Kunstig intelligens (KI)

- fra CERN til teknologiutvikling i Norge

Are Strandlie, professor i fysikk
NTNU i Gjøvik

Møte i Østre Toten Rotaryklubb, 17/2 - 2025

- Litt om min bakgrunn:
  - Doktorgrad fra år 2000 i elementærpartikkelfysikk fra Fysisk Institutt, Universitetet i Oslo (UiO)
  - Jobbet to år som forsker på CERN etter doktorgrad med fokus på KI-inspirerte metoder
  - Førsteamanuensis og etter hvert professor i fysikk ved NTNU i Gjøvik (Høgskolen i Gjøvik frem til 2016)
  - Professor II (tidligere) ved Fysisk Institutt, UiO, i en 10-årsperiode
  - Nytt fokus på forskning med bruk av KI-metoder de siste årene

- Dette foredraget vil IKKE dreie seg om svært viktige temaer som eksempelvis
  - store KI-baserte språkmodeller (ChatGPT, DeepSeek, ..) og kunstig genererte bilder og video
  - samfunnsmessige konsekvenser av KI
  - generell kunstig intelligens
- Fokus vil være på en historisk svært viktig driver for KI-utvikling
  - **behovet for analyse av svært store mengder av komplekse naturvitenskapelige og teknologiske data**
  - det internasjonale fysikk-forskningssenteret CERN i Geneve er en av eksponentene for en slik type utvikling

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PRESS RELEASE

8 October 2024

The Nobel Prize in Physics 2024

The Royal Swedish Academy of Sciences has decided to award the Nobel Prize in Physics 2024 to

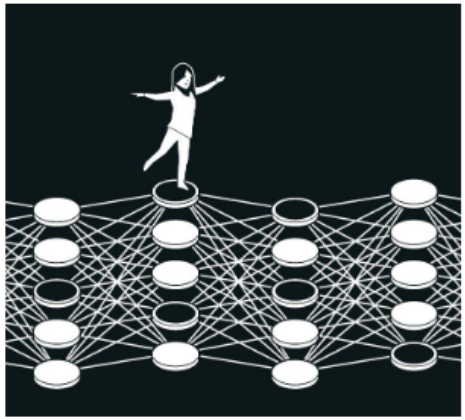
John J. Hopfield
Princeton University, NJ, USA

Geoffrey Hinton
University of Toronto, Canada

"for foundational discoveries and inventions that enable machine learning with artificial neural networks"

They trained artificial neural networks using physics

They used physics to find patterns in information



Many people have experienced how computers can translate between languages, interpret images and even conduct reasonable conversations. What is perhaps less well known is that this type of technology has long been important for research, including the sorting and analysis of vast amounts of data. The development of machine learning has exploded over the past fifteen to twenty years and utilises a structure called an artificial neural network. Nowadays, when we talk about *artificial intelligence*, this is often the type of technology we mean.

Første publikasjon (1987) av KI ved CERN

NEURAL NETWORKS AND CELLULAR AUTOMATA IN EXPERIMENTAL HIGH ENERGY PHYSICS

B. DENBY

Laboratoire de l'Accélérateur Linéaire, Orsay, France

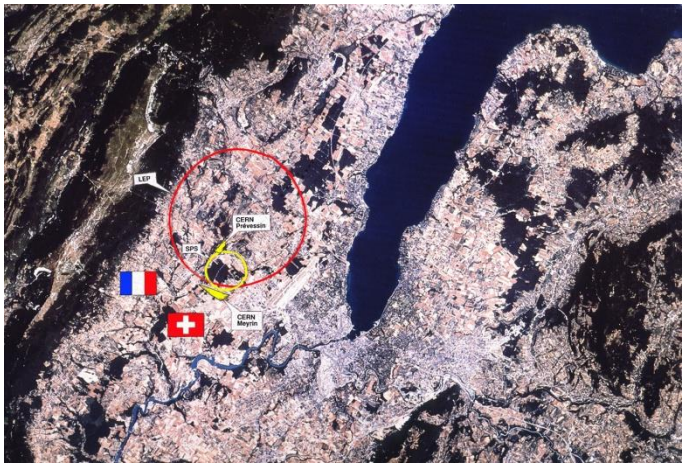
Received 20 September 1987; in revised form 28 December 1987

