Quantum and Laser Fusion Science Camp

Casper College, Casper, Wyoming, July 14-25, 2025

Sunday, July 13, 2025

3:00 PM: Snack food is being delivered to Residence Hall kitchen 352

6:00 PM: Dinner is set in the Residence Hall kitchen 352 and stored in fridge for late arrivals

Monday, July 14, 2025

Lectures will be in Loftin Life Science Center, Room 206 (**LS 206**) and Wold Physical Science Center, Room 103 (**PS 103**). Labs are in Wold Physical Science Center, Rooms 201-210 (**PS 201-210**)

7:00 – 8:00 AM	**BREAKFAST**	Tobin Cafeteria, bottom floor of UU building
PS 103		
8:10 – 8:40 AM	Bob Brick, *Quantum Camp & Symposium* Brandon Kosine, *President of Casper College* *Representative of the Casper College Board of Trustees*	**Overview and Welcome**
8:40 – 10:10 AM	Suhail Zubairy *TAMU*	Birth of Quantum Mechanics: Planck, Einstein, Bohr, De Broglie, black body radiation, photoelectric effect, atomic models
10:10 – 10:30 AM	BREAK	
PS 201-210		
10:30 – 12:20 PM	Lab	Photoelectric effect
12:20 PM	**LUNCH**	Tobin Cafeteria (bottom floor UU Bldg.)
Afternoon recreational activities		
PS 201-210		
5:15 – 6:15 PM	Problem-solving session	
6:15 – 7:00 PM	**DINNER**	Lobby of PS Building (next to pendulum)
PS 103		
7:00 – 8:00 PM	Robert Nevels *TAMU*	Radio and the Science of Wireless Transmission

Tuesday, July 15, 2025

7:00 – 8:00 AM	**BREAKFAST**	Tobin Cafeteria
PS 103		
8:10 – 9:40 AM	Suhail Zubairy, *TAMU*	Quantum interference, Heisenberg uncertainty relations, wave-particle duality, double slit experiment
9:40 – 10:00 AM	BREAK	
PS 201-210		
10:00 – 12:20 PM	Lab	Radio waves
12:20 PM	**LUNCH**	Tobin Cafeteria
Afternoon recreational activities		
PS 201-210		
5:15 – 6:15 PM	Problem-solving session	
6:15 – 7:00 PM	**DINNER**	Lobby of PS Building (next to pendulum)
PS 103		
7:00 – 7:50 PM	Andrew Young *Casper College*	The Life Cycle of Radio Galaxies
7:50 – 8:40 PM	Gordon Chen, *TAMU*	A Chitchat on Artificial Intelligence

Wednesday, July 16, 2025

7:00 – 8:00 AM	**BREAKFAST**	Tobin Cafeteria
PS 103		
8:10 – 9:40 AM	Suhail Zubairy, *TAMU*	Simple quantum systems: Polarizers and beam splitters, photons
9:40 – 10:00 AM	BREAK	
PS 201-210		
10:00 – 12:20 PM	Lab	Polarization of microwaves and visible light
12:20 PM	**LUNCH**	Tobin Cafeteria
Afternoon recreational activities		
PS 201-210		
5:15 – 6:15 PM	Problem-solving session	
6:15 – 7:00 PM	**DINNER**	Lobby of PS Building (next to pendulum)
PS 103		
7:00 – 7:15 PM	Sijmon Verhoef Fernandez, *TAMU*	Origins of the Hydrogen Bomb and its Implications in Fusion Energy Production
7:15 – 8:05 PM	Aart Verhoef, *TAMU*	Raman Spectroscopy, History and Applications
8:05 – 8:30 PM	Alma Fernández *TAMU*	Magnetoreception Mystery in Sensory Biology

