Imagine Day 2022: Physics and Astronomy

11:00 Introductions & Welcome

11:15 General Program Information

- Honours, Majors, Minor - Mark van Raamsdonk
- Astronomy Program – Aaron Boley
- Biophysics Program – Carl Michal
- Co-op – Javed Iqbal
- Club Presentations:
  - Physsoc – Willow Benitz
  - Astronomy Club – Lucas Kuhn

12:00 Lunch [in the hallway outside]

12:30 Research in Physics and Astronomy

- Optical Physics – Valery Milner
- Astronomy/Astrophysics – Aaron Boley
- Condensed Matter Physics and Quantum Information – Marcel Franz
- Bio & Medical Physics – Sabrina Leslie
- Particle Physics – Colin Gay
- Gravity and Strings – Mark van Raamsdonk

1:30 Graduation and Beyond – C. Michal & J. Heyl

- Graduation requirements
- Getting into research
- Career Options/grad school
- Grad School Planning

1:50 Student-led Q&A [no faculty]

Introduction

- Professor Colin Gay
  Head, Department of Physics and Astronomy

  Group Leader

- Shawn Salgadoe – Undergraduate Program Coordinator

- Associate Professor Carl Michal
  Undergraduate Chair

- Advisors: Profs: Mark van Raamsdonk, Aaron Boley, Vesna Sossi (regrets) and Kristin Schleich (regrets).

UBC

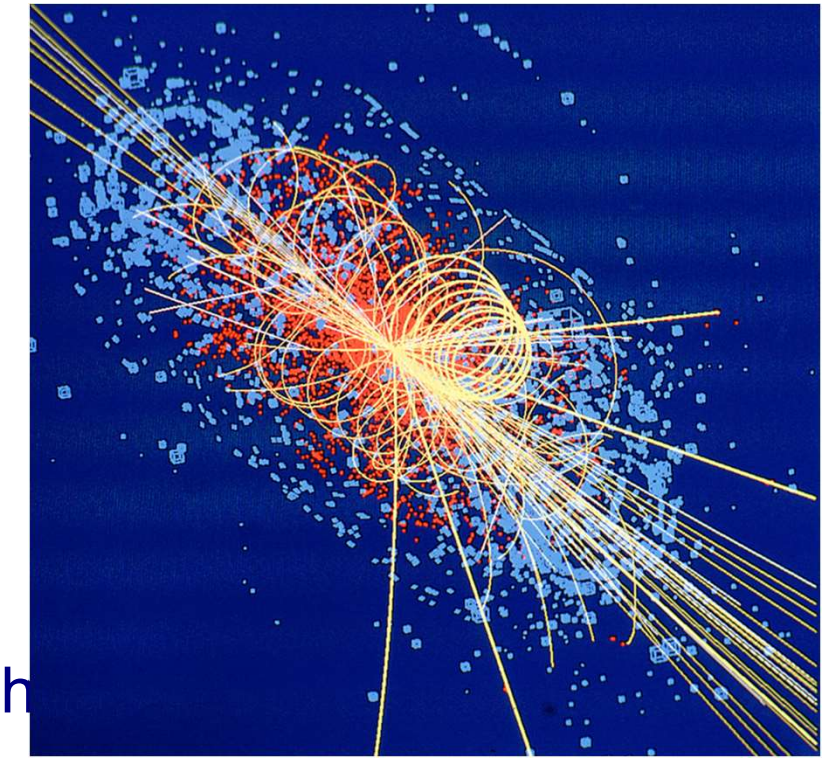
Shawn Salgadoe
Undergraduate Program Coordinator

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

- General program inquiries
- PHYS & ASTR course registration issues
- Specialization applications and specialization changes
- USRA applications and other summer research opportunity enquiries
- Liaison between department, student clubs and students: student events mailing etc.

PLEASE: always include your student number in your emails to the department
(right on the subject line is best!)

PHAS General Program Info



Undergraduate chair: Carl Michal
1st -year advisor: Michael Hasinoff
2nd -year advisor: Mark Van Raamsdonk
3rd- and 4th-year advisor: Kristen Schleich
Astronomy advisor: Aaron Boley
Biophysics Advisor: Vesna Sossi
Combined Major in Science: any PHAS Advisor

Program coordinator: Shawn Salgadoe 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:
http://www.science.ubc.ca/students/degree

www.calendar.ubc.ca/vancouver
Then look under "Faculties, Colleges and Schools" then
"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 get a "Graduation Check" from Science Advising, and/or our PHAS Undergraduate Co-ordinator

BSc Graduation Requirements

Summary of Program Requirements Science

	Major, Combined Major, or General Science	Major+Minor in Science	Major+Major (Science)	Honours or Combined Honours	Honours+Minor in Science
Minimum Total Credits	120	120	120	132	132
of which courses 300+	48	48	60	48	60
Minimum Total Science Credits	72	72	72	72	72
of which courses 300+	30	42	54	42	54
Minimum Total Arts Credits	12	12	12	12	12
Maximum Credits that can be double counted	-	6	6	-	6
Maximum credits not in Science or Arts	24	24	24	24	24

All Majors BSc: 120 credits

All Honours BSc: 132 credits

Science Breadth requirement – all BSc programs entered 2020+
(older students may go by old program requirements in 2016-2019 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 session**
- **Must not fail any courses.**
- **2020 (due to covid): minimum 27 credits Sept-April for Honours**

Major Degrees

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

★MAJOR is NOT the recommended stream for graduate studies, although Majors who take ALL the core senior honours physics courses + have research experience 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, + more)

- 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

http://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

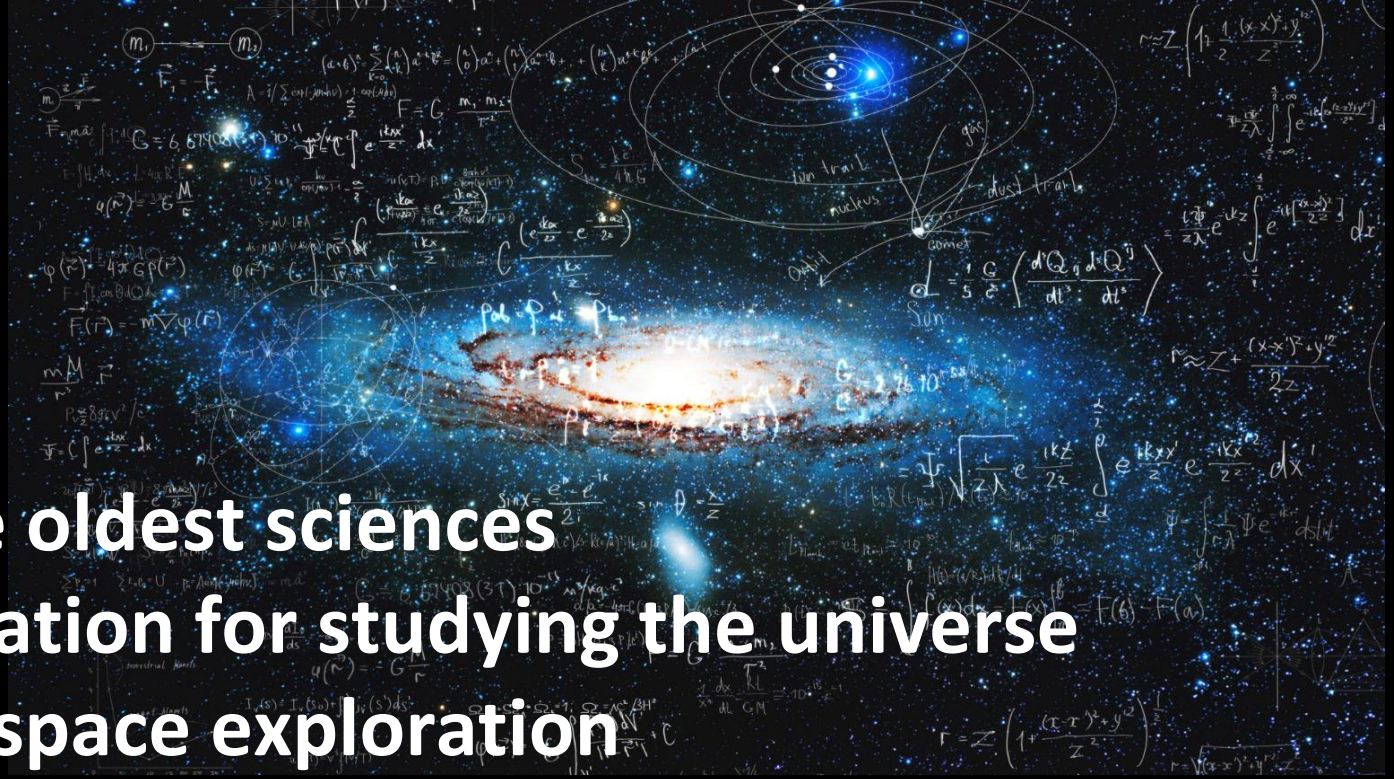
★Not much "elective room" to add a minor to Combined Honours or Combined Majors program – but it has been done.

- 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.

Astronomy



- One of the oldest sciences
- The foundation for studying the universe
- Critical to space exploration
- Provides opportunities to test fundamental physical laws
- Fully integrated into society

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

Course #	Name	MAJ	HON
ASTR 101	Intro to the Solar System		
ASTR 102	Stars, galaxies, cosmology		
ASTR 200	Frontiers of Astrophysics	X	X
ASTR 205	Stars and Stellar Populations	X	X
ASTR 303	Galaxies	X	X
ASTR 333	Exoplanets and Astrobiology		
ASTR 403	Cosmology		Rcmnd
ASTR 404	Astronomical & Astrophysical Measurements	X	X
ASTR 405	Astronomical Lab	X	X
ASTR 406	High-Energy Astrophysics	X	X
ASTR 407	Planetary Science	X	Rcmnd
ASTR 449	Directed Research in Astronomy		X

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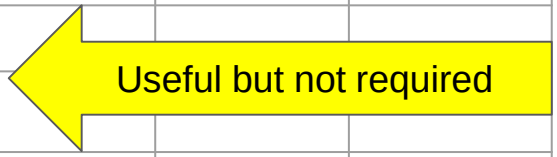

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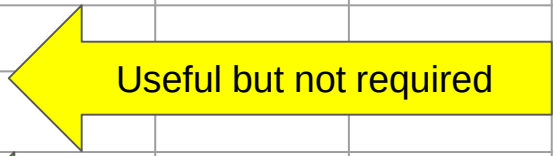
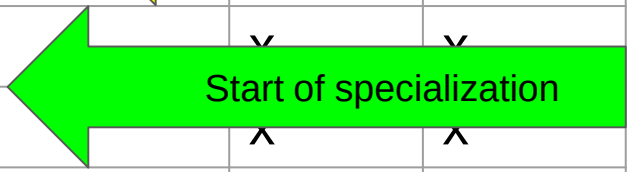
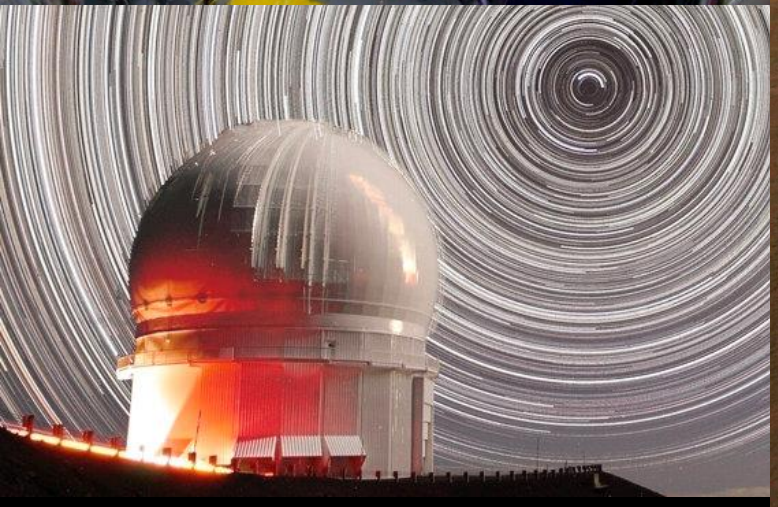




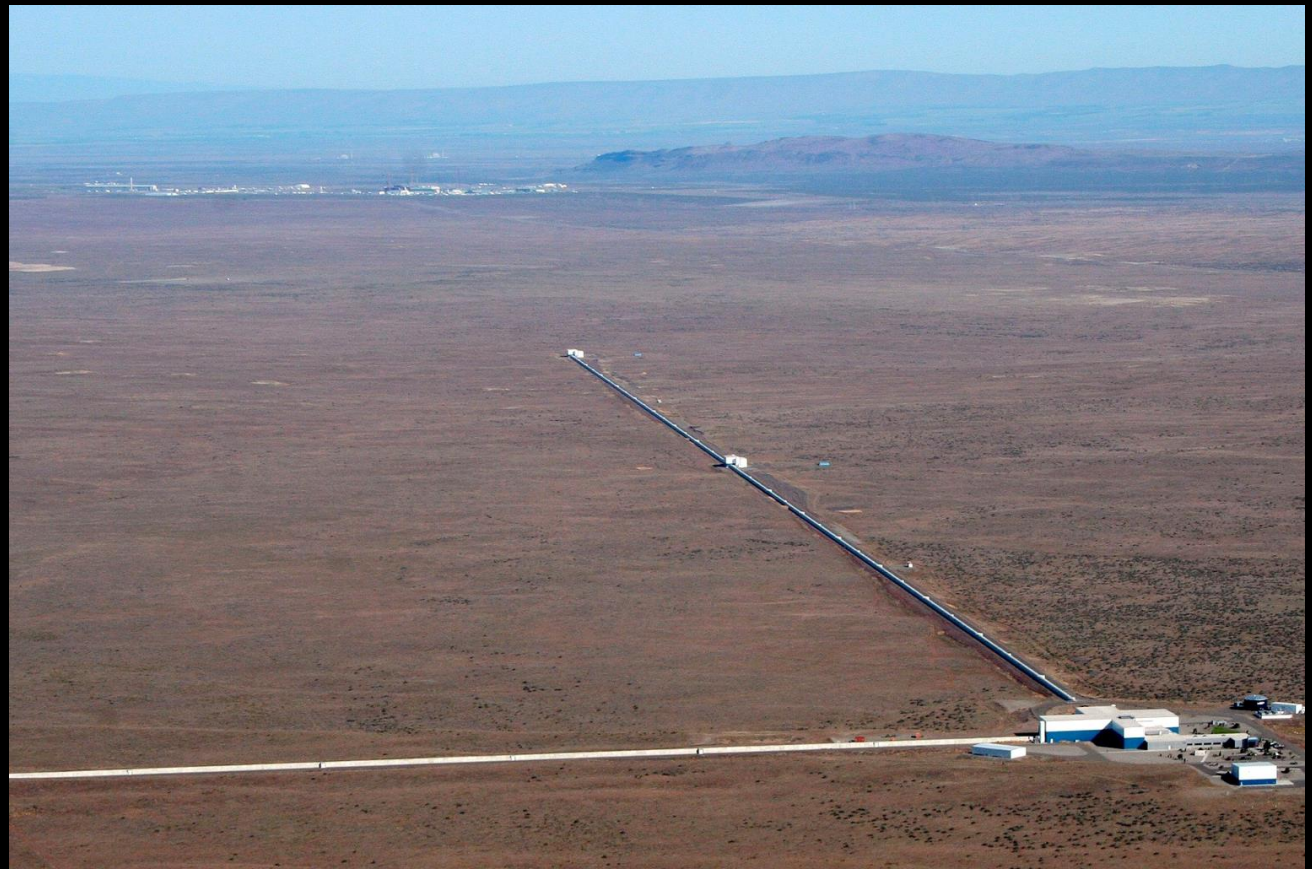
Astronomy Opportunities at UBC

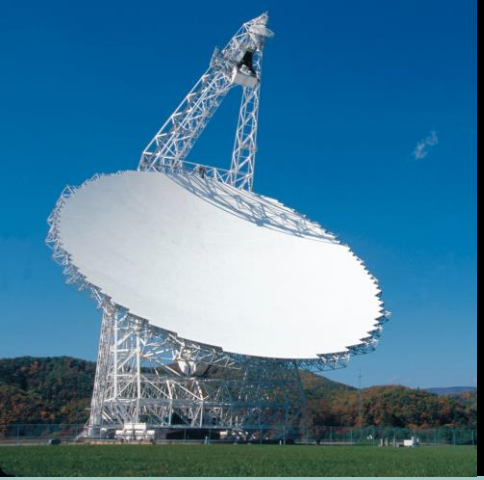
- Wide range of research topics (discussed later)
- A 0.5 metre optical telescope in Chile for student training and research
- A Small Radio Telescope on the roof of Hebb for student training
- Many opportunities to get involved with using different facilities in Canada and throughout the world!
  - LIGO
  - CHIME
  - Green Bank Telescope
  - ALMA
  - CFHT
  - Gemini
  - Hubble
  - JWST
  - Chandra
  - Eventually Square Kilometre Array and a very large optical telescope
  - Supercomputing facilities, too!

CFHT, Gemini, and CHIME: Canadian-led or large Canadian contribution observatories (experiment)



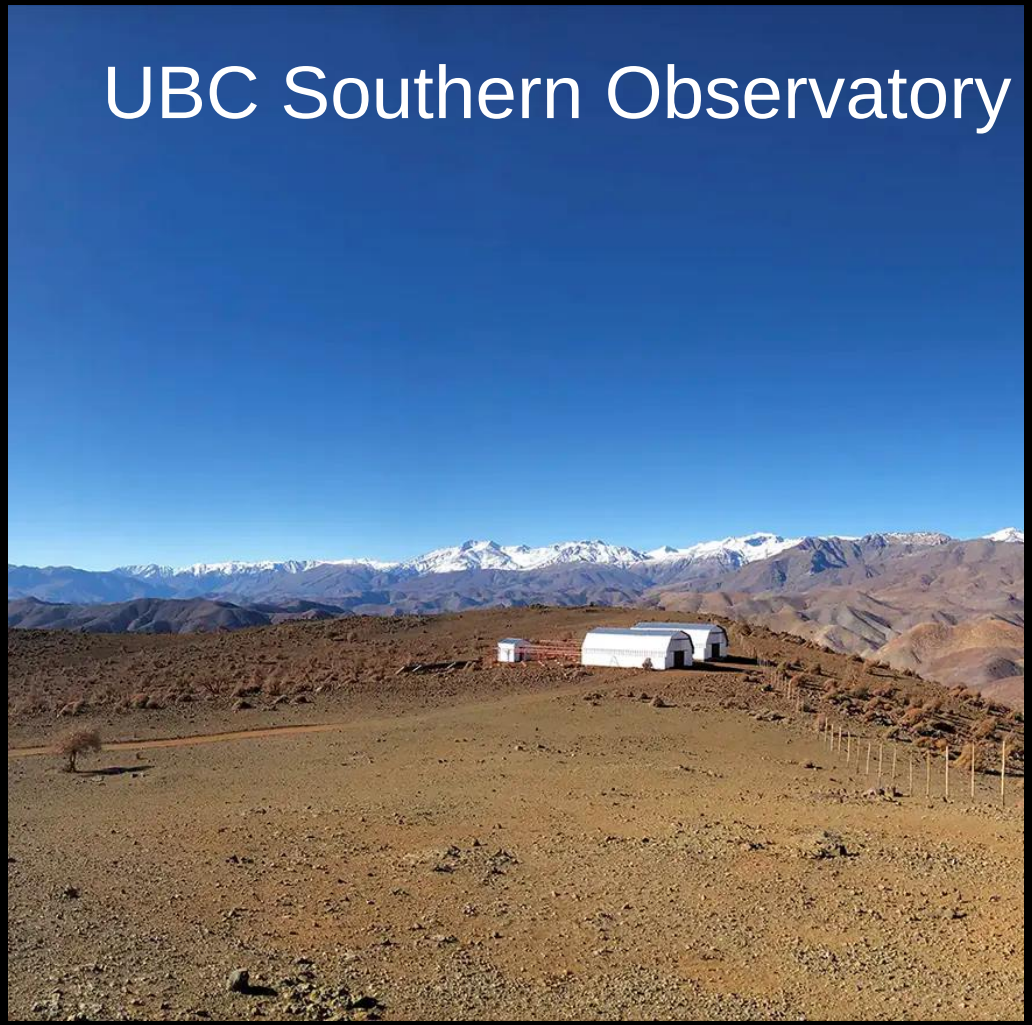
LIGO: Gravitational Wave Physics

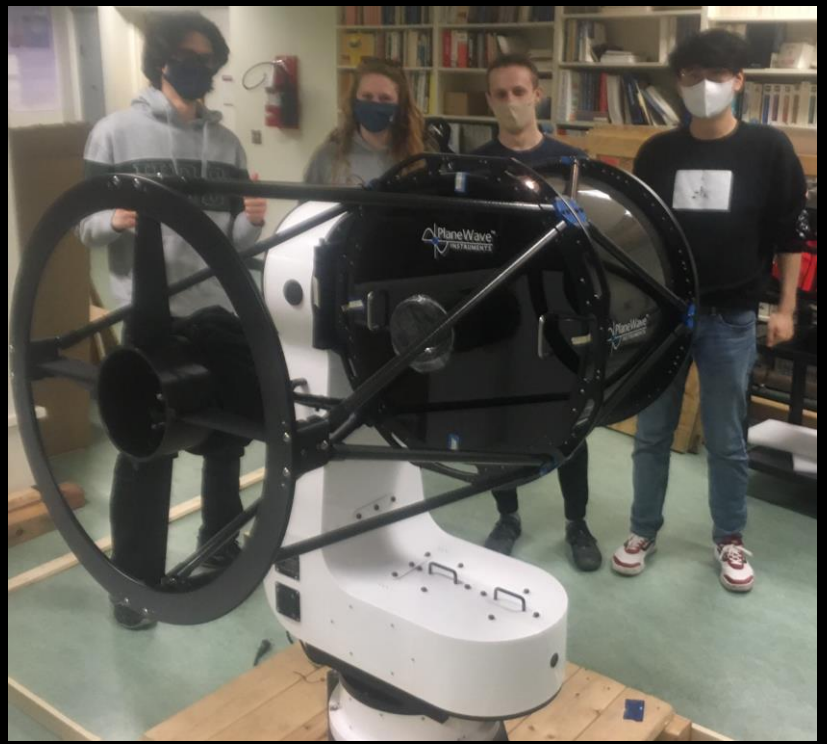




Green Bank Telescope, ALMA, and SKA: Radio and millimetre astronomy

UBC Southern Observatory for teaching and research (in Chile)





Astronomy Career Information

- https://casca.ca/?page_id=93
- https://aas.org/learn/careers-astronomy
- https://ras.ac.uk/education-and-careers/careers

Astronomy Advising

Prof. Aaron Boley
Hennings 320A
ug-astr@phas.ubc.ca

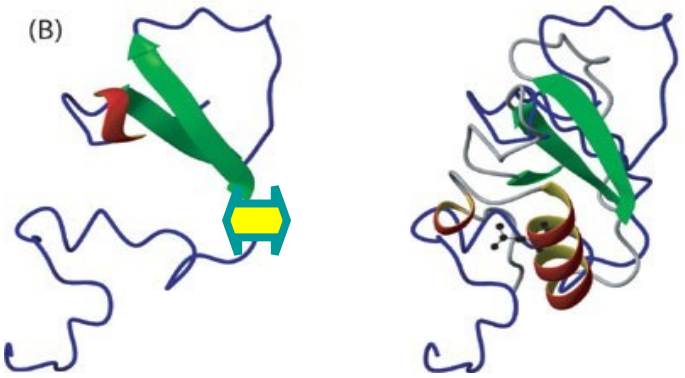
Combined Honours Biophysics program

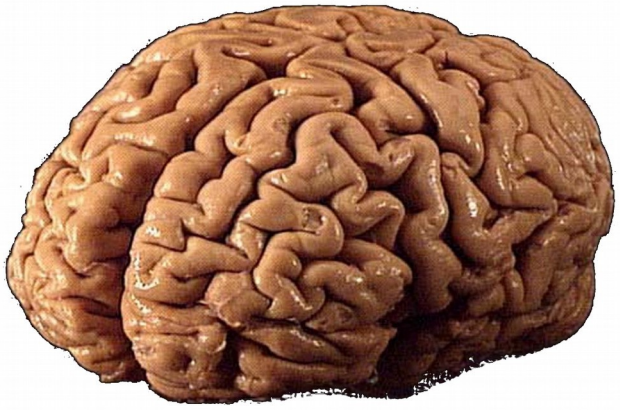
What is Biophysics?

An interdisciplinary science that applies theories, concepts 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?





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**

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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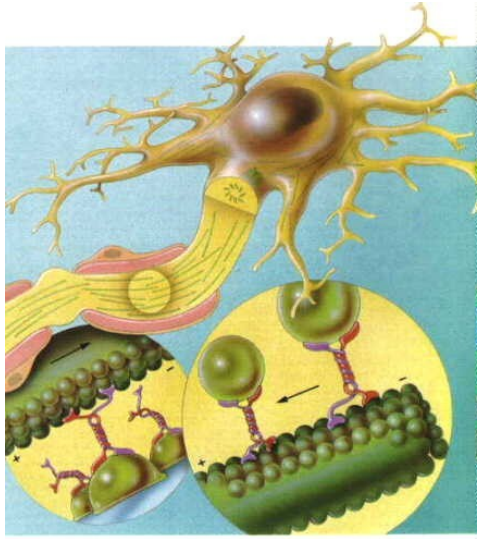
3) Honours thesis

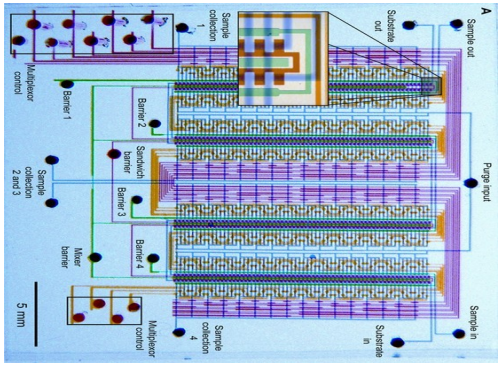
Diverse!

Physics, Math, Chemistry, Biochemistry, Biology!

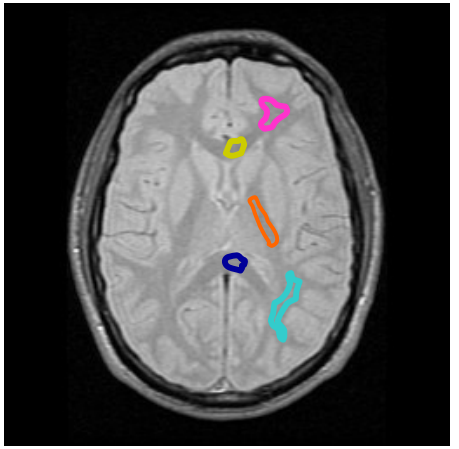
Who is the Biophysics program for?



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]



Entrance to the Biophysics program:

For entry in second year apply through the Faculty of Science

The Biophysics program is an honours program, to **remain** in the program, UBC Science requires:

1. complete all courses attempted
2. complete a minimum of 30 credits per winter session (often more are needed).
3. maintain a minimum of 68 % average in each academic session.

Entrance to the Biophysics program:

Entrance in 3rd year is possible, at the discretion of the PHAS Biophysics and Undergraduate advisors.

Requirements:

- Average of at least 72% in second year
- Have never failed a course
- Taken a minimum of 30 credits in second year
- Course selections to date appropriate for the Biophysics program

These are minimum requirements. Applications considered on a case by case basis.

Entrance to the Biophysics program:

Recommendations:

Follow as closely as possible the program outlined for the Honours Biophysics program in the second year. Some missed courses can be taken in summer.

http://phas.ubc.ca/undergrad-honours-biophysics

Come and talk to the Program advisors!

Support is available:

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

  Biophysics students are encouraged to join Physsoc

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

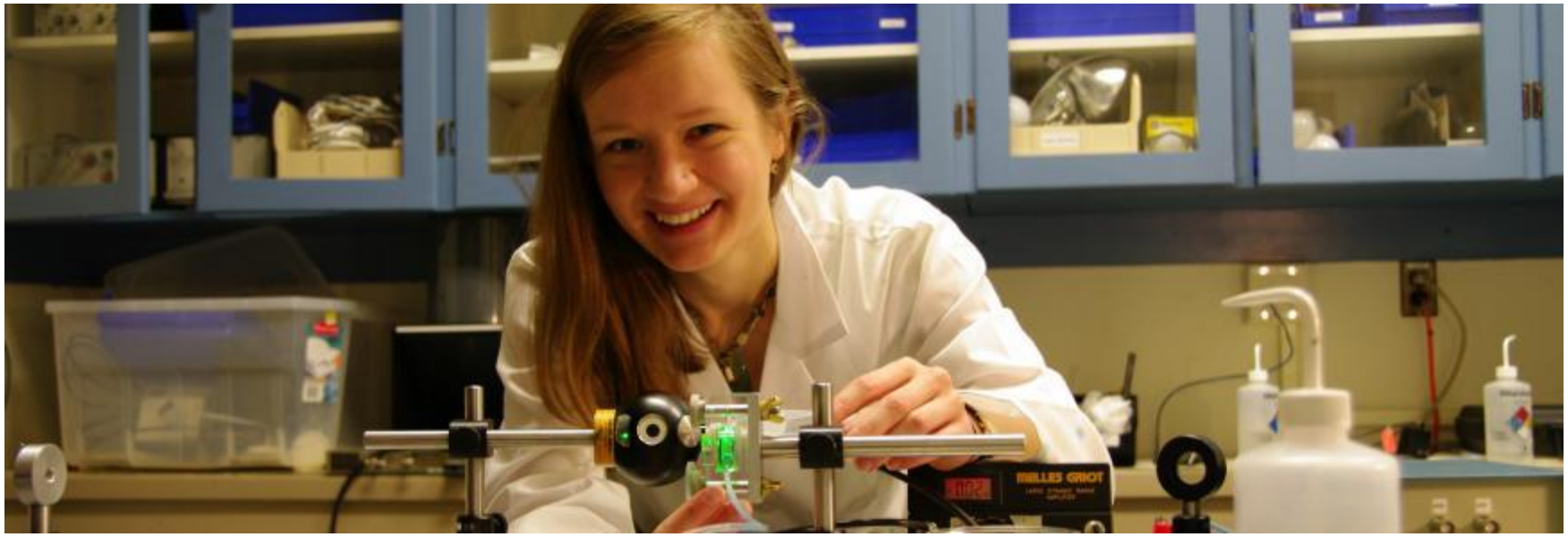
  - help with studying

  - social activities

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

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

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-operative Education?