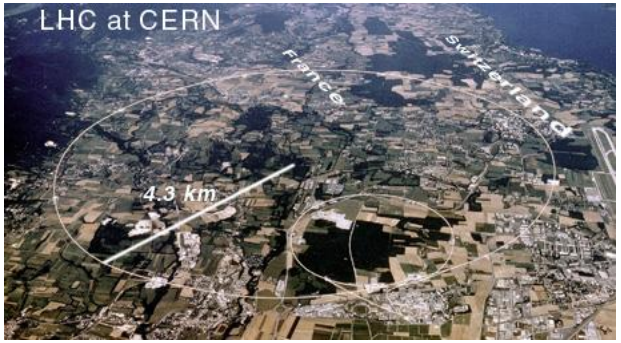
Within the past few years, two novel computing techniques, cellular automata and neural networks, have shown considerable promise in the solution of problems of a very high degree of complexity, such as turbulent fluid flow, image processing, and pattern recognition. Many of the problems faced in experimental high energy physics are also of this nature. Track reconstruction in wire chambers and cluster finding in cellular calorimeters, for instance, involve pattern recognition and high combinatorial complexity since many combinations of hits or cells must be considered in order to arrive at the final tracks or clusters. Here we examine in what way connective network methods can be applied to some of the problems of experimental high energy physics. It is found that such problems as track and cluster finding adapt naturally to these approaches. When large scale hard-wired connective networks become available, it will be possible to realize solutions to such problems in a fraction of the time required by traditional methods. For certain types of problems, faster solutions are already possible using model networks implemented on vector or other massively parallel machines. It should also be possible, using existing technology, to build simplified networks that will allow detailed reconstructed event information to be used in fast trigger decisions.

Innhold

- Hva er CERN ?
- Hvordan anvendes kunstig intelligens ved CERN ?
- Hvordan kan det norske samfunnet nyttiggjøre seg denne type kunnskap ?

- CERN (European Laboratory for Particle Physics)
  - Verdens største forskningslab for elementærpartikkel-fysikk
  - Befinner seg på grensen mellom Sveits og Frankrike rett utenfor Geneve



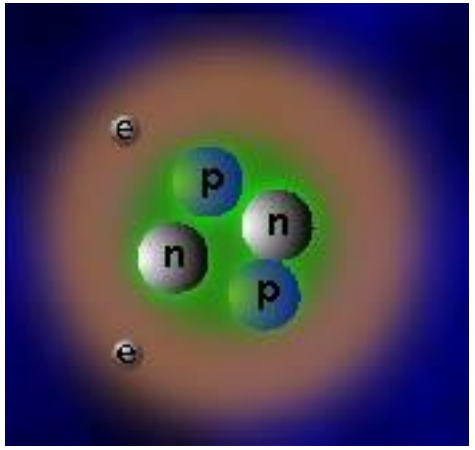


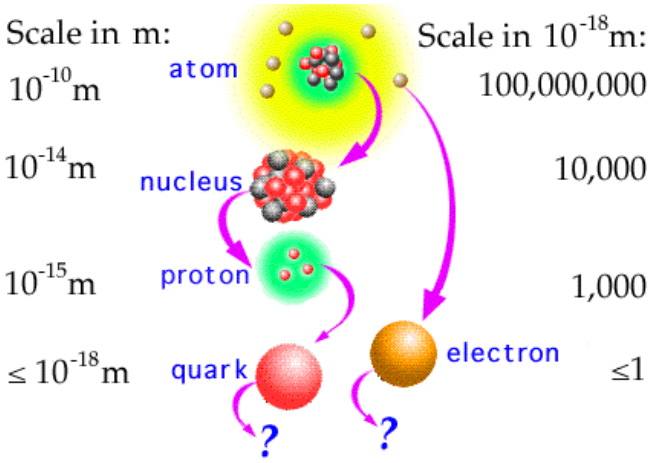
- Elementærpartikkel-fysikk
  - Læren om de aller minste byggesteinene i naturen og kreftene som holder dem sammen
- Atomet

