



Big thanks to Jonas
for presenting!

Outreach and IPPOG

Christian Ohm (KTH), with material from *many*
Particle Days, Uppsala, Oct 22, 2024



Outreach

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 - Strong interest!
 - Experience \Rightarrow creativity and improved skills

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- Many reasons!
 - **Inspire** the next generation of scientists!
 - Our **responsibility** to inform the general public, they help pay for it — we need to nurture their trust
 - Inform about what our research **gives back to society**
 - Explain **how** we do research
 - **Fun!** Reminds us of the big picture, rewarding on a personal level
 - It's our job! Outreach is the **third task** for faculty (law since 1977)
⇒ Despite this, **very little/no resources and funding** are available for it

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Will showcase recent examples of outreach activities as collected for [RECFA meeting in Lund in May!](#)

Visits to CERN

- Frequently organize visits for high school and university groups at CERN
- Gives **strong and lasting impression**, not unusual that these visits lead to longer term goal of working in physics
- But: As CERN's visit capacity has grown, so has bureaucracy - now both **more time consuming and stressful to organize** visits as Member of Personnel at CERN (→ can ACCU help?)

HS visiting from Strängnäs (April 2024)



Group incl. HS students from Falun in 2023

KTH physics students at CERN, Jan 2024

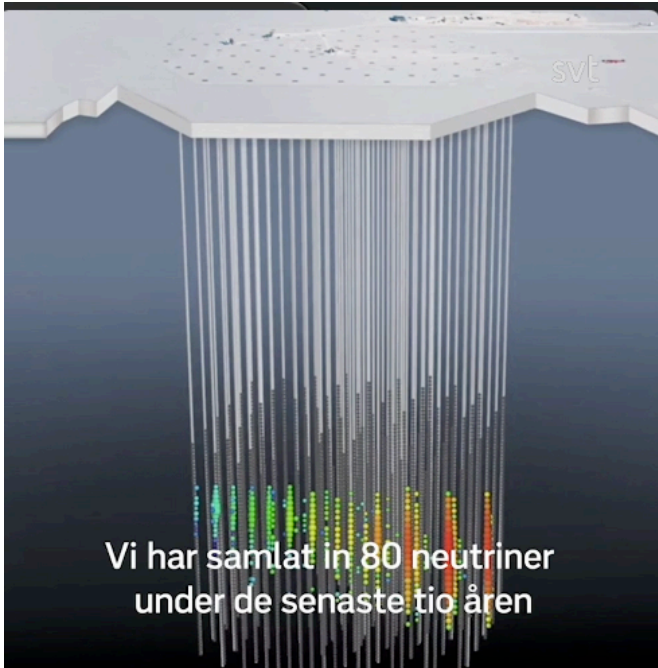


Museum events (general public)



- Organized “researcher holiday” at Technology Museum in Stockholm three years in a row, during November school break — lots of families visit (~3k visitors/day)
- Children can win prizes if they **meet and talk to researchers** and check off if they find ones who
 - have lived in a different country
 - made a mistake
 - ...
- Fantastic setting to **practice explaining what we do** to different people — ideal training ground!
- Also organized popular science lectures at “Life Eternal” exhibition by Nobel Prize Museum and Liljevalchs art gallery ([link](#))

Media: TV, radio, magazines, podcasts, etc



svdigerSRADIO Start Nyheter Poddar & program Kanaler Min sida Mer

Studio Ett Start Alla avsnitt Om... Kontakt Textarkiv

Fysikum Spåra naturen... ta delar

Fysiker använder v... instrument för... ninst...

Till vänster, Magdalena Vande Voorde, doktorand i experimentell partikelfysik på KTH. Till höger, Ellen Riefel doktorand i experimentell partikelfysik på Stockholms universitet. De visar upp en legomodell av ATLAS-detektorn som ingår i ett av de stora fysikexperimentet vid forskningscentret CERN i Schweiz. Foto: Lovisa Gustavsson/Sveriges Radio

VISA ALLA BILDER (2)

Häng med till Tekniska museet som firar höstlov och 100 år

svdigerSRADIO Start Nyheter Poddar & program Kanaler Min sida Mer

Vetenskapsradion Nyheter Start Lyssna på nyheterna Program Klimatet Den fossila fallen Kontakt Tipsa

Arvet efter Peter Higgs – partikeln som öppnat en ny värld

20 min - fre 12 apr kl 12:09

Peter Higgs belönades med Nobelpriset i fysik 2013 för den teori han presenterat nästan 50 år tidigare, om ett fält som genomsyrar allt och som för med sig en partikel, som kom att kallas Higgspartikeln och vars existens bevisades 2012. Men, att hitta Higgspartikeln var motsatsen till slutet på ett sökande. Den var en nyckel till en låst dörr och bakom den ligger en ny värld och uträckligt att forska på för närmast oändlig tid framöver. Vad kan vi hitta med hjälp av Higgspartikeln?

Ladda ner (20 min, MP3) Min sida Dela

Medverkande: Sara Strandberg, professor i partikelfysik vid Stockholms Universitet och verksam vid CERN i Schweiz.

SEGMENT | 17:13

Tracing A Neutrino's 4 Billion Light-Year Journey

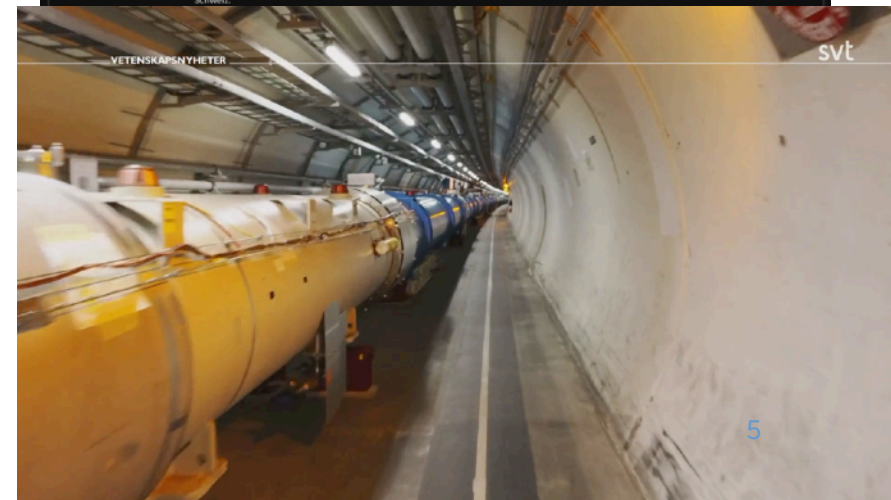
Scientists were able to pinpoint the origin of a high-energy neutrino to a supermassive black hole for the first time.

