOSA newsletter, I jumped at the chance.

Ruby Raheem does graduate-level Biophotonics research at the University of Edinburgh. When she's not using optics to probe into the molecular mechanism of living cells, she's organizing optics activities on campus, and dedicating time to reach out to young students. She is particularly interested in encouraging girls to study math and science studies. Recently, Ruby traveled to Ghana, Dubai, and India to give optics demonstrations to high school and college students through a grant from the OSA Foundation. I caught up with Ruby to learn about her studies, outreach work and travel adventures.



Residence:
*Edinburgh,
Scotland*

Ph. D. Advisor: *Dr.
Alistair Elfick*

Professional: *Ph.D. candidate in the
Centre for Biomedical Engineering,
School of Engineering and Electronics
at the University of Edinburgh*

Kruschwitz: *Ruby I would love to learn a little about what life was like growing up in India and the academic system for young students. Are children exposed to science at an early age?*

Raheem: I was born and raised in South India – in a beautiful town on top of a mountain – over 7000 feet high. We had to travel on narrow winding roads with hairpin bends, zigzagging for nearly eighty miles on steep mountain sides, to reach our home at the top. We lived in the middle of deep, enchanted woods and gurgling streams.

I enjoyed school and my lessons, especially math and science; and had plenty of encouragement at home to study and do well. You may be surprised to learn that our classes started at 9:00 am and lasted until 4:00 pm, Monday through Friday (plus half a day on Saturday during grad school). We had highly dedicated teachers and an educational program where we could lose a whole year if we failed in a single subject.

Education was seen as part of spiritual development in India and perhaps dates back to the pre-vedic period. Nalanda (400 CE) and Takshashila (600 BCE) were ancient universities in India. Educated people were considered spiritually enlightened. As a result, all tools of knowledge are still treated with great reverence.

I have just looked up a few report cards, as I was curious as to when we started formal mathematics. We had Arithmetic, Geometry, Science, History and Geography starting in grade two (age six).

Kruschwitz: *Your father was a solar physicist; did he encourage you to pursue a career in science?*

Raheem: I grew up around the Kodaikanal Observatory, where my Father worked as a solar physicist. He designed his own telescopes, spectroheliographs and other devices needed for observation. He always encouraged me to study physics, while my Mother wanted me to practice medicine.

My parents were involved in my studies, especially during my pre-teen years. I remember my Mother teaching me long division even before I started school. Frankly, at that age, I preferred to play; and my Mother was not pleased when I told her what I thought of studying. I also have a vague recollection of spending time with my Father adding things like “ $a + a + a + a + a = 5a$ ” during his days off.

I recall my Father telling me that if I did well in school he would send me to America for higher studies.

Kruschwitz: *You have studied at institutions around the world, including India, the US and Scotland. What are some of the similarities and differences you have observed and do you have a favorite?*

Raheem: Full time students in the US take between 9 and 12 credits during their graduate studies. Full time students in India don't get to choose the number of credits they take; and thus spend between 40 and 45 hours per week in classrooms and laboratories. Because of this, I think the Indian curriculum is more of a packaged deal, whereas there is greater flexibility in choosing subjects in the US. The UK programs, on the other hand, are not as structured as those in India, nor are they as flexible as those in the US. Both the US and the UK have many resources for experimental research, which is not the case in India.

I studied undergraduate Physics at [Providence Women's College](#) in [Calicut University](#); which is where my involvement in outreach activities began. I started a notice board called, “The Capsule”, to explain Physics to those studying non-scientific fields – and I am happy to report, it still exists today.

I have special memories of [Marquette University](#), in Milwaukee, Wisconsin, USA, as it was my first overseas academic experience; and I could not have selected a better place. I moved from Physics to Engineering at [Virginia Tech](#) in Blacksburg, Virginia, USA, as they had a great Fiber Optics program. The region was known as Silica Valley due to the extensive Fiber Optics research and technologies that emerged. Virginia Tech has one of the most beautiful campuses in the country and it is also a wonderful place to study.

After my studies at Virginia Tech, I worked in Research and Development at [AMD](#) and [Corning, Inc.](#), on a variety of “Applied Physics” projects. I realized that I was ready to do Ph.D. in Optics while at Corning, and the telecom crash provided me with the opportunity to move into the academic world again.

