UNIVERSITEIT GENT

Towards a future collider

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BND School

Blankenberge, Belgium

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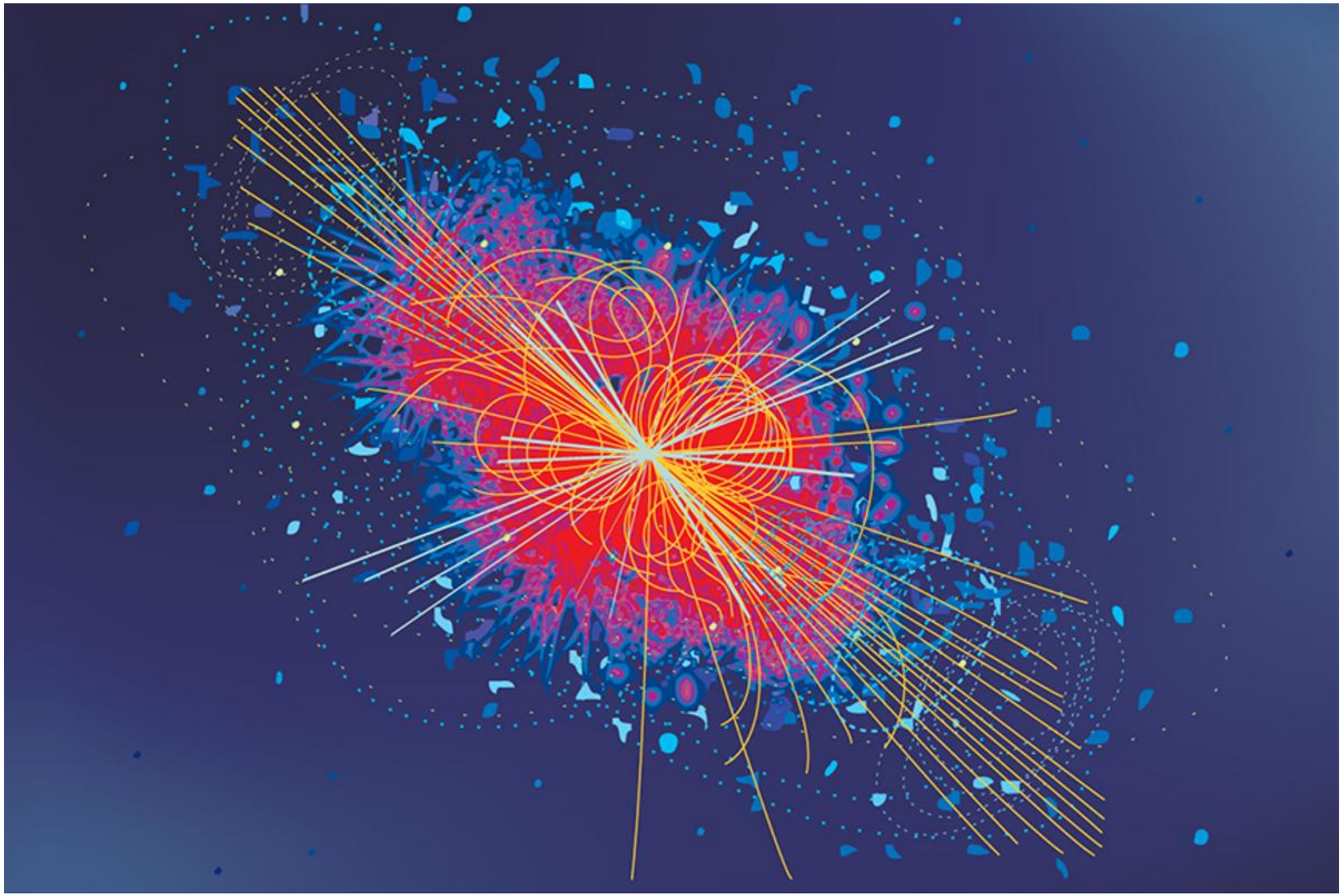
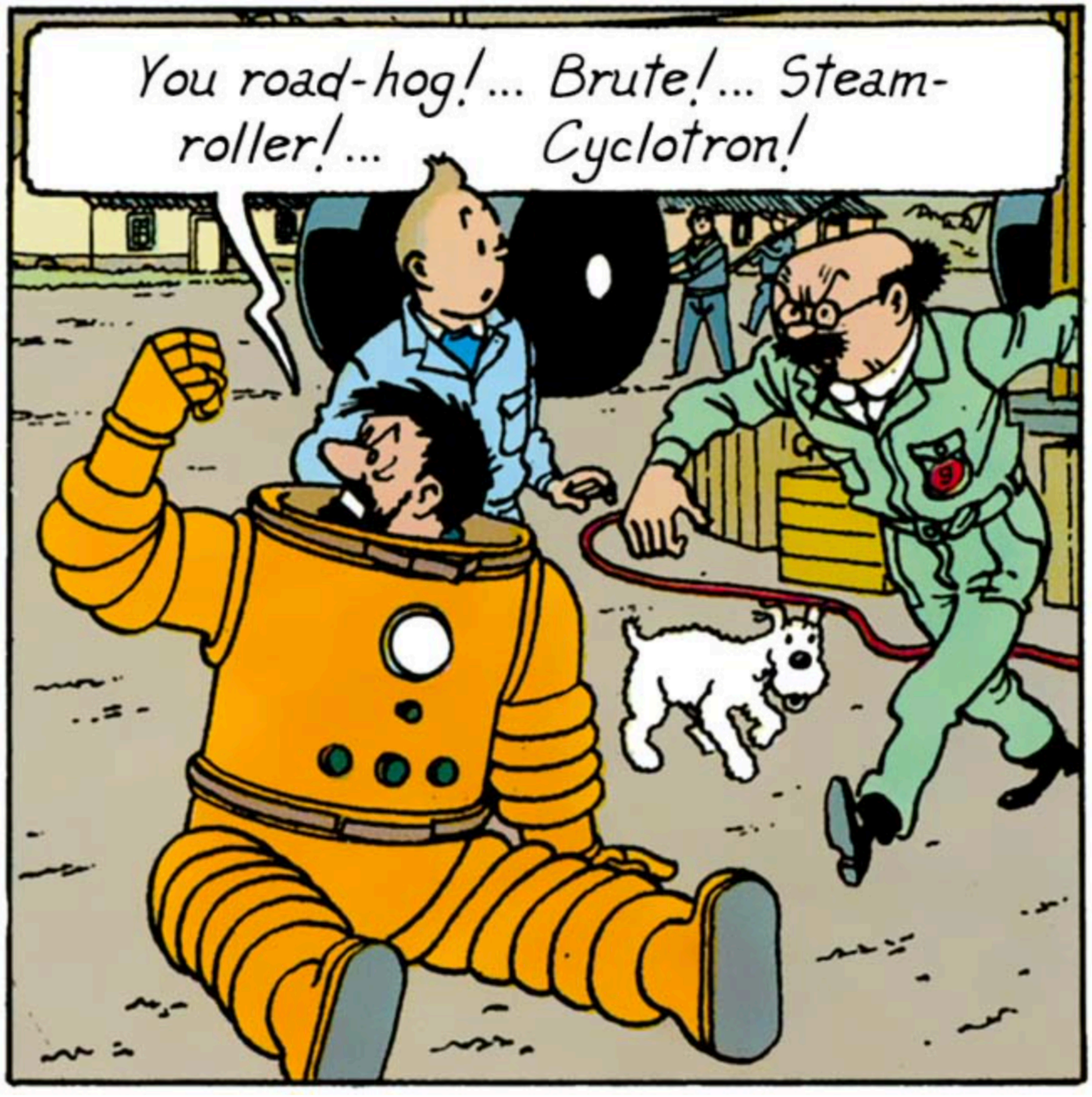
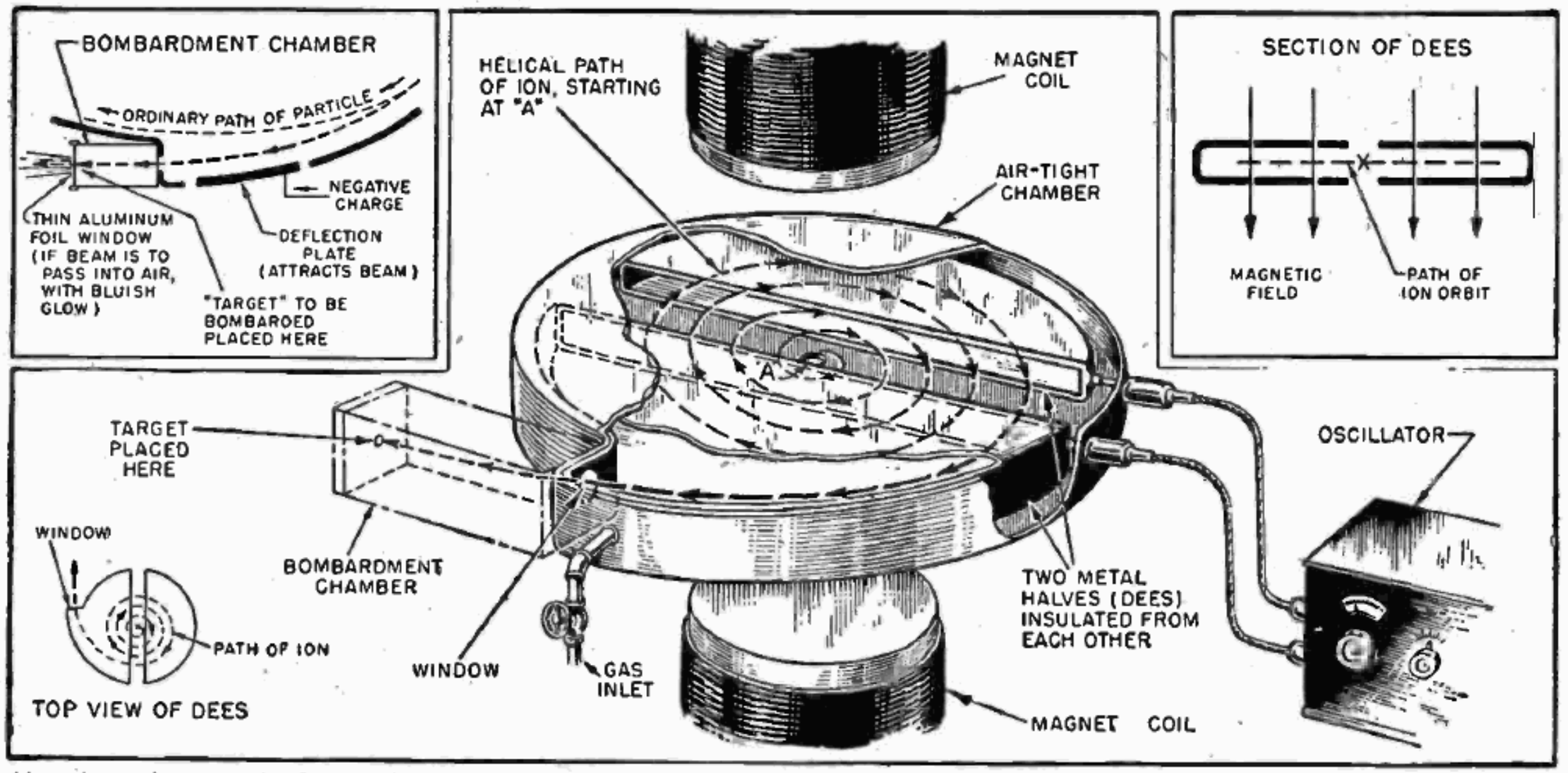
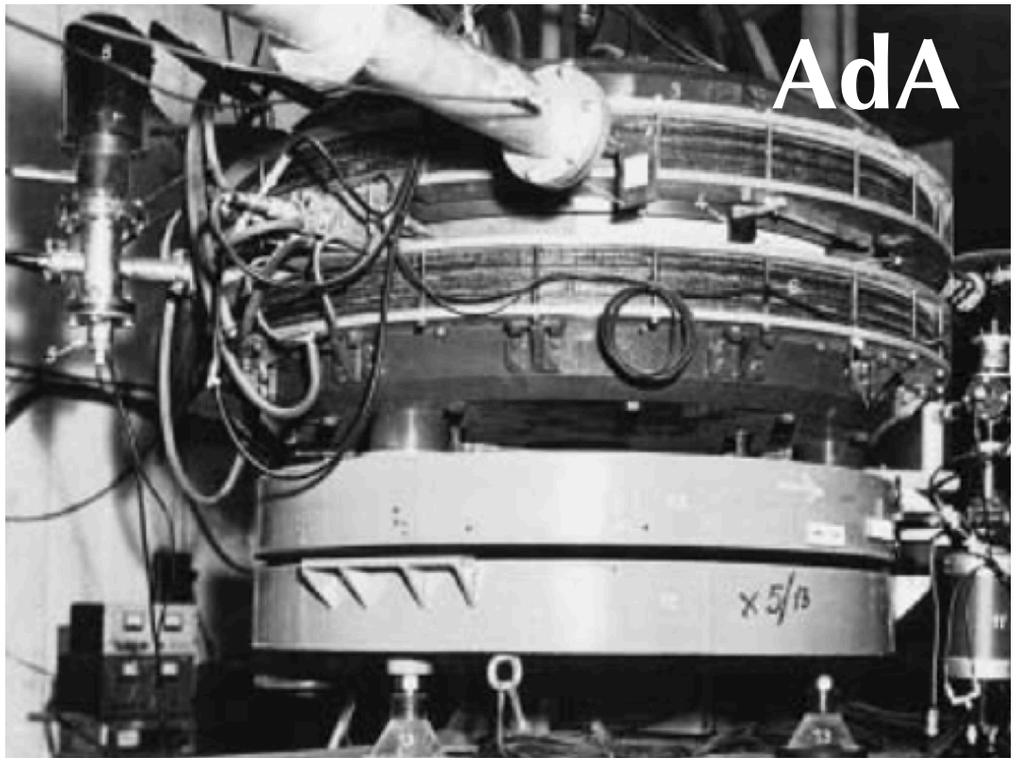
Why collide?

