

WELCOME

Dynamics of Strongly Interacting Electrons

Boulder School for Condensed Matter and Materials Physics 2025
(BSS2025)

25th School



University of Colorado at Boulder

\$\$\$ ***NSF-DMR, CU Boulder***

School's Founders

- Founded in 2000 by Steve Girvin, Matthew Fisher, Andy Millis and L.R.



Steve Girvin



Andy Millis



Matthew Fisher




Leo Radzihovsky

- Andy Millis -> Cristina Marchetti



School funding and operations

-  – DMR \$320K/year, thanks Daryl Hess
- University of Colorado (CU) Physics Department
- Advisory board of 20 distinguished scientists
- Past schools from superconductivity to biophysics
<http://boulderschool.yale.edu/>



Boulder School 2025

Dynamics of Strongly Interacting Electrons

<https://boulderschool.yale.edu/2025/boulder-school-2025>

Great program, thanks to hard work by the co-organizers:



Debanjan Chowdhury



Andy Lucas



Minhyea Lee



Sean Hartnoll

Local Details *(all in Miscellaneous link)*

- Assistants: *audio/visual: Jack, Emil, Mert*
- Reimbursement: *Maura, Dakota* email: nanton@colorado.edu
- Library privileges upon request
- Rec center facilities (pool, weight-room, basketball court, climbing wall, soccer field, ice rink,...) free with room key card and name tag
- Computers: *UCB guest wireless, eduroam*
- Exchange of linens Mon July 14, 7-8am, 4-6pm
– drop/pick up at Darley North front desk
- No alcohol in public areas
- No housekeeping

Meals

- **daily dinning:**

- Breakfast (Mon-Sat) at Williams Village (WV) Hall
- Lunch (Sat, Sun) at WV, (Mon-Fri) at APG in UMC
- Dinner (Mon-Sun) at WV
- **NO** breakfast on Sundays

- **exceptions:**

- Dinners:

June 30 - Farrand Dining Hall

July 7 - Alfred-Packer Grill (APG)

July 11 - 6:30-8pm, catered dinner Gamow Tower

July 15 - APG

July 16 - APG (followed by public lecture)

- Lunches:

Friday, July 4 at Farrand Dining Hall

all-you-can-eat but only one pass, no reentry at APG and Farrand

Things to do in Boulder

- Hiking (guides/maps available in the back)
- Biking (rent on the Hill)
- Tubing in the Boulder creek (3 tubes in back)
- Chautauqua park
- Shakespeare Festival
- Eldorado Canyon
- Rocky Mountain National Park
- Red Rocks Amphitheater
- Pearl Street Mall fine dining and hanging out

Discount for BSS attendees on BCycle

- Download app: <https://boulder.bcycle.com/nav/start-riding>
- Apply promo code CUSR25:
 - *gives a free single ride July 1-8*
- Start riding! *Use the BCycle app to check out bikes and see system info*
- Keep every trip under 60 minutes to avoid overtime fees. A pre-authorization on your credit card will disappear within 1-3 business days

Participate

- Ask lots of questions
- Organize student seminars, discussions and tutorials
- Set up Slack
- Facebook group
- Actively participate in the poster/social sessions
- Organize research projects
- Meet classmates and lecturers
- *T-shirts designs urgently needed!*

Pedagogical Remarks

If you feel lost or find the lectures unclear, don't be discouraged!

- Ask questions during and after lecture
- Some of the students are more expert and are available to help, answer questions, organize tutorials, etc.
- The first lectures of every mini-course are critical: don't wait until you are lost

Special Events *(see schedule)*

- **Tonight:** *Participant Introductions, brief (1 min) comments about yourself, your social and scientific interests*
- **Tomorrow night:** *Dessert on Flagstaff mountain; busses leave WV at 6pm sharp, return at 8:30*
- **week 1-3 evenings:** *Poster Sessions (Mon, Mon, Tue) preceded by 2 min slide-free advertisements -> 1st tonight*
- **Friday night week 2:** *special Indian dinner on 11th floor of Gamow Tower*
- **Wednesday night week 3:** *public lecture by Margaret Murnane*
- **Friday end of day each week:** *Problem solving, "What have we learned?" discussion*

