

# **Summer Particle Astrophysics Workshop 2023 (EIEIOO)**



## **Report of Contributions**

Contribution ID: 1

Type: **not specified**

## Introduction

*Tuesday 2 May 2023 12:00 (30 minutes)*

**Presenter:** BAIOCCHI, Melissa

Contribution ID: 2

Type: **not specified**

## Introduction to Particle Physics

*Tuesday 2 May 2023 12:30 (1 hour)*

“It’s a dangerous business, Frodo, going out your door. You step onto the road, and if you don’t keep your feet, there’s no knowing where you might be swept off to.”

***In-Person (Stirling Rm 501)***

**Presenter:** TAM, Benjamin (Queen’s University)

Contribution ID: 3

Type: **not specified**

## Particle Astrophysics Overview

*Tuesday 2 May 2023 14:00 (1 hour)*

Particle astrophysics lies at the rich interface between astrophysics, cosmology and fundamental physics. It aims to find answers for the most fundamental questions about our universe, its origin and evolution, using the complementary information provided by the cosmic messengers that arrive to us: cosmic rays, neutrinos, photons and gravitational waves.

This lecture aims at telling the story of the origins of astroparticle physics, the current puzzles that need to be solved, while presenting the different cosmic messengers from a very experimental perspective.

***Virtual***

**Presenter:** INACIO, Ana Sofia

Contribution ID: 4

Type: **not specified**

# **Intro to Unix Command Line Interface (CLI) and Tools for Scientific Computing**

*Tuesday 2 May 2023 16:00 (2 hours)*

Virtual

**Primary author:** GALLACHER, David

**Presenter:** GALLACHER, David

Contribution ID: 5

Type: **not specified**

## Astronomy Overview

*Wednesday 3 May 2023 12:30 (1 hour)*

In-Person (Stirling Rm 501)

**Presenter:** COURTEAU, Stéphane

Contribution ID: 6

Type: **not specified**

## Accelerator Physics

*Wednesday 3 May 2023 15:00 (1 hour)*

Virtual

**Presenter:** VACHON, Brigitte (McGill University, (CA))

Contribution ID: 7

Type: **not specified**

# ATLAS

*Wednesday 3 May 2023 17:00 (30 minutes)*

The ATLAS detector is one of the two general-purpose experiments at the CERN Large Hadron Collider that discovered the Higgs boson. It performs precision measurements of the properties and interactions of Higgs bosons, top quarks, W and Z bosons, and (nearly) all the other particles in the Standard Model. But how do we design an experimental apparatus to measure particles whose existence is so fleeting that they decay instantly, in the vacuum of the beam pipe, without ever reaching the detector? The talk will be a lightning introduction to both the ATLAS detector and the collaboration of thousands of scientists who built and operate it and sift through the wealth of data it provides.

***Virtual*****Presenter:** TRIGGER, Isabel (TRIUMF (CA))



Contribution ID: 8

Type: **not specified**

## BELLE II

*Wednesday 3 May 2023 17:30 (30 minutes)*

The Belle II detector is a general-purpose detector located at the SuperKEKB particle collider (the highest luminosity collider ever). It is the successor experiment to Belle and BaBar, whose experimental confirmation of B-meson CP violation predicted by the Kobayashi-Masakawa theory led to the 2008 Nobel Prize in Physics.

This intro talk will give you a quick walkthrough of how the highest precision collider experiment in the world is built and operated by over a thousand scientists and what kind of Physics it seeks to achieve.

***Virtual***

**Presenter:** BEAUBIEN, Alexandre

Contribution ID: 9

Type: **not specified**

## Direct and In-Direct Detection

*Thursday 4 May 2023 12:00 (1 hour)*

This talk will cover two ways of searching for dark matter: direct and indirect detection. Direct detection uses sensitive particle detectors to search for dark matter colliding with nuclei or electrons in the lab, allowing us to measure or constrain its scattering cross section. In indirect detection, we search for astronomical signals—such as photons and cosmic rays—which could have been produced by dark matter decay or annihilation. I will briefly discuss evidence for dark matter, and the argument for the popular WIMP (Weakly Interacting Massive Particle) model of dark matter. I will then cover techniques used for indirect detection. We will discuss several observed excesses, unexplained astrophysical signals that could be caused by dark matter, and see how different observations and background modeling can challenge or constrain the dark matter interpretation of these signals. We will then cover the history of direct detection, and the basics of computing detection rates. We will end by looking at how different types of direct detection experiment are optimized to search for different models of dark matter, motivating a wide variety of different techniques and technologies.

