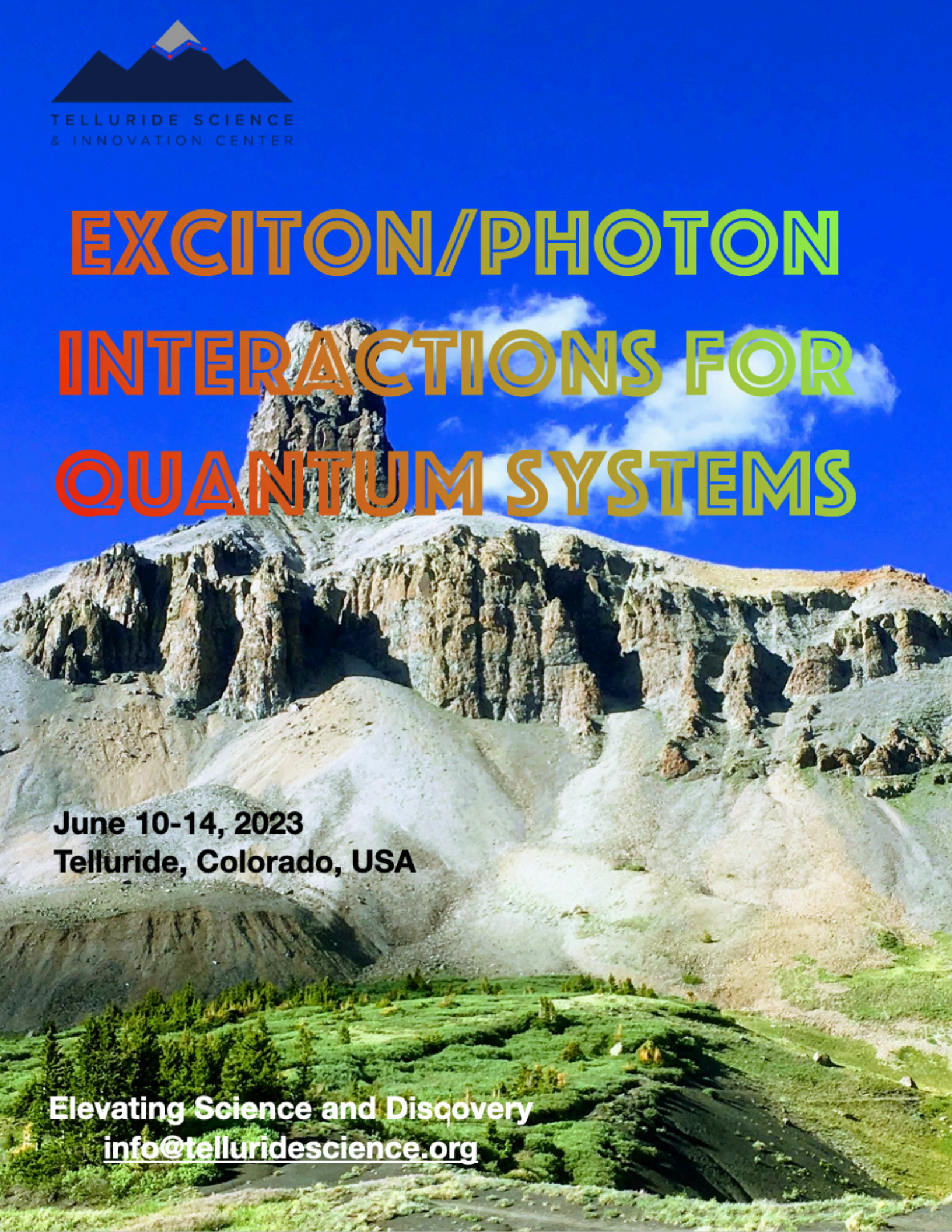
TELLURIDE SCIENCE
& INNOVATION CENTER

EXCITON/PHOTON INTERACTIONS FOR QUANTUM SYSTEMS



June 10-14, 2023
Telluride, Colorado, USA

Elevating Science and Discovery
info@telluridescience.org

This is the short version of the booklet for print use.

This template originates from LaTeXTemplates.com and is based on the original version at:
https://github.com/maximelucas/AMCOS_booklet

Contents

About

Exciton/Photon Interactions for Quantum Systems
Telluride Science and Innovation Center
06/10/2023 - 06/14/2023

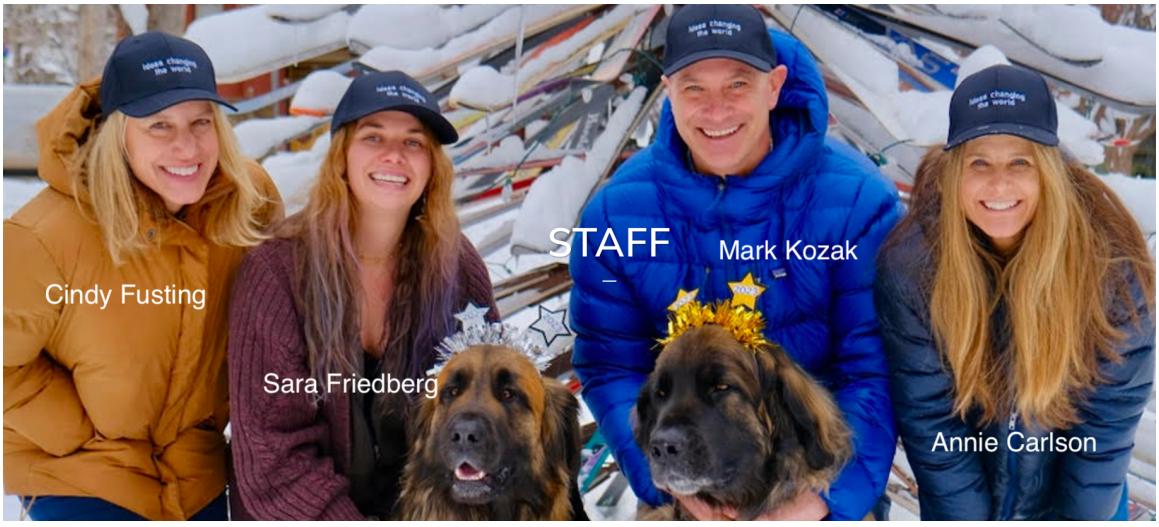
TSRC is now Telluride Science and Innovation Center

Telluride Science is about expanding the frontiers of science, exploring new ideas, and building collaborations. The workshop schedule will allow for substantial unstructured time for participants to talk and think. All participants are expected to stay for the entire duration of the workshop. Scientists are encouraged to consider bringing family or friends. Telluride offers a number of options for children's camps (including Telluride Academy, Aha School for the Arts, and Pinhead Institute). There is more information on childcare, camps, and family activities on TSRC's website. Feel free to contact TSRC's staff to help with any planning and/or coordinating care.

Organizing committee

- Eric Bittner, email: bittner@uh.edu, cell: 832-316-0381
- Carlos Silva
- Andrei Piryatinski

Local Contacts: These are the folks who make it all happen.



Scientific Scope:

This workshop builds upon a history of four highly successful prior Telluride Science workshops focused upon quantum coherences and collective behavior that evolve due to the strong coupling between matter and a quantized radiation field. Here, we expand the scope of our workshop to beyond cavity QED systems and consider a broader range of physical effects stemming from strong light-matter interactions. Topics will include quantum optics, quantum computing, cavity QED effects, polaritons and polariton condensation, and quantum non-linear optics.

Notes: While the other lodging options have an early bird deadline of February 15th, the Avant Stay condos have an early bird deadline of February 1.

Meeting Venue: Telluride Intermediate School
721 West Colorado Ave., Telluride, CO 81435

Click Here for Directions

Meeting Details:

Workshop Price: $ 449.00 Early Bird Lodging Discount Available Until: 02/15/2023 A $100.00 discount is applied to your lodging cost when you register before 02/15/2023.