Scientific Program

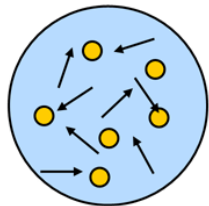
2025 Boulder Summer School for Condensed Matter and Materials Physics					
Dynamics of Strongly Correlated Electrons					
<u>Schedule Overview</u>					
	Monday	Tuesday	Wednesday	Thursday	Friday
Week 1: June 30- July 4					
8:30 - 9:00	Welcome				
9:00 - 10:30	D. Maslov	D. Maslov	D. Maslov	D. Maslov	S. Todadri
10:30 - 11:00	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
11:00 - 12:30	S. Todadri	P. Armitage	P. Armitage	P. Armitage	What have we learned this week?
12:30 - 13:45	Lunch	Lunch	Lunch	Lunch	Lunch <i>*at Farrand Dining Hall</i>
14:00 - 15:30	S. Kivelson	S. Kivelson	S. Todadri	S. Kivelson	<i>No afternoon lectures</i>
15:30 - 17:00	Participant Introductions				
Evening	17:00 - 18:00 <i>*Dinner at Farrand Dining Hall</i> 18:30 - 18:55 Poster Blurbs I 19:00 - 22:00 Poster Session I	18:00-20:30 Social Dessert on Flagstaff Mountain			
Week 2: July 7-11					
9:00 - 10:30	A. Chubukov	M. Murnane	P. Kim	A. Chubukov	M. Murnane
10:30 - 11:00	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
11:00 - 12:30	M. Murnane	A. MacDonald	A. Chubukov	A. MacDonald	A. MacDonald
12:30 - 13:45	Lunch	Lunch	Lunch	Lunch	Lunch
14:00 - 15:30	P. Kim	P. Kim	A. MacDonald	A. Chubukov	What have we learned this week?
Evening	17:00 - 18:00 <i>*Dinner at APG</i> 18:30 - 18:55 Poster Blurbs II 19:00 - 22:00 Poster Session II				19:00 - 21:30 Catered Dinner 11th floor Gamow Tower
Week 3: July 14-18					
9:00 - 10:30	S. Sachdev	S. Sachdev	L. Delacretaz	S. Sachdev	S. Sachdev
10:30 - 11:00	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
11:00 - 12:30	L. Delacretaz	L. Delacretaz	L. Levitov	L. Levitov	M. Lee
12:30 - 13:45	Lunch	Lunch	Lunch	Lunch	Lunch
14:00 - 15:30	L. Levitov	D. Chowdhury	D. Chowdhury	D. Dessau	What have we learned this week?
Evening		17:00 - 18:00 <i>*Dinner at APG</i> 18:30 - 18:55 Poster Blurbs III 19:00 - 22:00 Poster Session III	17:00 - 18:00 <i>*Dinner at APG</i> Public Lecture 19:00- 20:00 Murnane		
Week 4 July 21-25					
9:00 - 10:30	U. Mehta	A. Lucas	J. Shan	J. Shan	J. Shan
10:30 - 11:00	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
11:00 - 12:30	F. Pollmann	F. Pollmann	F. Pollmann	F. Pollmann	What have we learned this month?
12:30 - 13:45	Lunch	Lunch	Lunch	Lunch	Lunch
14:00 - 15:30	A. Lucas	M. Hermele	M. Hermele		
Evening	<i>*Dinner at APG</i>				
<p>All lectures are in Duane Physics G130 Public lecture is in Duane Physics G1B20 Poster sessions are on the 11th floor of the Gamow tower Catered dinner is on the 11th floor of the Gamow tower Unless otherwise noted lunches are held at the Alfred-Packard Grill and dinners at WVCC Dining Hall</p>					

Scientific Program

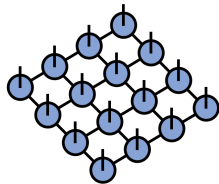
BSS 2025

Dynamics of Strongly Correlated Electrons

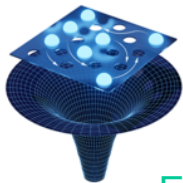
theory



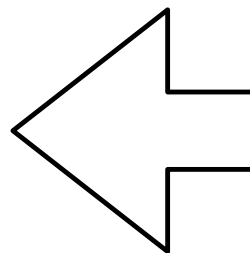
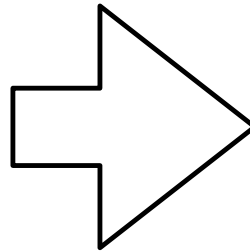
kinetics,
perturbative...



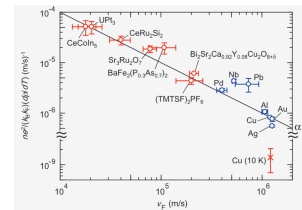
numerics...



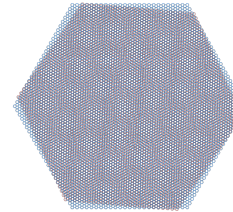
EFTs, SYK,
non-Fermi liquid...



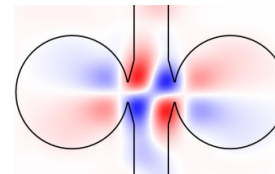
experiment



universality



new
materials



diverse
probes

Scientific Program

Overview of topics:

Week 1: transport, Fermi/non-Fermi liquids, Quantum Monte Carlo, Planckian dynamics

Week 2: ultrafast optics, superconductors, field theory, vdW and Moiré materials

Week 3: SYK models, hydrodynamics, transport bounds, ...

Week 4: Fermi surface bosonization, TMDs, tensor networks, fractons

This mature field is **driven by experiments** on quantum materials.

Many old mysteries remain unsolved. Innovative theoretical tools might solve them?

We have many new materials and methods to probe them. Applying mature theoretical methods in these new settings is also important.

This school aims to provide you with many perspectives on correlated electrons: formal/practical theory, computational methods, and experimental insight.

WELCOME!