  -> atomkjerne

  -> protoner

  -> kvarker





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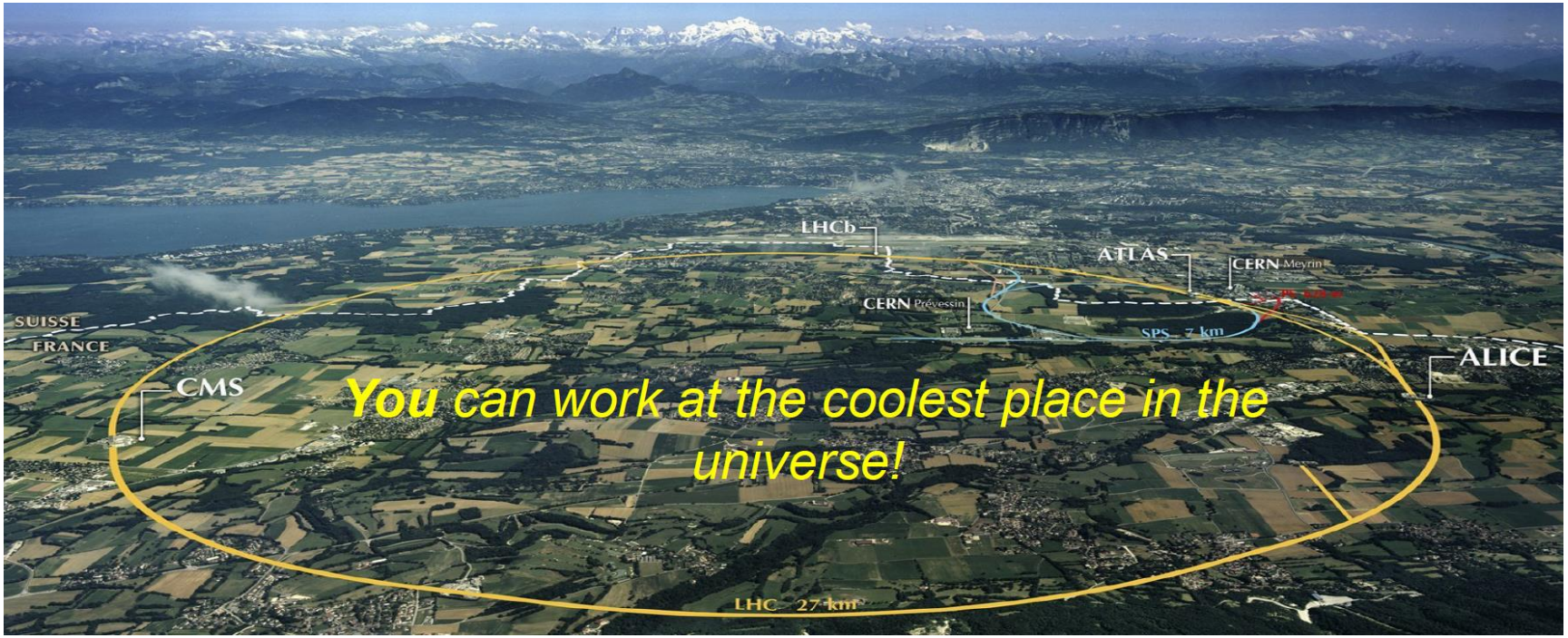
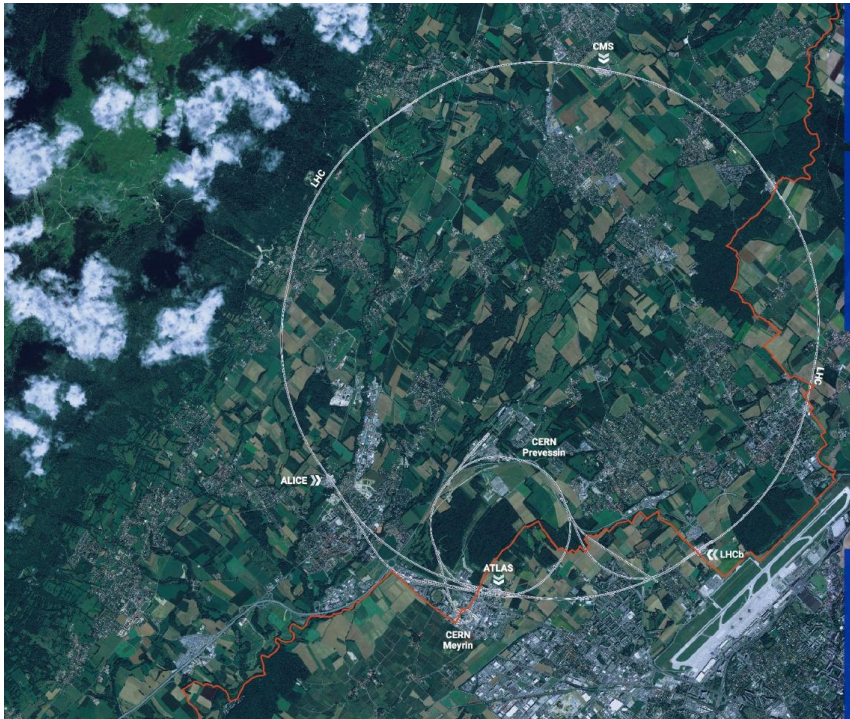


***You** can work at the coolest place in the universe!*



CERN is the world's biggest laboratory for particle physics.

