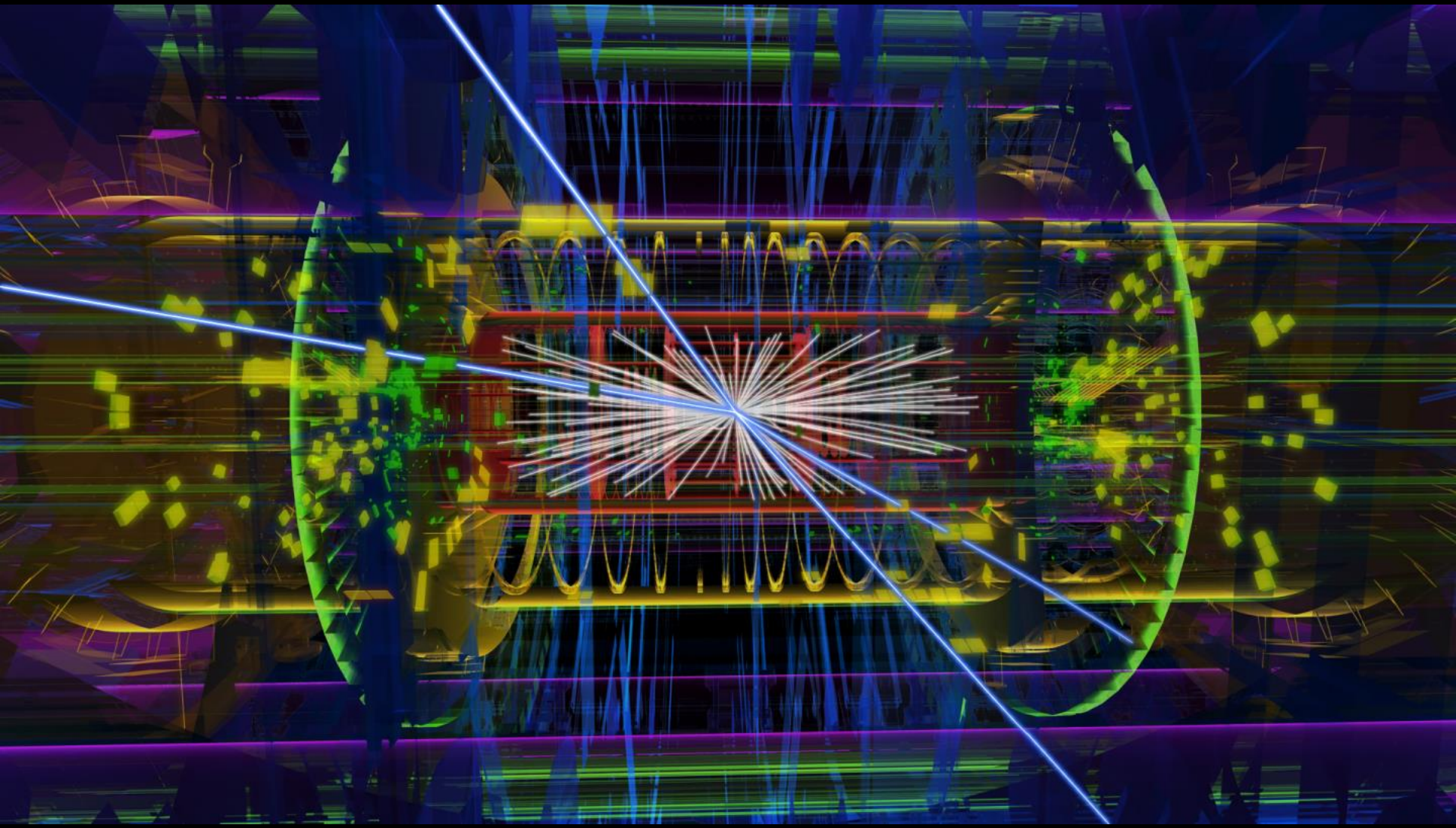
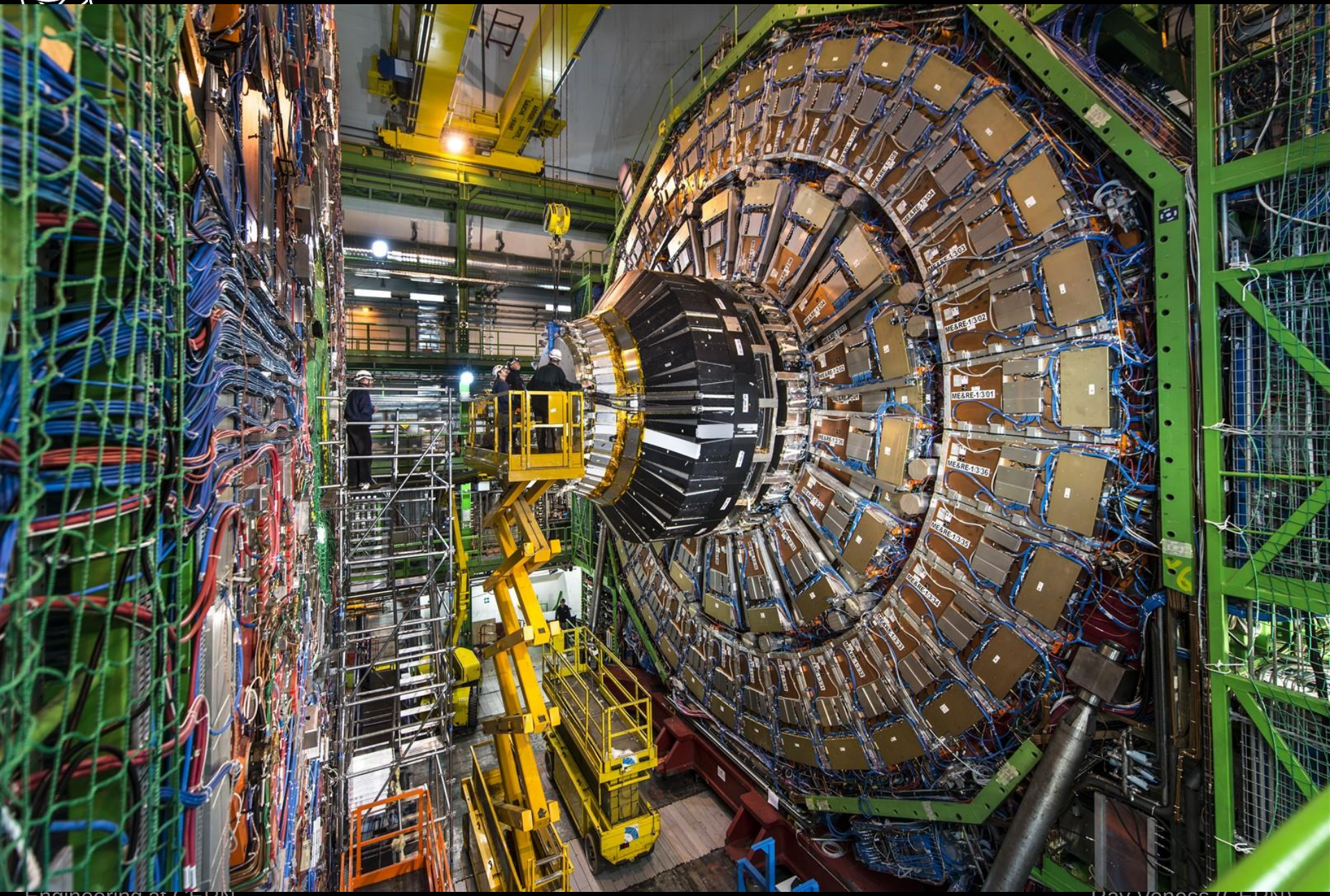
An Introduction to Engineering at CERN

