DWC Profiles: Bianca Sawyer, PhD student in the Dodd-Walls Centre

Bianca Sawyer is a pillar of the student community at Otago University and is passionate about sharing the wonders of science. She was the driving force behind the Luminescence Festival in 2015, which celebrated the International Year of Light with interactive events for adults and children. She was co-chair for IONS KOALA, an international conference for optics students. She also organises social and professional development events for students as a member of the Otago Optics Chapter, which she was President of for two years running. And she recently joined a new Women in Science Group.

Amazingly Bianca also has time for her PhD research, developing a technique for observing atoms as they move and interact. She works in the Light and Matter Physics Group under the supervision of Dodd-Walls Principal Investigator Niels Kjærgaard.

Research: Talking to Atoms Without Disturbing Them

The lab where Bianca's group works was the first Cold Atom Facility in the Southern Hemisphere. Now after decades of fine-tuning the equipment and building a knowledge base and a culture, the lab has developed an international reputation.

> "It is really exciting to directly experience the atoms behaving just as we learnt in quantum physics classes. Back then it seemed so abstract. Now it is happening right in front of me."

The experimental set-up offers a highly controllable playing field to explore the quantum world. They can trap atoms, cool them to near absolute zero, move them around, alter their state and observe them as they interact and collide with one another. At these ultra-cold temperatures quantum effects come into play.

One of the biggest challenges with these experiments is keeping track of the atoms. Even though the equipment fills a whole room, the sample of atoms is only a fraction the width of a human hair across. The atoms themselves are thousands of times smaller again. So it is very hard to 'see' what's happening.

To observe an atom you have to interact with it. You do this with laser light. Atoms only absorb (or resonate with) specific frequencies of light. The normal way to see where an atom is and what state it is in is to fire at it with a resonant laser frequency. This projects a shadow on the screen behind, a tiny dark spot, showing where the atom is.

“This is a powerful method,” says Bianca, “but when the atoms absorb resonant light the sample gets heated up and destroyed so we can only get a single snapshot in time. To monitor the atoms in a dynamic process we have to run the experiment many times which is very slow.”

Bianca is working on a new way to observe atoms as they move without disturbing them. It is called “dispersive probing” and uses off-resonant light to avoid heating the atoms.

“The huge advantage with this kind of probing system is its efficiency and speed. We can acquire hundreds of data points in a single experimental run sometimes saving days. It also eliminates uncertainties due to fluctuating conditions in the lab such as temperature or atom numbers.”

Student Life at Otago

Bianca grew up in Dunedin and loves the city.

“It is small without being too small,” she says. “It’s beautiful. It has an amazing culture and it has that college-town atmosphere, which is rare in Australasia.”

Bianca has done both her undergraduate and postgraduate study in the Otago Physics Department and over the years has been a star contributor to the vibrant and friendly culture.

“EVERYONE’S FRIENDS WITH EVERYONE, EVEN AS UNDERGRADS WE WERE ON FIRST NAME BASIS WITH OUR LECTURERS. I NEVER FELT INTIMIDATED GOING TO ANYONE’S OFFICE FOR HELP.”

Bianca especially enjoys the relationship the Physics Department has with Otago Museum who value the input of students.

“A COUPLE OF MONTHS AGO THE MUSEUM INVITED US ALL FOR DRINKS AND NIBBLES JUST TO TALK TO US ABOUT COOL IDEAS WE MIGHT HAVE FOR THE MUSEUM.”

A Passion for Outreach

Bianca’s enthusiasm for science outreach is infectious.

“I especially enjoy working with children,” she says. “They have such huge enthusiasm. I believe it's extremely important that people from all backgrounds are exposed to the exciting world of science from a young age when they are the most curious and impressionable.”

Bianca has been a lead coordinator for school visits, community outreach festivals, stage shows, public talks and expos and a photography competition. She has written funding applications, come up with visions for events, managed volunteers, finances, marketing, programme development, and of course the actual delivery of the outreach events.

One of the highlights of Bianca's outreach work was the Luminescence Festival at Otago University in 2015. She brought together a team of students and inspired the creation of a whole new range of hands-on science activities for children and adults. They were a hit. Over 500 people attended the festival. There were hourly talks from prominent scientists and a constant stream of excited children exploring the wonders of light. The activities have since been used for school visits, events and festivals.

"Being a part of outreach initiatives is fun and hugely rewarding, as well as a fantastic way to diversify my skill set," says Bianca. "I aim to make outreach a major part of my future career as a scientist and am excited to find out where that might take me."