Our goal is to understand the most fundamental particles and laws of the universe.

Located near Geneva on either side of the Swiss French border

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Science for peace

CERN was founded in 1954 with 12 European Member States

24 Member States

Austria – Belgium – Bulgaria – Czech Republic
Denmark – Estonia - Finland – France – Germany –
Greece Hungary – Israel – Italy – Netherlands –
Norway - Poland – Portugal – Romania – Serbia –
Slovakia Spain – Sweden – Switzerland – United Kingdom

2 Associate Member States in the pre-stage to membership

Cyprus – Slovenia

8 Associate Member States

Brazil - Croatia – India – Latvia – Lithuania – Pakistan
Türkiye – Ukraine

6 Observers

Japan – Russia (suspended) – USA
European Union – JINR (suspended) – UNESCO

CERN's annual budget (2024)
1224 MCHF (equivalent
to a medium-sized European
university)

As of 31 December 2023
Employees:
2666 staff, **1008** graduates & fellows
776 students
Associates:
12 370 users, **990** others

Around 50 Cooperation Agreements
with non-Member States and Territories

Albania – Algeria – Argentina – Armenia – Australia – Azerbaijan – Bangladesh – Belarus – Bolivia
Bosnia and Herzegovina – Brazil – Canada – Chile – Colombia – Costa Rica – Ecuador – Egypt – Georgia – Honduras
Iceland – Iran – Jordan – Kazakhstan – Lebanon – Malta – Mexico – Mongolia – Montenegro – Morocco – Nepal
New Zealand – North Macedonia – Palestine – Paraguay – People's Republic of China – Peru – Philippines – Qatar
Republic of Korea – Saudi Arabia – Sri Lanka – South Africa – Thailand – Tunisia – United Arab Emirates – Vietnam

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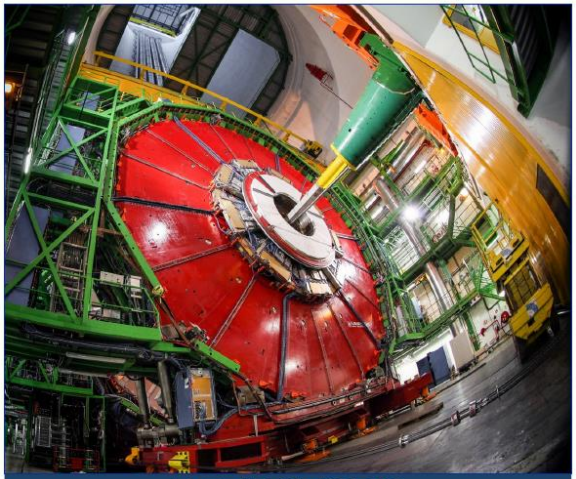
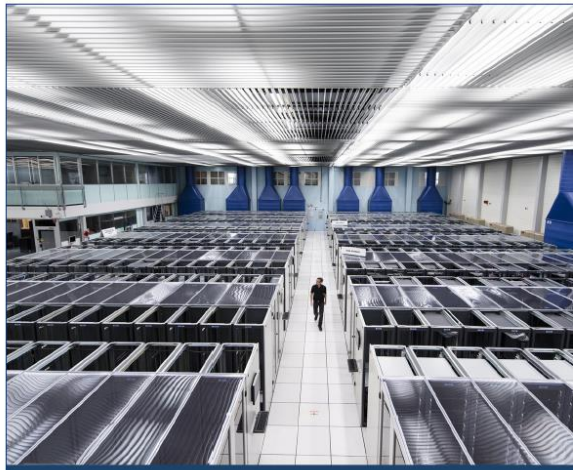
How do we do it?