Ray Veness

CERN

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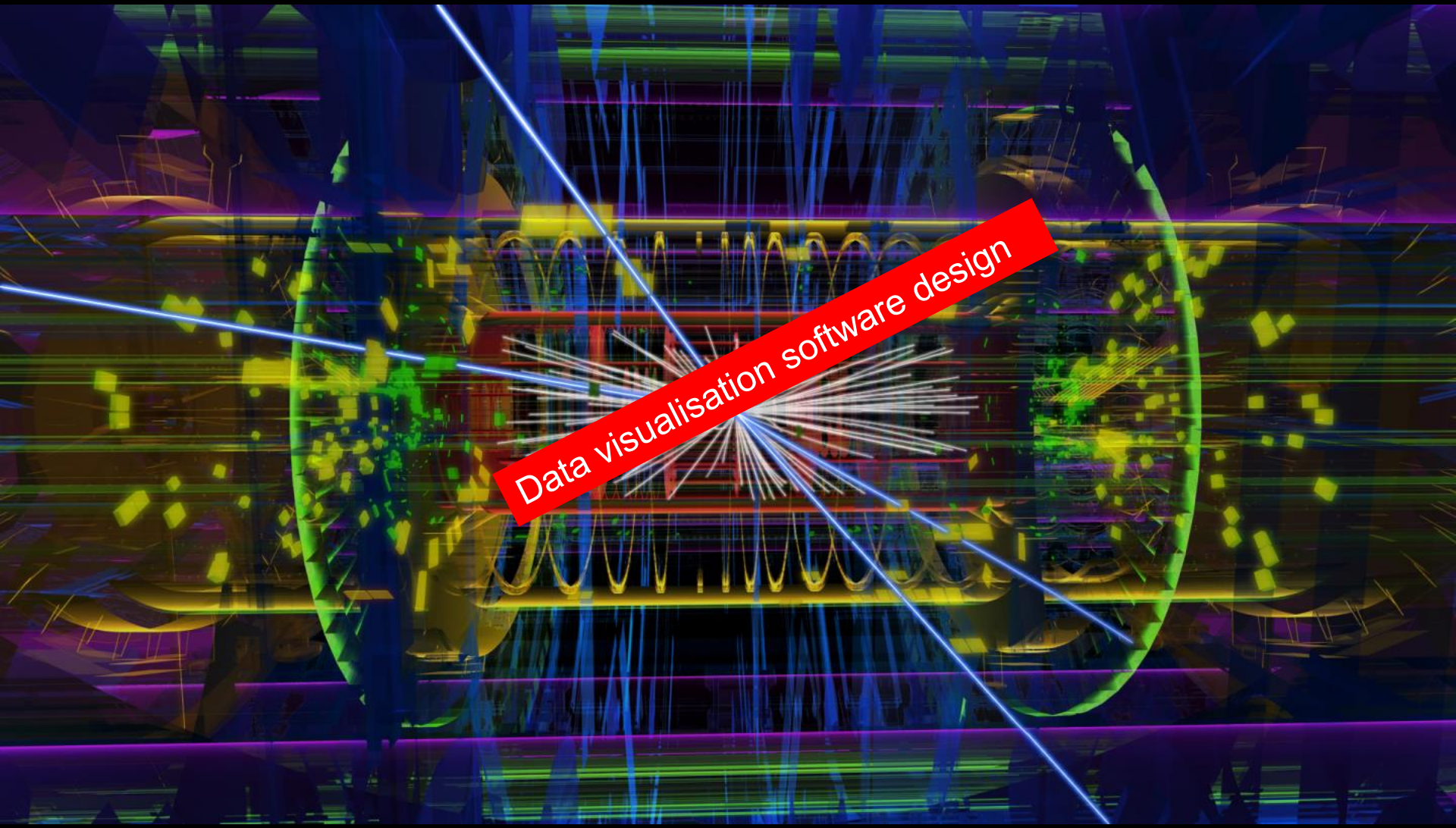
Data visualisation software design


Computer hardware
Databases
Network Infrastructures


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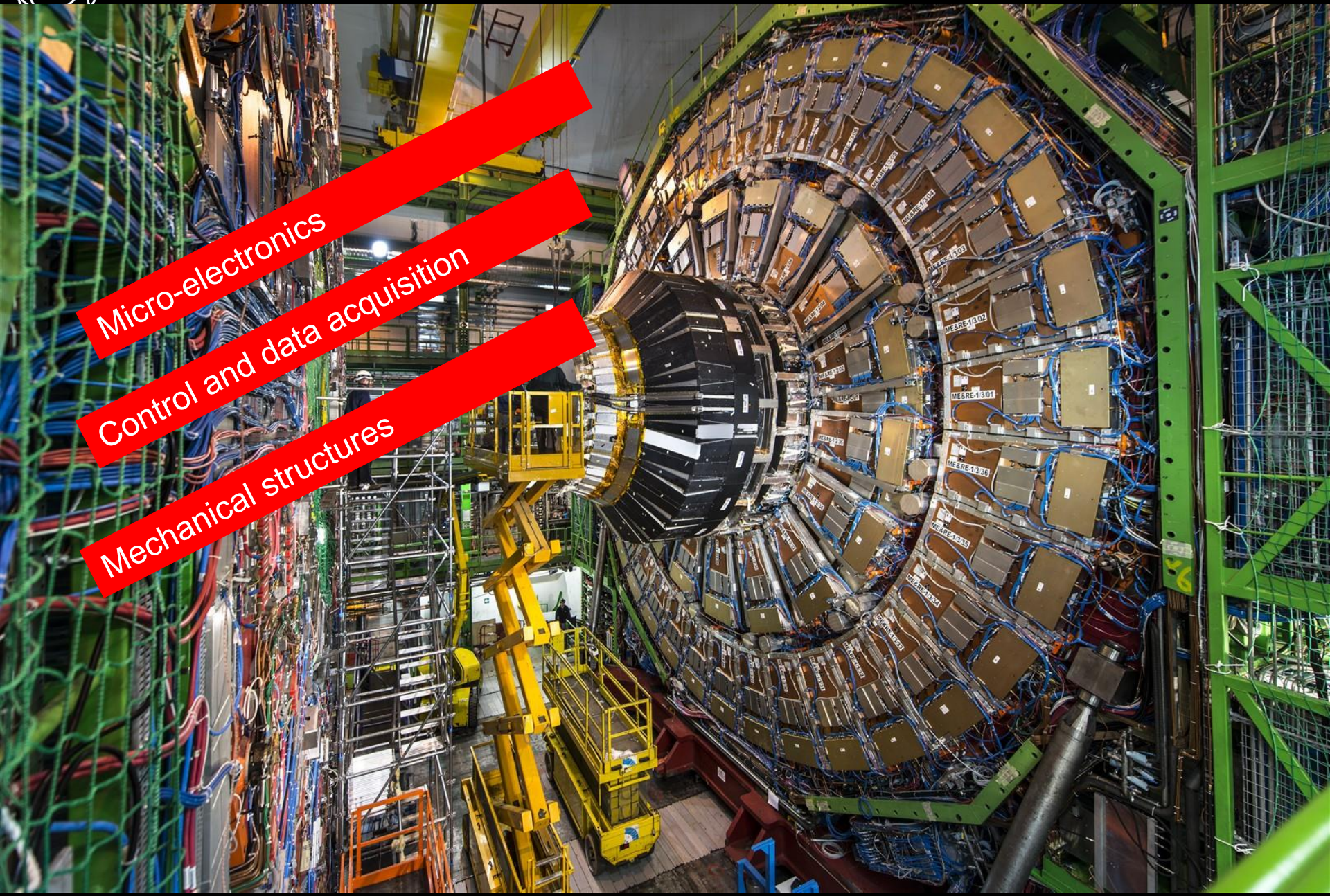
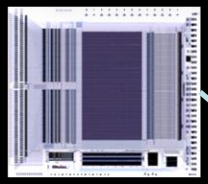
3/4/2013 4:10:16 pm
4:10 pm
4:20 pm
UKI-NORTHGRID-LIV-HEP
UKI-NORTHGRID-SHEF-HEP
UKI-SOUTHGRID-BHAM-HEP
UKI-SOUTHGRID-CAM-HEP
UKI-SOUTHGRID-OX-HEP
UKI-SOUTHGRID-BRIS-HEP
EFDA-JET
RAL-LCG2
UKI-LT2-IC-HEP
UKI-LT2-QMUL
UKI-SOUTHGRID-SUSX
RUG-CIT
NIKHEF-ELPROD
SARA-MATRIX
GOEGRID
UNI-DORTMUND
WUPPERTALPROD
UNI-SIEGEN-HEP
UNI-BONN
MAIGRID
ITWM
FZK-LCG2
GRIF
IN2P3-IRES
LRZ-LMU
MPPMU
UNI-FREIBURG
IN2P3-SUBATECH
HEPHY-UIBK
UNIBE-LHEP
CERN-PROD
UNIGE-DPNG
CSCS-LCG2
IN2P3-CC
IN2P3-LAPP
IN2P3-LPC
Grid computing
WLCG
CMS
LHCb
dashboard
Google earth