READ MORE →

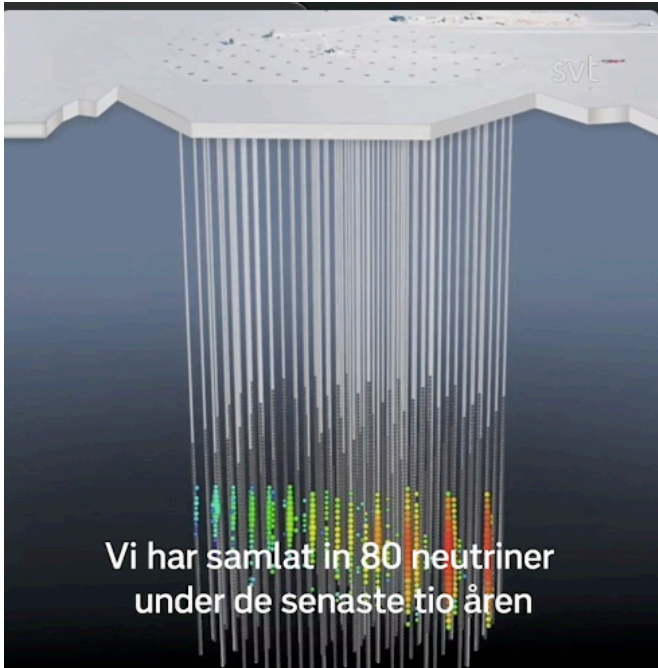
IDÉER SOM FÖRÄNDRAR VÄRLDEN #68

Mörk materia – med Christian Ohm

August 30, 2023 • 46 min • Listen later



Media: TV, radio, magazines, podcasts, etc



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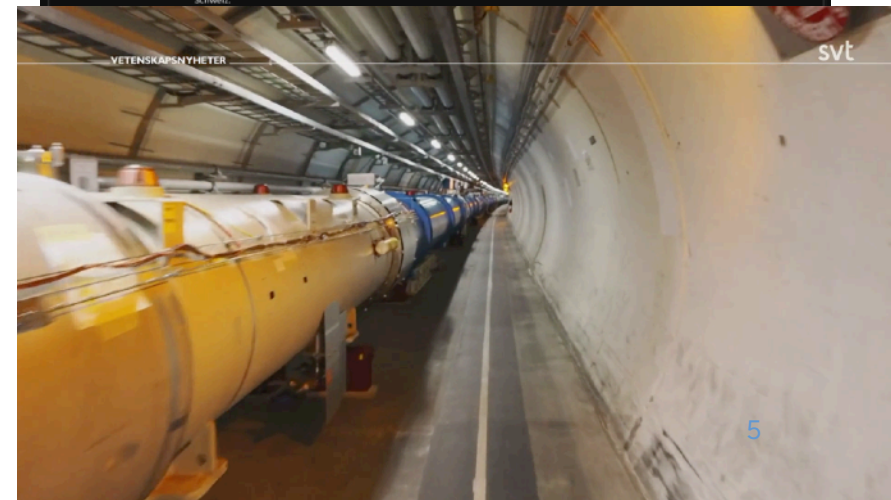
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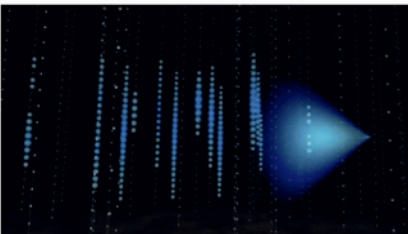
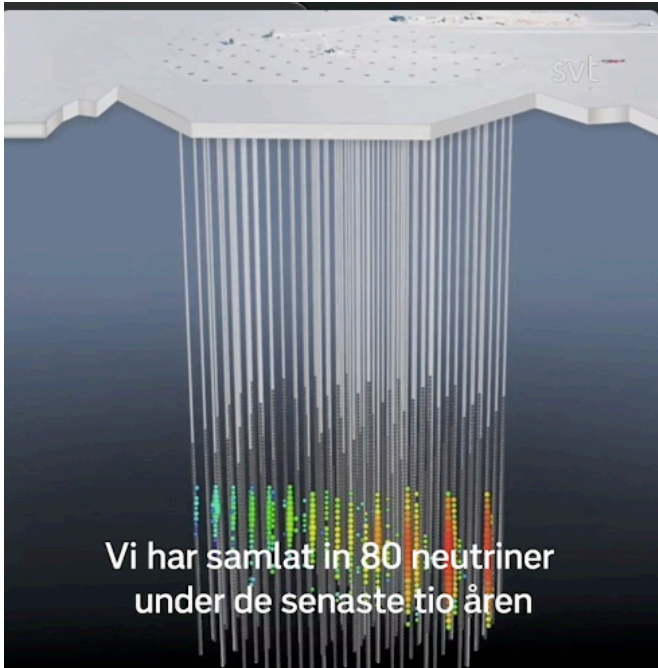
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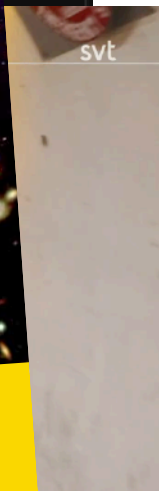
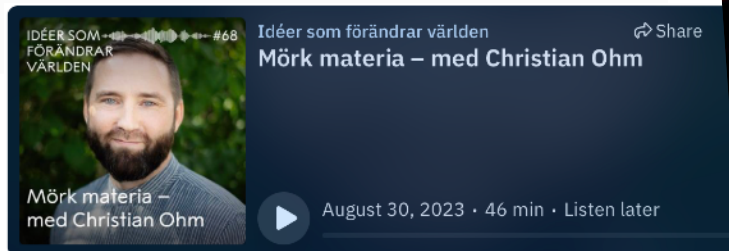


