Anne Schukraft

Fermilab

My way into physics and what I love about being a scientist

Who I am

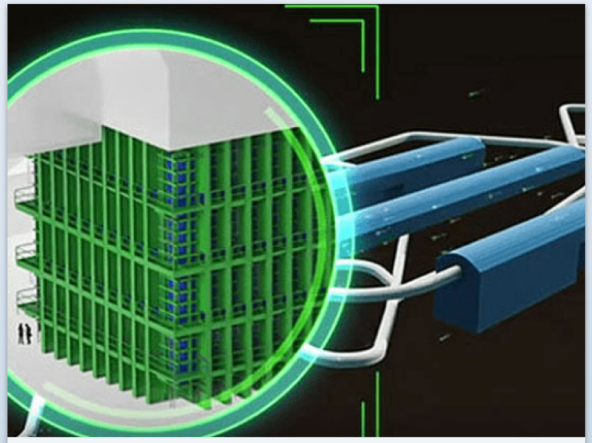
- Born 1985 in Karlsruhe, Germany
- Graduated from High School in 2004
  - I always liked Math and Physics (but also other classes)
- 2004 – 2009 Physics undergraduate at RWTH Aachen University, Germany
- 2009 – 2013 PhD in Physics at RWTH Aachen University, Germany
- Since 2013: I work at Fermilab!

When I don’t do physics, I swim!

Fermilab

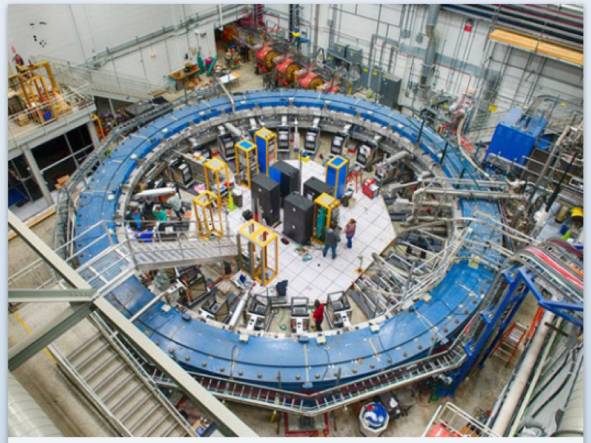
- United States' premier particle physics laboratory, founded 1967.
- 1,750 employees include scientists and engineers from all around the world.
- Fermilab collaborates with more than 50 countries on physics experiments based in the United States and elsewhere.

What we do



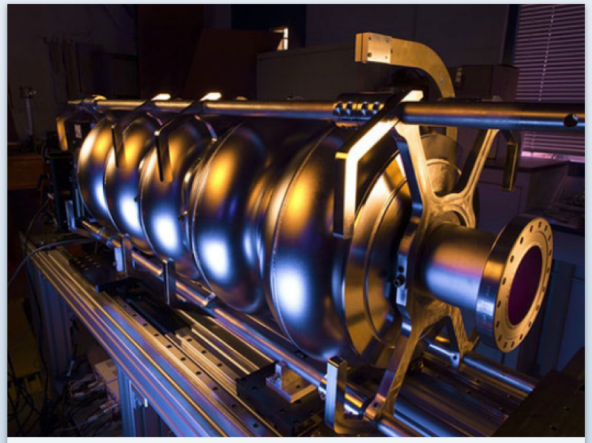
Deep Underground Neutrino Experiment

Fermilab hosts DUNE and the Long-Baseline Neutrino Facility, being built by scientists and engineers from more than 30 countries.



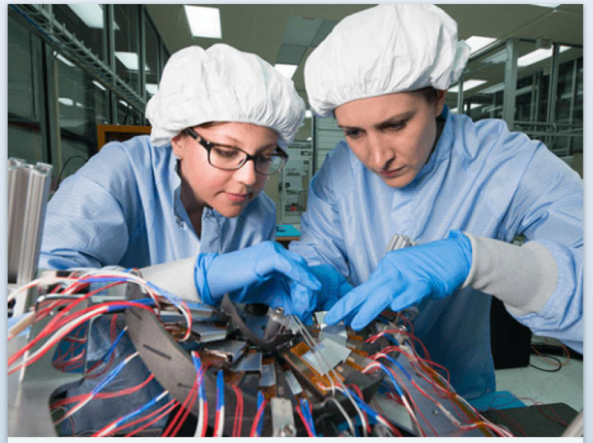
Particle physics

Fermilab explores the universe at the smallest and largest scales, studying the fundamental particles and forces that govern our universe.