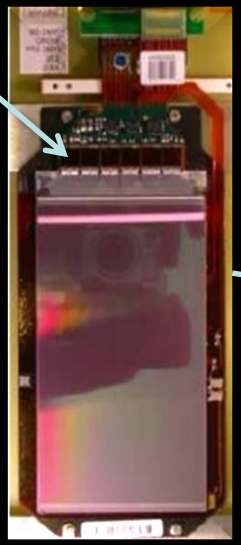

Micro-electronics
Control and data acquisition
Mechanical structures

Microchips for Megastructures

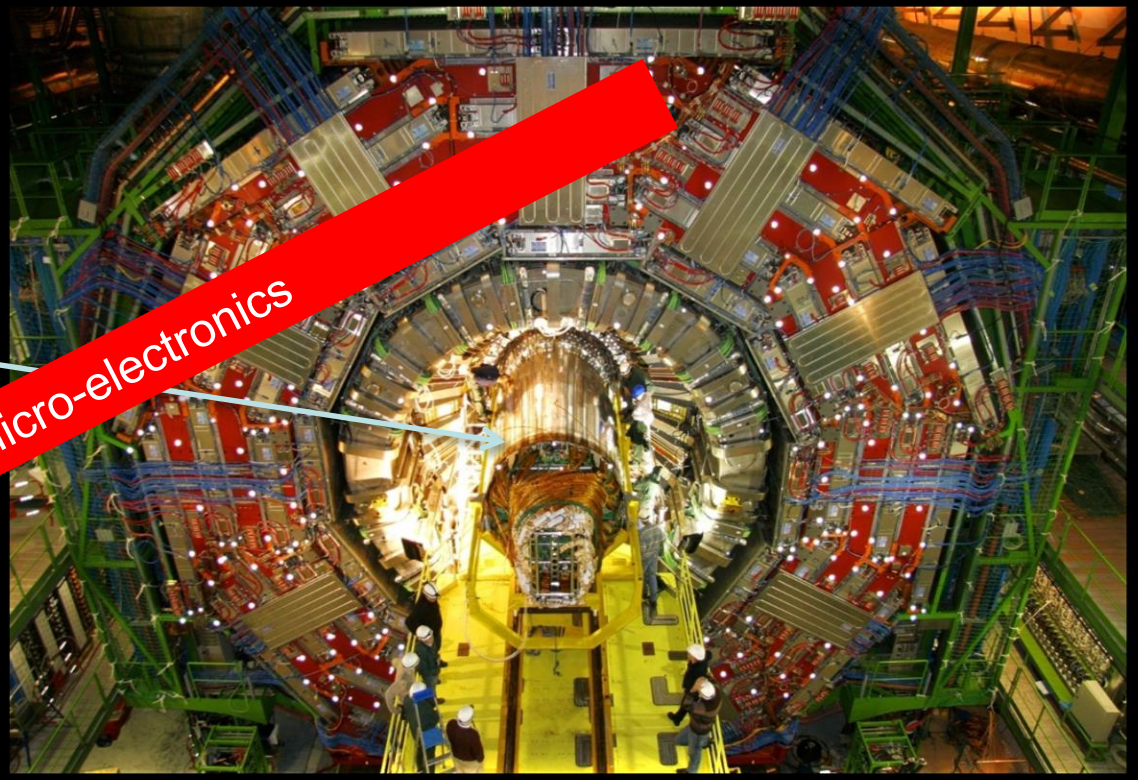
Front-End ASIC

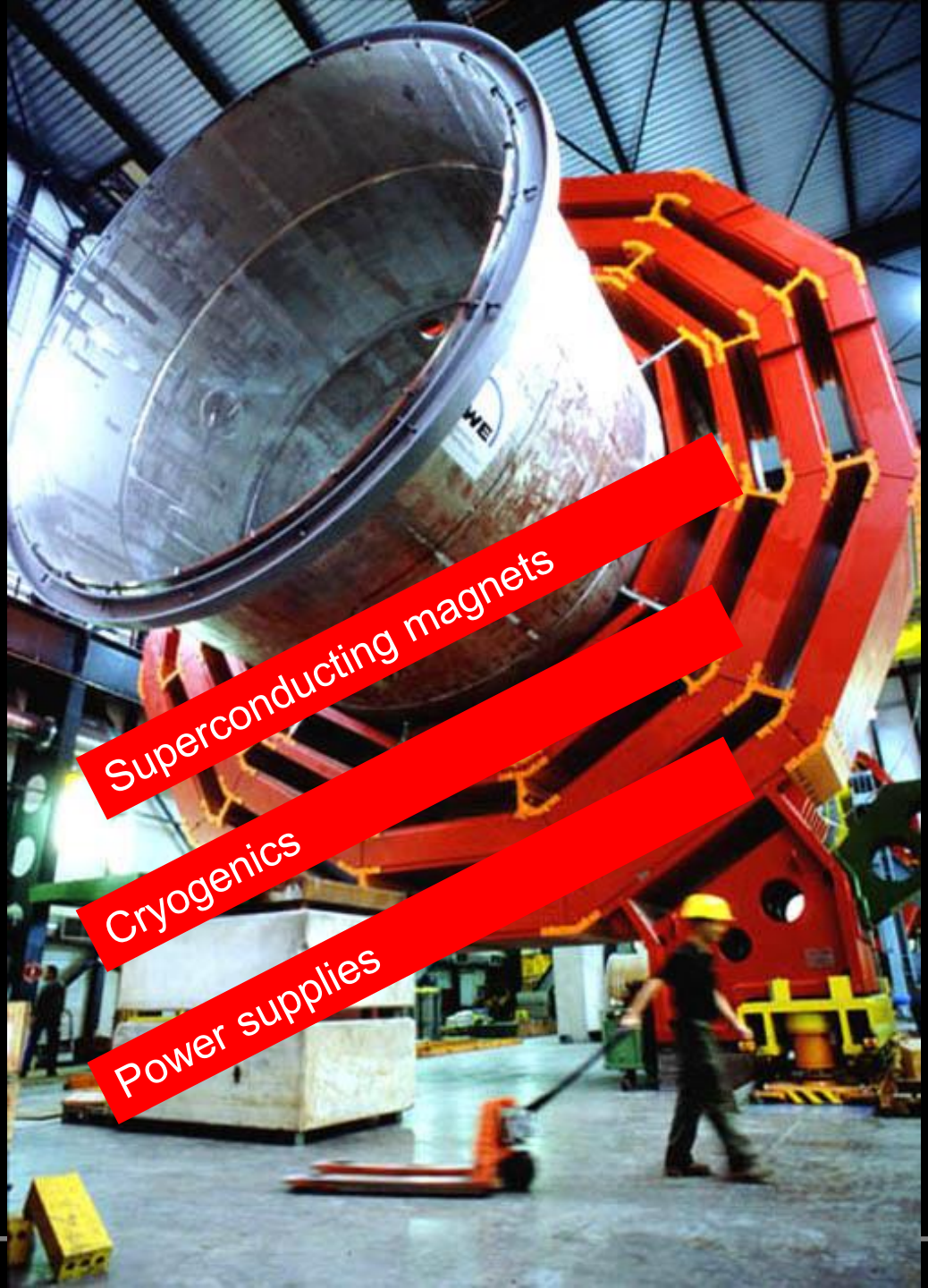


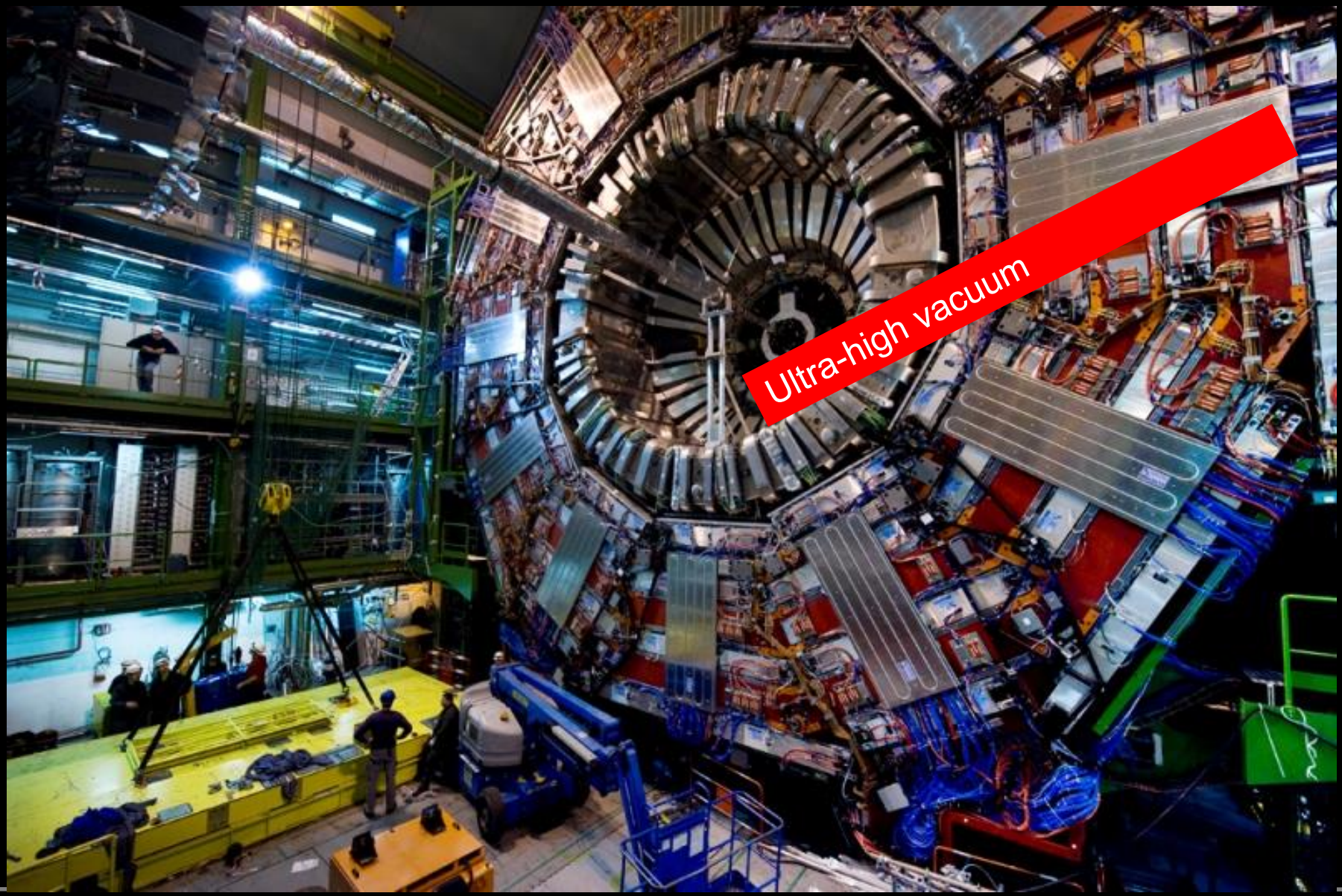
Silicon Tracker Hybrid



CMS experiment on the LHC accelerator at CERN