Media: TV, radio, magazines, podcasts, etc

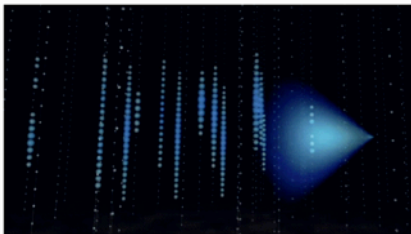
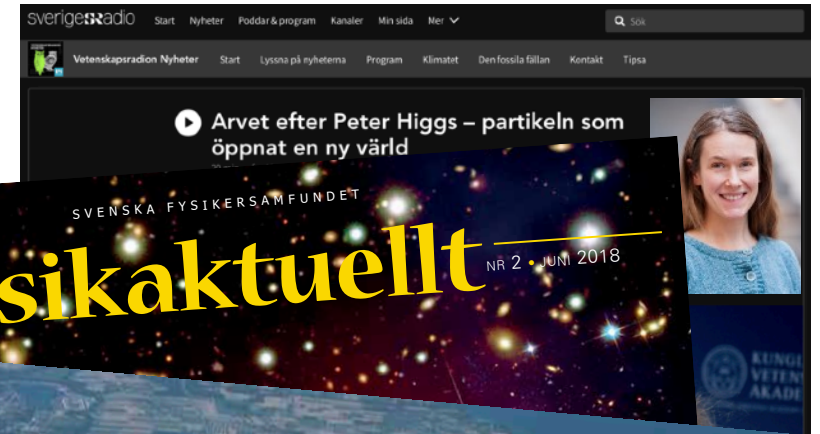
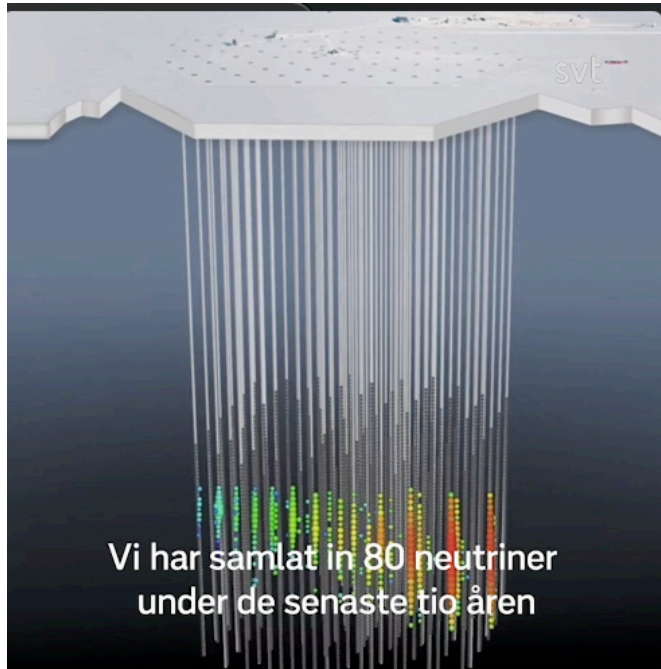


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Public talks and science festivals

Öppna föreläsningar Stockholm U.

SciFest in Uppsala



Many of these lectures are recorded and available online!

11 OKT Neutrino Astronomy with a Telescope in Antarctica's Ice



Two kilometres deep in the glacial ice at the South Pole lies what is perhaps the world's strangest telescope. This is the IceCube Neutrino Observatory: thousands of detectors spaced throughout a cubic kilometre of ice, looking for the light made by subatomic particles that are streaming through the Earth. Neutrinos are unique particles that pass easily through matter, and they can reach us from hidden places like the interiors of stars and from the most powerful particle accelerators in the cosmos. In this talk I will describe how we do neutrino astronomy at the South Pole, and the universe that neutrinos reveal to us.

Meet Chad Finley, lecturer

7 MAR Dark Matter: How to bring light into the dark universe



From astrophysical observations over the last 100 years we have learned that the stars, planets and all the matter which surrounds us only make up 5% of the total energy density in the universe. The unknown 95% consist of the invisible dark matter and the even more mysterious dark energy. I will discuss how we try to find dark matter using a big detector 1400 m under a mountain in Italy with the most sensitive light detectors in the world, which we test here in Stockholm.

Meet Jörn Mahlstedt, postdoc
Tid: kl 18.15 - 19.15



NMT days in Lund



Kunskapsfesten in Eskilstuna



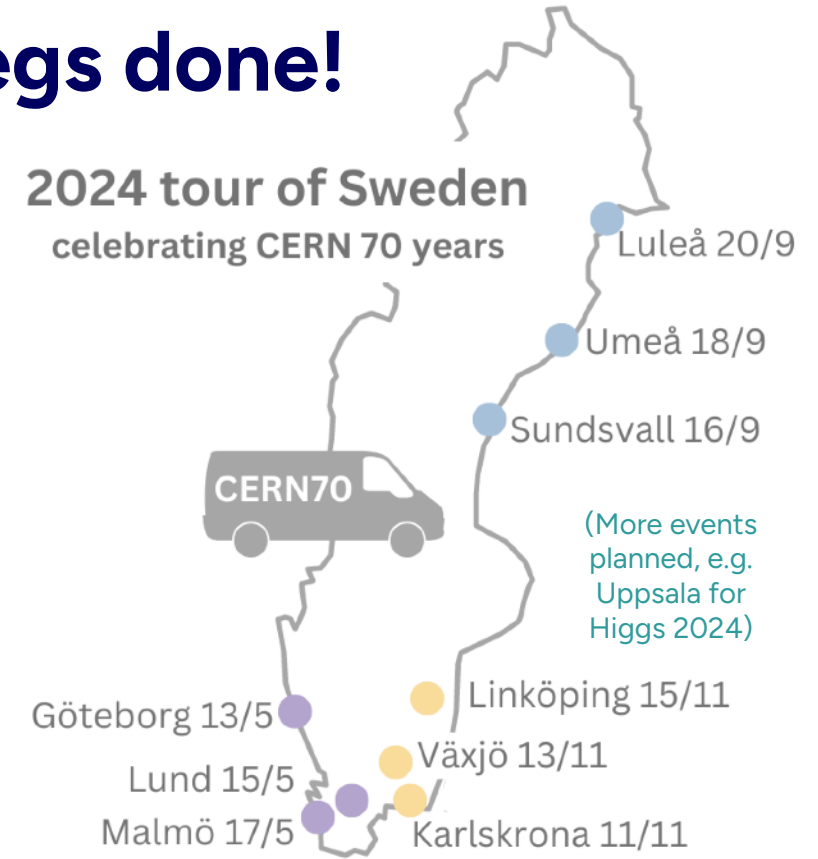
Lise Meitner Days in Stockholm



CERN 70 outreach tour - two of three legs done!

- Repeat of successful tour for 60th anniversary!
 - **Advertise CERN student programs** at universities, especially those without hep-ex research
 - Lectures for **general public** — in varying settings
- Organized in collaboration with Big Science Sweden

2024 tour of Sweden celebrating CERN 70 years




CELEBRATE CERN 70 YEARS

GÖTEBORG CHALMERS	LUND UNIVERSITY ASTRONOMIHUSET	MALMÖ UNIVERSITY ORKANEN
Exhibition 10:00-16.00	Exhibition 10:00-16.00	Exhibition 13:00-16.00
Lunch seminar 12.15 About CERN, and the opportunities available to Swedish students	Lunch seminar 12.15 About CERN, and the opportunities available to Swedish students	Lunch seminar 12.15 About CERN, and the opportunities available to Swedish students
Evening lecture 19.00 Pitchers sports bar in Majorna	Evening event 18.00 Science Showcase at Stadshallen	Evening lecture 17.30 The Wisdome Malmö Teknikens och Sjöfartens hus

QR codes for each location are provided. The poster also features logos for Veterskapsrådet, Jacob Wallenbergs Stiftelse, Big Science Sweden, KTH, Lund University, Uppsala University, and Stockholm University. A registration link www.bigsciencecareer.se is included.