- 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: $2800

Benefits of Co-op

- Practical work experience
- Work on real-life problems
- Focused education
- Increased job prospects after graduation
- Networking and life skills

PHAS Co-op Schedule -1

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/BIOP Co-op Schedule -2

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	

PHAS & BIOP Co-op Placements (last two last years)

Physics/Astronomy

- Arista Networks
- Ballard Power Systems
- BC Cancer Research
- Canadian Space Agency
- Cellcentric
- D-Wave Systems
- Environment Canada
- Geering Up!
- Incognito Software
- INTEL of Canada
- Ledcor Corp.
- MineSense Technologies
- NRC -
- SBQMI
- Triumf
- UBC (PHAS, CHEM, EOS)
- University of Toronto
- University of Wurzburg

Biophysics

- NINET
- Precision NanoSystems
- Michael Smith Labs
- NRC
- UBC (Biochemistry)
- UBC Psychology
- University of Calgary
- University of Toronto

Program Fees

- Co-op workshop fee: $ 266.75
- Co-op work term fee: $ 821.75/ WT
- Total cost of program (4 WT): $ 3,600

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.

Application Deadlines

Program:	Application Deadlines
PHYS/ASTR (2nd & 3rd Yr.) BIOP (3rd Yr.)	October 3, 2022

Apply online
www.sciencecoop.ubc.ca

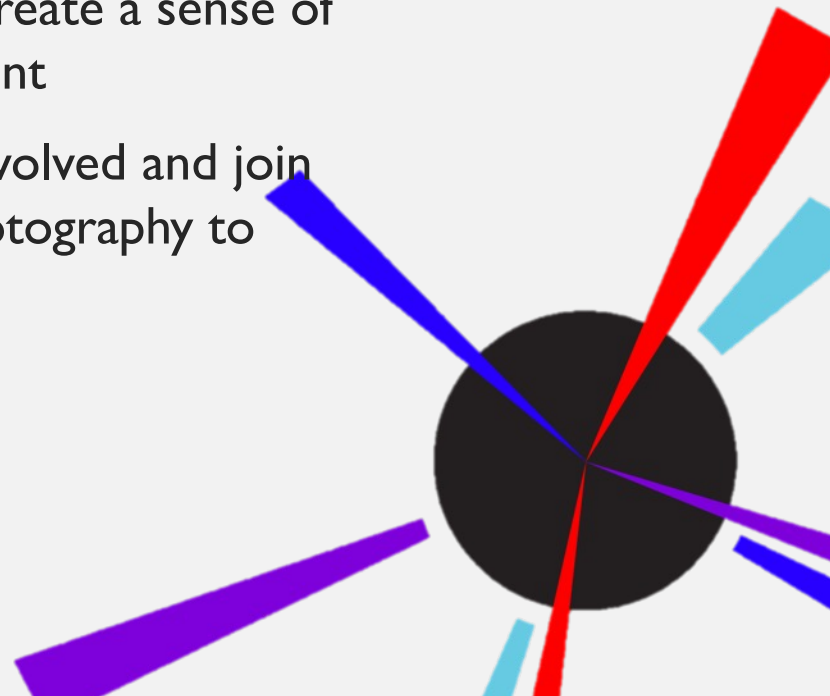
WELCOME TO PHYSSOC

Willow Benitz & Matthew Smith

Co-Presidents

WHO WE ARE

- The UBC Physics Society (PHYSSOC) is a group of students who want to help support, encourage, and be friends with you!
- We host both academic and social events and help to create a sense of community within the physics and astronomy department
- You can join our club as a member, or become more involved and join our council! There are many positions ranging from photography to event planning to academic specific events



BECOME A PART OF PHYSSOC COUNCIL

Our upcoming bi-election is and a great opportunity to get involved on campus!

WHAT WE DO

Midterm review sessions

Final exam practice booklets and review sessions

BBQs

Movie/board game nights

Term-end Wine and Cheese

Trivia events

Beef and Pizza (shaping the future of our courses!)

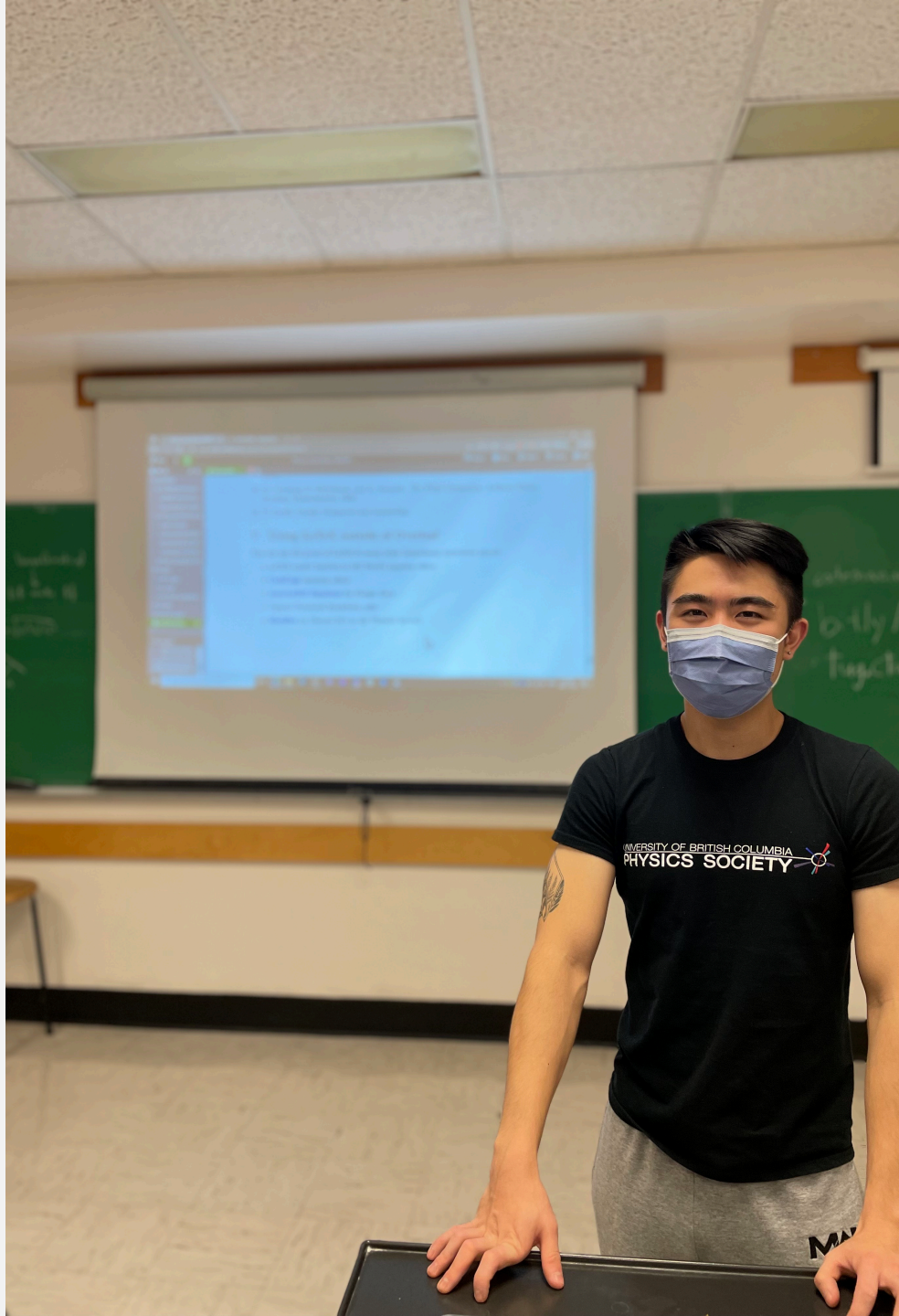
And all sorts of other fun, for $10 per membership!

WHERE WE ARE

HENN 307! Just upstairs

- Study/lounge rooms
- Kitchenette
- foosball table (and occasional tournaments)
- loads of textbooks up for use

Take a break between classes or meet up for a study session!



HOW TO JOIN

Check out our website & socials, it's also where you will find updated information on our upcoming events

https://physsoc.phas.ubc.ca/

The UBC Astronomy Club

The most stellar club on campus since 1984

Who are we?

We are a group of students at the University of British Columbia in Vancouver who share a passion for astronomy.

Our club's goal is to educate and promote interest in astronomy through the various types of events we run.

The UBC Astronomy Club is committed to being an open and inclusive club for everyone regardless of race, ethnicity, age, gender, religion, sexual orientation, gender identity, gender expression, disability, and other diverse backgrounds.

What do we do?

Observation

Flash Observations
Off Campus Observations

Academic

Lecture Series
Astro-Coding Workshops

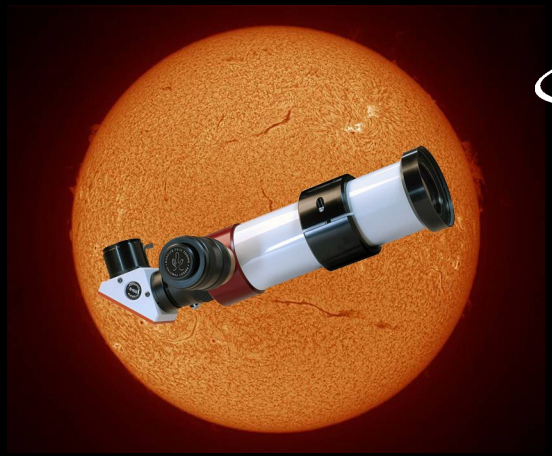
Social

Trivia Nights
Paint and Movie Nights

Get Involved!

- We host at least 3 events per month so drop by as many times as you want!
- How to join?
  - Standard member.
  - Exec team.
- Learn about Astronomy in an extracurricular setting.
  - Get practice using telescopes.
  - Learn how to code for research purposes.
  - Meet new friends with a shared passion for exploring the Universe!

Imagine Day Booth



Questions?

Ways to reach us


ubcastronomyclub@gmail.com


@ubcastronomy


facebook.com/UBCAstronomyClub


TheUBCAstronomyClub


@ubcastronomyclub


/u/ubcastronomyclub

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

The study and **control**
of atoms, molecules and photons,
and their **quantum interactions**.

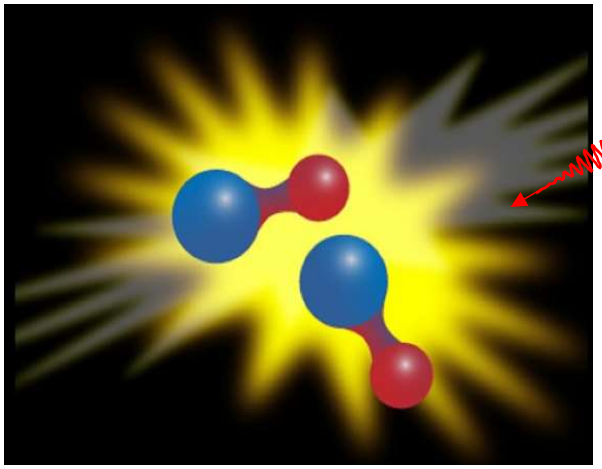
Controlled translation
Ultra-cold atoms

Controlled rotation
Molecular super-rotors

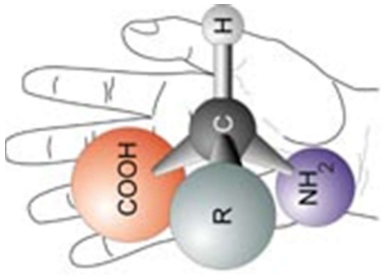
Control tools
Ultra-stable lasers
Ultra-short shaped pulses
Ultra-high frequencies

Control of Quantum Interactions: ***Molecule – Molecule***

Imagine….



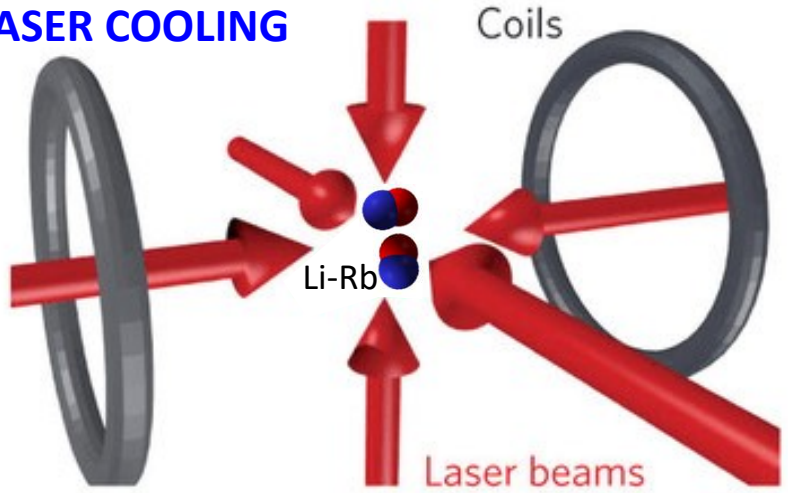
Laser Light



Useful

$$T \sim 1 \times 10^{-9}\,\mathrm{K}$$
$$v \sim 1\,\mathrm{mm/s}$$

LASER COOLING

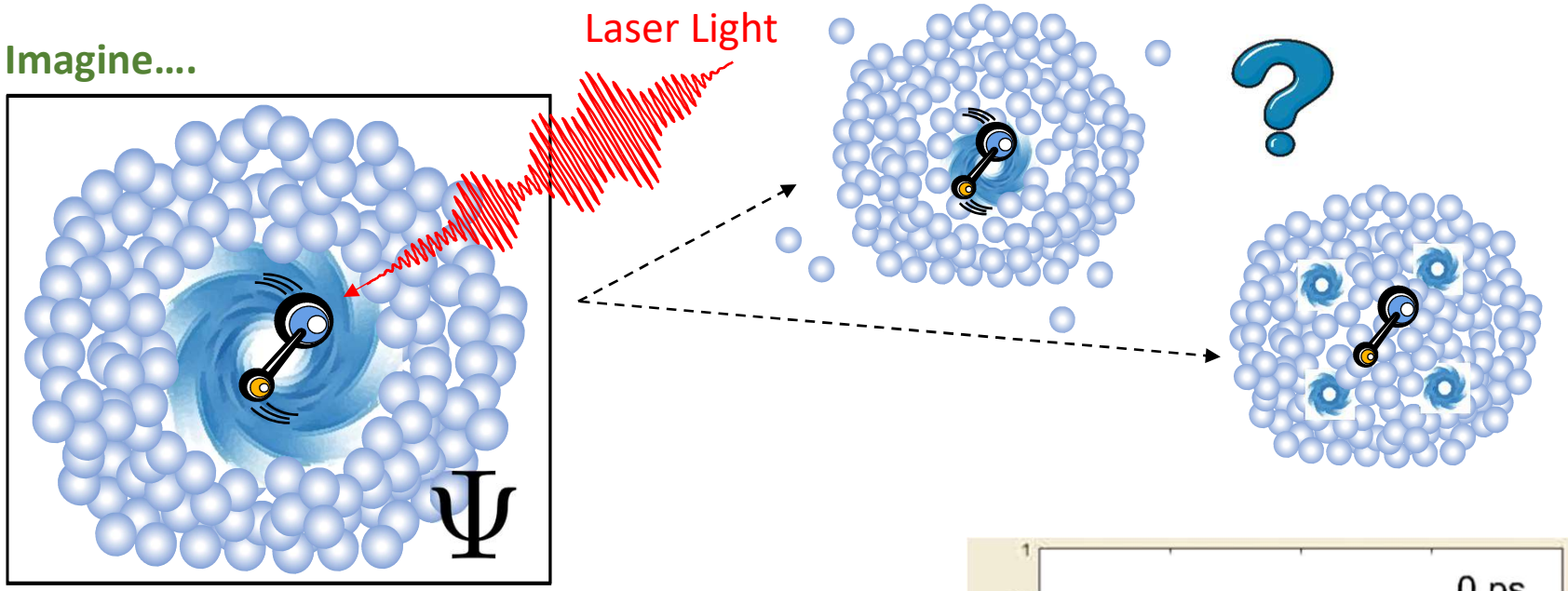


UBC experiment: K. Madison, T. Momose

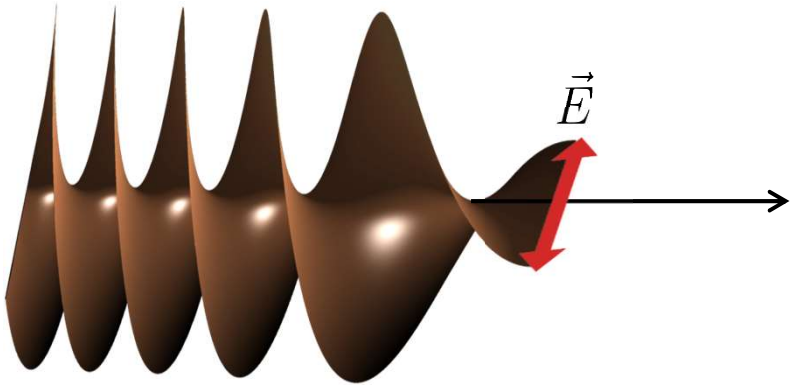
UBC theory: R. Krems, F. Zhou, M. Berciu

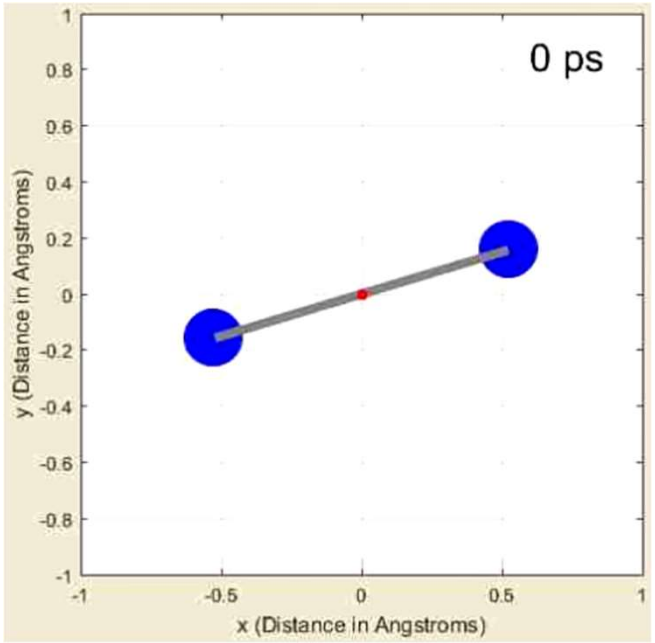
Control of Quantum Interactions: *Molecule – Many-Body System*

Imagine….



OPTICAL CENTRIFUGE



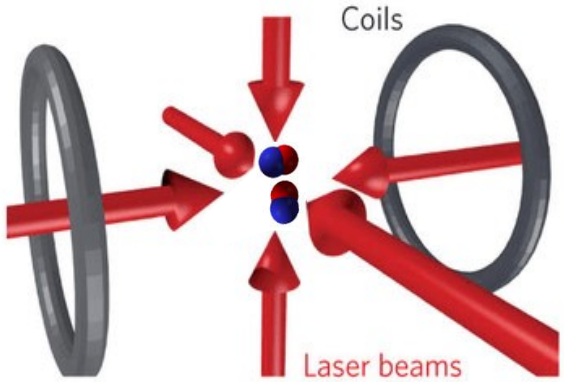


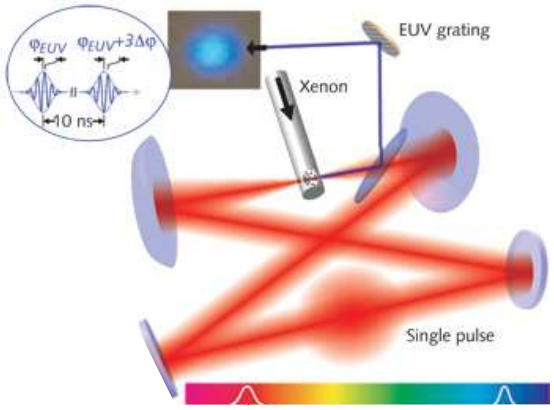
UBC experiment: V. Milner, E. Grant, T. Momose

UBC theory: P. Stamp, R. Krems

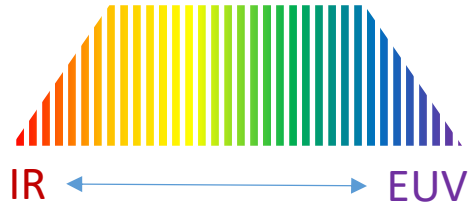
Control of Quantum Interactions: ***Laser Tools***

COOLING LASERS

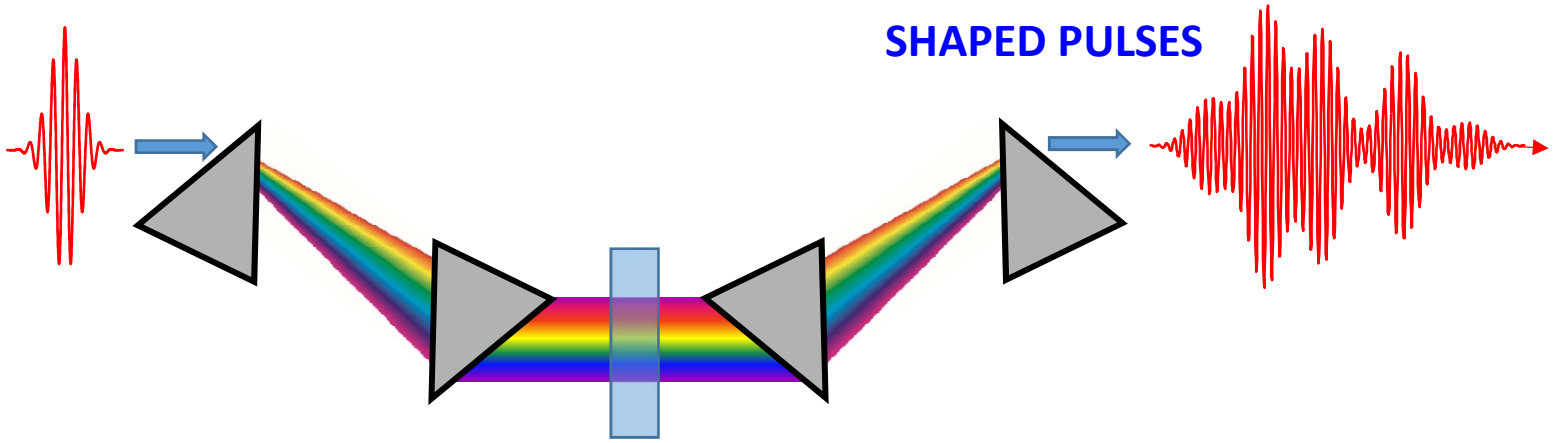




FREQUENCY COMBS



SHAPED PULSES



UBC experiment: D. Jones, K. Madison, V. Milner, T. Momose

Laser Control of Quantum Interactions: ***Where To Learn?***

Fundamentals

PHYS 408 *(lectures + labs)*
"Fundamental & Modern Optics"

1. Wave optics
2. Fourier optics
3. Polarization optics
4. Optical cavities
5. Laser physics
6. Ultrafast lasers

Advanced

PHYS 532
"Nonlinear Optics & Quantum Electronics"

1. Interaction of light with *Solids*
2. Interaction of light with *Atoms*

PHYS 533
"Laser Physics"

1. Theory of laser operation
2. Laser types
3. Applications of lasers

Astronomy research highlights at UBC

Imagine Day 2022

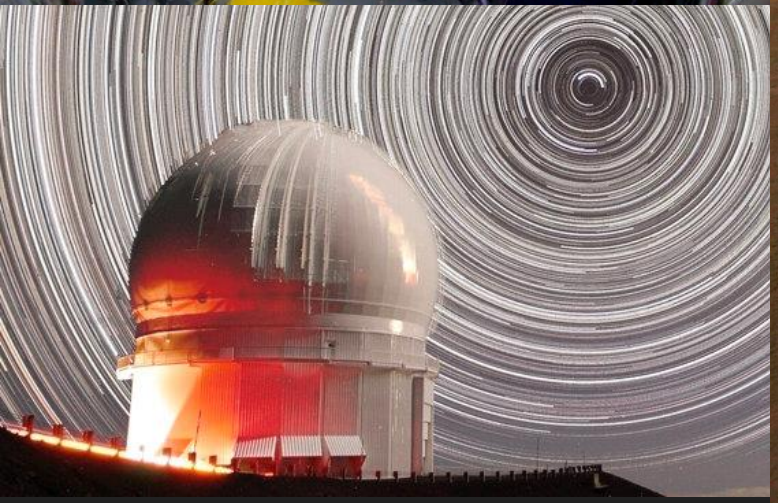
We cover the full range of astronomical scales, from planetary science to cosmology

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

If you’re interested in any particular type of astronomy, let us know to find out about possible research opportunities

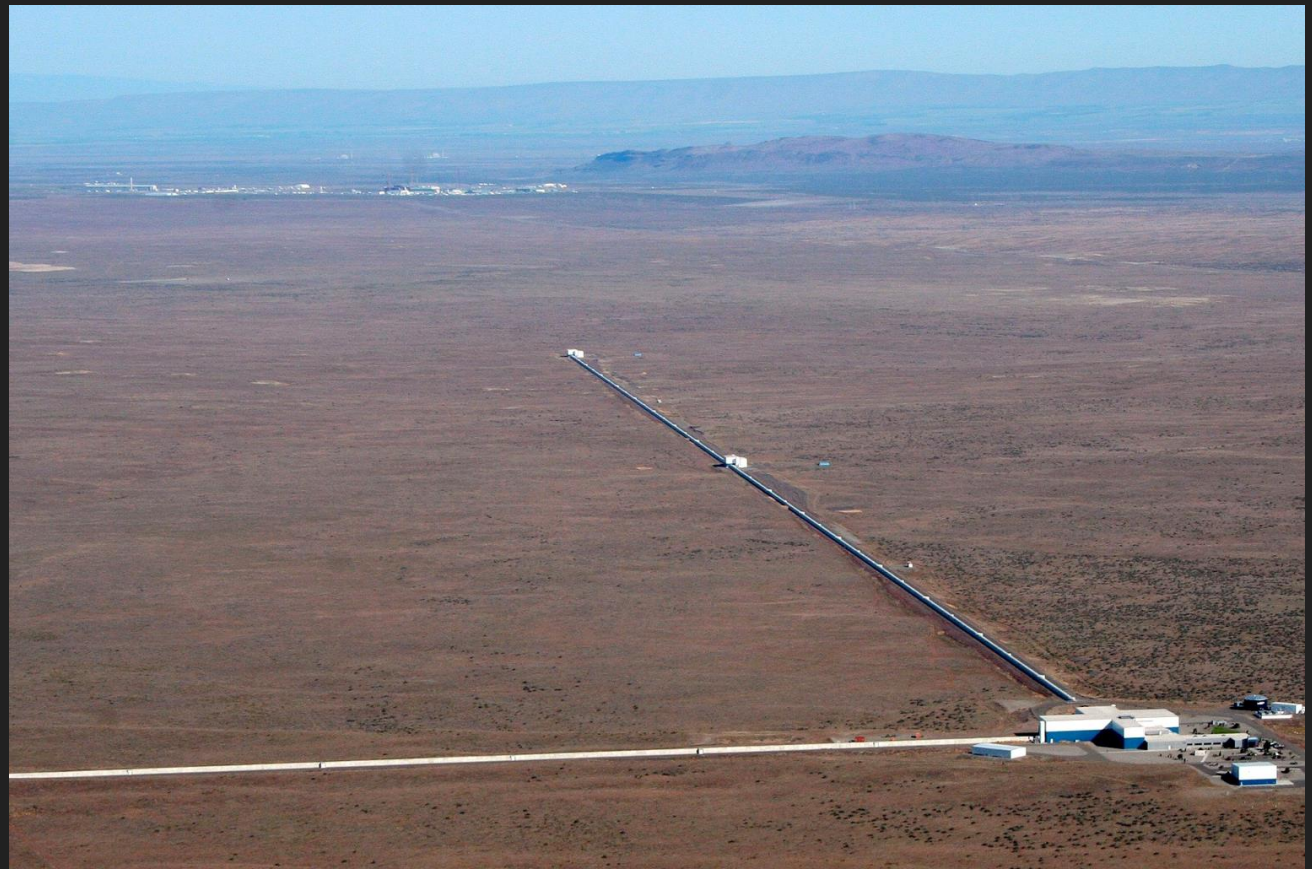
A non-exhaustive list of research facilities and tools

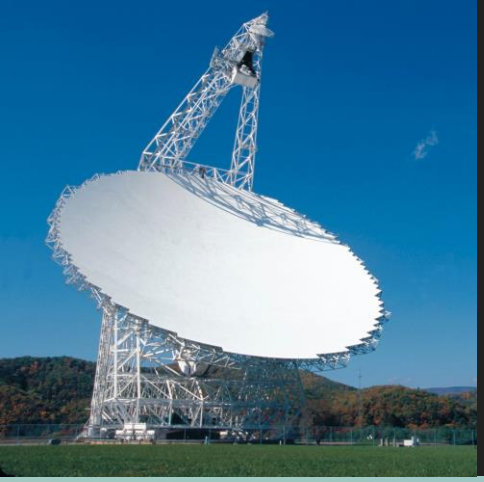
(not to mention the extensive computational resources)



CFHT, Gemini, and CHIME: Canadian-led or large Canadian contribution observatories (experiment)