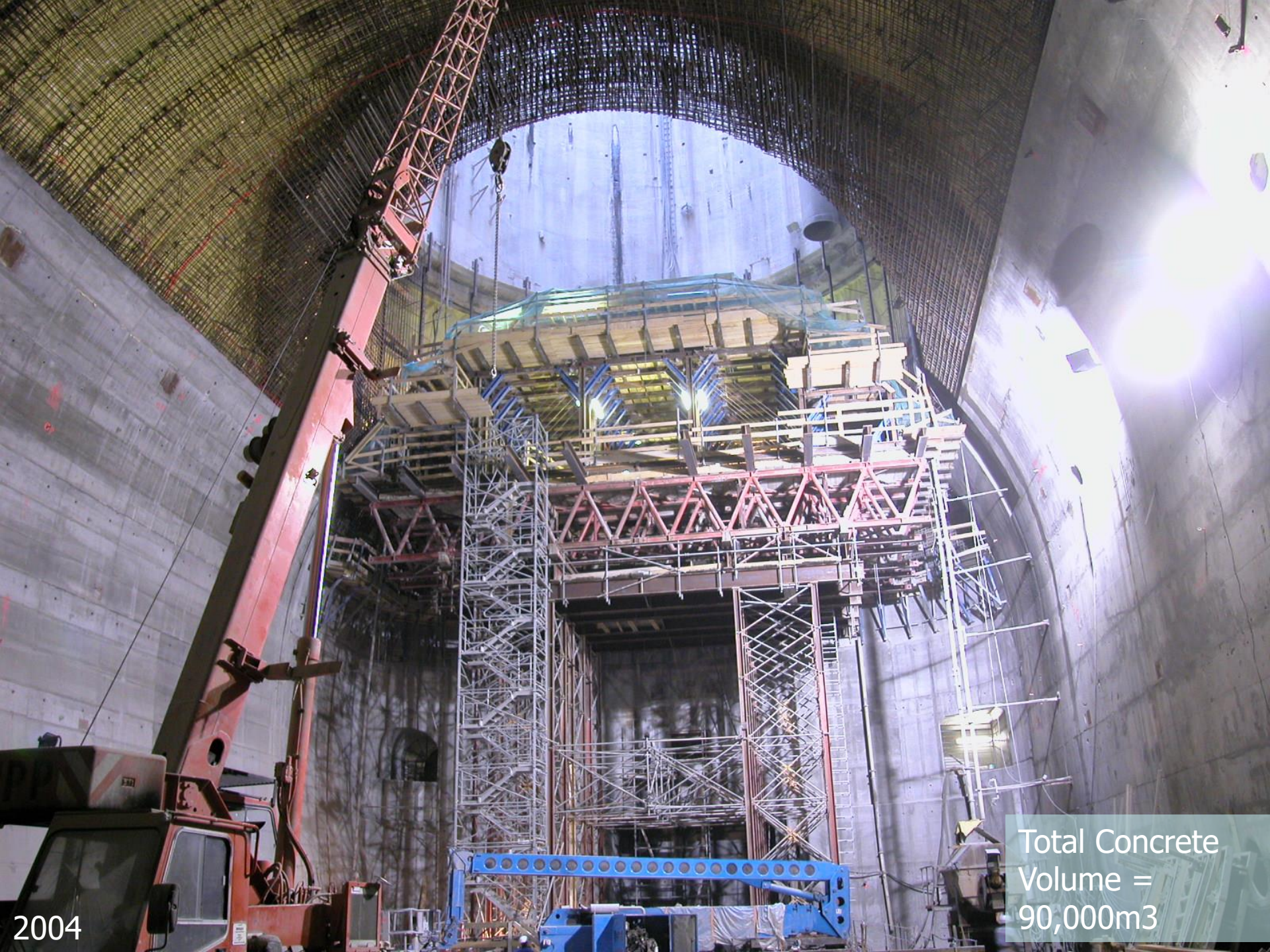

Superconducting magnets
Cryogenics
Power supplies


Ultra-high vacuum


Underground Civil structures
Cooling and ventilation
Heavy handling

Point 5 -Excavation commencement of PM54 shaft - July 09, 1999 - CERN ST-CE

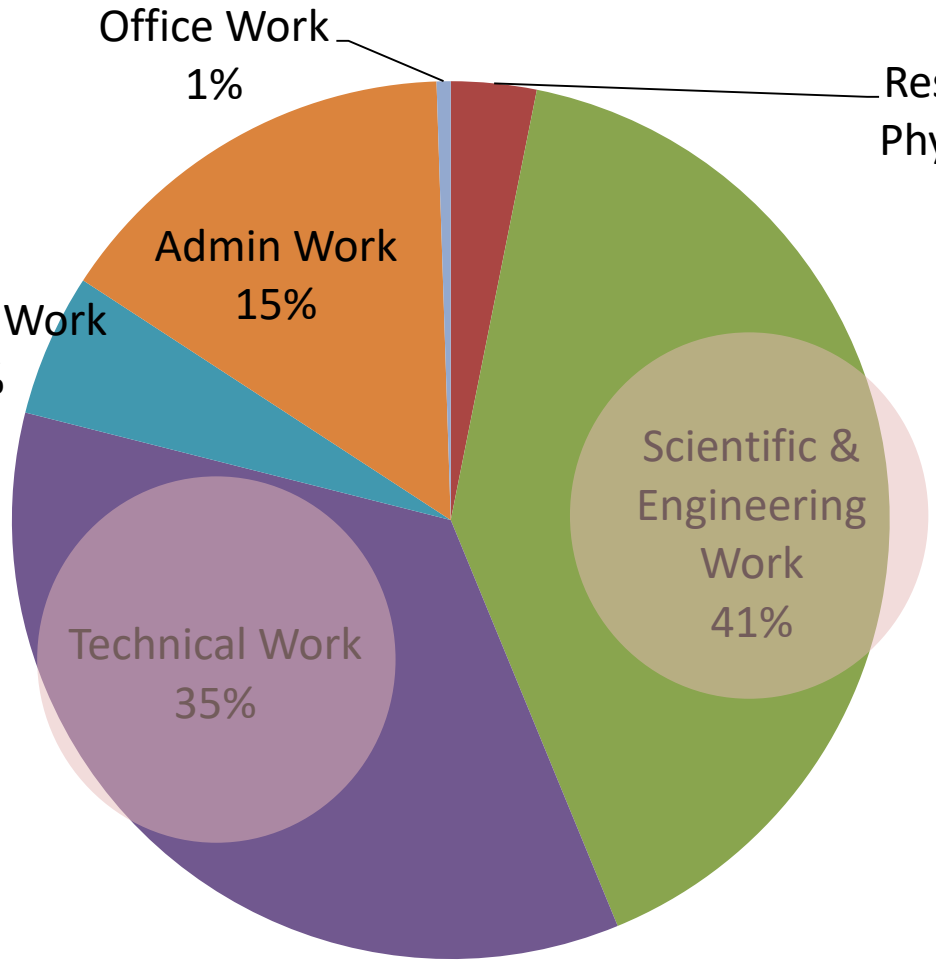

PAOLO DE NICOLA


Total Concrete Volume = 90,000m3
2004

Ray Veness (CERN)