I am now doing biophotonics research (funded by the Engineering and Physical Sciences Research Council) at the Centre for Biomedical Engineering in the King's Buildings campus of the [University of Edinburgh](#). I work in a multidisciplinary department headed by Professor Bill Eason. The researchers have backgrounds in Physics, Chemistry, Biology, Engineering and Computer Science. Dr. Alistair Elfick, my Ph.D. supervisor, has a background in bio-mechanics and has research projects in hip/joint replacement engineering, synthetic biology and biophotonics. He is also the faculty advisor for AaSCOSA.

Kruschwitz: *Currently, you are studying at the [University of Edinburgh](#) and have recently started an OSA student chapter. Tell us a little bit about your chapter, and what motivated you to get it started?*

Raheem: What motivated me? – Well, I enjoy science communication; and am genuinely concerned with the dwindling number of science and Physics students. From the age of six, I spent about six hours a day for fifteen years of my life, sitting in classrooms listening to teachers and lectures. There were many teachers who could make their subjects come alive and keep us focused. I admired them and wanted to be like them.

Through the OSA student chapter, we have the unique opportunity to spread the word about Optics and Science education, without having to be in the traditional role of a teacher or a professor.

I have been an OSA member for some years now, but I never really got to know the OSA community until my first [Frontier in Optics Conference](#) in October of 2006. OSA gave me a travel award to attend the conference, and I witnessed the way OSA encouraged and supported students from all over the world. I met many wonderful people during that conference and felt I had to be a part of all the excitement, so I looked around for some way to get involved. When, [KiKi L'Italien](#), Chapter & Student Services Manager at OSA, told me that Scotland had never had a student chapter, I knew that I wanted to start one. Since then I have had very little time to sit back and relax.

At first, it was not easy to get students to sign up, but I got some support from my supervisor, Dr. Elfick, to get the word out to other Scottish universities. Students started to trickle in from the [University of Strathclyde](#) and the [University of St. Andrews](#). We were officially recognized as a chapter with seven student members. Now, nearly eight months later, we have 15 student members studying Chemistry, Physics and Engineering. I would like to eventually have members from Biology and the Arts.

We have a dedicated team of committee members – Laurence Wilson, Marcel Reuter, David Hughes (Strathclyde University) and a very helpful outreach advisor, Dr Andrew Firth.

The UK as a whole is invested in fostering Physics education; and the University of Edinburgh is recognized as one of the leaders so, I could not have chosen a better campus to start the historic OSA student chapter.

Kruschwitz: *The Chapter name, the Albannach Alliance Student Chapter of OSA (AaSCOSA) is particularly interesting, could you explain its origin and meaning?*

Raheem: We wanted to find a suitable name that would stand the test of time. Dr. Elfick, who is Scottish, said 'Alba' [al-a-ppa] was the Scottish word for Scotland. I did some research and soon found that Albannach stood for "Scottish", so we became the Albannach Alliance Student Chapter of OSA or AaSCOSA for short. One of our slogans is "AaSCOSA? Ask us about light."

Kruschwitz: *Almost immediately after starting the chapter, you jumped into education outreach and requested a grant from the [OSA Foundation](#) to fund a trip to help and encourage students in Ghana and India to explore the science of light. What prompted you to pursue outreach in these countries?*

Raheem: I had an opportunity to attend an optics conference in Ghana where OSA was one of the sponsors. This was a chance for me to combine the trip with outreach activities and really introduce AaSCOSA to the world. Without funding from the [OSA Foundation](#), I could not have attended the conference or carried out the outreach efforts.

The needs of the industrially developing world are different. Text book education is not very expensive; but quite often students struggle to conceptualize abstract concepts; as they do not have access to demo kits and suitable laboratories. I originally came from a developing nation and so felt I would be able to relate to their needs.

Kruschwitz: *While in Ghana, you gave a talk on [optical illusions](#) to a group of young girls. Was it their first encounter with such a topic; what was their reaction?*

Raheem: I wanted the students to have fun with optics, and a talk on [Optical Illusions](#) was a great ice breaker. They had never seen most of the images and there were a lot of surprised “oohs and aahs”, “I don’t believe it” and “can you show that again”.

Kruschwitz: *During your stay in Ghana, you also became familiar with the [Laser Atomic Molecular and Optical Sciences Network](#), could you tell us a bit about this group and the work they are doing in Africa?*

Raheem: I met many optical scientists from Africa when I attended the Winter School in Optics at Trieste in 2007 and 2008. I was surprised to learn that until 1991, optics was not taught in schools in Africa.