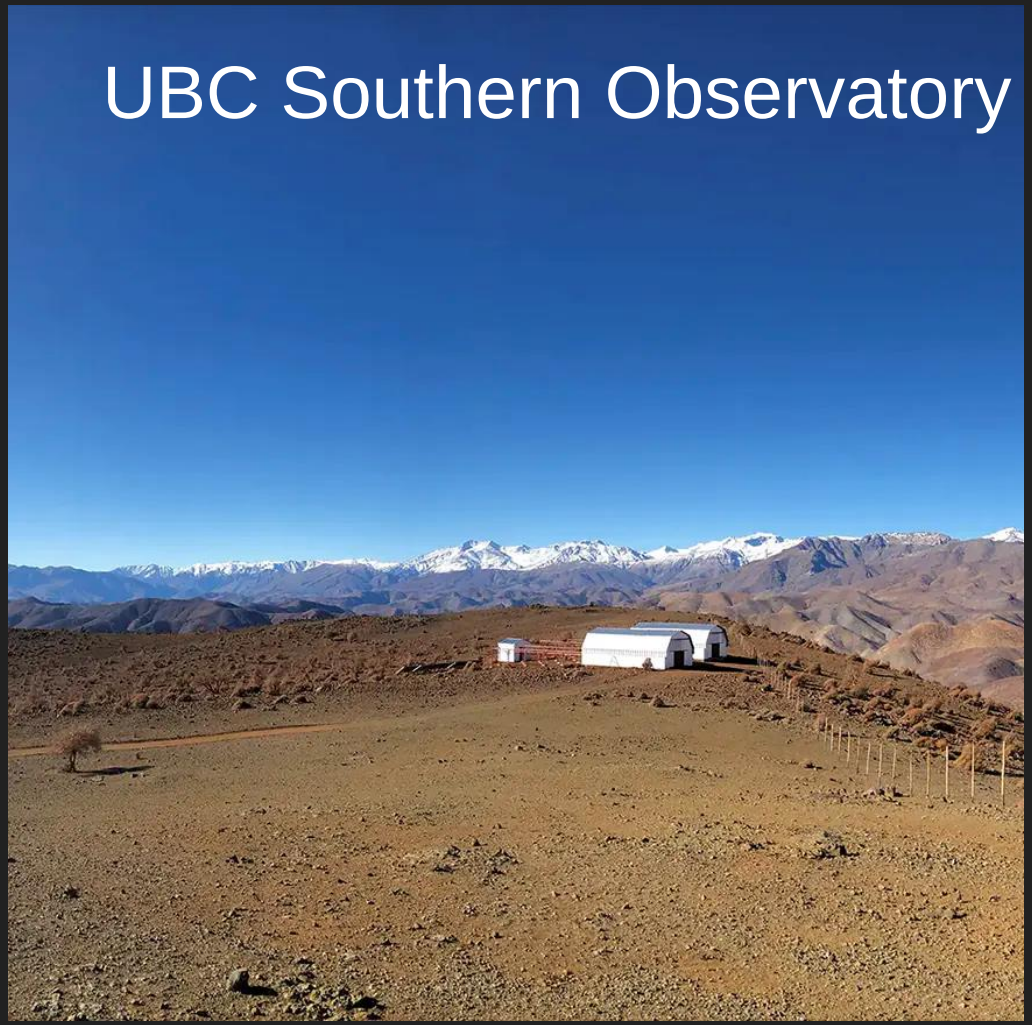
LIGO: Gravitational Wave Physics

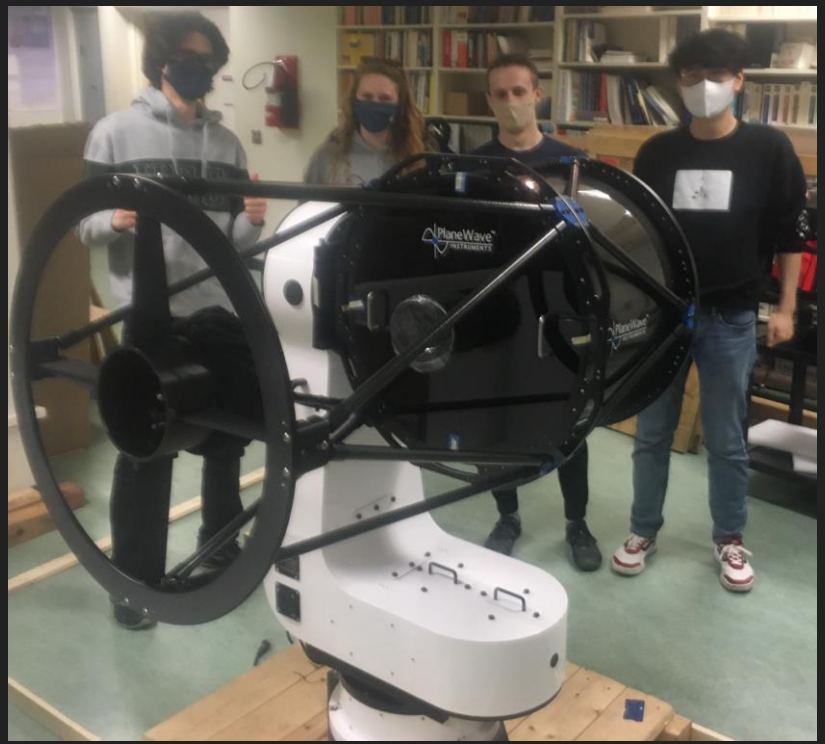




Green Bank Telescope, ALMA, and SKA: Radio and millimetre astronomy

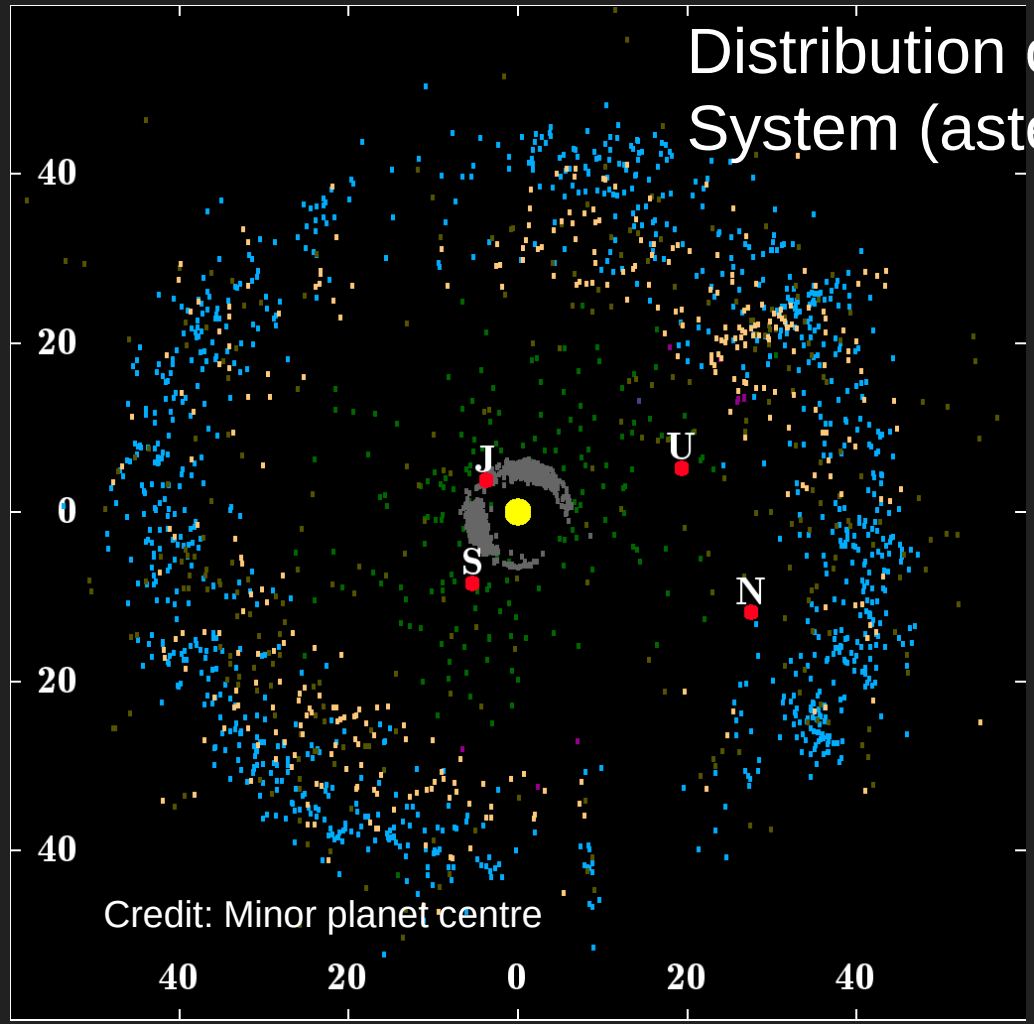
UBC Southern Observatory for teaching and research (in Chile)





What are some of the big questions UBC astronomers are addressing?

Distribution of small bodies in the Solar System (asteroids and small icy bodies)



Credit: Minor planet centre

What was the formation history and evolution of the Solar System?

What can small bodies and meteorites tell us about that history?


Image of the meteorite Allende (Wikimedia)

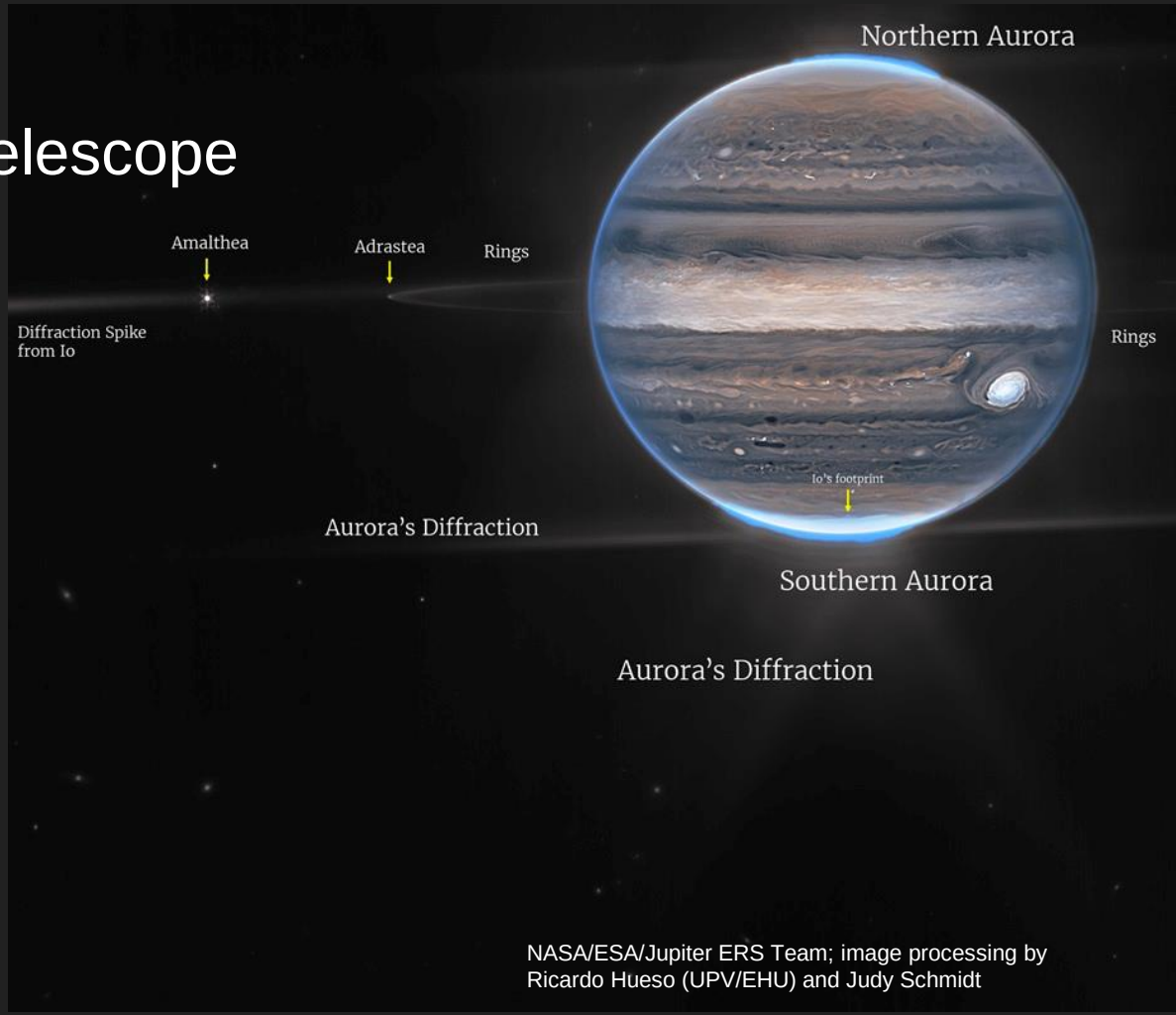
Jupiter
as seen by the Webb Telescope

How do planets form?

How do the building blocks of planets form?

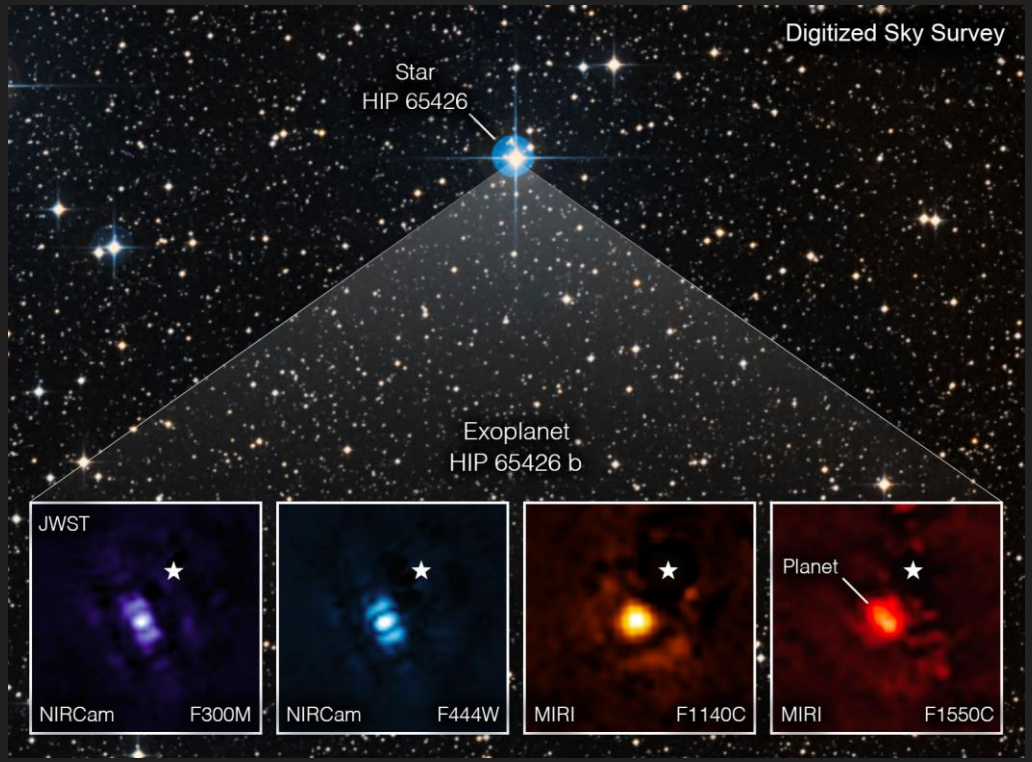
What processes set planetary architectures?

How do planetary systems evolve?



NASA/ESA/Jupiter ERS Team; image processing by Ricardo Hueso (UPV/EHU) and Judy Schmidt

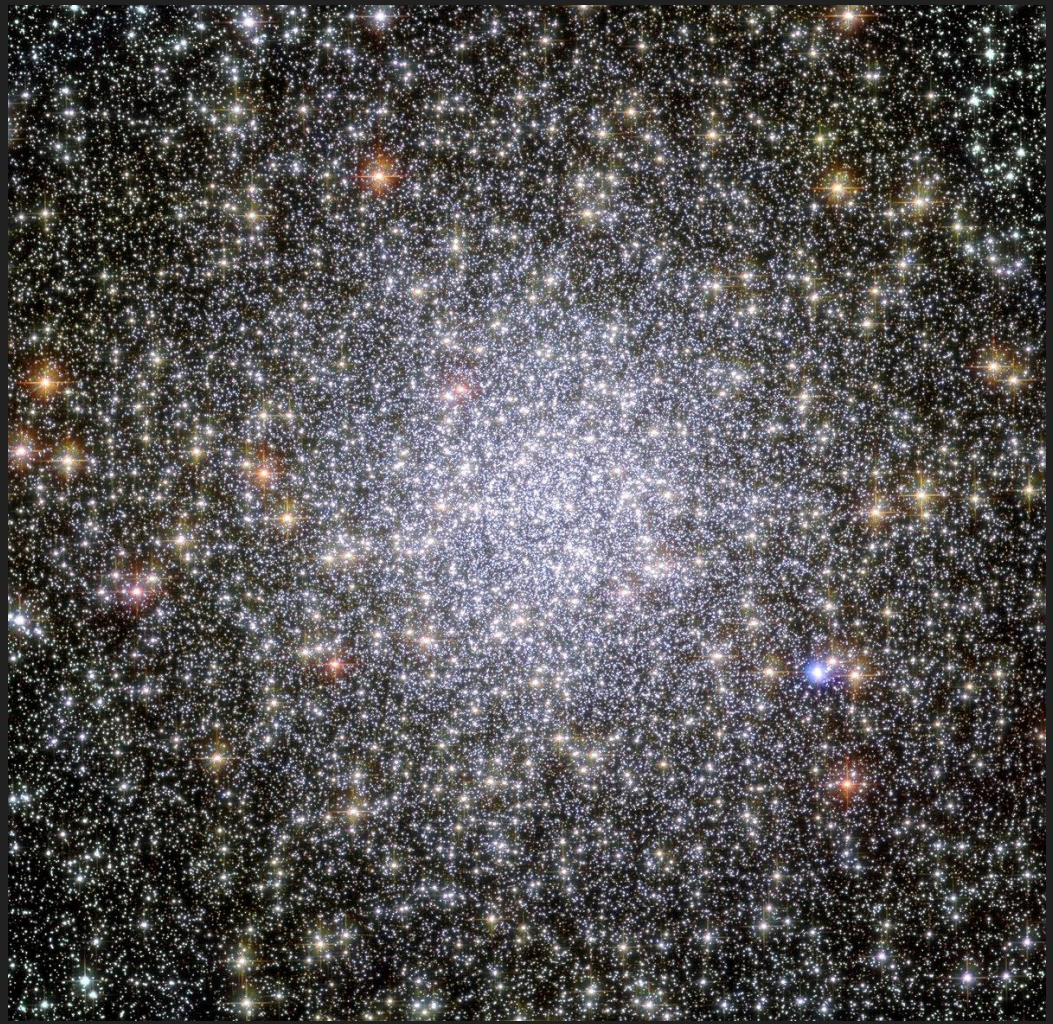
Directly imaged planet HIP 65426 b as see by the Webb Telescope



Credit: NASA/ESA/CSA, A Carter (UCSC), the ERS 1386 team, and A. Pagan (STScI).

What can exoplanets tell us about the possibilities for life elsewhere in the Universe?

What are the connections between star and planet formation?



47 Tuc as seen by the Hubble Space Telescope

How was the Milky Way Galaxy assembled?

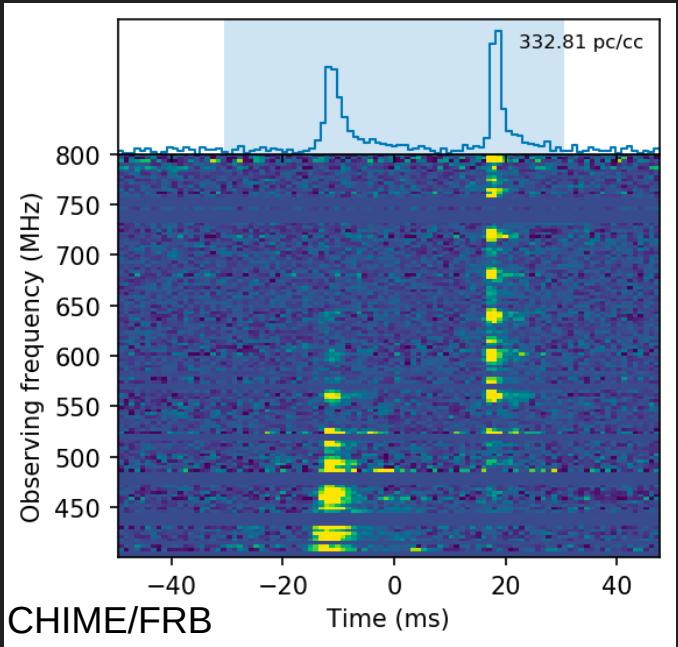
What is the record of that assembly in stellar populations?

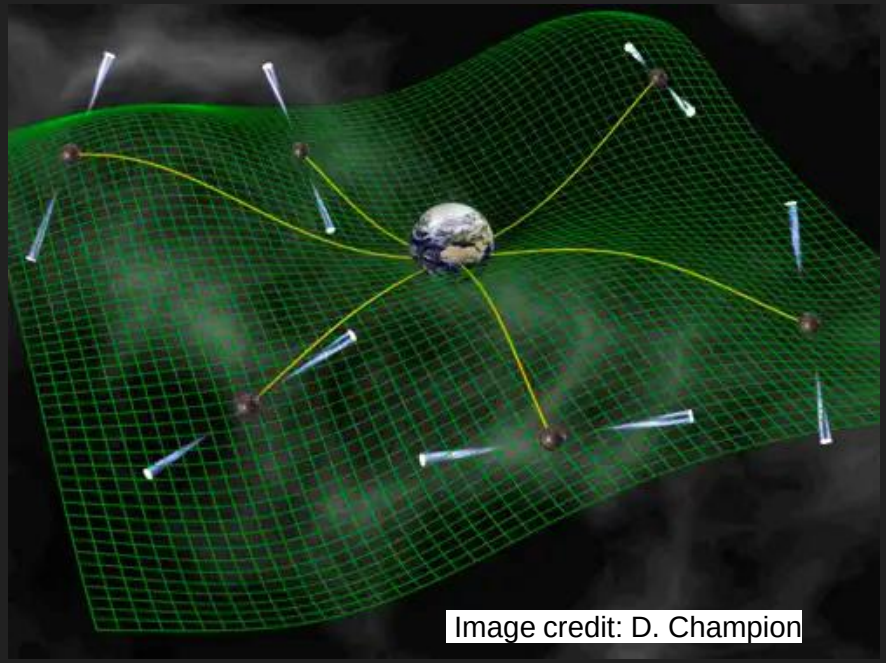
Credit: HST/Richer et al.

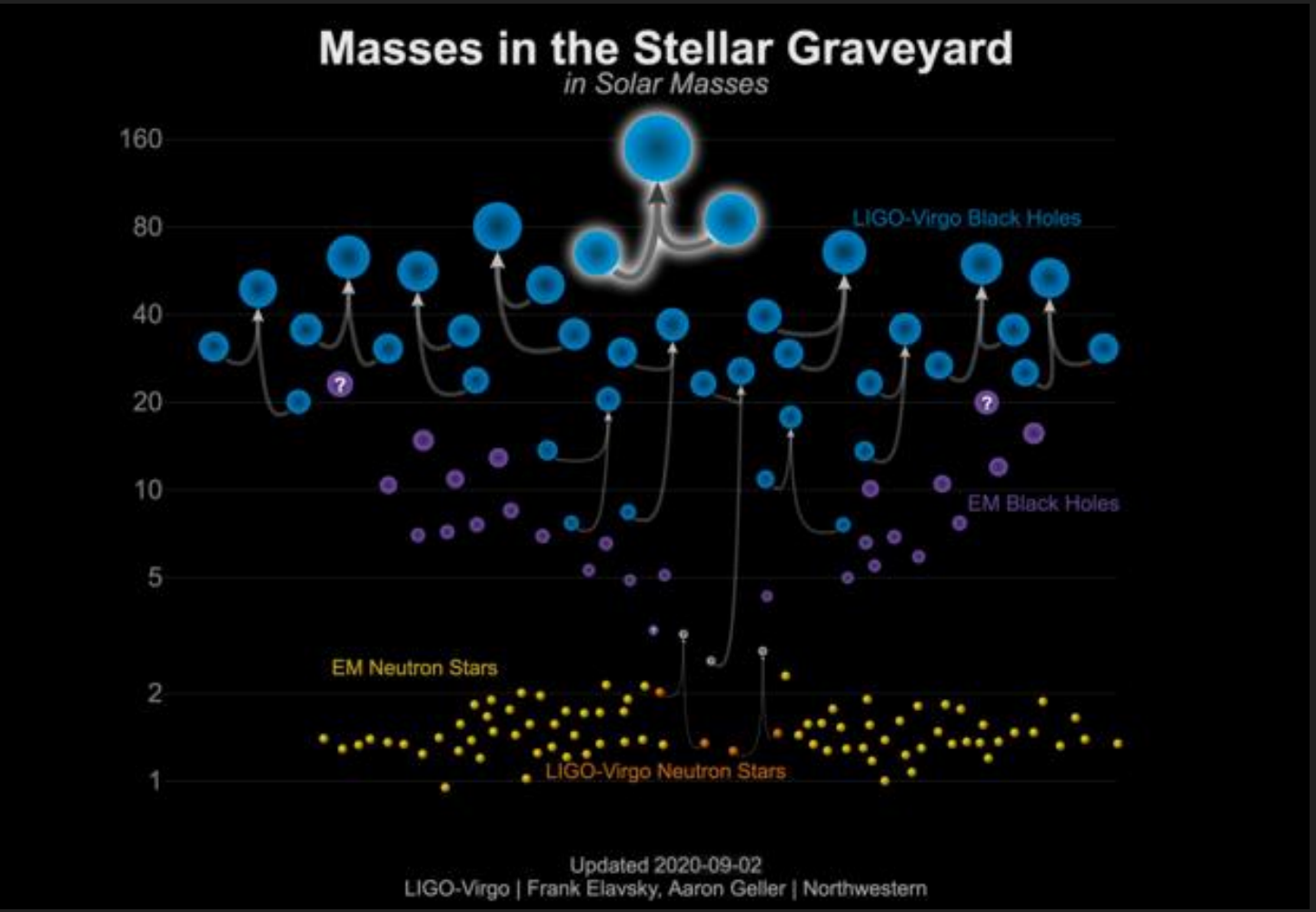
CHIME/FRB and Pulsar Timing Arrays

What are the extreme physical conditions in compact objects and do they show a need for extensions to standard physics?

What can compact objects tell us about gravity and gravitational waves?







What are the mass ranges of blackholes?

What are the merger rates of black holes and compact objects?

Image credit: NASA, ESA, CSA, and STScI

“Stephan’s Quintet”
as seen by the Webb Telescope

How do galaxy interactions alter the gas and stars in galaxies?

How are galaxies influenced by their large-scale environment in which they reside?

Galaxy cluster SMACS 0723
as seen by the Webb Telescope

When did the first galaxies form?

What reionized the Universe - massive stars or supermassive black holes?

What was the evolution of the early Universe?