**In-Person (Stirling Rm 501)****Primary author:** CAPPIELLO, Christopher**Presenter:** CAPPIELLO, Christopher

Contribution ID: **10**

Type: **not specified**

## Neutrino Overview

*Thursday 4 May 2023 14:00 (1 hour)*

In-Person (Stirling Rm 501)

**Presenter:** MCDONALD, Arthur

Contribution ID: **11**

Type: **not specified**

## **SNO+**

*Thursday 4 May 2023 15:00 (30 minutes)*

In-Person (Stirling Rm 501)

**Presenter:** WRIGHT, Alex (IPP/Queen's University)

Contribution ID: 12

Type: **not specified**

## Super-Kamiokande

*Thursday 4 May 2023 16:30 (30 minutes)*

Virtual

**Primary author:** AJMI, Ali

**Presenters:** AJMI, Ali; ALLEGA, Anthony (Queen's University)

Contribution ID: **13**

Type: **not specified**

## **nEXO**

*Thursday 4 May 2023 17:00 (30 minutes)*

Virtual

**Primary author:** BRUNNER, Thomas (McGill University)

**Presenters:** ALLEGA, Anthony (Queen's University); BRUNNER, Thomas (McGill University)

Contribution ID: 14

Type: **not specified**

## IceCube

*Thursday 4 May 2023 17:30 (30 minutes)*

In-Person (Stirling Rm 501)

**Primary author:** HATCH, Patrick (Queen's University)

**Presenters:** ALLEGA, Anthony (Queen's University); HATCH, Patrick (Queen's University)

Contribution ID: 15

Type: **not specified**

## Pacific Ocean Neutrino Experiment (P-ONE)

*Thursday 4 May 2023 18:00 (30 minutes)*

The Pacific Ocean Neutrino Experiment is a new neutrino telescope in the Pacific Ocean. Consisting of 70 instrumented mooring lines, P-ONE aims to detect neutrinos with energies ranging from TeV to PeV, and will cover areas of the sky that are yet uncovered by the other existing neutrino telescopes.

Following two successful pathfinder missions, the P-ONE collaboration is now developing the first mooring line of P-ONE. This mooring line is expected to be deployed in 2024 and will demonstrate the feasibility of a larger installation.

The presentation will give a short overview of the pathfinder missions and the current status of P-ONE.

***Virtual***

**Primary author:** GAERTNER, Andreas

**Presenters:** GAERTNER, Andreas; ALLEGA, Anthony (Queen's University)



Contribution ID: 16

Type: **not specified**

## Dark Matter Overview

*Friday 5 May 2023 12:30 (1 hour)*

Virtual

**Primary author:** MOHLABENG, Gopolang (University of California, Irvine)

**Presenters:** MOHLABENG, Gopolang (University of California, Irvine); BLEAU, Katarina (Queen's University)

Contribution ID: 17

Type: **not specified**

## Dark Matter Modulation and COSINUS

*Friday 5 May 2023 14:00 (30 minutes)*

Virtual

**Primary author:** STUKEL, Matthew Jake (Gran Sasso Science Institute)

**Presenters:** BLEAU, Katarina (Queen's University); STUKEL, Matthew Jake (Gran Sasso Science Institute)

Contribution ID: **18**

Type: **not specified**

## Darkside

*Friday 5 May 2023 14:30 (30 minutes)*

Virtual

**Primary author:** MANECKI, Szymon (Queen's University)

**Presenters:** BLEAU, Katarina (Queen's University); MANECKI, Szymon (Queen's University)

Contribution ID: **19**

Type: **not specified**

## Git

*Friday 5 May 2023 16:00 (2 hours)*

Virtual

**Primary author:** RHEA, Carter (Université de Montreal)

**Presenters:** RHEA, Carter (Université de Montreal); YE, Tianai (Queen's University)

Contribution ID: 20

Type: **not specified**

## Statistics and Error Analysis

*Monday 8 May 2023 16:00 (2 hours)*

In this whirlwind review of elementary statistics, I will cram half a semester's worth of material into the bare minimum necessary to make use of popular statistical techniques like fitting, chi-squared estimation, and Bayesian analysis. I will probably fail. ☒

**Virtual**

**Primary author:** OSER, Scott

**Presenter:** OSER, Scott

Contribution ID: **21**

Type: **not specified**

## **PMTs**

*Thursday 4 May 2023 13:15 (30 minutes)*

In-Person (Stirling Rm 501)

**Primary author:** SKENSVED, Peter

**Presenters:** SKENSVED, Peter; BOUKHTOUCHEN, Yilda (Queen's University)

Contribution ID: 22

Type: **not specified**

## Balloon Physics

*Monday 8 May 2023 12:30 (1 hour)*

In-Person (Stirling Rm 501)

