Imagine Day 2019: Physics and Astronomy

11:00 Introductions: Colin Gay (Department Head), Chris Waltham (UG chair), Kirsty Dickson (UG Coordinator)

11:15 **2nd Year Student Session – Janis McKenna**

- Honours, Majors, Minors Programs – Janis McKenna
- Biophysics Program – Carl Michal (11:30)
- Astronomy Program - Ingrid Stairs (11:40)
- Science Co-op – Javed Iqbal (11.50)
- Club Presentations (12:00)
  - PhysSoc (Ella Meyer)
  - Biophysics Society (Bellinda Yin)
  - Astronomy Club (Katie Rink)

12:15 Lunch (sandwiches)

12:30 **Physics & Astronomy -- Research Programs**

- Optical Physics – Valery Milner
- Astronomy/Astrophysics – Ingrid Stairs (12:40)
- Condensed Matter Physics – Marcel Franz (12:50)
- Medical/BioPhysics – Carl Michal (13:00)
- Particle Physics – Colin Gay (13:10)
- Gravity/String theory (13:20)

13:30 **3rd/4th Year Student Session – Chris Waltham and Jeremy Heyl**

- Final year, graduation check
- What if you don't want to go to grad school (and most of you won't)?
- Grad School Planning, NSERC PG Scholarship Applications, other FAQs

Introduction

- Professor Colin Gay

Head, Department of Physics and Astronomy

Group Leader

- Kirsty Dickson
  Undergraduate Program Coordinator
- Professor Chris Waltham (MC)

Undergraduate Chair

Kirsty Dickson
Undergraduate Program Coordinator

Office: Hennings 329A
Office hours: 8:30-4:30
Phone: 604-822-3026
Email: ugcoord@phas.ubc.ca

1. General program inquiries and advising.

2. PHYS & ASTR course registration issues: course add/drop/audit, course conflict, section changes, full section force registration, and prerequisites override.

3. Specialization applications and specialization changes.

4. Graduation check on specialization requirements only.
   - For Breadth & Faculty requirements please check with Science Advising.

5. USRA applications and other summer research opportunity inquiries.

6. Liaison between department, student clubs and students: student events emailing (student clubs events, WOW event, CAP University Prize Exam, and CAP Lecture Tour etc.)

7. ***Important: Always include your student number in your emails to the department:**
   - Please Include your student # and full name in your email subject line!!!

Second year in Physics and Astronomy

Undergraduate chair: Chris Waltham
1st -year advisor: James Charbonneau
2nd -year advisor: Janis McKenna
that's me: janis@physics.ubc.ca
3rd- and 4th-year advisor: Janis McKenna
Astronomy advisor: Ingrid Stairs
Biophysics Advisor: Vesna Sossi
Combined Major in Science: any PHAS Advisor
Program coordinator: Kirsty Dickson ugcoord@phas.ubc.ca
All of us are here to offer advice, help with any program/course issues.

2nd Year – gateway to PHAS programs

In 2nd year, you entered one of our Programs:

- ★Honours Physics
- ★Combined Honours/Major Physics plus another Science
- ★Major Physics, Major Astronomy
- ★Dual Degree Program – BSc (Physics) & BEd (Secondary)
  BSc (Physics) & B Arts
  BSc (Physics) & B Music
- ★You may be in another program doing a Minor in Physics

Or in 3rd year, you may enter:

Combined Major in Science & choose a Phys and Astro "package"

Graduation Requirements

You are responsible for knowing your graduation requirements. Consult UBC Calendar and Faculty of Science online:
https://www.science.ubc.ca/students/degree

www.calendar.ubc.ca/vancouver - under "Faculties, Colleges and Schools" choose "Science" then "Physics" or "Astronomy"

Arts Electives, Science Electives, Science Breadth Requirement, Communication/English requirements are all necessary to graduate.

Use Degree Navigator in SIS to help you check that you're meeting your program requirements. At end of 3rd year come get a "Graduation Check" from Science Advising, or our PHAS Undergraduate Co-ordinator

BSc Graduation Requirements

Summary of Minimum Program Requirements Science

	Major, Combined Major, or General Science	Major+Minor in Science	Major+Major (Science)	Honours or Combined Honours	Honours+Minor in Science
Total Credits	120	120	120	132	132
of which courses 300+	48	48	60	48	60
Total Science Credits	72	72	72	72	72
of which courses 300+	30	42	54	42	54
Total Arts Credits	18	18	18	18	18
Max. credits not in Science or Arts (optional)	18	18	18	18	18

Science Breadth requirement – all BSc degrees 2019+

(3rd and 4th year students go by old Breadth requirement from 2016-2018 Calendar)

Majors, Honours: 3 cr from 6 of the 7 Science Categories

Combined Majors, Combined Honours: 3 cr from 5 of the 7 Science Categories

Categories: MATH, PHYS, CHEM, CPSC, (STAT/DSCI)*, BIOL*, (EOSC/ASTR/ATSC,GEOB,ENVR)*

* some special cases/exceptions, see http://www.calendar.ubc.ca/vancouver/index.cfm?tree=12,215,410,1663

Honours

For those intending to enter career in research or continue to graduate school.

Honours degrees require a 6 credit Honours thesis.

- Honours Physics
- Honours Biophysics
- Honours Physics and Astronomy
- Honours Physics and Mathematics
- Honours Computer Science and Physics
- Honours Chemical Physics
- Honours Physics and another Science Subject

(We can help you formulate and get approval for a program which meets all Honours requirements, Faculty of Science requirements and UBC graduation requirements)

All Honours Science Degrees:

- **Must take at least 30 credits Sept-April (or 15 credits/term if co-op)**
- **Must maintain average >68% each academic year**
- **Must not fail any courses.**

Major

★**For those intending to enter career in science/ technology, education, science-related.**

★NOT the recommended stream for graduate studies, although Majors who take ALL the core senior honours physics courses have been accepted to graduate schools.

★Offers more flexibility than Honours (more electives)

★Fewer total credits (120 in Major, 132 in Honours)

★"Easy" to fit in a Minor (Minor could be in Arts, Commerce, Science.)

- Major Physics
- Major Astronomy
- Combined Major Physics and Computer Science
- Combined Major Physics and Oceanography
- Double Major in Science and Arts

Dual Degree

★**For those intending to add a second specialization outside of Science.**

★NOT the recommended stream for graduate studies, although students who take all core senior honours physics courses may be accepted to graduate schools.

- Dual Degree Science and Arts BSc(Physics) & BA
- Dual Degree Science and Music BSc(Physics) & BMus
- Dual Degree Science and Education

5 year program:

Dual Degree Program: BSc(Physics) BEd (Secondary)

Graduate with qualifications/certification to accept teaching position

Combined Major in Science

https://cms.science.ubc.ca/

- ★Broad-based Science education
- ★Maximum flexibility, allows for large breadth
- ★Choose 3 CMS “packages” or specializations
- ★**NOT** for those planning for graduate studies in Physics/ Astronomy

Physics and Astronomy CMS Package

1. Physics Option

Prerequisites: MATH 200; PHYS 117 (or 101 or 107); PHYS 118/119 (or 102 or 108/109); PHYS 200. PHYS 219, 229 and MATH 215 recommended

Package Courses: 3 credits of PHYS numbered 300 or higher (except: PHYS 348) and 6 credits PHYS or ASTR courses numbered 300 or higher (except: PHYS 348).

Recommended Courses: PHYS 301, 304, 305, 309, 312, 314, 315, 318, 319, 330, 333, 404, 405, 420

2. Astronomy Option

Prerequisites: (MATH 200, MATH 317) or MATH 217; MATH 215; PHYS 117 (or PHYS 101 or PHYS 107); PHYS 118 (or PHYS 102 or PHYS 108); PHYS 200; PHYS 203; PHYS 216. PHYS 210, ASTR 200, and ASTR 205 recommended

Package Courses: 6 credits from ASTR 300, 333, 403, 406, 407 and 3 credits of PHYS numbered 300 or higher

Other “Packages”:
Chemistry, Earth/Environmental Science, Life Science, Mathematical Science

Minor (outside Physics/Astronomy)

★Pick up a second specialization

★Relatively easy to add a Minor to a Major Physics or Major Astronomy due to more flexibility in Majors program and courses

★With planning: add a Minor to Honours Physics

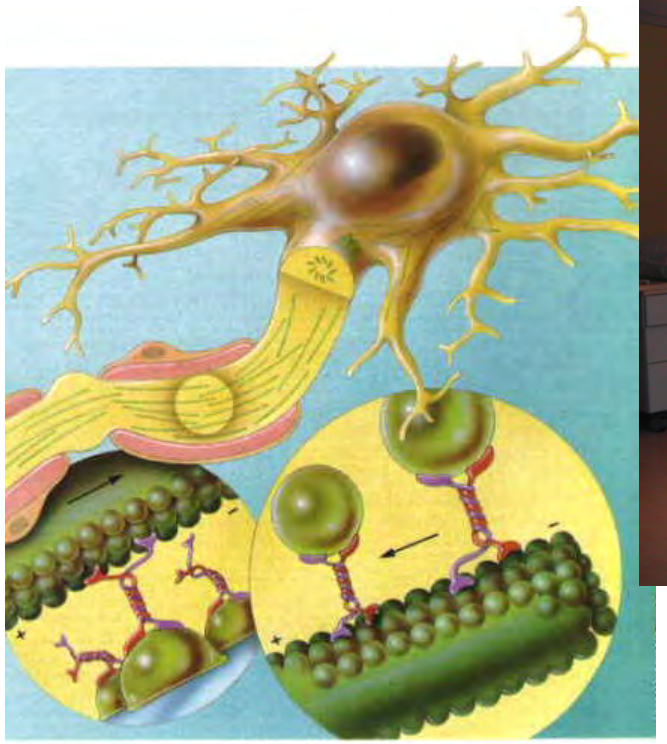
★Not much “elective room” to add a minor to Combined Honours or Combined Majors program – but it has been done.

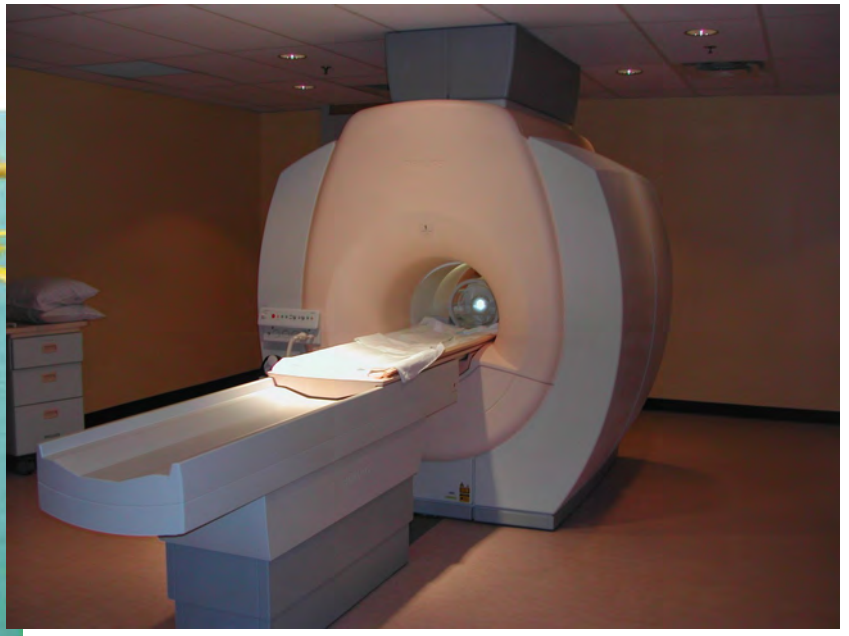
- Minor in another Science
- Minor in any Arts subject (Economics, Philosophy, a language, often seen in PHAS, but any Arts minor possible)
- Minor in Commerce
- Minor in Human Kinetics
- Minor in Land and Food Systems

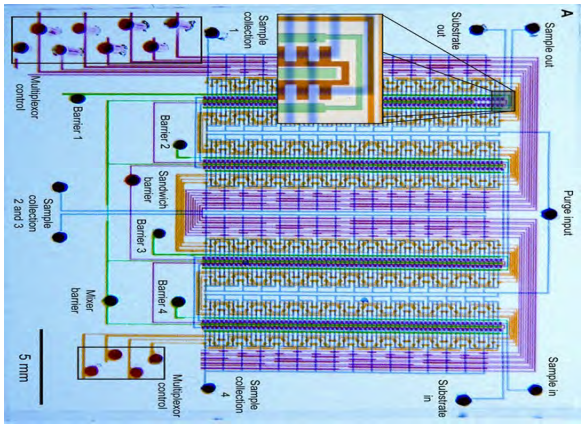
Typically need 18 upper level (300- 400-level) credits
Some Arts Minors require 30 credits, 18 of which must be upper level.

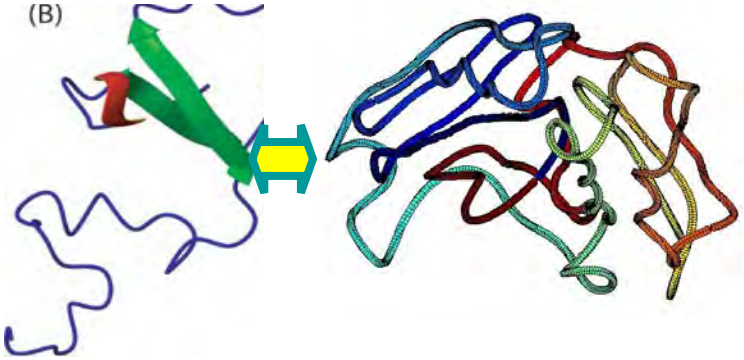
To apply for Minor: download forms from Faculty Science website.

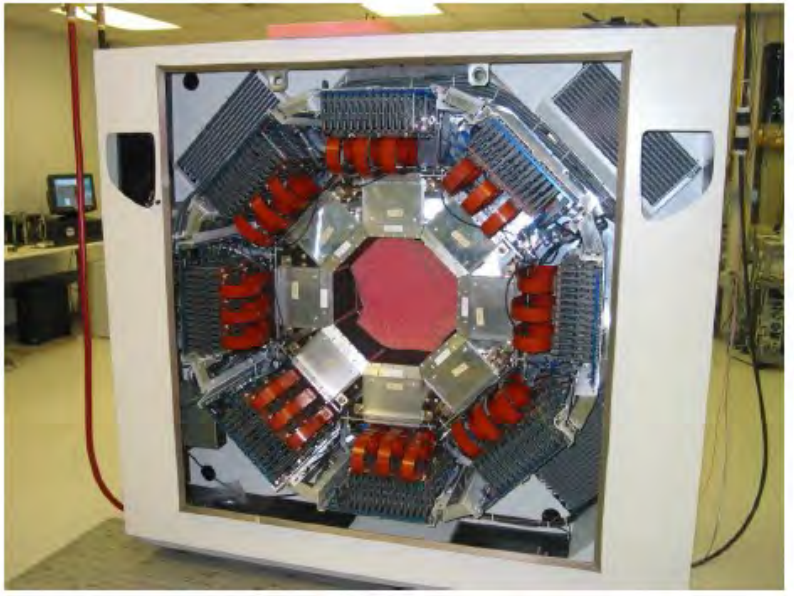
Biological and Medical Physics





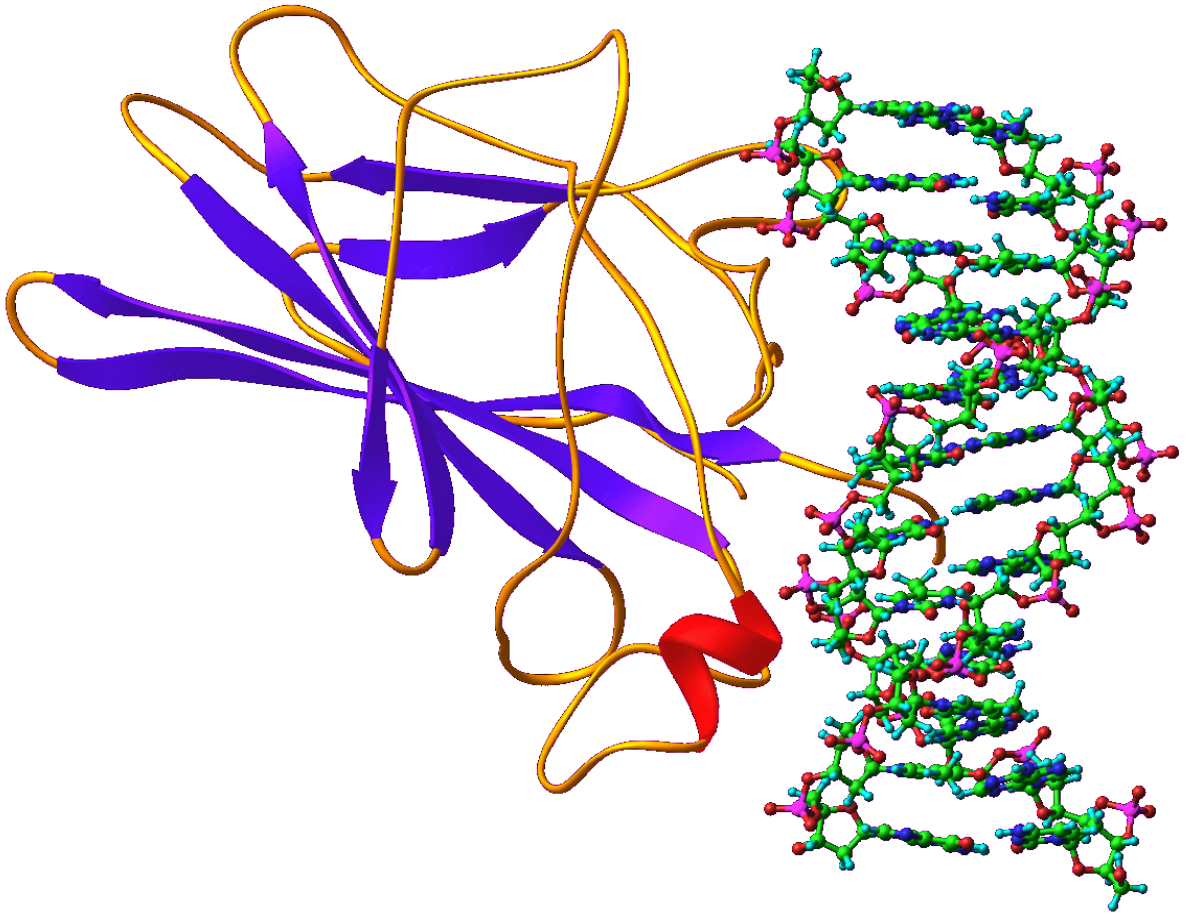






What is Biophysics?

an interdisciplinary area of science that applies the theories and methods of physics to questions of biology.

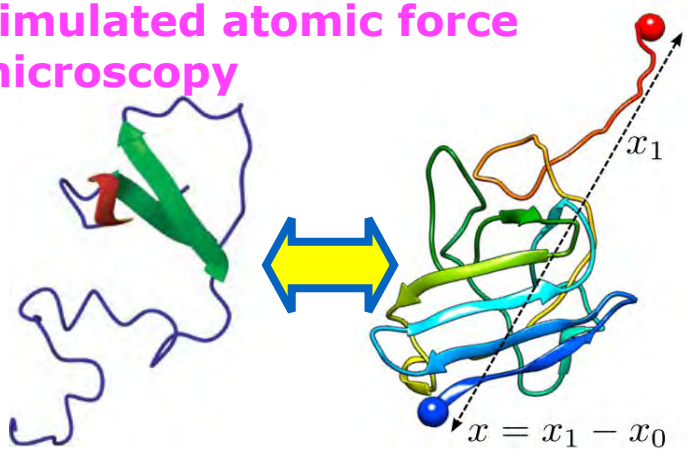


Steven Plotkin:

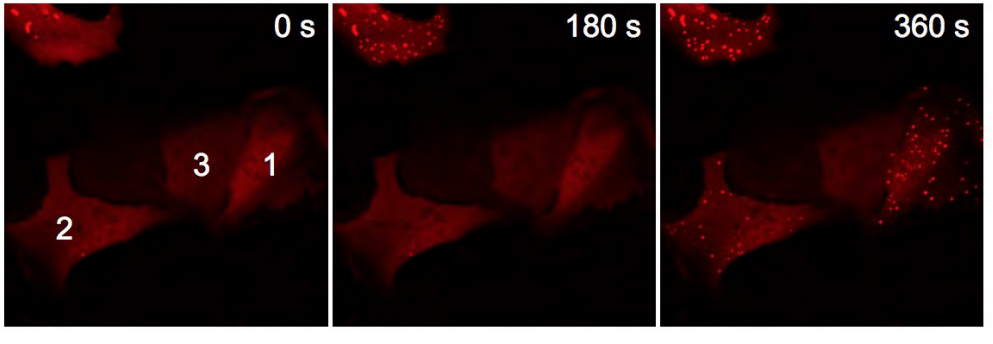
Experiments, computation, and theory.

