

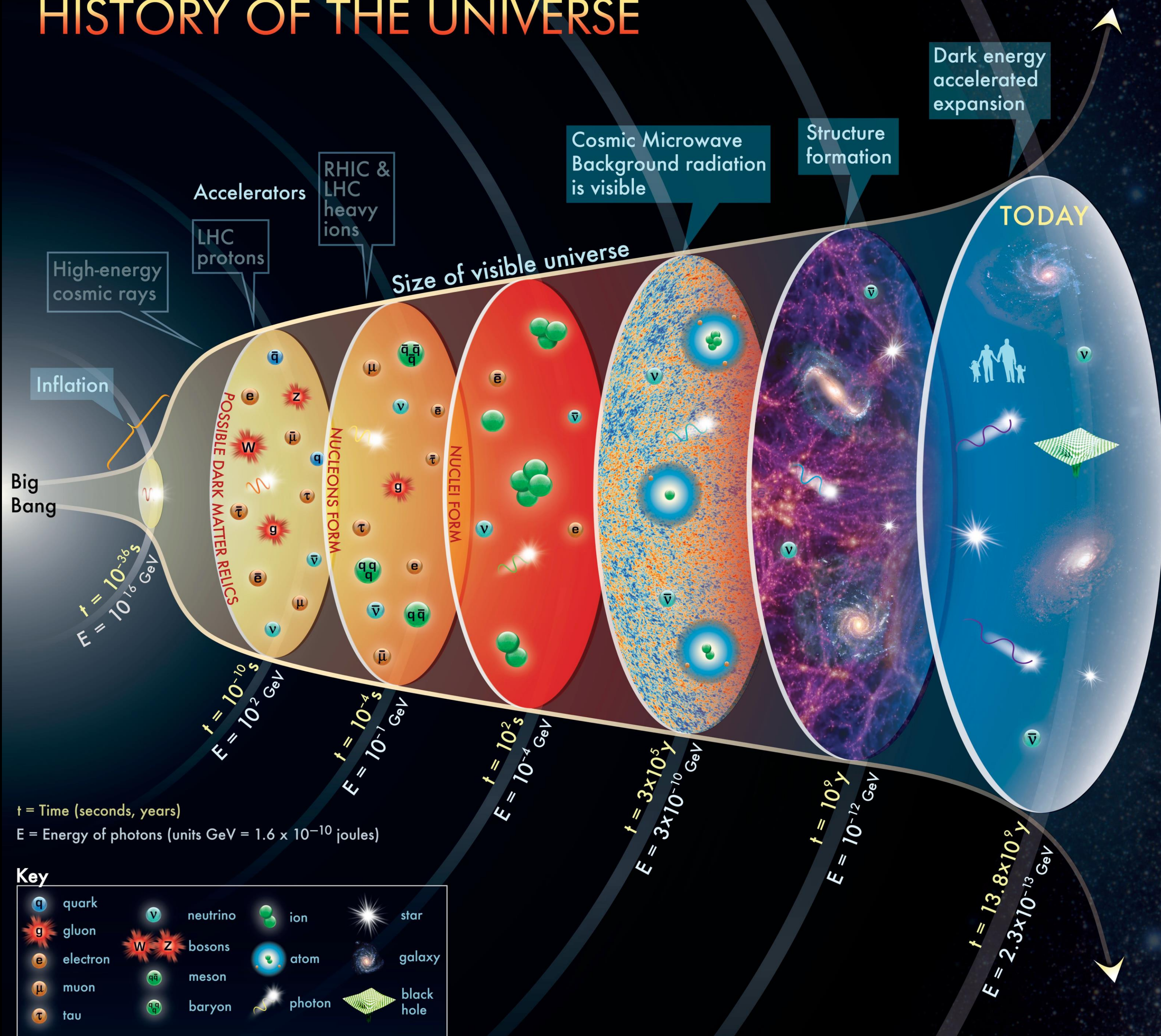
ALICE — Journey to the Big Bang

Kai Schweda (GSI/CERN)