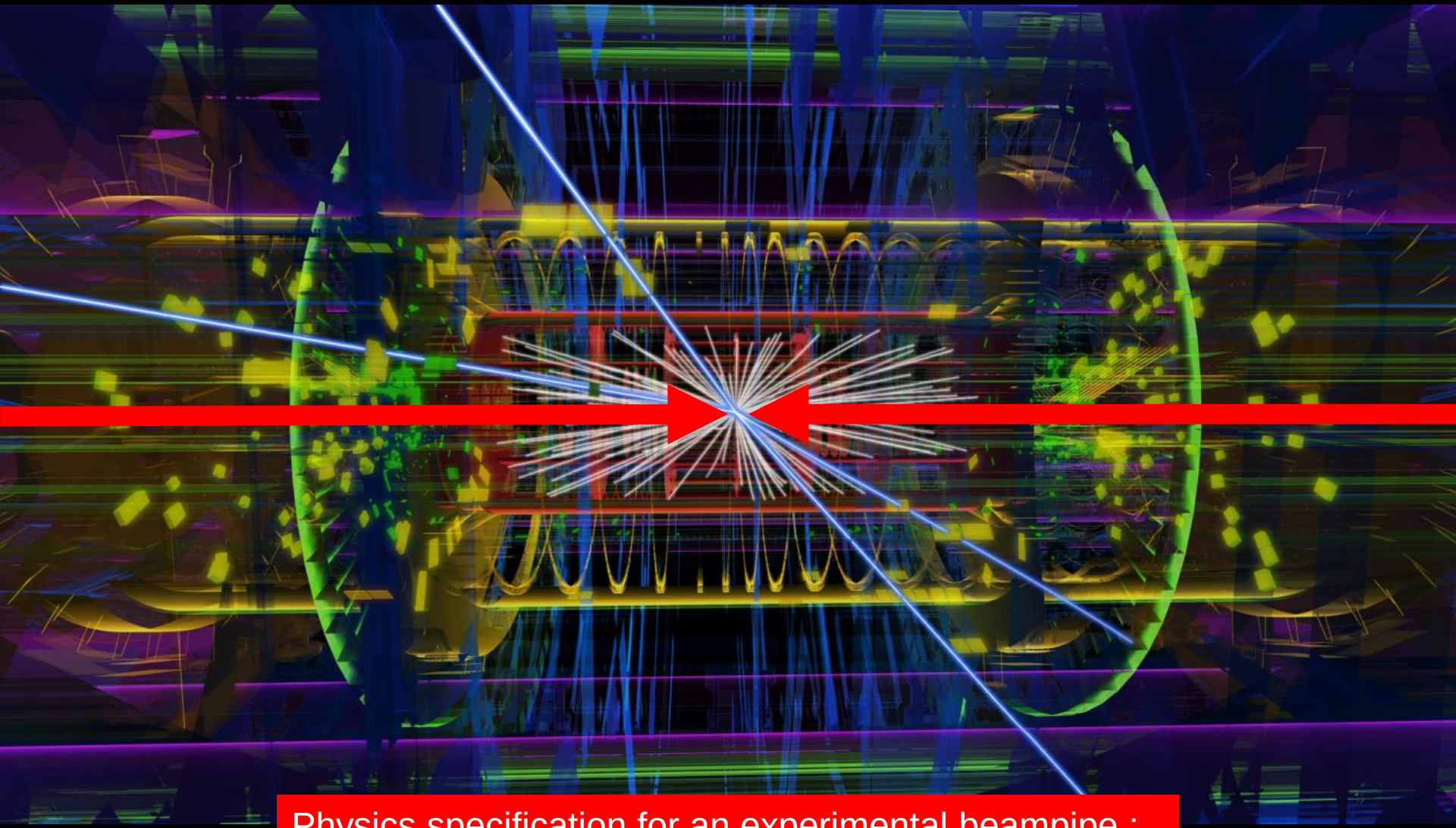
Image courtesy British Gas

CERN Staff by job description

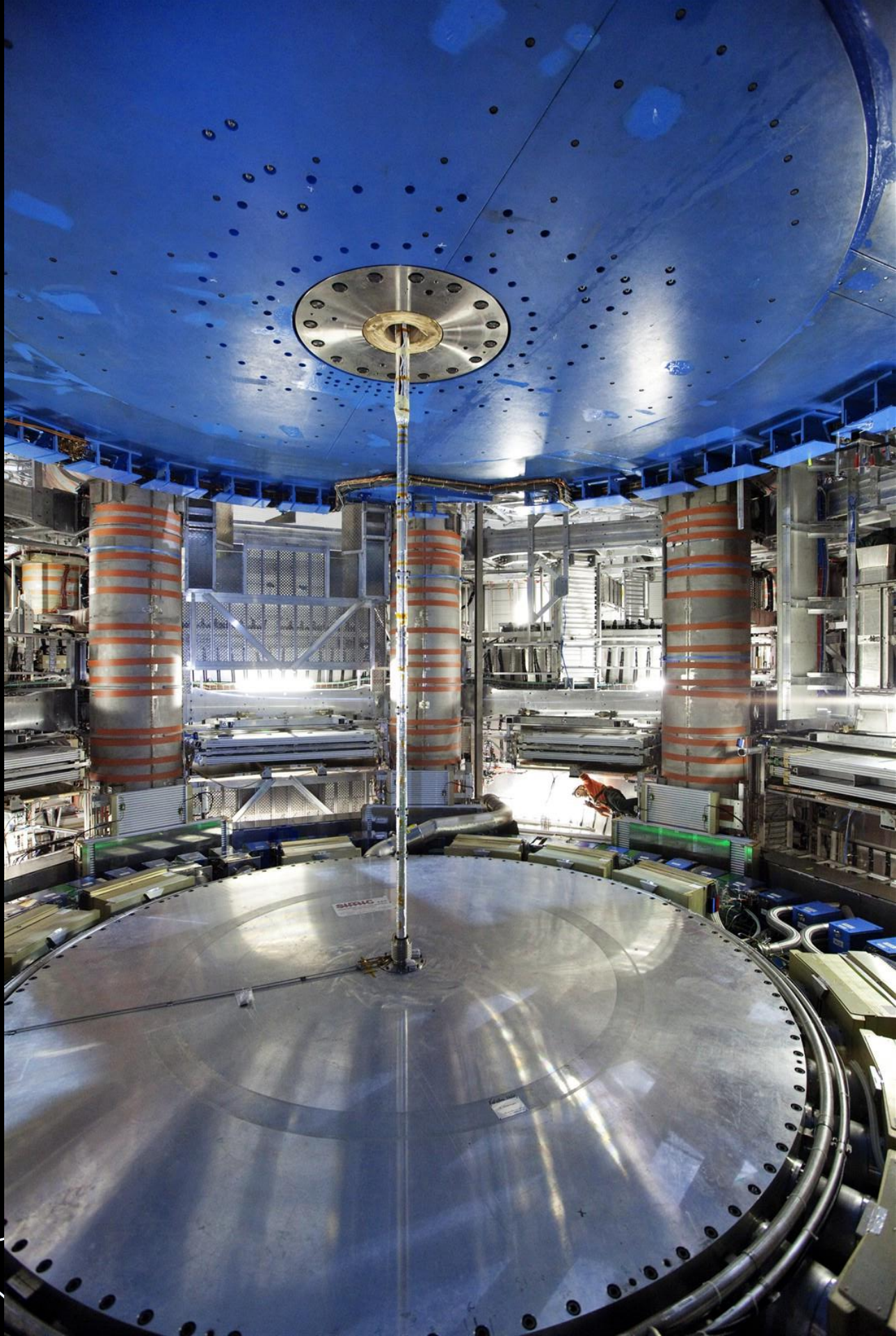


Engineers
-Electrical/Electronic
-Mechanical
-Civil
-Computing
Applied physicists

Technicians