Cancellation Policy: Once a credit card has been charged, cancelled registrations will be subject to a cancellation fee. Registration fees will be automatically processed once registration is complete. A $25 cancellation fee will be retained from a registration refund. Lodging fee payments will be processed 60 days prior to arrival, and a $100 cancellation fee will apply if cancellations occur after a lodging fee payment is completed. Telluride Science can only guarantee a refund for the remaining lodging fees if requested prior to the cancellation deadline that is specific to each lodging provider. Telluride Science recommends that participants purchase travel insurance to protect against unforeseen, last-minute travel plan changes.

Code of Conduct

- Treat your fellow participants and Telluride Science staff with consideration and professionalism, respecting diversity of views and opinions.
- Communicate openly with civility for others, critiquing ideas rather than individuals.
- Be mindful of your surroundings and fellow participants. Anyone requested to stop unacceptable behavior is expected to comply immediately. Telluride Science staff may take any action deemed necessary and appropriate, including immediate removal from the meeting without warning or refund.
- Be kind and considerate of people in the Telluride community. You represent Telluride Science when you are in town.

Unacceptable behaviour: Harassment, intimidation, exclusion, or discrimination. Physical or verbal abuse.

Reporting Unacceptable Behavior: If you are the target of unacceptable behavior or have witnessed any such behavior, please immediately notify a Telluride Science or the workshop organizer. Alert Telluride Science staff, and 911 if appropriate, if you notice a dangerous situation or someone in distress. Report concerns to report@telluridescience.org. All reports will be treated confidentially and with discretion.

Diversity & Inclusion Statement Telluride Science values diversity and inclusion and is committed to creating a respectful, equitable, and welcoming environment free from discrimination, exclusion, and harassment for all participants. Telluride Science is known for its collegial workshops that spawn new ideas and collaborations. We encourage the open expression and exchange of ideas, and we are dedicated to strengthening our culture of diverse and inclusive workshops, conferences, and schools. The Telluride Science Board actively works with workshop, conference, and school organizers to promote diversity in all Telluride Science-sponsored events. Anyone with suggestions or concerns is encouraged to contact Cindy Fusting.

Most importantly: Have fun! Be inspired! Make new friends!


Daily Schedule

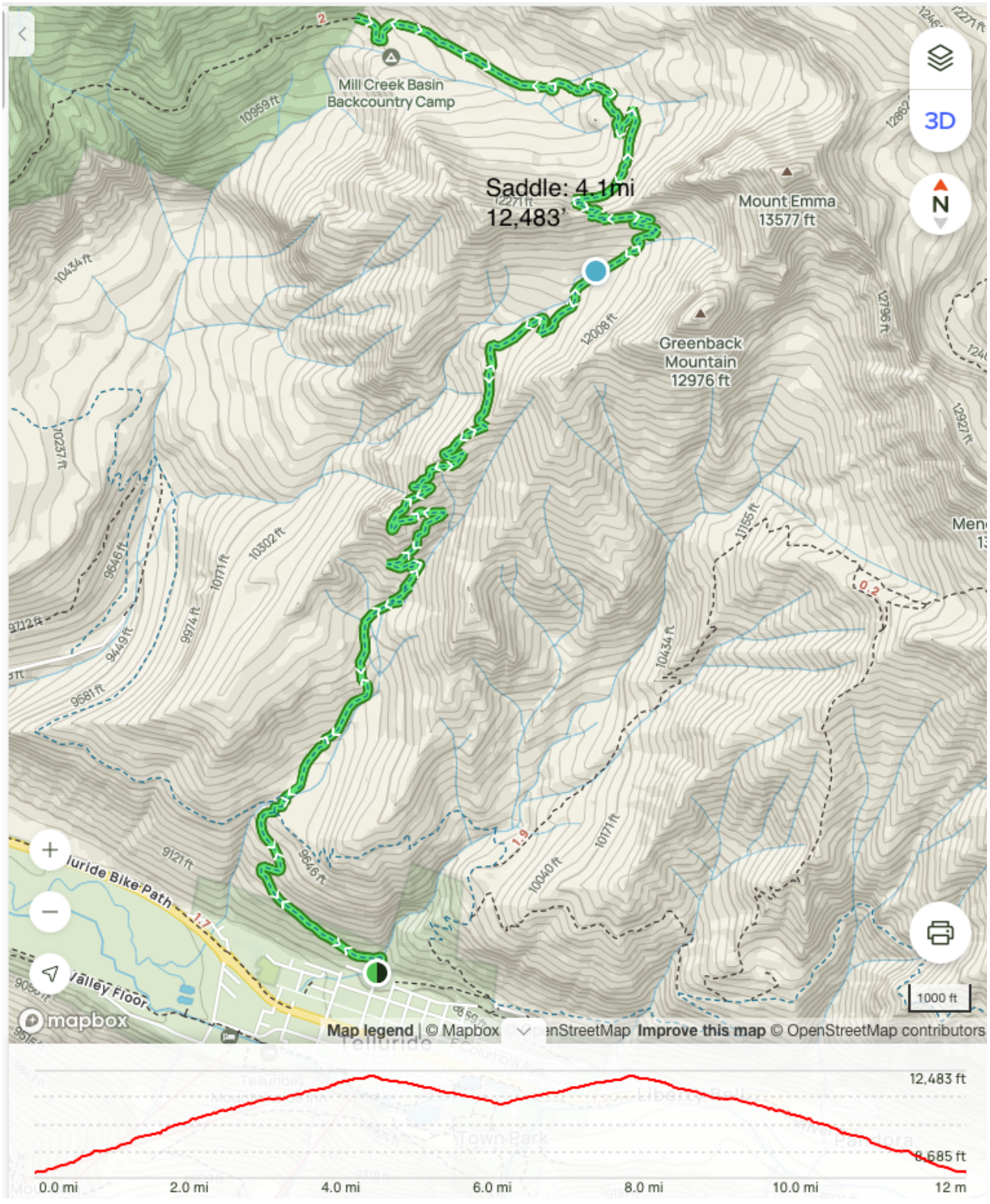
Note that breakfast will be served from 7am-9am at the Workshop site. Lunch and dinner are on your own. We recommend Clark's Grocery for lunch. They have an excellent sandwich counter and OK sushi.

CT: Contributed Talk, IS: Invited Speaker, GH: Group Hike, TT: Town Talk.

Day 1: Saturday, June 10

7:00–9:00	**Breakfast & Badge Pickup**		
8:30–8:45	**Welcome remarks by ERB**		
Session 0	**Group hike**		
8:45–16:00		**Eric Bittner** UH, USA	Sneffel Highline Tour and discussion of many-body quantum mechanics & philosophy of science.
17:10–19:30	**Welcome and badge pickup at Pheonix Bean**		

Rather than starting off with a full day of intense sessions, we will take a group hike up to the pass on the Sneffels Highline trail. This will be a pretty strenuous hike of about 8.2 miles out and back. A map is on the next page. Our goal will be the saddle at 4.1 miles, but the valley at the blue-dot is a spectacular view. Incidentally, the photo of the bear on pg 28 was taken just above the blue dot on this trail. Depending on weather/snow conditions we may stop at that point or go for the saddle. Bring water, sunscreen, lunch, wear hiking shoes, and bring rain gear. I will bring at least 1 or 2 water filters to refill canteens along the way.


Mill Creek Basin
Backcountry Camp
Saddle: 4.1mi
12,483'
Mount Emma
13577 ft
Greenback
Mountain
12976 ft
3D
N
1000 ft
mapbox
Map legend | © Mapbox
OpenStreetMap Improve this map © OpenStreetMap contributors
12,483 ft
8,685 ft
0.0 mi
2.0 mi
4.0 mi
6.0 mi
8.0 mi
10.0 mi
12 m

Day 2: Sunday, June 11

We begin the formal science parts! Our daily format will be to meet in the morning. Unless otherwise noted, all talks will be 30 minutes in length, with 5-10 minutes for Q/A.