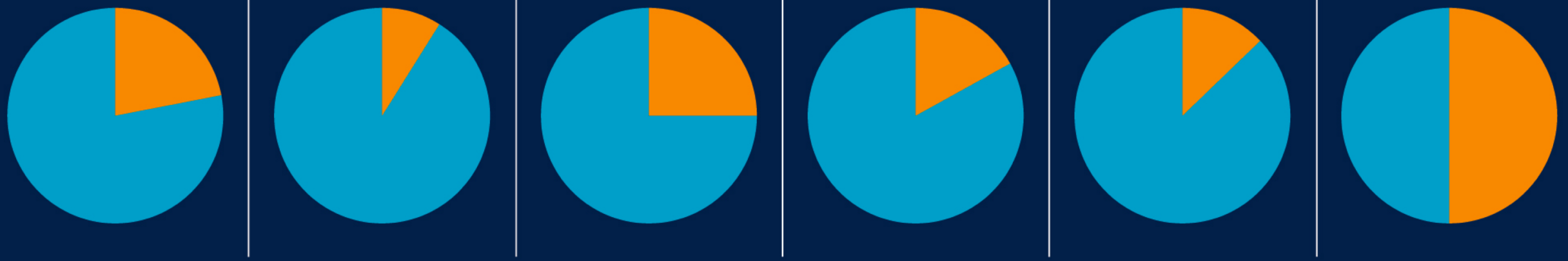
Accelerator science and technology

Fermilab designs, builds and operates powerful accelerators to investigate nature's building blocks, advancing technology for science and society.



Detectors, computing and quantum science

Fermilab pioneers the research and development of particle detection technology and scientific computing applications and facilities.



	Computing	Engineers	Postdocs	Scientists	Technical	Mission Support
Female %	22%	9%	25%	17%	13%	50%
Male %	78%	91%	75%	83%	87%	50%

http://diversity.fnal.gov/

Come visit us!

(Not just today)

The Fermilab Education & Outreach office offers a variety of events all year round

https://ed.fnal.gov/

Of interest for you:

High School level

- Saturday morning physics
  11-week series of lectures and tours on Saturdays
- TARGET, QuarkNet
  Summer internships

Undergraduate level

- SIST, SULI, CCI, Lee Tang
  Summer internships

Field Trips, Study Units & Tours

High School Tours
Guided and Self-guided Tours
Field Trips & Study Units (K-8)
Lederman Science Center

Classes & Special Events

Science Adventures
Scout Programs
Saturday Morning Physics
Special Events for Families & Students

Professional Development

Teacher Workshops - Scholarships
QuarkNet
Teacher Resource Center
Physical and Life Sciences Resources

Research Participation

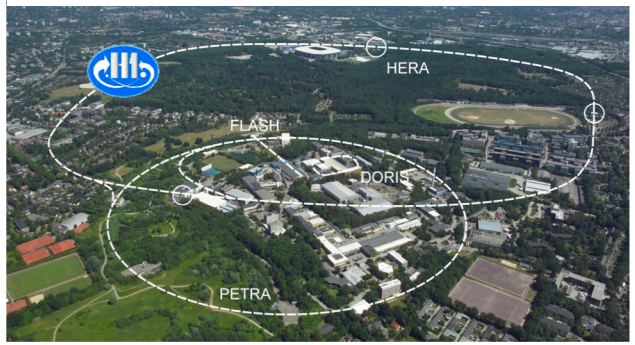
High School Research Experience
Internships
Data-based Investigations

How I became interested in physics

- In High School
  - I liked **Math, Physics, Chemistry**… but also other topics
  - During the final two years my high school offered
    - A **programming class**… which turned out to be really fun, although I knew nothing about programming before I joined.
    - A **physics club**, where we learned about quantum physics, particle physics, and astronomy

