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### Shawna Hollen, Assistant Professor, Physics (CEPS) travel to Switzerland

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*University of New Hampshire, Durham*

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UNH Global

# Shawna Hollen

Assistant Professor, Physics (CEPS) ~ Switzerland



Angelicum Pontifical University, site of Graphene 2019

In July of 2019 I was able to take advantage of a unique opportunity to do hands-on work in a colleague's lab at Universität Zürich, Zürich, Switzerland alongside my UNH IROP mentee, Alana Gudinas. This opportunity also lined up with an important international conference in Rome, Italy, "Graphene 2019." Because of the International Development Grant, I was able to present at the conference and spend a week in Zürich learning a valuable new lab technique.

While at Graphene 2019, I met with a group of international colleagues and had useful discussions about our current research on quantum phase transitions in graphene-based devices. I also learned much more about current industrial efforts in graphene and other two-dimensional materials and attended talks that expand from fundamental science to applications.

My colleague in Zürich, Prof. Fabian Natterer, is an expert in a new scanning tunneling spectroscopy technique that allows us to probe fast dynamics of vibrations, spin, and charge on an atomic scale. While scanning tunneling microscopy (STM) and spectroscopy (STS) are well-known techniques for studying atomic scale structure and electronic states, they are typically very slow, taking seconds to hours to acquire data. The technique that extends their utility into the time domain is called pump-probe spectroscopy and uses very fast voltage pulses to excite and subsequently probe nanosecond dynamics at a single site on a surface of interest. Learning this technique and implementing it at UNH opens a host of new experimental possibilities for our UNH lab. Additionally, rising senior Alana Gudinas is spending the summer as an IROP awardee in Prof. Natterer's group learning the technique in great detail and writing code for her own experimental protocols to bring back to my group and implement as her senior thesis.



Alana Gudinas filling liquid nitrogen for our experiment



The time I spent in Zürich was immensely valuable. Alana, Prof. Natterer, and I worked together closely. Alana explained what she had learned so far and when I was caught up, we set to work understanding the details of the

Fabian Natterer's group in Zürich; Fabian Natterer fourth from right, Alana Gudinas far left, and Shawna Hollen far right

protocols she was writing. By the end of the week, we had made good progress on the protocols for more universal implementation of the technique and made plans for her return to

campus. I also left with a full lecture prepared on the technique, which I delivered to interested graduate students (including my own) and faculty in the physics department. The intensive hands-on time spent in Zürich gives me great confidence that Alana and I can successfully implement this technique at UNH upon her return. This expands research horizons at UNH for current and future UNH students, will help me bring in more funding for this work, and establishes a close connection with the Universität Zürich. The university has been very supportive of Alana and I believe this connection will lead to more opportunities for student exchanges in the near future, with Prof. Natterer's group or with other faculty we connected with while there.

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