- PhD students, postdocs, faculty all contributing enthusiastically and significantly
- Fun and rewarding — also serves as team building

CERN 70 outreach tour - Sundsvall (Mon Sep 16)

Lunch lecture on campus



Particle personality quiz!



Public lecture at XYZ

CERN 70 outreach tour - Umeå (Wed Sep 18)

Public lecture
at Curiosum



Bubble chamber discussions
at exhibition on campus



Lunch lecture on campus for students



CERN 70 outreach tour - Luleå (Fri Sep 20)

Exhibition
on campus



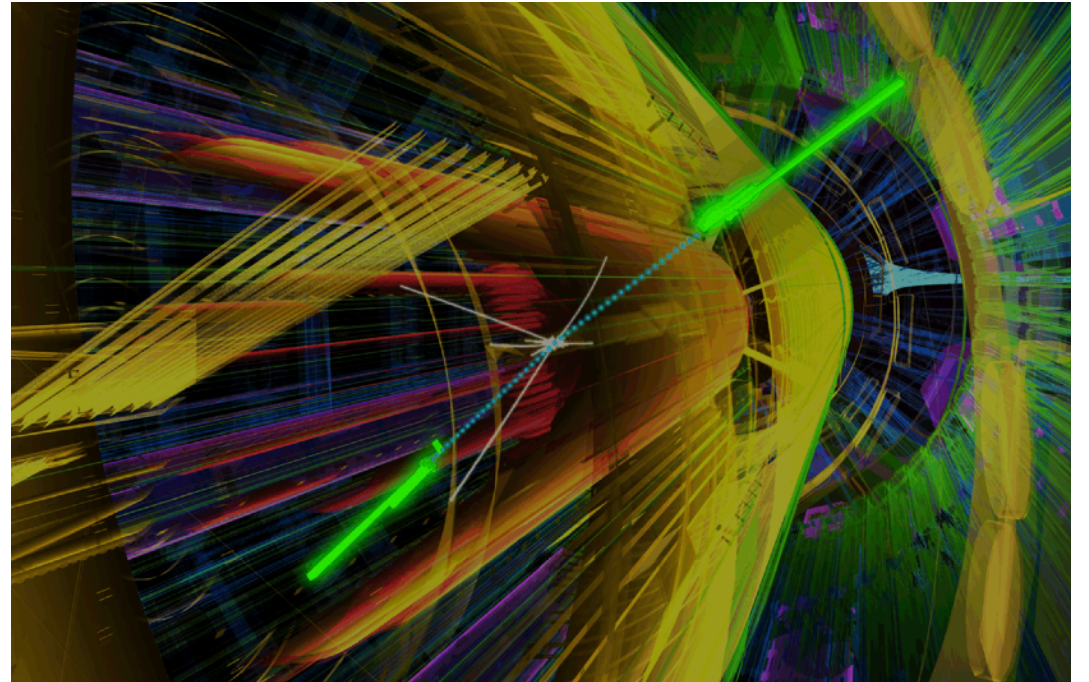
Lunch lecture on campus for students



Public lecture at Vetenskapens hus

International Masterclasses (high school students)

- Driven and supported through IPPOG, reaching over 10k students/year
- Full day with 20-50 students + teachers, video conference with CERN and schools in other countries
- [ATLAS](#) (W^\pm/Z) and [IceCube](#)
- Given in all cities with experimental HEP research (Lund, Uppsala, Stockholm), and also Gothenburg
 - Challenging during COVID, need to ramp up again, but e.g. Lund very active recently, twice per year
 - Good to plan **now** for organizing this spring!



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Quote from high school teacher (sent to Korinna Zapp, LU):

“Thanks for giving us the possibility to send students to the masterclasses in particle physics. Last year three students attended, and today two of them study physics and one mathematics at LTH”



International Particle Physics Outreach Group (IPPOG)

Brief history:

- started as a network called the European network (EPPOG) in 1997
 - Strong Swedish involvement from the start, national representative appointed through Fysikersamfundet
 - Growing gradually, **now 42 members**: 34 countries, 7 experiments, 1 International lab (2 national labs are associate members)
- Tightly connected to CERN in the beginning, changed name to IPPOG to reach out worldwide
- Has expanded, now covers much more than accelerator-based particle physics, in particular strong activities in cosmic-ray (astroparticle) physics outreach

Transformed from a network into a formal collaboration some years ago, with membership fees.

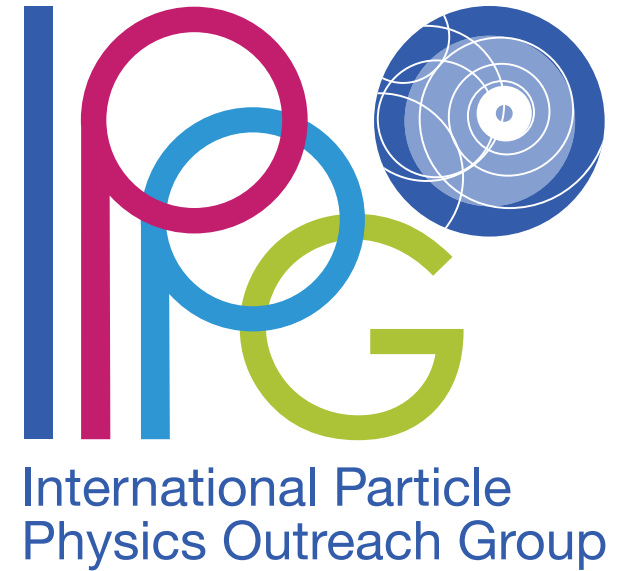
- Members can be countries, laboratories or experiments
- Fees are low (1 kEUR/year), **medium (3 kEUR)**, or large (5 kEUR), depending on the GDP and size of community
- Allows going from ideas to action, produce material, and pay for critical organizational support
- Meet twice per year for 2.5 days of intense meetings
- Fun to go to! In spring 2024 we met in Madrid, Spain. The fall meeting is normally at CERN every year.

IPPOG's goals and excerpts from mission

- Instil and foster an appreciation for fundamental scientific research;
- Establish a firm understanding of the scientific process and evidence-based reasoning;
- Build trust with a broad and diverse set of worldwide communities;
- Inform and motivate future generations of scientists and citizens.

“.. [IPPOG's] principal aim is to maximize the impact of education and outreach efforts..”

.. IPPOG's purpose is to raise standards of global outreach and informal science education efforts of particle physics, to communicate its results and findings to the public..



IPPOG meeting at CIEMAT in Madrid, April 2024 ([indico](#))



IPPOG - example of highlights from working groups

New participant: University of Kenya in Nairobi



"The school we have invited is in a poor area of Nairobi. For most of the students, if not all of them, it was their first time using a computer. I think they did very well."