Programmers
Accelerator operators



Physics specification for an experimental beampipe :
Nothing, contained by nothing!



Nothing, contained by nothing!

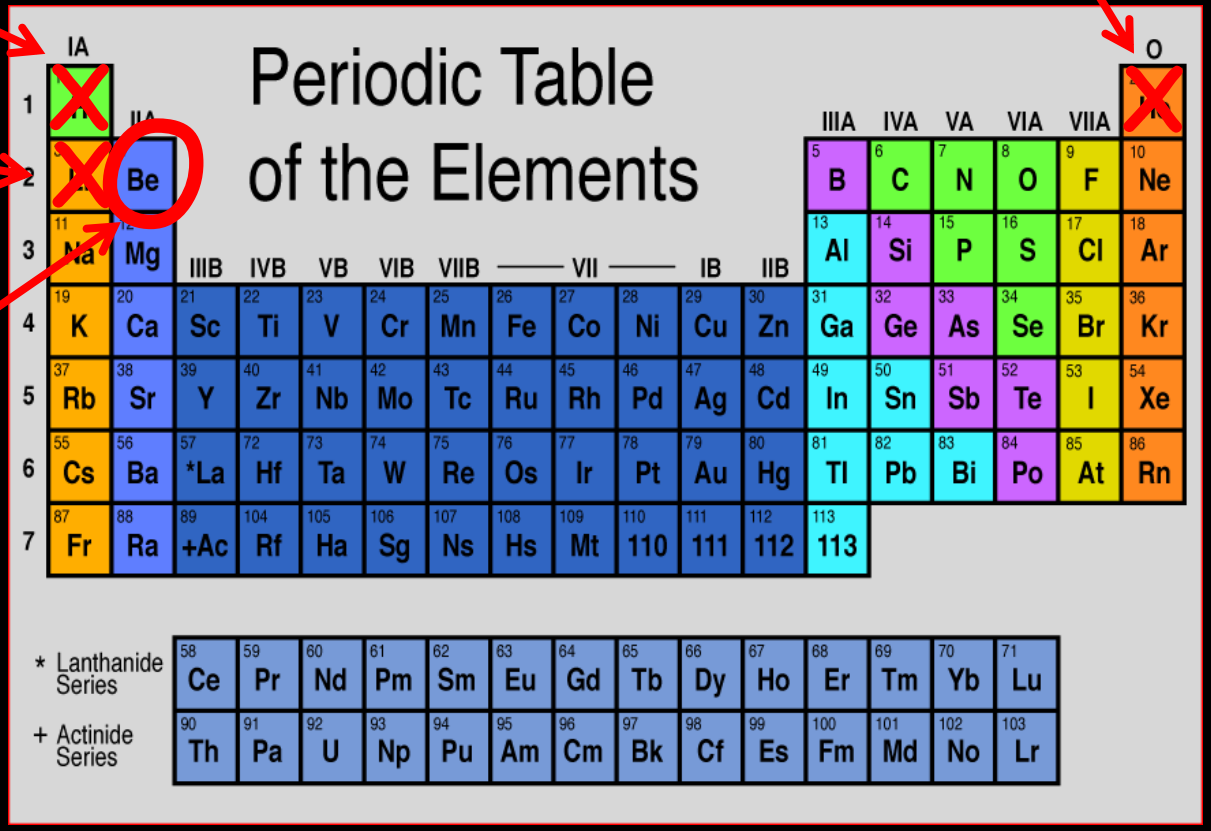
Hydrogen is a gas at room temperature!