- We build the largest machines to study the smallest particles in the universe
- We develop technology to advance the limits of what is possible

ACCELERATORS



DETECTORS



COMPUTING

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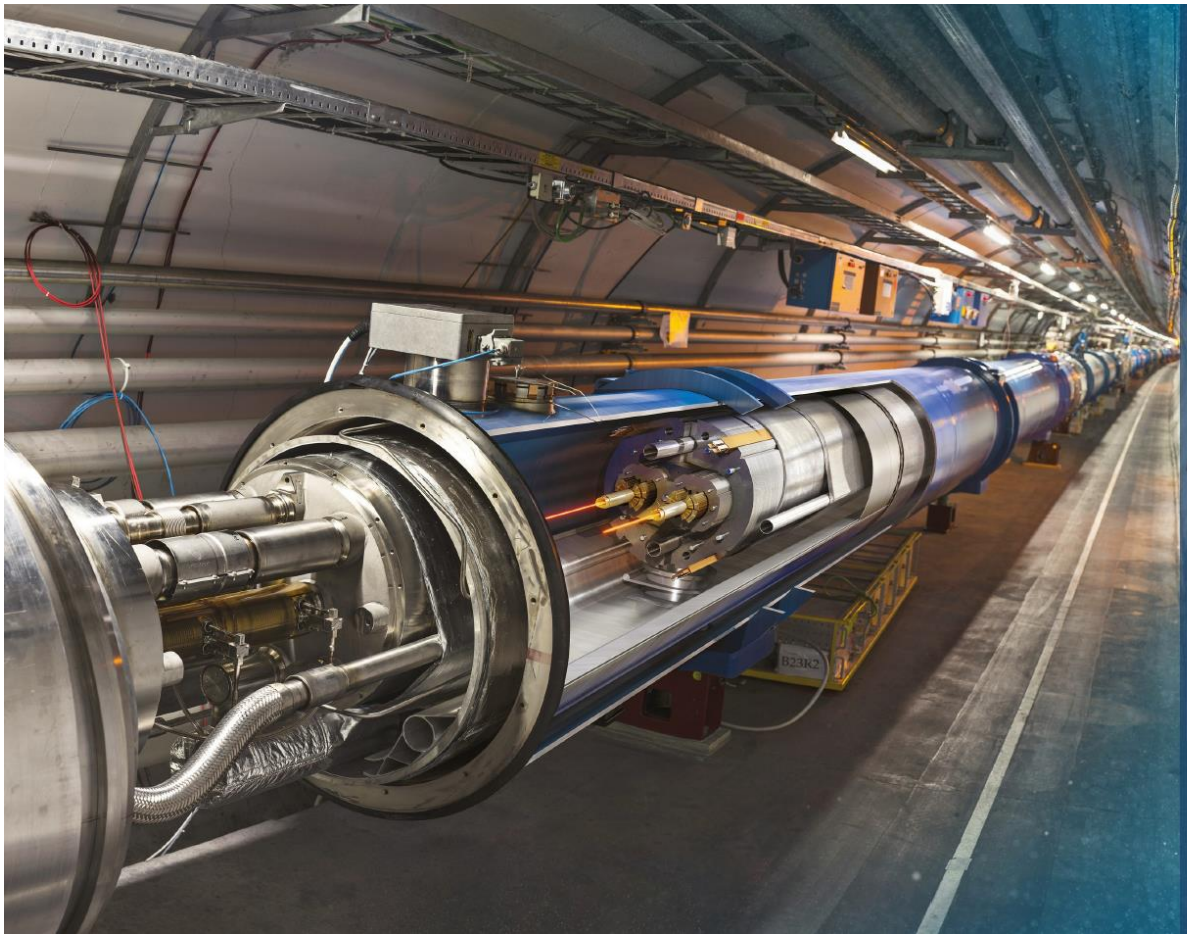

Large Hadron Collider (LHC)

- 27 km in circumference
- About 100 m underground
- Superconducting magnets steer the particles around the ring
- Particles are accelerated to close to the speed of light