- [International Masterclasses](#) - key IPPOG-related outreach activity reaching many
 - New countries participating!
 - Cape Verde (Praia)
 - University of Kenya (Nairobi)
 - In total over 12k high school students joined the CERN and Fermilab LHC events in 2023 (over 15k in total)
- WG on "Applications for Society" collecting examples of inventions based on CERN technology on a [webpage](#) - good to be aware of when doing outreach!
- Next meeting [Nov 25-27 at CERN](#)

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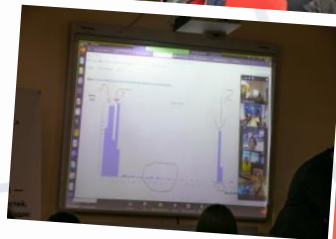
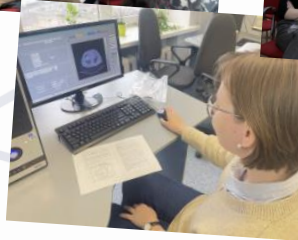
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2 Masterclasses in Ukraine



CMS Masterclass on March 1
Particle Therapy Masterclass on March 15



"The school we have is in a poor area of Nairobi, and these students, if not for this, they would not have had their first time using a computer. We think they did very well."

"Both masterclasses were attended by more than 30 participants and it was a great success. I've received lots of positive messages from parents and students after the masterclasses."



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Statistics for IMC24 (numbers from 2023 in brackets)

CERN LHC Masterclasses
233 MCs with CERN VC (211)
• 115 ATLAS (99)
• 67 CMS (56)
• 26 LHCb (26)
• 36 ALICE (30)
10,570 participants

Fermilab LHC Masterclasses
40 MCs with Fermilab VC (40)
• 28 CMS (29)
• 9 ATLAS (11)
MINERvA Masterclasses
8 MCs (8)
NOvA Masterclasses
5 MCs (2)
1,440 participants

GSI Hadron Therapy Masterclasses
47 MCs (30)
8 VCs (9)
1,500 participants

KEK Belle II Masterclasses
16 MCs (16)
7+2 VCs (5)
630 participants

Malargue Pierre Auger Masterclasses
17 MCs (12)
5 VCs (3)
530 participants

In total: 14,670 participants



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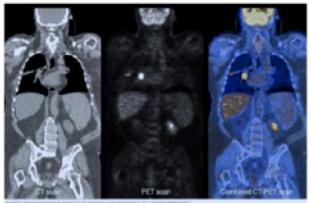
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2 Masterclasses in Ultrasonography

International Particle Physics Outreach Group



01 July, 2024

Positron Emission Tomography: can crystals used in particle detectors save lives?

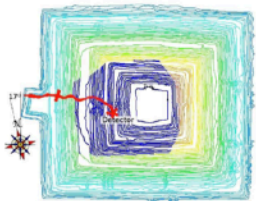
The Positron Emission Tomography (PET) is explained as a medical imaging technique widely used in hospitals to detect anomalies in the body of patients (like cancer tumors) on a daily basis. The article explains how PET works and how knowledge of basic physics processes is used to visualize the physiological processes in biological systems.



01 July, 2024

Einstein's Relativity in Action – the GPS Navigation System knows it

One unexpected real-life application of Einstein's theory of relativity, used by almost everybody every day, is the GPS navigation system. Some details of how this works are given in this short story.



01 July, 2024

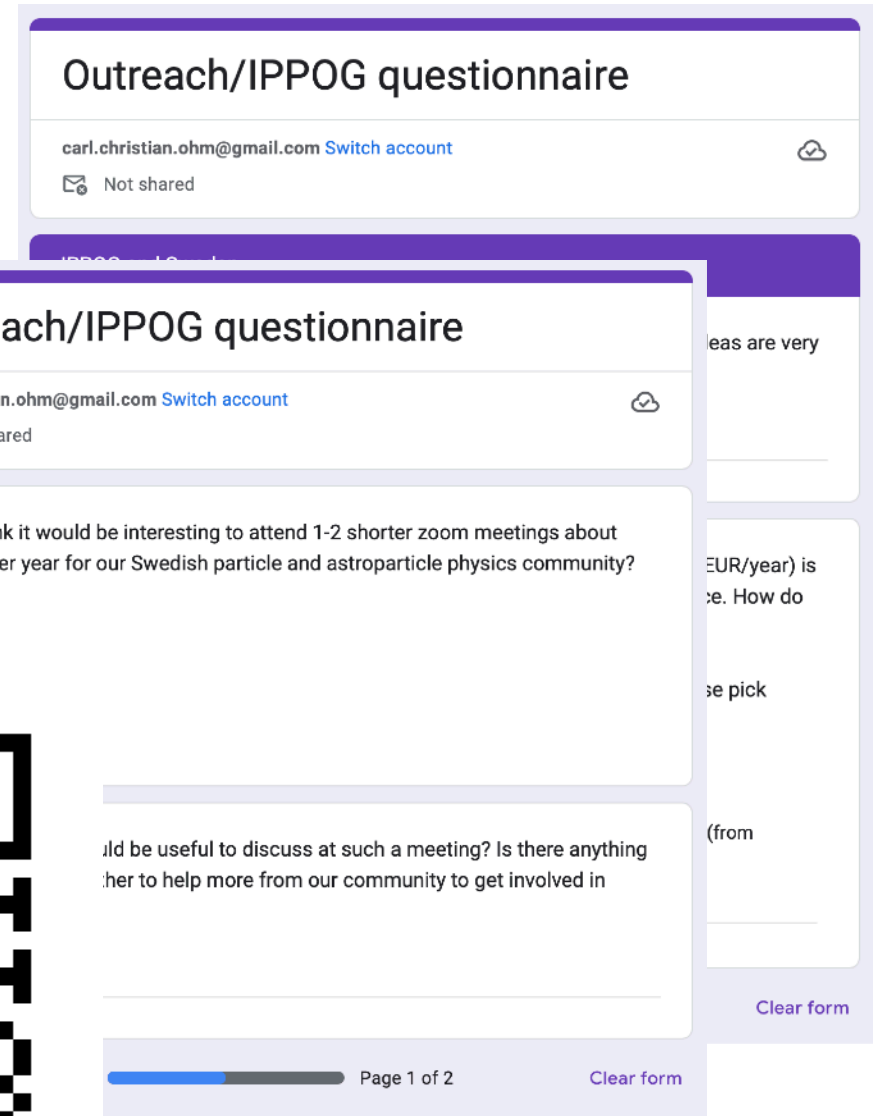
Searching for hidden cavities inside the Sun pyramid in Mexico

A first-hand witness of the experience of the main author searching for hidden cavities inside the Sun pyramid in Mexico, in a collaboration of Mexican physics groups and archeologists. This is explained as an example of the many applications of muon tomography.

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IPPOG - what do we want out of it?