- **The evolution of multicellularity. What are its molecular genetic origins? How do DNA and proteins collectively act to make an organism multicellular?**
- **Rational design of therapeutics for Alzheimer's disease, schizophrenia, and other protein-misfolding related diseases.**

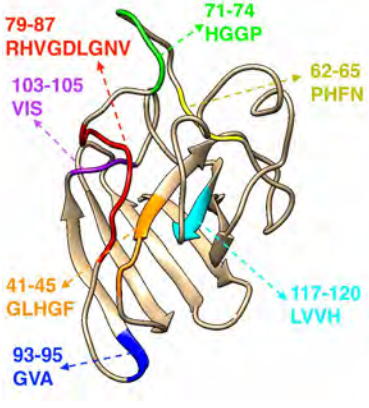
Simulated atomic force microscopy

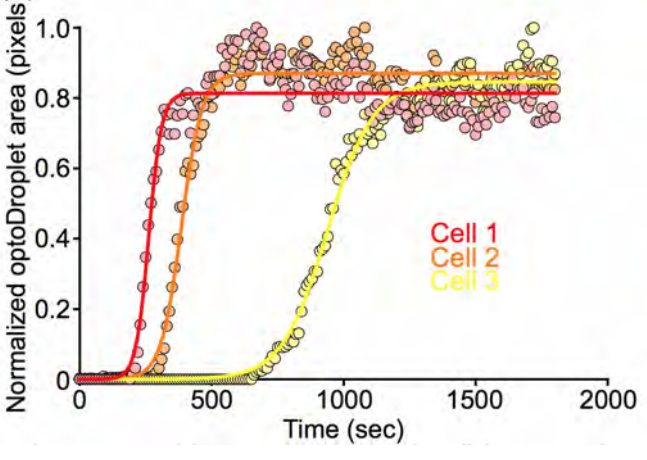


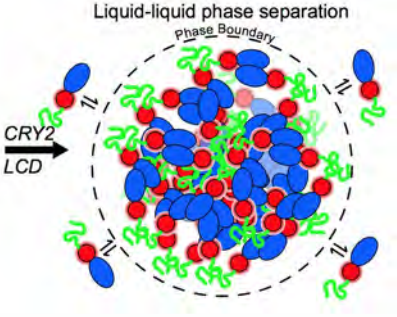
Light-activated optogenetic proteins



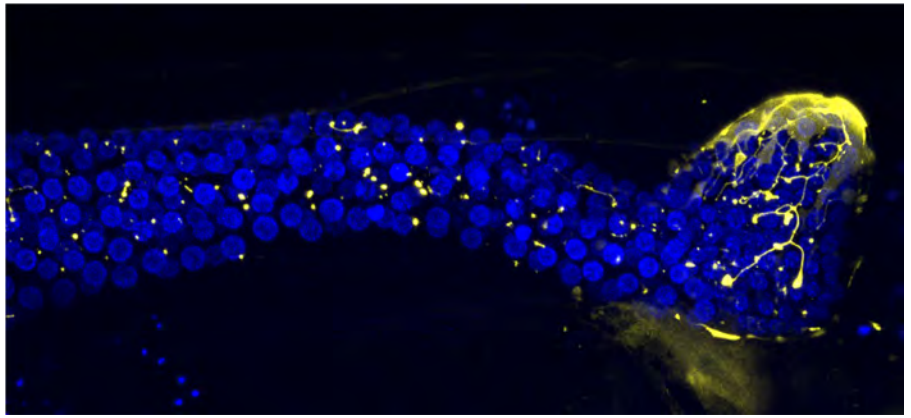
Computational misfolding-specific epitope prediction

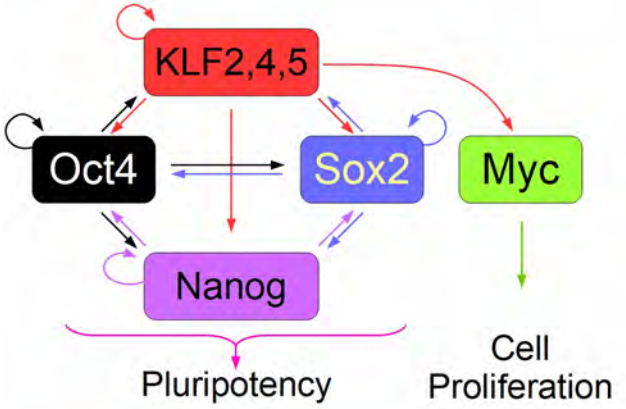






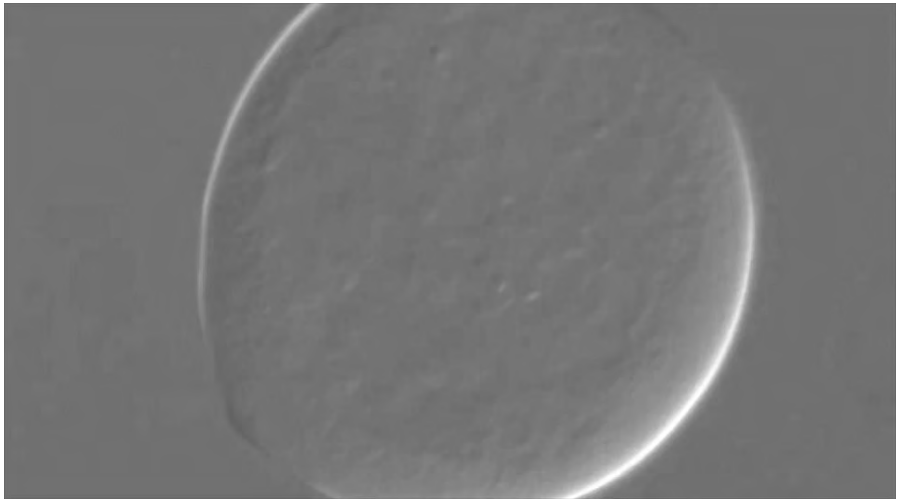
…and genetic editing tools such as CRISPR to explore stem cell gene regulatory networks.





Our current "model organism" is perhaps the most anciently-branching multicellular animal on the tree of life, the ctenophore (comb jelly) Mnemiopsis leidyi

Mnemiopsis in our tanks



Coordinated cell division in the embryo

Joerg Rottler: Biopolymer Physics

- Single molecule biophysics: force spectrosopy on DNA and proteins with molecular simulations

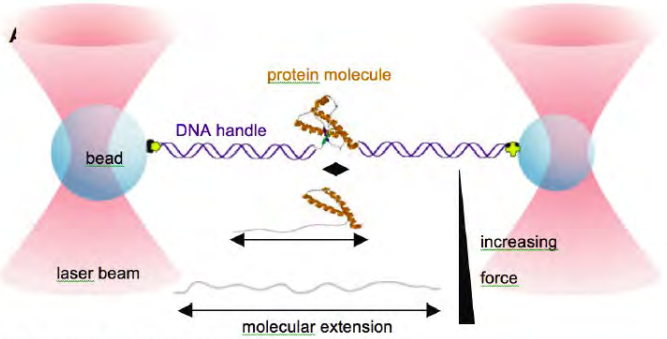
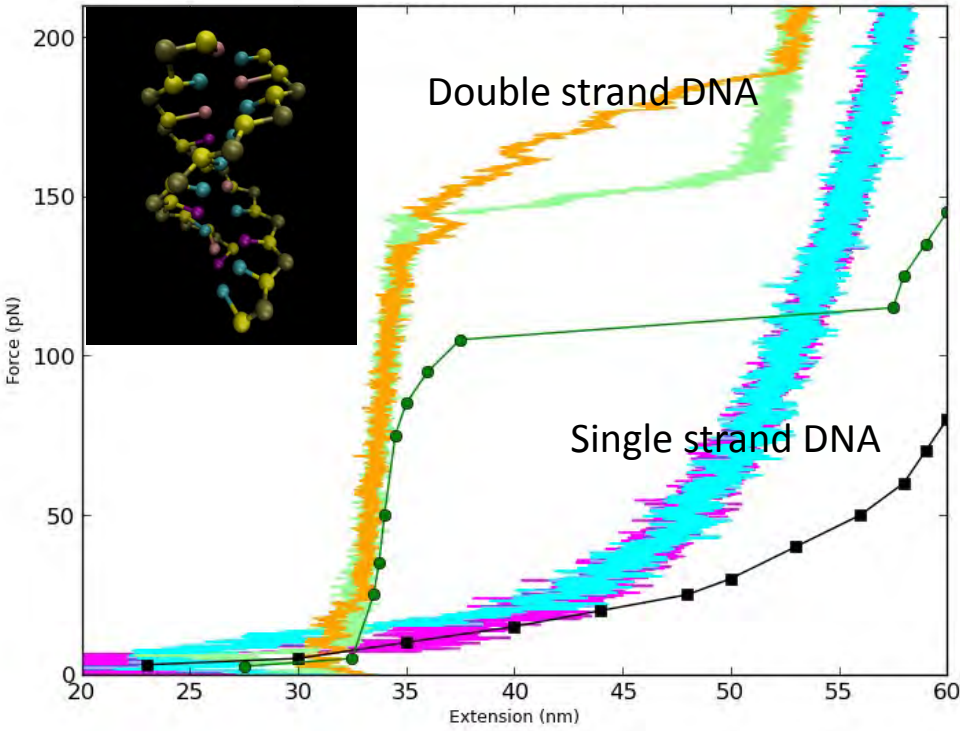
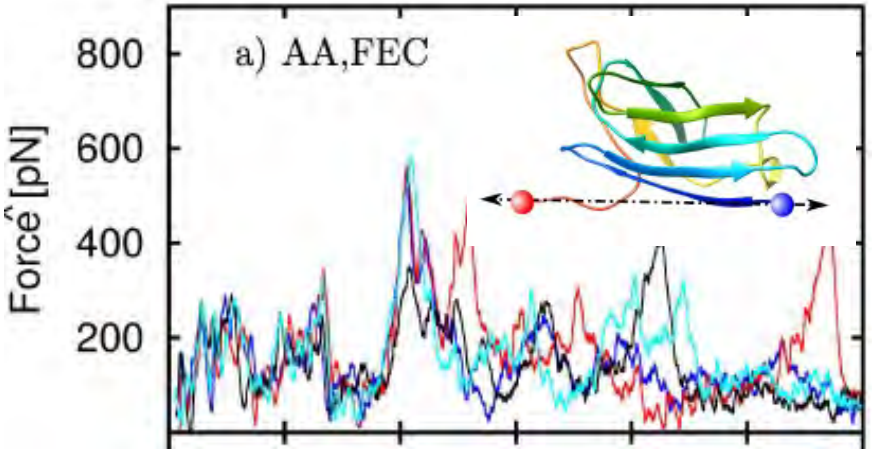


Figure 2: Schematic description of the optical trap.

DNA (over)stretching



Mechanical unfolding of proteins



Superoxide dismutase 1

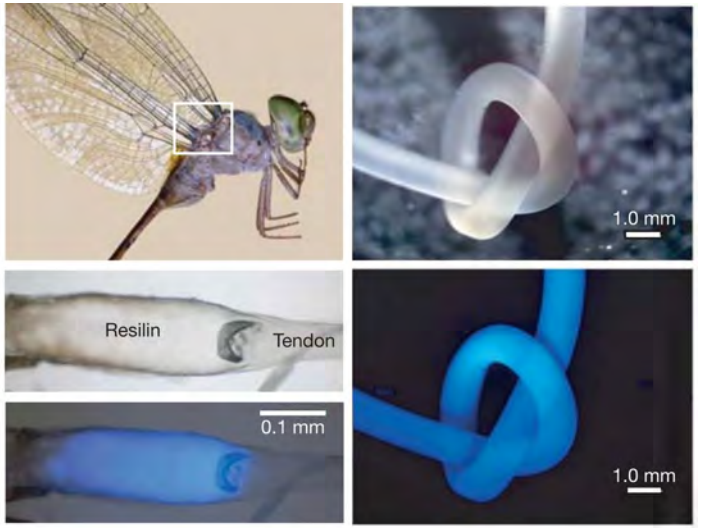
- Mechanical properties of biopolymer networks and cell assemblies

Carl Michal – Solid-State NMR of biological materials

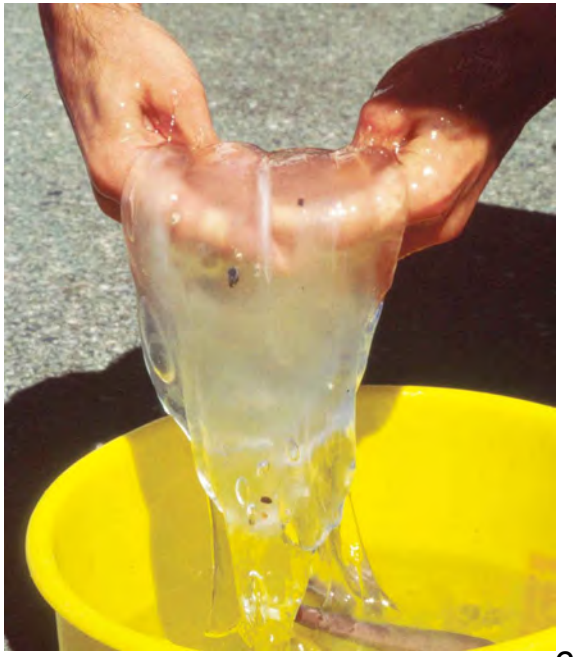
Structure-properties-function relationships

Spider silk

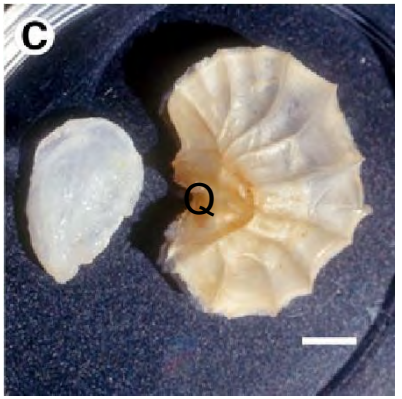
Resilin

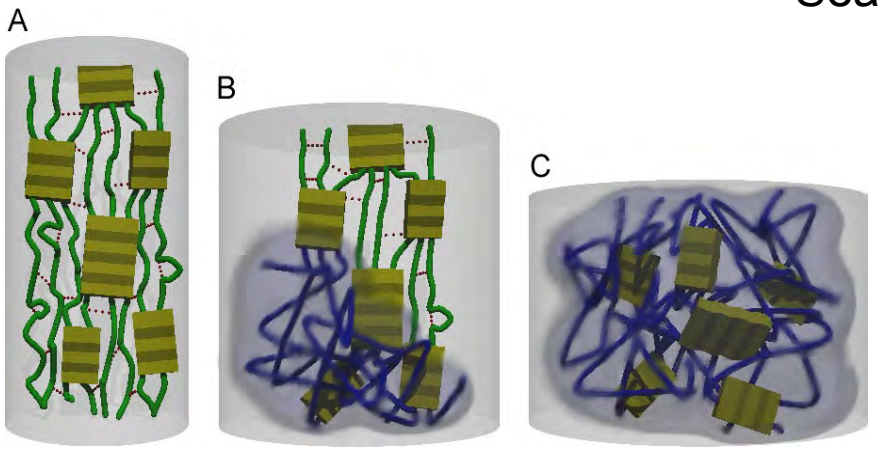


Hagfish slime threads



Sea-snail egg capsule

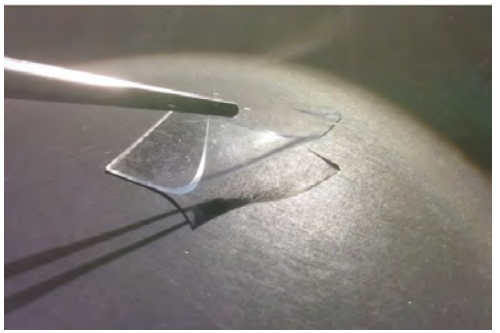




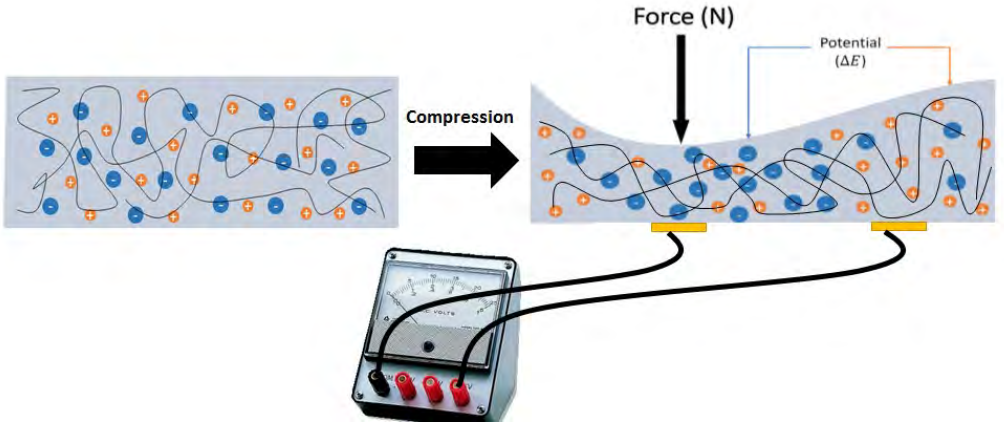
Carl Michal

Understanding the NMR in MRI:

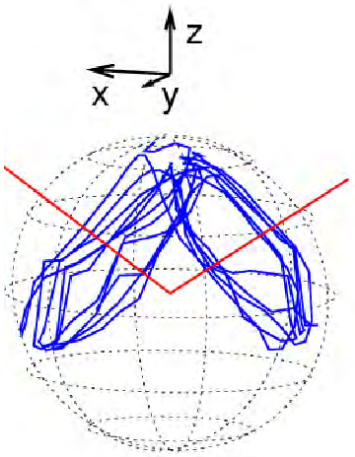
Ion transport in polymer gels and 'energy materials'

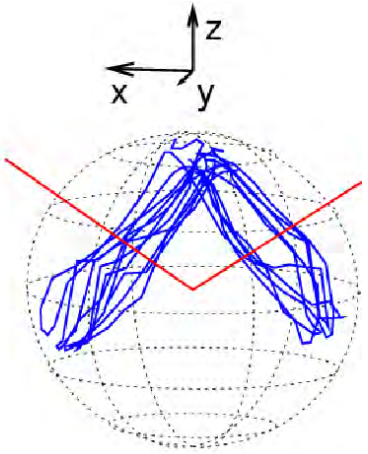


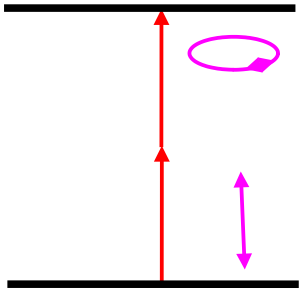
Piezoionic effect

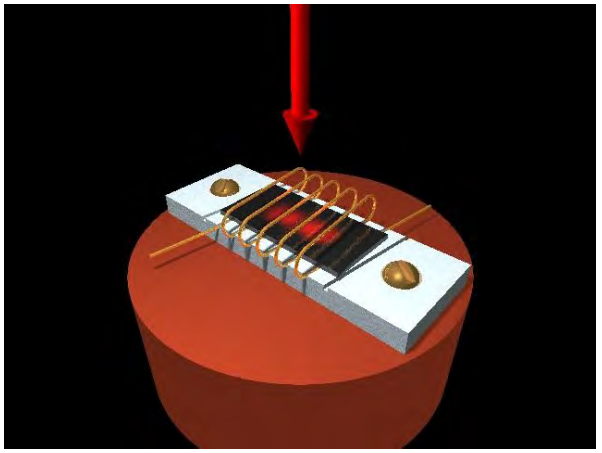


Novel NMR techniques: Two-photon NMR, noise spectroscopy, microcoils optically pumped NMR





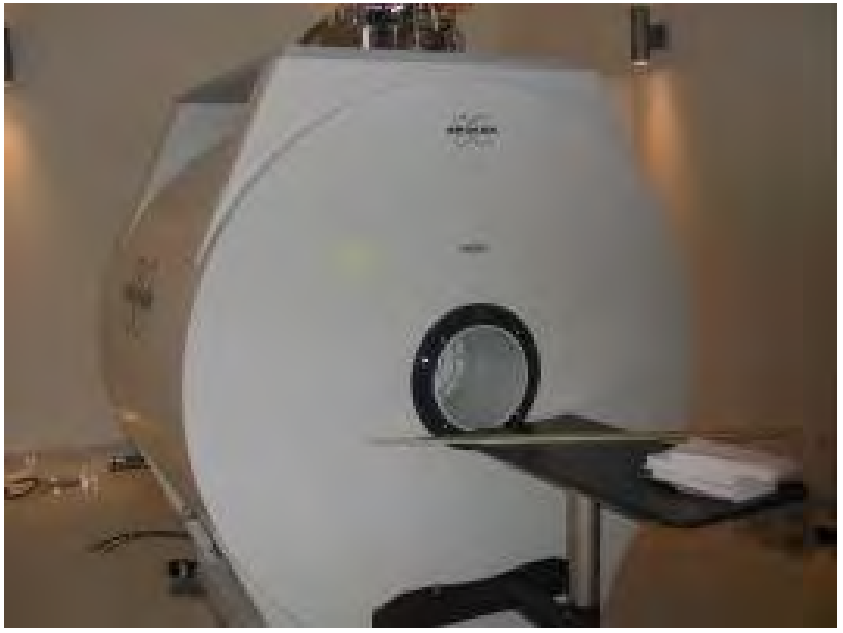




What is Medical Physics?

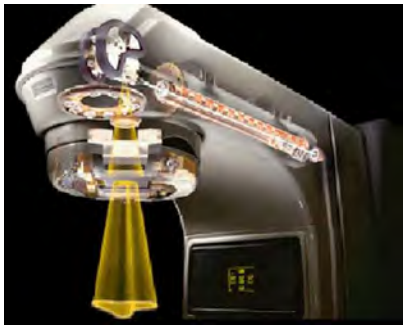
- The application of physics to medicine

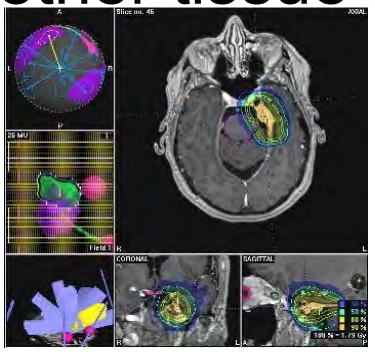
- Clinical and Research



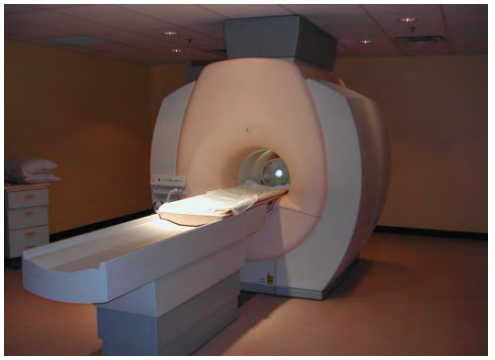
Medical Physics

- Therapy: how can we find the optimal way to kill cancer cells while leaving other tissue unscathed?





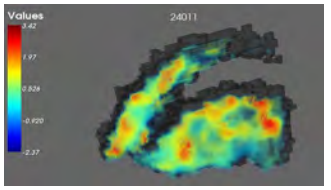
- Imaging: Can we create a basis for personalized medicine with quantitative measurements of physiological parameters?



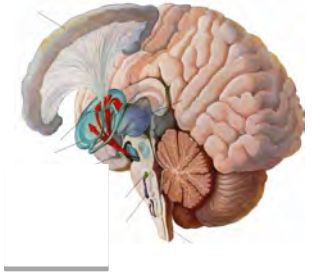
- **Brain health and illness:** Can we understand how the brain works and how it is affected by disease?

PET and **MRI** Imaging can provide a wealth of information on brain function

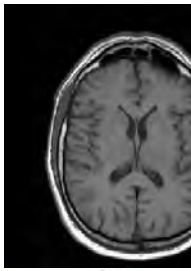
Neurotransmitter systems



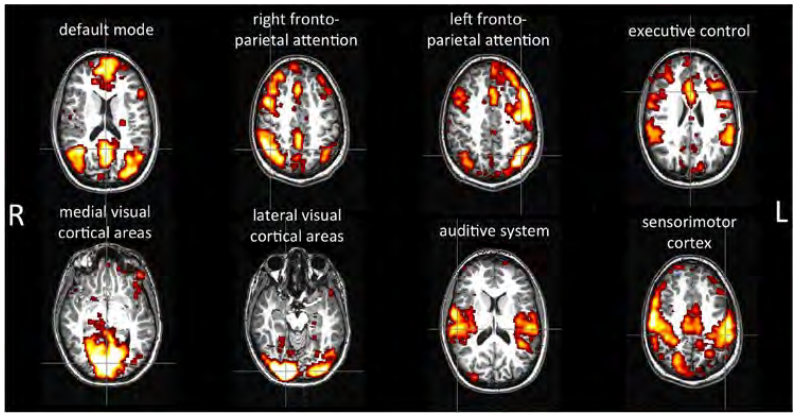
Neurotransmitter release in rats

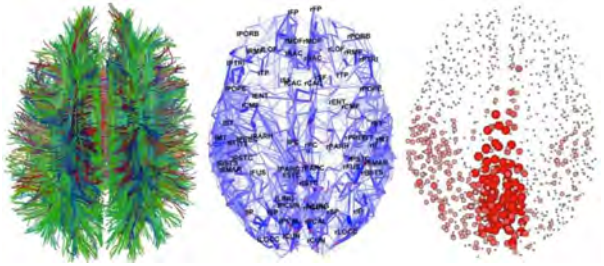


Brain function at rest



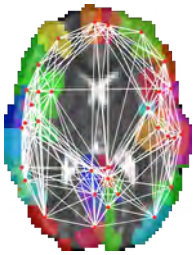
Anatomy

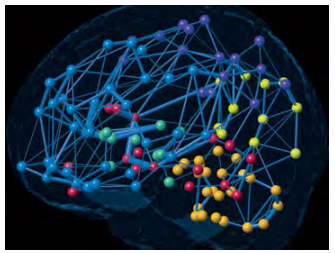




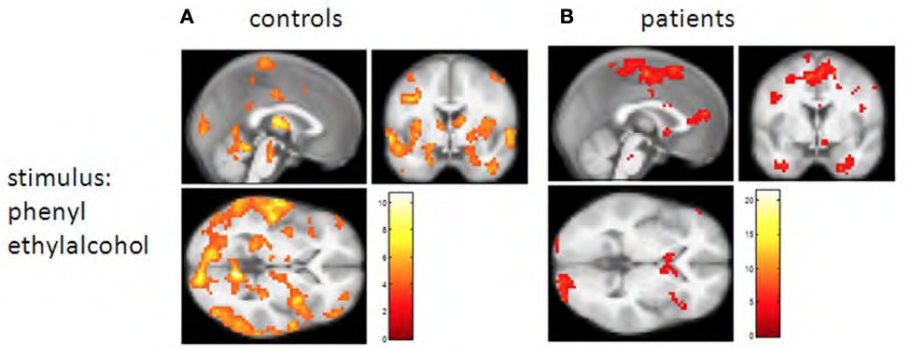
Structural connectivity

Graph analysis of connectivity





Brain function in response to a task



Astronomy specializations at UBC

Astronomy Major

Career options include: technical support personnel at international observatories, astronomy educators, and outreach experts at science centres and planetaria. The diverse skills acquired in this specialization are attractive to non-academic employers.