7:00-9:00	**Breakfast available at site.**		
8:45-9:00	**Welcome remarks by organizers**		
Session 1	**Quantum Light Emitters**		
9:00-9:40		**Kimberly Hall** Dalhause Univ, Canada	Coherent Laser Driving of Excitons in Semiconductor Quantum Emitters
9:40-10:20		**Han Htoon** LANL,USA	Proximity Induced Chiral Quantum Light Generation in Strain Engineered WSe2/MPX3 Heterostructures
10:20–10:50	**Coffee**		
10:50–11:30		**Andrew Jones** LANL, USA	Inducing Chiral Photoluminescence in Single Photon Quantum Emitters using Chiral Induced Spin Selectivity Effects
11:30–14:00	**Lunch (on your own) & Discussion**		
Session 2	**Plasmonic Cavity and Nano-Antenna Effects**		
14:00–14:40		**Andrei Piryatinski** LANL,USA	Exciton-Plasmon-Polariton Dynamics in Nonlinear Plasmonic Nanostructures under Strong Coupling Regime with Quantum Emitters
14:40–15:20		**Wendu Ding** Wake Forrest University	Plasmon-Coupled Resonance Energy Transfer and Modified Frequency-Dependent Exciton Diffusion Properties in the Presence of Silver Nanoparticles
15:20–15:40		**Syed Shah** LANL	Shah's talk
15:40–16:00	**Coffee break**		
Session 3	**Photonic Cavity Polaritons 1**		
16:00–16:40		**Jiaqi Hu** Univ. of Michigan, USA	Polariton lasers with grating-based cavities
16:40–17:20		**Yu Zhang** LANL,USA	Interplay between disorder-induced localization and polariton-induced delocalization in J aggregates

Day 3: Monday, June 12

7:00-9:00	**Breakfast available at site.**		
Session 4	**Photonic Cavity Polaritons 1**		
9:00 – 9:40		**Arghadip Koner** UCSD, USA	A path towards single molecule vibrational strong coupling in a Fabry-Perot microcavity
9:40–10:20		**Piper Fowler-Wright** Univ of St. Andrews, UK	Extensions and validity of mean-field approaches for light-matter systems
10:20-10:40	**Coffee Break**		
Session 5	**Quantum Dynamics of Excitons**		
10:40–11:20		**Ignacio Franco** U Rochester, US	Mapping Electronic Decoherence Pathways in Molecules
11:20–12:00		**Fumika Suzuki** LANL	Quantum dynamics of composite particles
12:00-14:00	**Lunch & informal discussion**		
Session 6	**Quantum Spectroscopy and Entanglement**		
14:00-14:40		**Ajay Kandada** Wake Forest, US	Measurement principles for quantum spectroscopy of molecular materials with entangled photons
14:40–15:20		**Hao Li** U Houston, US	A stochastic approach to spectral lineshapes with non-stationary backgrounds
15:20-15:40	**Coffee/Biobreak**		
15:40-16:20		**Jiri Vanicek** EPFL	TBA
16:20-17:00		**Nikolai Sinitsyn** LANL	Phase transition in fluctuations of interacting spins at infinite temperature
17:30–	**TSRC BBQ/Picnic at the Depot Station**		

Day 4: Tuesday, June 13

7:00-9:00	**Breakfast available at site.**		
Session 7	**Intro to local Geology**		
8:30–12:00		**Jon Snow** LSU, USA	Group Hike/Photoshoot. Meet at Town Park and *depart* by 8:45am. We may be able to car-pool from TSRC site.
12–13:00	**Lunch**		
Session 7	**Cavity Polaritons 2**		
13:00-13:40		**Daniel Finkelstein-Shapiro** UNAM	TiO_2 – Au_n supermolecules as nanocavities
13:40–14:20		**Natia Frank** U. Nevada-Reno	Gating of Spin-based Quantum States for QISE
14:20–14:40		**Rayven Malatesta** GaTech	Approaches to spectroscopy using polarization-entangled photon pairs
14:40–15:00	**Coffee/Biological Break**		
15:00-15:20		**Nosheen Younas** UH	Nosheen's Talk
15:20-16:00		**Roman Dimitrov** UH	Puzzles of Photoemission Spectra in Alkali Metals
16:00-16:20		**Esteban Rojas** Ga Tech	Probing Nonlinear Interactions through Ultrafast Spectroscopy
6:30pm		**OMAR FARHA** Telluride Town Talk	Solving Big Problems with Small Things

Town Talks will be held at the Telluride Conference Center in Mountain Village. Town Talks start at 6:30 pm (doors open at 6 pm).

Day 5: Wednesday, June 14

7:00-9:00	**Breakfast available at site.**		
Session 8	**TITLE**		
9:00 – 9:40		**Anne Serkey** City1, Country1	TBA
9:40–10:20		**Anne Serkey** City1, Country1	TBA
10:20–10:45		**Author 3** Planet Earth	TBA
10:45–11:10	**Coffee**		
Session 12	**TITLE**		
11:10-11:40		**Anne Serkey** City3, Country3	TBA
11:40–12:35		**Amy Singh** City3, Country3	TBA

12:35–12:45	**Conclusion**

Unfortunately, we have to cut our Wednesday session short because of the Telluride Bluegrass Festival.

List of Participants

Last Updated: June 6, 2023

#	Name	Institution	Preferred Email
Sat	Bittner, Eric	Houston	bittner@uh.edu
Sun	Ding, Wendu	Wake Forest	dingw@wfu.edu
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Sun	Htoon, Han	LANL	htoon@lanl.gov
Sun	Hu, Jiaqi	Michigan	hujiaqi@umich.edu
Sun	Jones, Andrew	LANL	acj@lanl.gov
Sun	Piryatinski, Andrei	LANL	apiryat@lanl.gov
Sun	Zhang, Yu	LANL	zhy@lanl.gov
Mon	Fowler-Wright, Piper	St Andrews	pfw1@st-andrews.ac.uk
Mon	Franco, Ignacio	Rochester	ignacio.franco@rochester.edu
Mon	Koner, Arghadip	UC San Diego	akoner@ucsd.edu
Mon	Li, Hao	Houston	hli726@gmail.com
Mon	Sinitsyn, Nikolai	LANL	nsinitsyn@lanl.gov
Mon	Srimath Kandada, Ajay Ram	Wake Forest	srimatar@wfu.edu
Mon	Suzuki, Fumika	LANL	fsuzuki@lanl.gov
Mon	Vanicek, Jiri	EPFL	jiri.vanicek@epfl.ch
Tue	Dmitriev, Roman	Houston	romandm90@gmail.com
Tue	Finkelstein-Shapiro, Daniel	UNAM	daniel.finkelstein@iquimica.unam.mx
Tue	Malatesta, Ravyn	Ga Tech	rmalatesta7@gatech.edu
Tue	Rojas, Esteban	Ga Tech	esteban.rojas@gatech.edu
Tue	Shah, Syed	LANL	shah@lanl.gov
Tue	Snow, Jon	LSU	jesnow@lsu.edu
Tue	Younas, Nosheen	Houston	nyounas2@CougarNet.UH.EDU
Tue	Dambal, Sameer	Houston	sadambal@Central.UH.EDU
Tue.	Frank, Natia	UNR	nfrank@unr.edu

= scheduled date for talk

Where are people coming from?

Useful Information

Talks will be held at the **Telluride Intermediate School**. See the map on page 20.

Morning Breakfast: While lunch and dinner are on your own, breakfast in the form of bagels, coffee, juice, danishes, yoghurt, and fruit will be available each morning.

Coffee breaks will be offered to all participants in a common room shared by the concurrent workshops. Snacks, water, and coffee/tea will also be available throughout the day.