- What are your thoughts about outreach in Sweden - would we benefit from more collaboration?
- Sweden is a member of IPPOG, so we have the possibility to influence the activities
 - What do **you** think IPPOG should focus on?
 - What would **help us to do more/better** outreach in Sweden?
- Brief survey with [four short questions](#) - **please fill it out** to help me gauge interest and collect ideas for our work and what IPPOG should focus on!
- Feel free to get in touch with me! (christian.ohm@cern.ch)



Outreach/IPPOG questionnaire

carl.christian.ohm@gmail.com [Switch account](#)

Not shared

Outreach/IPPOG questionnaire

carl.christian.ohm@gmail.com [Switch account](#)

Not shared

Do **you** think it would be interesting to attend 1-2 shorter zoom meetings about outreach per year for our Swedish particle and astroparticle physics community?

Yes

ould be useful to discuss at such a meeting? Is there anything
her to help more from our community to get involved in

Page 1 of 2 [Clear form](#)

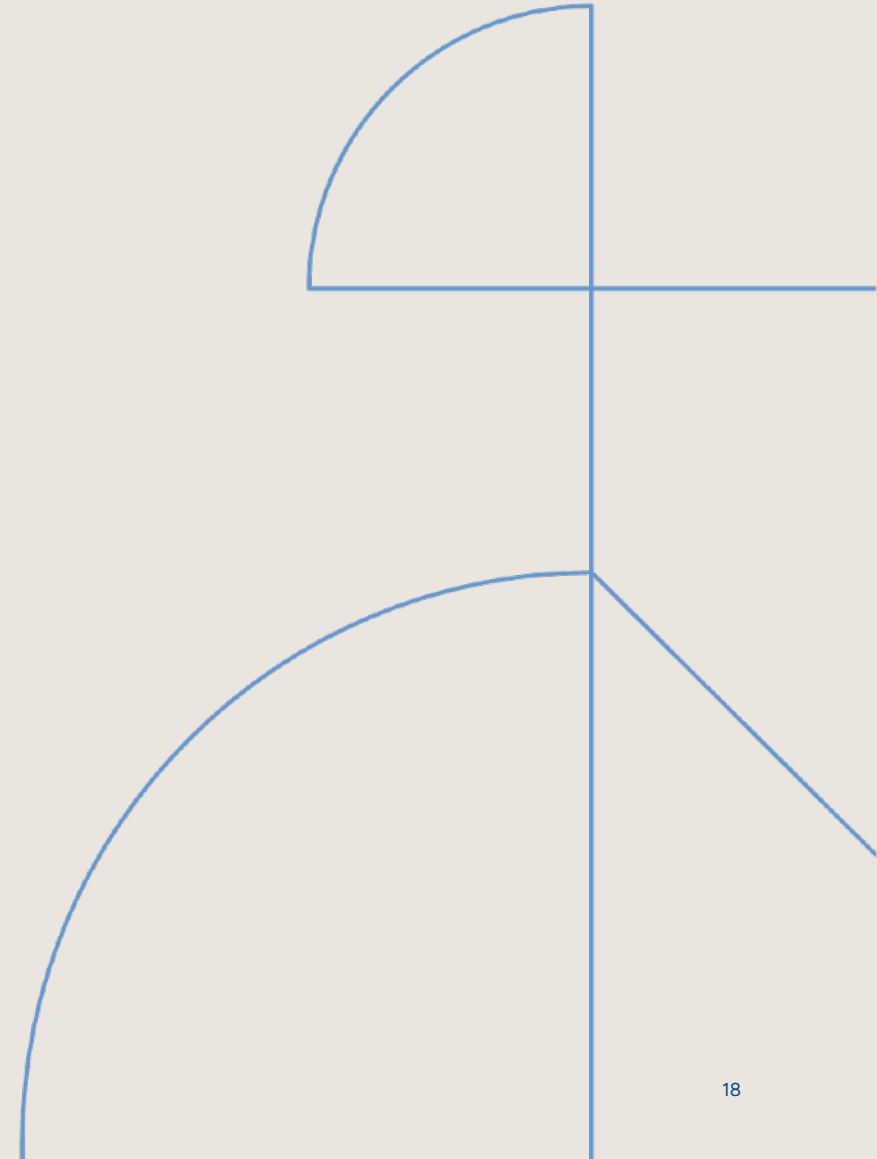
Concluding remarks

- Outreach is critical for *inspiring the younger generation* and *explaining the value of our research*
- IPPOG: *formal international collaboration* collecting resources and best-practice examples of good outreach in particle physics - Sweden long-time member, nat. rep. Jonas Strandberg ⇒ CO (2024)
 - Would like your input on what you think IPPOG should do that would help us do outreach
 - IPPOG membership fee is EUR 3k/year, but a *time-consuming struggle every year* to find funds we're *allowed* to pay it with
- Several new initiatives for reaching more people in new contexts have been tried successfully
 - Would it be helpful to have a couple of meetings to exchange ideas on outreach in our Swedish community?
 - Big Science Sweden (students), science festivals and museums (general public) — *good partnerships* make for *more effective outreach*, and we can build further on this!

Feedback wanted - only takes a few mins!
(or use this link: <https://cern.ch/66nzw>)



Back-up slides



CERN 70 outreach tour - Gothenburg (Monday)