**Presenter:** FISSEL, Laura (Queen's University)

Contribution ID: 24

Type: **not specified**

## Academic Presentations

*Tuesday 9 May 2023 12:30 (1 hour)*

**Presenters:** FLYNN, Blaire (SNOLAB); DELOYE, Juliette (SNOLAB)



Contribution ID: 25

Type: **not specified**

## Superallowed Beta Decays

*Tuesday 9 May 2023 14:30 (30 minutes)*

### **Superallowed Fermi $\beta$ Decay: The precision frontier of nuclear physics**

**Dr. Gwen Grinyer (she/her)** Department of Physics, University of Regina, Regina, SK S4S 0A2, Canada

High precision measurements of the  $ft$  values for superallowed Fermi  $\beta$  decays provide fundamental data with which to constrain the conserved vector current (CVC) hypothesis, set limits on the Standard Model description of electroweak interactions, and test unitarity of the Cabibbo-Kobayashi-Maskawa (CKM) quark mixing matrix. In this lecture, I will present the status of the world data on the superallowed Fermi  $\beta$  emitters and explain how we go from state-of-the-art measurements in the lab to extracting fundamental physics at the precision frontier.

*Virtual*

**Presenter:** Prof. GRINYER, Gwen

Contribution ID: 26

Type: **not specified**

# Python

*Tuesday 9 May 2023 16:00 (2 hours)*

Introduction to Python!

Power point : <https://docs.google.com/presentation/d/1nXaZIDt4WC83qW3L7TKHp3KK1Rmdxzjh/edit?usp=sharing&ouid>

Colab notebook: <https://colab.research.google.com/drive/1VVvvl8rD05QmJgt6LaOmXOdy7PN60XeO?usp=sharing>

*Virtual*

**Primary author:** FRONENBERG, Hannah (McGill University)

**Presenters:** ALLEGA, Anthony (Queen's University); FRONENBERG, Hannah (McGill University)

Contribution ID: 27

Type: **not specified**

**C++**

*Wednesday 10 May 2023 12:30 (2 hours)*

In-Person (Stirling Rm 501)

**Primary author:** HUCKER, Jonathan

**Presenter:** HUCKER, Jonathan

Contribution ID: **28**

Type: **not specified**

## **SBC**

*Wednesday 10 May 2023 15:30 (30 minutes)*

Virtual

**Primary author:** PIRO, Marie Cecile (Rensselaer Polytechnic Institute (RPI))

**Presenters:** PIRO, Marie Cecile (Rensselaer Polytechnic Institute (RPI)); SWIDINSKY, Nicholas (Queen's University)

Contribution ID: 29

Type: **not specified**

## PICO

*Wednesday 10 May 2023 16:00 (30 minutes)*

**Primary author:** MOORE, Colin

**Presenters:** MOORE, Colin; SWIDINSKY, Nicholas (Queen's University)

Contribution ID: **30**

Type: **not specified**

## NEWS-G

*Wednesday 10 May 2023 16:30 (30 minutes)*

Virtual

**Primary author:** Mr DURNFORD, Daniel (University of Alberta)

**Presenters:** Mr DURNFORD, Daniel (University of Alberta); SWIDINSKY, Nicholas (Queen's University)

Contribution ID: 31

Type: **not specified**

## SuperCDMS

*Wednesday 10 May 2023 17:00 (30 minutes)*

The Super Cryogenic Dark Matter Search (SuperCDMS) Collaboration uses cryogenic semiconductor detectors to look for evidence of dark matter interactions with ordinary matter. The current generation of the experiment is under construction at the SNOLAB underground facility in Sudbury, Canada. Two complimentary detector designs, interleaved Z-sensitivity Ionization and Phonon (iZIP) detectors and High Voltage (HV) detectors, made of Germanium or Silicon will be used to probe low mass dark matter parameter space. This talk will provide an overview of the experiment and detector technology and present the expected sensitivity of SuperCDMS SNOLAB to different detection channels.

***Virtual*****Primary author:** FASCIONE, Eleanor (TRIUMF/Queen's University)**Presenters:** FASCIONE, Eleanor (TRIUMF/Queen's University); SWIDINSKY, Nicholas (Queen's University)

Contribution ID: **32**

Type: **not specified**

## **Medical Physics**

*Tuesday 9 May 2023 14:00 (30 minutes)*

Virtual

**Presenter:** FLETCHER, Liz (Carleton University)



Contribution ID: **33**

Type: **not specified**

## **Multi-Messenger Astrophysics**

*Wednesday 3 May 2023 13:45 (1 hour)*

In-Person (Stirling Rm 501)