<https://alice.cern/>

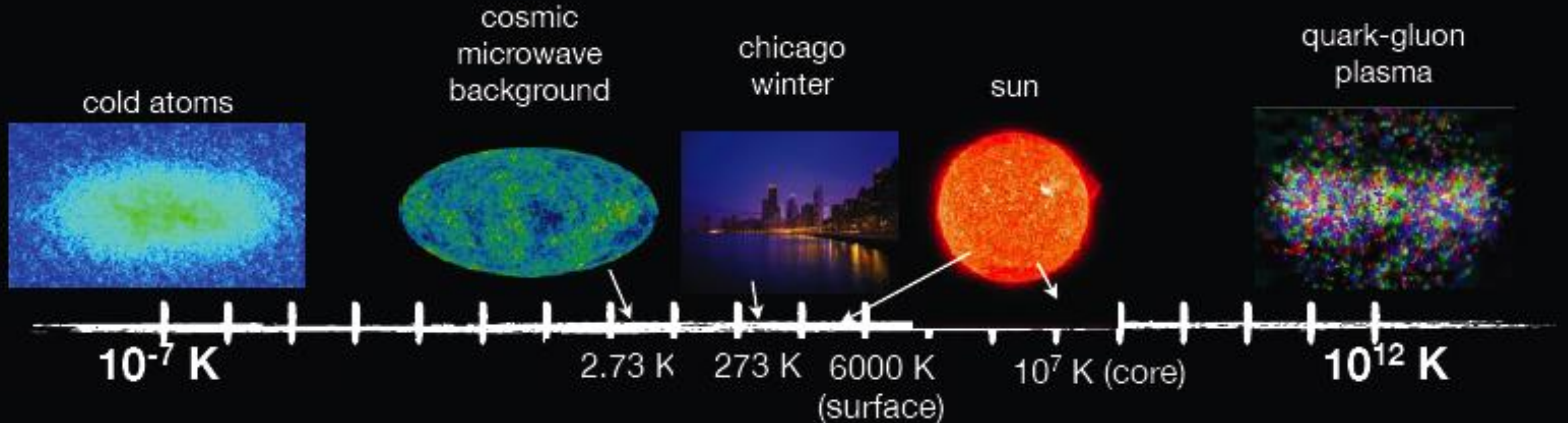


HISTORY OF THE UNIVERSE

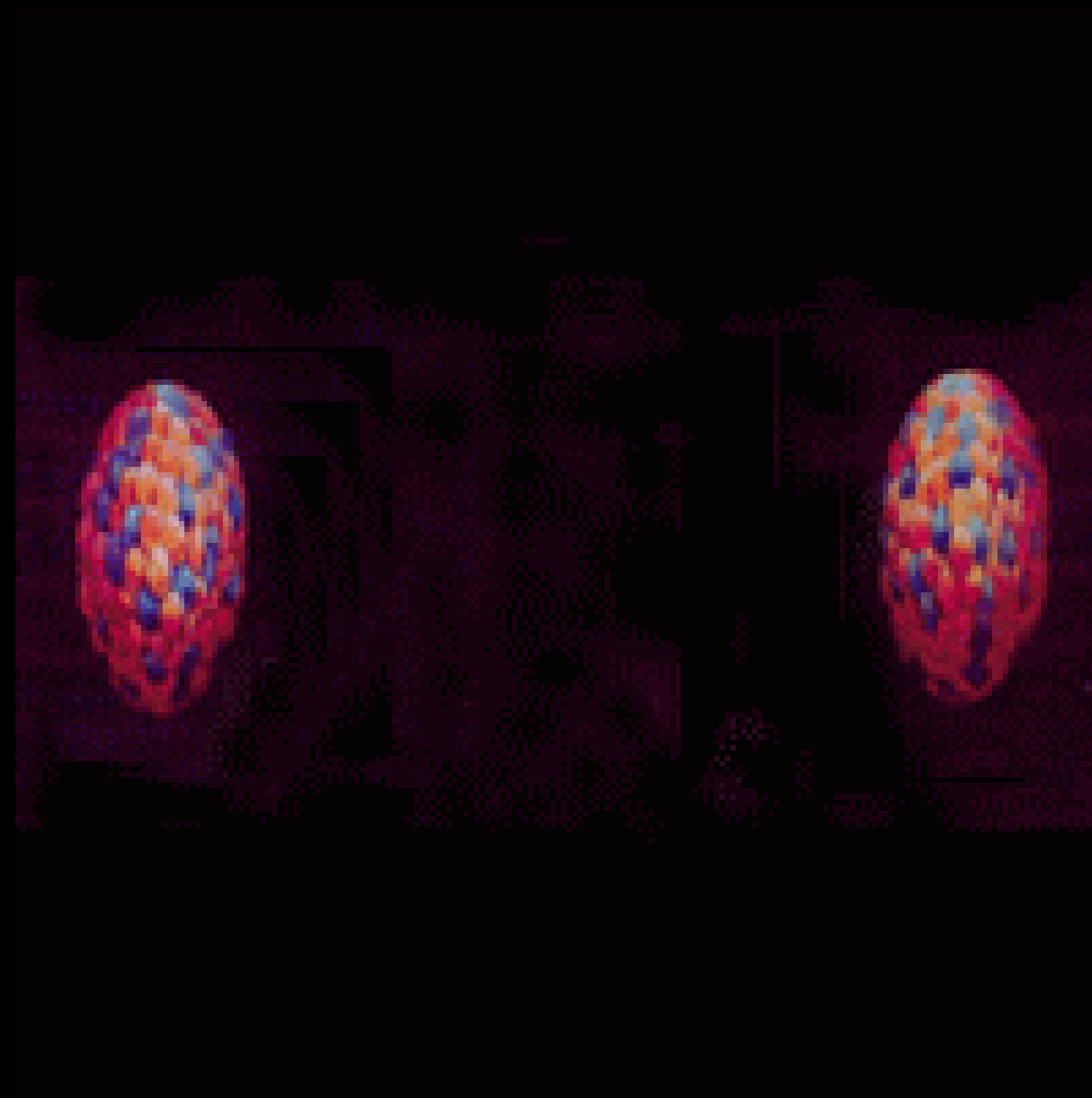


The concept for the above figure originated in a 1986 paper by Michael Turner.