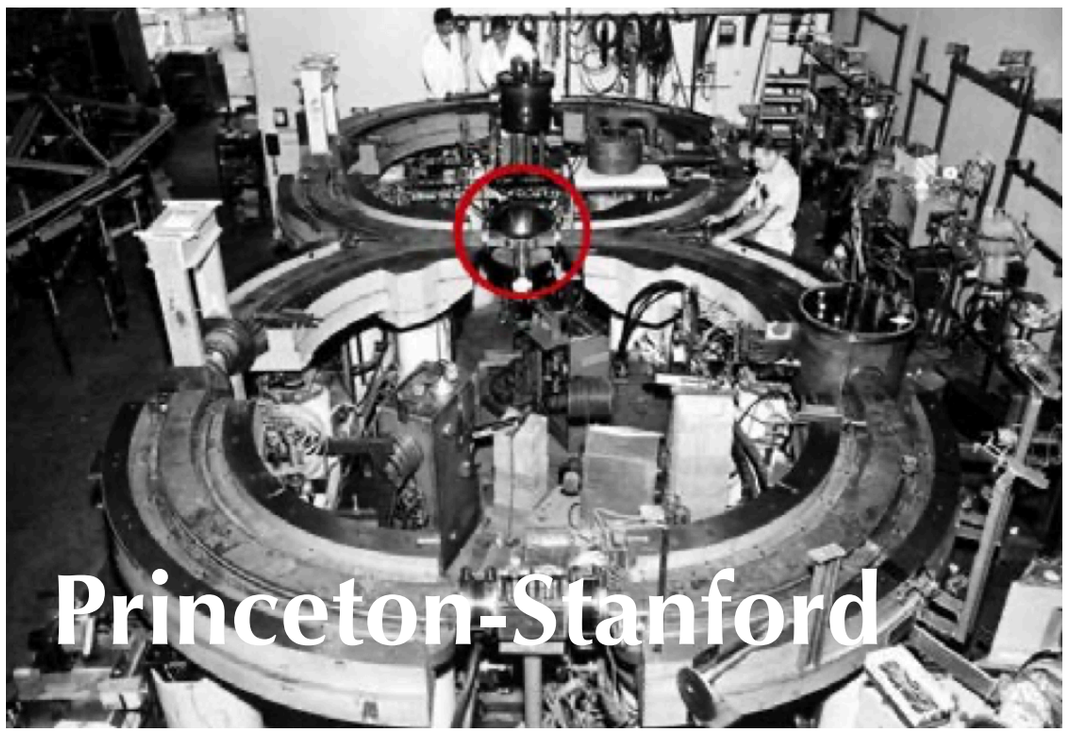



You road-hog!... Brute!... Steam-roller!... Cyclotron!

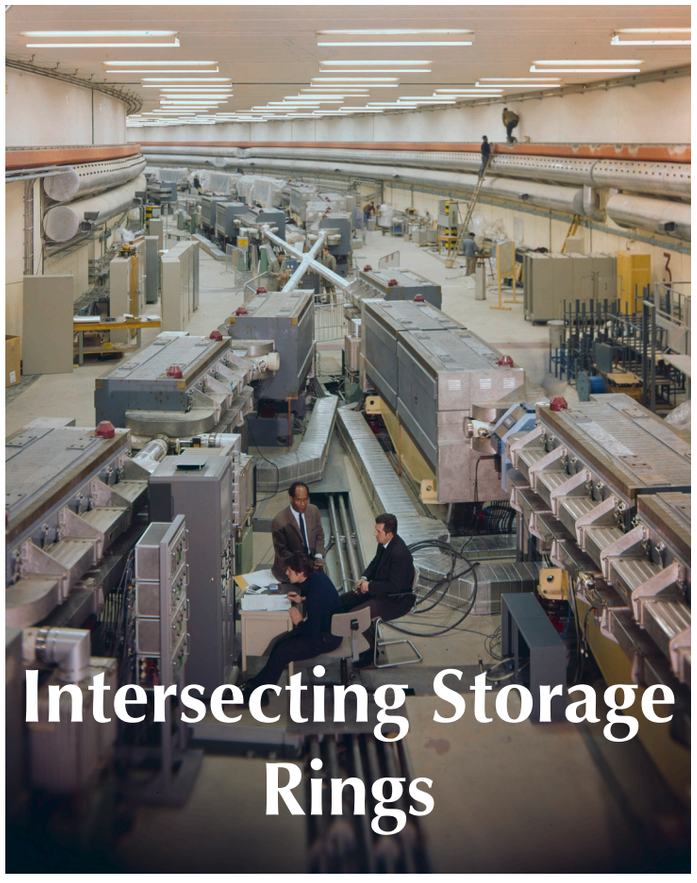

BOMBARDMENT CHAMBER
ORDINARY PATH OF PARTICLE
NEGATIVE CHARGE
THIN ALUMINUM FOIL WINDOW (IF BEAM IS TO PASS INTO AIR, WITH BLUISH GLOW)
DEFLECTION PLATE (ATTRACTS BEAM)
"TARGET" TO BE BOMBARDED PLACED HERE
HELICAL PATH OF ION, STARTING AT "A"
MAGNET COIL
AIR-TIGHT CHAMBER
SECTION OF DEES
MAGNETIC FIELD
PATH OF ION ORBIT
TARGET PLACED HERE
WINDOW
PATH OF ION
TOP VIEW OF DEES
BOMBARDMENT CHAMBER
WINDOW
GAS INLET
TWO METAL HALVES (DEES) INSULATED FROM EACH OTHER
OSCILLATOR
MAGNET COIL