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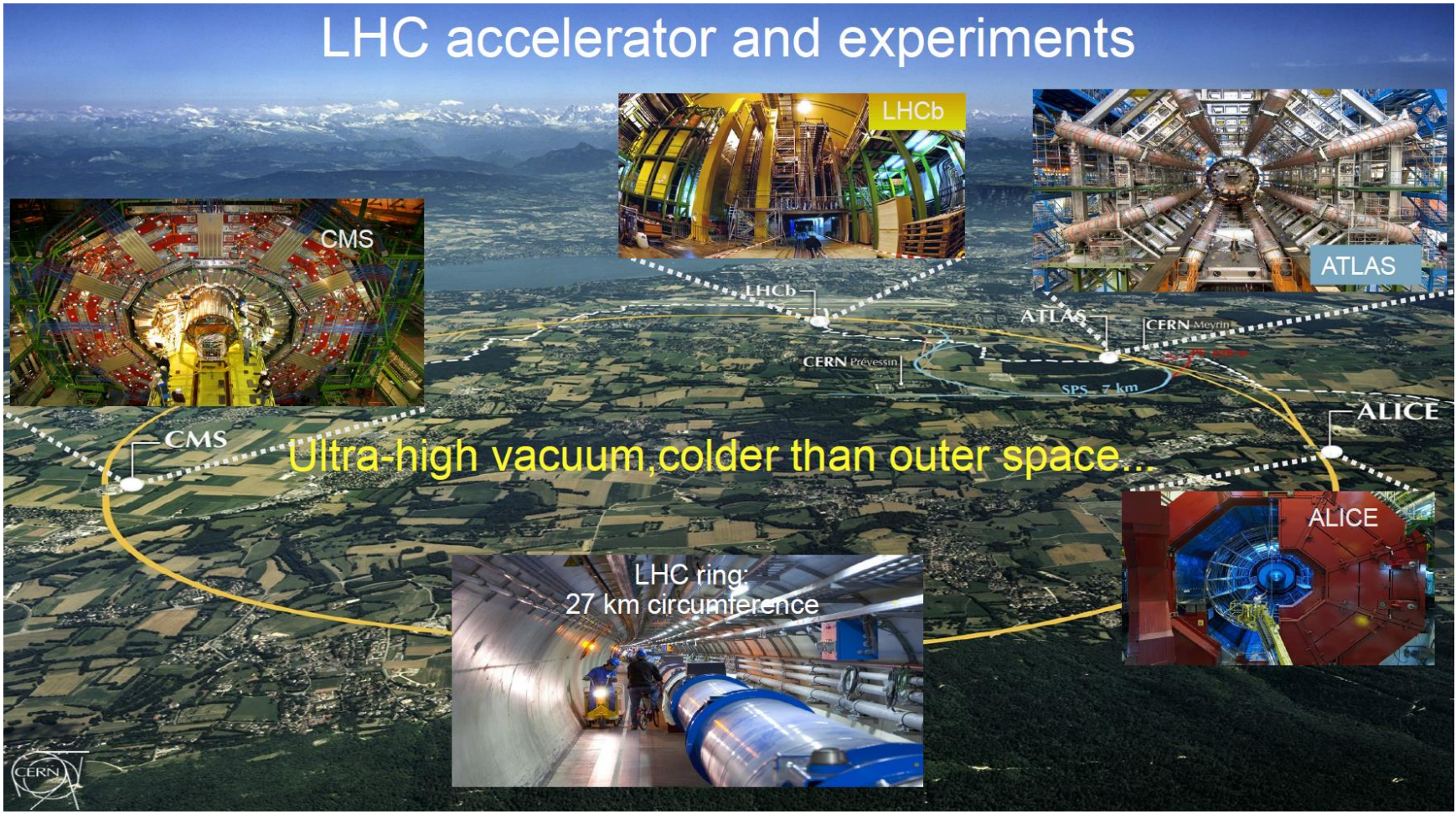
LHC accelerator and experiments



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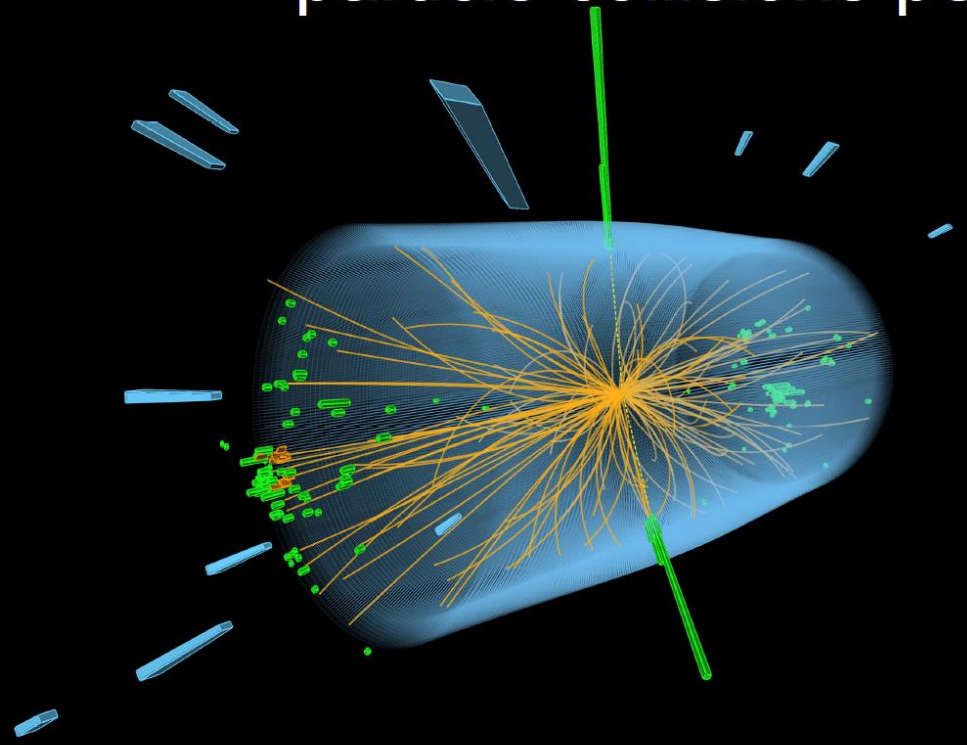
The LHC produces more than 1 billion particle collisions per second