TEMPERATURES IN THE UNIVERSE



COLLISIONS OF ATOMIC NUCLEI



THE LARGE HADRON COLLIDER AT CERN

LHC	7	TeV	$c - 10 \text{ km/h}$
Geiger and Marsden	1	MeV	$c * 5\%$



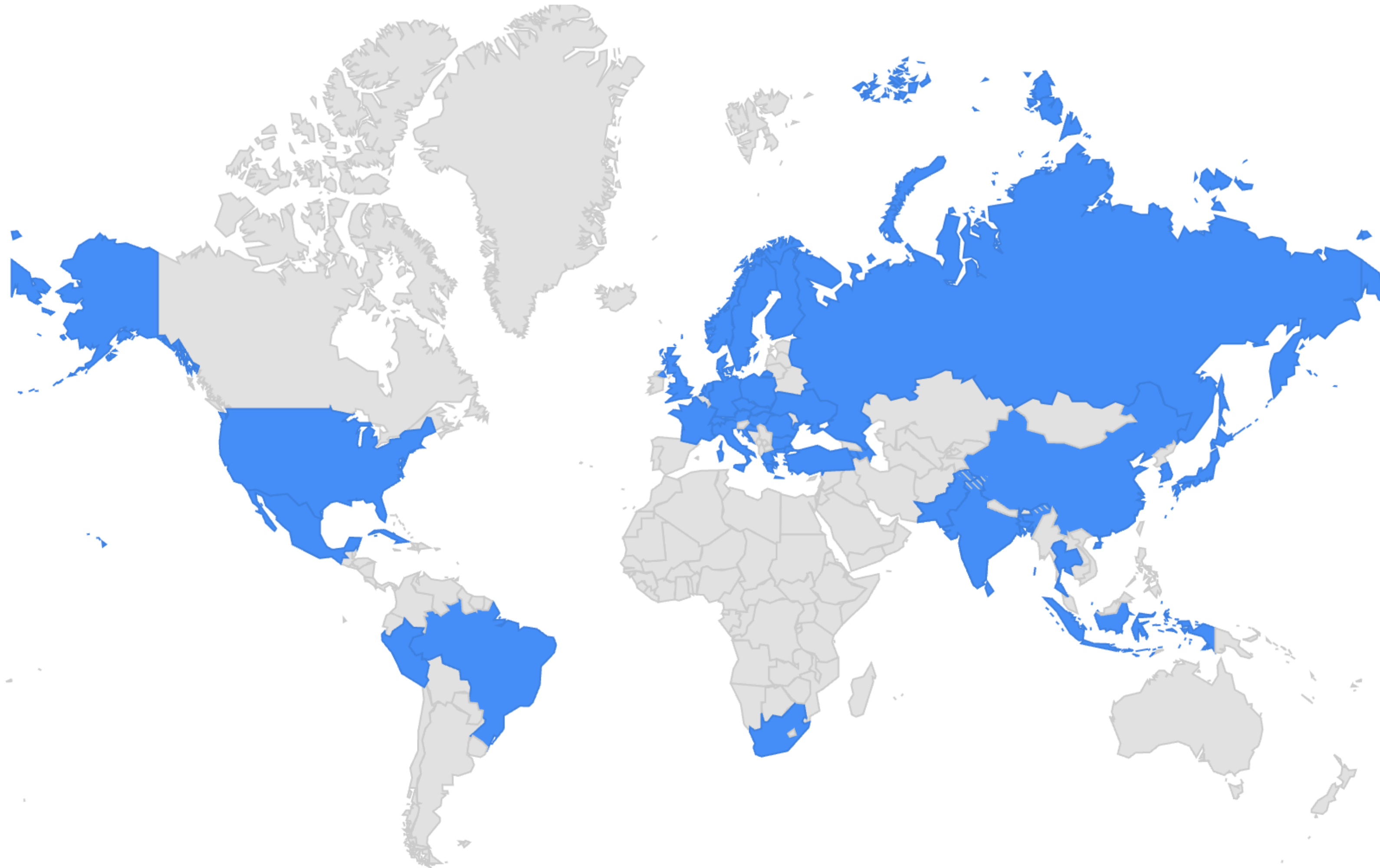
ALICE



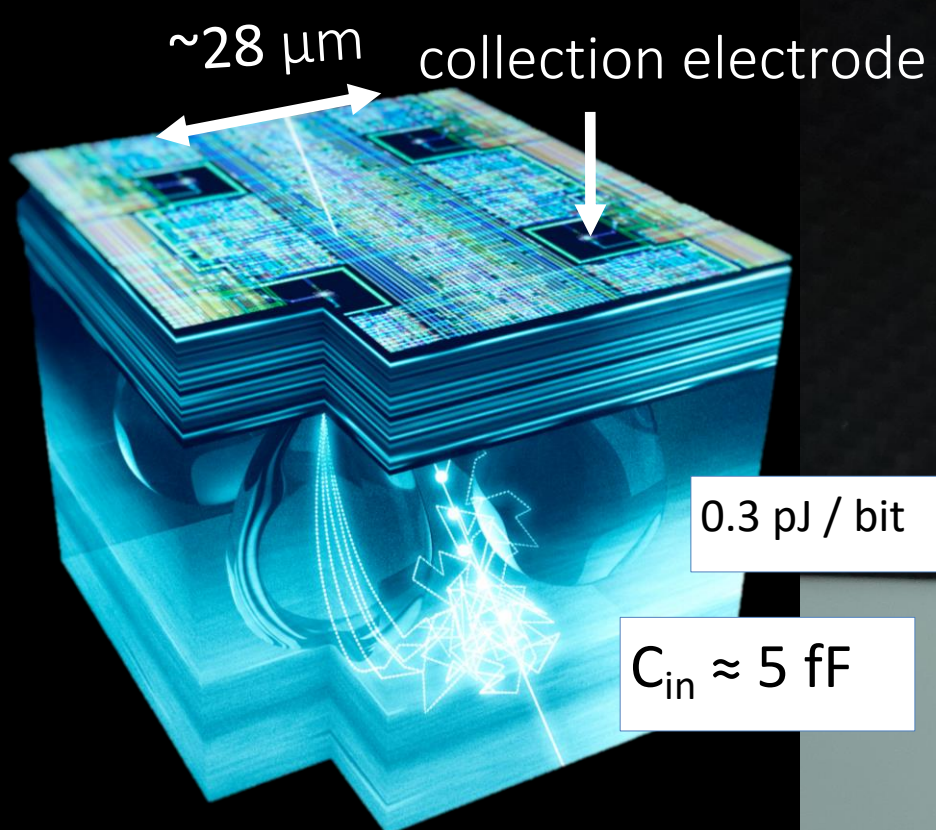
40 COUNTRIES, 169 INSTITUTES, 2000 MEMBERS



ALICE



Inner Tracking System (ITS2)
7 layers, 10 m² silicon
based on MAPS, 12.5 G pixels



0.3 pJ / bit

$C_{in} \approx 5$ fF

Q_{in} (MIP) ≈ 1300 e $\Rightarrow V \approx 40$ mV

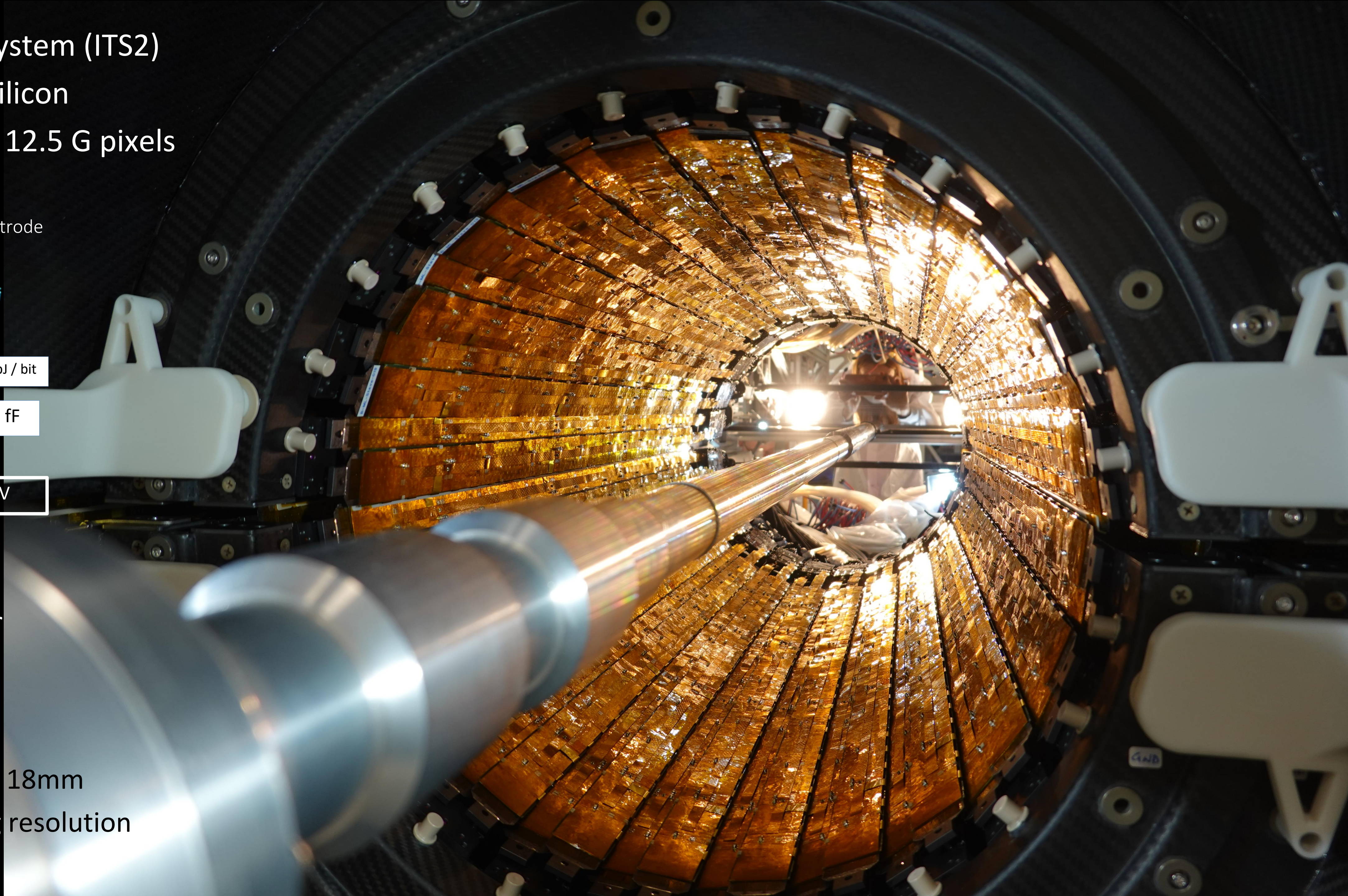
0.36% χ_0 per layer

pixel size:

30 x 30 μm^2

beam pipe radius: 18mm

3x higher pointing resolution



Time Projection Chamber (TPC)

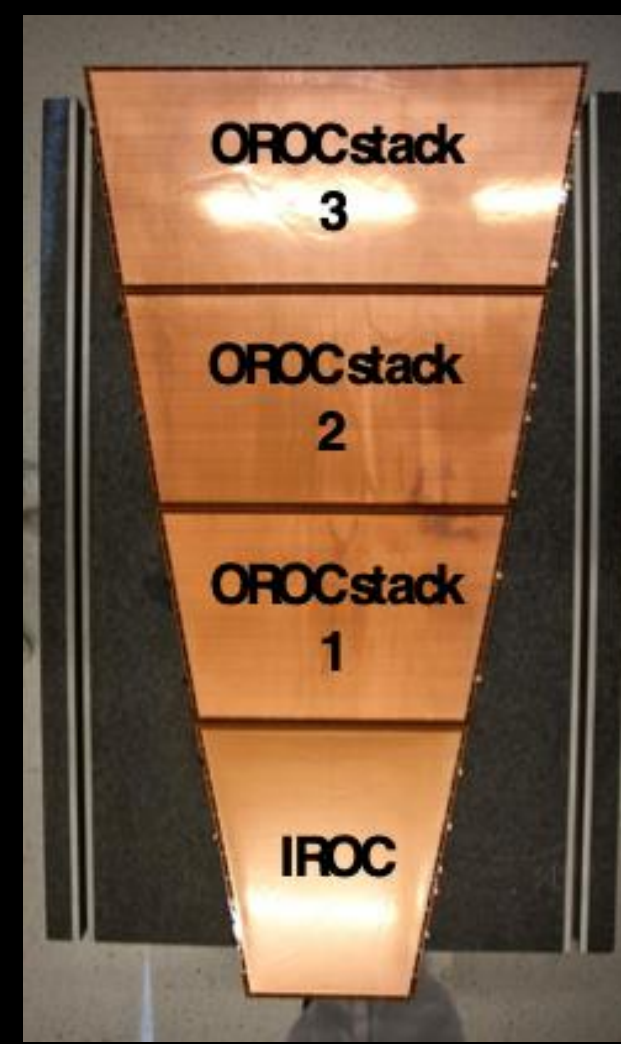
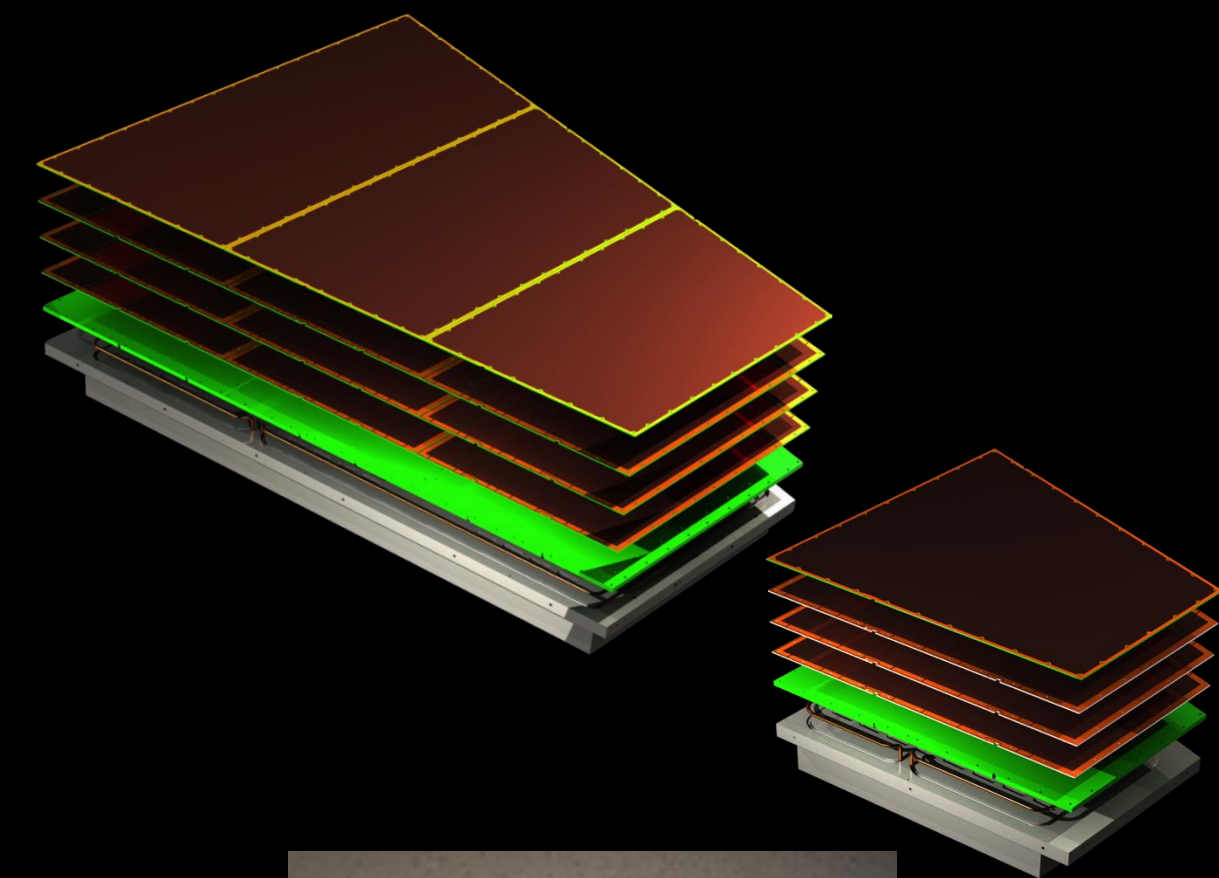
$$V = 88\text{m}^3, \Delta T < 0.1\text{K}$$

Multiwire proportional chamber

→ quadruple-GEM readout

→ continuous readout (100x faster)