Wi-Fi will be available during the conference.

The **TSRC Picnic** will be held sometime, someplace.

Town Talk

In 1991, Telluride Science founders Peter Salamon and R. Stephen Berry started the lecture series in the old elementary school on Thursday nights as a way to give back to the Telluride community. The Town Talks have grown in popularity through the years and have moved locations several times–from the elementary school, to the Wilkinson Public Library to the Palm Theatre to the Telluride Conference Center.

Getting there and getting around

Telluride is nestled in box canyon in the San Juan Mountains of southwest Colorado. Whether you are flying into the region or venturing on a road trip, Telluride offers a unique journey marked with unmatched scenery, heritage and charm. We recommend arriving as early as possible the day before your workshop begins. Once you arrive, it is very easy to familiarize yourself with our mountain paradise. In the meantime, these FAQs might be helpful.

- **Air Travel** The Montrose Regional Airport (**MTJ**) is the primary airport for Telluride, and is a scenic 65 miles away. During the winter months, guests can take advantage of nonstop flights from 10 major hubs, and summer offers nonstop service from 5 major U.S. cities. **RECOMMENDED**

  Telluride Science participants are eligible for discounted shuttle service to and from the Montrose airport with Telluride Express; however, the discounted rate is only available when a reservation is made prior to your arrival with the code TSRC. **RECOMMENDED**

- **Rental cars** are also available at the Montrose Airport, but we recommend the ground transportation option because you do not need a car in Telluride (difficult at best!). Some of the lodging providers also charge for parking (usually $30/day!).

- **The Telluride Airport (TEX)** is located 10 minutes from the town of Telluride. Denver Air Connection offers

service from Phoenix and Denver to Telluride and partners with United Airlines, which enables travelers to book and connect through the global United network. **Not-Recommended! These get cancelled on a whim due to the highly unstable summer mountain weather.**

There are two other regional airports that are two to three hours by car away from Telluride: Grand Junction Regional Airport (GJT) and Durango Regional Airport (DRO). However, the shuttle service from these airports tends to be quite expensive and typically requires a car rental. **Not-Recommended, unless you want to do a fun driving vacation to and from Telluride. It's actually a really nice drive.**

- **Getting around Telluride.** Telluride is 1.5 km long and 0.6 km wide at most, making it a walking friendly town. The scenery is stunning and all hotels are within walking distance to all Telluride Science venues. No points in Telluride are separated by more than a 10-15 min. walk. If you get lost, walk down hill until you get the river or walk uphill until you're clearly heading up a mountain. **Recommend:** Bring a sturdy pair of hiking or walking shoes.

Map of Telluride

Here is a convenient map of Telluride with a few important landmarks highlighted. If you're a first-timer, Colorado Ave is the Main Street through town.

Hiking Trails: The blue arrows indicate the starting point and directions for couple of nice hiking trails heading out of town.

Eric's Hiking Guide To Telluride

I've been coming to Telluride for close to 20 yrs and have hiked or climbed most of trails and peaks around Telluride at some point or another. If you go out, take water, a snack, sun screen, rain jacket, your cell phone, a trail map, and ideally a partner.

Importantly, if you go off on one of the longer hikes, let one of the local TSRC staff know where you're going, who you're going with, and what time to expect you to check back in.

- **Bear Creek Trail**: Easy out/back heading up to Bear Creek Falls. About 45 - 60 min up to the falls and 30 min back down. It's a must-do, you can't get lost, and you can enjoy a refreshing swim at the end.


  This is also a great place for a group picture.

- **Jud Wiebe Trail**: Head across the creek at the North end of Aspen St. After a seemingly endless grind up the side of the slope and a few switch-backs, you encounter a fork. Continue to the **right** looping along a trail overlooking the north-side of Telluride. You eventually hit the Liberty Trail. At this point, take a right (DOWNHILL) and eventually come out at about the Telluride Historical Museum. The Cornerhouse Grill is a great place to get a beer after this one, you deserve it. About 1-2.5 hrs depending on your lung capacity for the initial climb. Trail is popular and well marked.

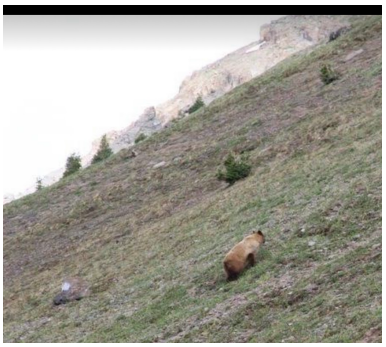
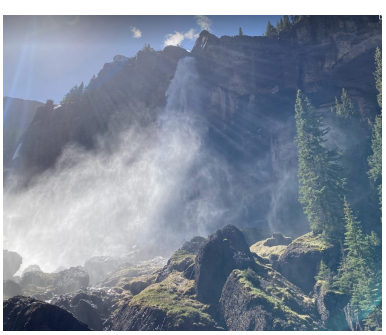


Figure 1: A local black bear (it's a blonde) on the trails around Telluride. It's important to note that you don't need to be able to out run the bear (because you can't), *you just need to outrun your hiking partner*.

- **Sneffels Highline Trail**: I consider this to be the best trail in the valley and you have multiple ways to complete it. It's about 14.5 miles as a complete loop if you go the summit and then through Mill Valley. Incidentally, the Tom Waits scene in "Ballad of Buster Scruggs" was filmed just below Dallas Peak. I've done the loop in 5 hrs, I recommend 6-8 hrs. A popular option is to go to the saddle point, enjoy the view and return (4-4.5 hrs round trip). It's also an excellent location for a group photo. Do be forewarned that this goes to almost 13,000' and the last portion is well above the tree line.

- **Bridal Vail Falls.** Super fun! Walk or drive to the trail-head at the end of town and keep walking up. At the top is an old mine that you can partially enter and collect some interesting mineral samples. Also, a great place for a swim and a group photo.




For the more adventurous

Most of the peaks you see from town are climbable without technical gear. The exceptions are Dallas Peak and Pagosa. Ballard Peak requires a good deal of bushwacking and trail finding. An awesome loop is the Wasatch Connection. For this, take the Gondola up to the St. Sophia Station, then walk up the See Forever Trail, connecting to the Wasatch trail on Gold Hill. From here you can head *down* the Bear Creek trail or loop behind Wasatch and Ballard to Blue Lakes, then come down the Bridal Vail Falls trail. This latter option is about 20 miles.

- **Lizard Head**: This is the little thumb you see looking SE from Telluride towards Wilson Peak and on the cover of this book. The formation itself is the core of a long extinct volcano. This 8-9 mile trail takes you to about 13,000' and most of the trail is between 11,000' and 12,000'. Jon Snow and I did this in the summer of 2022. For a day trip, I highly recommend taking 2 cars leaving one at the start and finish to avoid a 2 mile hike back to the trailhead along the highway.

  An alternative hike is to start at the Cross Mountain Trail Head and hike into the cirque below Wilson Peak. This looks like fun!

- **Mt. Sneffels**. This is the beautiful 14,000' mountain you see as you come in from Ridgeway. You "can" do it as a day hike if you have a 4WD capable of driving into the Yankee Boy Basin from Ouray. Alternatively, you can hike in along the Blue Lakes Trail (different Blue Lakes!) after driving in to the trail-head, camp at about 12,000' and do either the standard route or a very airy ridge climb. While not a technical climb, you do need a good head for heights! Hao Li and I did this in 2022.