So is helium…

Lithium explodes in air… not so good

Beryllium… that would be good!

…except that it is pretty hard to get hold of!

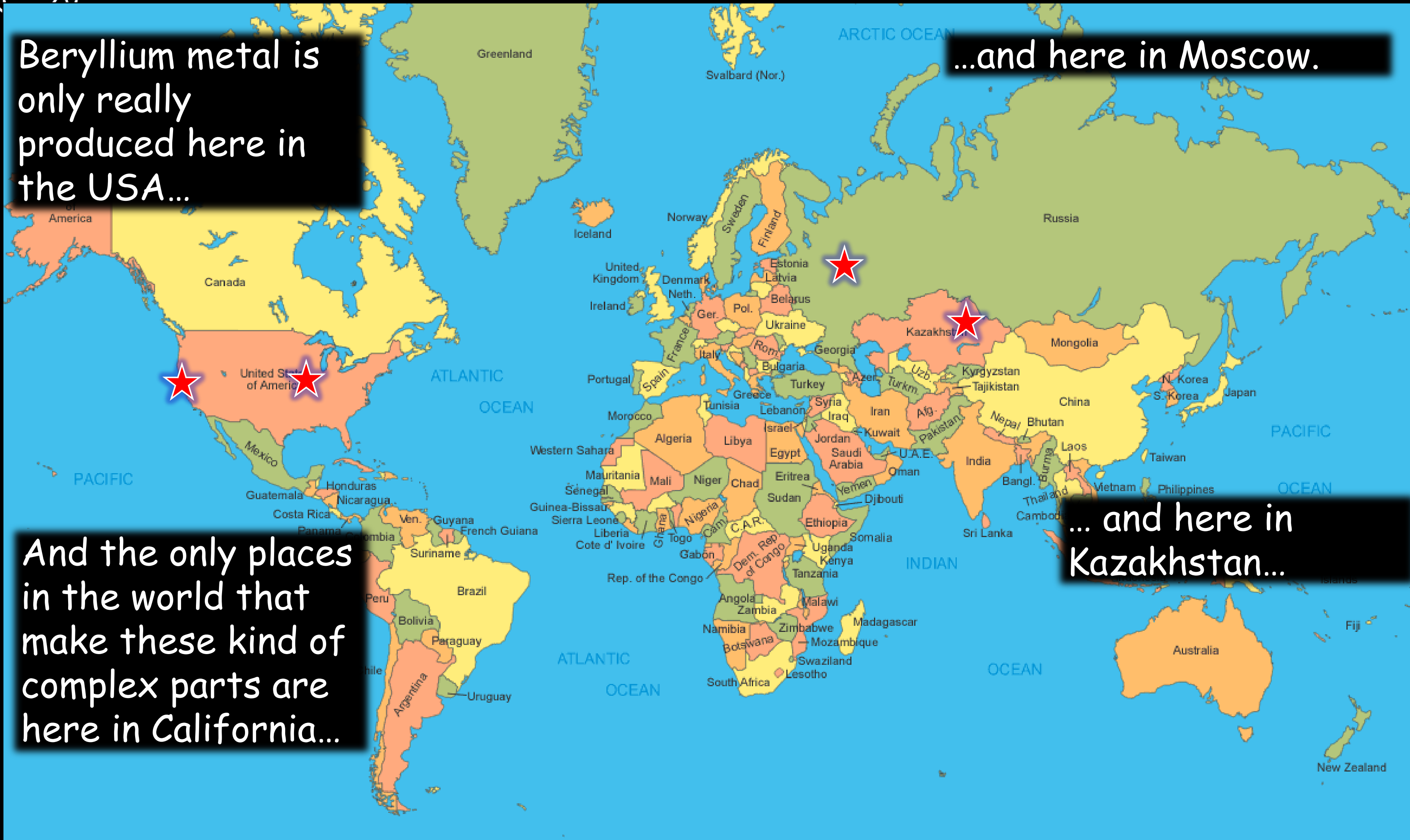


Beryllium metal is only really produced here in the USA…

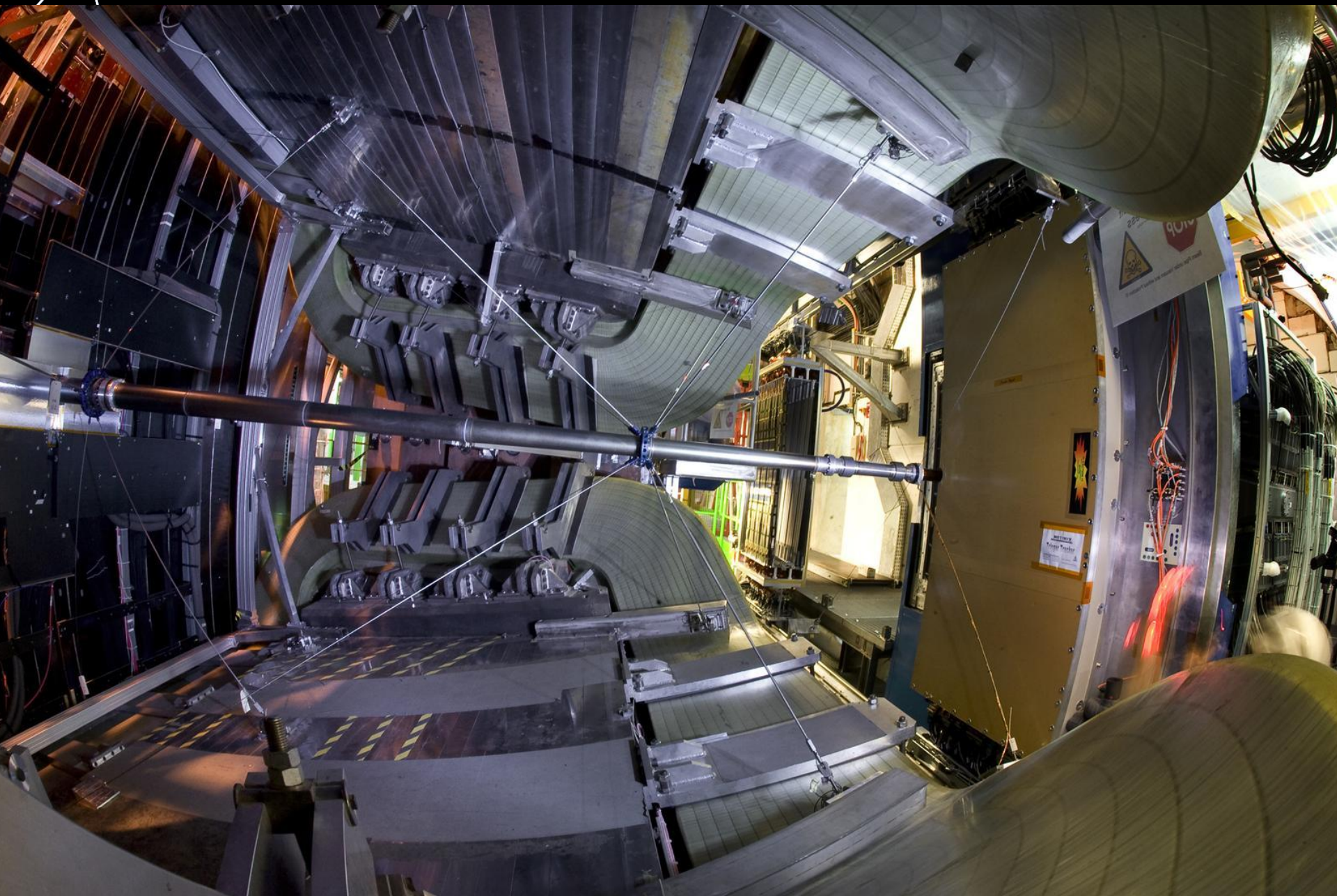
…and here in Moscow.