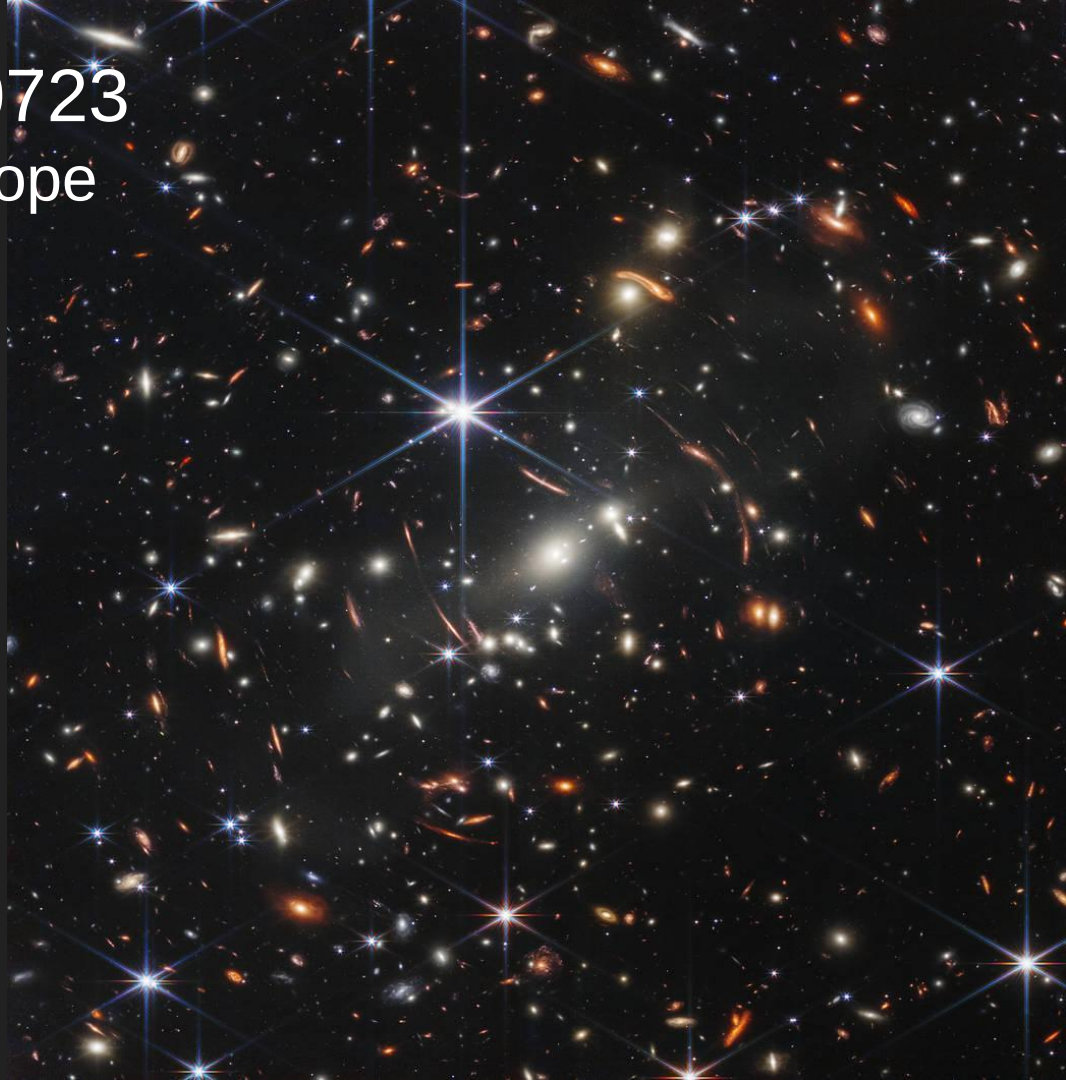


Image credit: NASA, ESA, CSA, and STScI

Cosmology – Origin and Evolution of the Universe

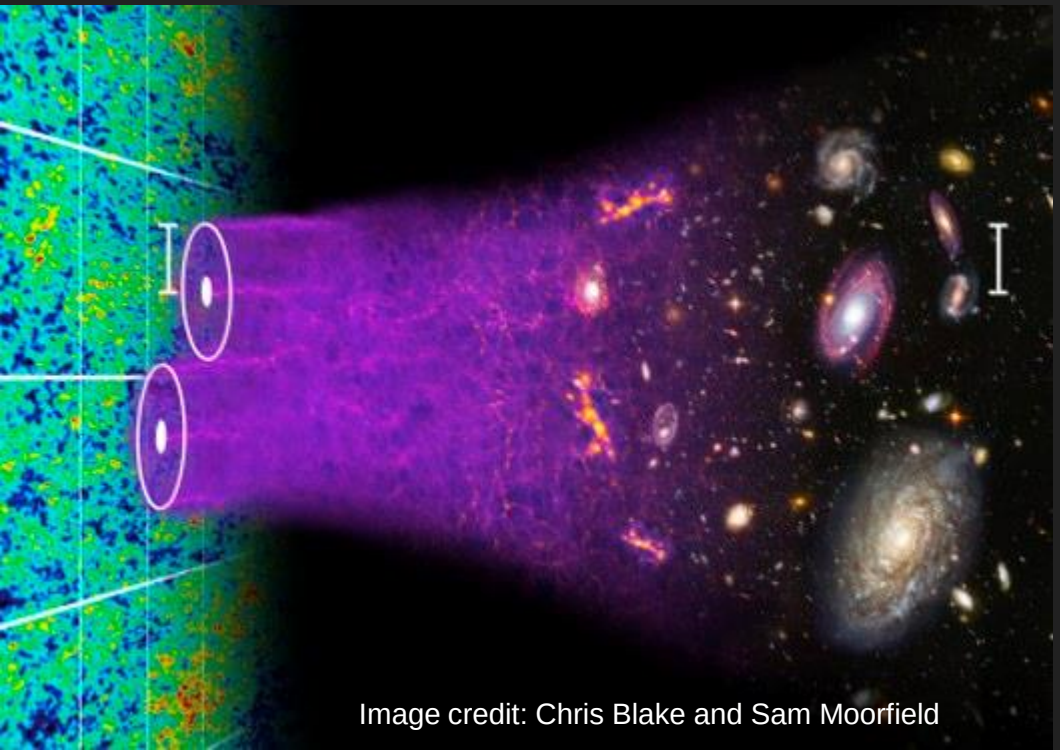
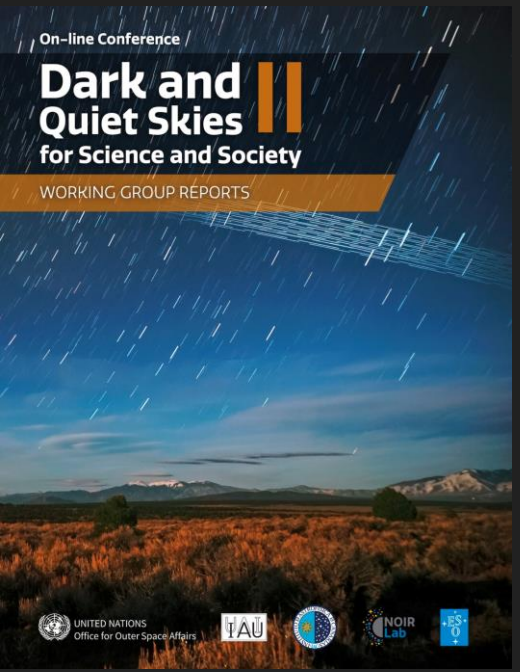


Image credit: Chris Blake and Sam Moorfield

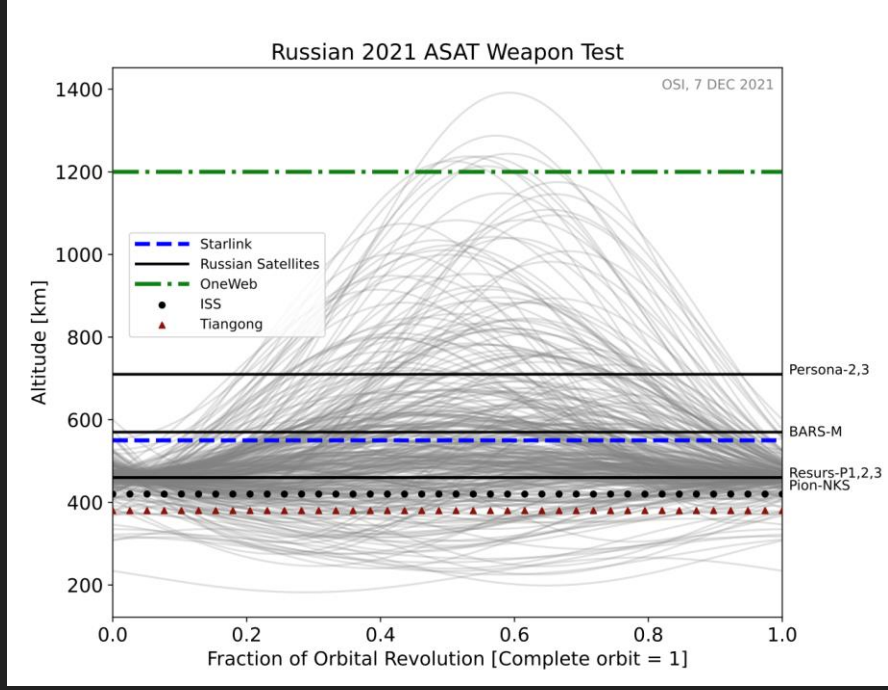
What are the precise values of the numbers that describe our Cosmos?

What is Dark Matter and what is Dark Energy?

Space Sustainability and Science-Policy



How do we develop space while protecting access to dark and quiet skies?



How do we avoid conflict in space?

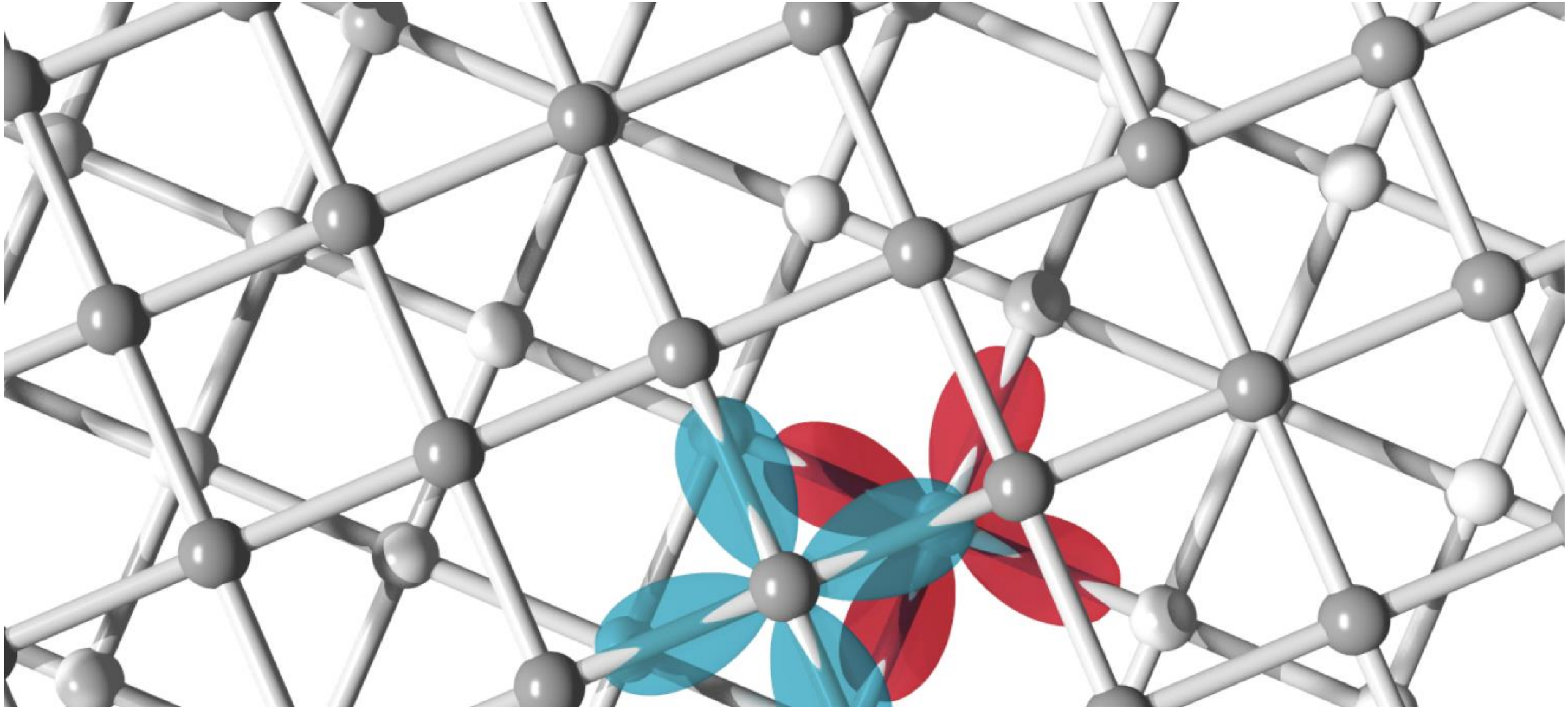
How can space be developed such that future generations can also develop space?

The Astro Faculty Team

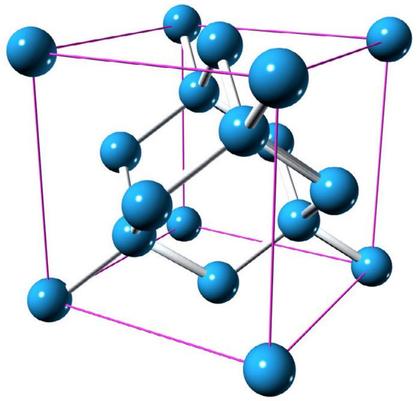
- **Jeremy Heyl:** White dwarfs, neutron stars, black holes, global clusters, transients
- **Paul Hickson:** Galaxies and groups, instrumentation, adaptive optics
- **Ingrid Stairs:** Pulsars, fast radio bursts (FRBs), binary evolution, tests of GR, gravitational waves
- **Harvey Richer:** Stellar populations, star clusters, space telescopes
- **Jess McIver:** Gravitational wave physics, multi-messenger astronomy, machine learning, large-scale instrument characterization
- **Brett Gladman:** Dynamics of planets and asteroids, observations of solar system bodies, planetary sciences
- **Jaymie Matthews:** Stellar astrophysics, stellar pulsation, astroseismology, exoplanetary science
- **Aaron Boley:** Planet formation and evolution, astrophysical discs, meteorites, space sustainability, space security
- **Kris Sigurdson:** dark matter, particle cosmology, HI fluctuations, inflation, cosmic microwave background
- **Douglas Scott:** Early universe, structure formation, cosmic microwave background, high-redshift galaxies, astro-statistics
- **Ludo van Waerbeke:** Gravitational lensing, structure formation, galaxy formation, dark energy, dark matter
- **Gary Hinshaw:** Cosmology, cosmic microwave background, physical cosmology, star formation history
- **Mark Halpern:** Cosmic microwave background, high-redshift galaxies, baryon acoustic oscillations
- **Allison Man:** Galaxy formation and evolution, Early Universe, Star formation, Supermassive black holes, Galaxy mergers, Galaxy structure and kinematics, Stellar populations, Interstellar medium, Gravitational lensing
- **Jasper Wall:** Origin and Evolution of Galaxies, Active Galactic Nuclei, Unified Models, Statistics in Astronomy

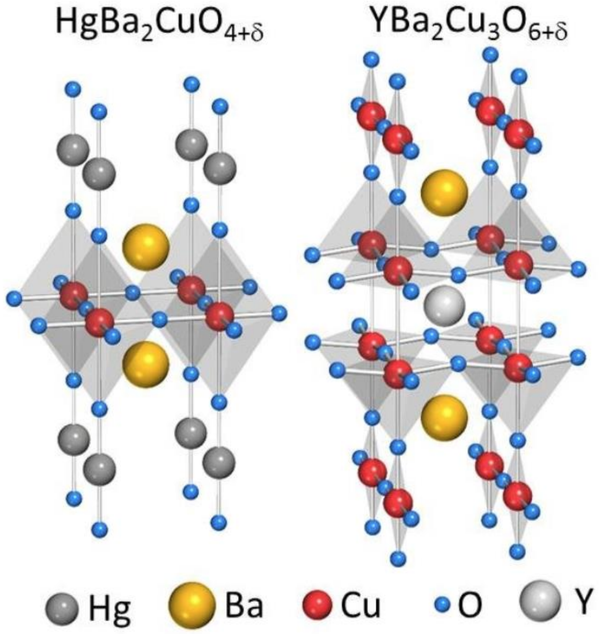
Condensed matter physics

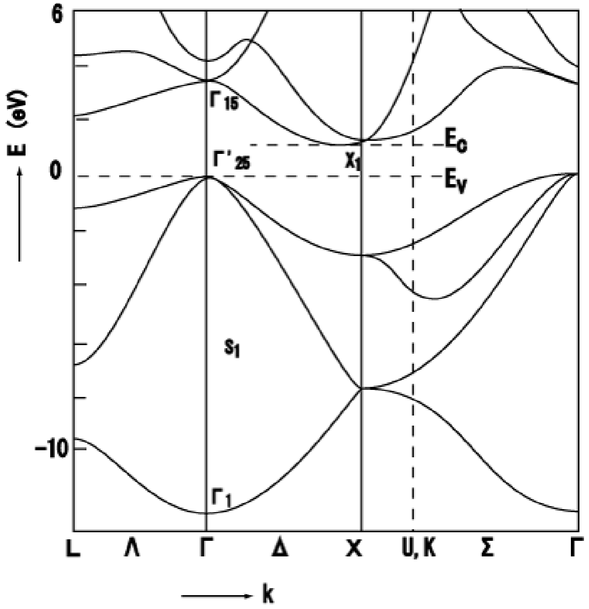
at UBC and more generally



Electron motion is crystal lattices



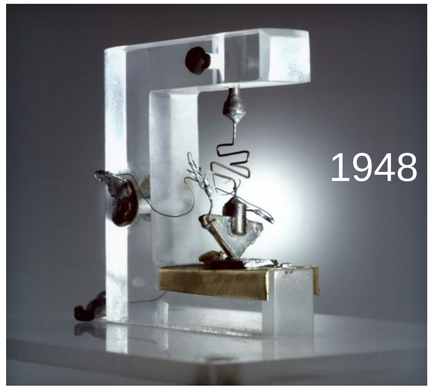


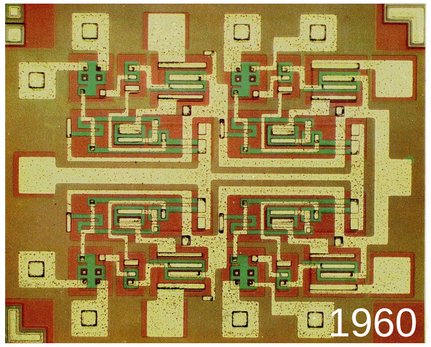


Understanding:
“band theory of solids”
1929

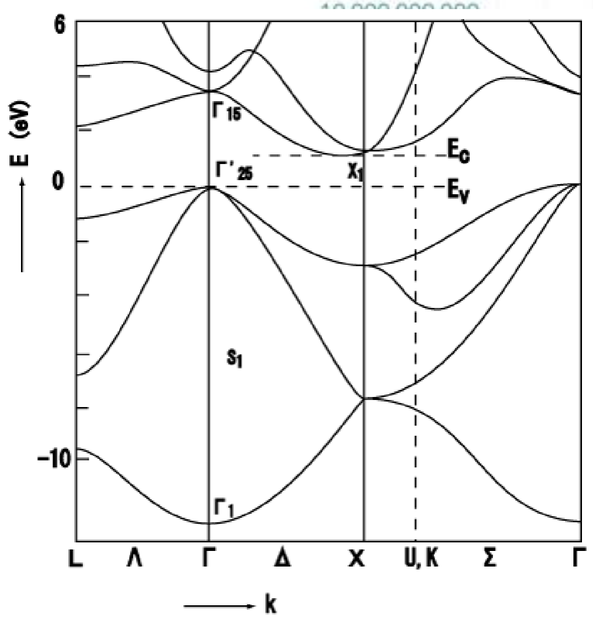
Invention of transistor 1948

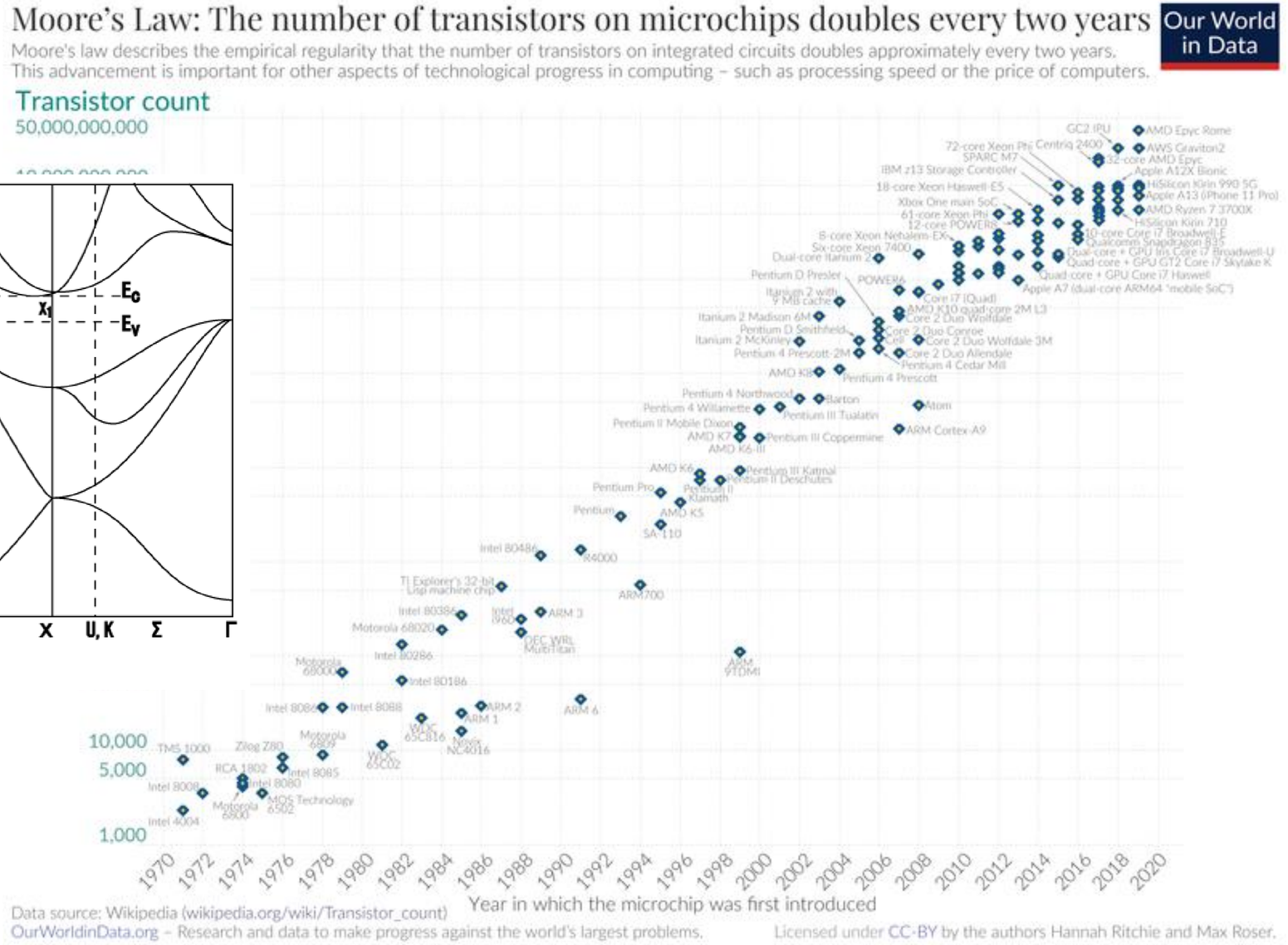
Transistor: The most influential invention in history?



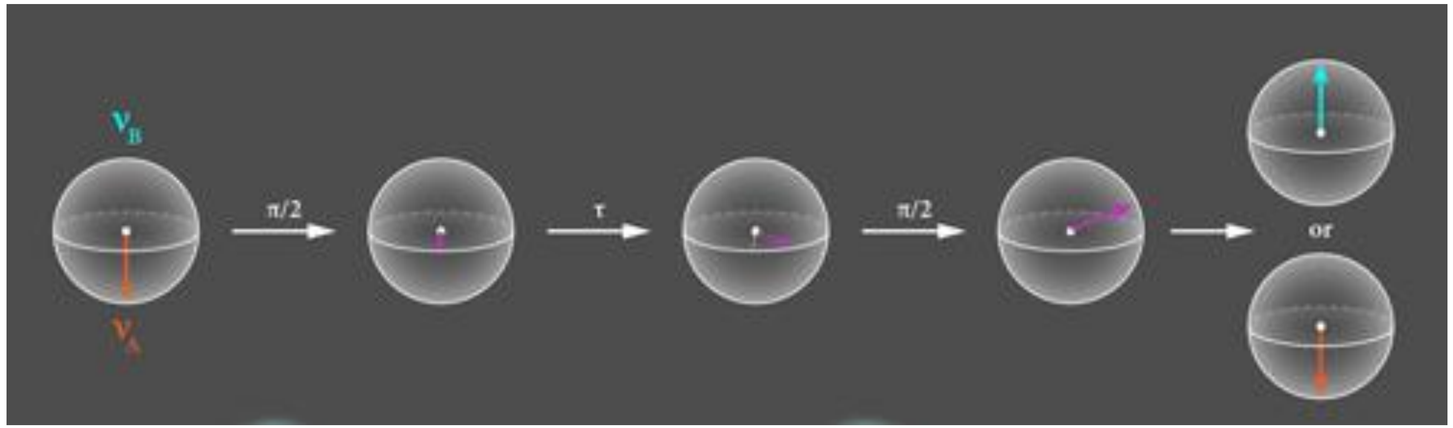


Today it is estimated that 30 trillion transistors are produced every second!

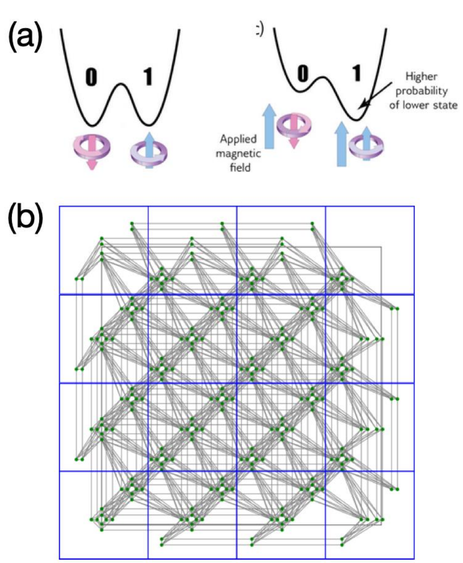


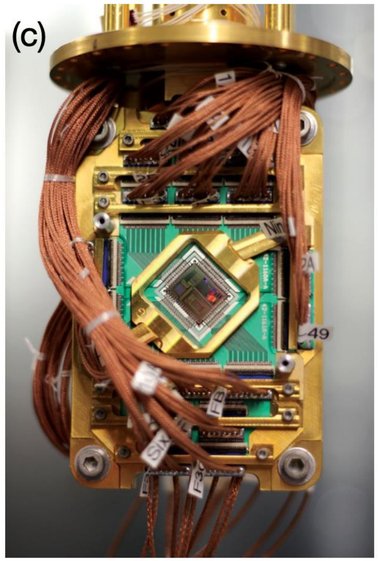


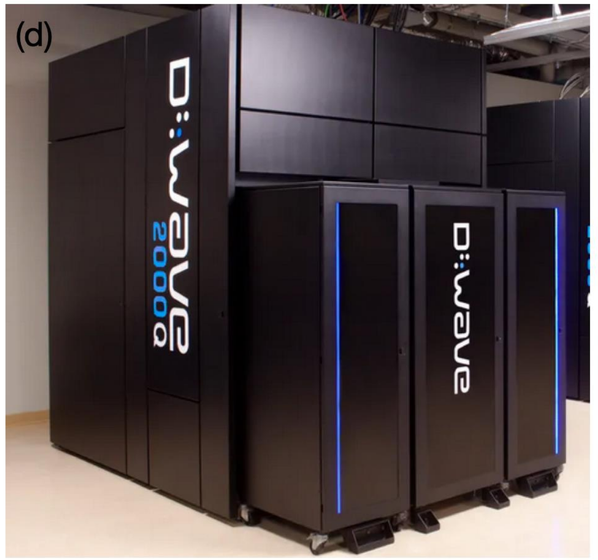
Quantum computing: The coming revolution



By exploiting the laws of quantum mechanics directly quantum computers are in theory capable of solving classically intractable computational problems.







SBQMI Overview

Andrea Damascelli
Scientific Director

Marcel Franz
Deputy Scientific Director

Kim Kiloh
Executive Director

Stewart Blusson
Quantum Matter Institute
THE UNIVERSITY OF BRITISH COLUMBIA

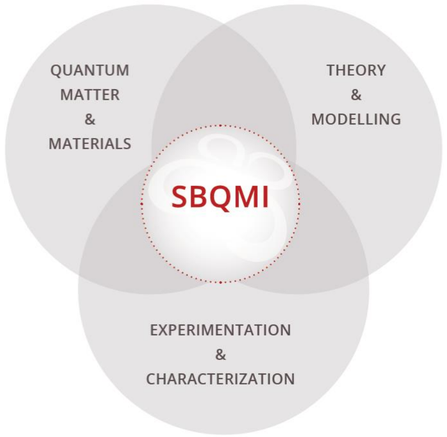
VISION

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**

• Physics • Chemistry • Electrical Engineering •


















Joerg Reitler

New Faculty
2017/18




New Faculty
2018/19

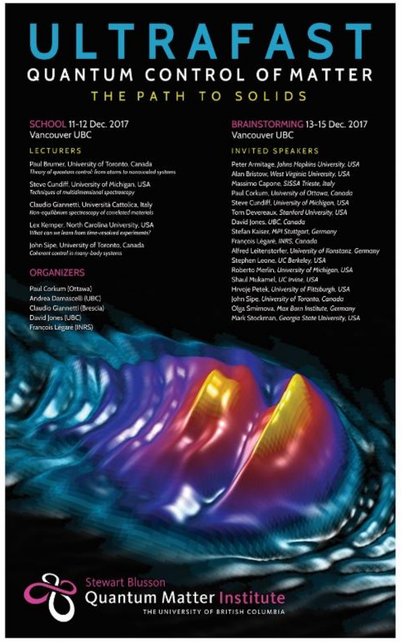
CONTINUED UBC SUPPORT & COMMITMENT

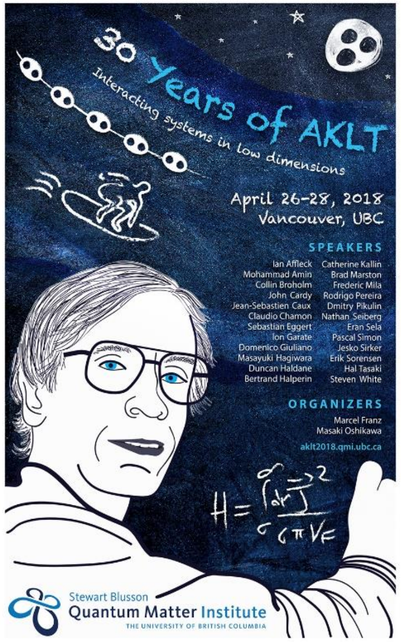
Major new funding CFREF

May 2017

- New building – expanded facilities/capabilities
- Infrastructure support
- 6 new faculty positions (for a total of 24)
- Student & PDF fellowships
- International opportunities and engagement


ELECTRONIC PROPERTIES OF STRONGLY CORRELATED MATERIALS
and their link to physical properties
DECEMBER 4 - 6, 2017
VANCOUVER UBC
INVITED SPEAKERS
P Abbamonte
I Affleck
JW Allen
OK Andersen
J van den Brink
A Damascelli
TP Devereaux
H Eskes
DL Feng
J Fink
A Fujimori
DG Hawthorne
B Keimer
DI Khomskii
G van der Laan
B Lau
J Lorenzana
D van der Marel
AM Oleś
TM Rice
GA Sawatzky
DJ Scalapino
KM Shen
ZX Shen
PCE Stamp
LH Tjeng
J Zaanen
Stewart Blusson Quantum Matter Institute
ORGANIZERS
M Berciu
LH Tjeng
D van der Marel


ULTRAFAST
QUANTUM CONTROL OF MATTER
THE PATH TO SOLIDS
SCHOOL 11-12 Dec. 2017
Vancouver UBC
LECTURERS
Paul Brumer, University of Toronto, Canada
Theory of ejectron control: from atoms to nonequilibrium systems
Steve Cundiff, University of Michigan, USA
Techniques of multidimensional spectroscopy
Claudio Giannetti, Universita Cattolica, Italy
Non-equilibrium spectroscopy of correlated materials
Lex Kemper, North Carolina University, USA
What can we learn from time-resolved experiments?
John Sipe, University of Toronto, Canada
Coherent control in many-body systems
ORGANIZERS
Paul Corkum (Ottawa)
Andrea Damascelli (UBC)
Claudio Giannetti (Brescia)
David Jones (UBC)
Francois Légaré (INRS)
BRAINSTORMING 13-15 Dec. 2017
Vancouver UBC
INVITED SPEAKERS
Peter Armitage, Johns Hopkins University, USA
Alan Bristow, West Virginia University, USA
Massimo Capone, SISSA Trieste, Italy
Paul Corkum, University of Ottawa, Canada
Steve Cundiff, University of Michigan, USA
Tom Devereaux, Stanford University, USA
David Jones, UBC, Canada
Stefan Kaiser, MPI Stuttgart, Germany
Francois Légaré, INRS, Canada
Alfred Leitenstorfer, University of Konstanz, Germany
Stephen Leone, UC Berkeley, USA
Roberto Merlin, University of Michigan, USA
Shai Mukamel, UC Irvine, USA
Hrvoje Petek, University of Pittsburgh, USA
John Sipe, University of Toronto, Canada
Olga Smirnova, Max Born Institute, Germany
Mark Stockman, Georgia State University, USA
Stewart Blusson Quantum Matter Institute
THE UNIVERSITY OF BRITISH COLUMBIA