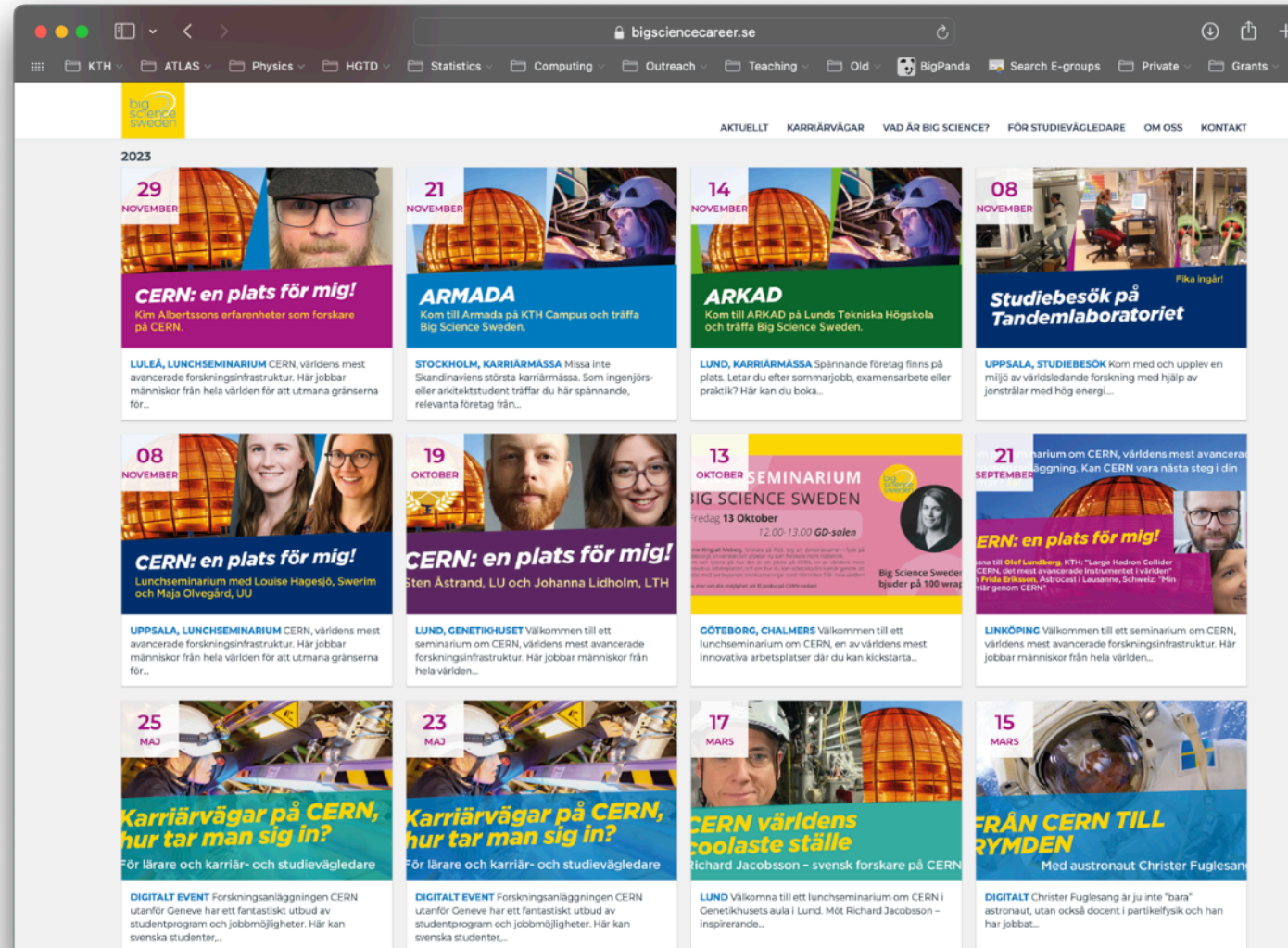


CERN 70 outreach tour - Lund (Wednesday)



Big Science Sweden (ILO) - advertises career opportunities

- Helping greatly to inform about **university students opportunities** at CERN
- In 2023 alone, 14 events were organized to advertise student programs and careers at various student fairs, lunch lectures, etc
 - Hope that this will increase the number of Swedish applications
- Big Science Sweden **now receives funding from VR** to help with this
- Good to be in touch with BiSS and join/help when they organize events at our universities! ([webpage](#), [LinkedIn](#), [LinkedIn](#))
- We can also use them to advertise events that we organize ⇒



Open data in teaching

- Labs created at our universities to let students use **open CERN data** and explore the subatomic world
- Example (KTH): 3rd-year students **measure mass of the Z** using real ATLAS data
 - ~600 students since 2018
 - Great task for teaching signal vs. bg, modeling, fitting, and stat. analysis — **key general skills** for science and engineering

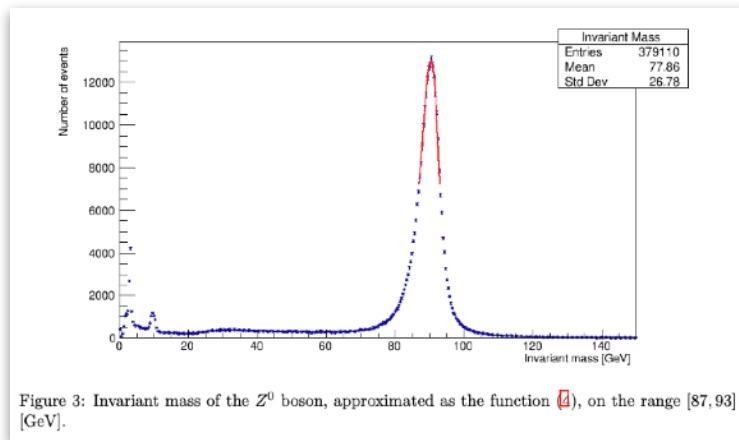
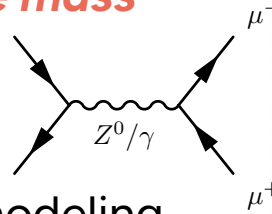
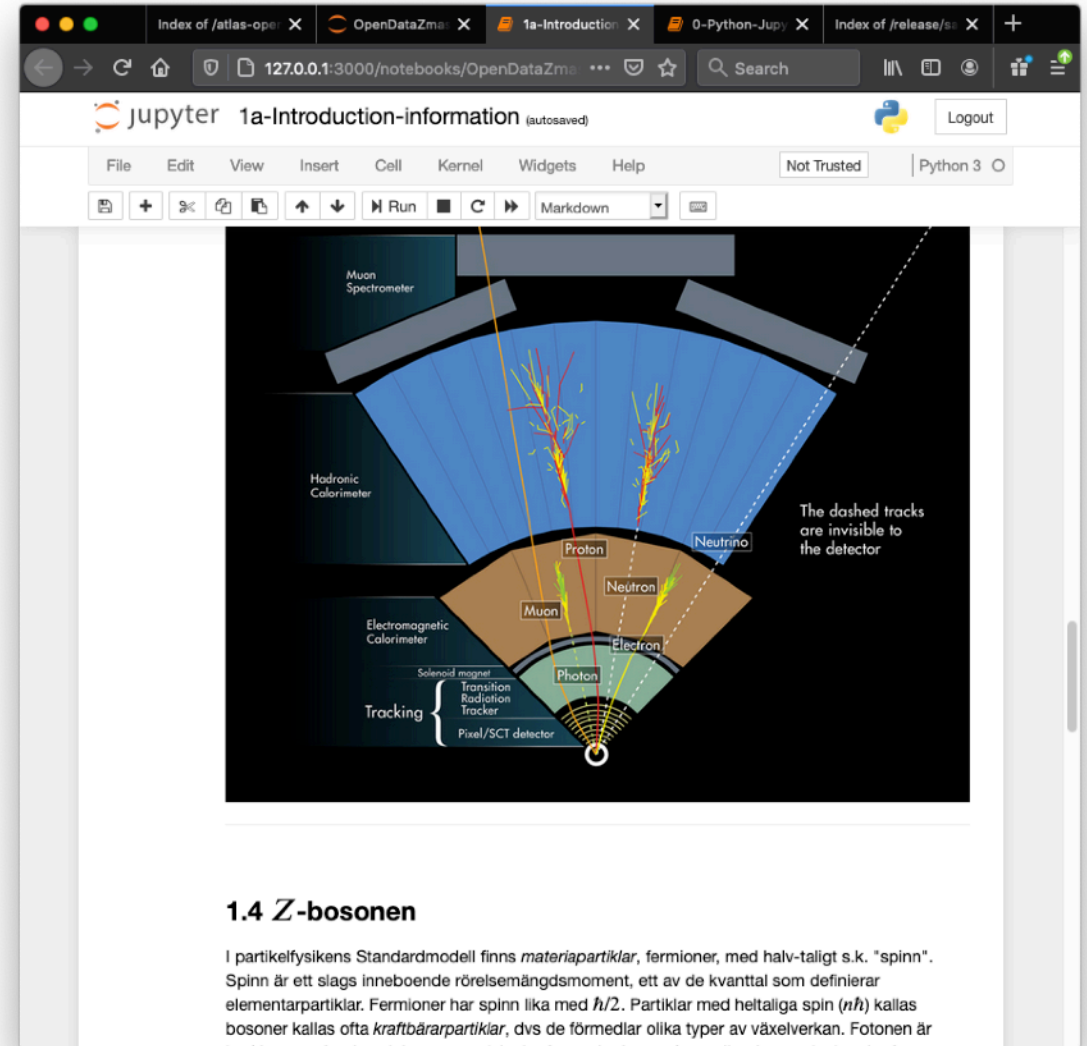