Thursday, July 17, 2025

7:00 – 8:00 AM	**BREAKFAST**	Tobin Cafeteria
PS 103		
8:10 – 9:40 AM	Suhail Zubairy, *TAMU*	Coherent superposition, quantum entanglement, Schrodinger cat paradox, Quantum teleportation
9:40 – 10:00 AM	BREAK	
PS 201-210		
10:00 – 12:20 PM	Lab	Young's double slit experiment
12:20 PM	**LUNCH**	Tobin Cafeteria
Afternoon recreational activities		
PS 201-210		
5:15 – 6:15 PM	Problem-solving session	
6:15 – 7:00 PM	**DINNER**	Lobby of PS Building (next to pendulum)
PS 103		
7:00 – 7:50 PM	Richard Sandberg *Brigham Young University*	From Pashen curve and plasma physics to laser driven fusion
7:50 – 8:40 PM	Alexei Sokolov, *TAMU*	Quantum coherence and implications to fusion energy

Friday, July 18, 2025

7:00 – 8:00 AM	**BREAKFAST**	Tobin Cafeteria
PS 103		
8:10 – 9:40 AM	Suhail Zubairy, *TAMU*	Einstein-Podolski-Rosen (EPR) paradox, Complementarity and Bell's inequalities
9:40 – 10:00 AM	BREAK	
PS 201-210		
10:00 – 12:20 PM	Lab	Vacuum systems and plasma, Paschen Curve, Plasma spectrum
12:20 PM	**LUNCH**	Tobin Cafeteria
Afternoon recreational activities		
PS 201-210		
5:15 – 6:15 PM	Problem-solving session	
6:15 – 7:00 PM	**DINNER**	Lobby of PS Building (next to pendulum)
PS 103		
7:00 – 7:50 PM	Olga Kocharovskaya *TAMU*	The race for ultimate clock
7:50 – 8:40 PM	Gerald Cleaver *Baylor University*	Quantum Mechanics, General Relativity, and Quantum Gravity

Saturday, July 19, 2025

8:00 – 9:00 AM	**BREAKFAST**	Dorm kitchen
PS 103		Moderators:
9:10 – 10:00 AM	Video 3	Anatoly Svidzinsky, *TAMU* Wenzhuo Zhang, *TAMU*
10:00 – 10:10 AM	BREAK	
10:10 – 11:00 AM	Video 4	
11:00 – 11:10 AM	BREAK	
11:10 – 12:00 PM	Video 5	
12:10 PM	**LUNCH**	Dorm kitchen
6:00 PM	**Dinner, Dorm kitchen**	

Sunday, July 20, 2025

8:00 – 9:00 AM	**BREAKFAST**	Dorm kitchen
PS 103		Moderators:
9:10 – 10:00 AM	Video 6	Anatoly Svidzinsky, *TAMU* Wenzhuo Zhang, *TAMU*
10:00 – 10:10 AM	BREAK	
10:10 – 11:00 AM	Video 7	
11:00 – 11:10 AM	BREAK	
11:10 – 12:00 PM	Video 8	
12:10 PM	**LUNCH**	Dorm kitchen
6:00 PM	**Dinner, Dorm kitchen**	

Monday, July 21, 2025

7:00 – 8:00 AM	**BREAKFAST**	Tobin Cafeteria, bottom floor of UU building
PS 103		
8:10 – 8:40 AM	Marlan Scully, *Quantum Camp & Symposium* Brandon Kosine, *President of Casper College* *Representative of Casper College Board of Trustees*	**Overview and Welcome**
8:40 – 9:10 AM	Siegfried Glenzer, *SLAC/Stanford,* The quest for high fusion gain	
9:10 – 9:20 AM	BREAK	
LS 206		
9:20 – 10:50 AM	Suhail Zubairy, *TAMU*	Quantum secure communication, Quantum cryptography, BB-84 protocol, Quantum money
10:50 – 11:10 AM	BREAK	
PS 201-210		
11:10 – 12:20 PM	Lab	Quantum Computer programming I: Bell's inequality
12:20 PM	**LUNCH**	Tobin Cafeteria (bottom floor UU Bldg.)
Afternoon recreational activities		
PS 201-210		
5:15 – 6:15 PM	Problem-solving session	
6:15 – 7:00 PM	**DINNER**	Lobby of PS Building (next to pendulum)
PS 103		
7:00 – 7:30 PM	John Kline, *Los Alamos*	Fundamentals of Laser Fusion
7:30 – 8:00 PM	Alexey Zheltikov *TAMU*	The meaning of half-life: nuclear decay and fusion vis-à-vis quantum mechanics