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Center for Nonlinear Studies

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APS Division of Chemical Physics DCP

Abstracts of Talks

Sunday

Quantum Light Emitters

Coherent Laser Driving of Excitons in Semiconductor Quantum Emitters

Kimberley Hall[1], ***Grant Wilbur***[1], ***Ali Binai-Motlagh***[1], ***Alison Clarke***[1], ***Ajan Ramachandran***[1], ***Nick Milson***[1], ***John P. Healey***[1], ***Sabine O'Neal***[2], ***D. G. Deppe***[2]

[1] Department of Physics and Atmospheric Science, Dalhousie University, Halifax, Nova Scotia B3H 4R2, Canada;
[2] The College of Optics and Photonics, University of Central Florida, Orlando, Florida 32816-2700, USA

A quantum emitter (QE) is a physical system that can be used to encode a quantum state via some internal degree of freedom (e.g. exciton, electron spin, valley) and is coupled to light via a dipolar transition that enables the conversion of that quantum state into the state of a photon and vice versa. Such QEs can be applied to sources of single and entangled photons for applications in quantum cryptography or quantum imaging [1] and a collection of coupled QEs can be used to realize a small quantum simulator or quantum memory node in a distributed quantum network [2]. Among solid state QE systems, semiconductor quantum dots are particularly attractive due to their high radiative quantum efficiencies [2] their strong optical coupling enabling fast [3] and arbitrary [4-7] qubit rotations, and their tunable emission in the range of standard telecommunication wavelengths. Our research group has developed a variety of schemes for coherent driving of excitonic qubits in semiconductor quantum dots, including quantum state initialization and coherent control. In this presentation, I will describe some of our recent work demonstrating suppression of dephasing tied to electron-phonon coupling in these systems [8] and the development of a new laser driving scheme called Notch-Filtered Adiabatic Rapid Passage (NARP) [9], which when applied to single photon sources will enable simultaneous high photon brightness and indistinguishability.

1. Senellart et al. Nat. Nanotechnol. 12, 1026 (2017); Huber et al. J. Opt. 20, 073002 (2018).
2. Atature et al. Nat. Rev. Mater. 3, 38 (2018).
3. Mathew et al. Phys. Rev. B 90, 035316 (2014).
4. Mathew et al. Phys. Rev. B 84, 205322 (2011).
5. Gamouras et al. J. Appl. Phys. 112, 014313 (2012).
6. Gamouras et al. Nano Letters 13, 4666 (2013).
7. Mathew et al. Phys. Rev. B 92, 155306 (2015).
8. Ramachandran et al., Optics Letters, 45, 6498 (2020).
9. Wilbur et al., APL Photonics 7, 111302 (2022).

Proximity Induced Chiral Quantum Light Generation in Strain Engineered WSe2/MPX3 Heterostructures

Han Htoon

Center for Integrated Nanotechnologies, Materials Physics and Applications Division, Los Alamos National Laboratory, Los Alamos, NM 87545, htoon@lanl.gov

Generation of chiral quantum light is critically needed for realization of non-reciprocal single photon devices, deterministic spin-photon interfaces, and complex quantum networks.1 To date however, emission of such chiral quantum light has only been achieved through the application of intense external magnetic fields, by electrical/optical injection of spin-polarized carriers/excitons,3 or by coupling with complex photonic/meta-structures. We exploit magnetic proximity interactions for the first time to realize free-space, zero-field generation of chiral quantum light.

"Proximity effects" – the class of phenomena by which an atomically-thin material borrows properties of an adjacent material (such as magnetism) via quantum mechanical interactions – has recently been explored by coupling transition metal dichalcogenides (TMD) with various bulk and 2D magnetic materials. However, chiral light emission without spin polarized carrier/exciton injection at zero magnetic field remains elusive to date. A van der Waals antiferromagnetic (AFM) material, NiPS3, has recently been identified as fertile ground for exploring emergent phenomena of 2D magnetism. Because this material displays in-plane AFM order, it is not conventionally expected to induce ferromagnetic proximity interactions necessary for chiral light emission. Surprisingly, however, our work shows that chiral quantum light sources with a high degree of circular polarization and 80% single-photon purity can be realized by strain-engineering the WSe2/NiPS3 heterostructure with nanoscale indentations. Through state of art scanning diamond NV microscopy experiment and temperature dependent magneto-photoluminescence studies, we show that the chiral quantum light emission arises from magnetic proximity interactions between localized excitons in the WSe2 monolayer and out-of-plane magnetization of AFM defects in NiPS3, both of which are co-localized by the strain field arising from the nanoscale indentations. Interestingly, a similar chiral localized excitonic emission is also observed in our more recent experiment performed on WSe2/MnPS3 and WSe2/FePS3 heterostructure with nano-indents (See Extended Data Fig. 10).

Our work establishes TMD/TMPX3 (TM = Mn, Ni, Fe, Co; X = S, Se) heterostructures as a novel material platform for not only exploring proximity-induced emergent phenomena but also for the development of spin-photon interfaces, magnon based quantum transduction, and sensing schemes. Our observations also reveal that local strain engineering can be utilized not only to create QEs, but also to localize ferromagnetic proximity effects required for creation of chiral single photon emitters in WSe2/NiPS3 heterostructures.

Inducing Chiral Photoluminescence in Single Photon Quantum Emitters using Chiral Induced Spin Selectivity Effects

Suryakant Mishra, **Eric G. Bowes**, **Tai C. Trinh**, **Jennifer Hollingsworth**, **Han Htoon**, **Andrew C. Jones***

Center for Integrated Nanotechnologies, Materials Physics and Applications Division, Los Alamos National Laboratory

Chiral quantum emitters or non-reciprocal single photon devices have the potential for playing a significant role in future quantum communication-based infrastructure. To date, the realization of circularly polarized quantum emitters generally requires complex and bulky experimental infrastructures such as high magnetic/electric fields and cryogenic-temperatures. One potential means of realizing chiral quantum emission in solid-state systems is Chiral-Induced Spin Selectivity (CISS). This effect is a well-known physical phenomena known to enable control over electronic spins via the asymmetric transport of electronic spins in chiral organic and inorganic systems. We have explored the utilization of CISS effects as a means of manipulating the circular polarization of photoluminescence from single quantum emitters. Here, cadmium selenide-quantum dots are immobilized on a chiral surface prepared using electrodeposition of aniline. We observe both the inducement a significant degree of circular polarized photoluminescence emission and a magnetization-dependent photoluminescence quenching by using a ferromagnet valve in the chiral substrate. These observations illustrate the potential of a CISS-based mechanisms for realizing chiral single photon emission sources in solid-state material devices. By further exploring the dependence of circularly polarized emission on the quantum dot shell thickness and the thickness of the chiral films, we develop and demonstrate a model for the energy transfer pathways experienced by differing spin orientations in this system.

Plasmonic Cavity and nano-antennas

Exciton-Plasmon-Polariton Dynamics in Nonlinear Plasmonic Nanostructures under Strong Coupling Regime with Quantum Emitters

Andrei Piryatinski[1], ***Syed Shah***[1], ***and Maxim Sukharev***[2]

[1]Theoretical Division, Los Alamos National Laboratory, [2]Department of Physics, Arizona State University

In this presentation, we will delve into the theoretical investigation of the dynamics of exciton-plasmon-polariton in plasmonic nanostructures, which are composed of plasmonic lattices and quantum emitters, e.g., semiconductor quantum dots. The focus will be on the interplay between the $\chi^{(2)}$-nonlinear response of the plasmonic nanostructures and the quantum emitter gain affecting the polariton dispersion and coherent multi-photon emission under strong coupling conditions. We will specifically examine the gain-enhanced second harmonic generation and lasing, as well as the effect of the parametric down-conversion.