3.4 TeraBytes/second



TIME PROJECTION CHAMBER



volume 95 m³

biggest TPC ever

3-d camera

voxel precision better

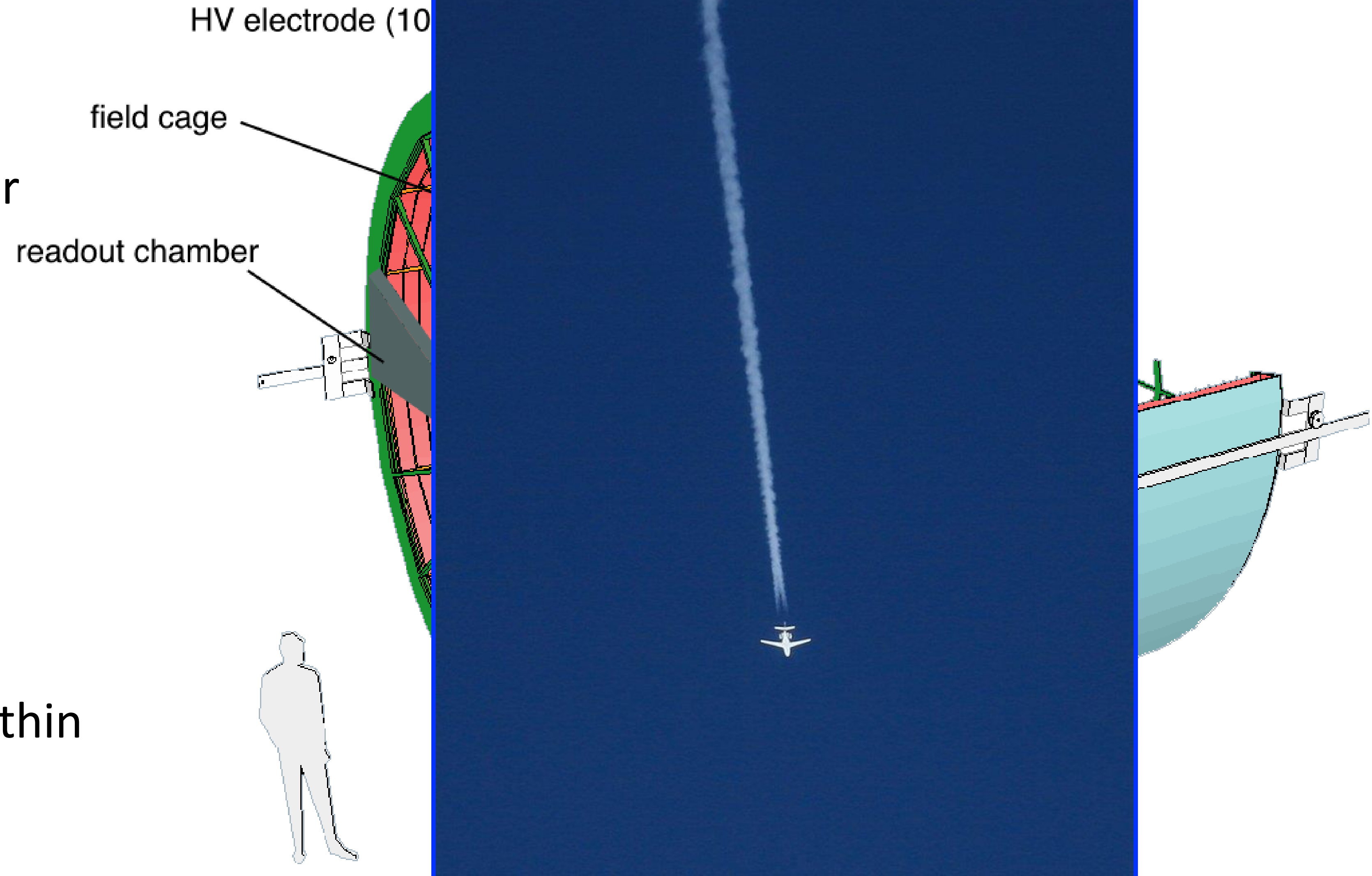
than 500 μ m

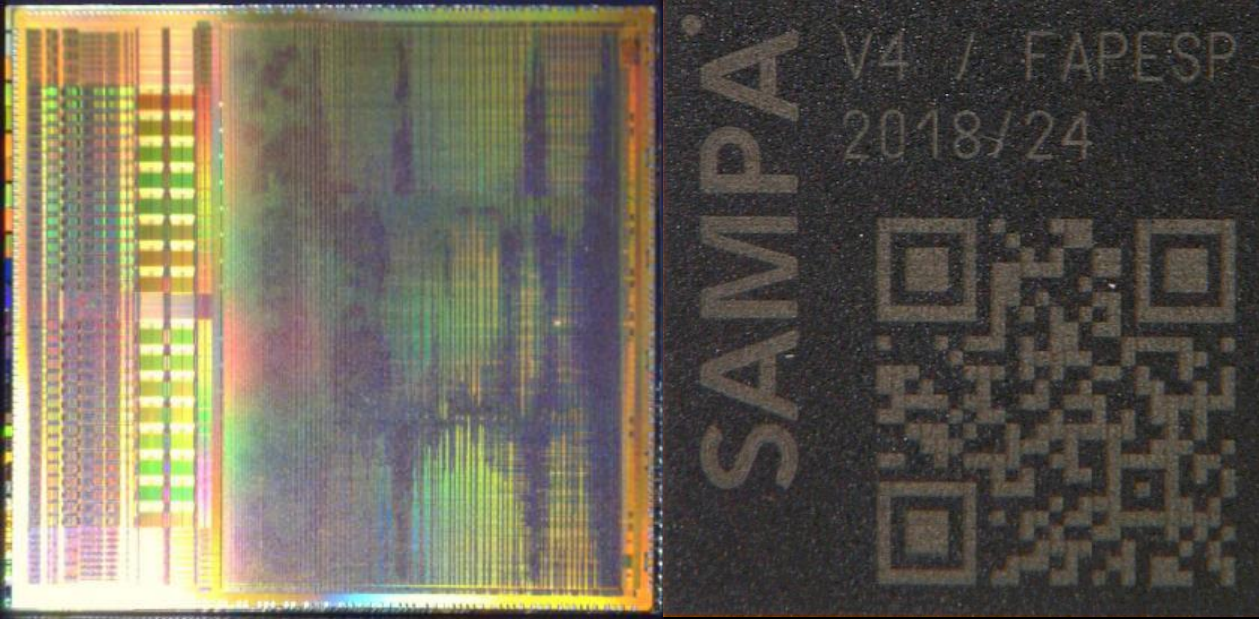
560 million voxels

50 0000 pictures