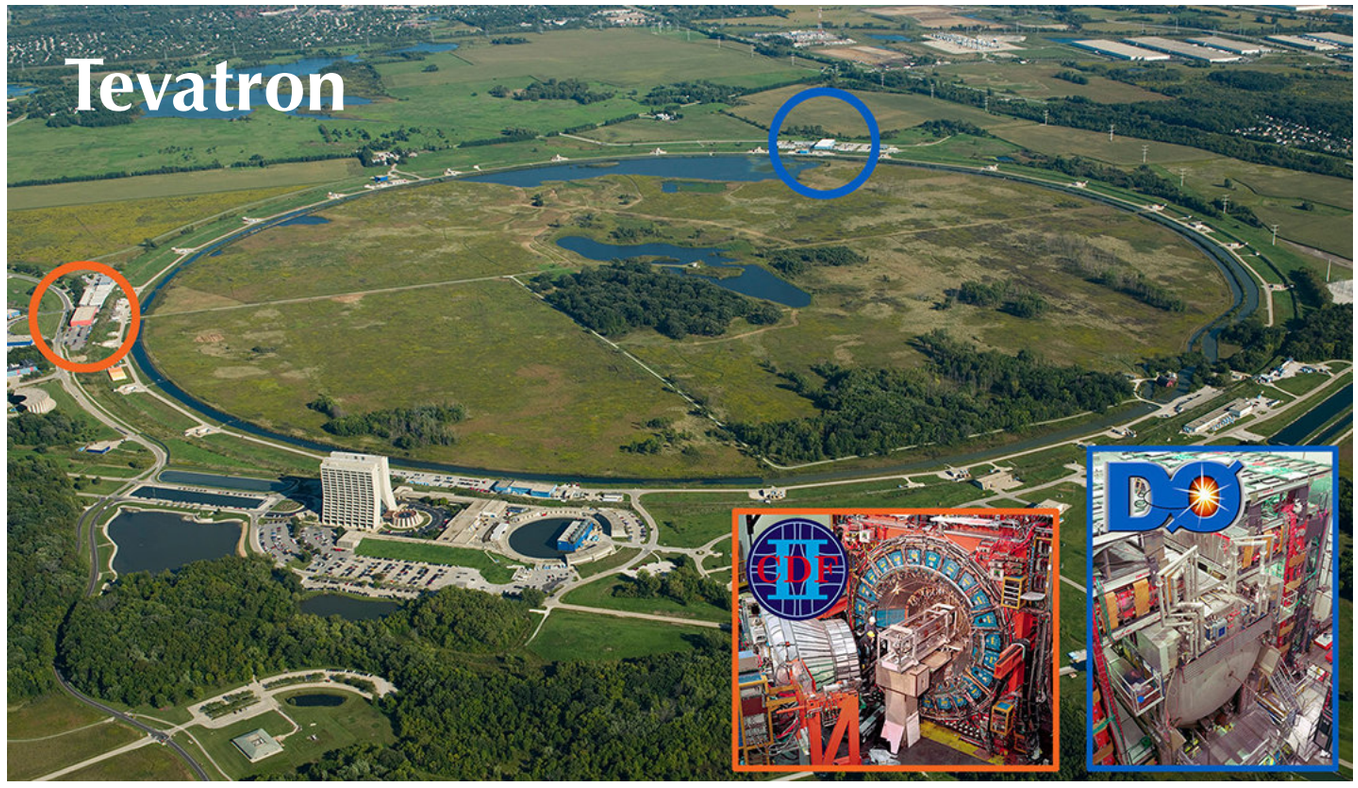
Lepton machines

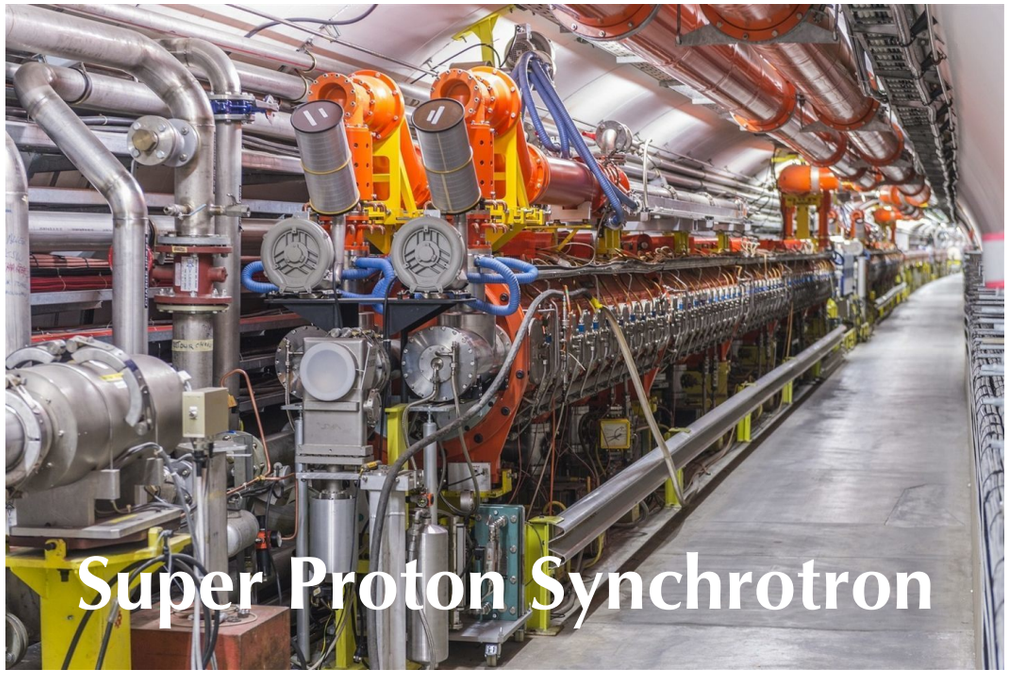


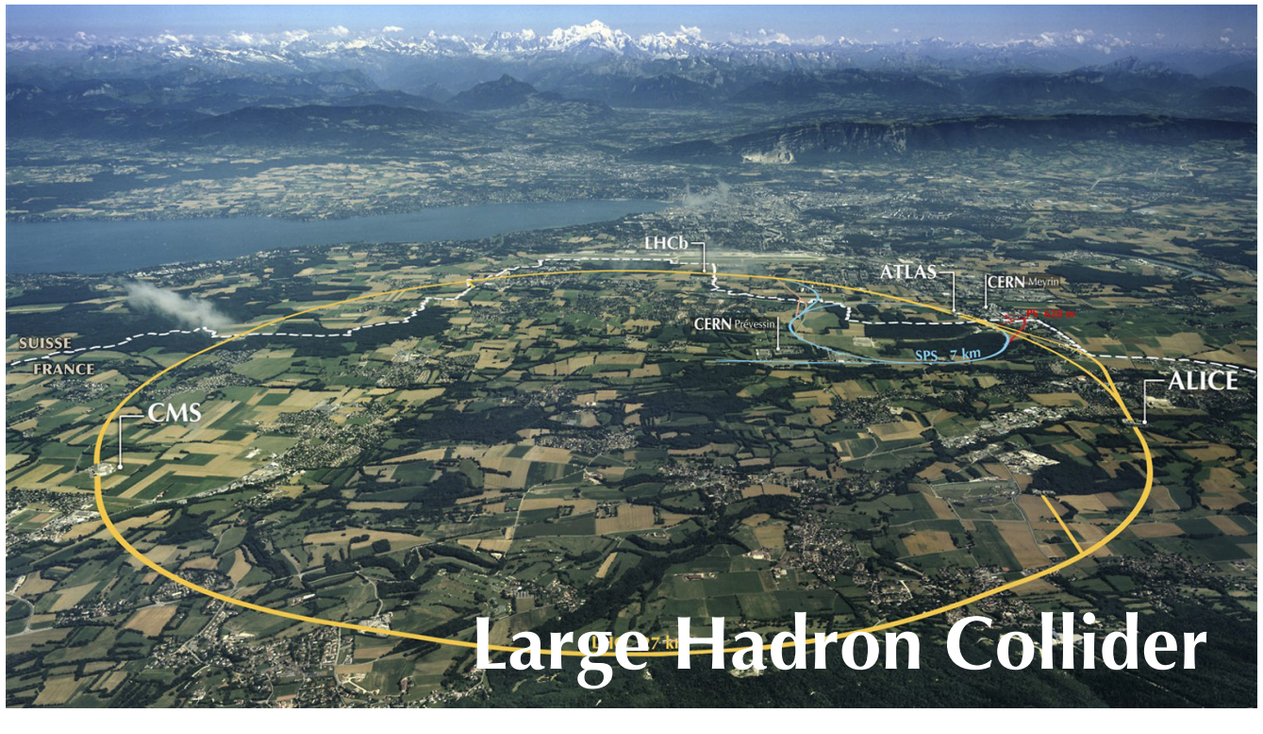


Hadron machines

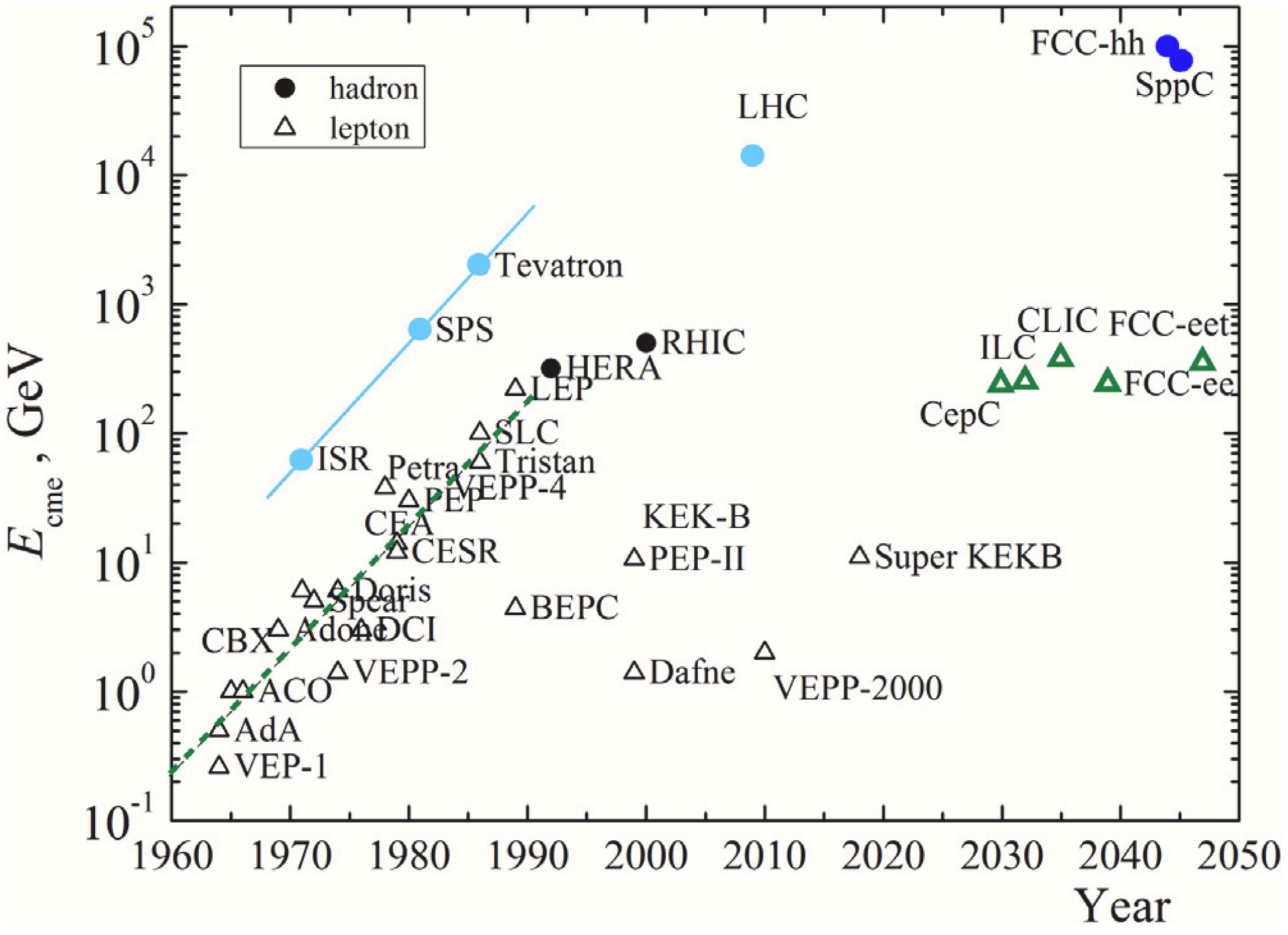




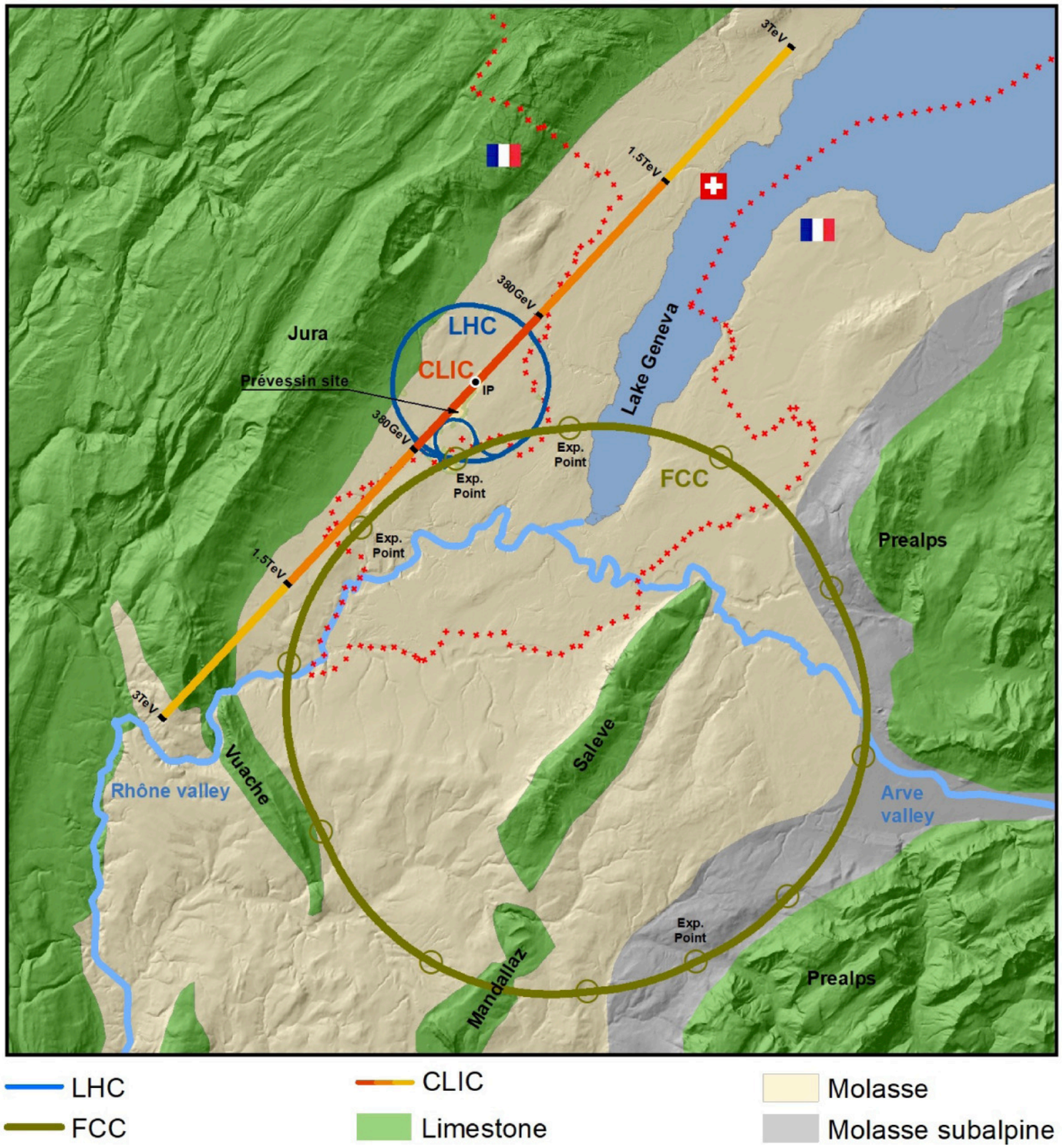