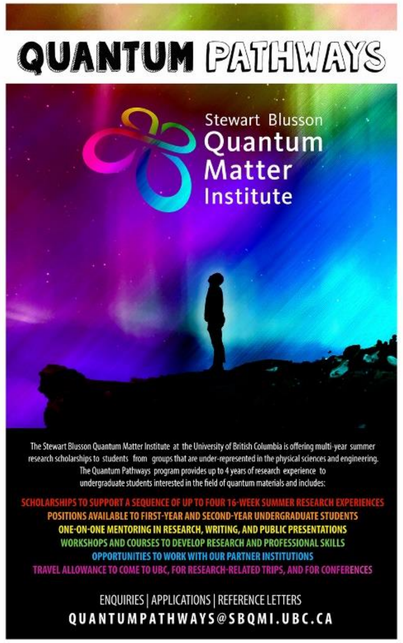

30 Years of AKLT
Interacting systems in low dimensions
April 26-28, 2018
Vancouver, UBC
SPEAKERS
Ian Affleck
Mohammad Amin
Collin Broholm
John Candy
Jean-Sebastien Caux
Claudio Chamon
Sebastian Eggert
Ian Garate
Domenico Giuliano
Masayuki Hagiwara
Duncan Haldane
Bertrand Halperin
Catherine Kallin
Brad Marston
Frederic Mila
Rodrigo Pereira
Dmitry Pikulin
Nathan Seiberg
Eran Sela
Pascal Simon
Jesko Sirker
Erik Sorensen
Hal Tasaki
Steven White
ORGANIZERS
Marcel Franz
Masaki Oshikawa
akllt2018.qmi.ubc.ca
Stewart Blusson Quantum Matter Institute
THE UNIVERSITY OF BRITISH COLUMBIA


NANOSCALE
THERMAL TRANSPORT
& HEAT LOCALIZATION
SCHOOL
August 29, 2018
UBC, Vancouver Campus
LECTURERS
Mahmoud Hussein, University of Colorado Boulder, USA
Baowen Li, University of Colorado Boulder, USA
John Page, University of Manitoba, Canada
ORGANIZERS
Alireza Nojeh, University of British Columbia
George Sawatzky, University of British Columbia
Joerg Rottler, University of British Columbia
Srikanth Phani, University of British Columbia
REGISTRATION
Please register at:
qmi.ubc.ca/nth2018
WORKSHOP
August 30 and 31, 2018
UBC, Vancouver Campus
INVITED SPEAKERS
David Cahill, University of Illinois at Urbana-Champaign, USA
Chris Dames, University of California, Berkeley, USA
Sergej Flach, Institute for Basic Science, Korea
Mahmoud Hussein, University of Colorado Boulder, USA
Baowen Li, University of Colorado Boulder, USA
Alan McGaughey, Carnegie Mellon University, USA
John Page, University of Manitoba, Canada
Quentin Ramasse, University of Leeds, UK
Chris Regan, University of California, Los Angeles, USA
Mona Zebarjadi, University of Virginia, USA
Stewart Blusson Quantum Matter Institute
THE UNIVERSITY OF BRITISH COLUMBIA
PETER WALL INSTITUTE FOR ADVANCED STUDIES


Stewart Blusson Quantum Matter Institute
THE UNIVERSITY OF BRITISH COLUMBIA
SBQMI WORKSHOP ON
SYNTHETIC TOPOLOGICAL MATTER
FEBRUARY 18-20, 2019
UNIVERSITY OF BRITISH COLUMBIA, VANCOUVER, CANADA
INVITED PARTICIPANTS:
Jason Alicea (Caltech)
Thomas Christensen (MIT)
Ashley Cook (Berkeley)
Chiara Daraio (Caltech)
Eugene Demler (Harvard)
Shanhui Fan (Stanford)
Gregory Fiete (UT Austin)
Romain Fleury (EPFL)
Michel Fruchart (Leiden)
Victor Galitski (Maryland)
Mohammad Hafezi (JQI)
Netanel Lindner (Technion)
Ivar Martin (Los Alamos)
Julia Meyer* (Grenoble)
Joel Moore (Berkeley)
Franco Nori (Michigan)
Yuval Oreg (Weizmann)
Sid Parameswaran (Oxford)
Tami Pereg-Barnea (McGill)
Mikael Rechtsman (Pennsylvania)
Mark Rudner (Copenhagen)
David Schuster (Chicago)
Eran Sela (Tel Aviv)
Justin Song (Singapore)
Jeffrey Teo (Virginia)
Ronny Thomale (Würzburg)
Norm Yao* (Berkeley)
* TO BE CONFIRMED
ORGANIZERS:
Gil Refael (Caltech)
Marcel Franz (UBC)
QMI.UBC.CA/TOPO2019


Stewart Blusson Quantum Matter Institute
THE UNIVERSITY OF BRITISH COLUMBIA
SBQMI brainstorming session and summer school on
INTERACTING MAJORANA FERMIONS
MAY 1 - 3, 2019, VANCOUVER BC
School: May 1 Brainstorming: May 2 and 3
Invited participants:
David Aasen (KITP)
Ching-Kai Chiu (KITS)
Paul Fendley (Oxford)
Sergey Frolov (Pittsburgh)
Guillaume Gervais (McGill)
Timothy Hsieh (Perimeter)
Jin-Feng Jia (Shanghai)
Charles Kane (Penn)
Hosho Katsura (Tokyo)
Dominique Laroche (Florida)
Dganit Meidan (Ben-Gurion)
Dmitry Pikulin (Station Q)
Armin Rahmani (Washington)
Constantin Schrade (MIT)
Jeffrey Teo (Virginia)
Organizers:
Ian Affleck (UBC)
Marcel Franz (UBC)
qmi.ubc.ca/majorana2019
UBC


NEW FRONTIERS
IN QUANTUM MATERIALS RESEARCH
October 3 - 4, 2019
QMI, UBC, VANCOUVER
RICE | RCQM
Rice Center for Quantum Materials
Stewart Blusson Quantum Matter Institute
THE UNIVERSITY OF BRITISH COLUMBIA
RICE SPEAKERS
Pulickel Ajayan
Pengcheng Dai
Rui-Rui Du
Sarah Grefe
Randy Hulet
Alex Kutana
Andriy Nevidomskyy
Qimiao Si
Boris Yakobson
Ming Yi
UBC SPEAKERS
Meigan Aronson
Mona Berciu
Doug Bonn
Andrea Damascelli
Joshua Folk
Alannah Hallas
Alireza Nojeh
George Sawatzky
Ziliang Ye
Ke Zou
ORGANIZERS
Qimiao Si (Rice University)
Andrea Damascelli (UBC)
nfqmr2019.qmi.ubc.ca
GORDON AND BETTY MOORE FOUNDATION
UBC


QUANTUM PATHWAYS
Stewart Blusson Quantum Matter Institute
The Stewart Blusson Quantum Matter Institute at the University of British Columbia is offering multi-year summer research scholarships to students from groups that are under-represented in the physical sciences and engineering. The Quantum Pathways program provides up to 4 years of research experience to undergraduate students interested in the field of quantum materials and includes:
SCHOLARSHIPS TO SUPPORT A SEQUENCE OF UP TO FOUR 16-WEEK SUMMER RESEARCH EXPERIENCES
POSITIONS AVAILABLE TO FIRST-YEAR AND SECOND-YEAR UNDERGRADUATE STUDENTS
ONE-ON-ONE MENTORING IN RESEARCH, WRITING, AND PUBLIC PRESENTATIONS
WORKSHOPS AND COURSES TO DEVELOP RESEARCH AND PROFESSIONAL SKILLS
OPPORTUNITIES TO WORK WITH OUR PARTNER INSTITUTIONS
TRAVEL ALLOWANCE TO COME TO UBC, FOR RESEARCH-RELATED TRIPS, AND FOR CONFERENCES
ENQUIRIES | APPLICATIONS | REFERENCE LETTERS
QUANTUMPATHWAYS@SBQMI.UBC.CA

INTERNATIONAL ACADEMIC PARTNERSHIPS

MP-UBC-UTokyo Centre for Quantum Materials

MAX PLANCK - $2.5M – UNIVERSITY OF TOKYO - $2.5m

OBJECTIVE: To promote and further the cooperation between researchers and research groups of both parties

- Student mobility agreement with University of Stuttgart
- Joint MP-UBC-Stuttgart PhD program in Quantum Materials

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

Biological and Medical Physics: the Physics of the 21st century ☺

@ UBC Physics and Astronomy

In collaboration with : Michael Smith Labs, SBME, GSAT, BIONF, Nanomedicine Center (NMIN), BC Cancer, Center for Brain Health..

2022 09 06 - UBC Imagine Day

Sabrina Leslie, Associate Professor UBC PHAS & MSL

Interdisciplinary Research: Team Effort ☺

In real life: PHAS biophysicists gather to share and energize research ☺

Leslie, Michal, Plotkin, Rottler groups, a team!
Actively recruiting new students in 2022/2023.

World class single-molecule, single-cell, NMR, MRI, and other imaging facilities

QMI fabrication and high-res imaging facilities enable device innovation and characterization

Practical interdisciplinary training brings physicists' skills, theory, imagination together with complex, fascinating challenges in biology

Solving big problems takes multiple scientific perspectives, communication, and talent

Feb 22 2022, MSL Auditorium @ UBC

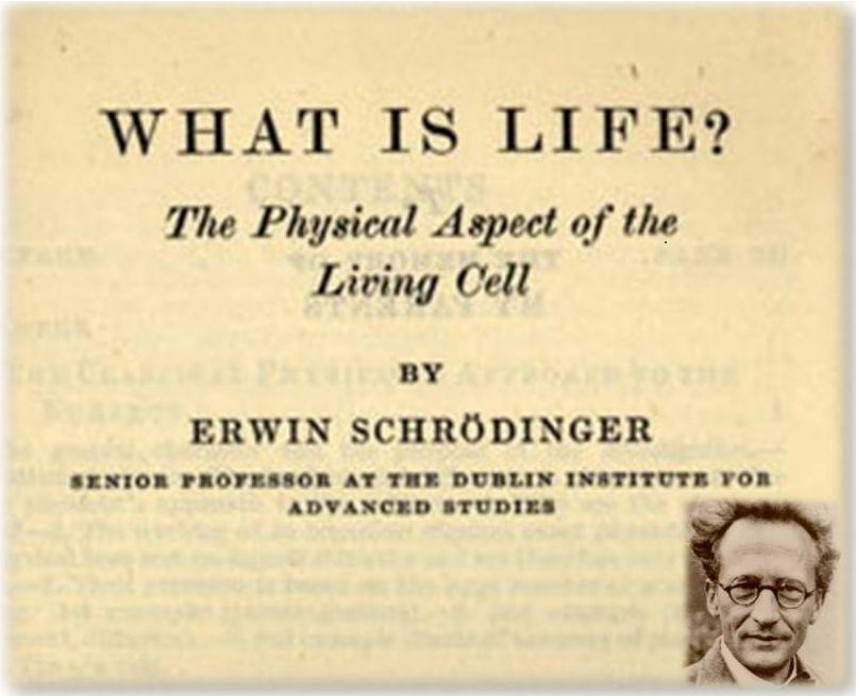
Working at the Interface of Physics, Biology, and Medicine

There's Plenty of Room at the Bottom

An invitation to enter a new field of physics.

by Richard P. Feynman

1978



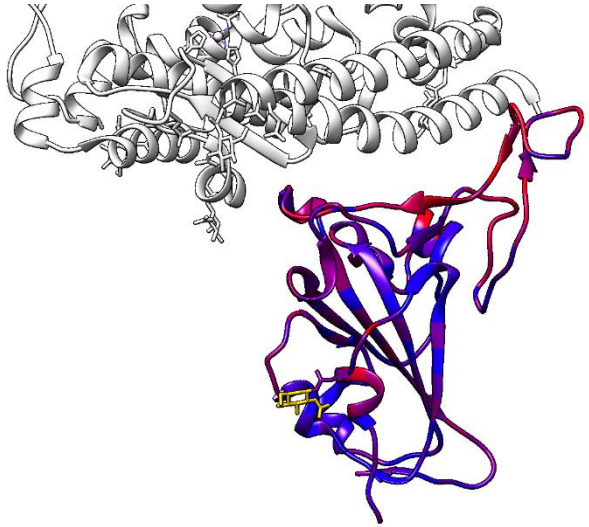
1944

New biophysical tools enable new discoveries

"..It is very easy to answer many of these fundamental biological questions; you just look at the thing! You will see the order of bases in the chain; you will see the structure of the microsome. Unfortunately the present microscope sees at a scale which is just a bit of information.."

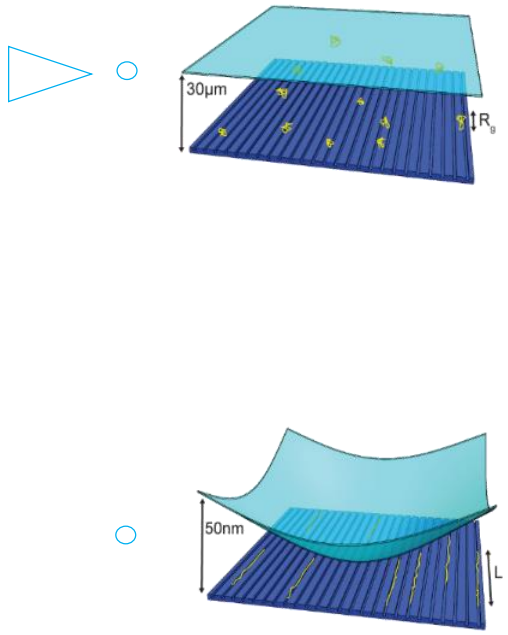
– Richard Feynman, 1978

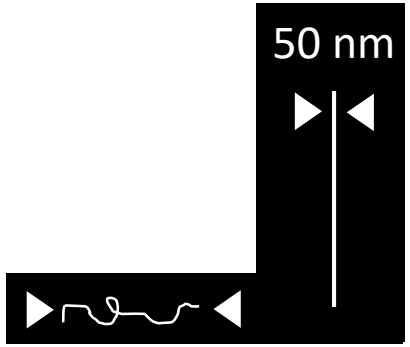
DNA



Spike protein on SARS-COV-2
2020

Seeing is believing: Isolating and imaging DNA in nano-grooves





λ-phage DNA labeled by YOYO1 dye
Fluorescence imaging, 100x magnification

https://leslielab.msl.ubc.ca/

Biophysics core subgroup @ PHAS

Sabrina Leslie
sabrinaleslie@phas.ubc.ca

Single-molecule microscopy, biophysics of DNA, RNA interactions, mechanisms of therapeutics/vaccines, Microfluidics/optics, nano scale device engineering, etc

Steve Plotkin
steve@phas.ubc.ca

Protein misfolding, SARS-CoV-2, Molecular genetic origins of multi cellular animals

Carl Michal
michal@phas.ubc.ca

NMR and MRI, brain research, spider silk, synthetic materials

Joerg Rottler
jrottler@physics.ubc.ca

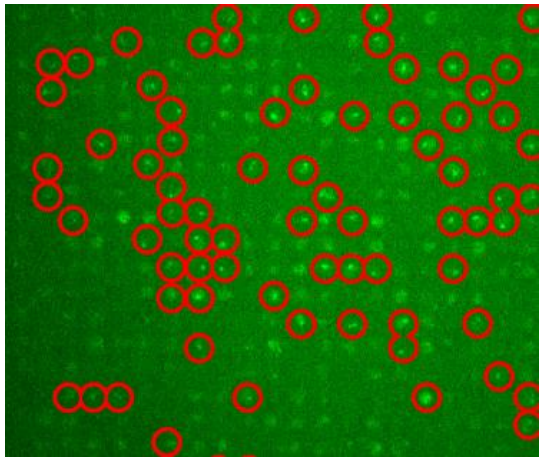
Material properties from an atomistic perspective, machine learning, polymers, biomaterials

In common: innovating instrumentation, analysis, theory

NMR and other microscopies

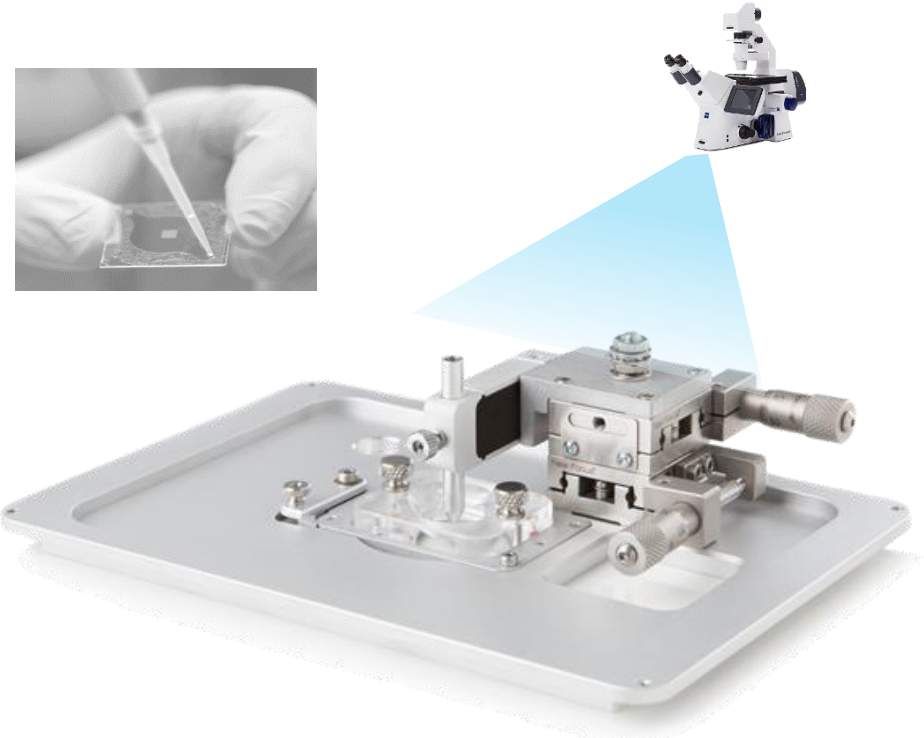
Can we democratize boutique technologies to accelerate science?

AI to assist data analysis



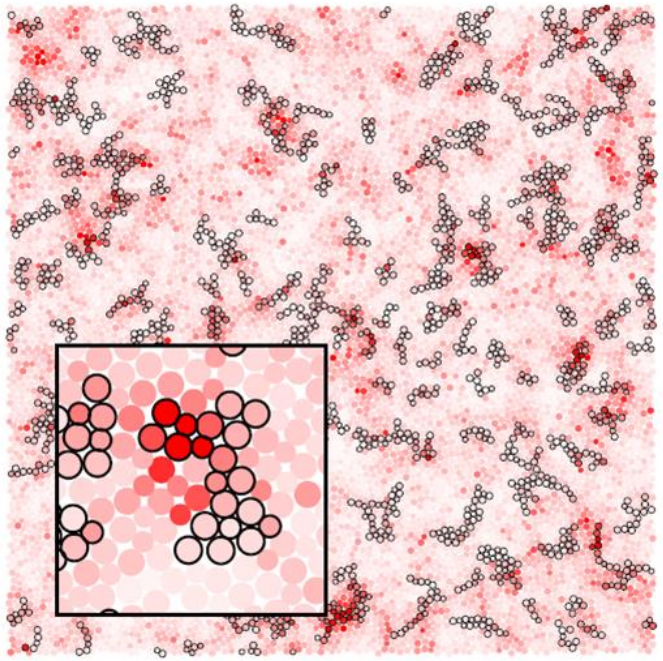
Seeing single molecules helps diagnostics

Single-molecule and single-cell microscopy
of molecules, particles, cells, tissues, ..

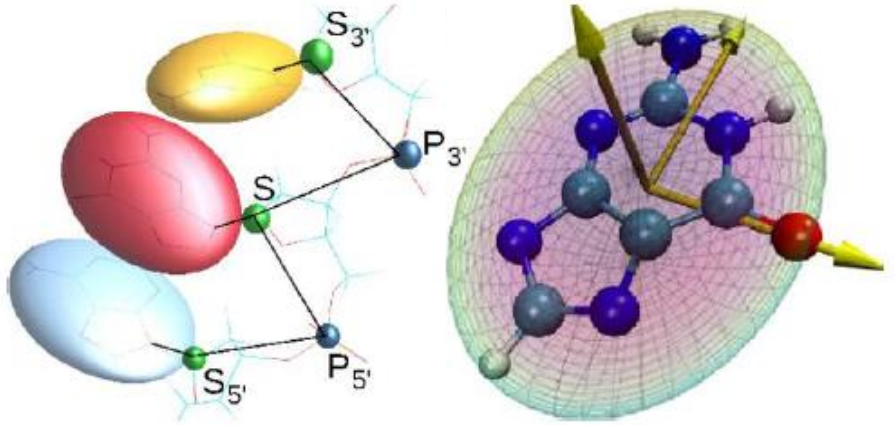


Biophysics skill sets through research:
Instrumentation, microscopies, optics, theory, computation, AI, machine learning, fabrication, wet sample handling, biotechnology

Rottler Lab



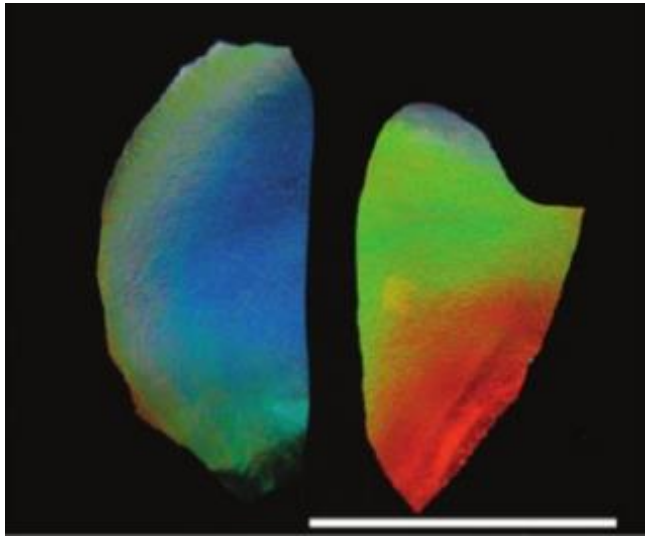
Towards an atomistic understanding of materials



Biopolymers, biomechanical response, AI, ..

Michal Lab

Brain research

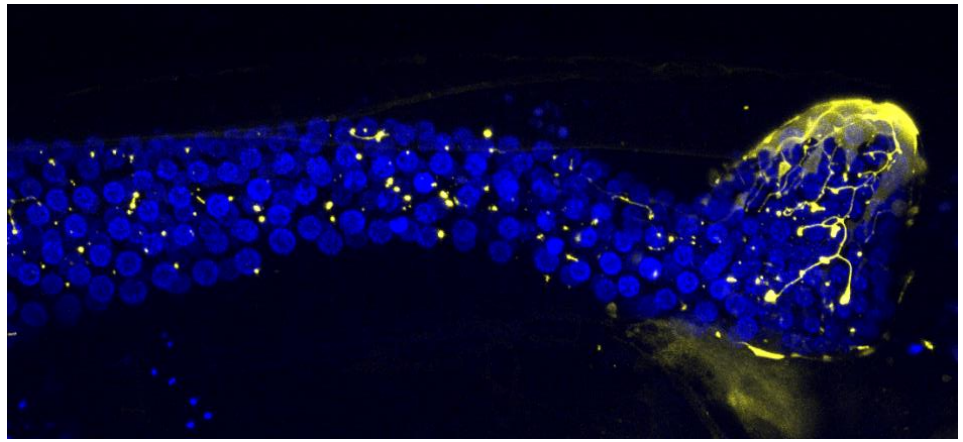


Spider silk and synthetic materials

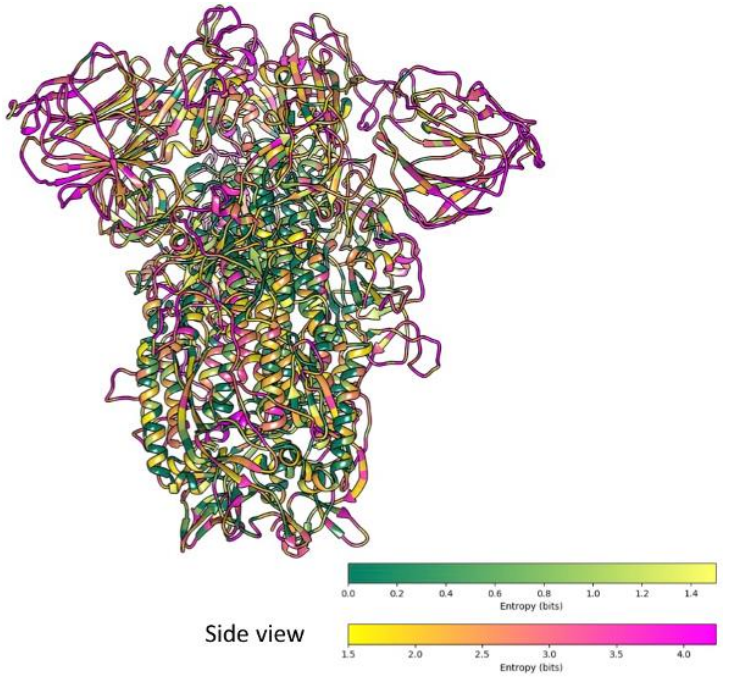
NMR

New investigations of bio materials using NMR and MRI; further innovating these tools to democratize their use

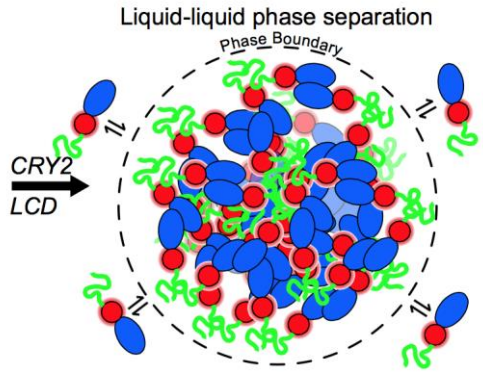
Plotkin Lab



Molecular genetic origins of multi cellular animals

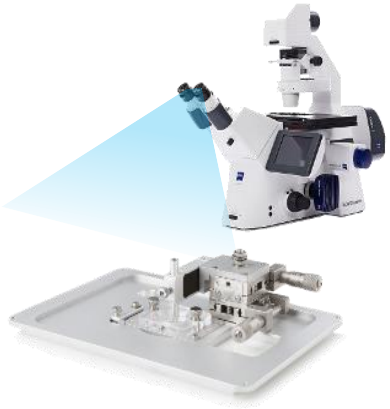


Viruses and therapies

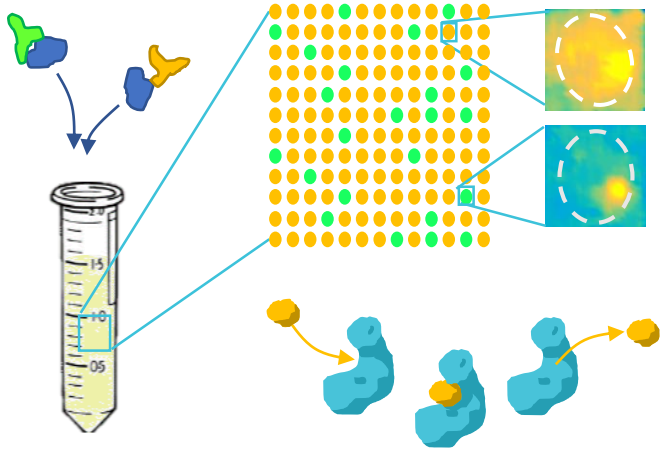


Protein aggregation

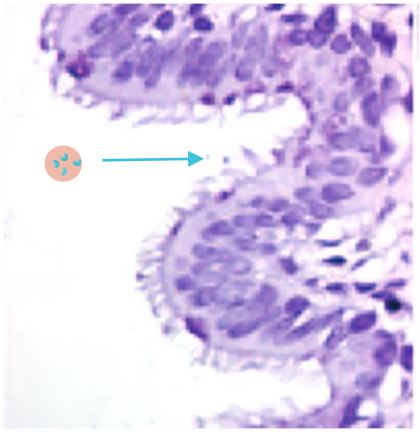
Leslie Lab



Enabling single-molecule visibility



Capturing drug/target interactions (and other molecules)

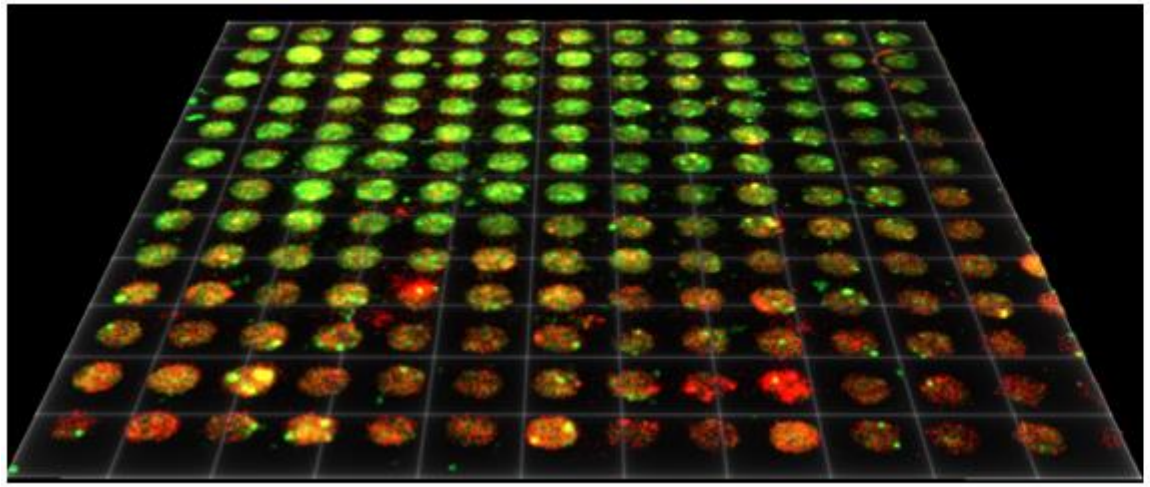


Understanding delivery dynamics in cells

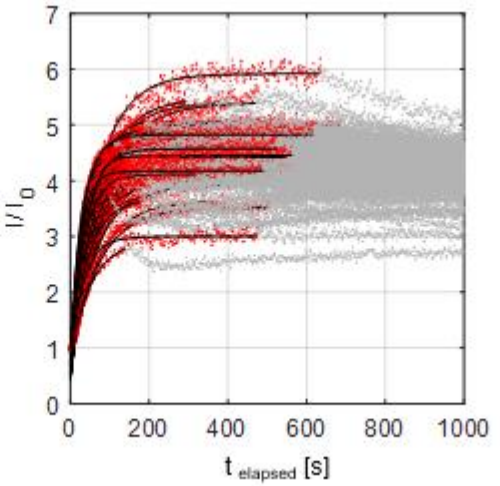
Single-molecule (SM) and single-cell platform for studies of molecular interactions, applications to therapeutics discovery

Collaborations with Nanomedicine, SBME, GSAT, etc

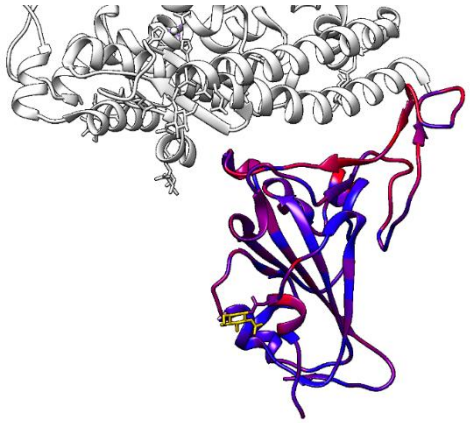
Example: Leslie and Cullis inspect vaccines one particle at a time:, mechanistic investigations, can we connect to clinical data?