Astronomy specializations at UBC

Astronomy Major

Career options include: technical support personnel at international observatories, astronomy educators, and outreach experts at science centres and planetaria. The diverse skills acquired in this specialization are attractive to non-academic employers.

Combined Honours Physics and Astronomy

Intended for students who want to go on to graduate studies in Astronomy and Astrophysics (or other areas of Physics, depending on upper-level electives). A Ph.D. is generally a requirement to be a scientist at a research institute or observatory, or to be a professor at a university.

Also available: Co-op, Minor, CMS

Astronomy courses at UBC

ASTR	101	Intro. to the Solar System		
ASTR	102	Stars, galaxies, cosmology		
ASTR	200	Frontiers of Astrophysics	Maj	Hon
ASTR	205	Stars and Stellar Populations	Maj	Hon
ASTR	303	Galaxies	Maj	Hon
ASTR	333	Exoplanets and Astrobiology		
ASTR	403	Cosmology		
ASTR	404	Astronomical & Astrophysical Measurements	Maj	Hon
ASTR	405	Astronomical Laboratory	Maj	Hon
ASTR	406	High-Energy Astrophysics	} Maj	Hon
ASTR	407	Planetary Science		
ASTR	449	Directed Research in Astronomy		Hon

Astronomy courses at UBC

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ASTR	404	Astronomical & Astrophysical Measurements	Maj	Hon
ASTR	405	Astronomical Laboratory	Maj	Hon
ASTR	406	High-Energy Astrophysics	} Maj	Hon
ASTR	407	Planetary Science		
ASTR	449	Directed Research in Astronomy		Hon

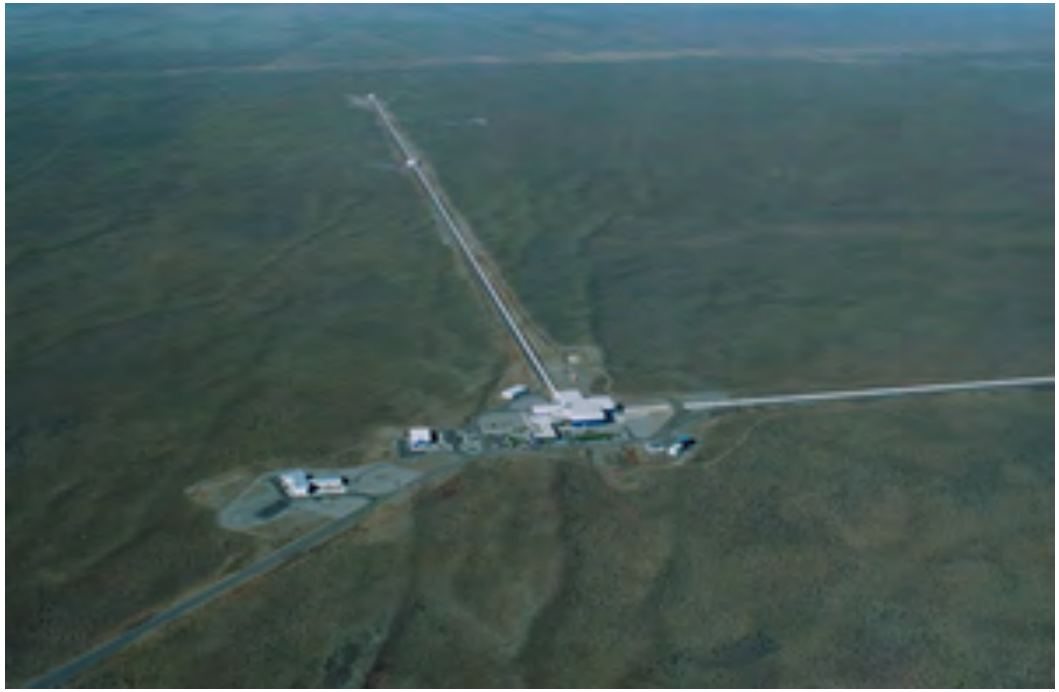
Useful background but not required

Start of specializations

Astronomy opportunities at UBC

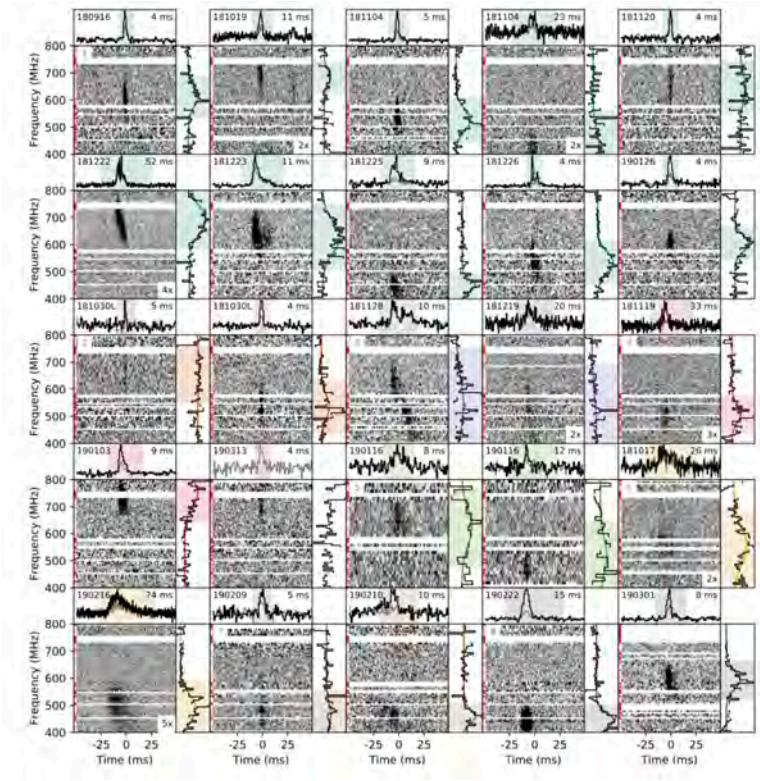
- Small, remotely-controlled optical telescope in Chile for undergraduate training and research
- The Small Radio Telescope will soon be reinstalled on the roof of Hebb for undergraduate teaching
- Lots of opportunities to get involved in research using many different telescopes: LIGO, CHIME, Arecibo, Green Bank, CFHT, Gemini, Hubble, Kepler, Chandra, LSST, eventually the Thirty Metre Telescope and the Square Kilometre Array… And of course there are theoretical and numerical opportunities, too!

LIGO



New faculty member Jess McIver offers students the chance to work on gravitational-wave detection.

CHIME



CHIME/FRB collaboration, arXiv:1908.03507

UBC, McGill, Toronto and DRAO have worked together to build an instrument in Penticton, BC that will measure the expansion history of the universe, monitor hundreds of pulsars every day, and discover huge numbers of the mysterious Fast Radio Bursts (FRBs). It has already found many FRBs, including repeaters.

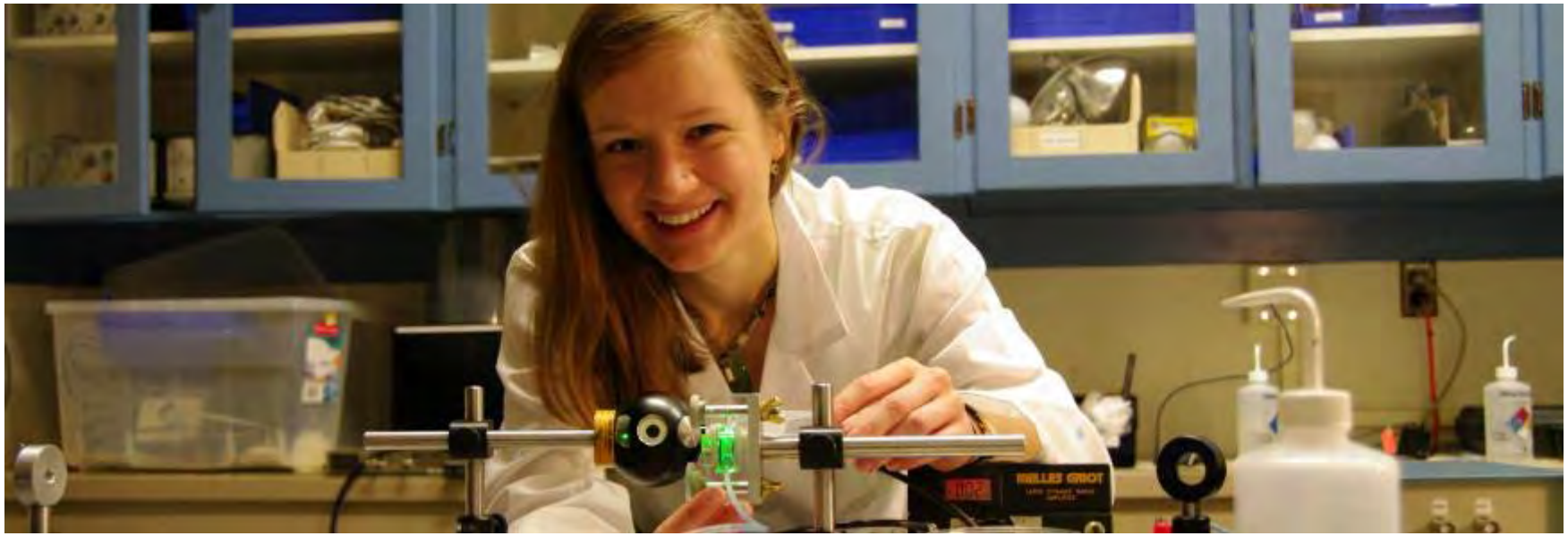
Astronomy Career Information

- http://casca.ca/?page_id=93
- https://aas.org/learn/careers-astronomy
- www.ras.org.uk/images/stories/ras_pdfs/careers_v12.pdf

Astronomy Advising

Prof. Ingrid Stairs
Hennings 332
ug-astr@phas.ubc.ca

UBC Science Co-op



Javed Iqbal iqbal@phas.ubc.ca

www.sciencecoop.ubc.ca

Science Co-op Programs

Atmospheric Science	Biochemistry	Biophysics	Biopsychology	Biotechnology
Chemistry	Cognitive Systems	Computer Science	Earth & Ocean Sciences	Engineering Physics
Environmental Sciences	General Sciences	Integrated Sciences	Land & Food Systems	Mathematics
Microbiology	Pharmacology	Physics & Astronomy	Statistics (Undergrad & Grad)	And more…

What is Co-op?

- Integration of academic studies with **relevant**, **paid**, **supervised** and **productive** work experience
- Co-op students gain skills and experience which prepare them for the future job market, graduate studies and give them improved employment opportunities upon graduation

Average monthly salary for Physics/Astronomy Co-op: $2500

PHAS Schedule - A

Year	Term1	Term 2	Summer
1	ST 1	ST 2/apply	
2	ST 3	WT1	WT2
3	ST 4	ST5	WT 3
4	WT4	ST 7	WT 5
5	ST 7	ST 8	

PHAS Schedule – B
BIOP Schedule

Year	Term1	Term 2	Summer
1	ST 1	ST 2	
2	ST 3	ST 4	
3	ST 5/apply	ST 6	WT 1
4	WT 2	WT 3	WT 4
5	ST 7	ST 8	

Benefits of Co-op

- Practical experience
- Work on real life problems
- Networking
- Increased job prospects after graduation
- Life skills

Where did the PHAS Co-op students worked the past summer?

- Ballard Power Systems
- Environment Canada
- E-One Moli Energy
- Eastside Games
- Canadian Space Agency
- ETH Zurich (Switzerland)
- Genome Institute of Singapore
- Honda Research Institute (Japan)
- Laser Zentrum Hannover (Germany)
- Max Planck Institutes (Germany)
- Ecole Polytechnique de Federale Lausanne (France)
- Sony Pictures Imageworks
- Safe Software
- Triumf
- UBC (PHAS, CHEM, EOS)
- University of Wurzburg (Germany)
- University of Tokyo (Japan)
- Thought Exchange

Where did the BIOP Co-op students work this Summer?

- International Collaboration on Repair Discoveries
- MPI for the Science of Light (Germany)
- Genome Institute of Singapore (Singapore)
- Robert Bosch (Germany)
- Laser Zentrum Hannover (Germany)
- UBC Michael Smith Lab
- UBC (Physics and Astronomy)
- UBC (Psychiatry)
- University of Montreal
- University of Wuerzburg (Germany)

Program Fees

- Co-op workshop fee: $ 251.75
- Co-op work term fee: $ 774.75 per WT
- Total cost of program: $ 3,200

Application Criteria

- Must have a minimum “B” average
- Willingness to work anywhere in Canada
- Positive attitude. Keen interest in chosen field.
- Each candidate is interviewed to assess their suitability to the program.

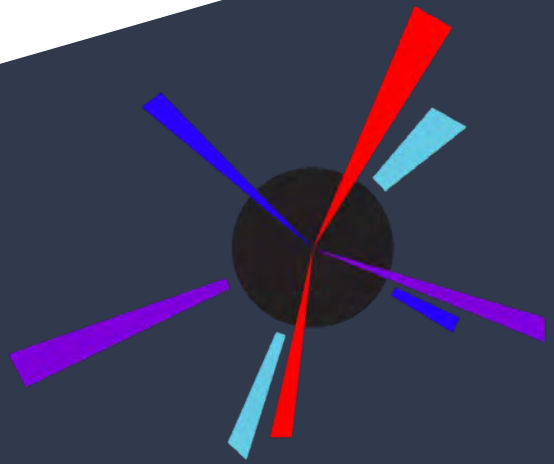
Upcoming Application Deadlines

Program:	Application Deadlines
PHYS/ASTR (2nd or 3rd Yr.) BIOP (3rd Yr.)	Sept. 30, 2019

Apply online at
https://sciencecoop.ubc.ca/prospective/applydeadlines

Welcome to Physsoc!

Presented by: Ella Meyer, Physics Society President



Who we are:

UBC Physics Society -> Physsoc

Undergrad group who want to support, encourage, and be friends with you!

Current Council:

President: Ella

Co-VP Academic: AJ and Henry

Co-VP Social: Willow and Tyson

We are having a bi-election soon! Come be an exec

What we do!

- Midterm review sessions
- Final exam practice booklets and review sessions
- Peer study groups
- AMS Tutoring
- BBQs
- Movie/board game nights
- Term-end Wine and Cheese
- Beef and Pizza (shaping the future of our courses!)
- Pi Day Bake Sale
- And all sorts of other fun, for $10 per membership!

Where we are

- HENN 307! Just upstairs
  - Includes 3 study/lounge rooms
  - Kitchenette
  - foosball table (and occasional tournaments)
  - loads of textbooks up for use
  - Cheapest pop on campus

How to Join

- Come on up to HENN 307 any day
- Stop by our welcome back BBQ on Thursday, September 12th!

BIOPHYSICS STUDENT SOCIETY

BPSS

WHAT WE DO

- OFFER SOCIAL AND ACADEMIC SUPPORT TO BPSS MEMBERS
- HOST A VARIETY OF EVENTS THROUGHOUT THE YEAR, INCLUDING MEET AND GREETS, SPECIALIZATION NIGHTS…

WHY JOIN

- MEET BIOPHYSICS STUDENTS AND FACULTY
- SOCIALIZE, NETWORK, AND LEARN ABOUT THE PROGRAM
- HOODIES and T-shirts
- FREE FOOD AT EVENTS

UBC biophys

JOIN US!

MEMBERSHIP

- $5
- Join at an event or send us an email.

BECOME AN EXECUTIVE

- Email us if you are interested!

bpss.exec@gmail.com

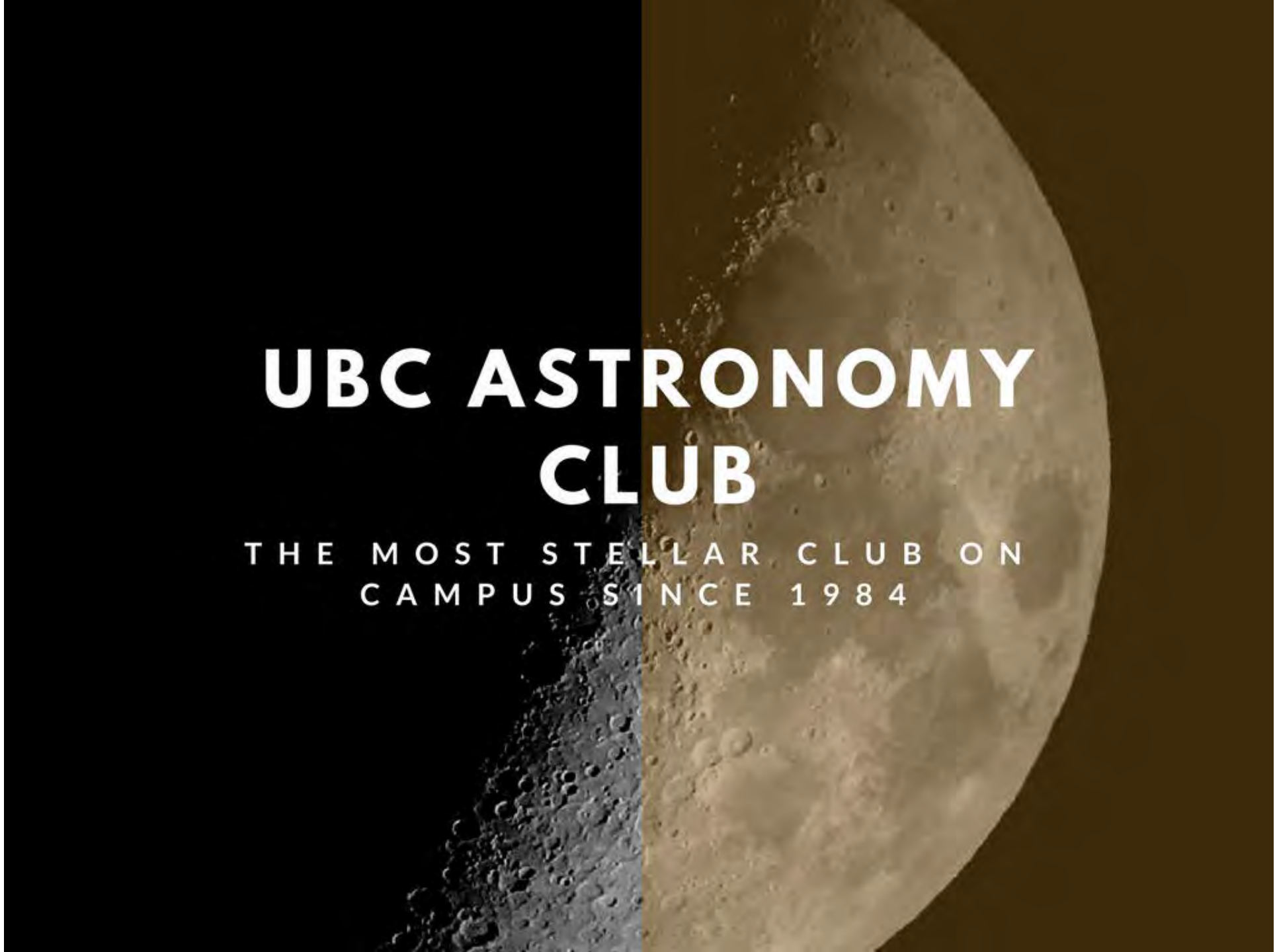
UBC biophys

CONTACT US

CURRENT EXECUTIVES

President: Bellinda Yin
VP Admin: Darius Menezes
Treasurer: Shira Agam
SUS Representative: James Dickson
3rd Year Representative: Hailey Ahn

FACEBOOK: UBC Biophysics Student Society
EMAIL: bpss.exec@gmail.com


UBC ASTRONOMY CLUB
THE MOST STELLAR CLUB ON CAMPUS SINCE 1984

WHO WE ARE

Mia Kramer

WE ARE MADE OF STAR STUFF...

We are a group of students who are passionate about astronomy!

Whether you are a graduate student studying dark matter or someone who wants to know more about this beautiful universe, we are the club for you!

EVENTS

OBSERVATIONS & LECTURES & SOCIALS, OH MY!

Mia Kramer

BUT DON'T JUST TAKE OUR WORD FOR IT...

OUR EVENTS HAVE BEEN FEATURED ON:

CBC Radio - Canada
CBC Vancouver
CTV Vancouver
The Daily Hive
The Georgia Straight
The Globe and Mail
The Province
Roundhouse Radio
The Ubyssey
Vancouver is Awesome
24 Hours Vancouver

COME WONDER WITH US!

WEBSITE | UBCASTRONOMYCLUB.COM
FACEBOOK | UBC ASTRONOMY CLUB
INSTAGRAM | UBCASTRONOMYCLUB

Atomic, Molecular and **Optical** (AMO) Physics

Valery Milner

The **study and control**
of **individual atoms, molecules and photons**,
and their **interactions** with one another.