Figure 3: Invariant mass of the Z^0 boson, approximated as the function (4), on the range [87, 93] [GeV].



The screenshot shows a Jupyter Notebook titled '1a-Introduction-information'. The main content is a diagram of the ATLAS detector, a large cylindrical structure. The diagram is divided into several regions: the Muon Spectrometer at the top, the Hadronic Calorimeter in the middle, and the Electromagnetic Calorimeter at the bottom. The innermost part is the Tracking system, which includes the Solenoid magnet, Transition Radiation Tracker, and Pixel/SCT detector. Particle tracks are shown originating from the center and moving outwards. Some tracks are solid lines, while others are dashed lines. A text box on the right side of the diagram states: 'The dashed tracks are invisible to the detector'. Below the diagram, there is a section titled '1.4 Z-bosonen' with text in Swedish explaining the Standard Model and fermions.

1.4 Z-bosonen

I partikelfysikens Standardmodell finns *materiapartiklar*, fermioner, med halv-taligt s.k. "spinn". Spinn är ett slags inneboende rörelsemängdsmoment, ett av de kvanttal som definierar elementarpartiklar. Fermioner har spinn lika med $\hbar/2$. Partiklar med heltalliga spin ($n\hbar$) kallas bosoner kallas ofta *kraftbärarpartiklar*, dvs de förmedlar olika typer av växelverkan. Fotonen är kraftbäraren för den elektromagnetiska kraften och gluonerna förmedlar den starka kärnkraften.

Open data in teaching

- Labs created at our universities to let students use **open CERN data** and explore the subatomic world
- Example (KTH): 3rd-year students **measure mass of the Z** using real ATLAS data
 - ~600 students since 2018
 - Great task for teaching signal vs. bg, modeling, fitting, and stat. analysis — **key general skills** for science and engineering

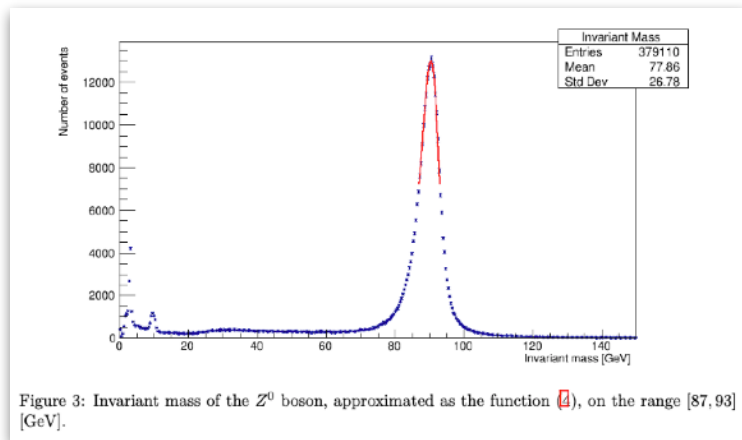
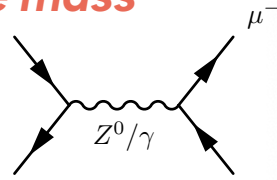


Figure 3: Invariant mass of the Z^0 boson, approximated as the function (4), on the range [87, 93] [GeV].

High School Project in 2019!

Accuracy and Precision of the Z Boson Mass
Measurement with the ATLAS Detector

Mariam D'Ciofalo Khodaverdian

Supervisors at the Royal Institute of Technology (KTH):
Christian Ohm, Giulia Ripellino
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Kungsholmen's Gymnasium
27/05-2019



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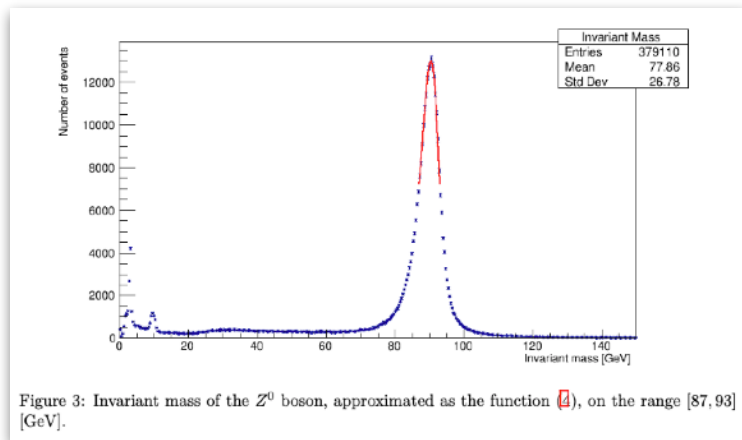
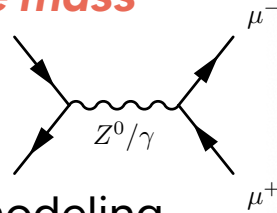


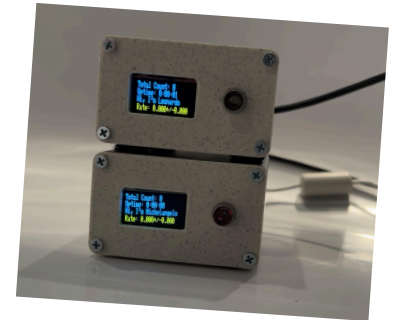
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High School Project in 2019!

Measurement of the Z Boson Mass
 HS Project in 2024 - now competing for Sweden in LA!

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Gymnasiearbete
 Läsåret 2023/2024



J. Andersson, J. Friberg, J. Lyreborn

Analys av atmosfäriskt myonflöde

Myonflödets energispridning och materialinteraktioner samt rymd- och zenitvinkelns påverkan på detektionsfrekvensen

Berzeliusskolan
 Naturvetenskapsprogrammet
 Mikael Rydfalk