CLiC single-imaging of vaccine nanoparticle dynamics in arrays



Pieter, 2022 Order of Canada @ LSI



Example: Plotkin and Tokuriki take a close look at viral evolution of SARS-CoV-2

Nobu, 2022 Full Prof @ MSL

Both examples are **applications of new biophysical tools** in combination with **theory** and expertise in **biochemistry** to advance our understanding of medicines and hopefully improve them

Recap: Core biophysics subgroup + interdisciplinary network

Sabrina
sabrinaleslie@phas.ubc.ca

Single-molecule microscopy, biophysics of DNA, RNA interactions, mechanisms of therapeutics/vaccines, Microfluidics/optics, nano scale device engineering, etc

Steve
steve@phas.ubc.ca

Protein misfolding, SARS-CoV-2, Molecular genetic origins of multi cellular animals

Carl
michal@phas.ubc.ca

NMR and MRI, brain research, spider silk, synthetic materials

Joerg
jrottler@physics.ubc.ca

Material properties from an atomistic perspective, machine learning, polymers, biomaterials

Recap: Core medical physics group + interdisciplinary network

[Medical Physics | UBC Physics & Astronomy]

Vesna Sossi, PET MRA Imaging

Stefan Reisenberg, Cancer Imaging, MRI

Biological and Medical Physics: the Physics of the 21st century

@ UBC Physics and Astronomy

Join us for a coffee and gathering after the Thurs Sept 22 PHAS Colloquium by Steve Michnick on the **Biophysics of Genomes**

Biophysics groups are actively looking for talented students, email us!

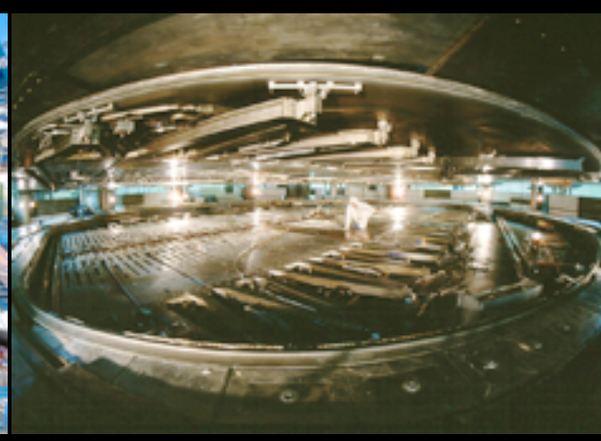
Lots of opportunities, careers in academia & Vancouver biotech/nano industry (Abcellera, Precision Nanosystems, Acuitas, Boreal, Notch, Dwave, and many others)




Subatomic Physics at UBC

Colin Gay



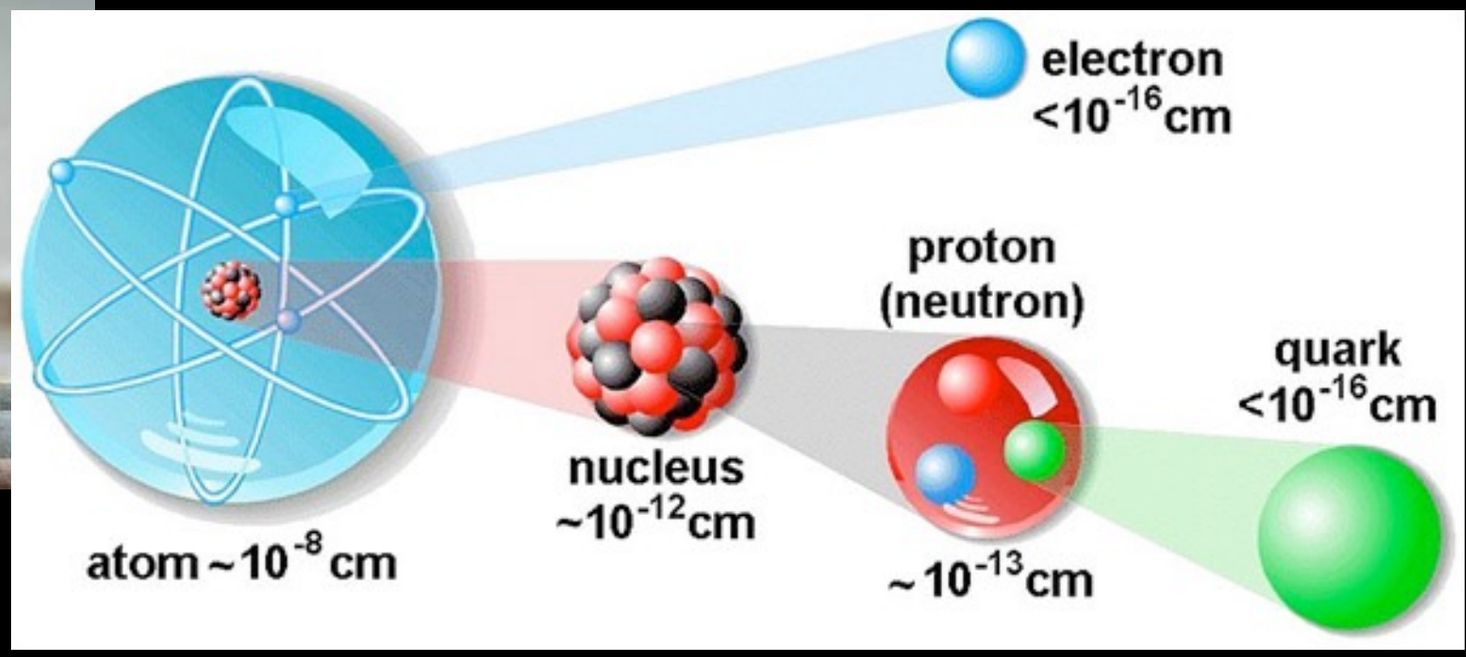



Particle (Subatomic) Physics is the prototypical reductionist field, asking the questions:

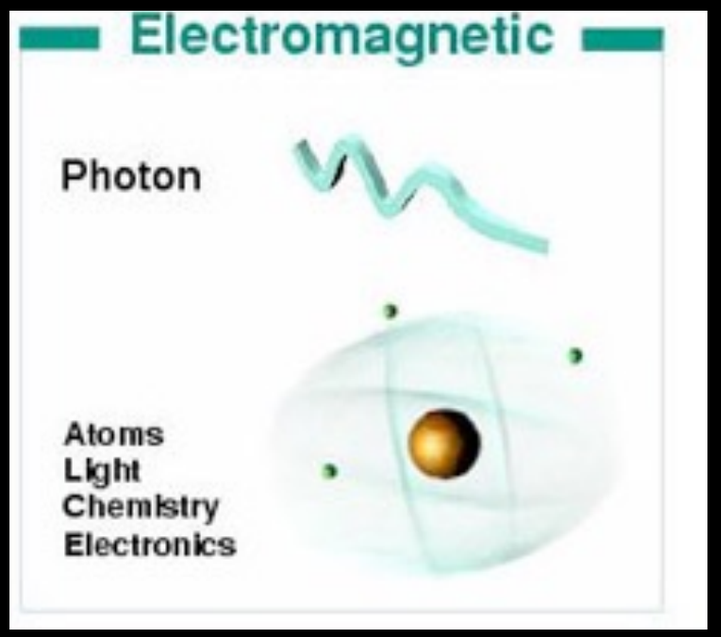
What are the indivisible building blocks of matter?

What are the fundamental forces?

and tries to find the most irreducible answer



= Magnetic Force
= exchanging photons

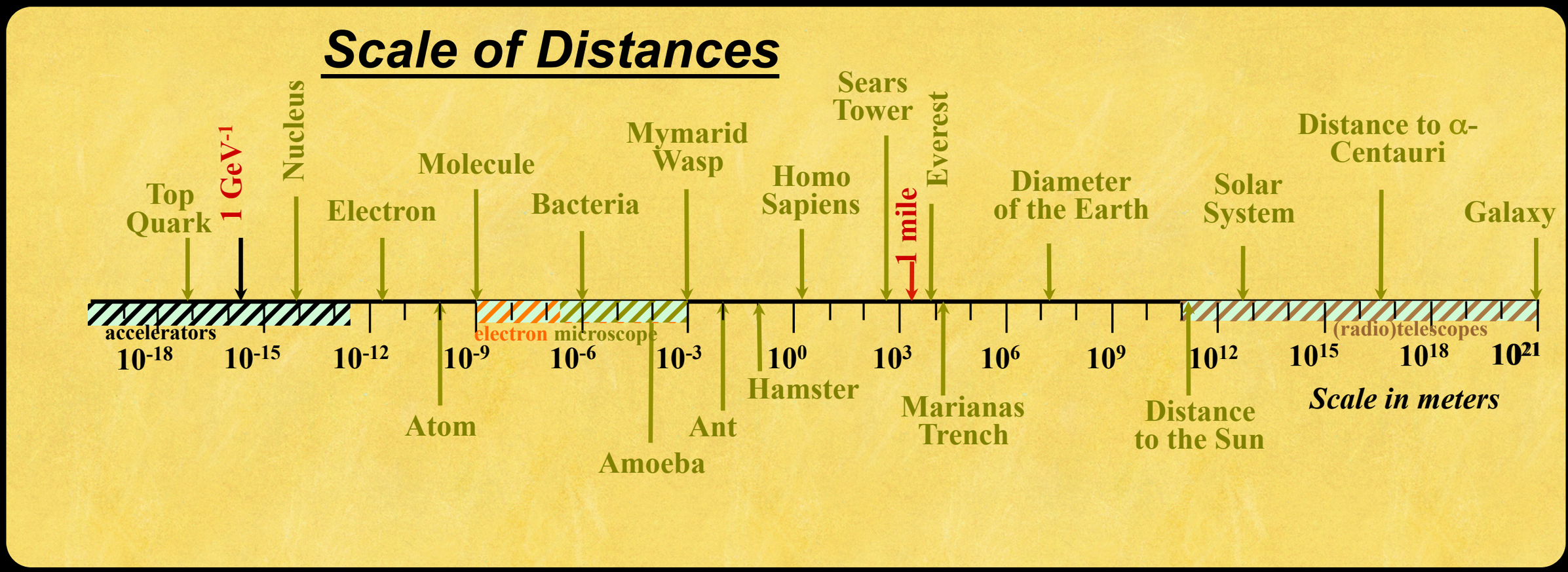


To do this, we need to probe to the *smallest distance* possible

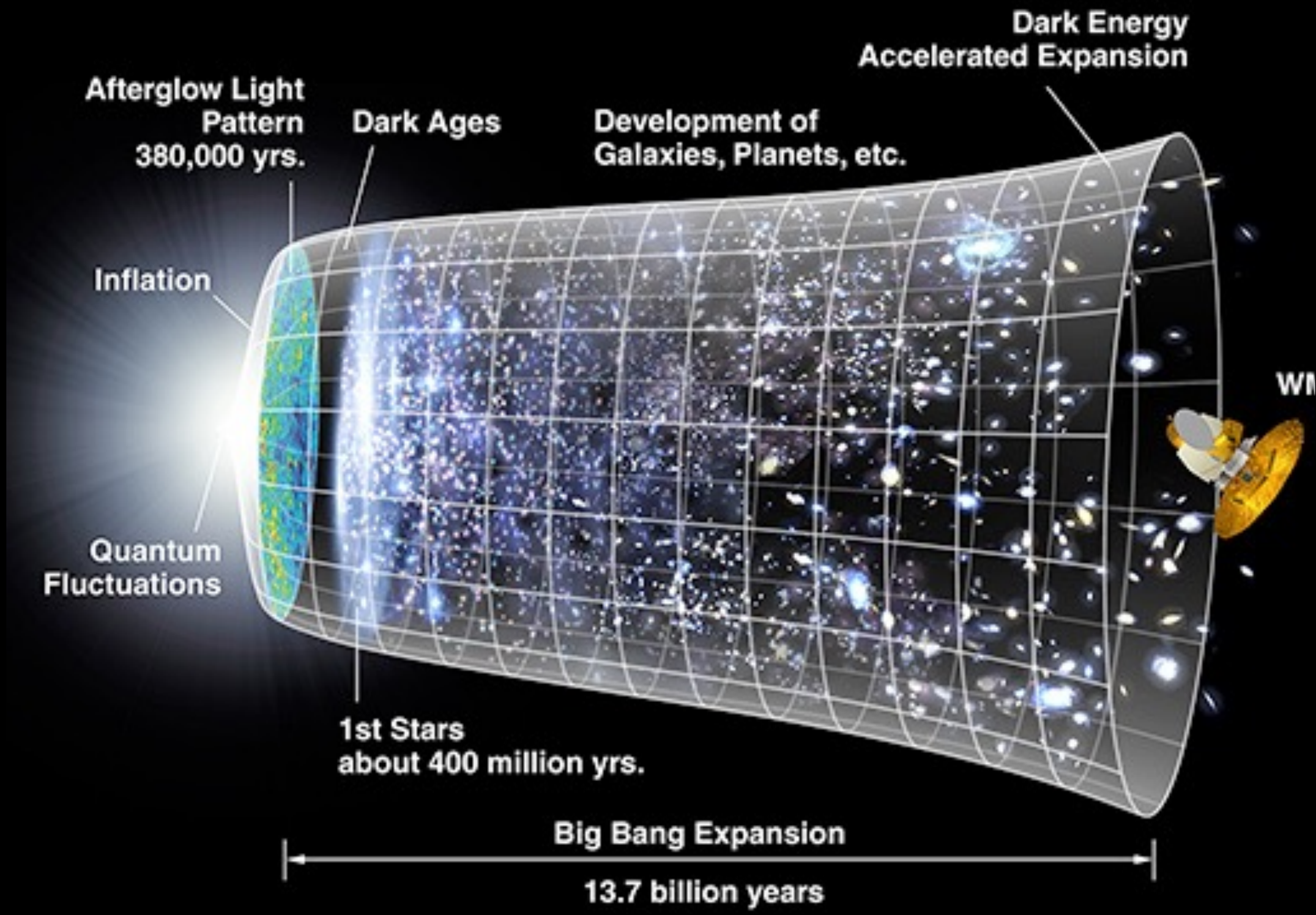
Equivalent to working at the *highest energy* possible

Or the *hottest temperature*

Or the *earliest time* in the universe



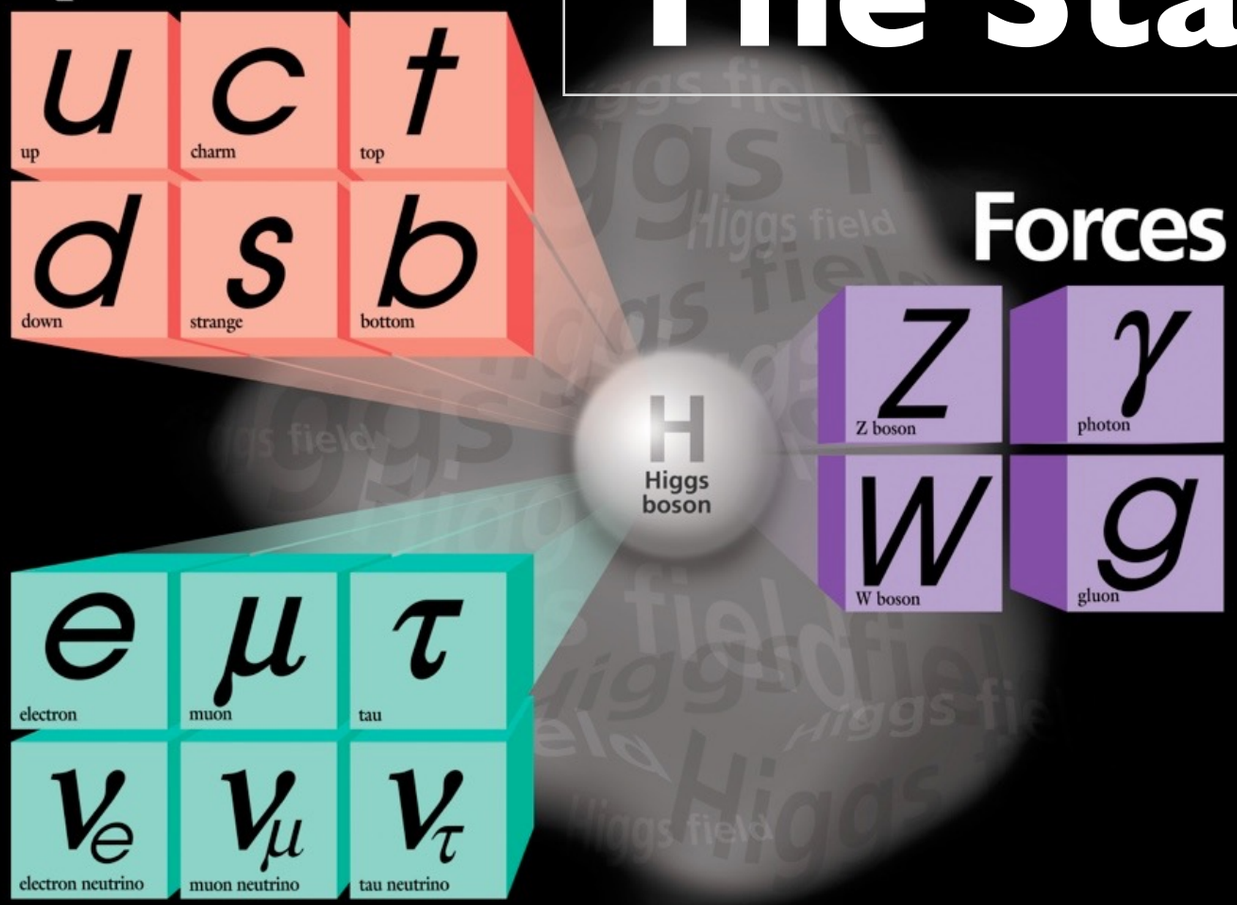
Particle Physics probes distance scales that are as far from the atomic scale as the atomic scale is from everyday scales



History of the Universe

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 (most) fundamental particles have mass

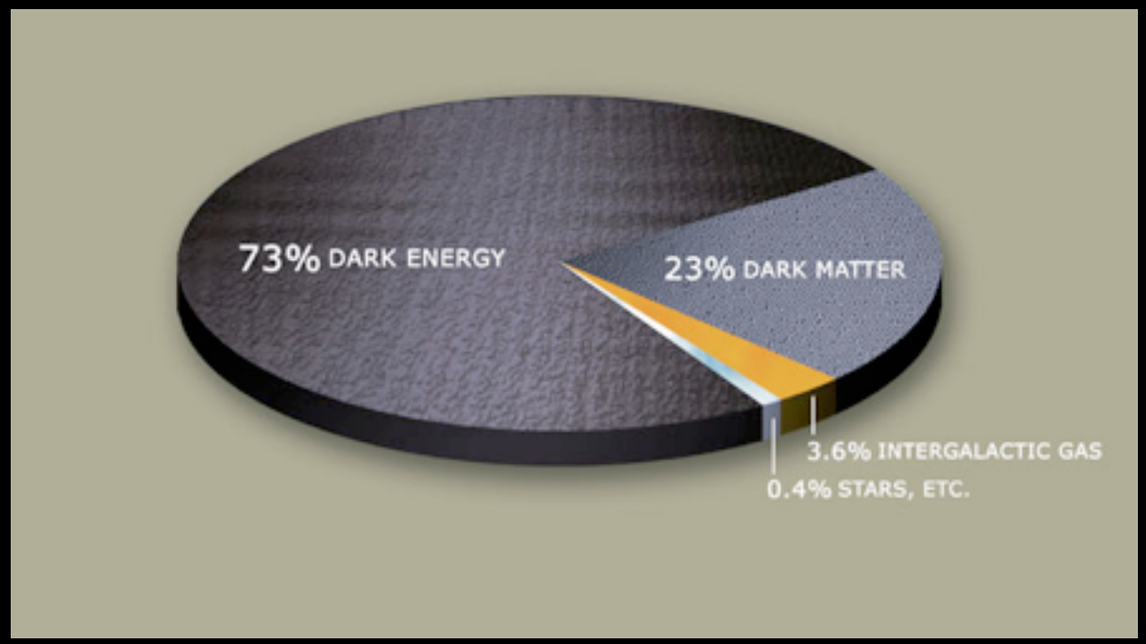
The Standard Model



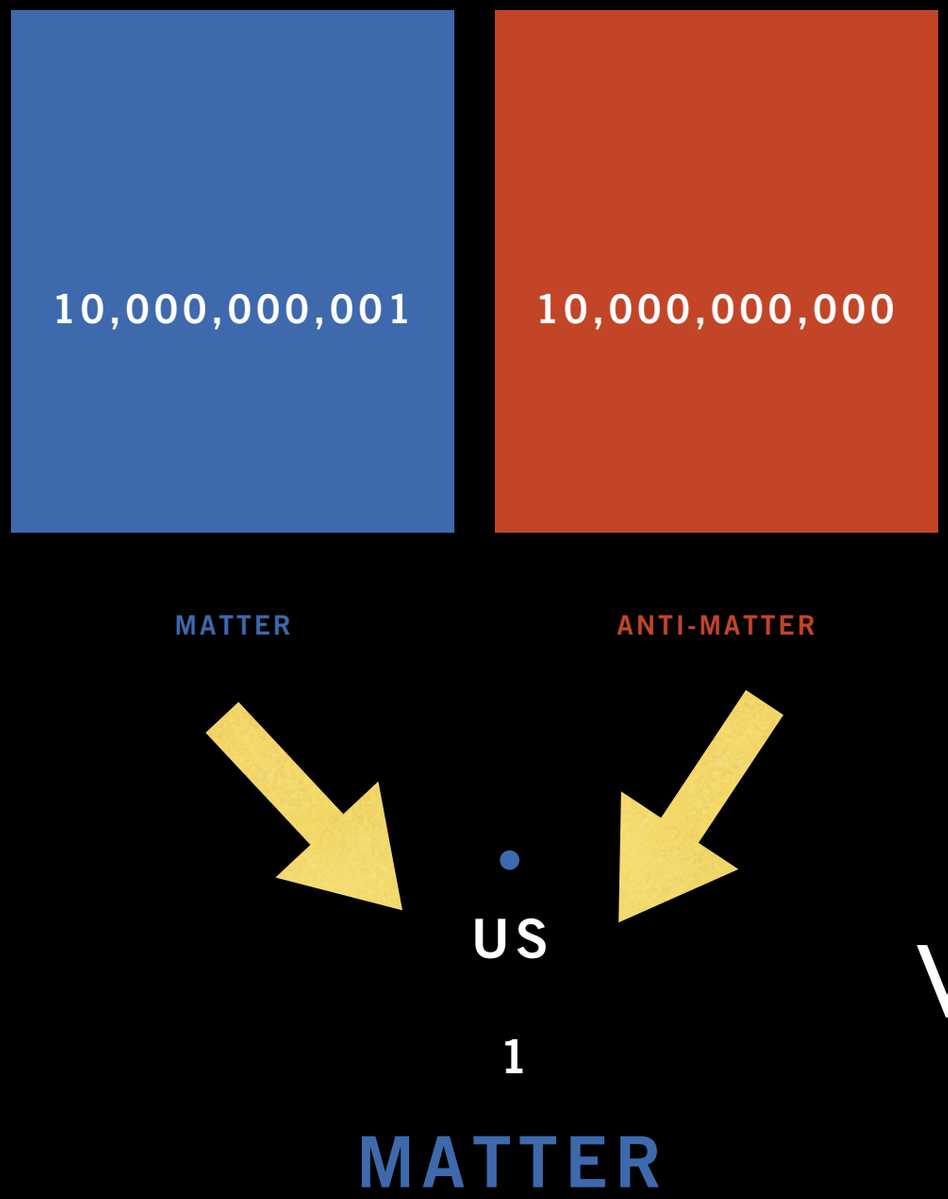
The Standard Model is one of the most well-tested theories ever.

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?

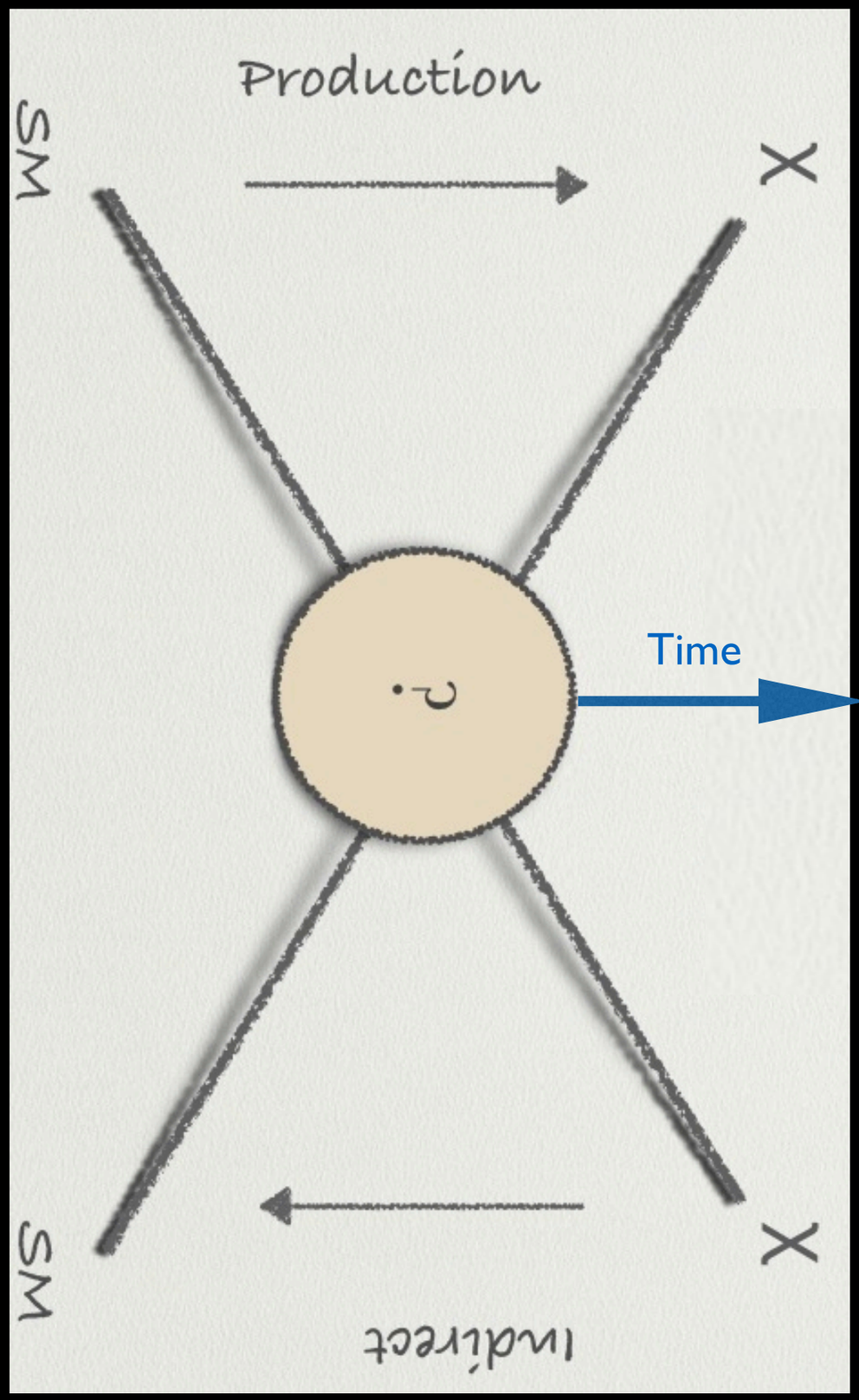
Search for Dark Matter

DM must be neutral (hence "Dark")