The LAM Network was started in 1991 by Prof. Ahmadou Wague of Senegal and a team of dedicated faculty members from Ghana, Algeria, Egypt and Sudan; with encouragement and support from [The International Centre for Theoretical Physics](#) (ICTP) under the leadership of late Professor Gallieno Denardo. OSA and the [International Commission on Optics](#) are also sponsors of the program. I understand from my recent discussions, that the LAM network has provided optics education to almost all countries in Africa.

Kruschwitz: *On your way to India, you gave a similar talk, but to a completely different audience: a group of undergraduates studying Interior Design at [MAHE, Manipal Dubai Campus](#). I am intrigued to hear their response to the talk and if they gave feedback as to whether or not it would influence their work as designers?*

Raheem: The students at MAHE in Dubai were quite eager to hear about Optics and optical illusions, and they participated enthusiastically, asking many questions. The teachers were equally absorbed in the discussions. I spoke about the way color and patterns could make an impact on the aesthetics of buildings, displays, room layouts and decorations. They were happy to explore the colorful diffraction patterns with the optics kits and enjoyed it as much as the optical illusions talk.

Kruschwitz: *Before we move on to discussing your research, what would you say was the most rewarding part of your outreach trip to Africa and India?*

Raheem: Most of the schools do not have access to the resources we take for granted. Thus, being able to distribute invaluable materials to educators and students and attract them to optics through demonstrations was incredibly rewarding.

I returned even more motivated to continue my outreach to these countries. Schools need books in their libraries and colleges would benefit from access to journals. I would like to collect old copies of Physics Today, OPN, journals, outdated and used text books and ship them to some of these schools and colleges.

**Read more about Ruby's trip to India and Africa on [Laser Focus World](#).*

Kruschwitz: *Your research is focused on biophotonics; what do you see as the single most interesting element of your work?*

Raheem: Biophotonics is an exciting field with a lot of molecular biology that is yet to be understood. I am able to design and build an optical trap, and I have been introduced to cell biology and molecular spectroscopy. We use light from laser diodes to gently probe the nucleus of living cells and retrieve information about DNA and proteins. The outcome of this research will be useful for exploring the molecular mechanism in health and disease. I enjoy my research immensely!

Kruschwitz: *Optics, in general is a predominantly male field. More and more women are making inroads, doing amazing research and making lasting contributions. Do you see the field of biophotonics as an area embraced by female scientists? Why?*

Raheem: When I popped the question to the ladies in my group, I was told that the “bio” in Biophotonics was likely to attract more female students to the field. There are more women in biological and medical fields than in Physics. I will not deny that I find the nano-scale study of “living cells” fascinating – perhaps it is the same feeling an astronomer has when she or he probes into the macrocosm – wanting to touch the truth.

It would be wonderful if there were as many women in Physics and Optics as there are men. To make that happen, the best place to start is with our children – by teaching them fundamental science as if it were the most exciting subject in the world. Teaching is an art. Great teachers are talented actors and actresses and should be given proper recognition, as the future of Optics, Physics and mathematics is really in their hands.

Kruschwitz: *It has been a pleasure getting to know you Ruby. Would you like to leave a parting message for your mentors, colleagues and future physicists?*

Raheem: The fruits of Physics that the students are now enjoying – mobile phones, computers, video games, etc. – did not evolve overnight. Several hundred years of steady progress in the field led to the development of these technologies. We must encourage the study of science and give support to

students interested in pursuing Physics, so future generations can continue to benefit from these and other technologies.

I would like to say “Thank You” to all my teachers, professors and mentors for sharing their passion for Physics and teaching.

Secondly, I could not have started the OSA student chapter or attended these conferences without the encouragement and support from my department and supervisor. Finally, I would like to thank the OSA Foundation for giving me the opportunity to represent OSA and AaSCOSA and during my travels to Ghana, Dubai and India.



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Jennifer is a Sr. Optical Coating Engineer and President of her coating design firm, [JK Consulting](#). She received her Bachelors and Masters Degree in Optics from the University of Rochester in 1989 and 1995 respectively. She has been working in the field of optical interference coatings since 1988. Jennifer has been an active member of OSA since 1990, serving in a variety of volunteer and governance capacities.