per second

10 billion pictures within
next 10 years





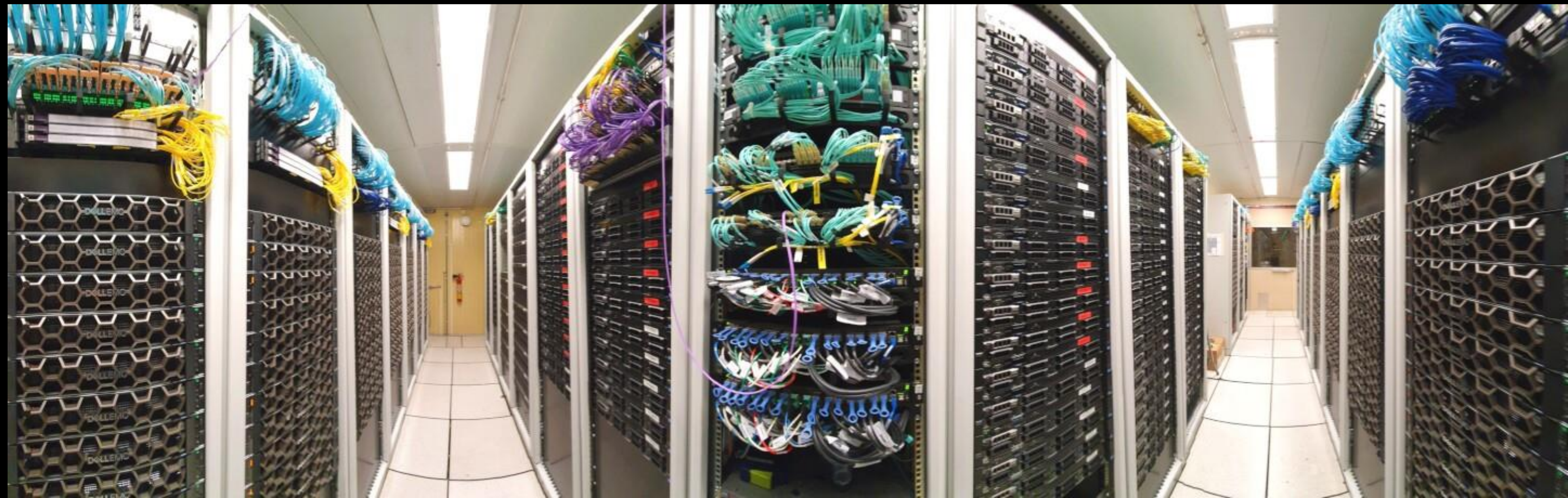
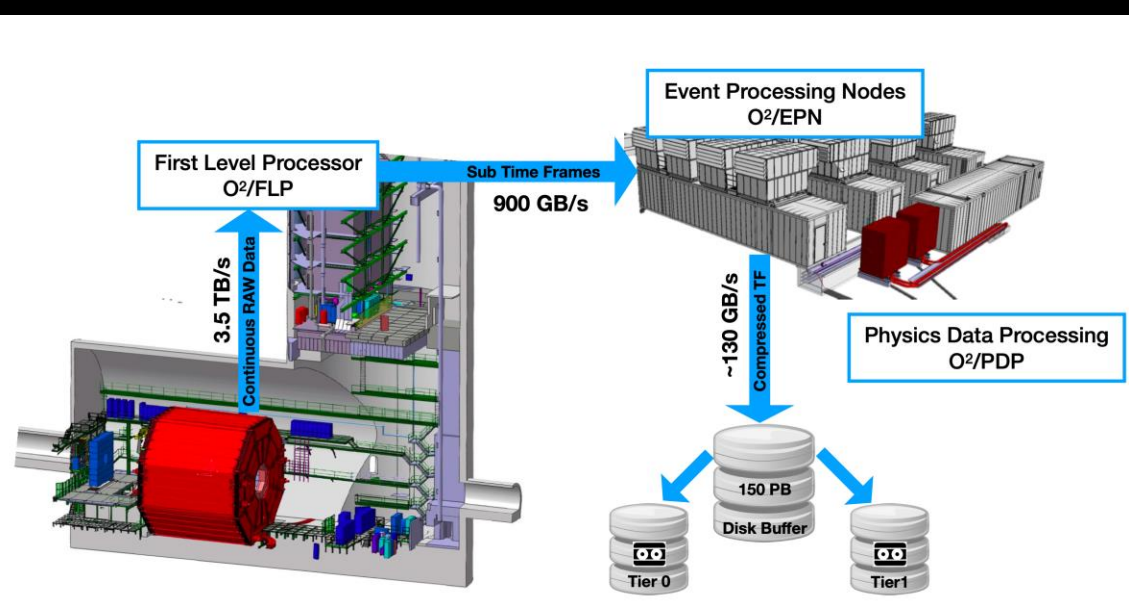
SAMPA chip

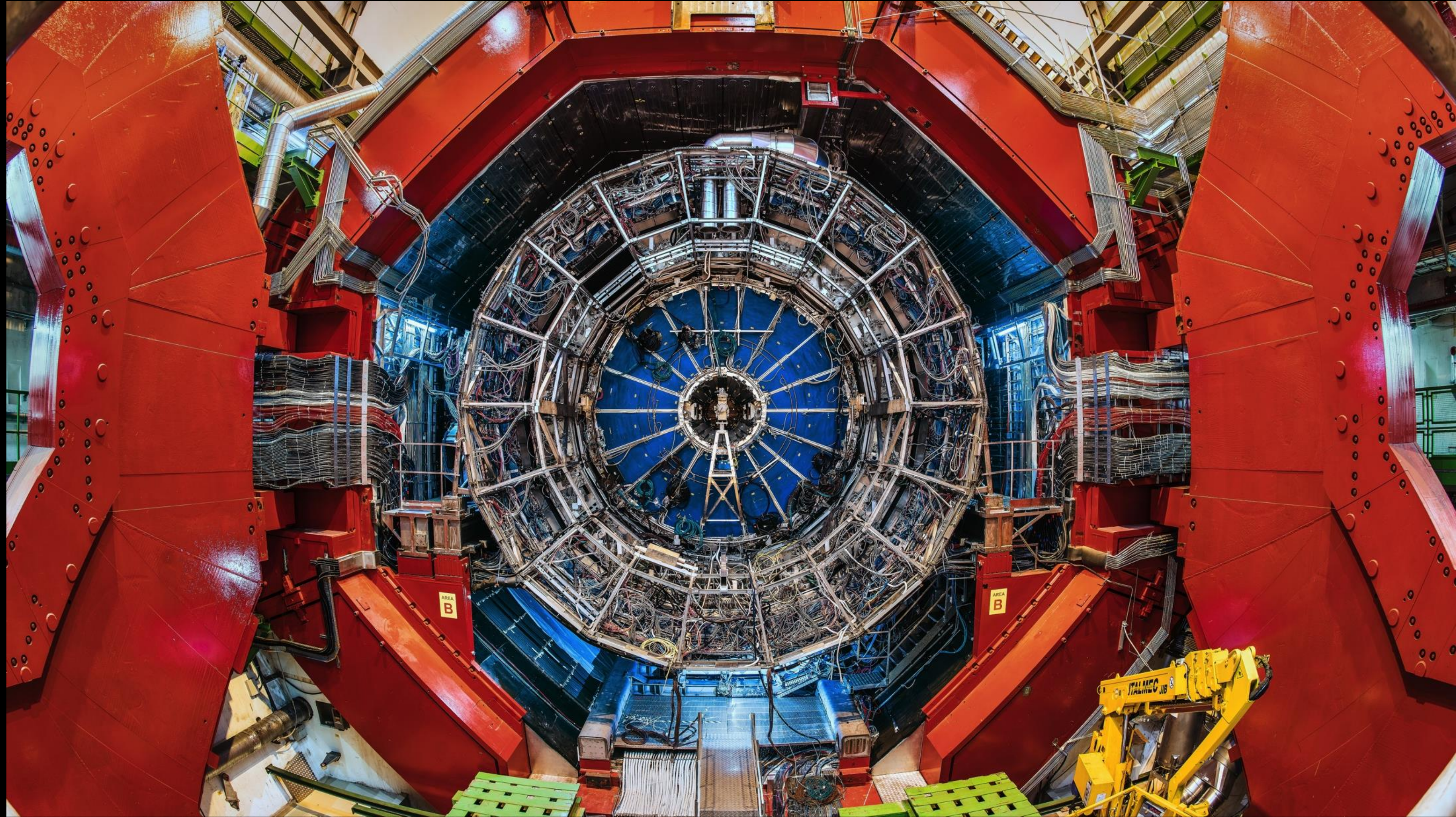
ALICE computing: 3.6 TeraBytes/s raw data → 170 GBytes/s to disk