Interacts *extremely weakly* with "normal" matter

Is cold, that is, speed is small compared to speed of light

Early Universe Dark Matter

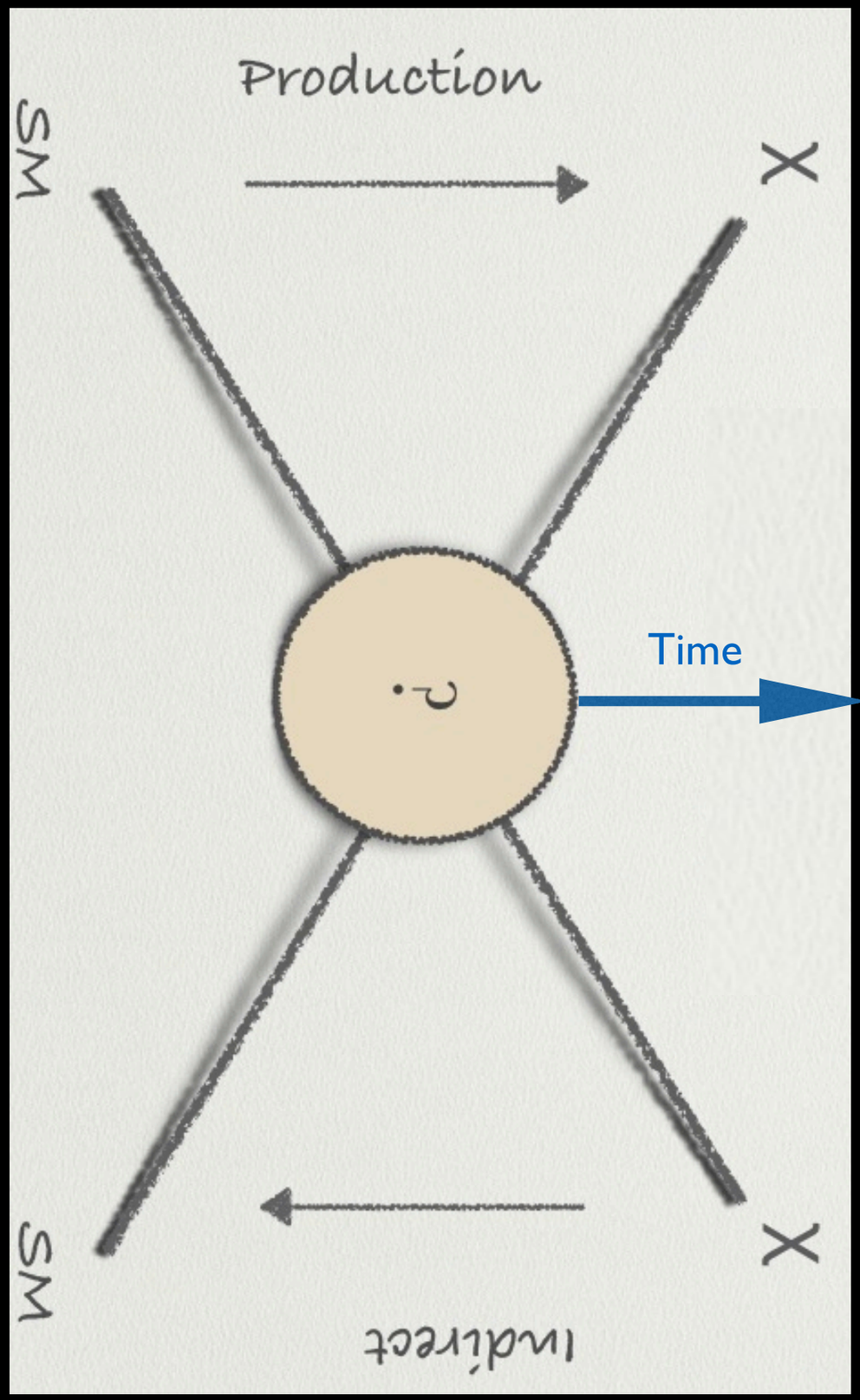


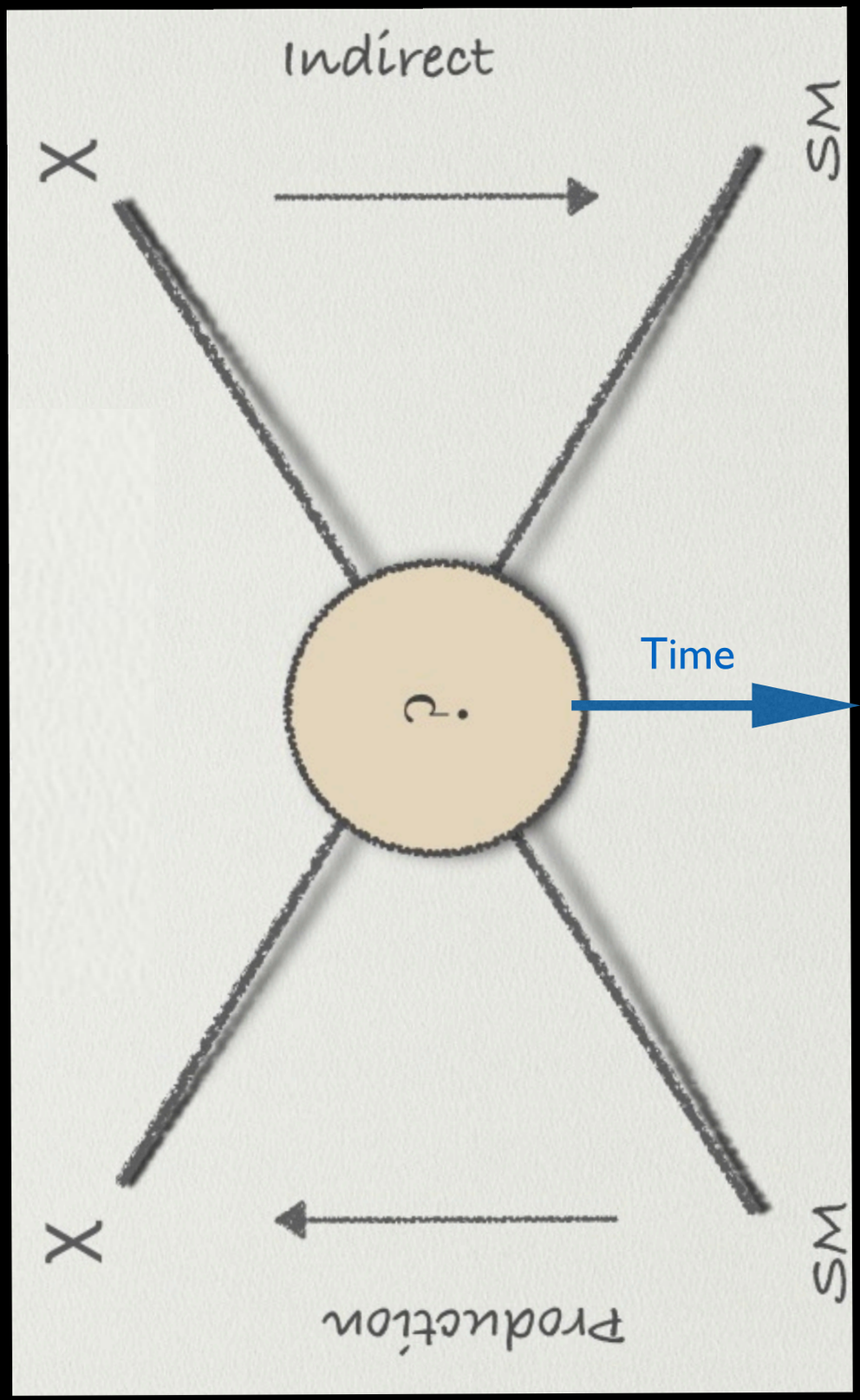
Universe is very hot

High energy collisions of "normal" (Standard Model) particles make DM

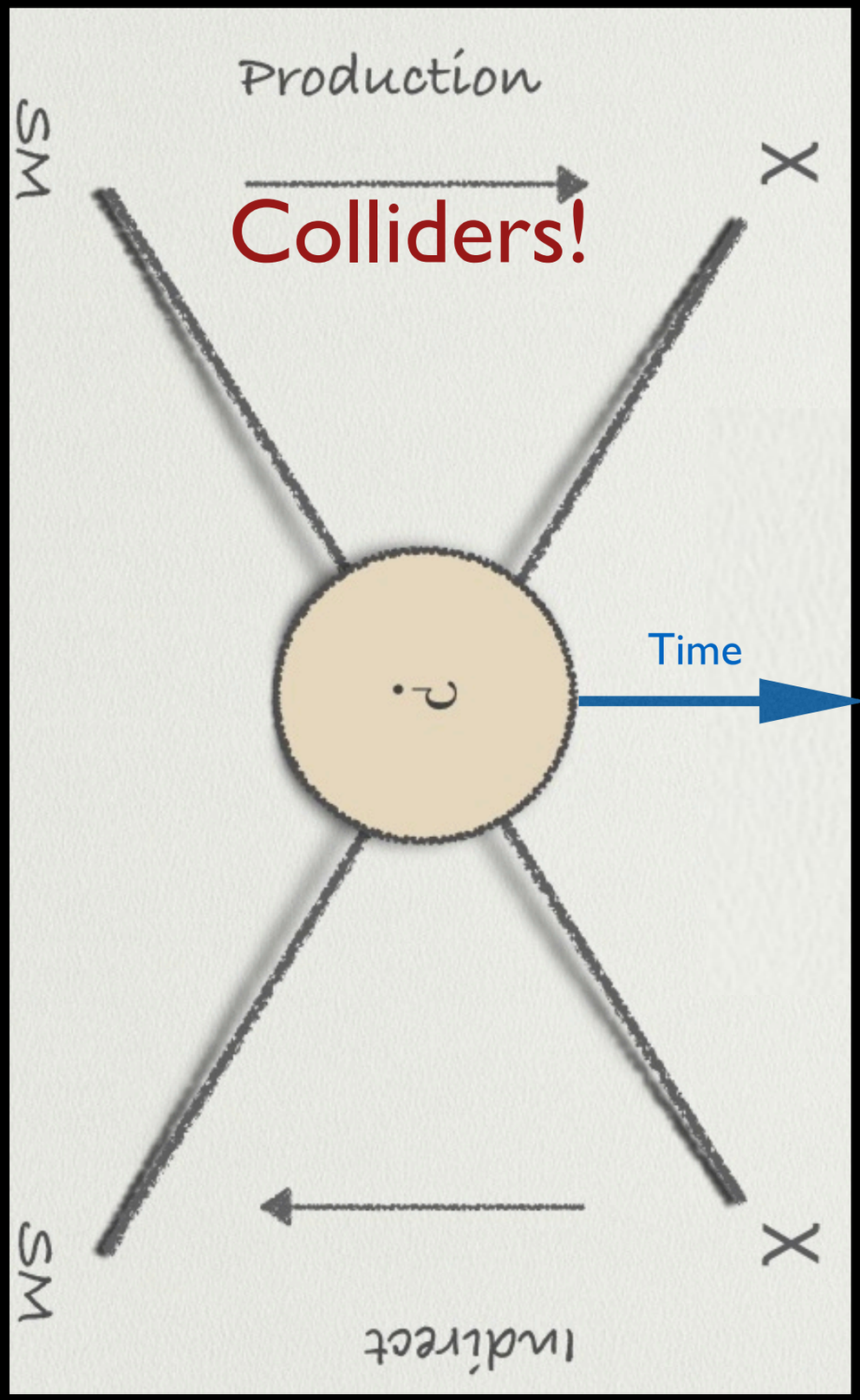
Reaction in equilibrium: DM also collides to make SM particles equally

Early Universe Dark Matter





Current Dark Matter Search

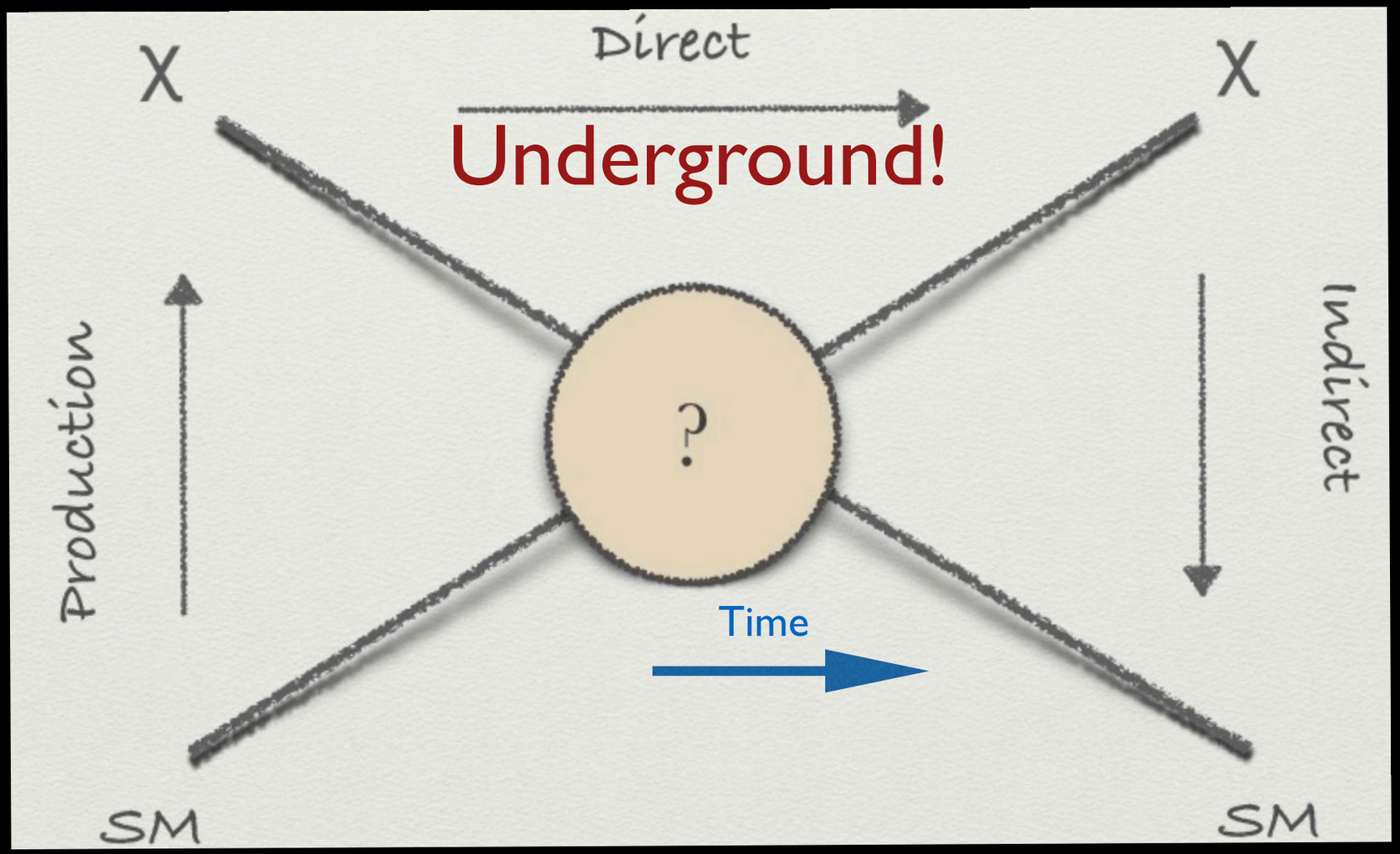


Particle colliders let us create conditions from early universe!

Eg: Large Hadron Collider in Switzerland: 10^{-12} s after Big Bang

Collide protons, make Dark Matter in a lab to study

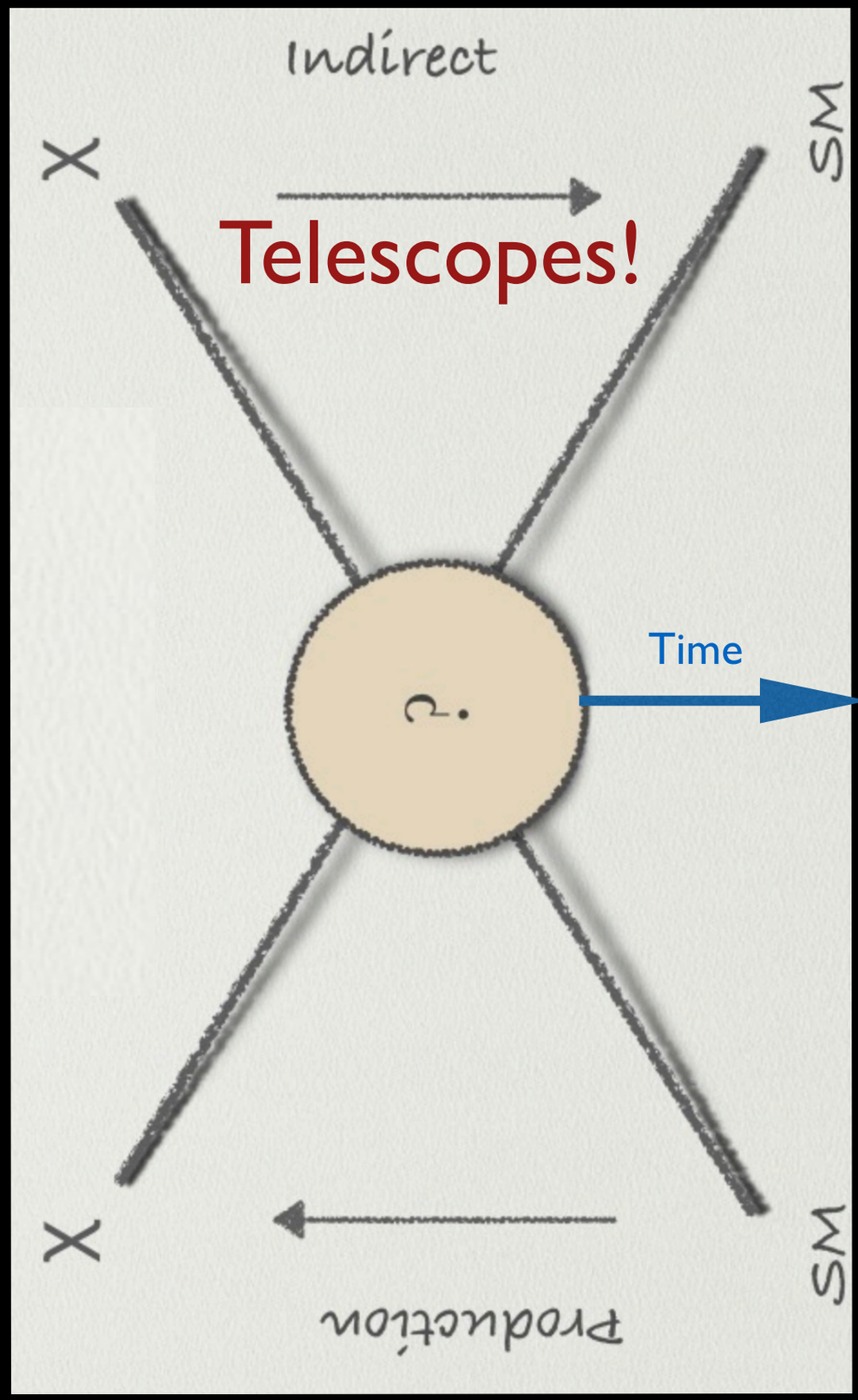
Current Dark Matter Search



Let existing DM hit huge amounts of "normal" matter, look for extremely rare interactions

Eg: SNOLab in Sudbury

Current Dark Matter Search



Might still get DM annihilation in very dense regions of space

Look for particular SM particle signatures coming from, eg, centres of galaxies

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?

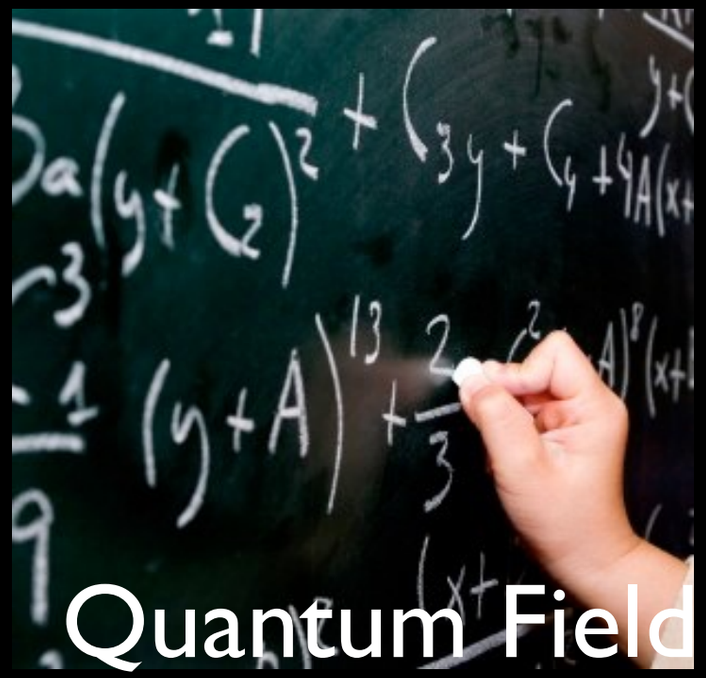
...

Tools of the Trade

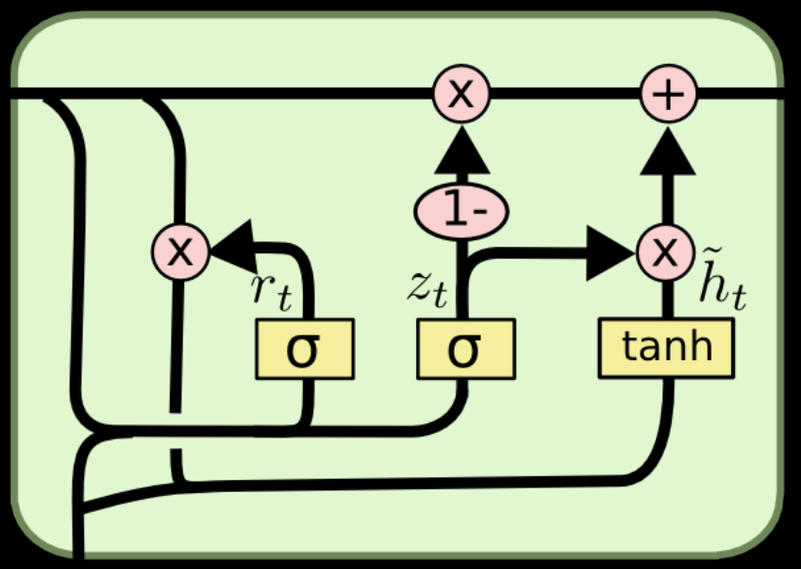
Accelerators

Massive Data sets

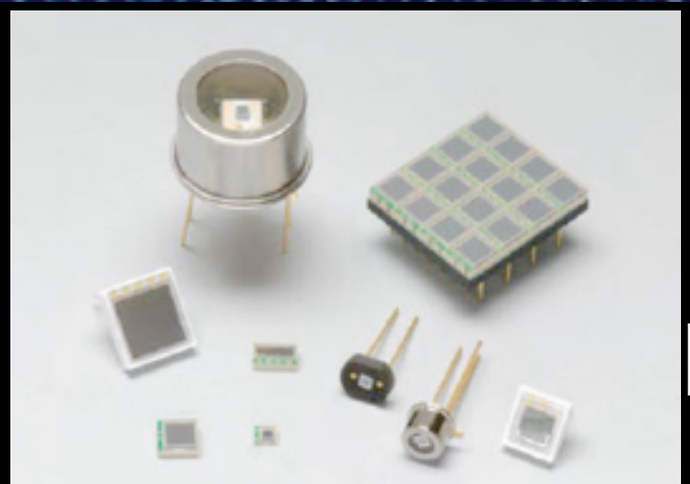
Underground labs



Quantum Field Theory



Machine Learning

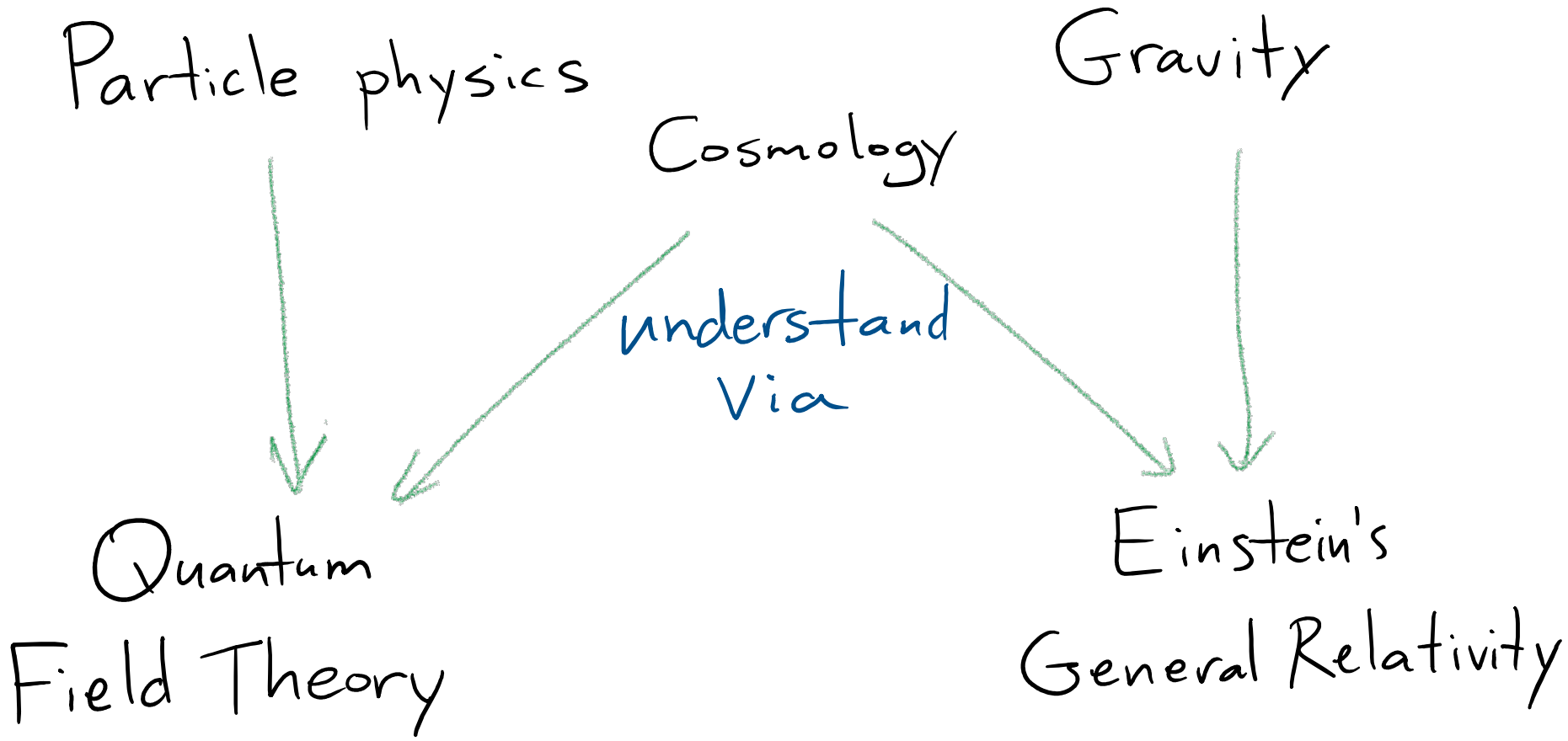


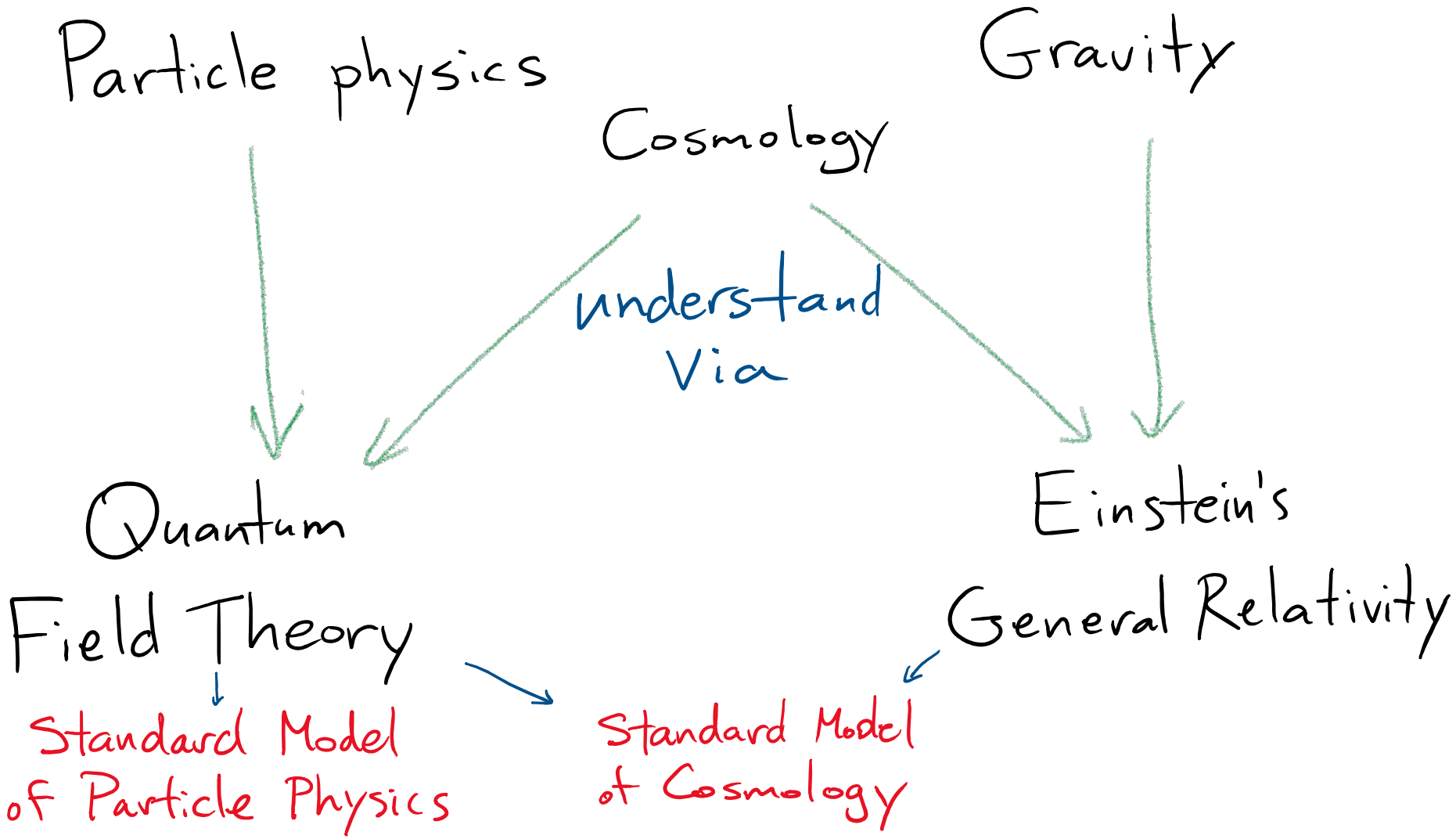
Fancy detectors/electronics

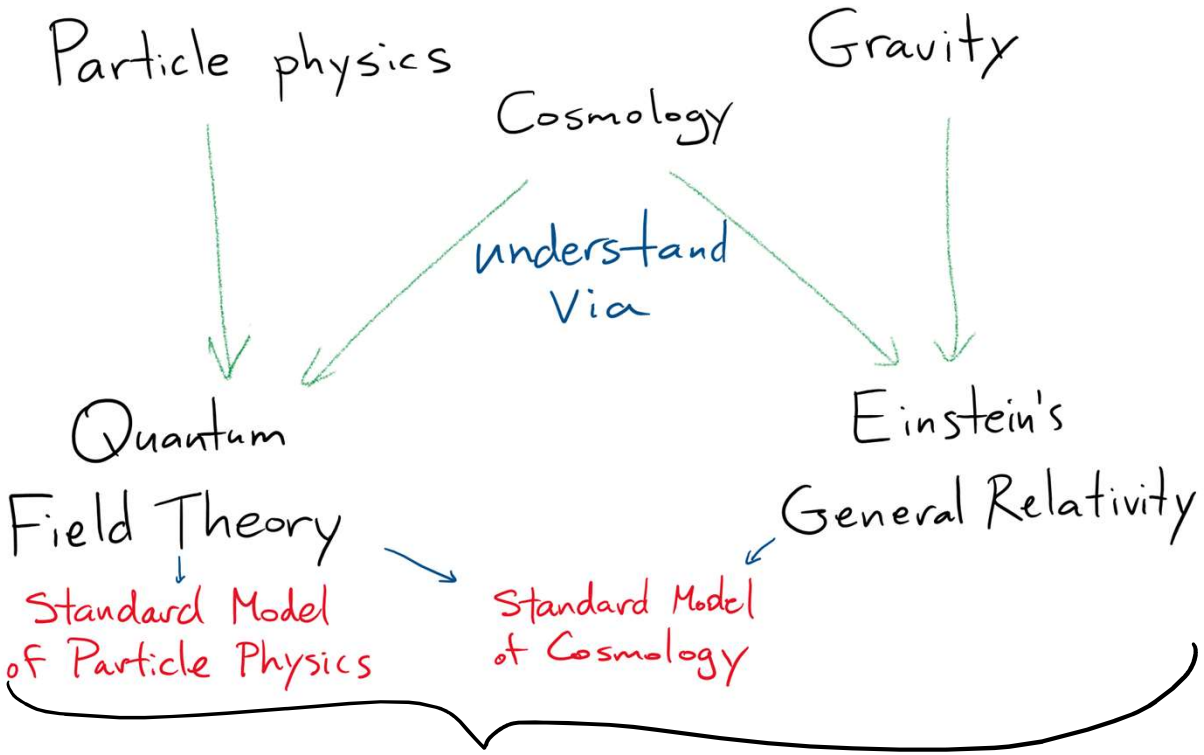
Experimental Particle Faculty

Douglas Bryman
Colin Gay
Mike Hasinoff
Christopher Hearty
Alison Lister
Tom Mattison
Janis McKenna
Scott Oser


Kris Sigurdson
David Morissey
(Triumf)
Bill Unruh
Jess McIver
Eric Zhitnitsky
Particle Phenomenology
Astroparticle
Cosmology
Matt Choptuik
Gravity
Philip Stamp
Kristin Schleich
Mark Van
Raamsdonk
Moshe Rozali
String Theory
Gordon
Semenoff
Joanna
Karczmarek


Particle physics
Gravity
Cosmology
understand
via
Quantum
Field Theory
Einstein's
General Relativity


Particle physics
Gravity
Cosmology
understand
via
Quantum
Field Theory
Einstein's
General Relativity
Standard Model
of Particle Physics
Standard Model
of Cosmology



Extremely successful, accurately predict/explain experiments e.g.