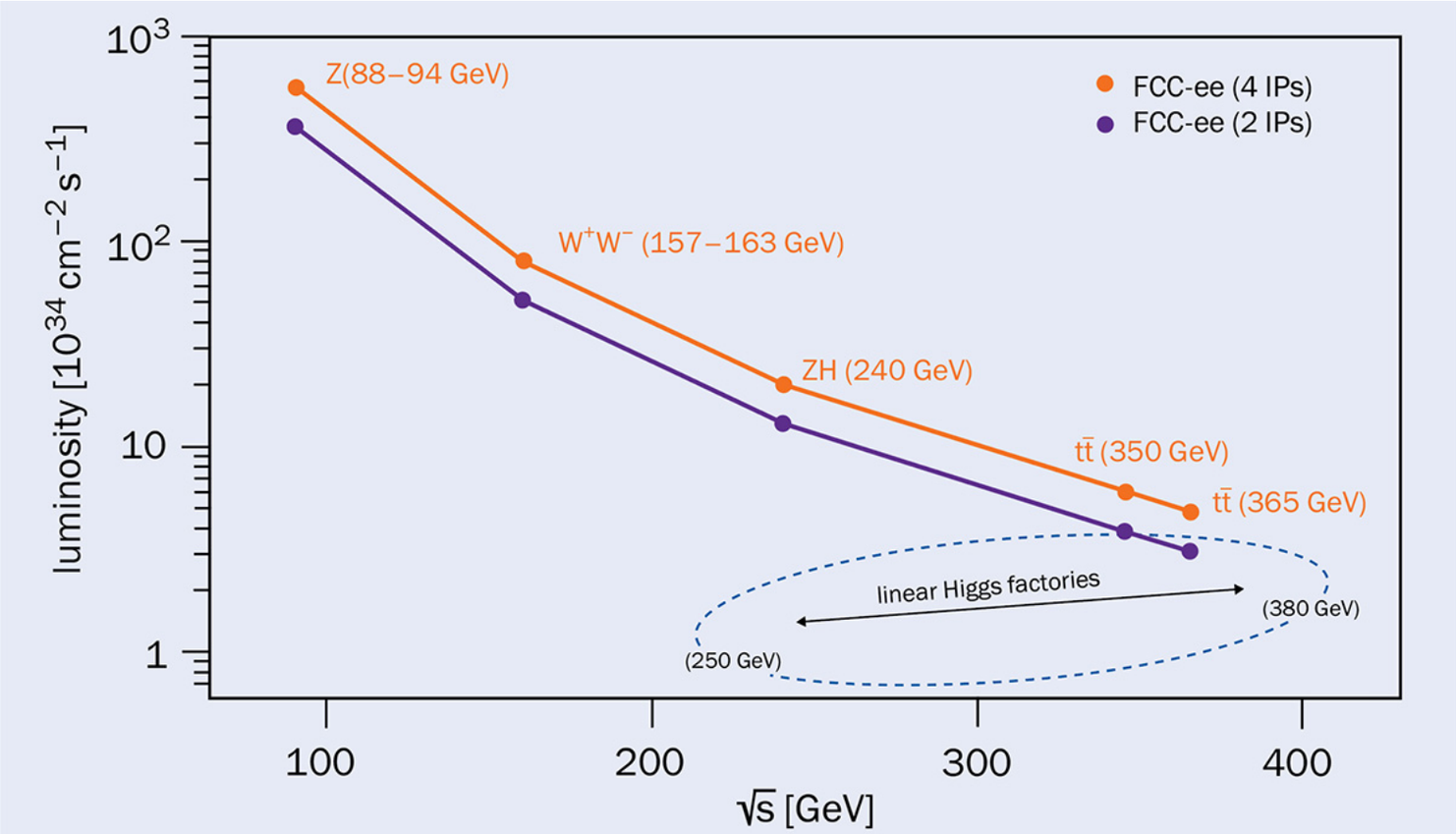
Past, present, future



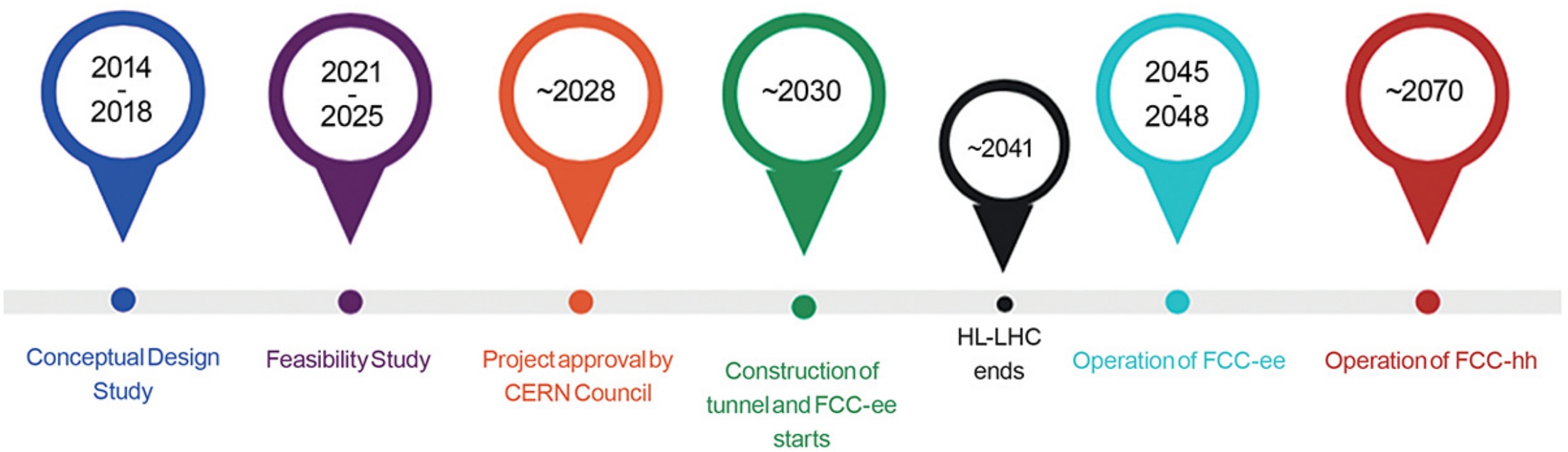
Future Circular Collider



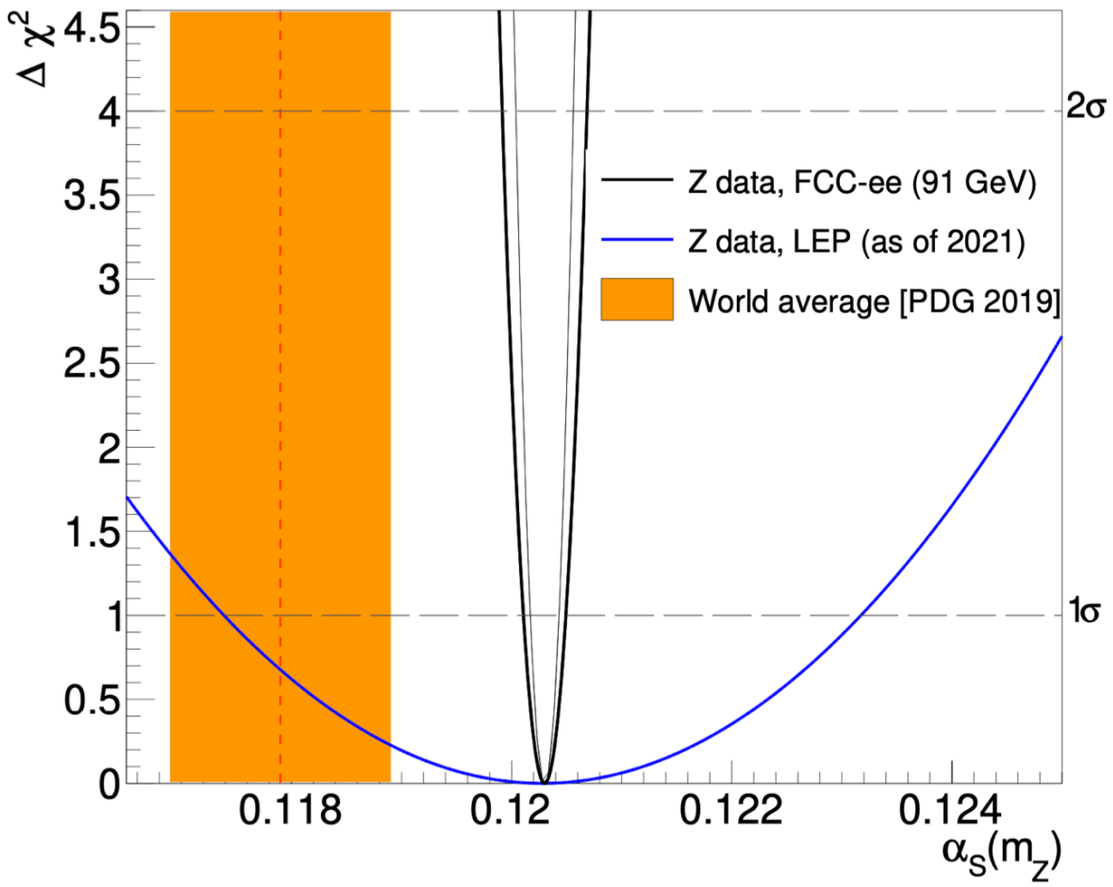
FCC-ee timeline

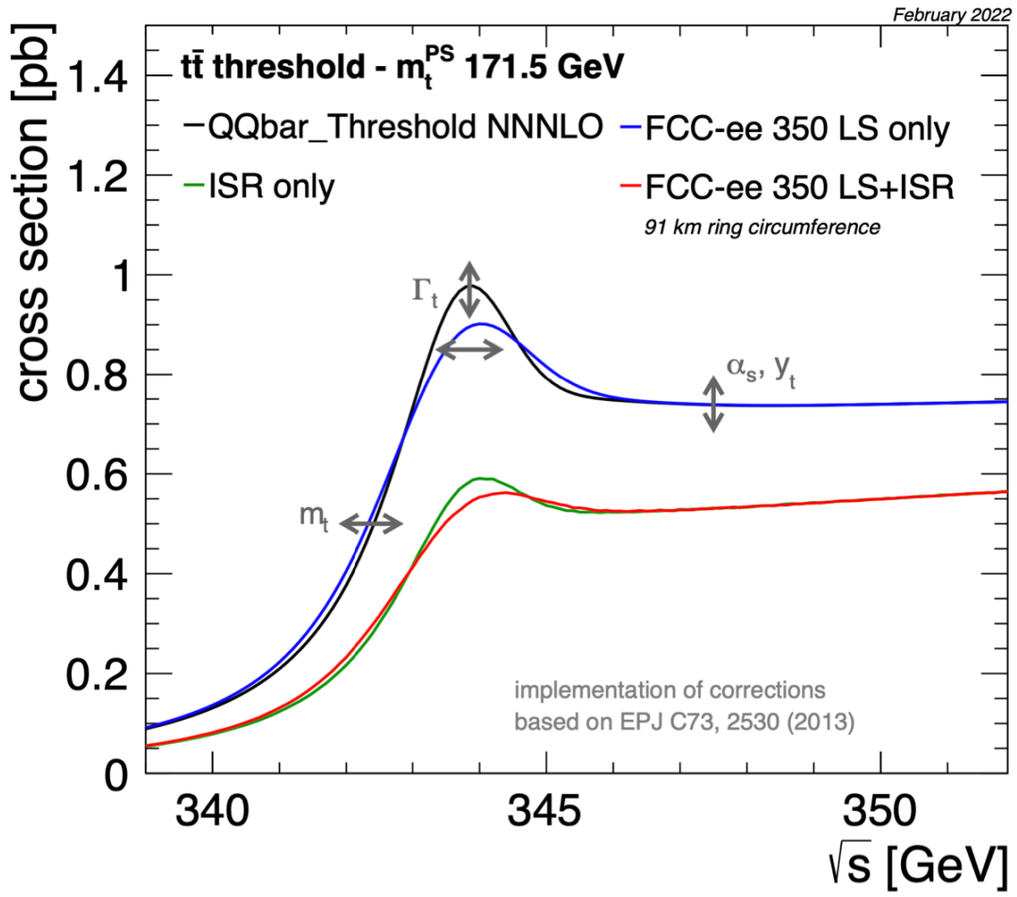


