Joel Cox
Mads Clausen Institute (MCI)
SDU Climate Cluster
Center for Polariton-driven Light-Matter Interactions (POLIMA)
DIAS
Email: cox@mci.sdu.dk
Phone: +4565504050

Teaching Experience

- Lecturer and course responsible for Quantum Mechanics [5 ECTS], The University of Southern Denmark [SDU], Denmark (Spring ’20, '21, and '22)
- Lecturer and course responsible for Atomic Physics [5 ECTS], SDU, Denmark (Fall '21 and '22)
- Lecturer and course responsible for Introduction to Nano Optics [5 ECTS], SDU, Denmark (Summer '20)
- Lecturer for Advanced Physical Optics [10 ECTS], SDU, Denmark (Spring ’19)
- Teaching assistant [TA] for Intermediate Electromagnetism/Introduction to Modern Physics, The University of Western Ontario [UWO], Canada (Fall/Spring ’09—’13)
- TA for Introductory Physics I/II, Physics for Engineering Students, UWO, Canada (Fall/Spring ’11—’13)
- TA for Introduction to Materials Science, UWO, Canada (Spring ’12)
- TA for Going Faster and Farther: The Science of the Sporting Environment, UWO, Canada (Spring ’09)
- TA for First-Year Physics Laboratory (Fall/Spring ’08—’09)

Young-researcher training, selected

- Line Jelver, SDU, Denmark: Supervision of postdoctoral research on nonlinear optical phenomena in atomically-thin materials ('21-present)
- Mikkel Have Eriksen, SDU, Denmark: Supervision of MSc thesis and subsequent PhD thesis on nonlinear atom-polariton interactions ('21-present)
- Jens-Christian Pedersen & Mads Harmuth Hegnby, SDU, Denmark: Supervision of BSc thesis on quantum effects in the optical response of nanoshells used in photothermal therapy ('21)
- Fabio Raspanti, SDU, Denmark: Supervision of MSc thesis on electrical control of quantum optical phenomena using graphene ('20)
- Theis Pilegaard Rasmussen, SDU, Denmark: Supervision of MSc thesis and subsequent PhD thesis on light-matter interactions in polaritonic waveguides ('19-present)
- Álvaro Rodríguez Echarri, The Institute of Photonic Sciences [ICFO], Spain: Co-supervision of MSc thesis and PhD dissertation on the optical properties of 2D metallic films ('16-present)
- Sandra de Vega, ICFO, Spain: Co-supervision of PhD research on carbon nanotube plasmons and nonlinear optics in 1D systems ('15-'20)
- Renwen Yu, ICFO, Spain: Co-supervision of PhD research on nonlinear plasmonics in nanostructured graphene ('15-'16)

Pedagogical View

Scientific research, which seeks to improve our understanding of the natural world, is founded upon an ever-growing body of existing knowledge and observations. The continuity of scientific progress relies on the transfer of skills and knowledge to future generations of researchers, who must first learn fundamental concepts and be trained to think critically. It is for these reasons that, as a scientist, I hold the privilege of teaching and mentoring young researchers in the highest esteem.

My formative teaching experiences, including undergraduate teaching assistant roles during my PhD candidacy in Canada and young-researcher training as a postdoctoral research fellow in Spain, have helped me develop the teaching philosophy I apply as a faculty member at the University of Southern Denmark. I strongly believe that the best way to truly understand a subject, particularly in the physical sciences, is to apply the knowledge obtained in lectures and readings to solve problems, conduct experiments, or carry out research projects. I strive to motivate, challenge, and support students in a progressive learning environment while framing the subject matter within the broader scope of its scientific, technological, and societal importance. In undergraduate teaching, I make additional efforts to understand the motivation of students enrolled in a particular class, which can provide insight into their diverse backgrounds, capabilities, and interests that informs my teaching. While I recognize that many students who enroll in an academic course only do so to satisfy a requirement of their study program or to acquire basic skills needed in their professional careers, and that my primary objective is to help students achieve the course learning goals, I believe that it is very important to seize opportunities to cultivate interest in scientific research. With these goals in mind, I complement traditional face-to-face theoretical lectures with comprehensive teaching notes that detailed examples of ways the course material can be applied in practice, which serves both to elucidate concepts and further motivate exceptional students with advanced capabilities.

As a teacher, I endeavor to provide a comfortable learning environment by encouraging students to interact with me during the lectures and in office hours after classes, with the latter venue providing opportunities to address specific questions or problems and to gauge students’ comprehension. In my view, students should actively participate in lectures and tutorial sessions to achieve a sense of ownership of the knowledge they attain, while feeling free to make mistakes that will

catalyze their learning experience. In physics courses, I emphasize the importance of problem-solving exercises as key opportunities to apply knowledge obtained though lectures and readings to solve problems that describe physical systems and predict the outcomes of experiments; I view the problem-solving component of a physics education as an arena in which to develop critical thinking and reasoning skills while deepening understanding of physics concepts. To foster valuable teamworking skills, I encourage students to work amongst themselves on assigned homework problems or reports, and I often allow them to submit assignments in small groups. I also allocate time for in-depth discussions pertaining to the solution of problems and interpretation of results, usually in the form of short classroom presentations by students to develop their communication skills.

Now that information and communication technology is becoming ever-more prevalent in our society, I believe that is very important that students enrolled in natural science and engineering programs are exposed to computational methods applied in the analysis or simulation of physical systems. For this reason, I seek opportunities to augment courses in physics and engineering with computational analysis components that allow students to visualize and experiment with course concepts using either simple programs that I develop or suitable commercial software packages. However, in my view, institutions of higher education must embrace the vast wealth of available computational tools without abandoning critical thinking and advanced reasoning skills that are taught in face-to-face lectures and tutorials, so that both resources can be used in tandem to achieve their full potential.

Teaching Capabilities

Considering my education, teaching experience, and research background, I am capable of teaching bachelor- and master-level courses on quantum physics, solid state physics, electromagnetism, classical and quantum optics, and atomic physics. I am also qualified to teach introductory university courses in physics, mathematics, and computational methods.

As a university faculty member, I have been course responsible for five courses over three years, including an intensive course that I developed to introduce undergraduate students to my own research field of nano-optics. In these cases, I have implemented face-to-face classroom teaching, with lectures complemented by textbook readings and self-prepared notes. I also prepare regular problem sets for students to work on independently and discuss in lectures or tutorial sessions, and sometimes submit as project reports that contribute to their assessment. I have experience conducting both oral and written examinations.

I have co-supervised bachelor, master, and PhD theses, and am the day-to-day main supervisor of both PhD and postdoctoral researchers.