- LHC
- Planck
- LIGO

Still many open questions:

What is dark matter?

What is dark energy?

Is there new physics beyond the standard model?

Why is there more matter than antimatter?

What is the origin structure in the universe?

PARTICLE THEORY & COSMOLOGY

Kris Sigurdson

My theoretical research interests span **cosmology and its connections to fundamental particle physics and string theory**.

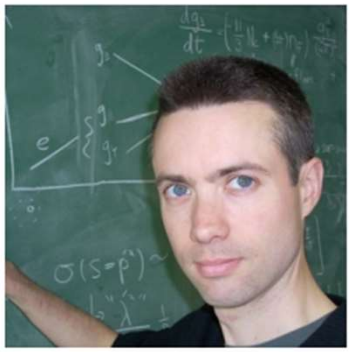
What physics do we need to explain **Dark Matter? Dark Energy? Inflation?**

Eric Zhitnitsky

I work on **Quantum Chromodynamics (QCD)** in the unusual environment when **temperature, chemical potential**, the so-called **theta parameter are non-zero**. Such a study is important in the area where the **particle physics / nuclear physics / astrophysics / cosmology** are overlapped.

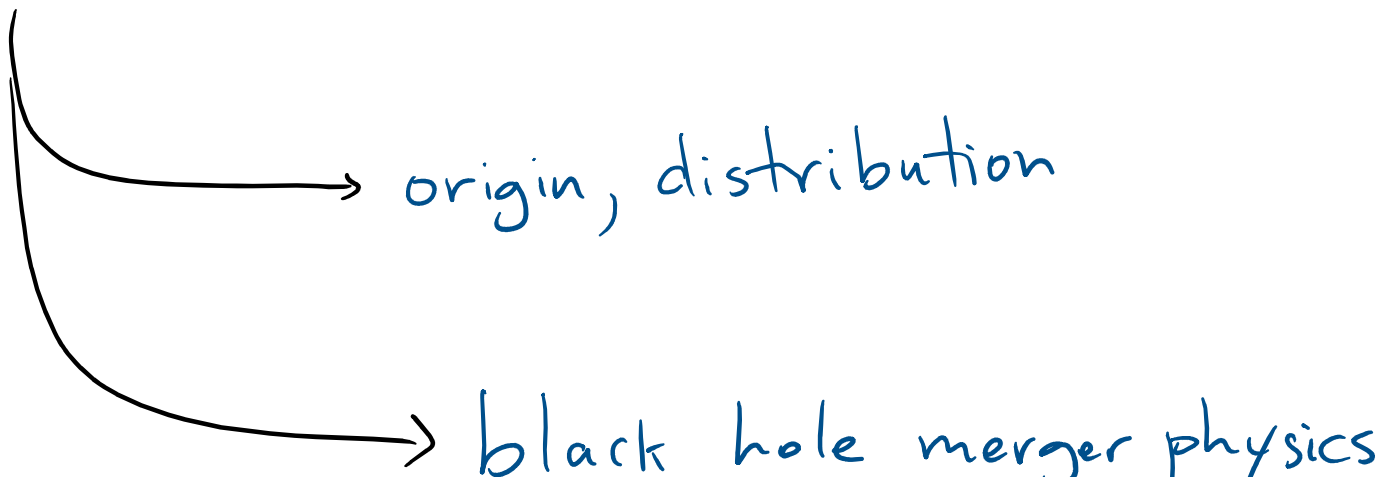
David Morissey

Elementary Particle Physics



- **New particles and interactions** (e.g. supersymmetry, extra dimensions, strong forces)
- Interpretation and explanation of **LHC data**
- Candidates for **dark matter**
- Origin of the **matter-antimatter asymmetry**
- Ways to test this stuff **experimentally**

What is the physics of black holes?



Jess McIver

Gravitational wave experiment with LIGO

- **Large-scale instrumentation**: improving the performance of the Advanced LIGO detectors
- **Noise characterization** and modelling
- Use GWs to explore **new tests of general relativity,** cosmology, and astrophysics

Part of team UBC at LIGO-Livingston

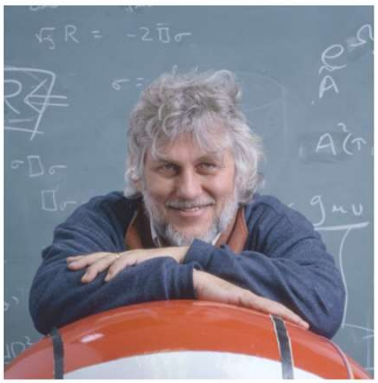
Matt Choptuik

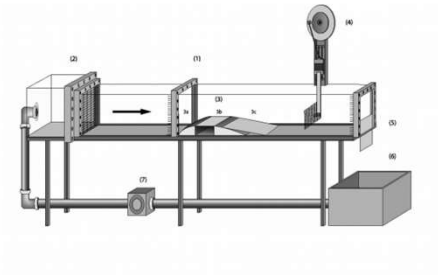
Numerical relativity at UBC:
see **http://laplace.phas.ubc.ca** for more info.

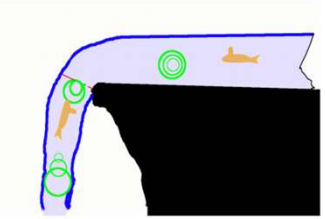
Theoretical aspects of gravity:

- intersections between gravity & quantum mechanics
- physics of black hole evaporation
- can exotic objects e.g. wormholes exist?

Bill Unruh







Black Hole analogy: (above) Model black hole quantum emission in fluids
(water waves, BEC, optical)

Kristin Schleich

Classical relativity and quantum gravity, especially the role **topology** plays in the classical and quantum dynamics of our universe.
General relativity in **higher dimensions**, with a focus on problems related to **M-theory and string theory**.

Quantum Cosmology

+

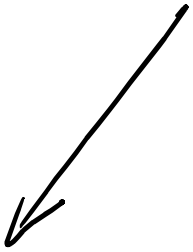
Foundations of Quantum Mechanics

PHILIP STAMP

Decoherence in quantum gravity

Alternatives to standard quantum mechanics & gravity

Can we understand quantum gravity?



string theory

AdS/CFT correspondence

Where do time + space come from?

What is the big bang?

What's inside a black hole?

- also alternative approaches

Joanna Karczmarek

also:
simple models
for low D
gravity

Moshe Rozali

quantum
chaos
& black holes

Mark Van Raamsdonk

connections
to quantum
information

connections to
condensed matter
physics

Gordon Semenoff

I work on **theoretical elementary particle physics, quantum field theory and string theory**:

Graduation and Beyond

Advisors:

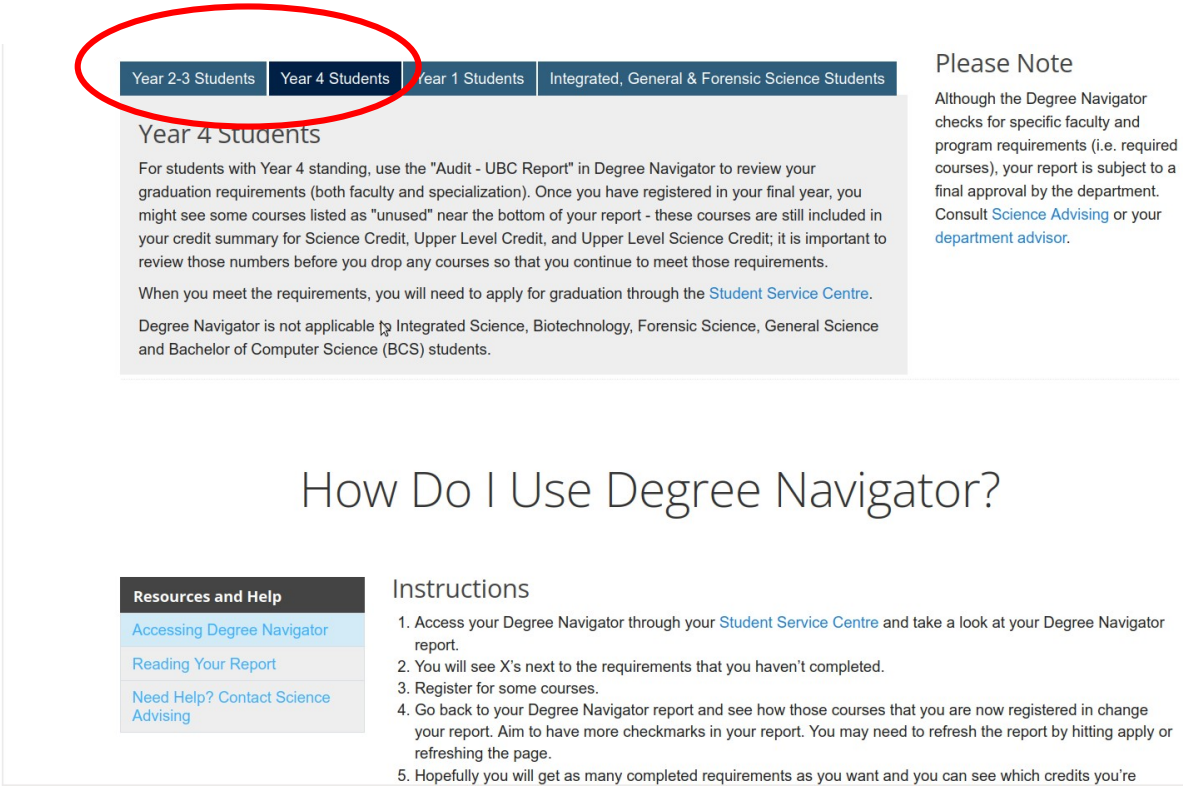
- Mark van Raamsdonk (2nd year)
  ug-phys2@phas.ubc.ca
- Kristin Schleich (physics and general)
  ug-phys34@phas.ubc.ca
- Vesna Sossi (biophysics)
  ug-biop@phas.ubc.ca
- Aaron Boley (astronomy)
  ug-astr@phas.ubc.ca
- Program chair: Carl Michal
  ug-chair@phas.ubc.ca

Coordinator: Shawn Salgadoe ug-coord@phas.ubc.ca

Graduating?

It is **your responsibility** to make sure you fulfill the departmental and Faculty of Science requirements for graduation! Check after registering, but before add/drop deadline [ie now!].

Degree Navigator, instructions here: https://science.ubc.ca/students/degree-navigator



Questions about what Degree Navigator says?

-> Science Advising grad check, or PHAS program advisor

Graduating?

You must follow all of the requirements from one year of the calendar [normally your 2nd year – when you entered the program].

- Honours requirements (>68% average, 30+ credits/year [except in final year when you should take only as many needed to graduate]).
- Arts, breadth requirements.

The Calendar

No matter what you see on phas.ubc.ca (which we to try to keep up to date) or anywhere else on the web, the UBC calendar is 'the rule book' and defines what is required to get a degree from UBC.

The Calendar

Most of what you really 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

The calendar's search tool is not always the easiest way to find what you are looking for...

BSc Graduation Requirements

Summary of Program Requirements Science

	Major, Combined Major, or General Science	Major+Minor in Science	Major+Major (Science)	Honours or Combined Honours	Honours+Minor in Science
Minimum Total Credits	120	120	120	132	132
of which courses 300+	48	48	60	48	60
Minimum Total Science Credits	72	72	72	72	72
of which courses 300+	30	42	54	42	54
Minimum Total Arts Credits	12	12	12	12	12
Maximum Credits that can be double counted	-	6	6	-	6
Maximum credits not in Science or Arts	24	24	24	24	24

All Majors BSc: 120 credits

All Honours BSc: 132 credits

Science Breadth requirement – all BSc programs entered 2020+
(you may go by program requirements in calendar year you entered program)

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

Graduating?

Degree Navigator...

Graduating?

You must **APPLY** for graduation!

Deadline: February

See:

https://students.ubc.ca/enrolment/graduation/applying-graduate

and

https://science.ubc.ca/students/requirements/graduation

It won't all be smooth sailing – what to do if you have issues:

- with your course:
  - Talk to your prof.
  - If the prof can't rectify – talk to an advisor or u/g chair
- with the program
  - Administrative issues: talk to the u/g coordinator Shawn Salgadoe
  - Advising: program advisors (Profs. van Raamsdonk Schleich/Boley/Sossi)
- with life (health, finance, harassment, careers, anything...)
  - https://students.ubc.ca
  - Science Advising
  - 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. You'll 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 (Directed Studies = mini-thesis) should contact Rob Kiefl for approval (typically requires 75% accumulated average and have a research project and supervisor in mind or under discussion).

449 Thesis, 349B Mini-Thesis

Discuss your ideas/interests with potential supervisors.
Many potential supervisors: faculty members, including adjunct professors whose research is based off campus.
Supervisors don't have to be UBC PHAS affiliated at all, but you'll need a PHAS co-supervisor if supervisor non-UBC

Send email, knock on doors,

Self-motivated:
- You'll work with advisor & PHYS 449/PHYS 349 instructor as your guides/mentors.
- You'll learn how to conduct research, write it up & give scientific presentations.
- Your thesis project is your own work.

Getting into Research II

There are other opportunities to do research while in the department:

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

For these and for 449/349 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 to fit students' strengths and interests.

Research – your opportunity

Examine your interests, seek opportunities

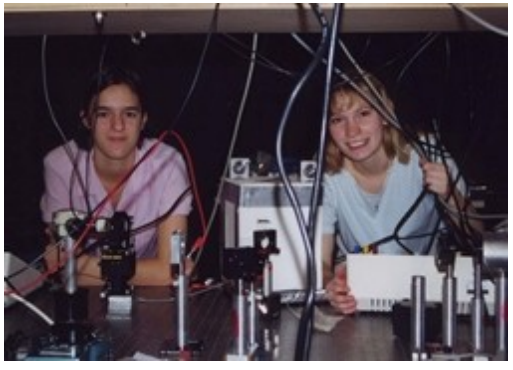
Talk to senior undergrads about their research experiences (meet them via PHYSSOC activities or in PHYSSOC lounge)

Research happens not only in academic institutions, but also government labs, high-tech industry and private companies.

Experience in computing/programming/design is a huge asset, whether seeking a job or seeking a graduate school position.

Ditto for technical experience.

I strongly recommend trying different opportunities, both inside and outside of university setting.



Paid Work/Research Opportunities for PHAS undergrads

- Co-op http://www.sciencecoop.ubc.ca/ (4- ,8-, or 12- month co-op jobs)
  (everything on this page except Work Learn (part-time) are valid for co-op workterms)
- NSERC USRA (Undergrad Student Research Award)
  https://www.nserc-crsng.gc.ca/students-etudiants/ug-pc/usra-brpc_eng.asp
- TRIUMF Summer student program (and 4-, 8- or 12-month co-op jobs)
  http://www.triumf.ca/undergraduate-student-program
- NRC (National Research Council Canada
  https://nrc.canada.ca/en/corporate/careers/post-secondary-students
- DAAD RISE (German Research Internships in Science & Engineering
  https://www.daad.de/rise/en/rise-germany/ UBC is a DAAD partner
- UBC Go Global - Research Abroad
  https://global.ubc.ca/go-global/international-experiences/research-abroad
- More Go Global international experiences
  https://global.ubc.ca/go-global/international-experiences
- UBC SURE (Science Undergraduate Research Experience):
  http://science.ubc.ca/giving/projects/sure-science-undergraduate-research-experience
- IAESTE (International Association for the Exchange of Students for Technical Experience)
  http://www.iaeste.org (Canadian IASTE office: https://iaestecanada.org/)
- UBC Work Learn Program paid, max 10 hours/week while fulltime student
  https://students.ubc.ca/career/ubc-experiences/work-learn-program

a place of mind

After Physics and Astronomy at UBC

Jeremy Heyl

September 6, 2022

What comes next?

Do I really have to think about this now?

It is not too soon (or too late) to start thinking about the future.

Acoustics Physicist
Aerodynamist
Aerospace Testing
Astronomer
Astrophysicist
Biophysicist
Cardiac Imaging Researcher
Chemical Physicist
Computer Specialist
Computer System Engineer
Satellite Data Analyst
Satellite Missions Analyst
Science Teacher
Science Writer
Automotive Engineer
Forensic Scientist
Occupational Safety Specialist
Quality Control Manager
Technical Illustrator
Geodesist
Geophysicist
Hydrologist
Lawyer
Medical Physicist
Medical Products Designer
Meteorologist
Seismologist
Stratigrapher
Environmental Analyst
Oceanographer
Scientific Photographer
Nuclear Power Plant Mgr

How to get there from here?

What to do after UBC?

First steps after UBC

- Work

How to get there from here?

What to do after UBC?

First steps after UBC

- Work
- Graduate School in Physics or Astronomy

How to get there from here?

What to do after UBC?

First steps after UBC

- Work
- Graduate School in Physics or Astronomy
- Work then Graduate School

How to get there from here?

What to do after UBC?

First steps after UBC

- Work
- Graduate School in Physics or Astronomy
- Work then Graduate School
- Graduate School then Work

How to get there from here?

What to do after UBC?

First steps after UBC

- Work
- Graduate School in Physics or Astronomy
- Work then Graduate School
- Graduate School then Work
- Research at UBC as an Undergraduate

How to get there from here?

What to do after UBC?

First steps after UBC

- Work
- Graduate School in Physics or Astronomy
- Work then Graduate School
- Graduate School then Work
- Research at UBC as an Undergraduate
- Professional school

How to get there from here?

What to do after UBC?

First steps after UBC

- Work
- Graduate School in Physics or Astronomy
- Work then Graduate School
- Graduate School then Work
- Research at UBC as an Undergraduate
- Professional school
- Teaching qualification

How to get there from here?

What to do after UBC?

First steps after UBC

- Work
- Graduate School in Physics or Astronomy
- Work then Graduate School
- Graduate School then Work
- Research at UBC as an Undergraduate
- Professional school
- Teaching qualification
- BCS

What to do now?

How to make the most of your time at UBC?

From the point of view of a graduate admissions chair in physics and astronomy (that's me)

What to do now?

How to make the most of your time at UBC?

From the point of view of a graduate admissions chair in physics and astronomy (that's me) . . . but also hiring manager, admissions officer for med school, . . .

- Get good grades (obviously?)

What to do now?

How to make the most of your time at UBC?

From the point of view of a graduate admissions chair in physics and astronomy (that's me) . . . but also hiring manager, admissions officer for med school, . . .

- Get good grades (obviously?)
- Work on a research project (get a "strong" reference)

What to do now?

How to make the most of your time at UBC?

From the point of view of a graduate admissions chair in physics and astronomy (that's me) . . . but also hiring manager, admissions officer for med school, . . .

- Get good grades (obviously?)
- Work on a research project (get a "strong" reference)
- Work in a group on something that you are passionate about (build "soft skills")

What about Graduate School?

Which kind?

Wide variety of possibilities!

- Pre-doctoral Program

What about Graduate School?

Which kind?

Wide variety of possibilities!

- Pre-doctoral Program
- Masters:

What about Graduate School?

Which kind?

Wide variety of possibilities!

- Pre-doctoral Program
- Masters:
  - M.Sc. (1 year or 2 year, tuition, salary, coursework or not ...)

What about Graduate School?

Which kind?

Wide variety of possibilities!

- Pre-doctoral Program
- Masters:
  - M.Sc. (1 year or 2 year, tuition, salary, coursework or not ...)
  - M.Phil.

What about Graduate School?

Which kind?

Wide variety of possibilities!

- Pre-doctoral Program
- Masters:
  - M.Sc. (1 year or 2 year, tuition, salary, coursework or not ...)
  - M.Phil.
  - M.Sci.

What about Graduate School?

Which kind?

Wide variety of possibilities!

- Pre-doctoral Program
- Masters:
  - M.Sc. (1 year or 2 year, tuition, salary, coursework or not ...)
  - M.Phil.
  - M.Sci.
  - M.Phys

What about Graduate School?

Which kind?

Wide variety of possibilities!

- Pre-doctoral Program
- Masters:
  - M.Sc. (1 year or 2 year, tuition, salary, coursework or not ...)
  - M.Phil.
  - M.Sci.
  - M.Phys
- PhD

What about Graduate School?

Which kind?

Wide variety of possibilities!

- Pre-doctoral Program
- Masters:
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  - M.Phil.
  - M.Sci.
  - M.Phys
- PhD
  - tuition, salary, how many courses?

What about Graduate School?

Which kind?

Wide variety of possibilities!

- Pre-doctoral Program
- Masters:
  - M.Sc. (1 year or 2 year, tuition, salary, coursework or not ...)
  - M.Phil.
  - M.Sci.
  - M.Phys
- PhD
  - tuition, salary, how many courses?
  - one supervisor from the start, or

What about Graduate School?

Which kind?

Wide variety of possibilities!

- Pre-doctoral Program
- Masters:
  - M.Sc. (1 year or 2 year, tuition, salary, coursework or not ...)
  - M.Phil.
  - M.Sci.
  - M.Phys
- PhD
  - tuition, salary, how many courses?
  - one supervisor from the start, or
  - a rotation of projects to start

What about Graduate School?

Which kind?

Wide variety of possibilities!

- Pre-doctoral Program
- Masters:
  - M.Sc. (1 year or 2 year, tuition, salary, coursework or not ...)
  - M.Phil.
  - M.Sci.
  - M.Phys
- PhD
  - tuition, salary, how many courses?
  - one supervisor from the start, or
  - a rotation of projects to start
  - What is "direct transfer"?

What about Graduate School?

How much?

"Show me the money!"

- What is the bottom line?

What about Graduate School?

How much?

"Show me the money!"

- What is the bottom line?
- Does the department pay you?

What about Graduate School?

How much?

"Show me the money!"

- What is the bottom line?
- Does the department pay you?
  - Research assistant

What about Graduate School?

How much?

"Show me the money!"

- What is the bottom line?
- Does the department pay you?
  - Research assistant
  - Teaching assistant

What about Graduate School?

How much?

"Show me the money!"

- What is the bottom line?
- Does the department pay you?
  - Research assistant
  - Teaching assistant
- Do you pay for tuition? How much?

What about Graduate School?

How much?

"Show me the money!"

- What is the bottom line?
- Does the department pay you?
  - Research assistant
  - Teaching assistant
- Do you pay for tuition? How much?
- What is the cost of living?

What about Graduate School?

How much?

"Show me the money!"

- What is the bottom line?
- Does the department pay you?
  - Research assistant
  - Teaching assistant
- Do you pay for tuition? How much?
- What is the cost of living?
- How to get additional funding?

What about Graduate School?

How much?

"Show me the money!"

- What is the bottom line?
- Does the department pay you?
  - Research assistant
  - Teaching assistant
- Do you pay for tuition? How much?
- What is the cost of living?
- How to get additional funding?
- Success breeds success.

What about Graduate School?

Woo Hoo! I got in!

Now, where do I go. Important things to consider:

- Supervisors

What about Graduate School?

Woo Hoo! I got in!

Now, where do I go. Important things to consider:

- Supervisors
- Supervisors

What about Graduate School?

Woo Hoo! I got in!

Now, where do I go. Important things to consider:

- Supervisors
- Supervisors
- Supervisors

What about Graduate School?

Woo Hoo! I got in!

Now, where do I go. Important things to consider:

- Supervisors
- Supervisors
- Supervisors
- Projects

What about Graduate School?

Woo Hoo! I got in!

Now, where do I go. Important things to consider:

- Supervisors
- Supervisors
- Supervisors
- Projects
- Projects

What about Graduate School?

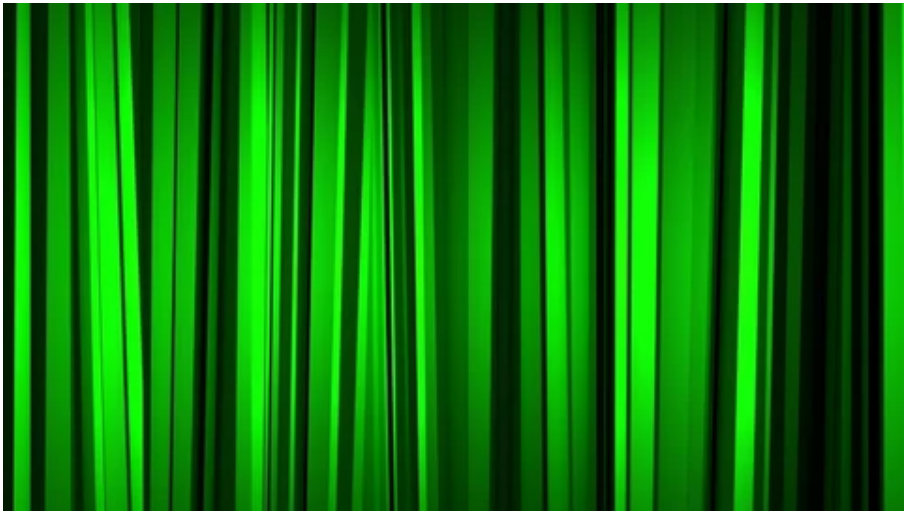
Woo Hoo! I got in!

Now, where do I go. Important things to consider:

- Supervisors
- Supervisors
- Supervisors
- Projects
- Projects
- Institution

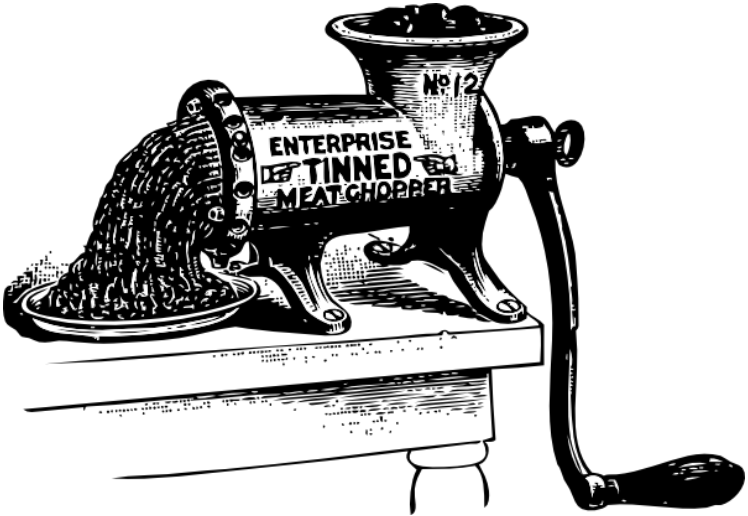
What is the goal of the admission process?

Looking behind the curtain



What is the goal of the admission process?

Looking behind the curtain



What is the goal of the admission process?

Looking behind the curtain

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- Researchers and universities are judged and rewarded according to the accomplishments of their students.

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Finding applicants who will become good researchers

What qualities do we look for?

- Capacity to learn

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What qualities do we look for?

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- Curiosity

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Good Luck!!!