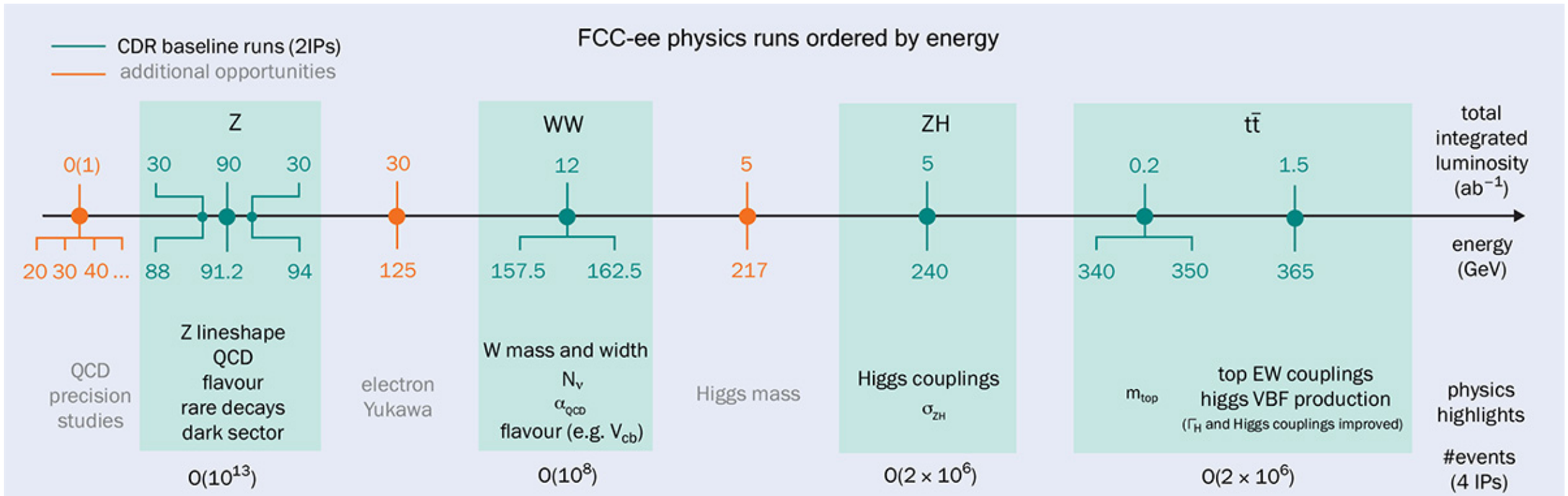
- Collision energies to go from **Z pole** to **top quark pair production threshold**
- **Energy scan** at the main operating energy points
- **High precision era** for electroweak, Higgs, and top physics
- **No pileup**



