Winter Graduate School on 
Atomic, Molecular and Optical Physics:

Cold Molecules for Quantum Information 
Technologies and Fundamental Physics

February 19 - 25, 2023

Hosted at Biosphere 2
Welcome to the 11th ITAMP Winter Graduate School on Atomic, Molecular and Optical Physics. This year's program focuses on Cold Molecules for Quantum Information Technologies and Fundamental Physics. We are delighted to have researchers who are undisputed world leaders in this field and outstanding teachers. We are grateful for their willingness to invest the considerable amount of time required to prepare and present their lectures.

Our primary goal for this school is to enable and encourage informal interactions as well as formal discussions during the school. We hope that you will take advantage of the unique setting of the Biosphere 2 campus and its relaxed and informal environment to interact extensively with the lecturers. Most of them will be able to spend several days with us. So, don’t miss this opportunity!

We have several extracurricular activities planned. So, it’s not just all work and no play. The schedule of lectures includes free afternoons for the faculty and students to enjoy the outdoors, or just relax in the beautiful surroundings of the B2 Campus.

Enjoy!

Hossein Sadeghpour
We have planned excursions and events during the week and a sign up sheet will be available.

- Hike/Outing
- Poster Session
- Possibly private car riding to Saguaro National Park
- Movie Night
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**Notes**

**Program**

**2023 ITAMP/B2 SCHOOL SCHEDULE**

**SUN, 2/19/2023**  
- End
  - 9:00

**MON, 2/20/2023**  
- Start
  - 7:30
  - Breakfast
  - 9:00

**TUE, 2/21/2023**  
- Arrival
  - 10:10

**WED, 2/22/2023**  
- Registration
  - 11:20
  - LUNCH
  - 12:30

**THUR, 2/23/2023**  
- Keys
  - 12:30

**FRI, 2/24/2023**  
- Outing
  - 5:30

**SAT, 2/25/2023**  
- Dinner
  - 7:30
Lecturers

John Bohn
JILA
Email: bohn@murphy.colorado.edu

Prof. Bohn’s primary research centers on the theory of collisions between trapped atoms and molecules in a dilute ultracold atomic gas. The goal is to unravel delicate energy exchanges and assess their response to external electromagnetic fields. More broadly, Prof. Bohn looks for novel approaches to understanding collective motions of many-body quantum-mechanical systems such as electrons in an atom or semiconductor device or atoms in a Bose-Einstein condensate.

Simon Cornish
Durham
Email: s.l.cornish@durham.ac.uk

Prof. Cornish’s current research interests are on Bose-Einstein condensation, two-species quantum degenerate throughout gases, ultracold atomic collisions and Feshbach resonances, ultracold molecules, bright matter-wave solitons and the application of neutral atoms and molecules to quantum simulation and precision measurement.
Notes

Lecturers

David DeMille
University of Chicago
Email: ddemille@uchicago.edu

Prof. DeMille is focused on development of methods for production and trapping of ultracold gasses of polar molecules, including both direct laser cooling and trapping and assembly from ultracold atoms, tests of symmetry-violation using ultracold molecules, architectures for quantum computation based on polar diatomic molecules, and spectroscopy of diatomic molecules.

Kang-Juen Ni
Harvard University
Email: kangkuenni@g.harvard.edu

Prof. Ni pursues new approaches to create and gain quantum control of ultracold molecules for studies of chemical reactions, quantum information processing, and quantum many-body physics. Notable recent achievements include building single molecules in movable optical tweezers, studying collisions in a new paradigm with exactly known numbers of collision partners and products, and probing, steering, and controlling ultracold bimolecular chemical reactions.
**Lecturers**

**Gerhard Rempe**  
Max Planck Institute for Quantum Optics  
Email: gerhard.rempe@mpq.mpg.de

Prof. Rempe’s research spans a broad range of topics from cavity QED to formation of cold polar molecules and Rydberg excitations in optical tweezers. The central aim is to interrogate strong non-linearities at the single photon limit and correlations in ultracold gasses for simulations of entangled quantum processes and for quantum information processing.

**Timur Tscherbul**  
University of Nevada - Reno  
E-mail: ttscherbul@unr.edu

Prof. Tscherbul’s research focuses on precise understanding of collisions between atoms and molecules and between molecules and how such interactions lead to rovibrational quench and spin relaxation. A particular emphasis is on the role long-range interaction and formation of long-lived resonances play to affect molecular reactions and ways to coherently control such processes.

**Contacts**

**ITAMP Contact:**  
Jaclyn Donahue - Administrative Coordinator  
Phone: 617-495-9524  
Email: Jaclyn.donahue@cfa.harvard.edu

**Biosphere Contact:**  
Kimberly Land - Events Operations Coordinator  
Phone: 520-621-0436  
Email: kland@arizona.edu
Helpful local information

* Please obey the speed zones on Oracle Road.

**Pharmacy:**
CVS - 25 minutes
10650 N Oracle Rd, Oro Valley, AZ 85737

**Hospitals:**
Oro Valley hospital - 22 minutes
1551 E Tangerine Rd, Oro Valley, AZ 85755

**Grocery store:**
Bashas - 17 minutes
15310 N Oracle Rd Tucson Az 85739

**Gas Station:**
Circle K - 8 minutes
2000 W American Ave, Oracle, AZ 85623

Circle K - 14 minutes
15935 N Oracle Rd, Tucson, AZ 85739

**Coffee:**
The Oracle Patio Cafe and Market - 11 minutes
270 W American Ave, Oracle, AZ 85623

**Restaurants:**
Sammy’s Mexican Grill - 15 minutes
16502 N Oracle Rd, Catalina AZ 85739

Sunny Side up Cafe - 16 minutes
15800 N Oracle Rd Tucson AZ 85739

Lupe’s Restaurant - 10 minutes
35480 AZ - 77, Saddlebrooke, AZ 85739

**Shopping:**
Oracle Crossings - 32 minutes
7881 N Oracle Rd, Oro Valley, AZ 85704

Lecturers

Nicholas Hutzler
Caltech
Email: hutzler@caltech.edu

Prof. Hutzler’s research explores experimental methods to trap and cool diatomic and polyatomic molecules and utilize them for probes of new physics. Among them are searches for the electron EDM, CP violations, and employing cold molecules as sensors for fundamental searches.
Organizer

Hossein Sadeghpour
Director
Center for Astrophysics | Harvard & Smithsonian

Research Interests:
Theoretical AMO physics, collision of cold and ultracold atoms and molecules, few- and many-body processes in quantum gases with Rydberg impurities, heating in ion microtraps, and precision photometry for cosmological surveys.

ITAMP began life in 1989 at the Center for Astrophysics | Harvard & Smithsonian. It is the only theoretical AMO "user facility" in the United States. It hosts workshops and visiting scholars, sponsors a speaker series, maintains a prestigious postdoctoral fellowship program, organizes a winter school on AMO physics, and hosts an endowed lecture series. ITAMP workshops and winter schools are archived on the institute YouTube channel. A Call for Proposal to organize workshops are available at http://itamp.harvard.edu.

ITAMP thrives in the larger Cambridge-area AMO physics ecosystem. The mission of ITAMP is to further the cause of theoretical AMO physics by providing resources, scientific and administrative expertise, enhancing collaborative efforts between theory and experiment, and advocating for theoretical AMO physics.