UBC

Interactions o

Inte

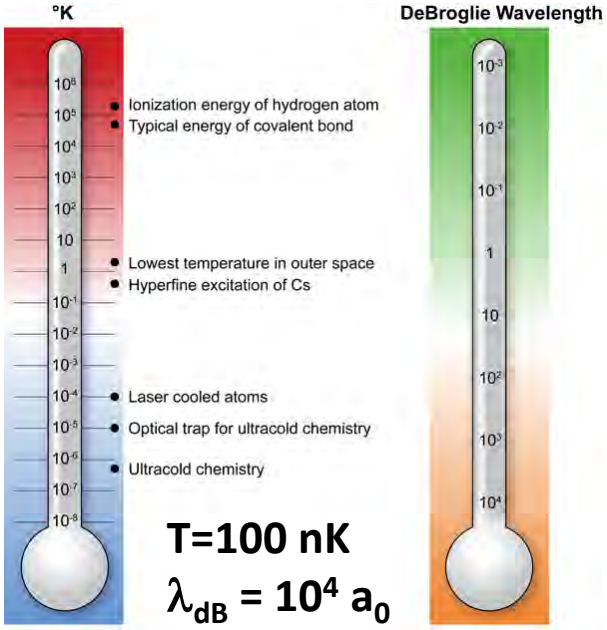
To test fundamental laws of nature
(anti-matter, chirality, …)

To understand complex systems
(quantum simulators, few-body interactions…)

To advance other branches of science
(quantum computing, controlled chemistry…)

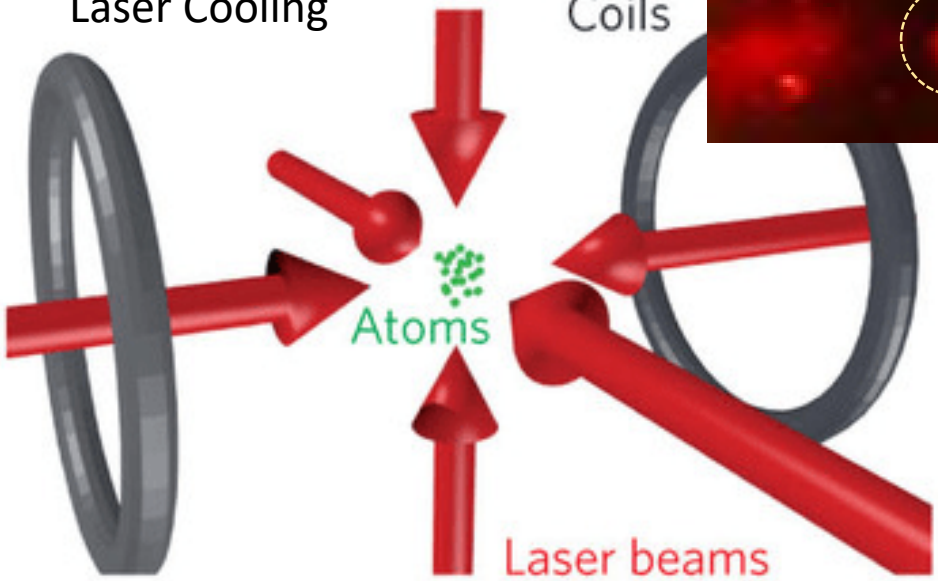
Madison Research Group

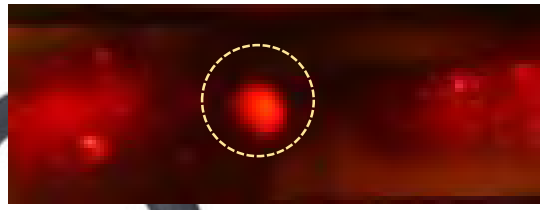
*Extreme Atomic States – **Ultralow Temperature***



T=100 nK

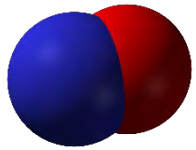
$\lambda_{dB} = 10^4\ a_0$



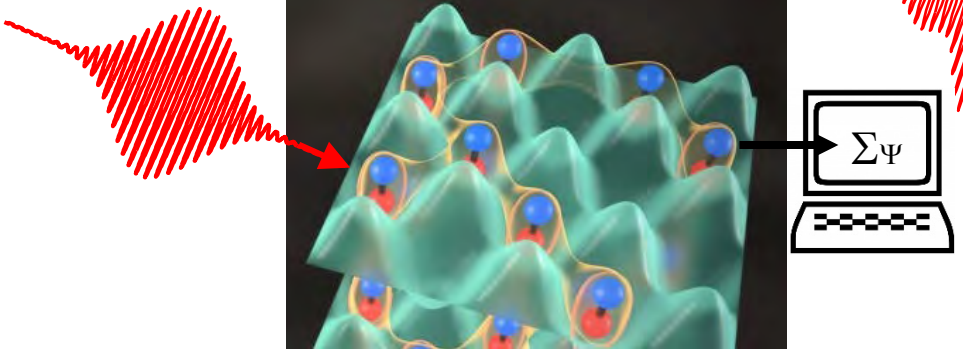


10^8 Li atoms at 0.5 μK

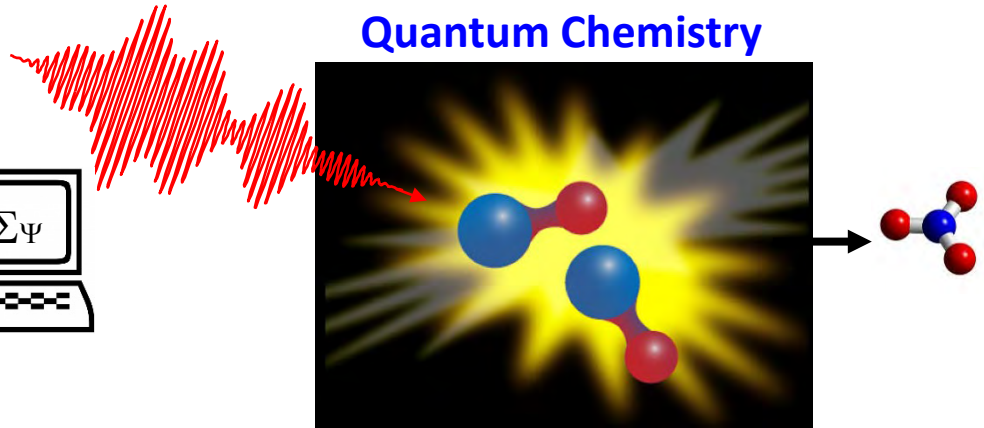
Li-Rb



Quantum Computing



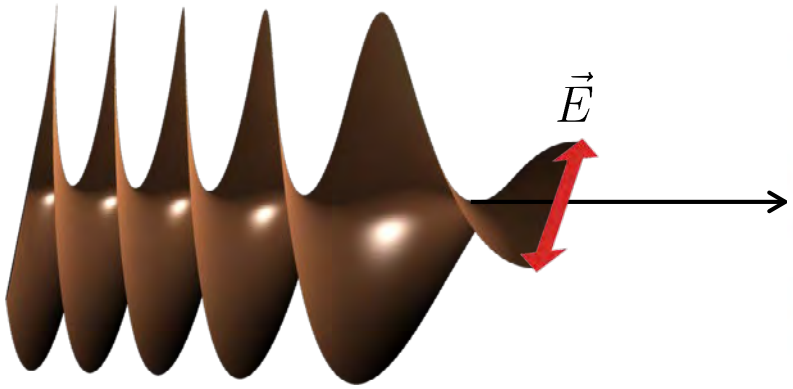
Quantum Chemistry

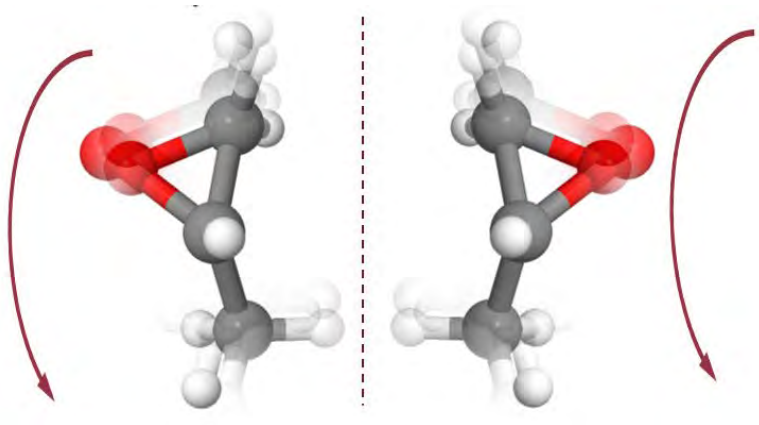


Milner Research Group

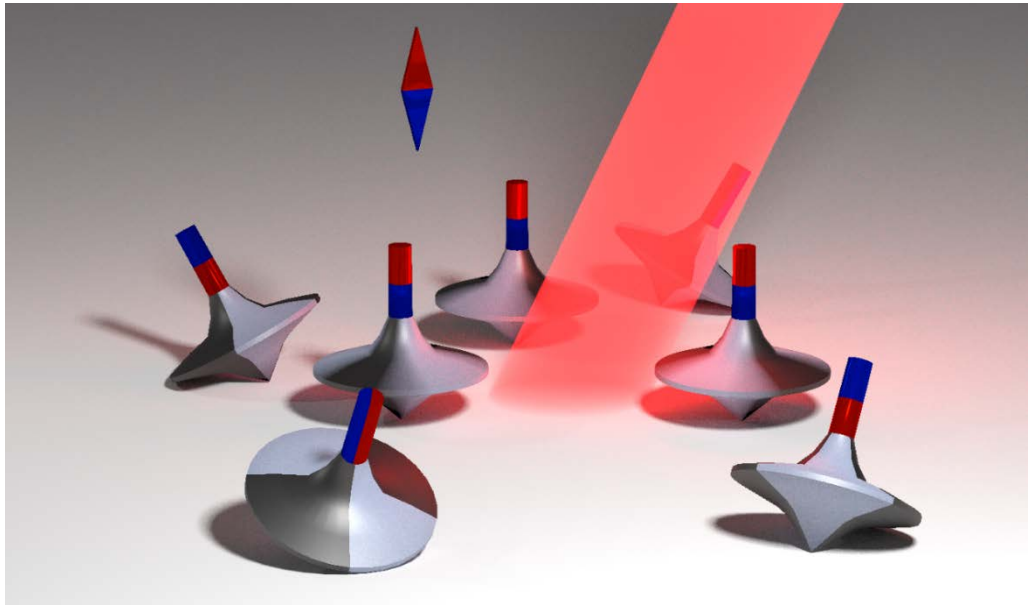
*Extreme Molecular States – **Ultrafast Rotation***

Optical Centrifuge



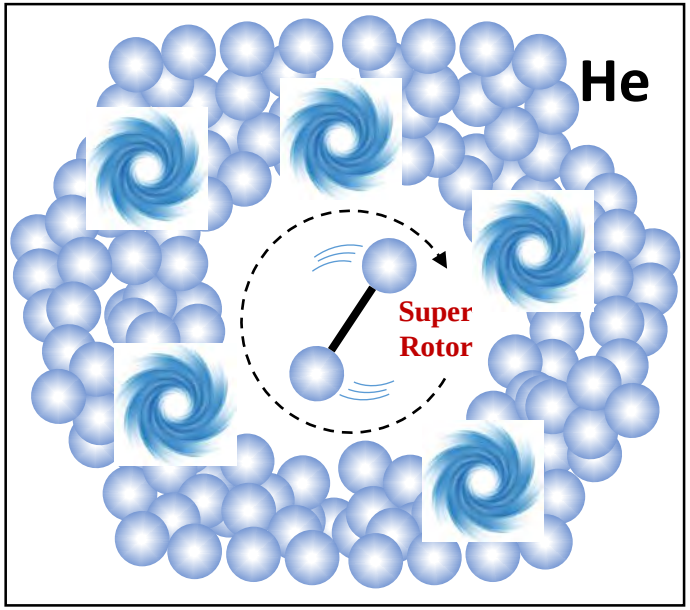


Properties of isolated super-rotors …



Optical, acoustic, magnetic properties at ultra-high J's

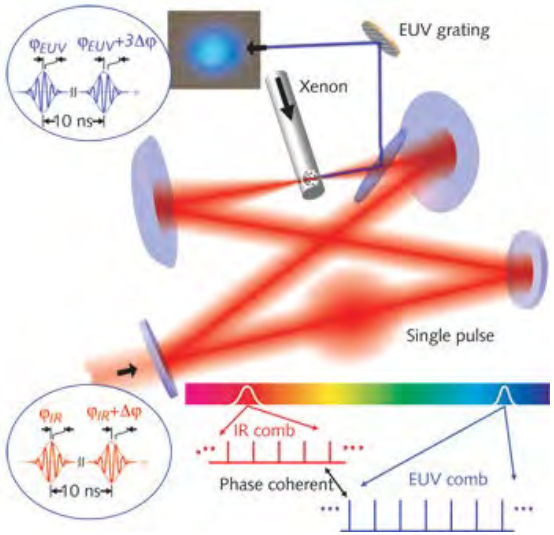
and in complex quantum environment

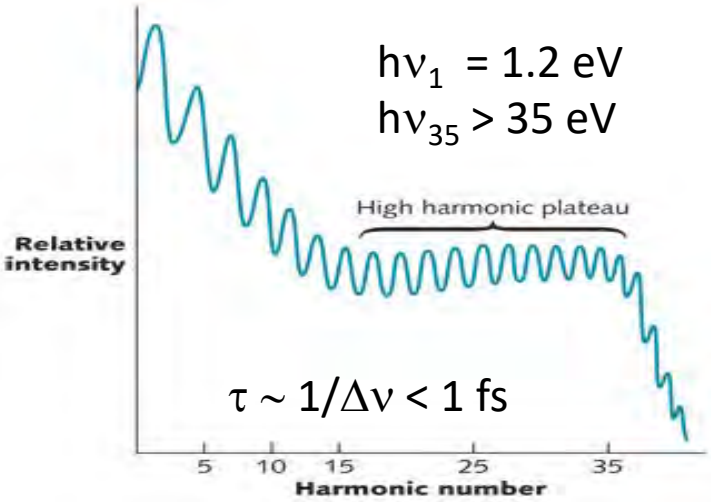


Probing superfluidity at the nanoscale

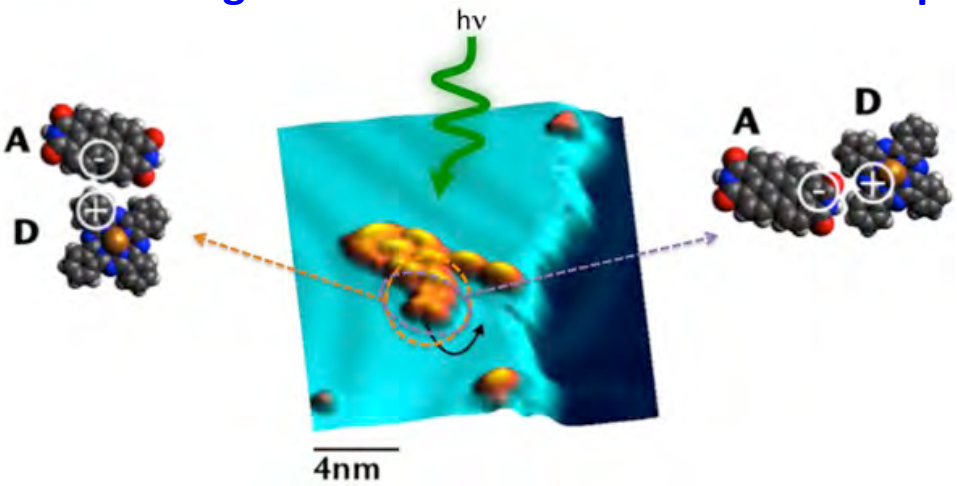
Jones Research Group

*Extreme Photon States – **Extreme UV***

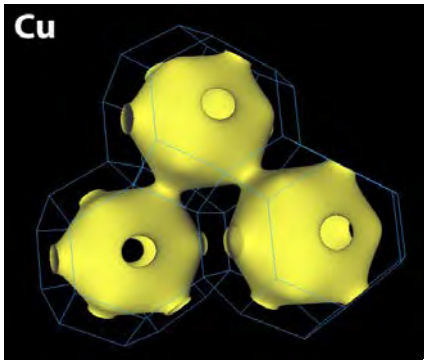


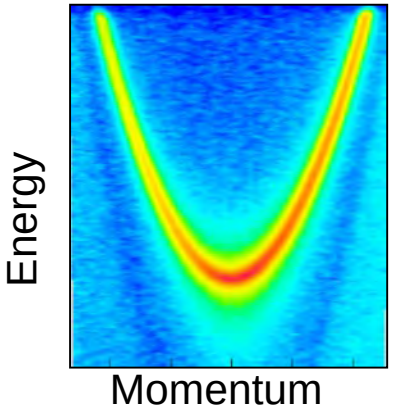


Organic Photovoltaics



Topological insulators and High-T_c superconductors





Two Centers for **AMO** Physics at UBC

CRUCS

Canadian Centre for Research on Ultra-Cold Systems

CHIROS

Chirality Research on Origins and Separation

Chirality Reseacrh On Origins and Separation

AMO @ UBC	Department of **PHYSICS**	Department of **CHEMISTRY**
EXPERIMENTAL STUDIES	David Jones Kirk Madison Valery Milner Jeff Young	Takamasa Momose Edward Grant Keng Chou
THEORETICAL STUDIES	Fie Zhou Mona Berciu	Roman Krems

Astronomy research at UBC

We cover the full range of astronomical scales, from planetary science to cosmology.

We have observers, experimentalists, modelers, theorists and those who do some of each.

If you're interested in any particular type of astronomy, we can probably get you into a research project.

CHFT (Cuillandre), Arecibo

Planetary Science

Brett Gladman: dynamics of asteroids, Kuiper Belt Objects, discovery of new moons. Large surveys with CFHT; local computing cluster.

Aaron Boley: simulations of the formation and stability of planetary systems. Millimetre-wavelength ALMA observations of young stellar and planetary systems.

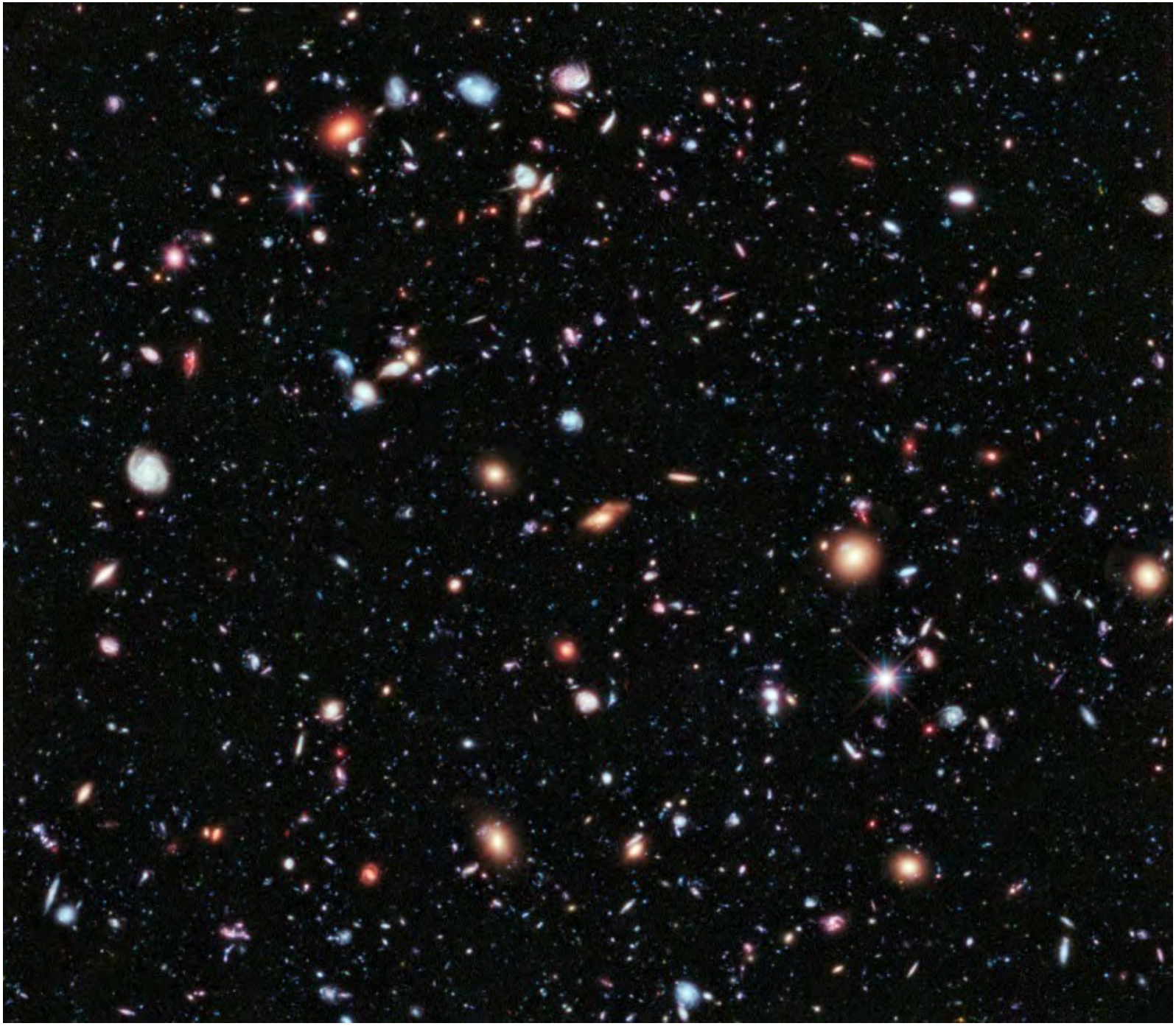
Jaymie Matthews: stellar oscillations and exoplanetary systems with the MOST and Kepler satellites.

Cosmology I

Mark Halpern: Many telescope experiments including WMAP and ACT. Cosmic Microwave Background, high-redshift Galaxies, Baryon Acoustic Oscillations

Gary Hinshaw: WMAP and other telescopes. Cosmic Microwave Background, high-redshift Galaxies and clusters, Baryon Acoustic Oscillations

Ludo van Waerbeke: Weak gravitational lensing, correlation with galaxy clusters



Hubble Extreme Deep Field – NASA/ESA

Cosmology II

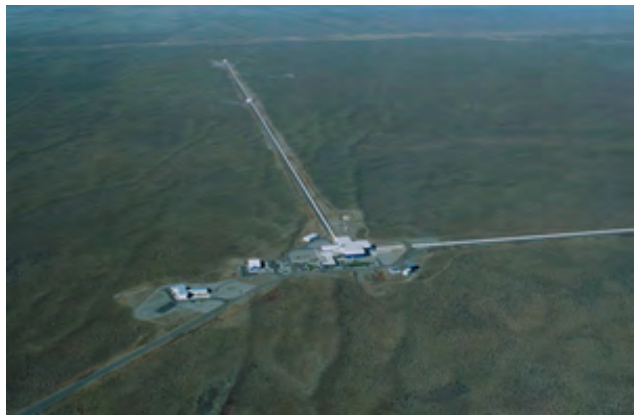
Douglas Scott: Cosmology theory, co-investigator on the Planck satellite (CMB).

Kris Sigurdson: particle dark matter, particle cosmology, HI fluctuations

Gravitational Waves

Jess McIver: New faculty member working on LIGO
Potential student research projects include:

- Improving the performance of the Advanced LIGO gravitational wave detectors
- Machine learning for diagnosing gravitational wave interferometer noise
- Improving GW astrophysical source property estimation
- Core-collapse supernovae with next generation GW detectors
- Searching for gravitational wave signals from spinning pulsars
- Building monitoring software for the LISA mission



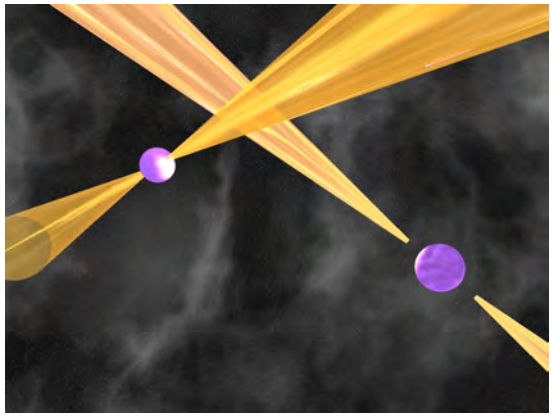
Stars Alive and Undead

Jeremy Heyl: astrophysics of white dwarfs, neutron stars and black holes, globular clusters, transients.

Harvey Richer: Stellar populations in open and globular clusters and nearby galaxies. Big user of the Hubble Space Telescope

Ingrid Stairs: radio observations of pulsars and Fast Radio Bursts (FRBs). Binary evolution, tests of general relativity, searches for a gravitational-wave background.