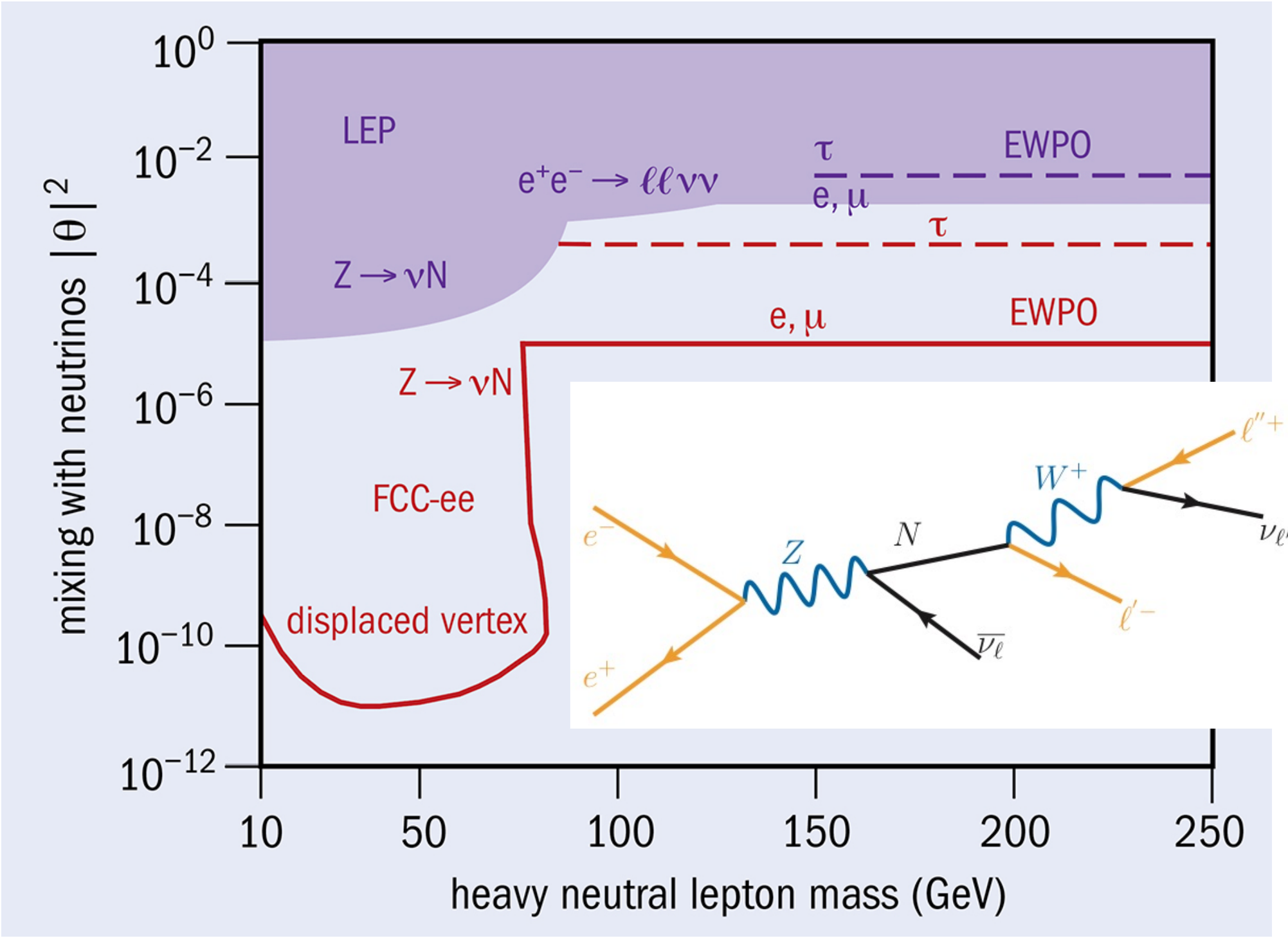
FCC-ee physics case



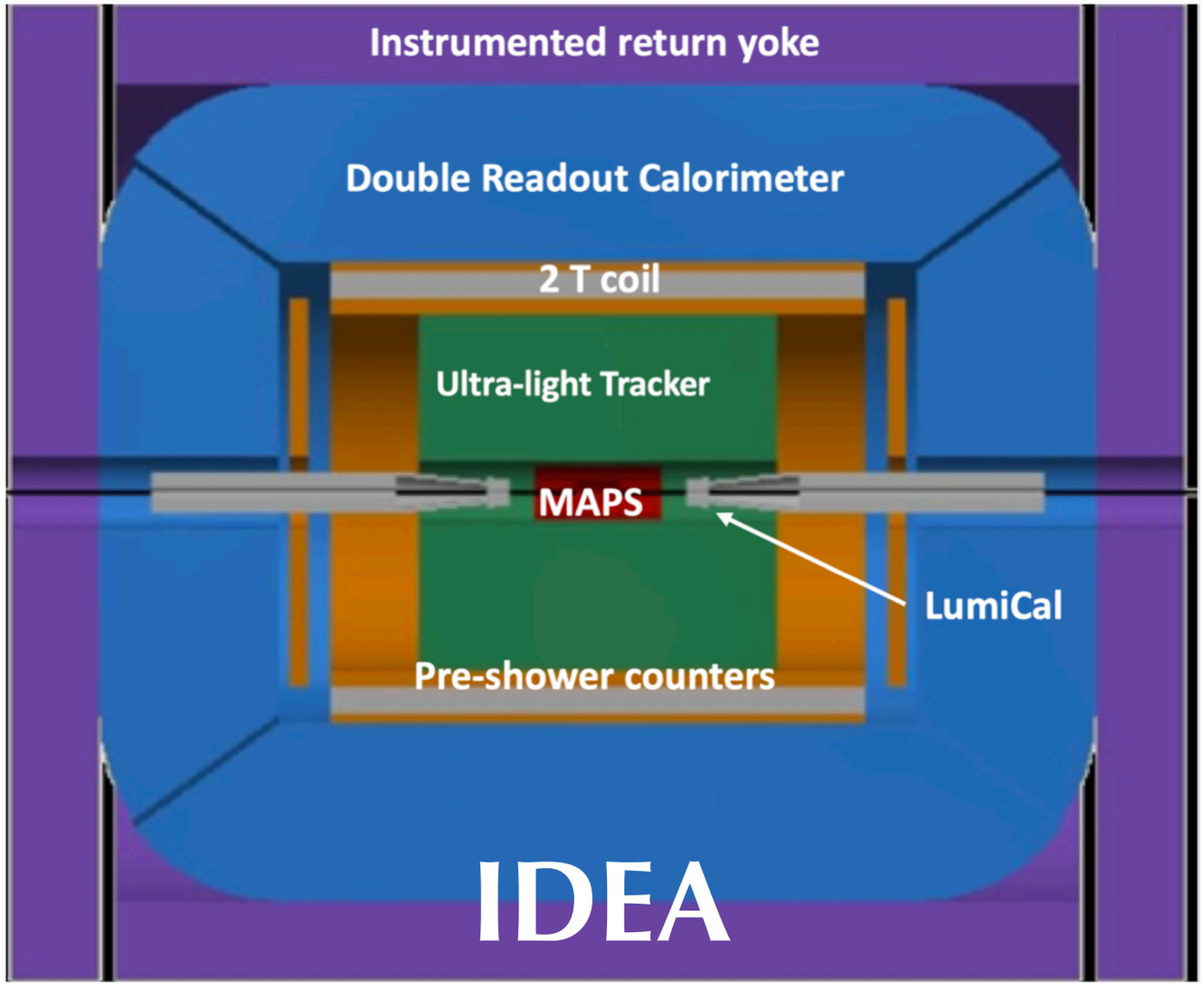


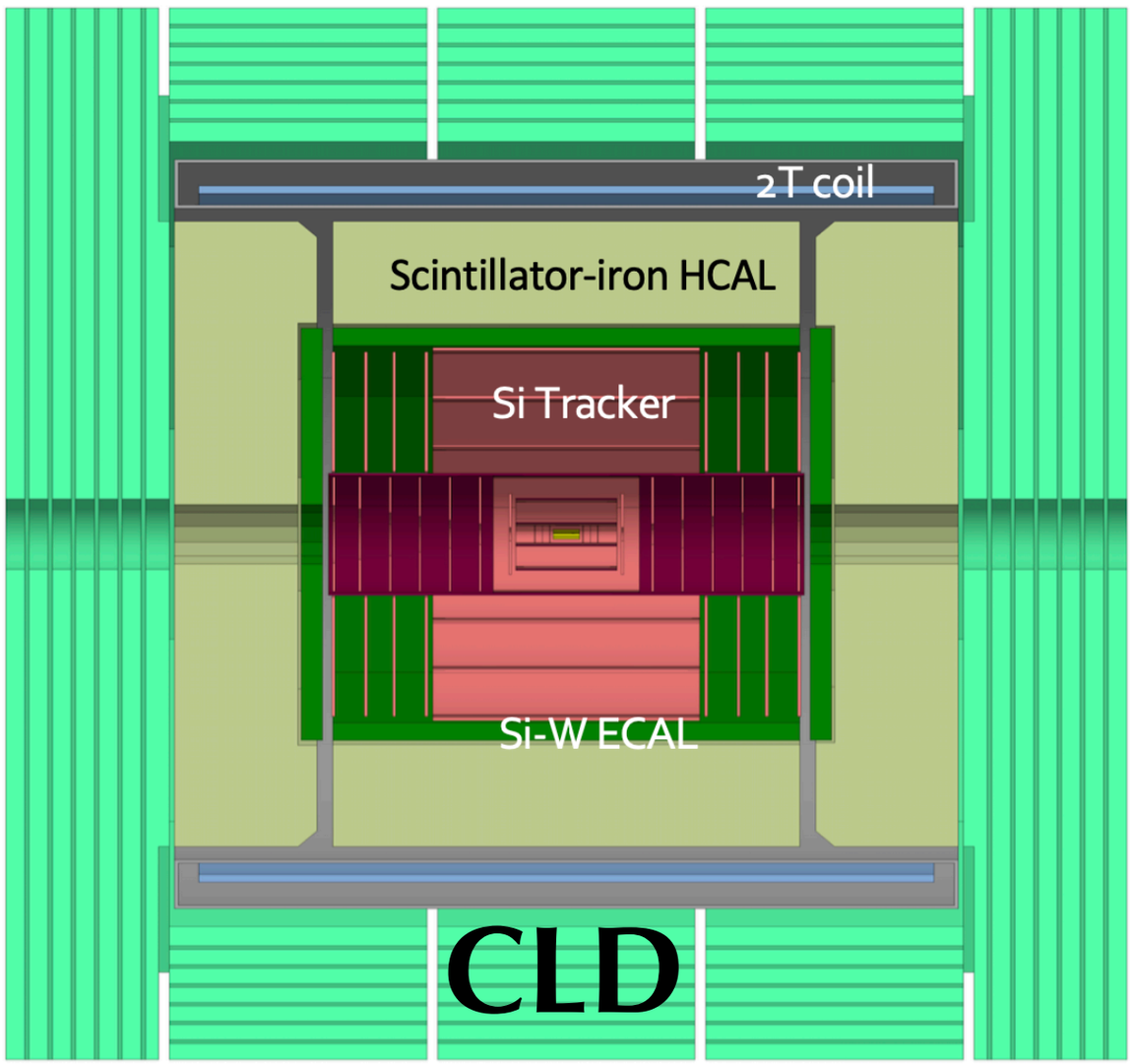


FCC-ee (new) physics case



FCC-ee detectors





- Silicon vertex detector
- Drift chambers for tracking
- Solenoid coil inside calorimeter
- Micro-RWELL for muon detection

- All silicon vertex detector and tracking
- High-granularity calorimeter
- Solenoid coil outside calorimeter
- RPC-based muon system

The project:
Future **C**ollider **E**xperiment

- **Time travel** a few decades into the future
- **Discover** how the physics analysis works with the data taken by the next-generation collider experiments
- **Measure** the already known processes
- **Hunt** for new particles and interactions

FCE

- We will use the **fce** analysis tool (platform-agnostic)
- Get it via **pypi**: https://pypi.org/project/fce/

