

# Winter Graduate School on Atomic, Molecular and Optical Physics:

## Cold Molecules for Quantum Information Technologies and Fundamental Physics



ITAMP, 60 Garden St., Cambridge, MA 02138 Tel. 617 495-9524

B2, 32540 S. Biosphere Road, Oracle Arizona 85623 Tel. 520 838-6200

**February 19 - 25, 2023**

**Hosted at**





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

## Events

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



## Notes

2023 ITAMP/B2 SCHOOL SCHEDULE							
	SUN	MON	TUE	WED	THUR	FRI	SAT
	2/19/2023	2/20/2023	2/21/2023	2/22/2023	2/23/2023	2/24/2023	2/25/2023
<u>Start</u>							
	<u>End</u>						
7:30							
9:00	Arrival	Gerhard Rempe	Gerhard Rempe	Kang-Kuen Ni	Simon Cornish	Timur Tschertbul	BREAKFAST
10:10	Pickup Registration Packets and Keys	John Bohn	Timur Tschertbul	John Bohn	Kang-Kuen Ni	Simon Cornish	BREAKFAST
11:20		Dave DeMille	Simon Cornish	Nick Hutzler	Nick Hutzler	John Bohn	BREAKFAST
12:30		LUNCH	LUNCH	LUNCH	LUNCH	LUNCH	BREAKFAST
1:30		Free Afternoon	Free Afternoon	OUTING	Free Afternoon	Free Afternoon	
5:30		Timur Tschertbul	Nick Hutzler	Catalina Mountain HIKE	Dave DeMille	Kang-Kuen Ni	
6:30	DINNER - SELF SERVE (Available from 5pm to 10pm)	DINNER	DINNER	DINNER	DINNER	DINNER	
7:30		Poster Session		Poster Session	Gerhard Rempe	Movie at the Biosphere	
8:30							Departure

## Lecturers



**John Bohn**

JILA

Email: [bohn@murphy.colorado.edu](mailto: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](mailto: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

## Notes

## Lecturers



**David DeMille**  
University of Chicago  
Email: [ddemille@uchicago.edu](mailto: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](mailto: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](mailto: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](mailto: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](mailto:Jaclyn.donahue@cfa.harvard.edu)

### Biosphere Contact:

Kimberly Land - Events Operations Coordinator

Phone: 520-621-0436

Email: [kland@arizona.edu](mailto: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

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## Lecturers



Nicholas Hutzler

Caltech

Email: [hutzler@caltech.edu](mailto: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.

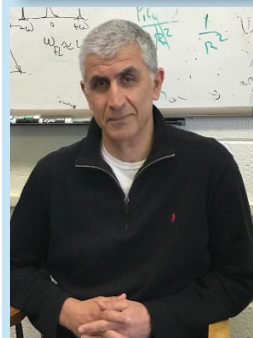
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## Winter School Group Photo 2017



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## Organizer



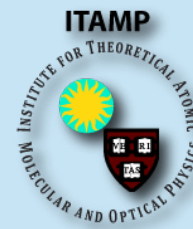
**HOSSEIN SADEGHPOUR**

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.

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## Winter School Group Photo 2022



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## Winter School Group Photo 2018



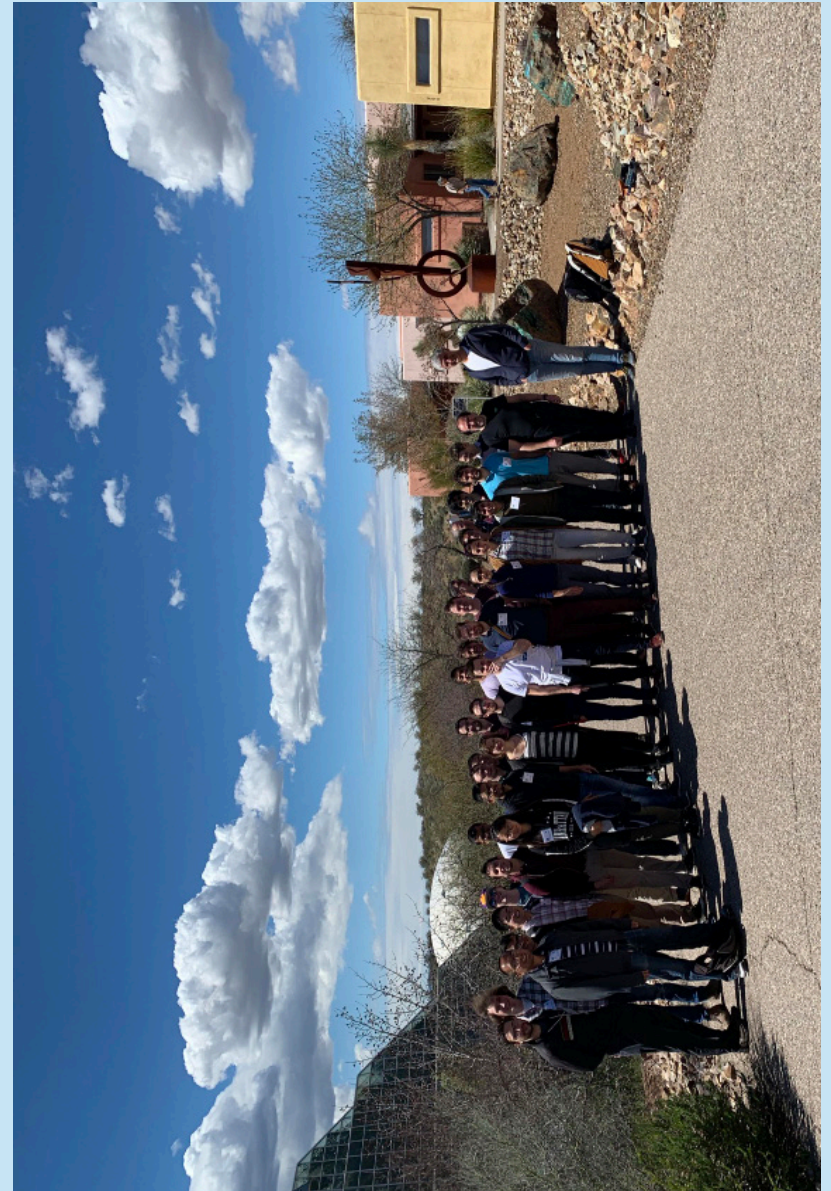
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## Winter School Group Photo 2019



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## Winter School Group Photo 2020



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