Messier 4 field – NASA and H. Richer
Double pulsar sketch – M. Kramer



Galaxies

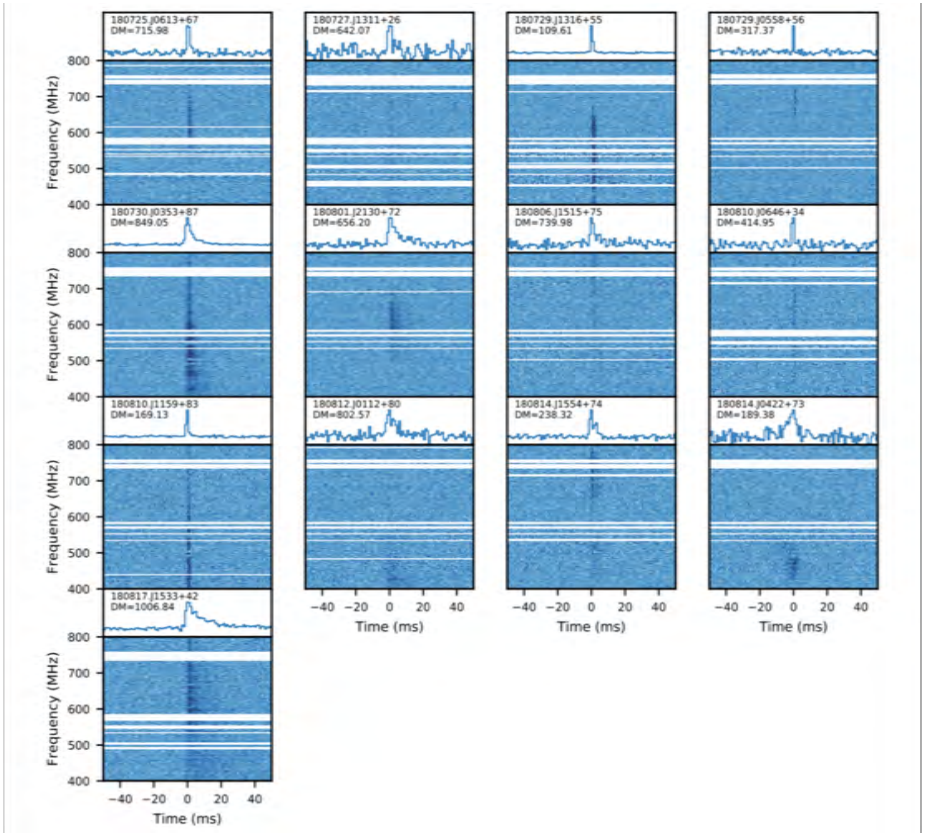
Paul Hickson: Galaxies and galaxy groups. Instrumentation including adaptive optics and, in the past, liquid mirror telescopes.

Jasper Wall: radio observations; space density of active galaxies, radio-loud quasars and submillimetre galaxies.

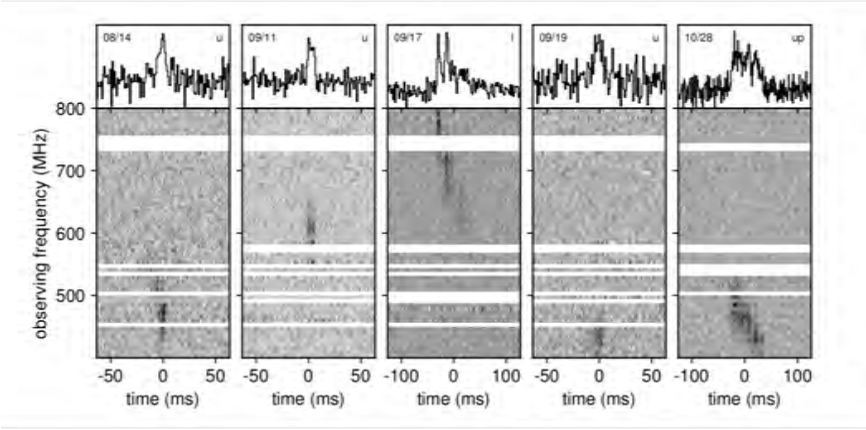
CHIME

Mark Halpern is the PI of the CHIME instrument in Penticton, BC that will measure the expansion history of the universe, monitor hundreds of pulsars every day, and discover huge numbers of the mysterious Fast Radio Bursts. Hinshaw, Sigurdson and Stairs are involved (Stairs only on FRBs and pulsars).

Recent CHIME/FRB discoveries



CHIME/FRB collaboration, Nature **566**, 230 (2019)



CHIME/FRB collaboration, Nature **566**, 235 (2019)

In January we published 13 new FRBs (left) including one new repeater (right). We've recently published several more repeaters, and are working on a catalog of many FRBs.

Stewart Blusson
Quantum Matter Institute
THE UNIVERSITY OF BRITISH COLUMBIA

Ke Zou: kzou@phas.ubc.ca

Our **People**

• Physics • Electrical Engineering • Chemistry •


Andrea **Damascelli**


Sarah **Burke**


Curtis **Berlinguette**


George **Sawatzky**


Mona **Berciu**


Jeff **Young**


Doug **Bonn**


Lukas **Chrostowski**


Josh **Folk**


Rob **Kiefl**


David **Jones**


Joerg **Rottler**


Alireza **Nojeh**


Marcel **Franz**


Mark **MacLachlan**


Ian **Affleck**


Andrew **MacFarlane**


Robert **Raussendorf**

New Faculty 2017/18


Ziliang **Ye**


Ke **Zou**

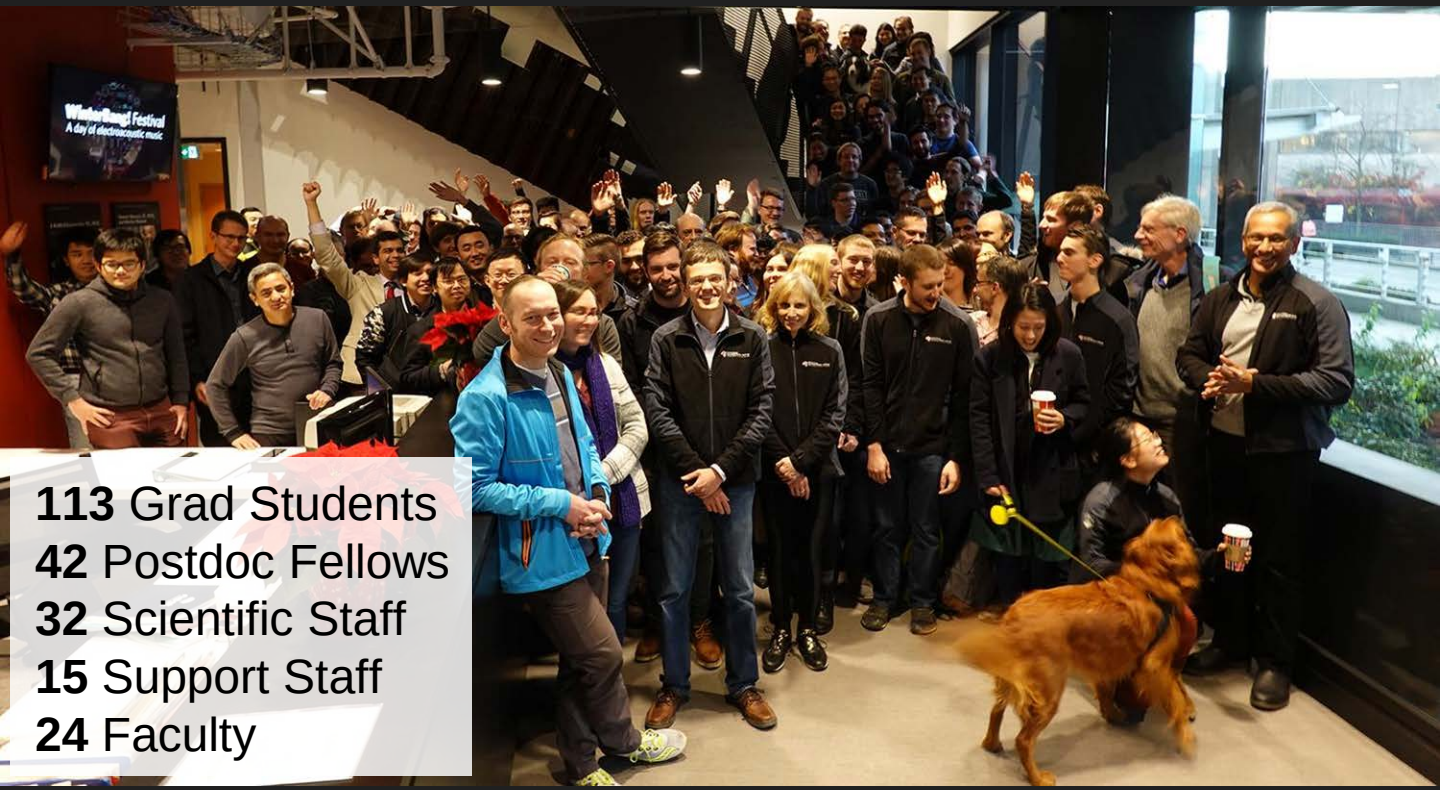
New Faculty 2018/19


Alannah **Hallas**


Steven **Dierker**


Meigan **Aronson**

Our **People**



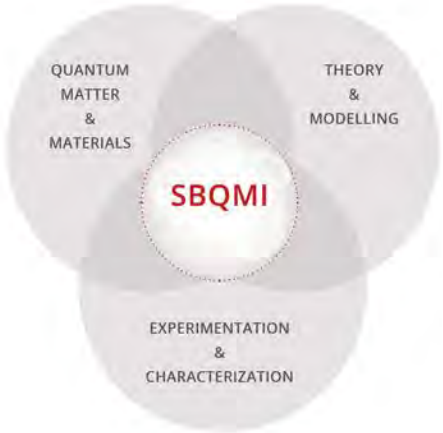
113 Grad Students
42 Postdoc Fellows
32 Scientific Staff
15 Support Staff
24 Faculty

Quantum Materials by Design

Creating the building blocks for future technologies that will transform the world

Vision

Become the world leading institute in quantum materials & devices, and nucleate an ecosystem of companies for future technologies



Research **Training** **Translation**

Research themes:

- Atomic-level Design of Quantum Materials
- Emergent Electronic Phenomena at Interfaces
- Topologically Protected Quantum States
- Photonic Manipulation of Quantum States

Research **Training** **Translation**

Max Planck-UBC-UTokyo Centre for **Quantum Materials**

• Joint Training • Collaborative Research • International Symposia •

Outline

What's new at SBQMI?

- ***Synthesis and design of quantum materials:***

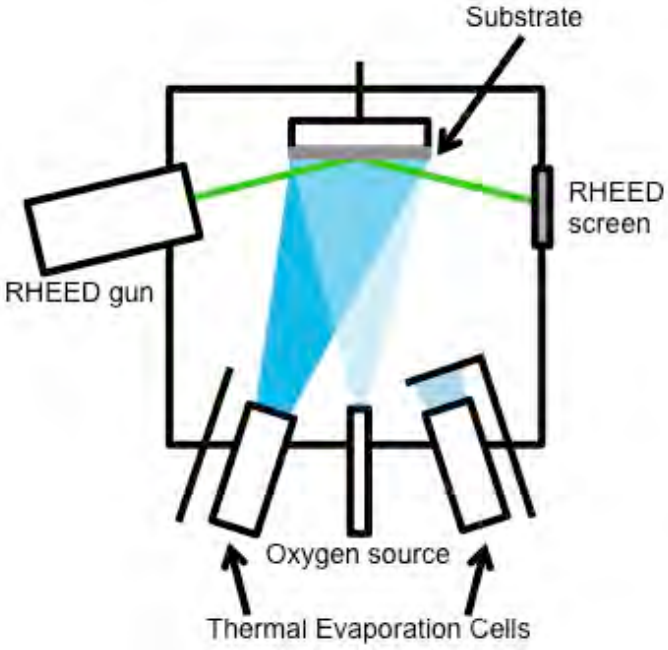
  Molecular Beam Epitaxy Lab – Ke Zou
  Quantum Materials Design Lab – Alannah Hallas, Meigan Aronson, Doug Bonn

- ***Characterization:***

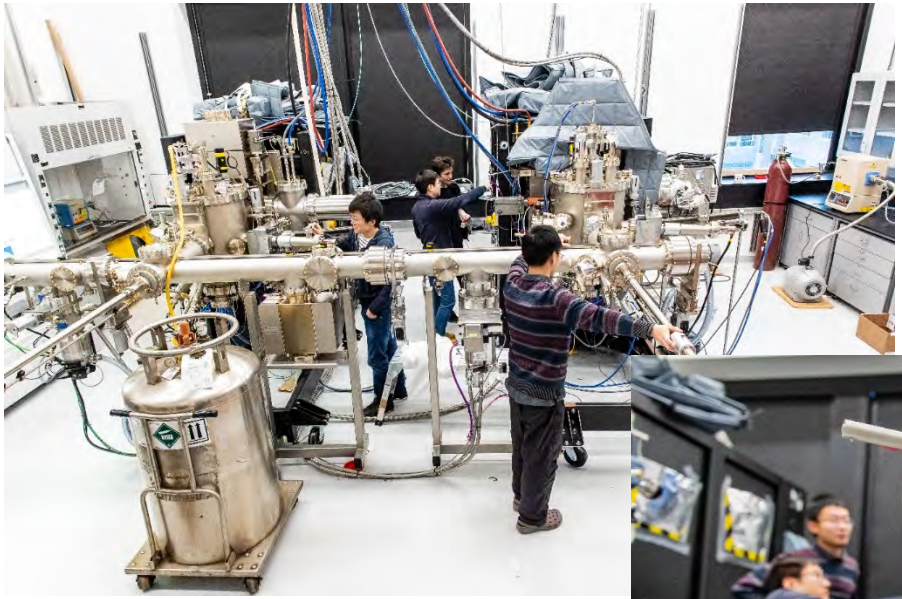
  Moore Center for Ultrafast Quantum Matter – Andrea Damascelli, David Jones
  Lab for Atomic Imaging Research – Sarah Burke, Doug Bonn
  Transmission Electron Microscopy Lab – George Sawatzky, Steve Dierker
  Optical Probe and Control in 2D Semiconductor Lab – Ziliang Ye

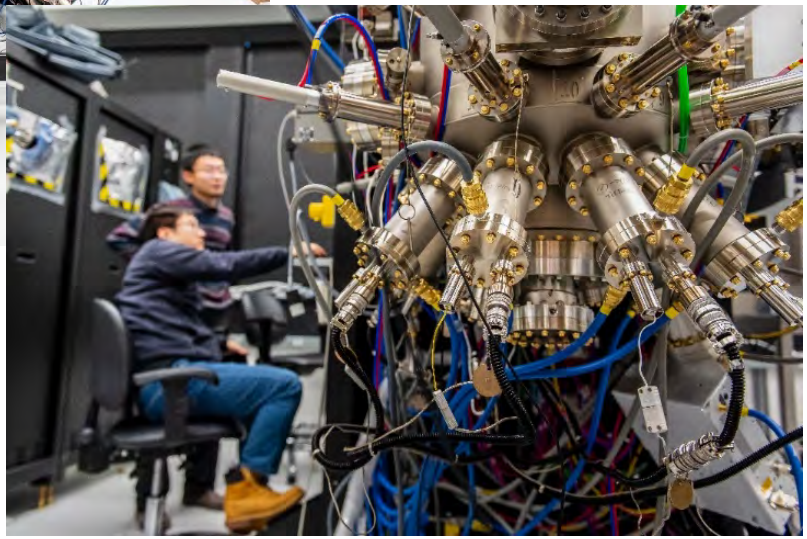
Molecular beam epitaxy:

- clean P ~ $1x10^{-10}$ Torr, precise atomic layer control, flexibility in source materials.
- Epitaxial films, heterostructures, superlattice on various substrates.



Quantum Materials and Devices Foundry



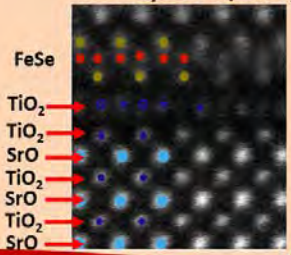


Quantum Materials and Devices Foundry

Materials synthesis

Oxide molecular beam epitaxy (MBE)
Chalcogenide MBE
CVD/PVD
Exfoliation of single crystal

STEM of high-Tc superconductor monolayer $FeSe/SrTiO_3$



2D materials with novel properties: Superconductors, topological insulators, Weyl semimetals, …

Nanofabrication

Dual-gated graphene field effect transistor

Characterization

X-ray diffraction (XRD)
Synchrotron XRD
Field effect devices
STM, *in situ* ARPES
(collaboration with UBC groups)

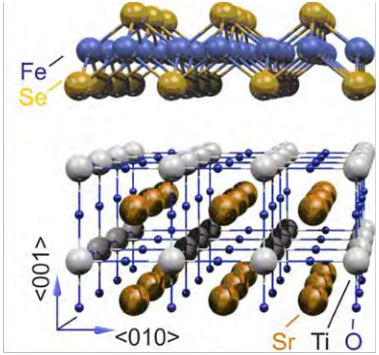
Theory/Simulation

Density functional theory
Tight binding approximation
(collaboration with UBC groups)

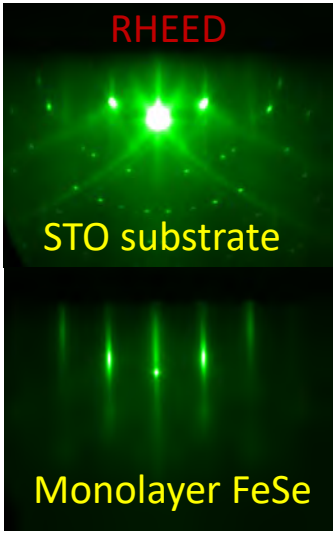
Candidates of topological superconductors

Monolayer $FeSe/SrTiO_3$ superconductor
Tc ~ 40-65 K

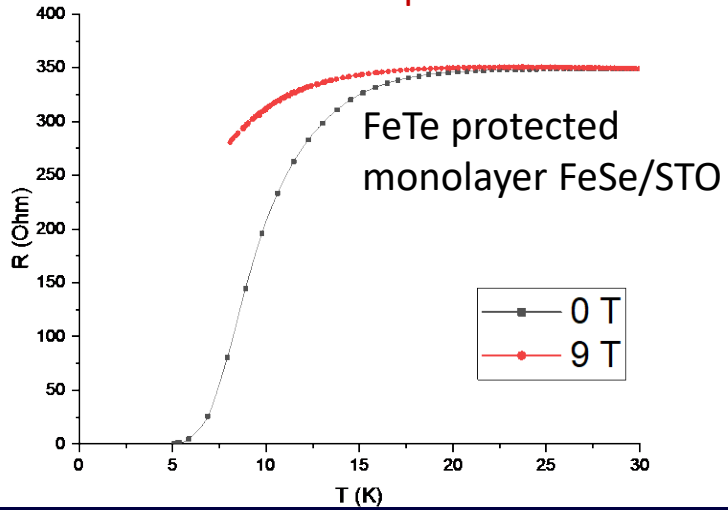
Q. Y. Wang et al., Chin. Phys. Lett. 29, 37402 (2012)



Monolayer FeSe prepared at UBC



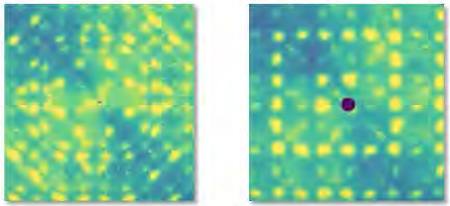
ex situ transport



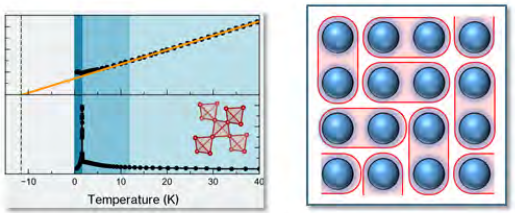
Alannah Hallas,
Meigan Aronson,
Doug Bonn

The Quantum Materials Design Lab

Targeted design and crystal growth of new materials with novel quantum states using state-of-the-art techniques including floating zone crystal growth and high pressure synthesis



Structural characterization with an emphasis on understanding the role of disorder to access the intrinsic physics



Uncovering exotic magnetic and electronic states through property measurements at low temperatures and high magnetic fields

Outline

What's new at SBQMI?

- ***Synthesis and design of quantum materials:***

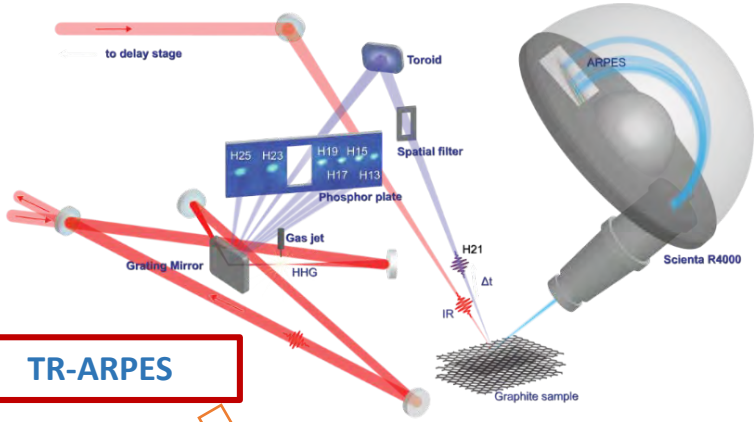
  Molecular Beam Epitaxy Lab – Ke Zou
  Quantum Materials Design Lab – Alannah Hallas, Meigan Aronson, Doug Bonn

- ***Characterization:***

  Moore Center for Ultrafast Quantum Matter – Andrea Damascelli, David Jones
  Lab for Atomic Imaging Research – Sarah Burke, Doug Bonn
  Transmission Electron Microscopy Lab – George Sawatzky, Steve Dierker
  Optical probe and control in 2D semiconductor Lab – Ziliang Ye

UBC-Moore Centre for Ultrafast Quantum Matter

Andrea Damascelli
David J. Jones



TR-ARPES

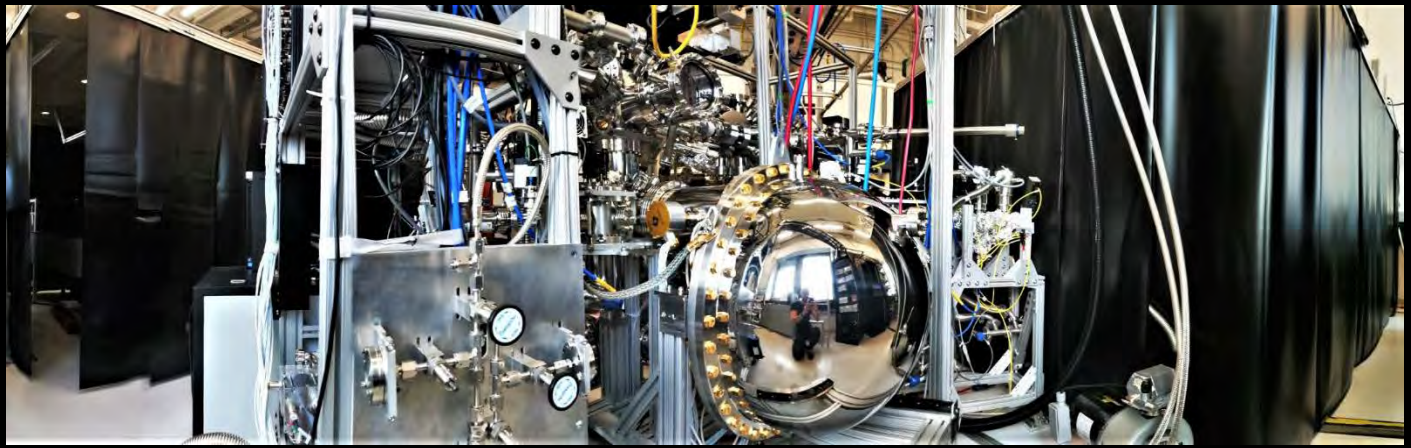
6.2 eV system

High Rep. rate HHG system
10-40 eV / 20 meV / 190 fs / 60 MHz

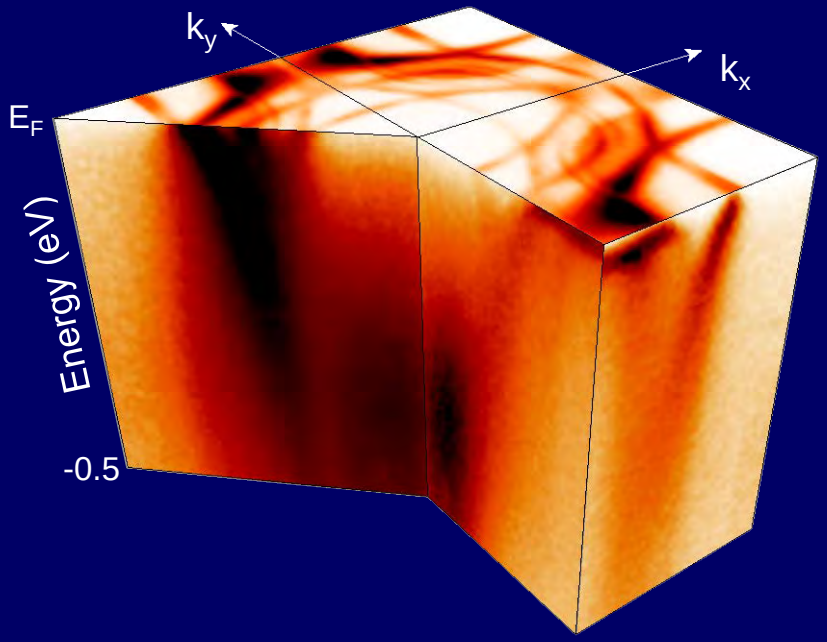
Transient Collapse high-Tc superconductivity in Bi2212
Boschini et al. Nat. Materials 17, 416 (2018)