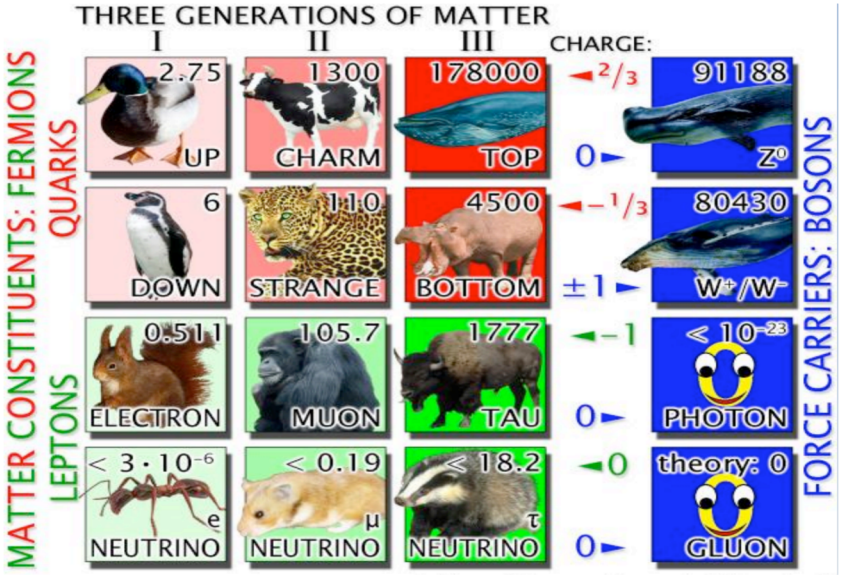
- As an undergraduate student
  - Early on, I started working for one of the physics institutes to help with particle physics experiments
    - I worked on a sub-system for the **AMS experiment** – AMS is now taking data on the International Space Station looking for anti-matter. I got to visit CERN!
    - I worked on **X-ray spectroscopy** measurements at DESY
    - I got to meet and work with graduate students and postdocs, and got to see what their job is like

DESY: German Accelerator Laboratory



- During my Masters and PhD thesis
  - I joined a real physics collaboration: **IceCube**
    - The experiment is like a telescope looking for neutrino signals from space to learn new things about the Universe. I did a lot of data analysis work.
    - More than 200 scientists from all over the world worked on IceCube. A lot of these are young people – I very much enjoyed traveling and making new friends!
    - Our experiment was located at the South Pole: I got to travel to Antarctica in 2011 for commissioning work.

What I find fascinating about particle physics

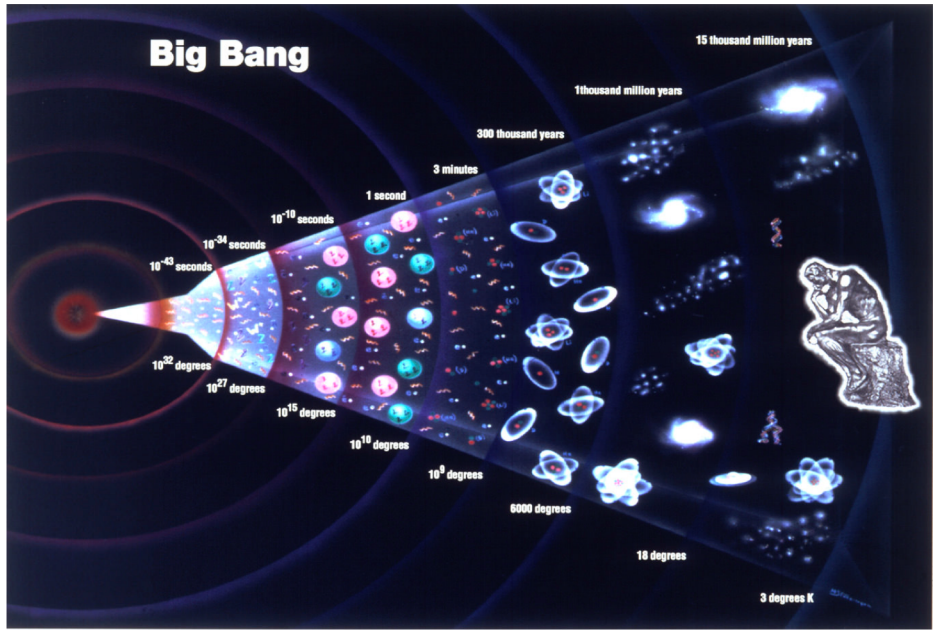


Answering the big questions about the very tiny and the very large:

- What are we all made of?
- How do elementary particles interact and form matter?
- Are there building blocks to our Universe that remain to be discovered?