Plasmon-Coupled Resonance Energy Transfer and Modified Frequency-Dependent Exciton Diffusion Properties in the Presence of Silver Nanoparticles

Wendu Ding

Wake Forest University

Resonance energy transfer (RET) can be a great tool for various applications, including photosynthesis, directional energy flow, molecular structure dynamics, bio and chemical sensing, etc. The theoretical models for such process were well studied in homogenous, non-dipersive, and non-absorbing environments, such as in aqueous solutions. However, advances in experimental techniques and methods enabled the exploration of RET in complex environments involving nanoparticles and nanocavities, which is beyond the capability of the commonly used Förster theory. I will briefly introduce the recently developed computational method of plasmon-coupled RET and the new concepts of coupling spectrum, which determines the RET rate influenced by the surrounding environment. The effect of different shapes and sizes of silver nanoparticles on RET will be demonstrated. These effects can in turn modify exciton diffusion dynamics in extended molecular systems in the presence of nanoparticles. We will discuss interplay between the frequency-dependent diffusion coefficient and enhanced emission in these systems and potential design principles to achieve high diffusion coefficient and large diffusion length.

Title

Sayed Shah

Student or Postdoc Presenter

CNLS/LANL

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Photonic Cavity Polaritons 1

Polariton lasers with grating-based cavities

Jiaqi Hu*, *Z. Wang*, *S. Kim*, *N. Lydick*, *H. Deng*, *N. H. Kwong*, *R. Binder

Student or Postdoc Presenter

University of Michigan, University of Arizona

Exciton-polaritons in semiconductor microcavities have been a platform to study macroscopic quantum phenomena. They exhibit phases like Bose–Einstein condensate (BEC) and conventional photon lasing. Due to their fermionic constituents, a Bardeen–Cooper–Schrieffer (BCS)-like phase has also been predicted at density levels in between that of a BEC and photon lasing. Studies of the different phases often require the capability to control the polariton properties. In this talk, experimental methods to engineer the photonic component of the polariton using grating-based microcavities as well as the identification of the lasing phases in these cavities will be presented.

A high-contrast grating that has polarization-selective high reflectivity is used as a reflector for a GaAs/AlGaAs microcavity with GaAs quantum wells. The features of the polariton emission spectra resemble a polariton BEC or a photon laser as detuning changes, while the reflection spectra of the underlying carriers reveal that the coherent emission is due to stimulated emission under population inversion in both cases, ruling out the possibility of a polariton BEC. The comparison with a theoretical model suggests the possibility of the polariton BCS phase that has been postulated in the past but still lacks direct experimental confirmation. These observations contribute to the understanding of the phases of exciton-polaritons at high densities.

By altering the grating geometry, it is possible to independently control the resonant frequency and the decay rate of the cavity mode and therefore of the resulting polariton mode. The tuning of energy, decay rate, polarization, and mode profile of the photonic mode is demonstrated with fabricated devices. Realizing designs with different values of these parameters in a single device may facilitate the study of non-Hermitian physics in exciton-polaritons.

Interplay between disorder-induced localization and polariton-induced delocalization in J aggregates

Yu Zhang

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localization and delocalization are the centers of many photophysical phenomena. In general, the disorders in the molecular aggregates lead to exciton localization. However, when the molecular aggregates are coupled to a nanoplasmonic cavity, the strong coupling between the molecular exciton and cavity photon could lead to the delocalized hybrid light-matter states, i.e., exciton-polaritons. Hence, there is competition between disorder-induced localization and polariton-induced delocalization, enabling new photophysical dynamics. In this talk, I will present our recent work on understanding the disorder effect in forming exciton-polaritons in J aggregates and polariton/disorder-induced photophysical dynamics via multiscale and multiphysics modeling.

Monday

A path towards single molecule vibrational strong coupling in a Fabry-Perot micro-cavity

Arghadip Koner[1], ***M. Du***[2], ***S. Pannir-Sivajothi***[1], ***R. H. Goldsmith***[3] ***and J. Yuen-Zhou***[1] **Student or Postdoc Presenter**

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Interaction between light and molecular vibrations leads to hybrid light-matter states called vibrational polaritons. Even though many intriguing phenomena have been predicted for single- molecule vibrational strong coupling (VSC), several studies suggest that these effects tend to be diminished in the many-molecule regime due to the presence of dark states. Achieving single or few-molecule vibrational polaritons has been constrained by the need for fabricating extremely small mode volume infrared cavities. In this theoretical work, we propose an alternative strategy to achieve single-molecule VSC in a cavity-enhanced Raman spectroscopy (CERS) setup, based on the physics of cavity optomechanics. We then present a scheme harnessing few-molecule VSC to thermodynamically couple two reactions, such that a spontaneous electron transfer can now fuel a thermodynamically uphill reaction that was non-spontaneous outside the cavity.

Extensions and validity of mean-field approaches for light-matter systems

Piper Fowler-Wright **Student or Postdoc Presenter**

University of St Andrews, St Andrews, United Kingdom

Mean-field theory and its extensions provide a powerful approach to study light-matter interactions in complex environments. In particular, cumulant expansions have been widely applied as systematic approximation scheme in which increasing orders of n-particle correlations are included in the description [1]. This talk divides into two parts. First, I demonstrate a mean-field decoupling that allows an exact model of vibronic structure to be included in the description of organic polaritons [2]. Second, I present a simple model with many-to-one coupling for which mean-field theory and cumulant expansions may fail, hence examining the validity of the methods in this context [3].

1. M. Sánchez-Barquilla, R. E. F. Silva, and J. Feist, J. Chem. Phys. 152, 034108 (2020).

2. P. Fowler-Wright, B. W. Lovett, and J. Keeling,Phys. Rev. Lett. 129, 173001 (2022).

3. P. Fowler-Wright, K. B. Arnardóttir, P. Kirton, B. W. Lovett, and J. Keeling, (2023), arXiv:2303.04410.

Mapping Electronic Decoherence Pathways in Molecules

Ignacio Gustin, Chang Woo Kim, David W. McCamant and Ignacio Franco

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We propose a strategy to elucidate how electronic quantum coherence is lost in molecular chromophores immersed in condensed phase environments. For this, we first identify resonant Raman spectroscopy as a general experimental method to reconstruct molecular spectral densities with full chemical complexity. We then show how to quantitatively capture the decoherence dynamics from the spectral densities and identify decoherence pathways by decomposing the overall coherence loss into contributions due to individual molecular vibrations and solvent. We illustrate the utility of the strategy by analyzing the electronic decoherence pathways of the DNA base thymine, its nucleoside and nucleotide in water. The approach opens opportunities to understand the connection between chemical structure and quantum decoherence as needed to unveil the fundamental chemical principles that underlie quantum coherence and its loss.

Quantum dynamics of composite particles

Fumika Suzuki

Student or Postdoc Presenter

LANL

First, I will discuss the quantum dynamics of Frenkel biexcitons. Because of their internal structure, biexcitons exhibit complex phenomena in impurity scattering and the Anderson model. I will explore the formulation of bound states in the continuum and the suppression of localization in the Anderson model. In addition, I will briefly touch upon current projects involving matter-wave interferometry with chiral molecules. Specifically, I will highlight how macroscopic QED can aid in calculating the effect of Casimir-Polder forces in matter-wave interferometry.

Measurement principles for quantum spectroscopy of molecular materials with entangled photons

Luca Moretti, Esteban Rojas-Gatjens, Lorenzo Uboldi, David Otto Tiede, Evan J Kumar, Cristian Manzoni, Giulio Cerullo, Ajay Ram Srimath Kandada

Department of Physics, Wake Forest University; Department of Physics, Politecnico di Milano

Nonlinear spectroscopy with quantum entangled photons is an emerging field of research which holds the promise to achieve superior signal to noise ratio and effectively isolate many-body interactions. Photon sources used for this purpose however lack the frequency tunability and spectral bandwidth demanded by contemporary molecular materials.Here, we present design strategies for efficient spontaneous parametric downconversion to generate biphoton states with adequate spectral bandwidth and at visible wavelengths. Importantly, we demonstrate, by suitable design of the nonlinear optical interaction, the scope to engineer the degree of spectral correlations between the photons of the pair. We also present an experimental methodology to effectively characterize such spectral correlations. Finally, we discuss our perspective of quantum optical spectroscopy in which the spectral correlations of a biphoton state transmitted through a sample (a microcavity in our case) are employed as effective optical probes of system-bath interactions.