The energy of the particles in collision is converted into new particles.

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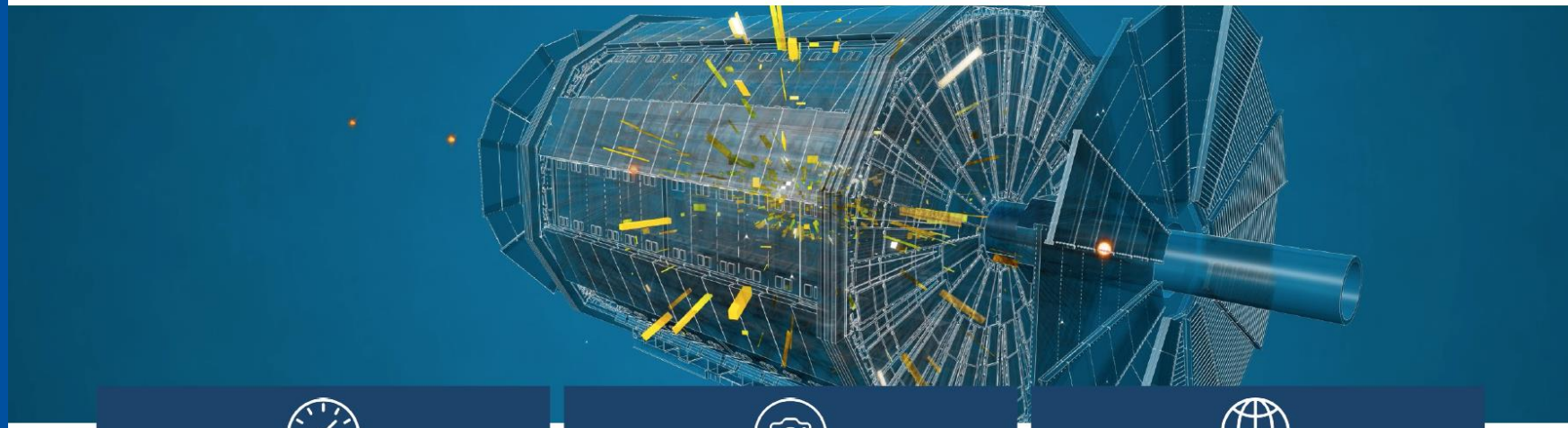
The LHC detectors are analogous to 3D cameras