Relation pseudogap and spin correlations in NCCO
Boschini*, Zonno* et al. submitted

Determination mode-projected electron-phonon matrix element in graphite
Na*, Mills*, Boschini et al. submitted



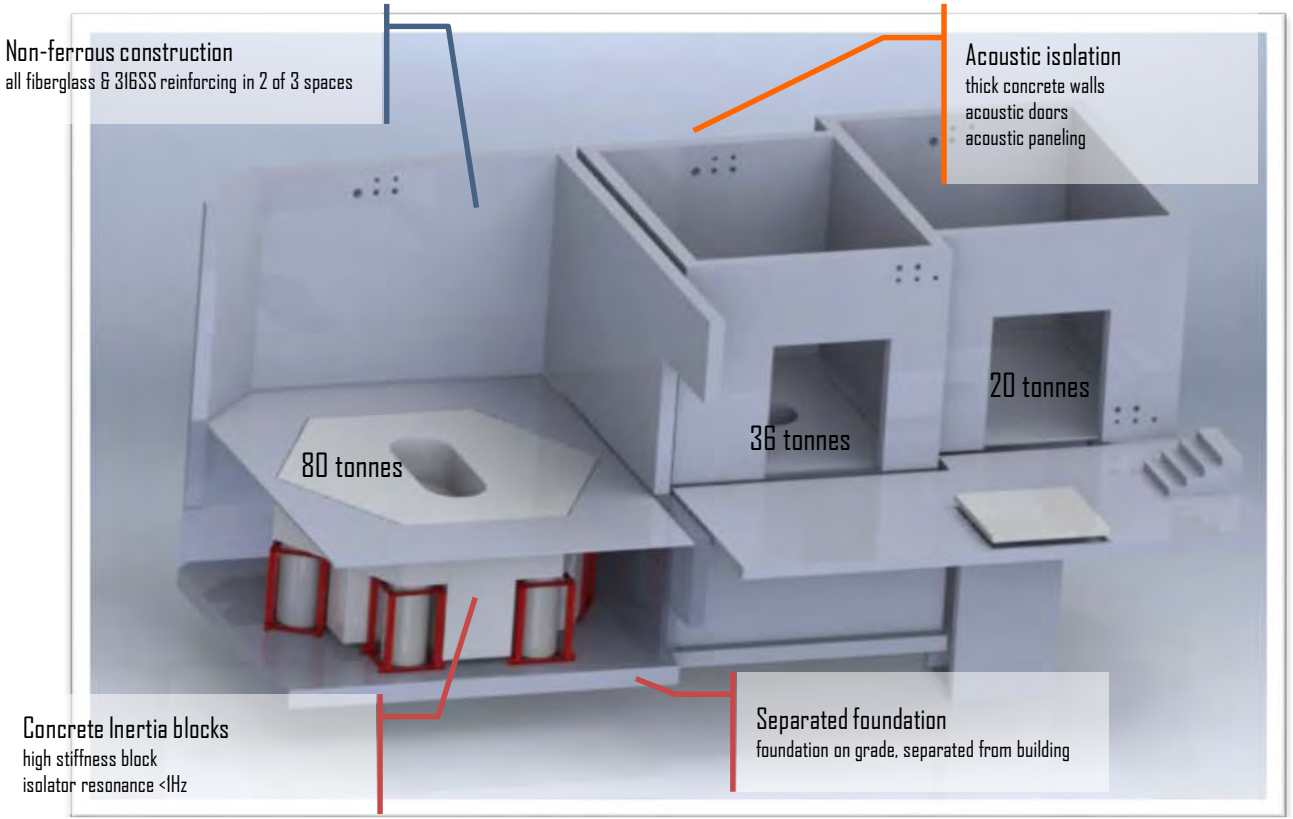
Surface-to-bulk progression of the electronic structure in Sr_2RuO_4



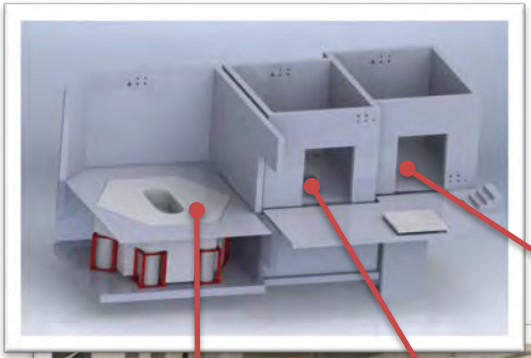
C.N. Veenstra et al., PRL **110**, 097004 (2013)

LAIR (**L**aboratory for **A**tomic **I**maging **R**esearch)

Sarah Burke, Doug Bonn

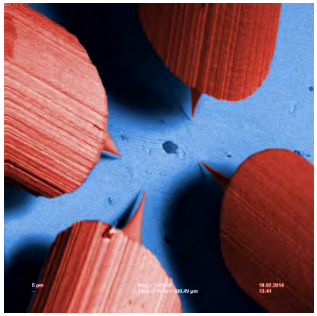


Operational instruments



4K Createc UHV STM/AFM (Burke/Bonn)
4K Omicron UHV STM/AFM with integrated optics (Burke)
50mK home-built UHV STM with vector magnet (7T/2T), high frequency cabling, MBE (Bonn)

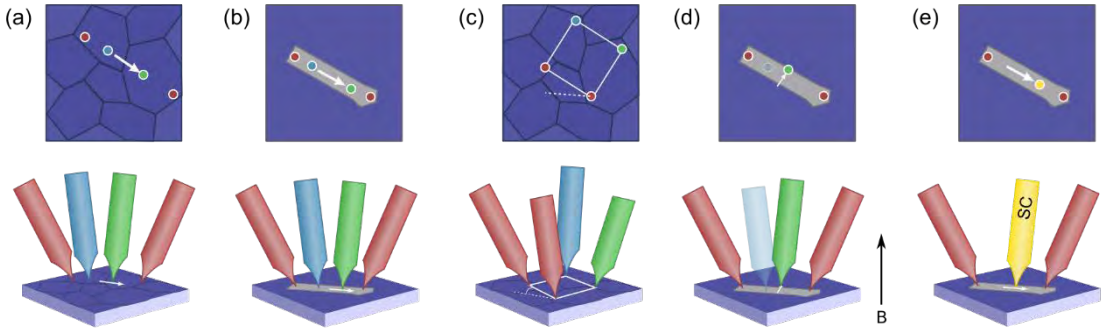
<1K 4-probe STM for quantum materials



Voightlander group, Forschungcentrum Jülich

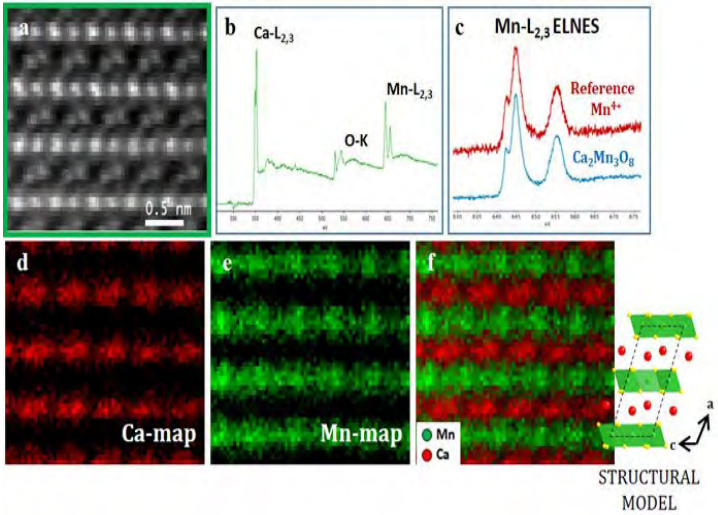
$3M CFI IF awarded for design & construction (Burke, Bonn, Folk)

~600 mK, 2-3 Tesla magnetic field
4 independent tips capable of atomic resolution or transport
Tip transfer: enables use of different tip materials (magnetic? Superconducting?)
SEM (or long-distance microscope) access for tip positioning, e.g. across grain boundaries or within; closest tip distance ~200nm
Different transport measurements possible in situ with movable electrodes; σ(x)



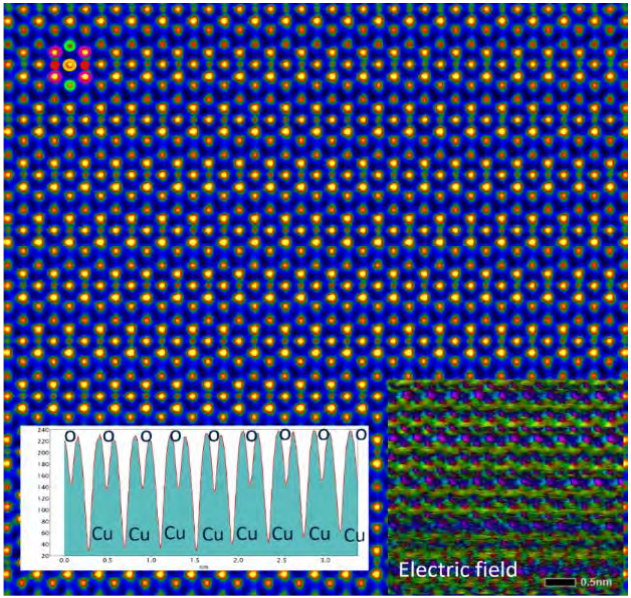
+ ??

- **Transmission Electron Microscopy**

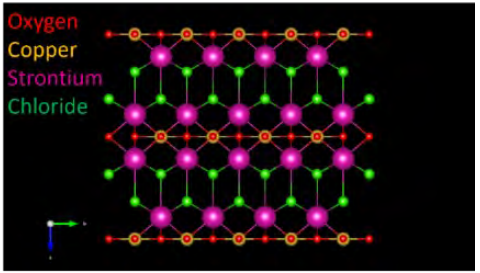


- **Electron Energy Loss Spectroscopy**

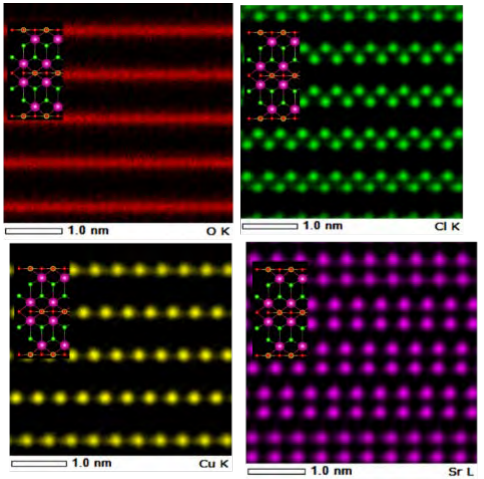
ATOMIC CHARACTERISATION:



Annular Bright Field Image of $Sr_2CuO_2Cl_2$ along the 001 axis. Insights shows a intensity profile along the CuO_2 stack, intensity dip corresponds to atoms.



Vizualisation of the crystal structure $Sr_2CuO_2Cl_2$ along the [100] axis.



EDS map with the corresponding crystal structure

OVERVIEW OF THE QMEMC

George Sawatzky, Steve Dierker

- **X TEM**: Mainstream 300kV double aberration corrected microscope:
  - Atomic resolved Imaging and elemental mapping.
  - Material characterization.

- **QSTEM**: a collaboration with Nion (the lead proponent of the tender) for a STEM microscope dedicated for angular and momentum resolved EELS with 6meV EELS resolution and q up to $6A^{-1}$.

- **FIB/SEM** for thin sample preparation and sample screening.

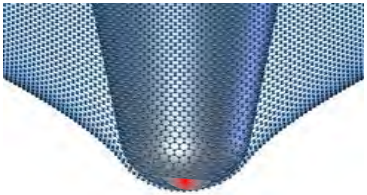
- **Complete Sample preparation Lab** with a complete workflow to study sample without exposing them to air.

Ziliang Ye
Optical Probe and Control in 2D Semiconductors

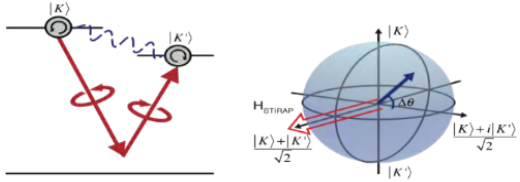
Nanoscale Phenomena

Strong Field Physics

TMD Monolayers

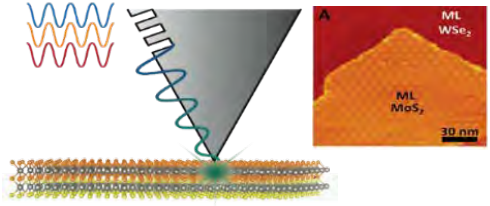


• Optical spectroscopy of the strain-induced single quantum dot in freestanding TMD membranes.

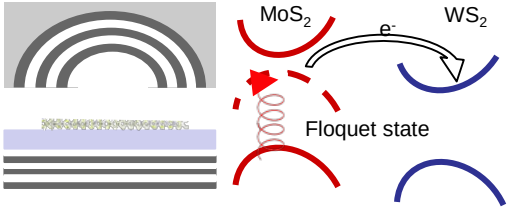


• Fully controlling the valley pseudospin in both azimuthal and polar directions for quantum information applications.

Van der Waals Heterostructures



• Hyperspectral imaging of the topological Moiré pattern below the optical diffraction limit.



• Creating steady Floquet state and studying its topological physics and nonequilibrium phenomena, including the interlayer tunneling.

Quantum materials by design

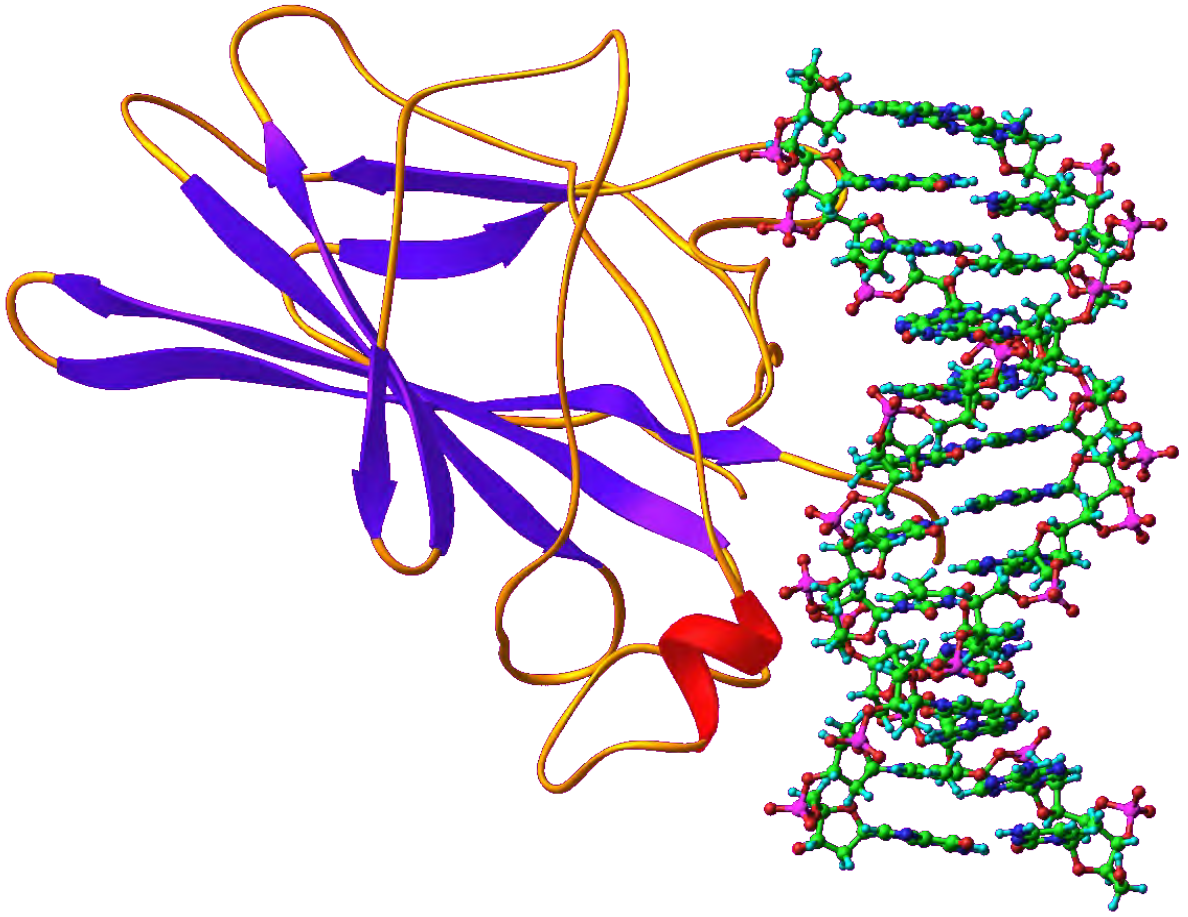
Creating the building blocks for future technologies that will transform the world

Stewart Blusson
Quantum Matter Institute
THE UNIVERSITY OF BRITISH COLUMBIA

Honours biophysics program

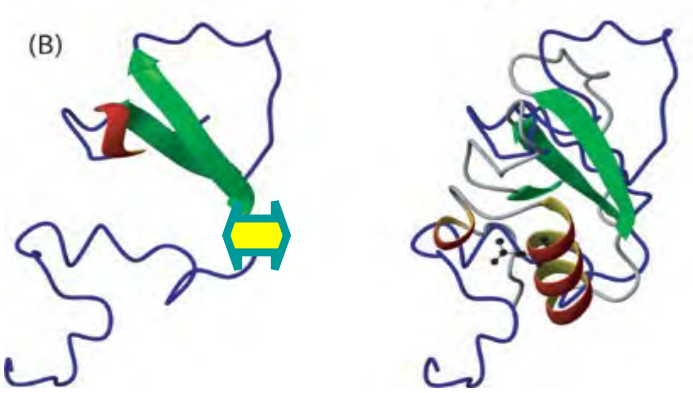
What is Biophysics?

an interdisciplinary area of science that applies the theories and methods of physics to questions of biology.



Biophysics: Big Questions

- How does life work?
- The Protein Folding Problem
- (How) Has biology exploited quantum mechanics to tailor biological function?
- Neurobiology: How does the brain work? How do we learn? Neuroplasticity?



The Honours Biophysics program:

1) Defined set of courses in Physics and Mathematics, eg:
   PHYS 301 Electricity & Magnetism
   PHYS 304 Quantum Mechanics
   PHYS 305 Biophysics
   Math 300 Complex Variables
   Math 316 Partial Differential Equations

2) Flexible Life sciences component: 18 credits of life sciences that you choose. Usually structured to emphasize one of:
   - molecular and cell biology
   - macrobiology (organism level)
   - applied biology (eg medical applications)

3) Honours thesis

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- molecular and cell biology
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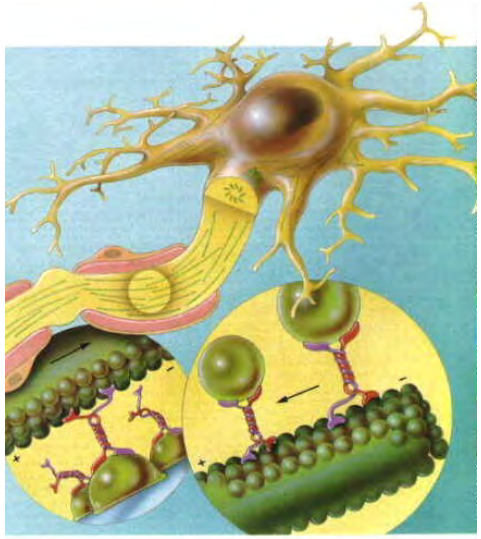
3) Honours thesis

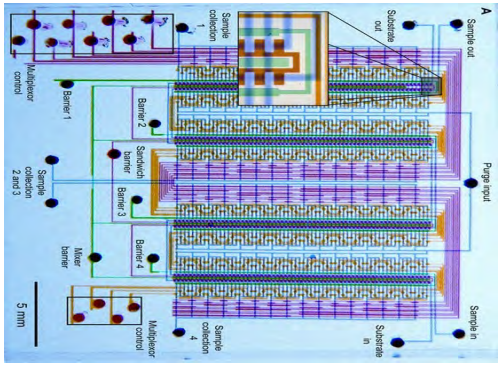
Diverse!

Physics, Math, Chemistry, Biochemistry, Biology!

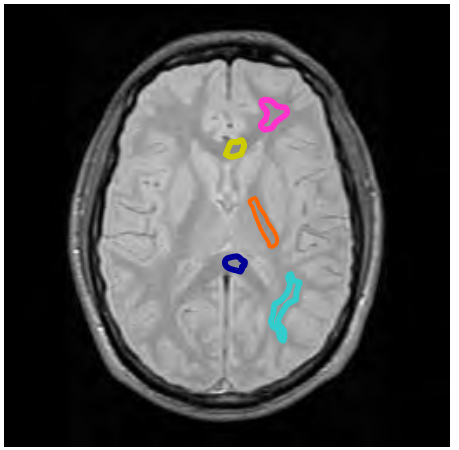
Who is the Biophysics program for?



Anyone interested in how physics and physics approaches can be applied to problems in the life sciences.



Students interested in upper level courses in all of PHYS, MATH, BIOC, BIOL
[and optionally: CHEM, CAPS, MICB, PCTH, MEDG]



What do Biophysics Program graduates do after graduation?

Most continue their education:

- Graduate School:
  - Biophysics
  - **Medical Physics**
  - Biochemistry
  - Neuroscience
  - Education
  - Mechanical Engineering(orthopaedics)
  - Pathology
  - Experimental Medicine
  - Epidemiology
- **Medical School**

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  - Education
  - Mechanical Engineering(orthopaedics)
  - Pathology
  - Experimental Medicine
  - Epidemiology
- **Medical School**

Co-op option is available!

Entrance to the Biophysics program:

- In second year apply through the Faculty of Science
- Later entry may be possible, talk to the Biophysics program advisor (the sooner the better)

The Biophysics program is an honours program

To stay in the program, the faculty of science requires that you:

1. complete all courses attempted
2. complete a minimum of 30 credits per winter session
3. maintain a minimum of 68 % average in each academic session.

Support is available:

- Biophysics is a small program, and traditionally very close-knit.