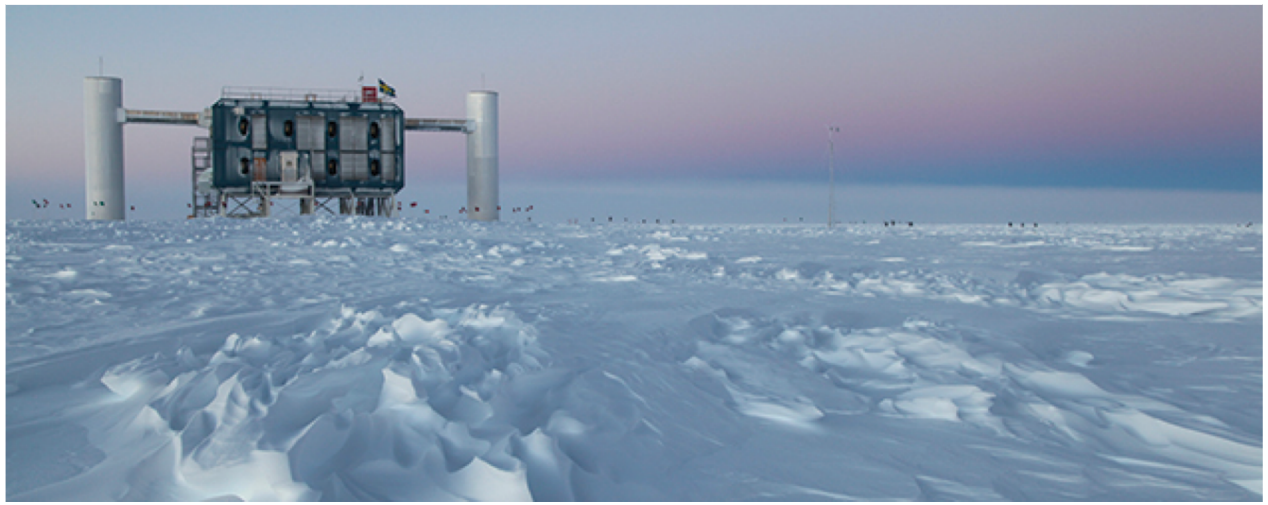
Interestingly, the very tiny and very large things in our world are closely connected!

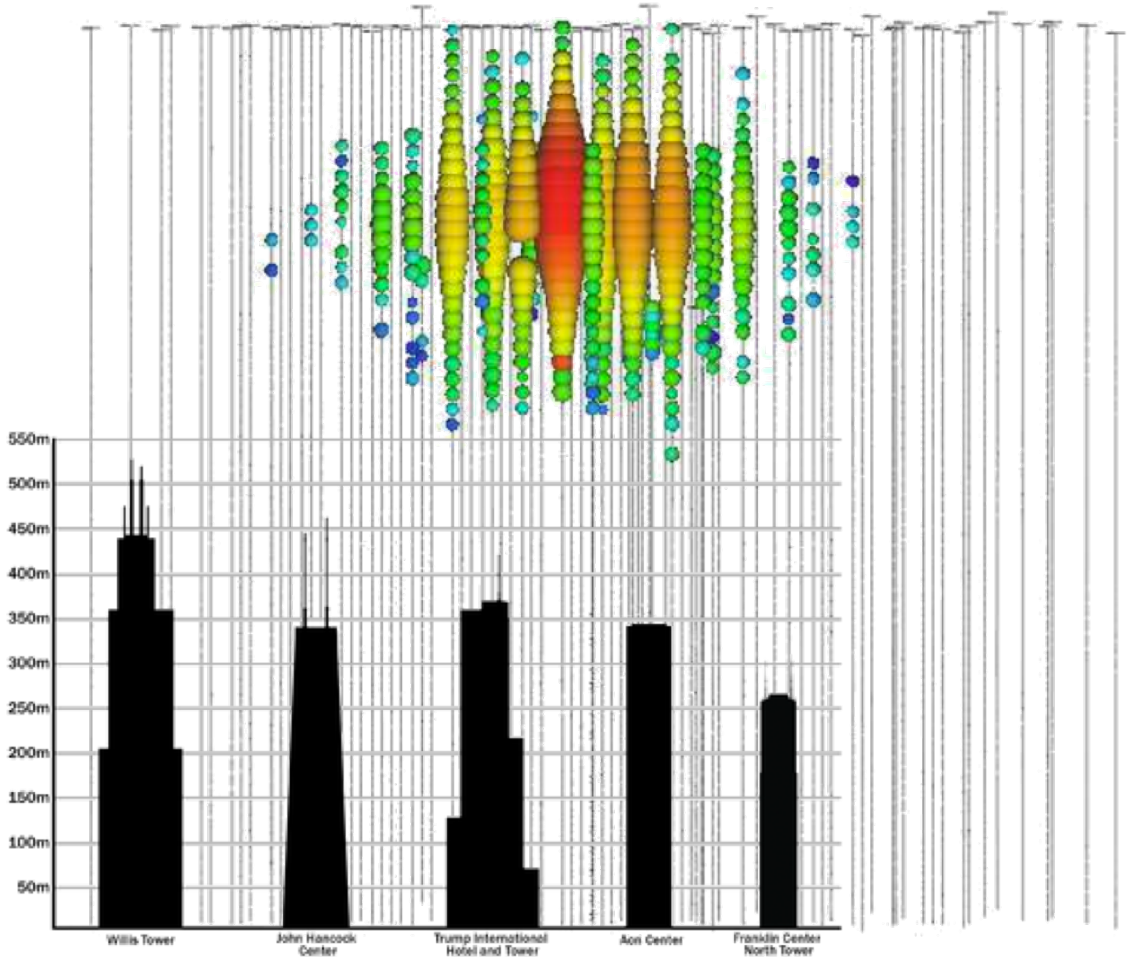
- How did the Universe evolve?
- How did structures like galaxies, suns, planets… form?