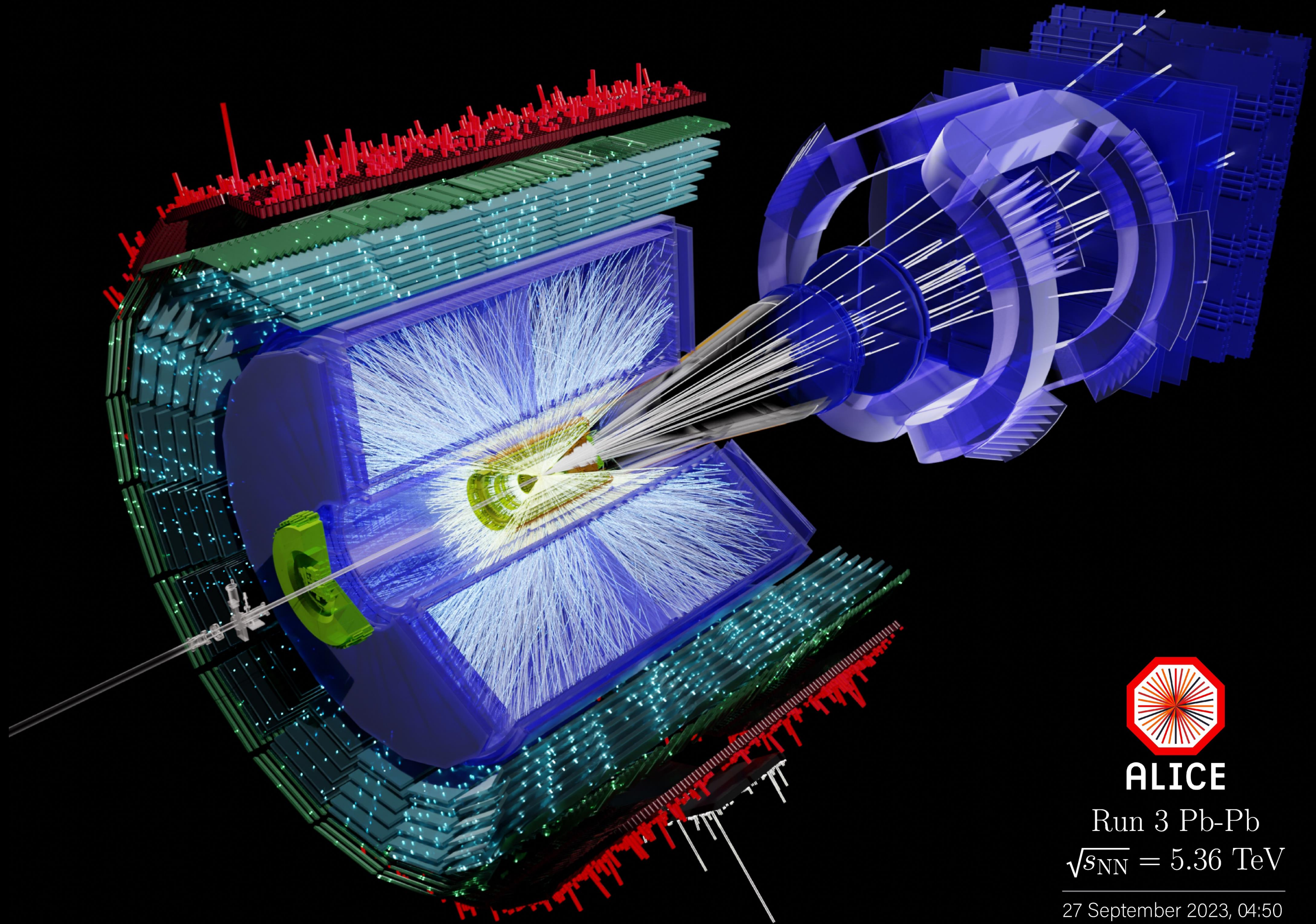
- 350 Server
- 50k CPUs
- 2800 AMD GPUs
- 130 PetaBytes disk



common readout unit
(world's largest FPGA)