  The Biophysics students' society can help:

  - get to know older students who've been through it before

  - help with studying

  - social activities

  - Departmental advisors and course instructors
  - Science advising centre
  - Science support programs: http://my.science.ubc.ca

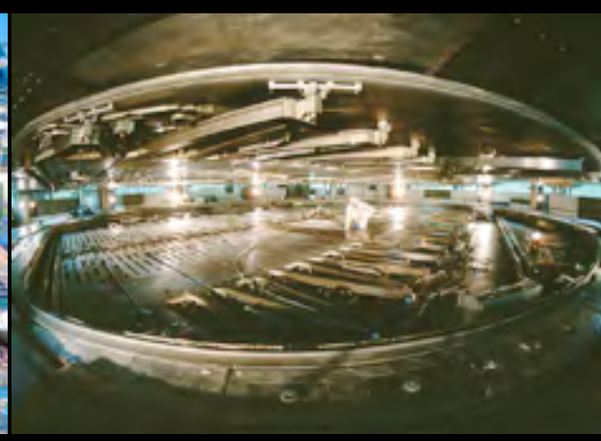
Any other questions:
please e-mail the program advisor: *vesna@phas.ubc.ca*
(phone 822 7710)




Subatomic Physics at UBC

Colin Gay



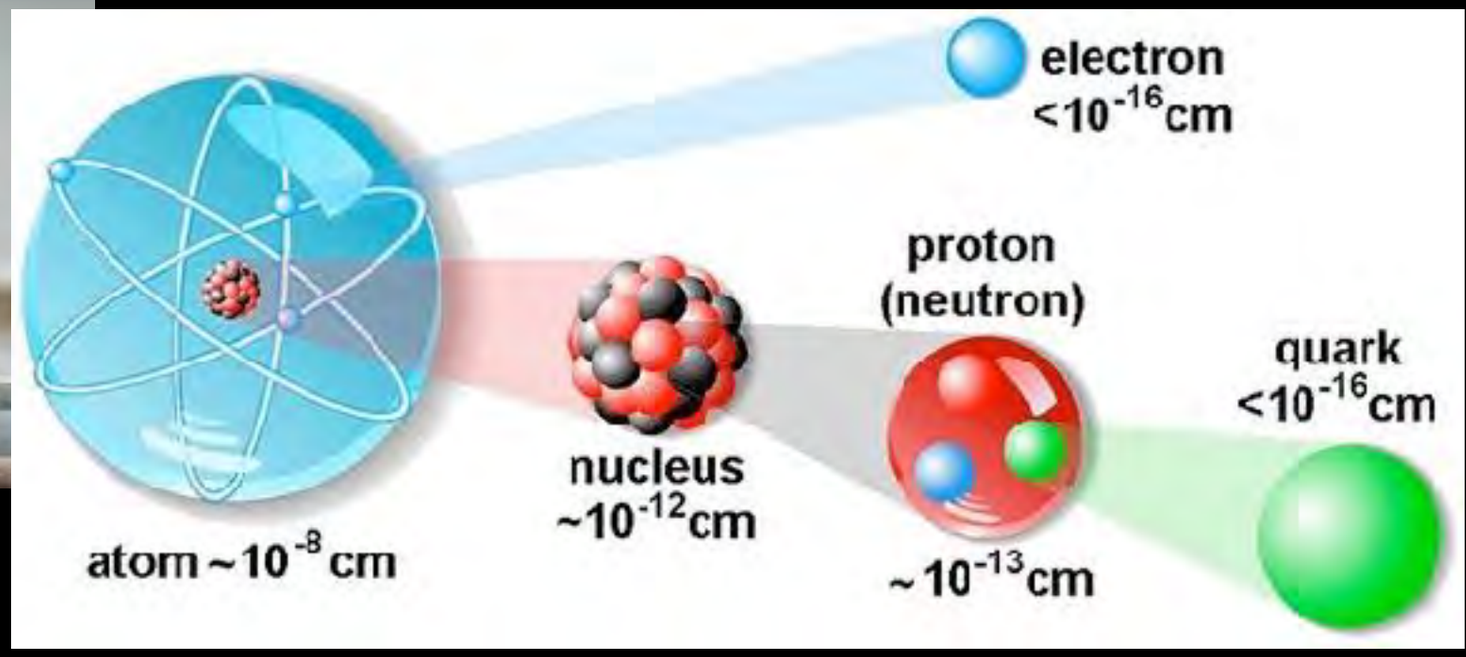



Particle (Subatomic) Physics starts with the questions:

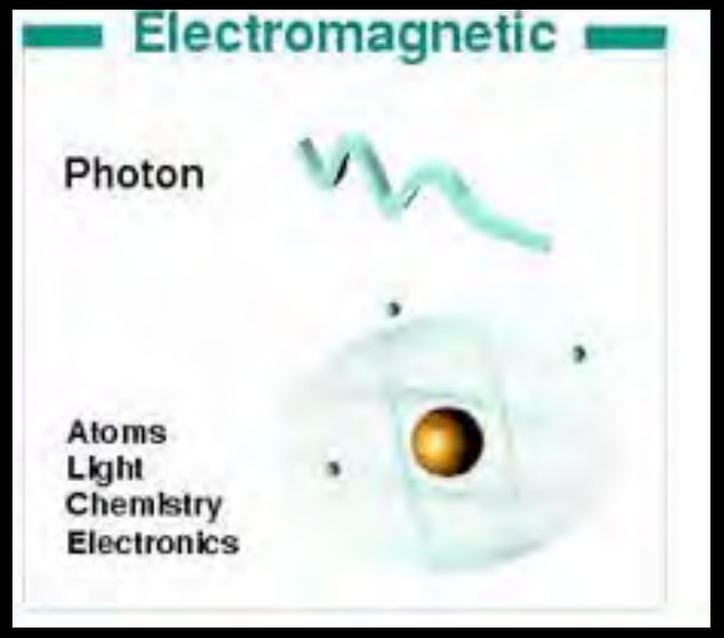
What's *that* made of?

How does *that* work?

and tries to find the most fundamental (ie irreducible) answer



= Magnetic Force
= exchanging photons

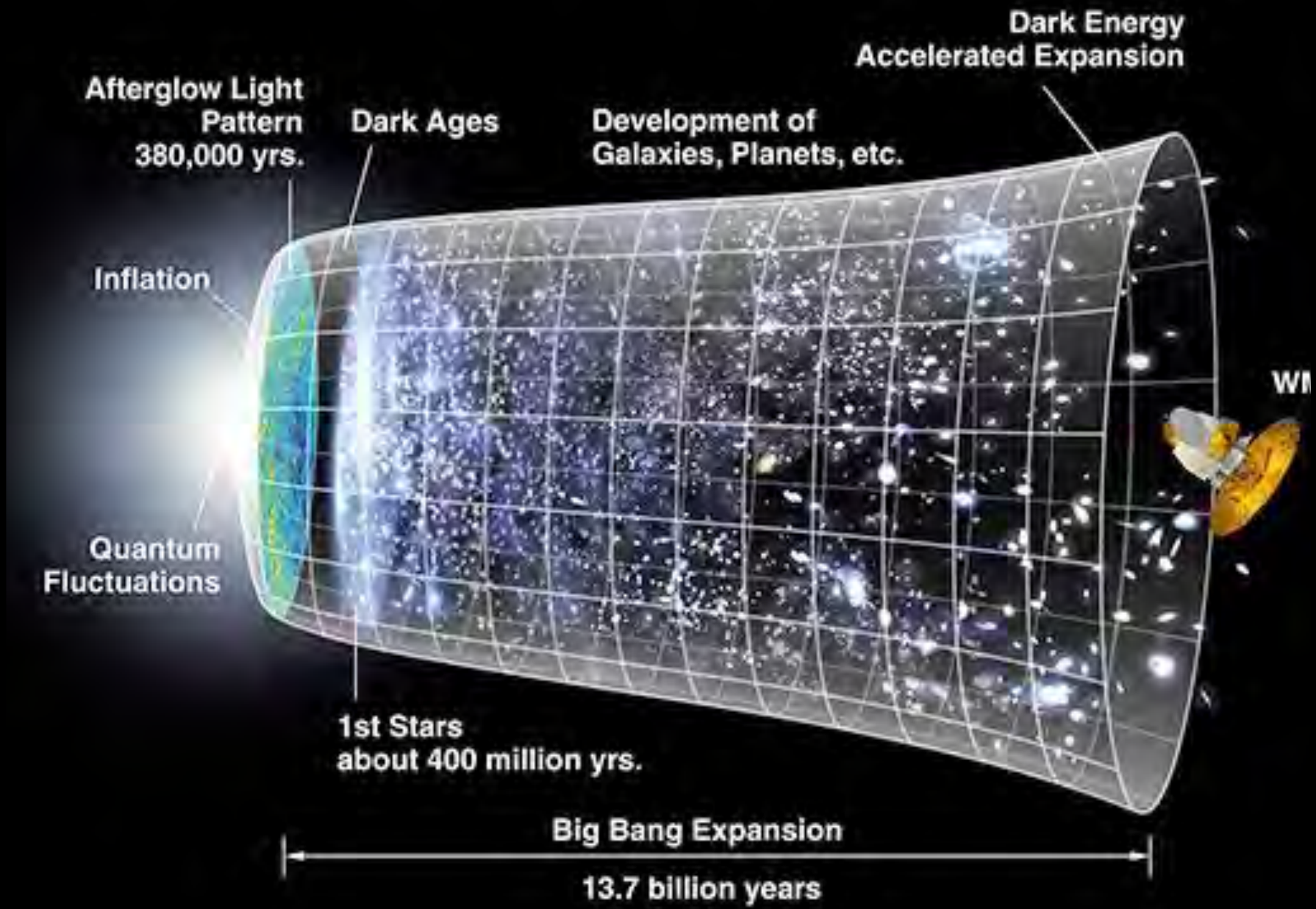


To do this, we need to probe to the *smallest distance* possible

Equivalent to working at the *highest energy* possible

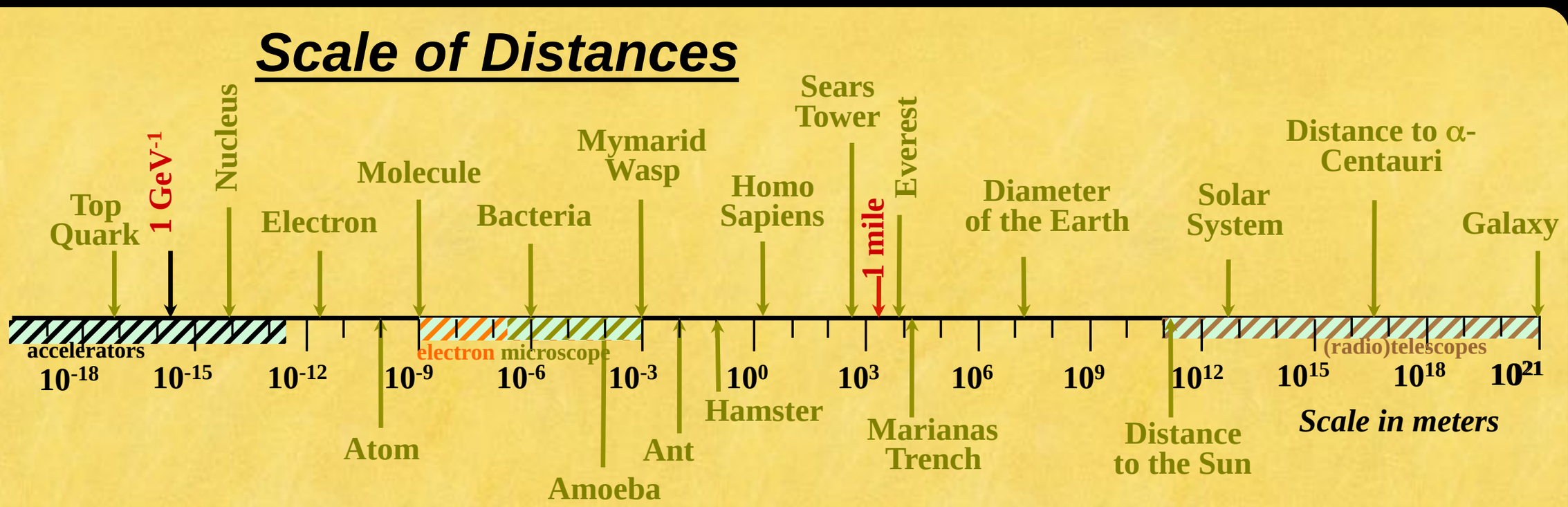
Or the *hottest temperature*

Or the *earliest time* in the universe



History of the Universe

Scale of Distances

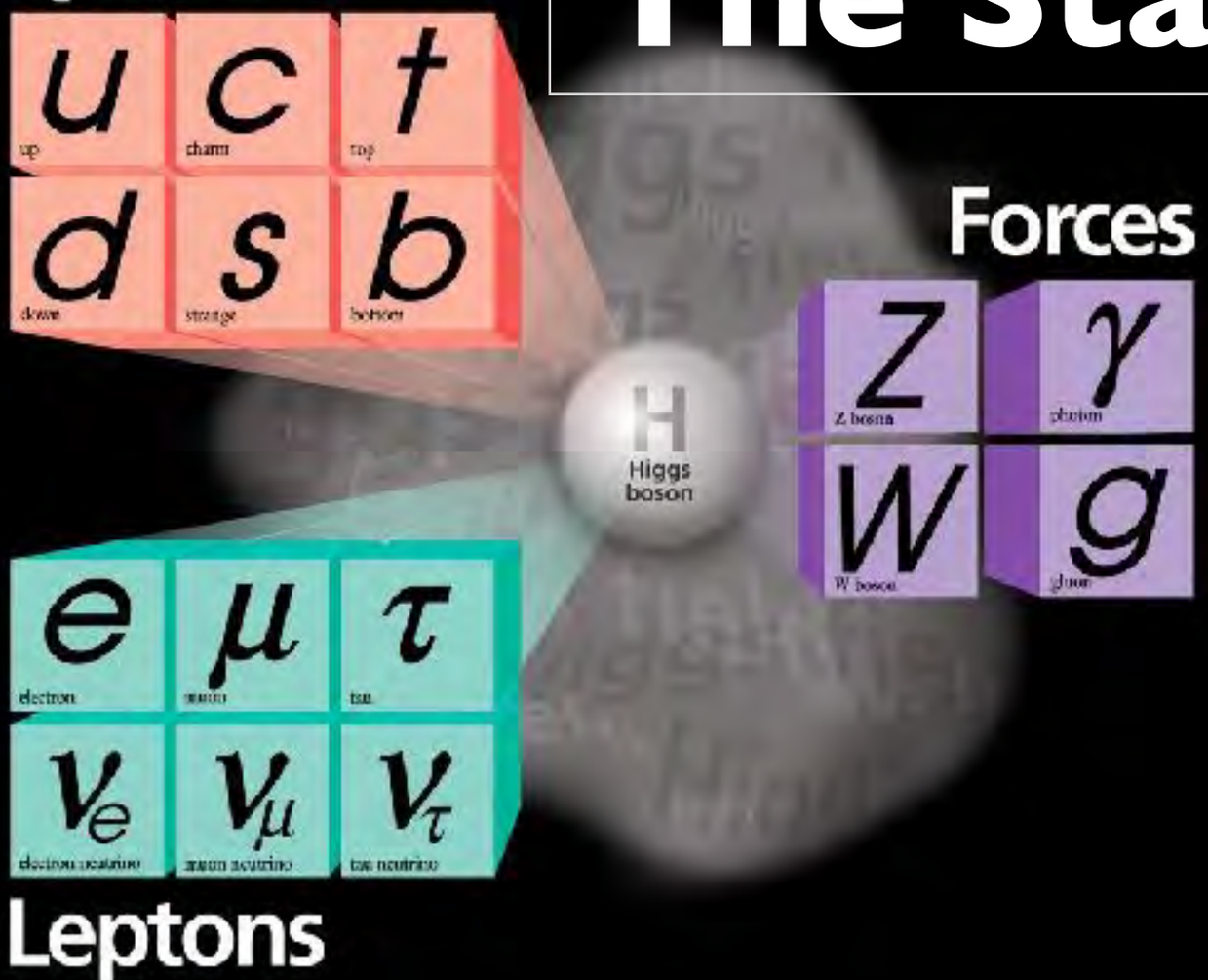


Amazingly, to understand, eg, how a star burns, at the most fundamental level, we need to understand how the Universe worked at 1 billionth of a second after the Big Bang

... and many of our open questions require probing much earlier times (both theoretically and experimentally)

We have a mathematical framework that incorporates all the indivisible particles we know, (6 quarks and 6 leptons) and 3 of the forces (Electromagnetism, Strong, Weak, but not Gravity) and (recently) explains why fundamental particles have mass

The Standard Model



The Standard Model is one of the most well-tested theories ever.

2013

We've had several major successes in past few years

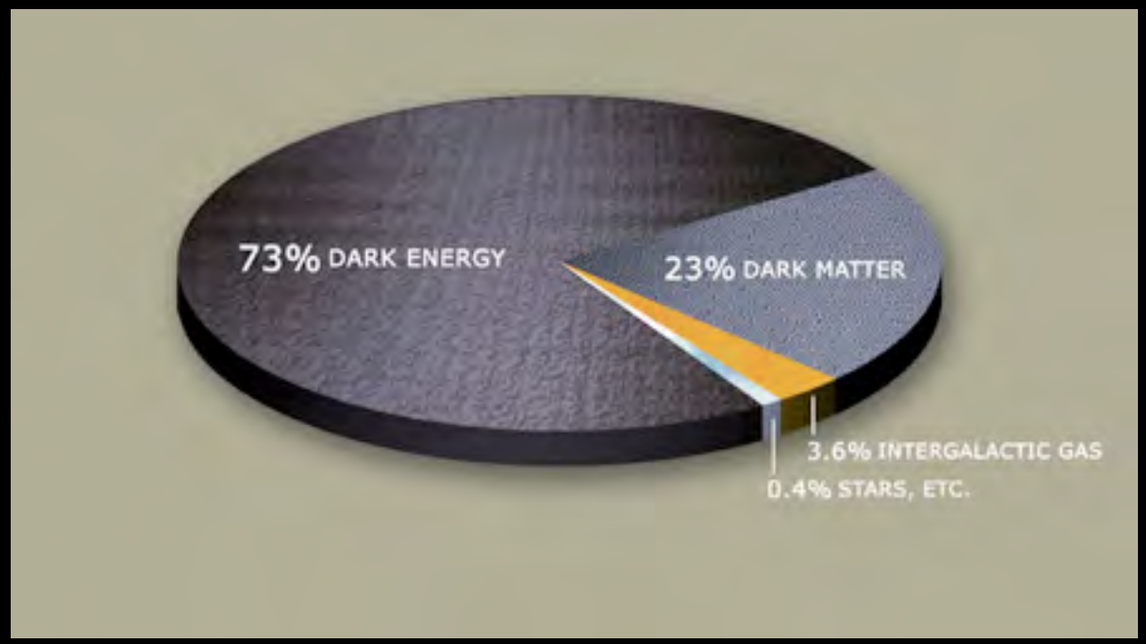
-Discovery of Higgs Boson (ATLAS expt. @ LHC)

- Discovery of neutrino oscillations and mass, solving solar neutrino problem (SNO, T2K)

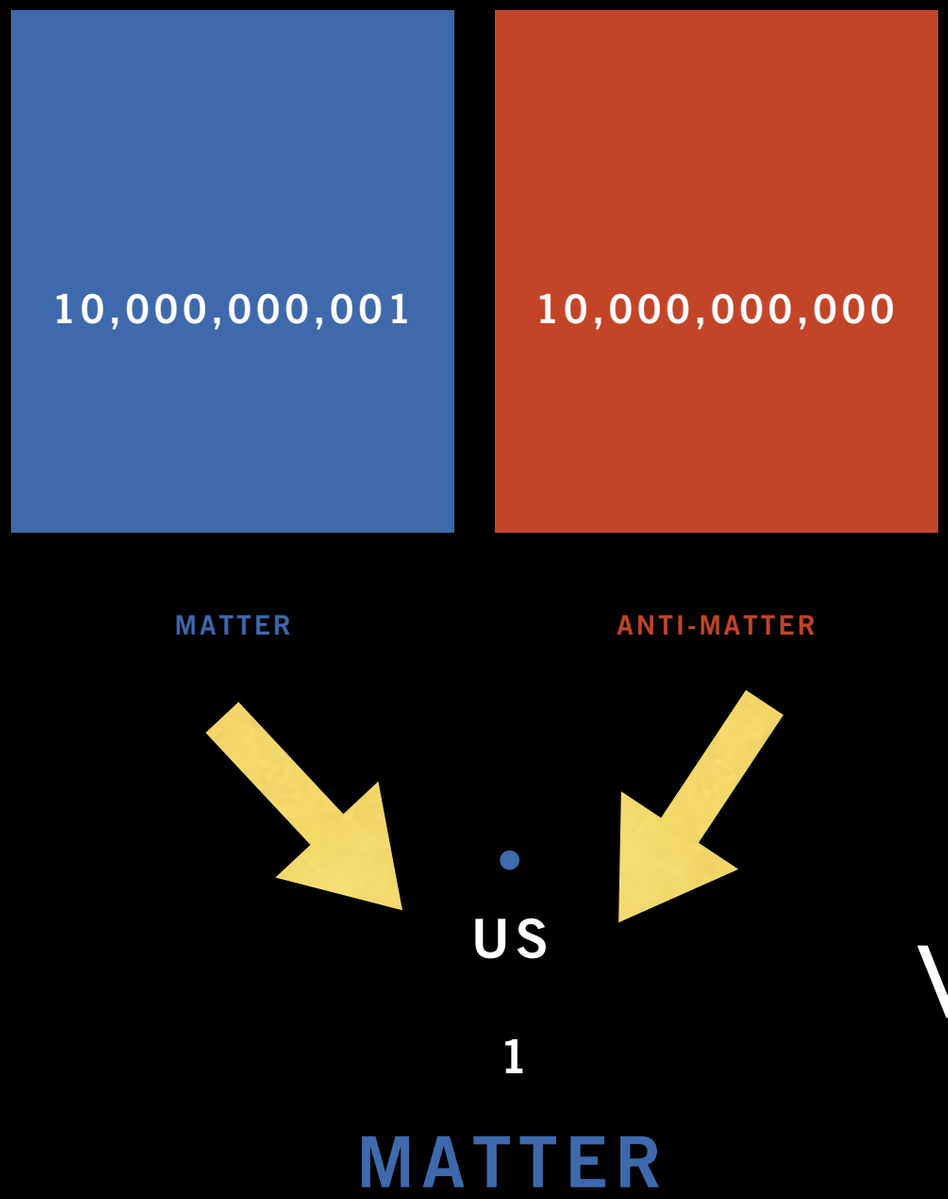
2015

However, it has many deficiencies that are very far-reaching

Still many Mysteries



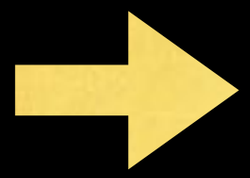
What is Dark Matter?



Why is there any matter left to make us?

Gravity is also very problematic

The Standard Model has no mechanism to incorporate gravity (yes, we have mass, no we don't have gravity)

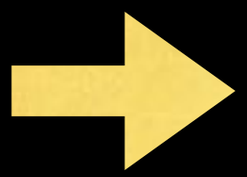


String Theory

What happened at very, very early times after the Big Bang, when gravity was as strong as the other forces?

Are particles really point-like?

Gravity is much weaker than all other forces



Extra Space Dimensions?
New Forces?

Lot's of big questions still to address:

Can we write a Grand Unified Theory
that unifies all the forces?

Are quarks and leptons indivisible?

Where did all the antimatter go?

What is Dark Matter made of?