What experimental particle physics is all about

Making things visible that nobody has ever seen before! -> We build the weirdest cameras you can imagine (“detectors”)





IceCube is a detector frozen one mile below the ice surface at the South Pole.

It detects high-energy neutrinos from highly energetic places in space.

It needs to be huge, because these high-energy neutrinos from space are so rare.

What experimental particle physics is all about

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MicroBooNE is a neutrino detector at Fermilab.

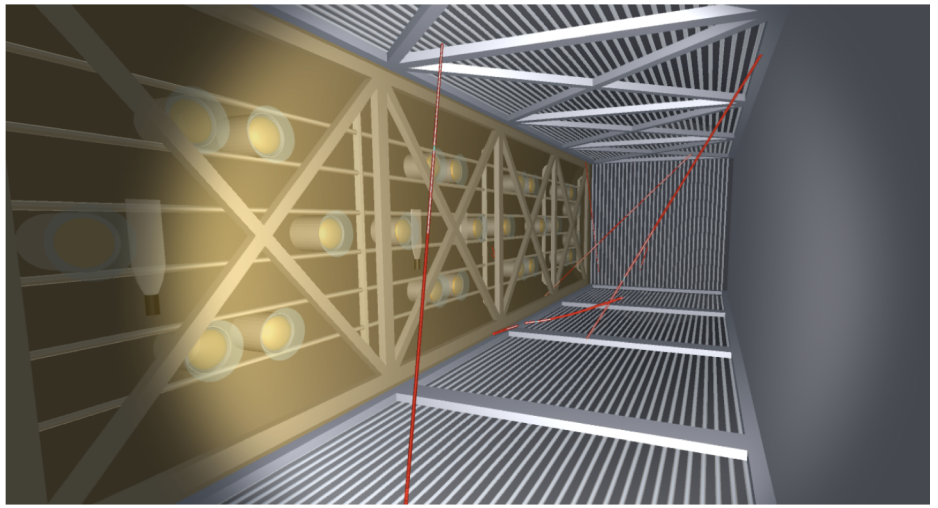
It is filled with 170 tons of liquid Argon (- 300 F).