**Presenter:** PARK, Nahee

Contribution ID: **34**

Type: **not specified**

## HELIX

*Monday 8 May 2023 14:30 (30 minutes)*

Virtual

**Presenter:** PARK, Nahee

Contribution ID: 35

Type: **not specified**

## CCAT

*Monday 8 May 2023 14:00 (30 minutes)*

In-Person (Stirling Rm 501)

**Presenter:** BAGCHI, Mayukh (Queen's University)

Contribution ID: **36**

Type: **not specified**

## Closing

*Thursday 11 May 2023 17:45 (30 minutes)*

**Presenters:** BAIOCCHI, Melissa; BAI, Minya (Queen's University)

Contribution ID: 37

Type: **not specified**

## Mandatory Fun

*Thursday 11 May 2023 18:15 (1 hour)*

Contribution ID: **38**Type: **not specified**

# ROOT

*Thursday 11 May 2023 12:30 (2 hours)*

A tutorial on programming with ROOT!

There will be a small project to work through in the second half of the session. To be able to work along through it you will need to have ROOT installed. As this can take some time, it will be better to try and install ROOT beforehand. As everyone will have different machinery setups, it's difficult to give exact instructions, but hopefully this can get you started. But if you are unable to get ROOT installed, the instructor will work through the examples live, and you can watch along and in that way still be able to take part in the tutorial.

ROOT install instructions:

There are many ways to get ROOT. There are lots more details here <https://root.cern/install/>, so if the below doesn't work for you check out the info there. It will be quicker to get the pre-compiled binaries, but if that doesn't work for whatever reason you can try building from source.

The first thing to do is make sure you have all the things ROOT depends on. A list of these, with instructions for different operating systems, can be found here: <https://root.cern/install/dependencies/>

MacOS:

Install homebrew <https://brew.sh>

Install XCode from the App Store

In a terminal, type: `brew install root`

`cd root`

`source /usr/local/Cellar/root/6.26.06_2/bin/thisroot.sh` (maybe the version and/or location are different)

Unix:

Get the precompiled binaries for your system from here: <https://root.cern/releases/release-62802/>  
`tar xvf root_v6.28.02.Linux-centos8-x86_64-gcc8.5.tar`

`source root/bin/thisroot.sh`

More detailed walk through <https://www.youtube.com/watch?v=QItrmchEQWE> (he builds from source but you can do this with the precompiled tar files)

Windows:

I think you should have access to Windows Subsystem for Linux or similar

It will probably be easiest to use the above Unix instructions within that

Then install Xming <https://sourceforge.net/projects/xming/>

type: `export DISPLAY="localhost:0"`

More detailed walk through <https://www.youtube.com/watch?v=pmfM4Zq6OQU> (he builds from source but you can do this with the precompiled tar files)

(Alternative) Building from Source:

Once you have the dependencies, get the source file here <https://root.cern/releases/release-62802/>  
`cd root`

`./configure --disable-castor --disable-rfio --disable-x11 --disable-gfal --disable-ldap` (these disabled options are all things I've found problems with on various systems, and we won't need them for the simple examples/project)

`make`

`source bin/thisroot.sh`

To check it's worked, type `root`. The terminal prompt should now be `root [0]`. If so, it seems root is installed ok! Now try TCanvas `c1`, if a blank window pops up, the graphics are all working too and you are good to go :)

If that all sounds like gobbledigook, please do not worry!! In the tutorial we will try and go through the installation process. (It can take time though so ideally we want to get as far through the process as possible beforehand.) But if you can't get it installed in time, you can just watch the tutorial without working along with it and that will be fine!

If you're having problems but are keen, there are many resources you can use online. <https://root.cern/install/> is the place to start but there are countless guides, videos, and forums online. Someone will have encountered your problem before, it's working out what to google which can be tricky! Hopefully this is enough to get you started and point you in the direction of where to find info for your specific setup.

Good luck! And to reiterate, if you can't get root installed, it won't completely preclude you from taking part in the tutorial

**In-Person (Stirling Rm 501)**

**Presenter:** PARKER, William

Contribution ID: 39

Type: **not specified**

## Machine Learning

*Thursday 11 May 2023 15:30 (2 hours)*

In-Person (Stirling Rm 501)

**Presenters:** COQUILLAT, Jean-Marie; ANDERSON, Mark; ROWE, Noah



Contribution ID: 40

Type: **not specified**

## CASST 2023

SNOLAB and the McDonald Institute invite you to the

***2023 CASST COMPETITION***

**AUGUST 17-18, 2023**

**VIRTUAL / LAURENTIAN**

**UNIVERSITY**

This event is for undergraduate students to show their work and will include networking opportunities. Participation in person or virtually is welcomed. Prizes will be awarded for best talks.

The Canadian Astroparticle physics Summer Student Talk Competition is an annual event for undergraduate students.

**Presenter:** KRAUS, Christine