➡ pip install fce --user

Histogram creation

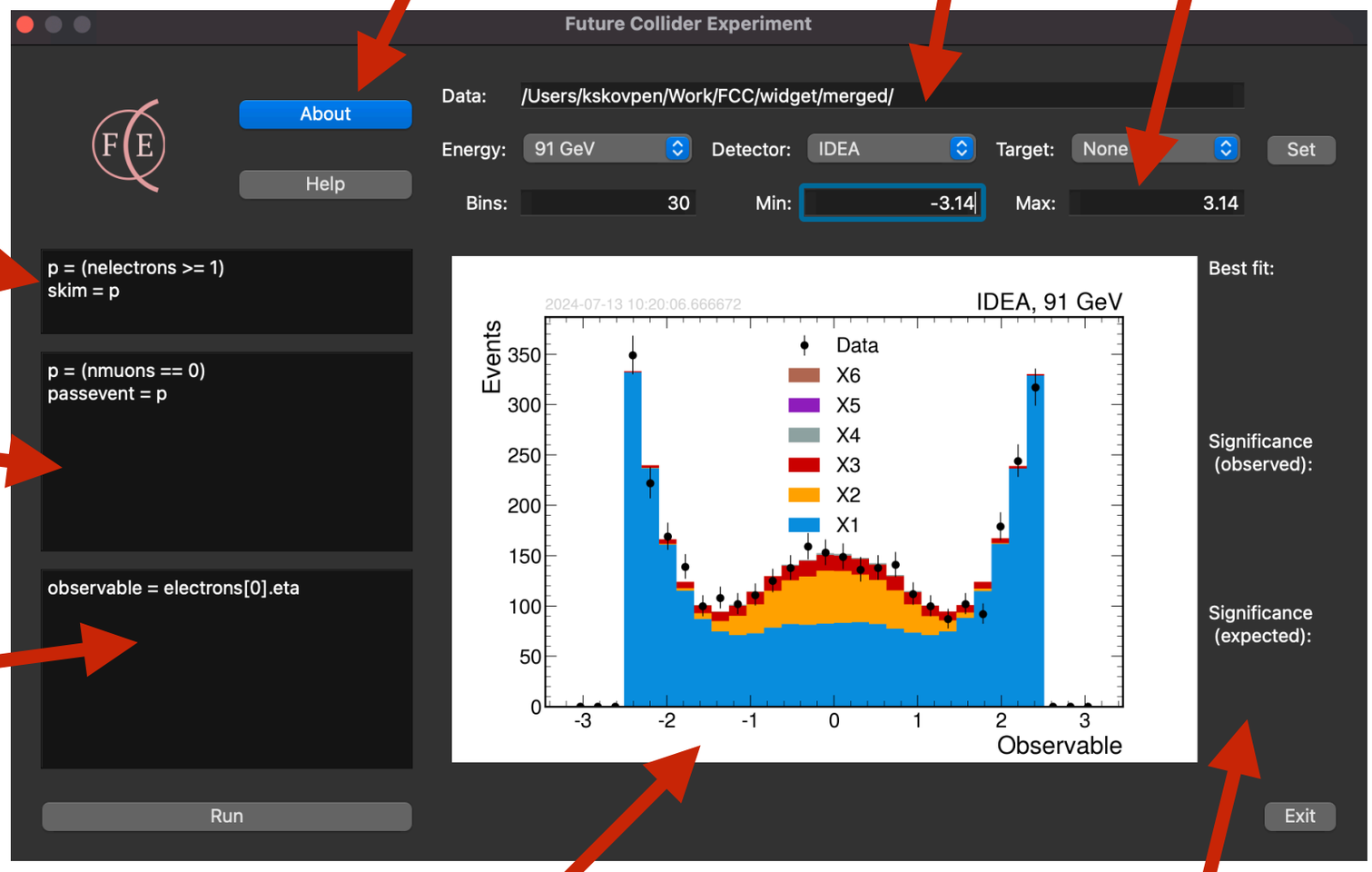
Dataset selection

List of predefined **variables**

Event **skim** selection

Event **selection** criteria

Define the main analysis **observable**



*N.B.: Code syntax is **python**!*

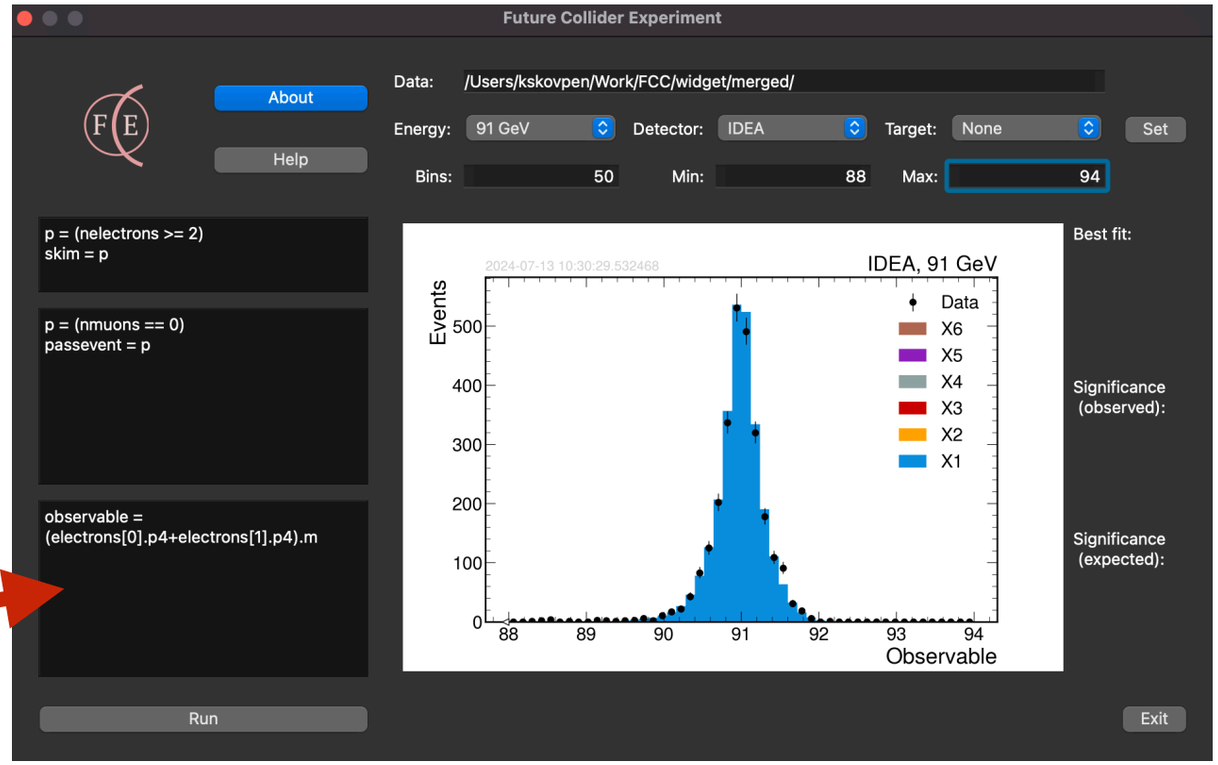
Analysis **result**

Statistical analysis

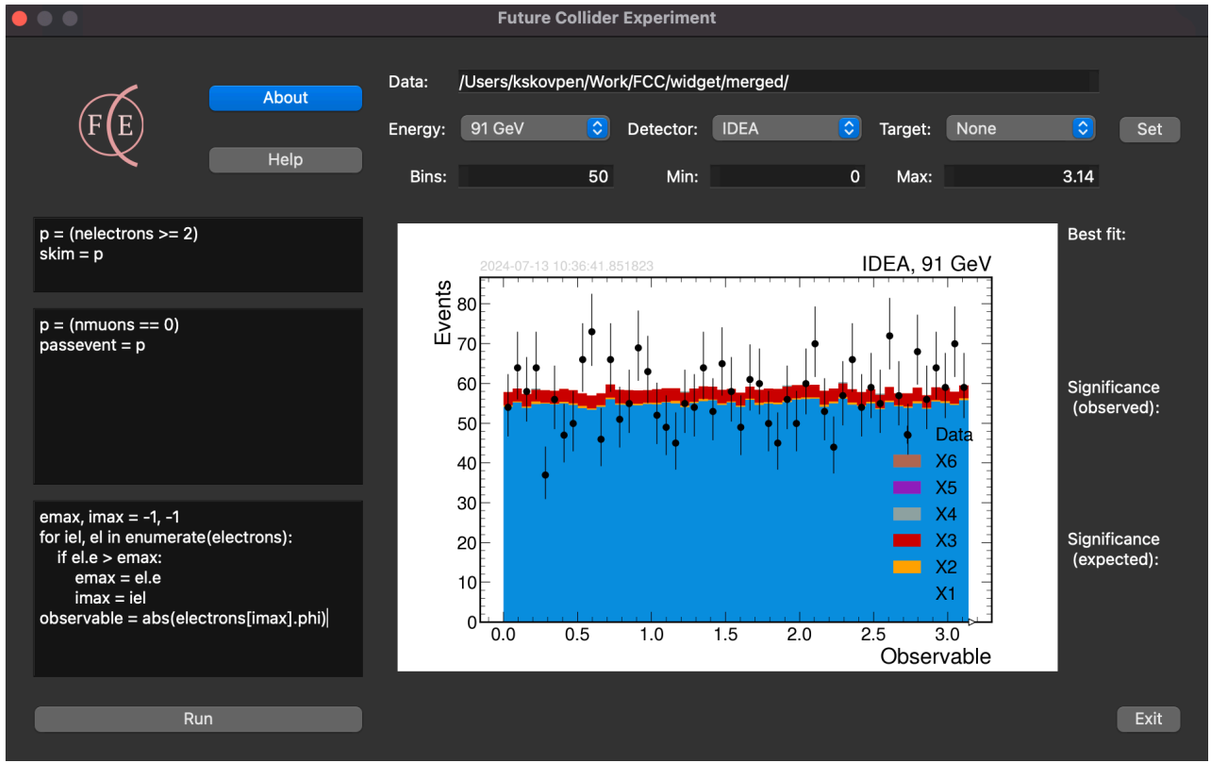
Analysis examples

Invariant mass of two electrons

Vector operations as defined by **vector** library



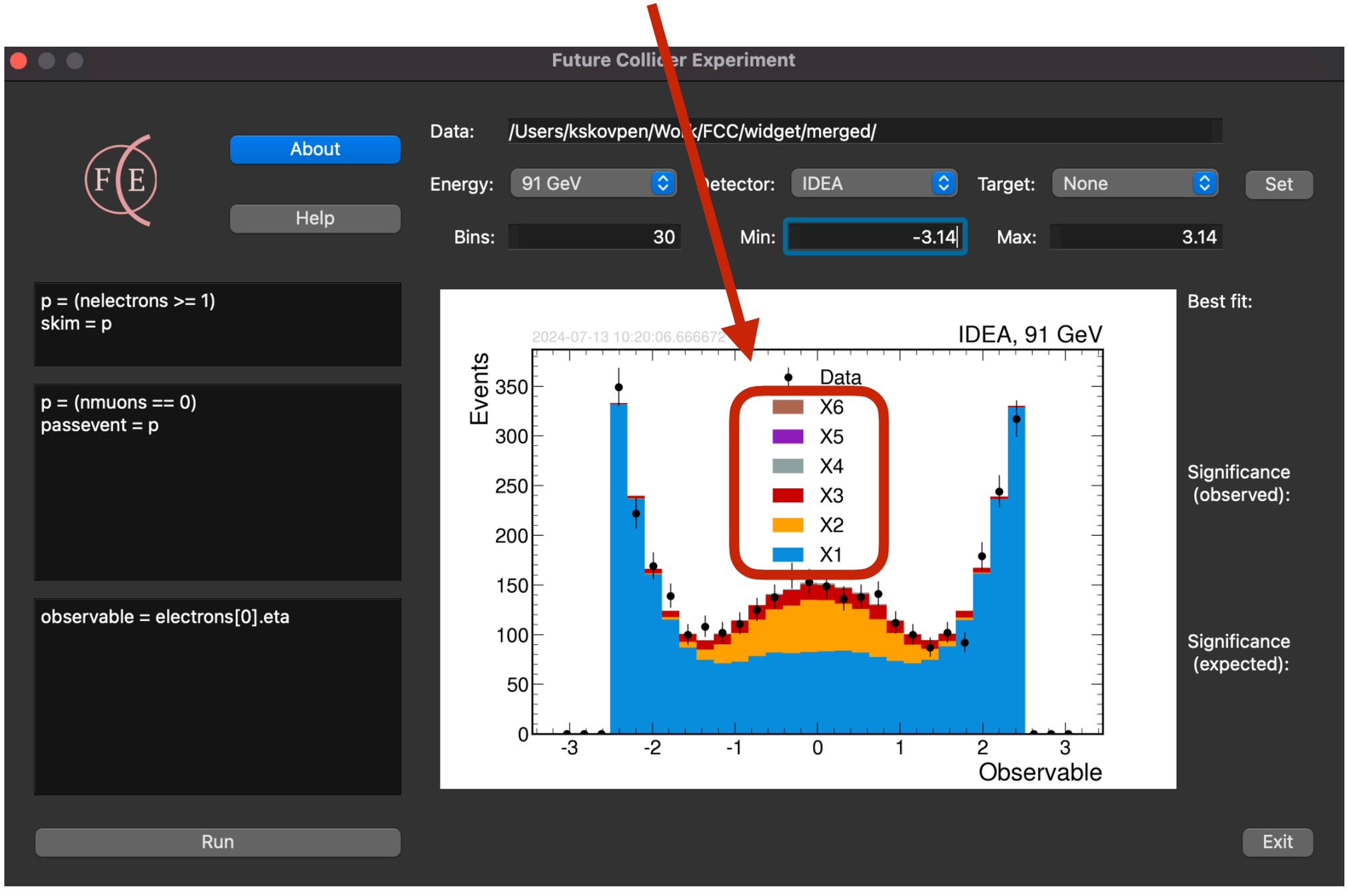
Beware of **tabulation** in python syntax



Azimuth angle of the **most energetic** electron in event

Task

What are these processes? Give the detailed definition and measure their production cross sections



Installation

Install

```
foo@bar:~$ pip install fce --user
```

Run

```
foo@bar:~$ fce
```

Data sets

The simulated collision events are available for the four main center-of-mass energies (91, 160, 240, and 365 GeV) and can be downloaded by:

```
foo@bar:~$ fce-datasets
```

This will download all available datasets in the current directory.

Can be done either **locally on your laptop**,
or just **log in** to bnd02.iihe.ac.be (the input data are available at /var/bnd/fcc/datasets/)

The work plan

- Split into **two research groups** = two collaborations (**IDEA** and **CLD**)
- **Organize** your experiment:
  - Work out strategies to study SM processes and look for new physics
  - Optimize task forces
  - Select the spokesperson …

➡ Study **FCC-ee** collisions at the four main energy points (**91**, **160**, **240**, and **365 GeV**)

➡ Prepare your results in the **presentation** format discussing observations and underlying physics

➡ The **assessment** of the results will be based on the quality of your discoveries as well as the level of understanding of the obtained results

➡ **Good luck**!