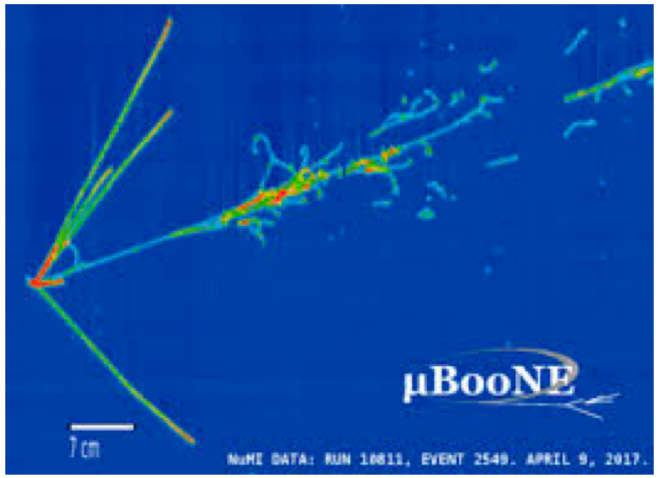
For particle physicists it is a “small” experiment.

The images have an amazing resolution.

Check out the VENu App for your phone! It was created by our graduate students and you can play a game trying to find neutrinos in 3D!

http://venu.physics.ox.ac.uk/



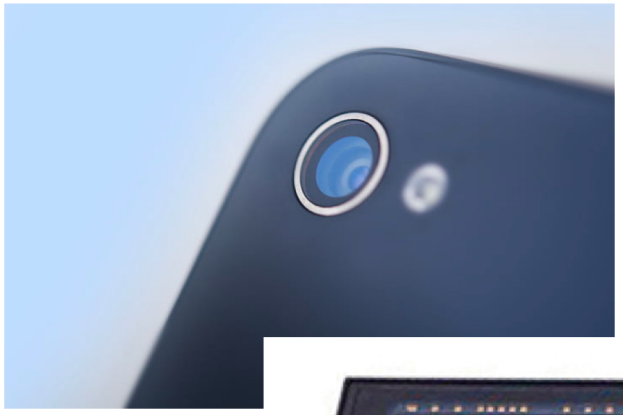


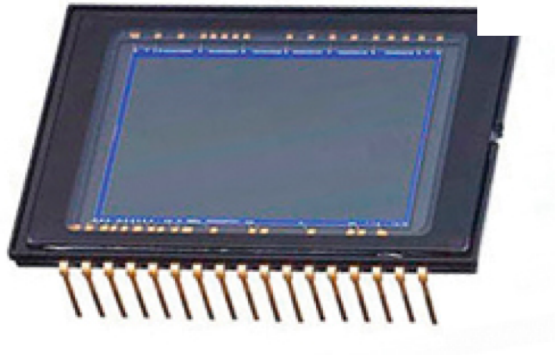
What particle physics has to do with you

A lot of technologies developed in particle physics find broad application. Some examples:

X-ray

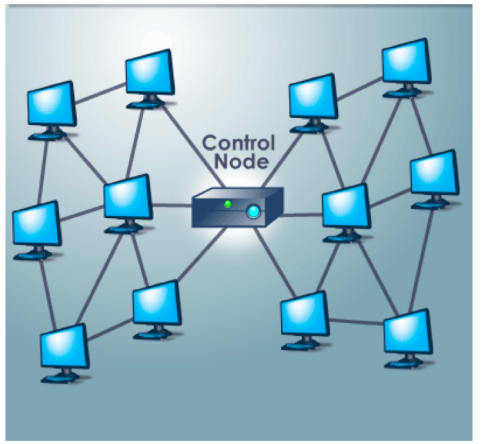
CCD cameras





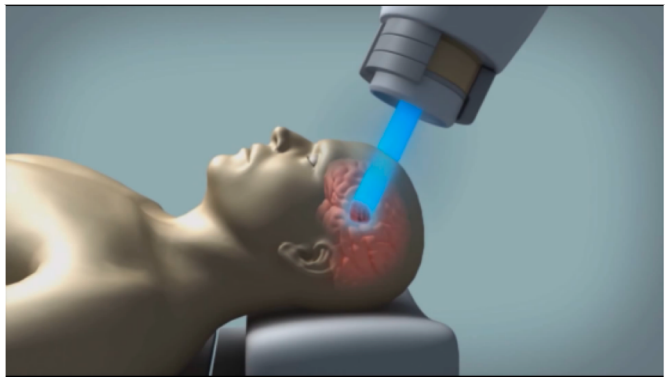
Shrink Wrap

Grid Computing



MRI

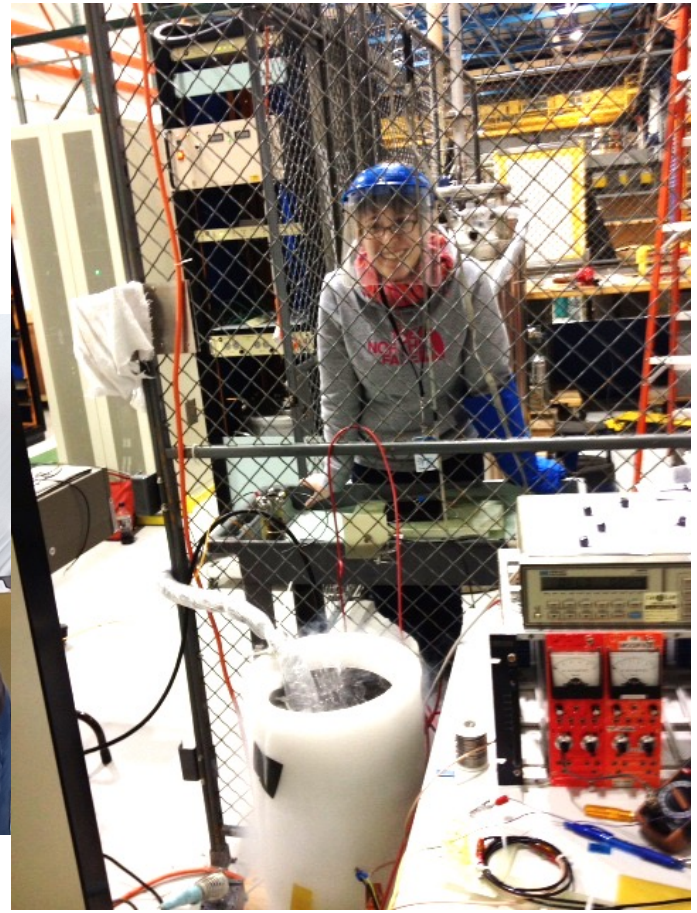
Radiation Therapy

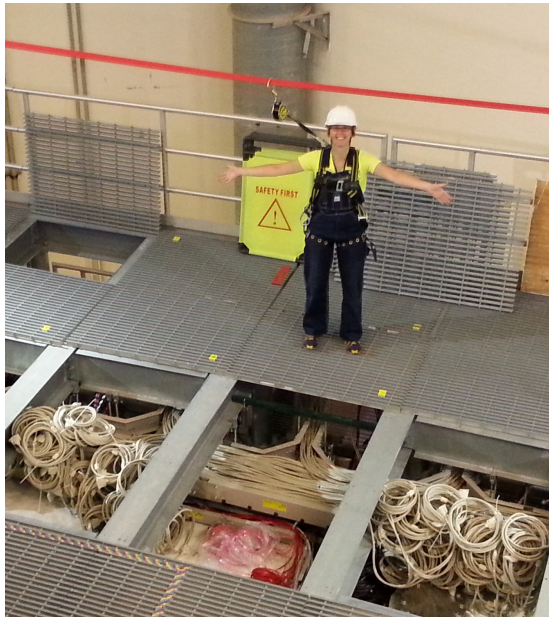


"**How Particle Physics Improves Your Life**",
Symmetry Magazine: https://www.symmetrymagazine.org/article/march-2013/how-particle-physics-improves-your-life

What I do: Build experiments

- Mechanical engineering
- Electrical engineering
- Electronics
- Material Science
- Cryogenics
- Data processing
- Construction