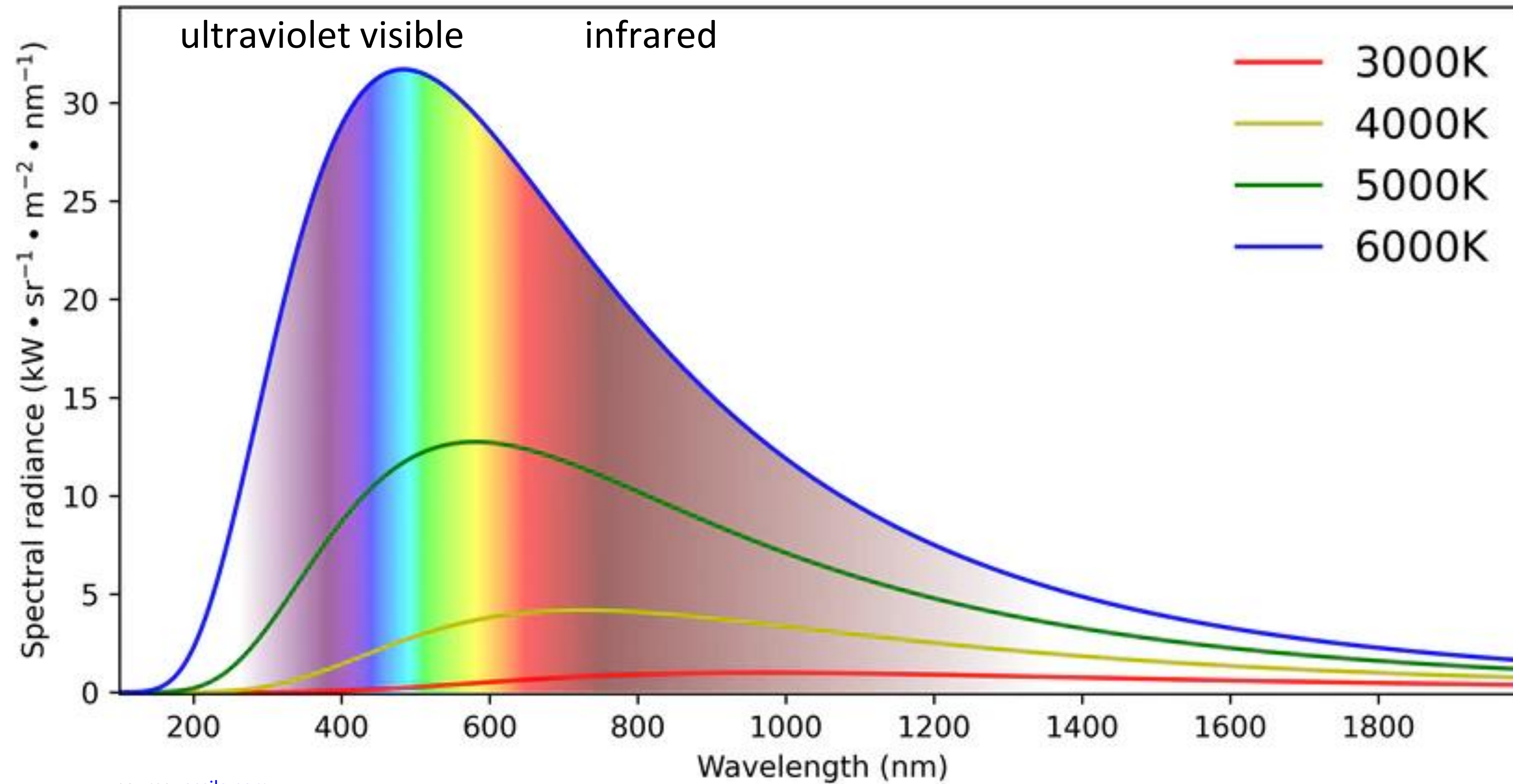
ALICE

Run 3 Pb-Pb

$\sqrt{s_{NN}} = 5.36 \text{ TeV}$

27 September 2023, 04:50

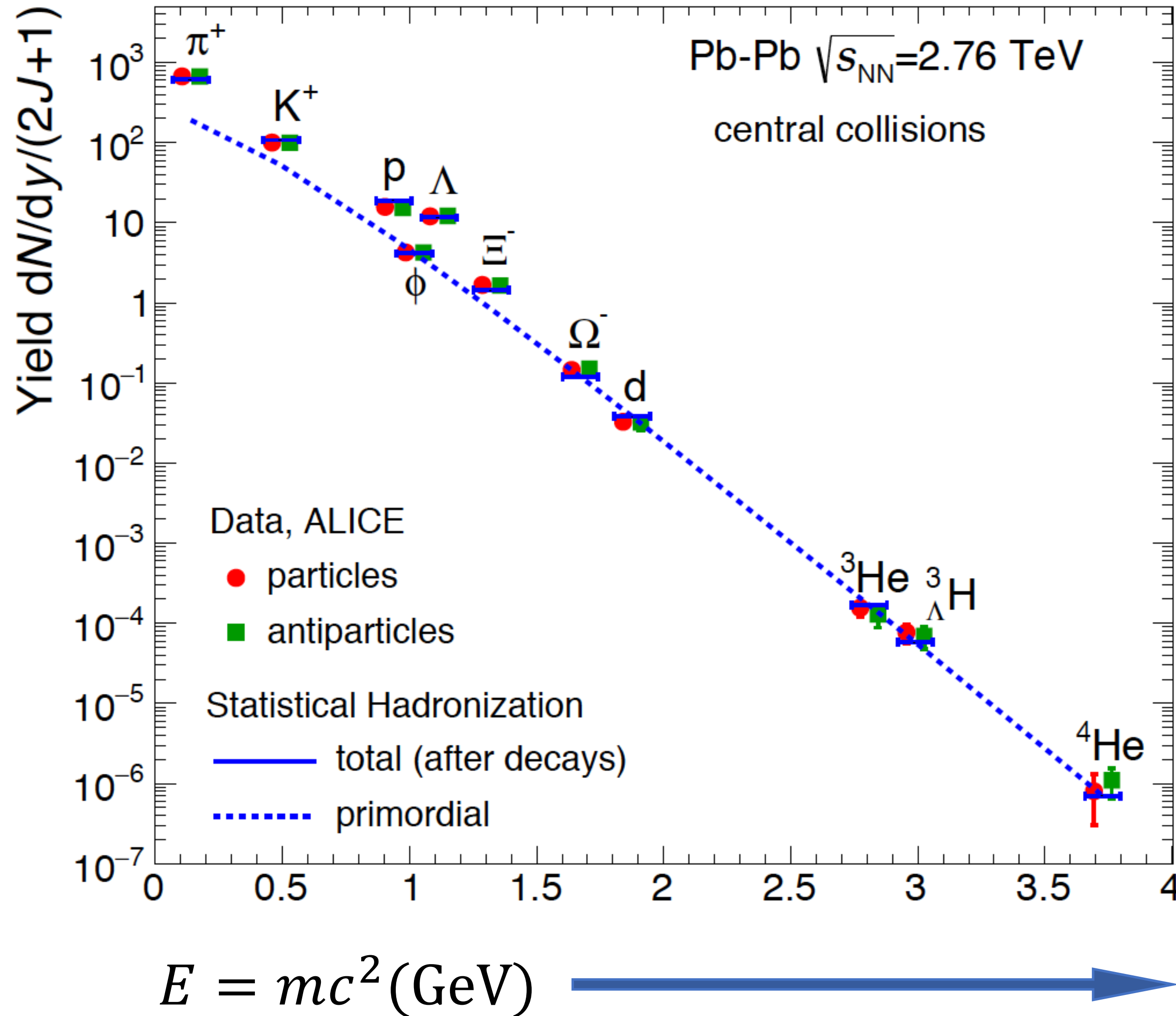
LIGHT FROM THE SUN



source: ossila.com

wave length and intensity solely defined by
temperature $T_{\text{sun}} = 5600 \text{ }^\circ\text{C}$

LIGHT FROM THE SUN



light source \Rightarrow **particle** source

abundance of particles best described by **temperature**

T = 2 000 000 000 000 °C
(2 trillion degree Celsius)

\Rightarrow **100 000 x hotter** than the core of our **sun** !

ALICE RUN CONTROL CENTRE AT P2



2009 - 2018: ALICE

2022 - 2032: ALICE 2

2035 - 2042: ALICE 3