Exploring many-body exciton/polaron correlations in 2D perovskites through non-linear spectroscopy

***Hao Li* and Eric Bittner**

Student or Postdoc Presenter

Department of Chemistry, University of Houston

Stochastic models have a long and important history in optical spectroscopy, particularly for spectral line broadening. Traditionally, such approaches assume a stationary environment that does not react to any external stimulus over the course of the system dynamics. However, in experiments of modern ultrafast spectroscopy, broadband laser pulses can create a background excitation that interacts and coevolves with the system leading to fluence-dependent dynamics. To extract this dynamic information through 2D coherent spectroscopy, we developed a stochastic many-body approach that describes the exciton dynamics in the presence of a non-stationary and coevolving background population of excitations. Starting from a field theory description for interacting bosonic excitons, we derive a reduced model in which bright excitons are coupled to an incoherent background of dark excitons. Using Ito calculus, the nonstationary background population is characterized by an Ornstein-Uhlenbeck process. The model is applied to interpret the evolution of 2D spectroscopy.

Looking under the hood and unraveling dark processes in excitonic systems

Eric Bittner & Hao Li

Departments of Physics & Chemistry,Univ. of Houston; CNLS/LANL

Modern multi-dimensional spectroscopy offers a unique look "under the hood" allowing us to probe the dynamics of excitons in semiconducting systems. In this talk, I shall review our recent quantum stochastic model for spectroscopic lineshapes in a co-evolving and non-stationary background population of excitations. Starting from a field theory description for interacting bosonic excitons, we derive a reduced model whereby optical excitons are coupled to an incoherent background via scattering as mediated by their screened Coulomb coupling. Such processes include intra- and inter-valley excitons. The Heisenberg equations of motion for the optical excitons are then driven by an auxiliary stochastic population variable, which we take as the solution of an Ornstein–Uhlenbeck process. Here we discuss an overview of the theoretical techniques we have developed to predict coherent non-linear spectroscopic signals. We show how direct (Coulomb) and exchange coupling to the bath give rise to distinct spectral signatures such as phase-scrambling, excitation-induced dephasing, and excitation-induced shifts. We also discuss mathematical limits on inverting spectral signatures to extract the background density of states.
Cross-listed with *Nanomaterials: Computation,Theory,Machine Learning and Experiment*

Gating of Spin-based Quantum States for QISE

Subrata Ghosh, Anitha Alanthadka, Devon Adecer, Harini Wimalasekera, Mitra Rooien, Sergey Varganov, and Natia L. Frank*

Univ. of Nevada-Reno

The optical manipulation of spin quantum states provides an important strategy for quantum control with both temporal and spatial resolution for quantum computing, sensing and communications. While significant progress has been made in the discovery of molecular spin-based qubits with long decoherence times, current challenges are focused on molecular quantum sensors that have long decoherence times, (achieved by isolation from the bath) and strong coupling to the environment (achieved by strong coupling to the bath) required for sensing of external field or analytes. We report here a strategy for coupling molecular spin-based qubits to the bath without sacrifice of decoherence times. Photochromic ligands that undergo isomerization in response to changes in solvation, electric field, temperature, or light can be used to modulate electron transfer-coupled spin transition processes, spin-orbit coupling, and ligand-metal electronic coupling in bound transition and lanthanide metal ions. Visible light irradiation (exc = 550-600 nm) of a spirooxazine cobaltdioxolene complex induces photoisomerization of the ligand that in turn triggers a reversible intramolecular charge-transfer coupled spin- transition process at the cobalt center between a low-spin Co(III)semiquinone doublet and a high-spin Co(II)bis-semiquinone sextet state. Determination of the spin relaxation and decoherence times of the low-spin Co(III)semiquinone doublet state reveal slow spin dynamics and decoherence, and a change in the population of the SQ state (ms ± 1/2) qubit state with light modulation. Extension of this strategy to low-spin transition metal (S = 1/2) and lanthanide complexes leads to reversible changes in spin relaxation rate, decoherence time, and g-value with changes in photochromic ligand state, providing a robust strategy for quantum sensing in molecular spin-based qubits. We report here a Cu(II) (N4) photochrome complex (S=1/2) that exhibits a shift in g-value at room temperature upon photoisomerization with a metastable state lifetime of 25-85 min at room temperature. Pulsed EPR measurements reveal an significant change in decoherence rates with isomerization, and Rabi oscillations with a spin-flip rate of 56 ns. Theory and pulsed EPR spectroscopy provides effective modeling of the phenomenon and long-term strategies to further modulate spin-based molecular systems for quantum sensing at the single molecule level.

Phase transition in fluctuations of interacting spins at infinite temperature

V. N. Gorshkov[1], ***N. A. Sinitsyn***[2], ***D. Mozyrsky***[2]

[1]National Technical University of Ukraine, [2]Theoretical Division, Los Alamos National Laboratory

The high temperature limit of interacting spins is usually not associated with ordering or critical phenomena. Nevertheless, spontaneous fluctuations of a local spin polarization at equilibrium have nontrivial dynamics even in this limit. Here, we demonstrate that the spin noise power spectrum of these fluctuations can undergo discontinuous changes as a function of an external magnetic field. As a simple illustration, we consider a model of Ising-like long range spin-spin interactions with a transverse magnetic field as a control parameter. This system undergoes a phase transition associated with disappearance of the noise power peak responsible for the most detrimental decoherence effect of the interactions.

Tuesday

TiO_2 – Au_n supermolecules as nanocavities

***Eduardo Domínguez-Ojeda1, Emmanuel García Villatoro*[1], *Jonathan Urrutia Anguiano*[2], *Alejandro Reyes Coronado*[2], *Daniel Finkelstein-Shapiro*[1]**

.1 Instituto de Química, Universidad Nacional Autónoma de México, México
2. Facultad de Ciencias, Universidad Nacional Autónoma de México, México

Periodic arrays of semiconducting or metallic nanoparticles can be constructed in 2D (using templates) or as 3D crystalline suprastructures. These new materials provide a wide array of functionality such as modified optical response, energy and charge transport, and chemical reactivity. However, generating finite arrangements of nanoparticles in colloidal suspension remains elusive. A methodology to realize such systems would for example allow better photocatalysts with modular functionality where different parts of the system carry out different reactions, or have different accessible geometries acting as nanocavities for strong light-matter coupling. We propose a method to assemble finite structure of nanoparticles using binary functionalized surfaces that exploit enthalpic forces to create Janus surfaces. By a judicious choice of the type of ligand, their ratio, the solvent and the nanoparticles surface, we successfully assemble ABn supermolcules where A: TiO_2 and B:Au. The system presents drastically modified optical properties that could be used for colloidal nanocavities with multiple interacting mode volumes.

Family of Gaussian wavepacket dynamics methods from the perspective of a nonlinear Schrödinger equation [1]

Jiří Vaníček

Ecole Polytechnique Fédérale de Lausanne (EPFL)

Many approximate solutions of the time-dependent Schrödinger equation can be formulated as exact solutions of a nonlinear Schrödinger equation with an effective Hamiltonian operator depending on the state of the system. We show that Heller's thawed Gaussian approximation, Coalson and Karplus's variational Gaussian approximation, and other Gaussian wavepacket dynamics methods fit into this framework if the effective potential is a quadratic polynomial with state-dependent coefficients. We study such a nonlinear Schrödinger equation in full generality: we derive general equations of motion for the Gaussian's parameters, demonstrate the time reversibility and norm conservation, and analyze conservation of the energy, effective energy, and symplectic structure. We also describe efficient, high-order geometric integrators for the numerical solution of this nonlinear Schrödinger equation. The general theory is illustrated by examples of this family of Gaussian wavepacket dynamics, including the variational and nonvariational thawed and frozen Gaussian approximations, and their special limits based on the global harmonic, local harmonic, single-Hessian, local cubic, and local quartic approximations for the potential energy. We also propose a new method by augmenting the local cubic approximation with a single fourth derivative. Without substantially increasing the cost, the proposed "single-quartic" variational Gaussian approximation improves the accuracy over the local cubic approximation and, at the same time, conserves both the effective energy and symplectic structure, unlike the much more expensive local quartic approximation. I will show applications to the vibrationally resolved electronic spectroscopy, including the finite-temperature effects via thermo-field coherence dynamics.