Tuesday, July 22, 2025

7:00 – 8:00 AM	**BREAKFAST**	Tobin Cafeteria
LS 206		
8:10 – 9:40 AM	Suhail Zubairy, *TAMU*	Quantum communication with invisible photons
9:40 – 10:00 AM	BREAK	
PS 201-210		
10:00 – 12:20 PM	Lab	Quantum eraser
12:20 PM	**LUNCH**	Tobin Cafeteria
Afternoon recreational activities		
PS 201-210		
5:15 – 6:15 PM	Problem-solving session	
6:15 – 7:00 PM	**DINNER**	Lobby of PS Building (next to pendulum)
PS 103		
7:00 – 8:00 PM	**Poster Presentations by graduate students**	
8:00 – 8:30 PM	BREAK	
8:30 – 9:30 PM	**Poster Presentations by graduate students**	

Wednesday, July 23, 2025

7:00 – 8:00 AM	**BREAKFAST**	Tobin Cafeteria
LS 206		
8:10 – 9:40 AM	Suhail Zubairy, *TAMU*	Quantum Computing I: Quantum logic gates, Deutsch algorithm, Quantum dense coding and shell game
9:40 – 10:00 AM	BREAK	
PS 201-210		
10:00 – 12:20 PM	Lab	BB84 protocol
12:20 PM	**LUNCH**	Tobin Cafeteria
Afternoon recreational activities		
5:00 PM, Barbeque Dinner, Gateway Center (GW) 221/225 6:00-6:45 PM: Suhail Zubairy, *TAMU*, 2024 Nobel Prize in Physics and Some Personal Memories		
LS 206		**Moderators:**
7:20 – 8:20 PM	Video 10	Jeff Prevost, *University of Texas at San Antonio*

Thursday, July 24, 2025

7:00 – 8:00 AM	**BREAKFAST**	Tobin Cafeteria
LS 206		
8:10 – 9:40 AM	Suhail Zubairy, *TAMU*	Quantum Computing II: Shor and Grover's Algorithms
9:40 – 10:00 AM	BREAK	
PS 201-210		
10:00 – 12:20 PM	Lab	Online Quantum Computer programming II
12:20 PM	**LUNCH**	Tobin Cafeteria
Afternoon recreational activities		
PS 103		
5:00 – 6:15 PM	**Problem presentations by high school students**	
6:15 – 7:00 PM	**DINNER**	Lobby of PS Building (next to pendulum)
LS 206		
7:00 – 8:30 PM	**Problem presentations by high school students**	

Friday, July 25, 2025

7:00 – 8:00 AM	**BREAKFAST**	Tobin Cafeteria
LS 206		
8:10 – 10:00 AM	Suhail Zubairy, *TAMU*	Schrodinger equation, interpretation of the wavefunction, Hydrogen atom, particle in a box
10:00 – 10:30 AM	BREAK	
PS 103		
10:30 AM	Brandon Kosine, *President of Casper College* *Representative of Casper College Board of Trustees* Marlan Scully, *Quantum Camp & Symposium*	**Concluding remarks, Group Photo, Certificates awarding ceremony**
12:00 PM	**LUNCH**	Tobin Cafeteria
Afternoon recreational activities		
6:00 – 7:00 PM	**DINNER**	Tobin Cafeteria

Saturday, July 26, 2025

5:30 – 8:30 AM	**BREAKFAST**	Dorm kitchen

Videos:

Video 1:

Models of Atom: Plum pudding model, Rutherford model, Bohr model
Matter waves, de Broglie wavelength
Quantum mechanical picture of Atoms and Chemical bonding

Video 2:

Heisenberg Uncertainty Principle
Structure of Atoms according to Quantum Mechanics
Crystals
Superconductivity
Solar Cells

Video 3:

Quantum Entanglement
Double-slit experiment and measurement in quantum mechanics
Delayed choice quantum eraser experiment
Why don't quantum effects occur in large objects

Video 4:

EPR paradox and Bell's inequality
How quantum mechanics produces reality
Copenhagen vs many worlds interpretation of quantum mechanics
Free will, consciousness, and quantum mechanics

Video 5:

Standard Model of Elementary Particles
Fundamental Forces of Nature
Strong Nuclear Force, Quantum Chromodynamics
Higgs boson and Higgs field
Electroweak force, Higgs mechanism of mass generation

Video 6:

Where do particles come from? Big Bang
Where do all the elements ultimately come from?
Where does mass of atoms come from?
Physics of the Sun
Neutron Stars and Pulsars

Link to Videos

Link to Summer School Program

Video 7:

Minkowski Spacetime and Special Relativity
General Theory of Relativity
Black holes and Hawking radiation
Problems with General Relativity
String Theory

Video 8:

Quantum Fields
Dark matter in the Universe
Theory of Everything
Supersymmetry

Video 9:

Cosmic Microwave Background Radiation
Dark Matter and Dark Energy in the Universe

Video 10:

Quantum Computer
How does a computer CPU work: classical vs quantum
What is Qubit made from
Superconducting Qubit
Quantum world of diamonds
Quantum computer algorithms
Quantum cryptography: the BB84 protocol

Video 11:

Origin of Life
How does smell work - Quantum connection
How quantum mechanics helps birds navigate
Quantum Mechanics in Photosynthesis
Quantum brain, Quantum mind and Consciousness

Video 12:

How lasers work
Inertial confinement nuclear fusion
Lithium-ion battery
Light Emitting Diode (LED)
Graphene – the miracle material

Afternoon Activities

- This year, we will feature a number of afternoon activities such as hiking, kayaking, swimming, rafting, and others.

- The activities will be divided into three groups: free activities, reserved paid activities that are organized by us beforehand, and other paid activities that you can organize yourselves.

- The sign-up sheets for these activities will be in the lobby of the dorms so that you can organize into groups and decide who will go, who will drive, etc.

- If you can drive, put a number to the right of your name in the "Number of seats" column. It is up to those interested in the activity to ensure that there are enough drivers with enough seats.

- Rafting and horseback riding can only accommodate a certain number of people, so do not write in more names than there are on the sign-up sheet.

- People generally congregate in the lobby around 1:30-2:00 p.m. after lunch to gather together and depart for the activity (although the reserved activities may start later in the afternoon).

Free Activities

Hiking:
The most common spots to hike around Casper are Rotary Park and Casper Mountain. Both are easily within driving range for an afternoon and feature beautiful views. More trails can be found on sites such as alltrails.com.

Swimming:
Sandy Beach at the nearby Alcova Reservoir features nice, cold water and a relatively large area for swimming.

Tate Geological Museum:
The Tate Geological Museum sits on the Casper College Campus at the top of the hill and features various geology and paleontology exhibits. It is free to enter, and we will attempt to organize either a guided tour with a paleontologist who works at the museum, or a fossil dig at some point throughout the duration of the summer school/science camp.

Reserved Paid Activities

To start, the summer school/science camp organizers will reserve only one outing of these paid activities for the first week, but we will not hesitate to reserve more if there is more interest shown than there is capacity for each activity. Additional interest forms will be included with the sign-up sheets in case the activity is full.

Rafting (now a free activity–paid for by IQSE and Casper Foundation):
The rafting will take place on the North Platte River which runs through Casper and features a few large rapids on the section of the route inside of the city. The cost is usually $20 per person, but the IQSE and Casper Foundation have graciously decided to pay the costs for all those who wish to attend. The location and time will be on the sign-up sheet.

Horseback Riding:
Horseback riding has always been a popular activity during the Casper summer school. For this activity, you will be taken on a trail ride around the area by the barn. The cost will be $65 per person. The location, time, and payment details will be on the sign-up sheet.

Other Paid Activities

These activities are activities that people have done in the past, but the summer school/science camp organizers will not make reservations for any groups prior to the start of the summer school/science camp.

Shooting Lessons:
Shooting lessons are offered at Wyoming Gun Company in Casper. They will teach you about gun safety, how to shoot properly, and let you practice some after the lesson. The details can be found at the Wyoming Gun Company's website under the "Events" tab.

Kayaking:
Kayaks can be rented relatively cheaply at Lake Alcova Resort. They serve on a first come, first serve basis, and rates, availability, and location can all be found at their website alcovaresort.com.