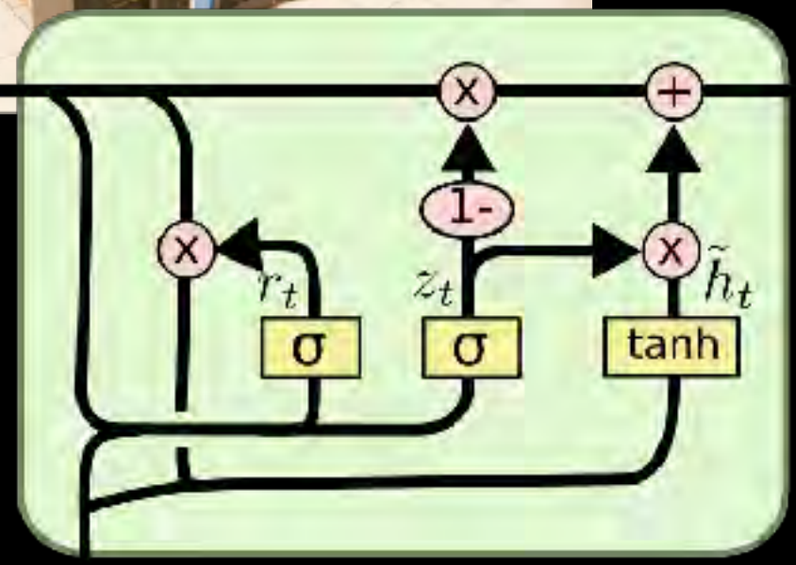
What is the nature of Dark Energy?

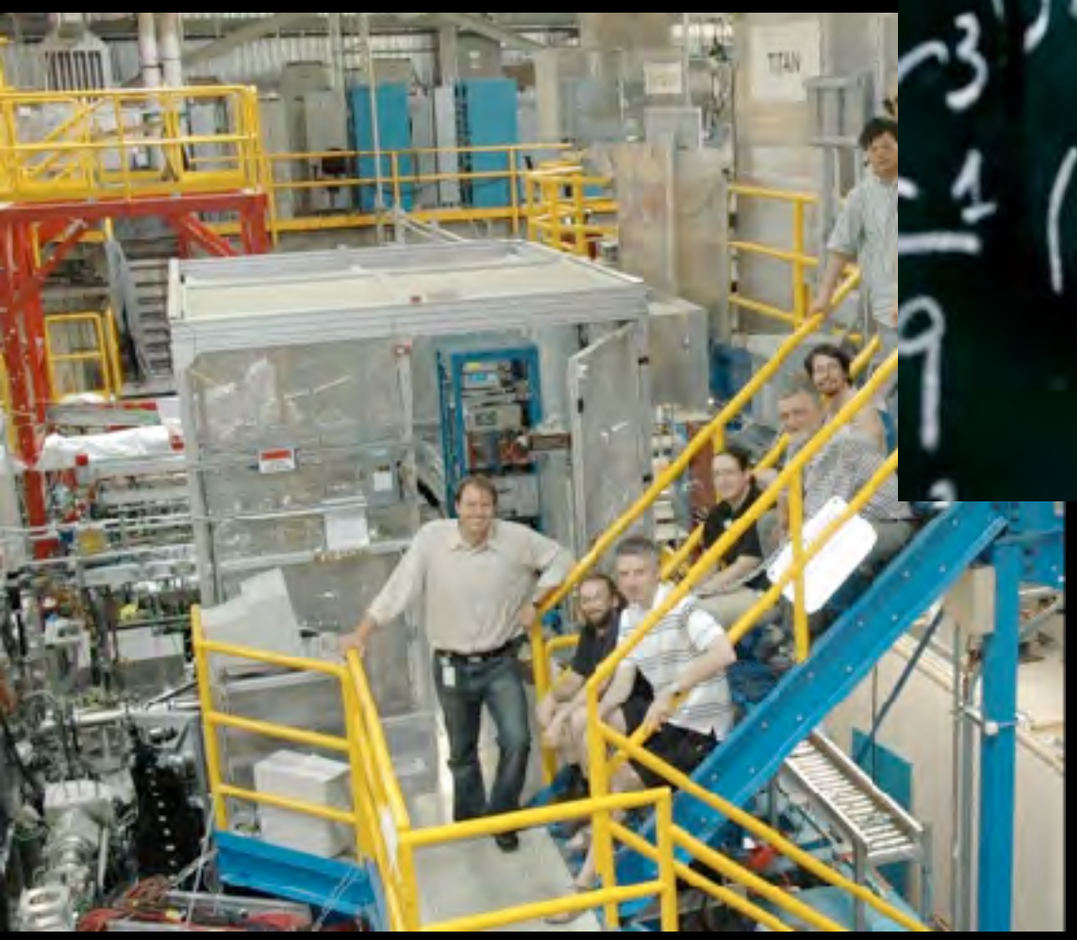
How many dimensions are there?

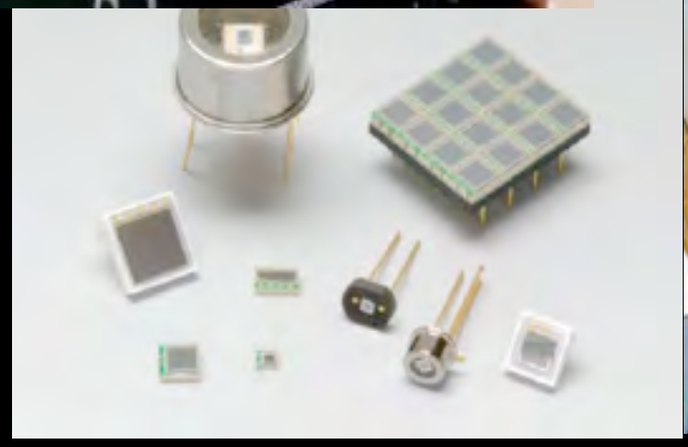
Are there new particles/forces to be found?

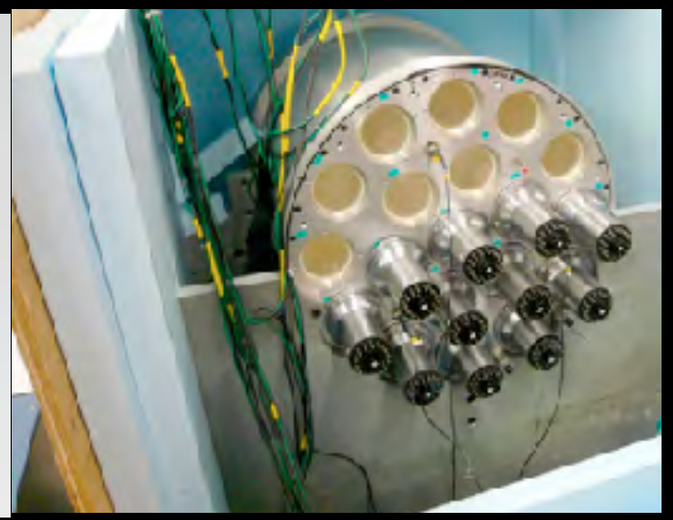
...

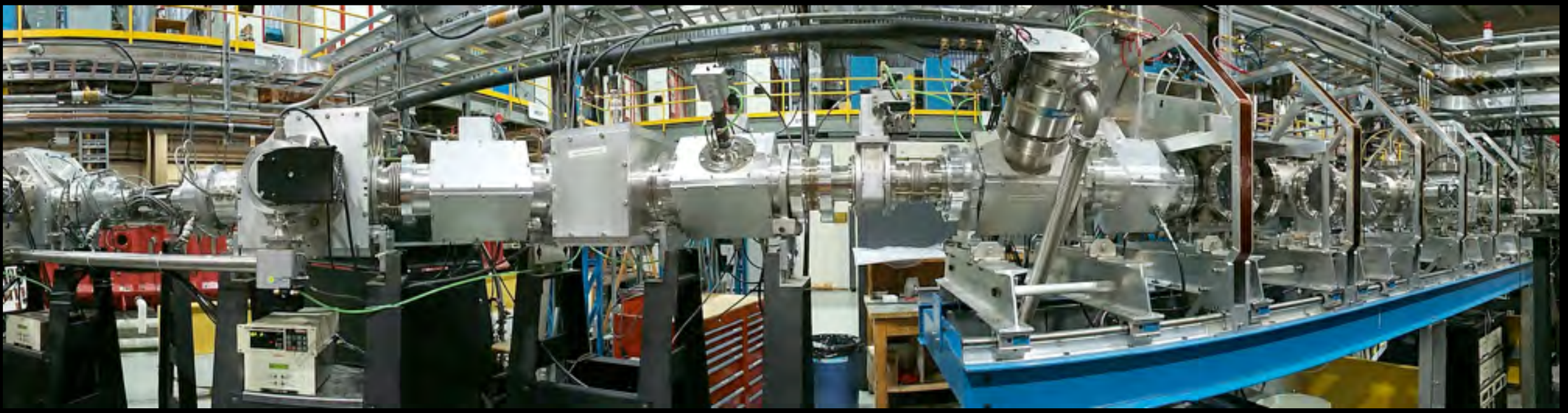
Tools of the Trade











TRIUMF is an enormous resource for our activities

Particle beams for experiments and tests (cyclotron)
Detector development
Machining, fabrication
Design, engineering
“Interdisciplinary” work with medical and other applications

UBC has one of the broadest Subatomic Physics research programs

Particle Experiment
Nuclear Experiment
String Theory
(Astro)Particle Phenomenology

Many names to list here, but check web pages and ask around to find out more. Lots of research opportunities for motivated undergrads

We look forward to hearing from you

Douglas Bryman
Colin Gay
Mike Hasinoff
Christopher Hearty

Alison Lister

Tom Mattison

Janis McKenna

Scott Oser
John Behr
Jens Dilling
Reiner Krücken

Stanley Yen

UBC Gravity and String Theory Groups

Matt Choptuik

Kristin Schleich

Bill Unruh

Joanna Karczmarek

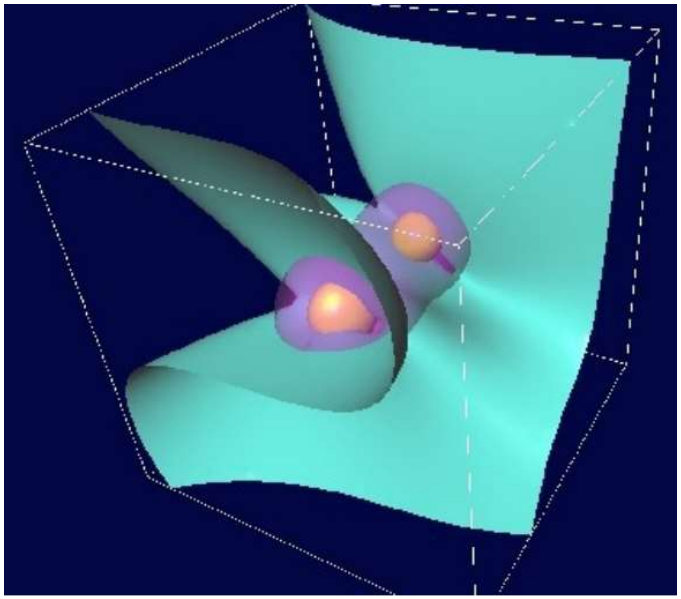
Moshe Rozali

Gordon Semenoff

Mark Van Raamsdonk

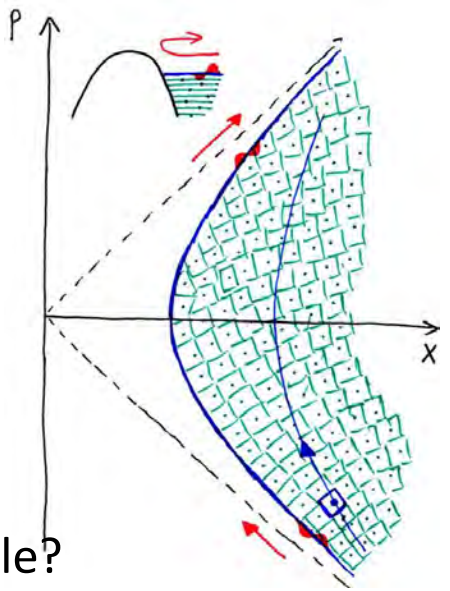
Classical gravity:

- dynamics of spacetime and its interaction with matter described by Einstein's theory of General Relativity
- Very difficult set of nonlinear differential equations: can try to prove mathematical results about the nature of solutions (e.g. Schleich), or treat numerically (e.g. Choptuik, Rozali)
- Interesting questions:
    - physics of formation, dynamics, and collision of black holes and other compact objects,
    - existence of wormholes and other topological features,
    - simpler analogs of gravitational physics (Unruh)
    - physics of dark matter/dark energy



Quantum gravity:

- Necessary for a full understanding of black holes or the big bang, possibly for dark energy.
- String theory is a consistent model for quantum gravity: most complete version is defined by an amazing equivalence between gravitational and non-gravitational quantum systems (the AdS/CFT correspondence)
- Interesting questions:
  - Is information lost in the formation and evaporation of a black hole?
  - What are the simplest quantum systems that have the physics of quantum black holes, and what can we learn from these? (Karczmarek,Rozali, Unruh)
  - Can we use gravity to learn about complicated non-gravitational systems?
  - How is the gravitational physics encoded in ordinary quantum systems in the AdS/CFT correspondence? (Karczmarek, Rozali, Semenoff, Van Raamsdonk)
  - Can we come up with a consistent theoretical model of the big bang?



- Fascinating connections to the physics of quantum information theory (Karczmarek, Van Raamsdonk)

3rd and 4th year Practicalities

Advisors:

- Janis McKenna (physics and general) ug-phys34@phas.ubc.ca
- Vesna Sossi (biophysics) ug-biop@phas.ubc.ca
- Ingrid Stairs (pro-tem, astronomy) ug-astr@phas.ubc.ca
- Program chair: Chris Waltham ug-chair@phas.ubc.ca

- Coordinator: Kirsty Dickson ug-coord@phas.ubc.ca

The Calendar

Whatever it says on phas.ubc.ca

(and we try and keep it as up to date and correct as possible),

the UBC Calendar has the final word.

Most of what you need to be familiar with can be found under:

- Faculty of Science BSc requirements:

http://www.calendar.ubc.ca/vancouver/index.cfm?tree=12,215,410,0

- Specialization requirements (for PHAS programs): Astro:

http://www.calendar.ubc.ca/vancouver/index.cfm?tree=12,215,410,415

- PHYS/BIOPHYS/Other combined programs:

http://www.calendar.ubc.ca/vancouver/index.cfm?tree=12,215,410,434

Using the search tool can be a Kafka-esque experience.

It won’t all be smooth sailing - what to do if you have issues

- With your course
  - Talk to your Prof.
  - If the Prof. cannot rectify - talk to the u/g chair, Chris Waltham (me)
- With the program
  - Administrative issues – talk to the u/g coordinator, Kirsty Dickson
  - Advising – talk to your program advisor (Profs. McKenna, Stairs, Sossi)
  - Academic issues – talk to the u/g chair, Chris Waltham (me), or Science Advising
- With life (health, finance, harassment, careers, anything...)
  - https://students.ubc.ca/
  - Health related issues for academic concession: Science Advising Centre
  - But also – talk to the person who is most likely to be of immediate help: your profs., advisors and u/g chair

Getting into Research I

Majors students will be exposed to research topics in PHYS 348 (Janis McKenna). Explore current research topics in depth, write reports and give presentations. Honours students often like to take this, too.

All Honours students take the PHYS 449 or ASTR 449 thesis course, working with a supervisor over the course of a year and conducting original research.

Anyone wanting to take PHYS 349 or ASTR 349 (mini version of Research Thesis) should contact Rob Kiefl and the undergrad chair for project approval, provided that you have at least 75% accumulative average and have a research project or supervisor in mind or under discussion.

FAQs

Take PHYS 449 (thesis) as a Majors student? - Usually no, but ask us if you are flying high in your program.

Take PHYS 449 in one term? - Usually no, but talk to us if co-op or exchanges make the two-term plan difficult.

Getting into Research II

- Summer NSERC USRA awards (deadline in January)
- Co-op terms
- Direct hiring by professors

For these and for 449 projects, don't hesitate to contact professors to help you figure out what to work on – we are used to having students ask us about projects, and can often find a project in our research program to fit students' strengths and interests.

Graduating?

See calendar at: http://www.calendar.ubc.ca/vancouver/index.cfm?tree=12,215,410,434 (anything with Physics) and http://www.calendar.ubc.ca/vancouver/index.cfm?tree=12,215,410,415 (Major/Minor Astronomy)

Use **Degree Navigator** in the SIS to check your progress in your degree program. This is important at the beginning of 4th year, after you have registered for all your final year courses. You may also ask Salena or Science Advising for a **"Graduation Check"** at the beginning of your final year just to check you have what you need to graduate.

You should use the calendar from the year you entered the specialization (i.e. your 2nd year) – click the "Calendar Archive" button – but in practice we will often accept any version of the program in effect during your years in the program, but you will need to follow one entire calendar version.

Honours students: must take 30+ credits/year and maintain 68% average (except in your last year, when you should take as many credits as you need to graduate). Majors students: have Science and Arts breadth requirements

Your responsibility to ensure you fulfill the departmental and Faculty of Science requirements for graduation! Check now before you finalize your courses.

What can you do with a B.Sc. in physics/astronomy?

Four broad areas:

- Teaching: ever-present need for physics/physical science/math teachers - worldwide
- Data, data, data: Gang of Four/government/healthcare
- Technology: environmental/government labs/medical
- Entertainment/gaming

Alternative to physics/astro grad school:

- Short, focussed professional Masters.

The current local scene

Product Developer
Indeed ★★★★½ 480 reviews
Vancouver, BC
$98,000 - $132,000 a year
BA Degree in Engineering, Computer Science, Physics, Math, or Statistics, or a related technical field. As the world's number 1 job site, our mission is to help…
Direct Apply
4 months ago save job more...

New Grad Engineers/Scientists
Ballard Power Systems Inc. ★★★☆☆ 2 reviews
Burnaby, BC
Preferably Mechanical Engineering, Chemical Engineering, Engineering Physics, Physics or Chemistry. Work effectively within a team of scientists and engineers…
30+ days ago save job more...

Junior Application Developer (Full-Time)
S-FRAME Software Inc.
Richmond, BC
Basic Understanding of Structural Engineering / Physics. Knowledge in areas such as algorithms, computer graphics, algebra, etc. will be a strong asset.
Direct Apply
1 day ago save job more...

Animator, 3D
DHX Media ★★★★☆ 21 reviews
Vancouver, BC
A strong understanding of basic human kinetics and real world physics. Complete assigned animation within scheduled timeframe. Why work at DHX Media?

Research Technologist
Molicel
Maple Ridge, BC
We are proud of our roots that first began in a Physics lab at UBC in 1977 and have evolved into a. E-One Moli Energy (Canada) Limited is a leading edge lithium…
Direct Apply
30+ days ago save job more...

Radiation Therapy Service Technologist
PHSA ★★★½☆ 92 reviews
Surrey, BC
Provides orientation on correct operating procedures to new staff including physics students, as assigned. Demonstrated knowledge of the principles of physics…
Provincial Health Services Authority 1 day ago save job more...

Systems Manager
University of British Columbia ★★★★½ 315 reviews
Vancouver, BC
$66,787 a year
Works within a team of other IT professionals. Provides advice and representation to groups on campus as well as within the department on IT-related issues…
15 days ago save job more...

Grade 8 to 12 Math/Science Teacher
Khalsa Secondary School ★★★☆☆ 2 reviews
Surrey, BC
$50,000 a year
Khalsa Secondary School is looking for Grade 8 to 12 Math/Science Teachers! There are 4 positions available. You must be eligible to be employed in Canada.
Direct Apply
Sponsored save job

Tutors Required in all Subjects
Above Grade Level
Surrey, BC
$20 - $24 an hour
Degree in Math, English, Physics and /or Chemistry or currently studying in these fields. Senior Math Tutors must be able to tutor Algebra, Geometry,…
Direct Apply
Sponsored 1 day ago save job

Research Associate, Power System Engineer
British Columbia Institute of Technology (BCIT)
★★★★½ 71 reviews
Burnaby, BC
$65,835 - $87,365 a year
This is an exciting opportunity to join a seasoned, multi-discipline team, in a fast-paced, collegial environment working on leading-edge Clean Energy and…
4 days ago save job more...

Grad School

- Get into an Honours program: they are tailored for graduate school preparation.
- How is it different from undergrad?
- The focus is on doing research – a 2-year project for an M.Sc. degree, and a 3-4-year project for a Ph.D. You do take some courses, but the idea (especially for a Ph.D.) is to be able to work independently and become the world's expert on your particular topic.
- An M.Sc. degree can be useful for jobs in many different fields (e.g. our medical physics program is accredited); a Ph.D. is something you should only do if you really love research.

I was removed from the Honours Program - can I get back in?

Maybe.

Ultimately this is a decision for the Dean's office (via Science Advising).

The best plan is to take all the Honours specialization courses for the year you are in, and to aim for a 75% average over the year.

If you can accomplish that, we can try to argue to the Dean that you should be readmitted to the Honours specialization.

You should also look at the requirements of the majors program to make sure you will meet them (e.g. breadth requirement).

Applying to Grad School

UBC admission requires at a minimum 80% average (in physics and math over the last two full years of study) – but the effective cutoff can be higher. www.phas.ubc.ca/graduate

Other Canadian schools have similar or sometimes less stringent requirements.

US and other international schools have lots of different requirements, sometimes very tough!

Things that help:

- Things that help: Carrying out research projects and/or having relevant co-op/work experience in tech or related fields
- Having good recommendation letters (your letter-writers should know you well enough to judge your likely success in grad school).
- Writing a good “statement of purpose.”
- Evidence of leadership potential.
- Knowing the person you want to work for.

Financial support

Most Canadian and US schools will support their grad students with a combination of teaching assistantships and research assistantships. You won't live like royalty, but you probably won't go (much) deeper into debt.

A good plan is to try to get a scholarship. To apply for Master's-level NSERC scholarships, you have to apply by Dec. 1 through the (Canadian) school you want to attend (you can choose up to 5 schools).

NSERC or CIHR scholarships

https://www.grad.ubc.ca/awards/nserc-postgraduate-scholarships

and http://www.grad.ubc.ca/awards/cihr-graduate-scholarships

Also look at https://www.grad.ubc.ca/awards/prospective-students for more opportunities (e.g. MITACS for industry-focused research and Michael Smith Foundation for health related research).

You'll need: 80% average in the last 2 years, transcripts, a research proposal, all the information for the Common CV format (a time-consuming thing to fill in!) and two letters from professors/ supervisors.

There will probably be an NSERC application information session sometime this fall – see your email for details.

Application deadlines

The UBC Physics & Astronomy deadline is Dec. 1st, 2019 (with all necessary documents uploaded by Dec. 15th). Can start the process Oct. 15th.

http://www.phas.ubc.ca/graduate-program-prospective-students

Other Canadian schools will have deadlines in December or later – check their websites.

Note that the NSERC application deadline is BEFORE the universities' application deadlines - indicate which schools you plan to apply to.

US schools typically have deadlines in December or early January – check their websites.

For the US: write the GRE www.ets.org/gre

Most US schools require the Graduate Record Exam or GRE. This consists of a General Test (Verbal, Math and Analytical Writing) and a Subject Test. The General Test is computer-based and is handled by Prometric

The Physics Subject Test is paper-based and given at UBC on Oct. 26th and April 4th. It is essential to take the test on Oct. 26th if you are applying to US grad schools this year; the April exam is too late.

Registration for the Oct. 26th exam closes very soon (Sep. 13th)

Do practice tests, for both the General Test (always changing) and especially the Physics Test.

Don't expect to be able to do all the problems on the test, but make sure you know everything you have learned so far thoroughly.