[1] J. Vanicek, arXiv:2302.10221 [quant-ph].

Approaches to spectroscopy using polarization-entangled photon pairs

Ravyn Malatesta

Student or Postdoc Presenter

Georgia Institute of Technology

The growing field of quantum-light spectroscopy promises to use the quantum advantage for experiments with higher sensitivity and access to information inaccessible with classical probes. So far, the bulk of research into using entangled photon pairs for spectroscopy focuses on time-frequency entanglement. In contrast, this work considers what can be learned using polarization-entangled photon pairs as a spectroscopic probe. Using the quantum optics technique of photonic state tomography, we can completely characterize the density matrix of biphoton states in the polarization basis and observe how the density matrix changes after light-matter interaction with an entangled-photon pair. We consider what can be learned from three different experimental schemes for the light-matter interaction: i) scattering of only the signal photon, ii) parallel scattering of both the signal and idler photons, and iii) interference of the signal and idler photons after scattering of the signal photon by the sample.

Title

Nosheen Younas

Student or Postdoc Presenter

UH

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Puzzles of Photoemission Spectra in Alkali Metals

Roman Dmitriev*, *Vassiliy Lubchenko

Student or Postdoc Presenter

University of Houston

Angular-resolved photoemission spectra of alkali metals exhibit a puzzling, non-dispersing peak in the apparent density of states near the Fermi energy. We argue that the holes left behind a significant fraction of photo-ejected electrons are not wavepacket-like objects used to describe excitations of an equilibrium Fermi liquid but, instead, are relatively localized entities resulting from photon-induced cavitation in the electron fluid. At the same time, these special, localized holes can be thought of as vacancies in a transient Wigner solid, while the corresponding contribution to the photoemission current is non-dispersive and bears certain similarities to photoemission from localized core orbitals. We also consider additional non-adiabatic effects of photoexcitation, however their contribution to the photoemission spectra is likely insignificant.

Probing Nonlinear Interactions through Ultrafast Spectroscopy

Jorge E. Rojas Gatgens

Student or Postdoc Presenter

GA Tech

The interactions between excited states result in a nonlinear response in the observables like polarization, photoluminescence, and photocurrent. In this talk, we will introduce the concepts of coherent and incoherent interactions in the context of semiconducting materials. We present two optical techniques designed to probe coherent and incoherent interactions selectively between photo-excitations. On one side, excitation correlation spectroscopy (ECS) is selective to incoherent nonlinear processes described by their recombination kinetics and detected through photoluminescence and photocurrent. Some examples are exciton-exciton bimolecular annihilation, Auger scattering, and trap-assisted recombination. On the other hand, two-dimensional coherent spectroscopy (COLBERT) measures the nonlinear third-order polarization induced in the material. This technique offers information about coherent correlations between states and loss of coherences on the excited state ensembled due to Coulomb interaction among it. Finally, we will provide a perspective on the application of nonlinear spectroscopy to study photophysical processes in polaritonic devices.

Analytic and algebraic topology of locally Euclidean parameterization of infinitely differentiable Riemannian manifold

Nicolai Ivanovich Lobachevsky

Kazan University, Kazan Governorate, Russian Empire

We are changing title of talk to *The Eternal Triangle* with Brigitte Bardot playing part of the hypotenuse.

Public Town Talk

Solving Big Problems with Small Things

OMAR FARHA

INTERNATIONAL INSTITUTE FOR NANOTECHNOLOGY

Town Talk

Eighty years ago, few people in the world had heard of polymers. But in the late 1930s, one polymer—nylon—became a household word in just a few months. While nylon took the stockings market by storm, the progression toward polymers becoming ubiquitous in clothing and beyond—in kitchenware, electronics, building materials, medicine, and more—took decades. We now know that polymers were one of the materials that characterized the 20th century. Looking ahead, metal–organic frameworks (MOFs), or smart and programmable sponges, are poised to be a defining material of the 21st century. Though this class of multidimensional crystalline materials is still in its early stages, 50 years from now, they will be an ever-present part of human life just as polymers are today. MOFs are a class of porous materials that we can think of as nano-sized Tinker Toy assemblies which repeat in periodic arrays. Researchers around the world have explored the relevance of MOFs for applications including, but not limited to, drug delivery, water harvesting, gas storage, separations, and destruction of nerve agents. Importantly, start-up companies have recently undertaken MOF commercialization within industrial sectors. This talk will focus on metal–organic frameworks as the enabling materials for protection from Basic Science to Implementation and Commercialization. From basic science to commercialization of smart programmable sponges for environmental remediation and protection.

About the organizers

Eric Bittner has been coming to Telluride for about 20 years. He received his PhD in 1994 from the University of Chicago and was an NSF Postdoctoral Fellow at the University of Texas at Austin from 1994-1996 and Stanford University. Since 1997, he has been a professor at the Univ. of Houston, where his main research interests concern the quantum dynamics of excitons in materials, quantum optics, many-body theory, quantum trajectory methods, stochastic models of quantum dynamics, and non-linear spectroscopy. Honors include Fellowship in the American Physical Society, American Association for the Advancement of Science, and the Royal Soc. of Chemistry. He is a 2007 Guggenheim Fellow and a 2012 Fulbright Fellow. He currently holds the Moores Professorship of Chemical Physics at the University of Houston and is the Ulam Distinguished Visiting Scholar at the Los Alamos National Laboratory. When not doing science, you usually find him either in the mountains, on a sail boat somewhere, playing guitar, or simply waiving a sword around.

Carlos Silva earned a Ph.D. in Chemical Physics from the University of Minnesota in 1998 and was then a Postdoctoral Associate in the Cavendish Laboratory, University of Cambridge. In 2001 he became EPSRC Advanced Research Fellow in the Cavendish Laboratory and Research Fellow at Darwin College, Cambridge. In 2005, he joined the Université de Montréal as Assistant Professor, where he held the Canada Research Chair in Organic Semiconductor Materials from 2005 to 2015 and a Université de Montréal Research Chair from 2014 to 2017. He joined Georgia Tech in 2017, where he is currently a Professor with a joint appointment in the School of Chemistry and Biochemistry and the School of Physics, and Professor by Courtesy Appointment in the School of Materials Science and Engineering. He is also an Honorary Professor in the Department of Applied Physics of the Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional (CINVESTAV Unidad Mérida). He is a Fellow of the American Physical Society and the Royal Society of Chemistry. His group focuses on the optical and electronic properties of organic and hybrid semiconductor materials, mainly probed by nonlinear ultrafast spectroscopies.

Andrei Piryatinski earned his Ph.D. in physics and optical sciences from the University of Toledo in 1997. He performed his postdoctoral training at the University of Rochester (1997-1999) and the University of Wisconsin-Madison (1999-2002). In 2002 he joined Los Alamos National Lab as a Center for Nonlinear Studies (CNLS) postdoc and became a Technical Staff Member. Dr. Piryatinski's research covers the theoretical study of ultrafast carrier and phonon dynamics in nanostructured and low-dimensional materials, ultrafast nonlinear and quantum-photon spectroscopies, photonic and nano-plasomonic cavity QED in strong coupling regime focusing on light-matter states such as polariton condensation, lasing and super-radiant phases.