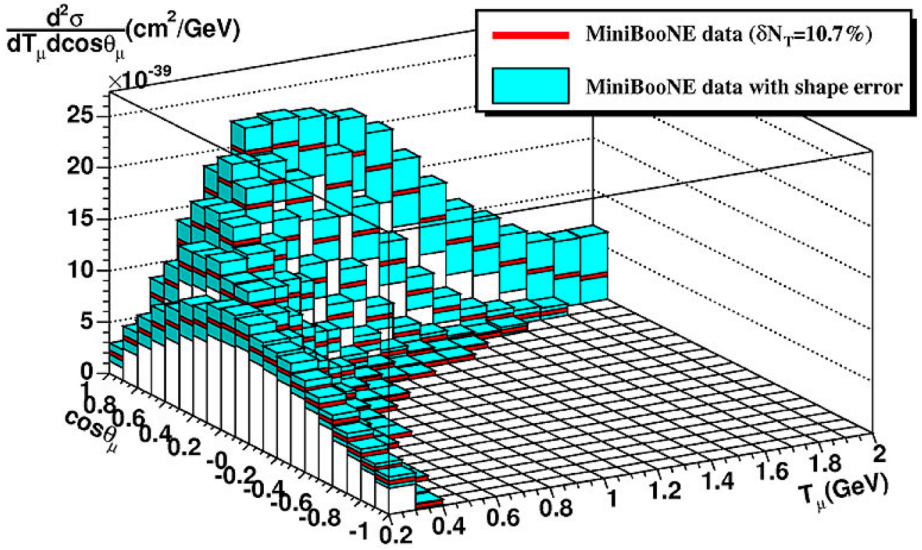


I work with

- Engineers
- Technicians
- Designers
- Project managers
- Financial Managers
- Graduate students and other scientists

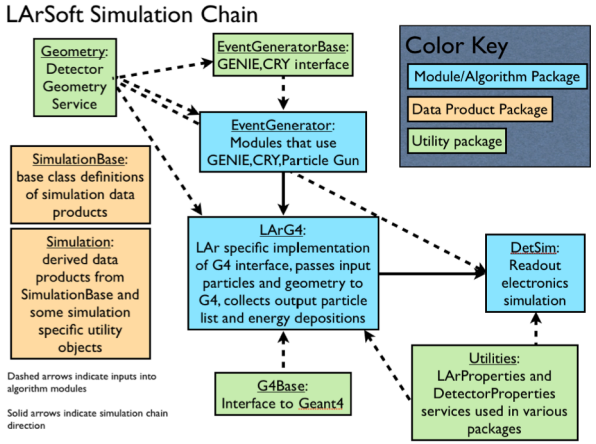
What I do: Analyze data

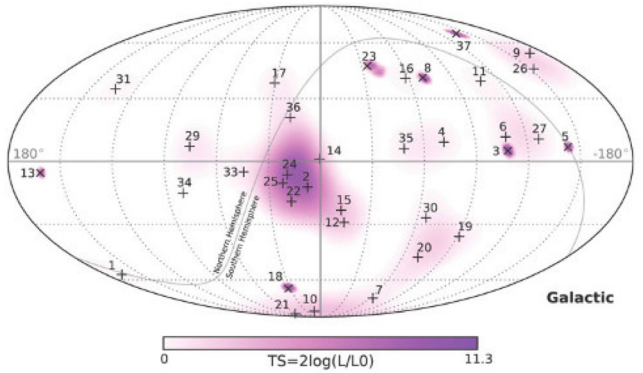
- Lots of programming
- Explore new computing techniques: grid computing, machine learning, …
- Statistical methods
- Computer simulation
- Connect experimental results to theoretical physics models



I work with

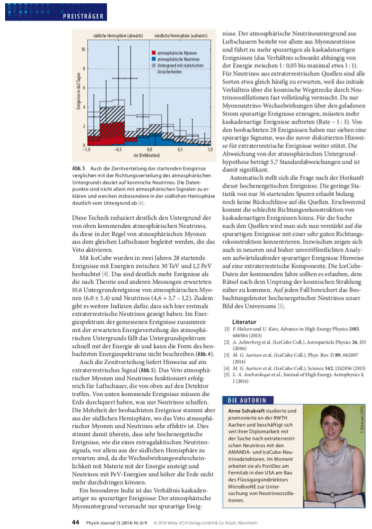
- Other scientists
- Graduate students
- Computing experts
- Theoretical physicists
- Scientists working in other disciplines like nuclear physics, astro physics, geo science, …





What I do: Talk about particle physics

- Conference presentations
- Seminars at Universities and other labs
- Lectures
- Outreach events
- Interviews, articles, etc…


PREISTRÄGER

DIE AUTORIN

I interact with

- Other scientists
- High school, undergraduate and graduate students
- Kids & adults interested in particle physics
- Journalists
- Communication Professionals

What I love about being a particle physicist

- Solving problems that nobody knows the answer to (yet) and which involves learning about so many different disciplines other than particle physics

- Collaborating and interacting with so many people world wide

DUNE experiment:
More than1000 scientists from 175 institutions in 32 countries

Have fun today!