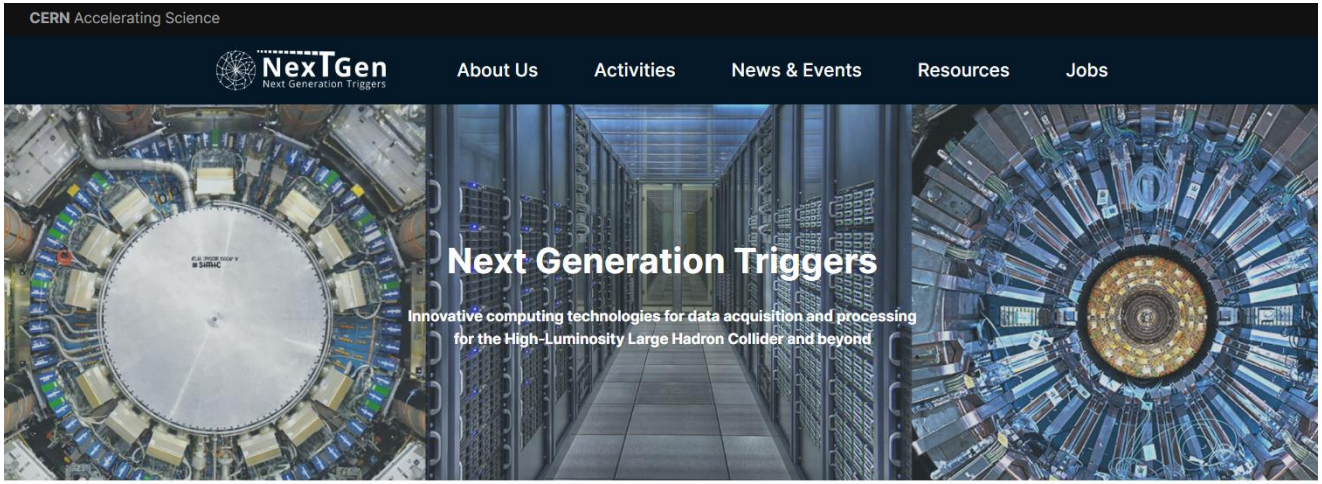
The detectors measure the energy, direction and charge of new particles formed.

They take 40 million pictures a second. Only 1000 are recorded and stored.

The LHC detectors have been built by international collaborations covering all regions of the Globe.

- Umulig å analysere data fra 40 millioner slike typer «bilder» hvert sekund manuelt
- Avanserte KI-algoritmer i utstrakt bruk for å automatisere denne analysen
  - Algoritmene lærer seg på egenhånd å forstå mønstre og systematikk i dataene
- Samme typer algoritmer som har blitt utviklet av de store teknologi-selskapene
  - Modifisert og videreutviklet for å analysere CERN-data heller enn å generere lyd, bilder og videoer

- Nytt KI-prosjekt ved CERN (400 millioner kroner fra 2024 - 2029) for neste generasjons-eksperimenter ved CERN



- **«En av de mest interessante teknologiske problemstillingene i dag»** ifølge Eric and Wendy Schmidt Fund for Strategic Innovation (Eric Schmidt er tidligere generaldirektør i Google)

Hvordan kan Norge nyte godt av denne kunnskapen?

Statnett MAIN MENU RECENT NEWS SEARCH

Frontpage / About Statnett / News and press releases / News archive 2024 / Statnett and CERN collaborate to embrace innovative energy

Statnett and CERN collaborate to embrace innovative energy

Statnett and CERN, the European Laboratory for Particle Physics, have signed a Memorandum of Cooperation (MoC). The agreement aims to explore collaborative opportunities across technological areas, find sustainable solutions for the operation of future grids, and foster innovative energy practices enabling an environment-friendly transition.

Nyhetsbrev

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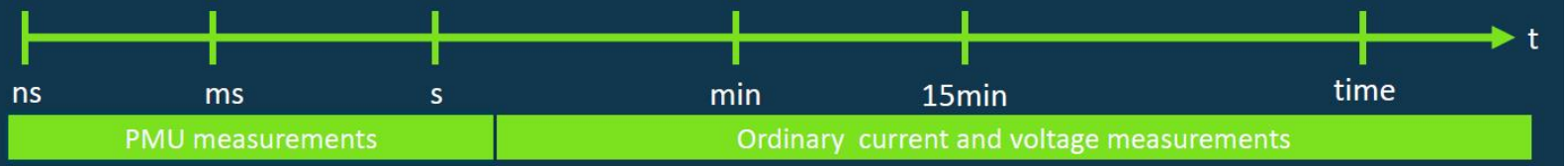
Power production from hydropower plants will be replaced by power from sun and wind power plants, power plants that are connected to the grid through power electronics, this gives the power grid new characteristic, and the grid needs to be monitored in a new way.

To enable the green shift in a safe way, the power grid needs to be monitored at millisecond level.

The PMU (Phasor Measurement Unit) is a component that can measure conditions in the network at the millisecond level



Statnett

Det **grønne** taktskiftet

- NTNU og flere andre norske universiteter går sammen med Statnett og CERN for å adressere problemstillingen
  - Ønsker å teste ut KI-algoritmer utviklet ved CERN for overvåkning av fremtidens energisystem i Norge
  - Søker midler fra Norges Forskningsråd
- Flere tilsvarende problemstillinger i norsk nærings- og samfunnsliv som kan angripes på tilsvarende måte i de nærmeste årene