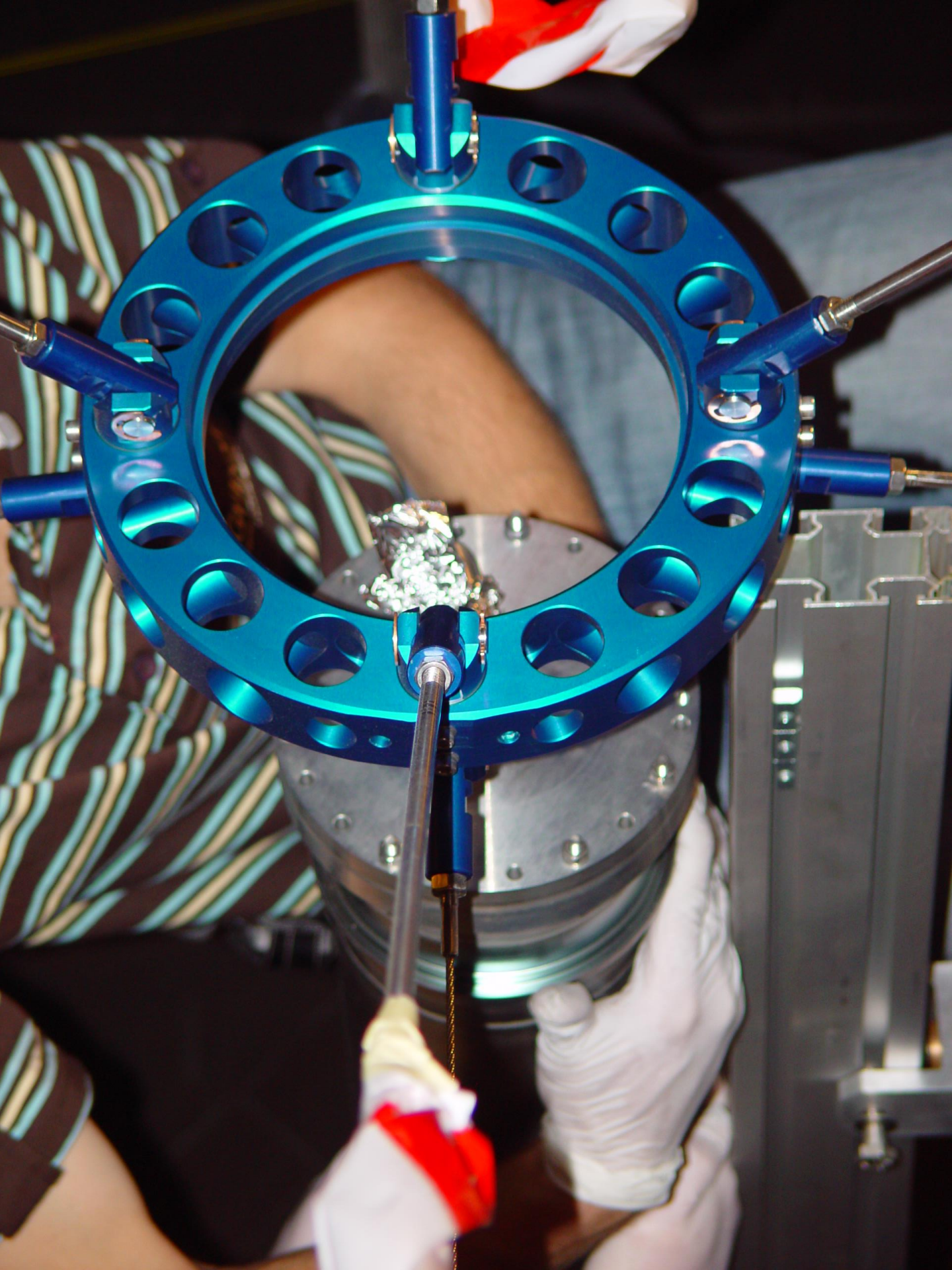
… and here in Kazakhstan…

And the only places in the world that make these kind of complex parts are here in California…



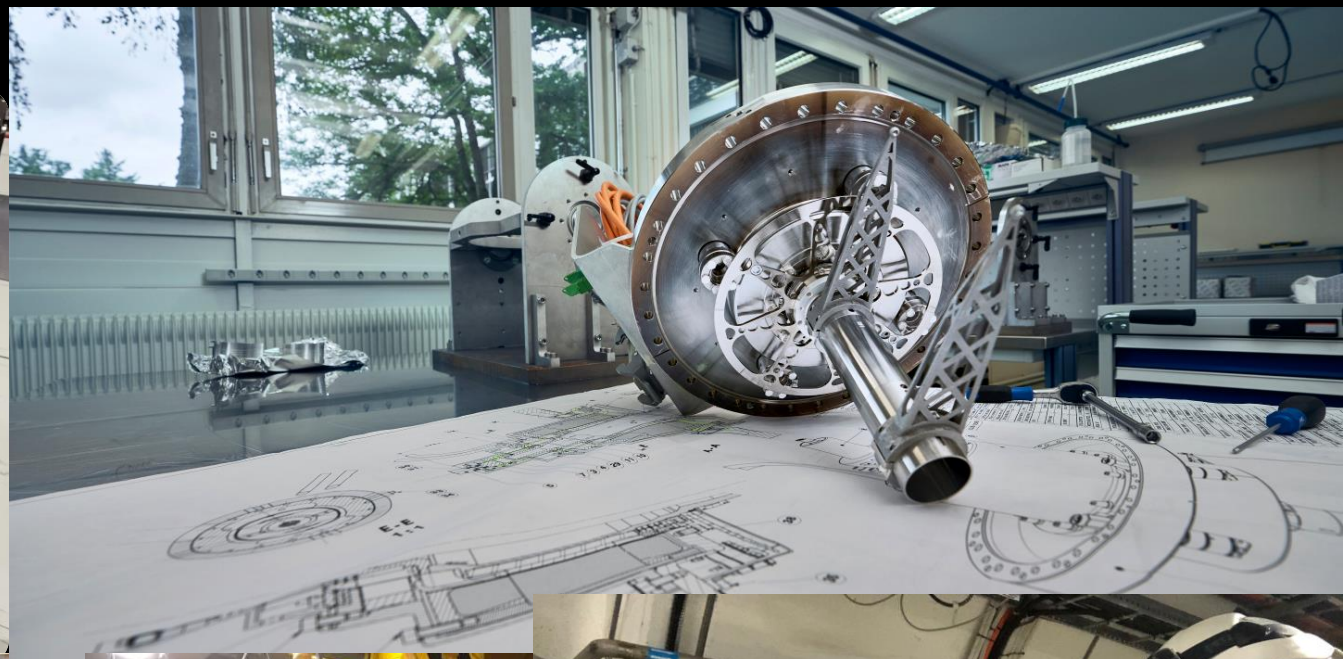
A photo I took of a CERN colleague, as we waited to cross the Khasakh-Russian border in 2004…





One slide on the long shutdown

More than 150 new beam instruments built and installed



Beam Instrumentation Mechanics Section BBQ, June 2023

"…It's my job to install your boiler and help with any boiler problems you may have…"

What is Engineering?

Oxford English Dictionary, 3rd Ed.

The branch of science and technology concerned with the development and modification of engines (in various senses), machines, structures, or other complicated systems and processes using specialized knowledge or skills, typically for public or commercial use…

Wikipedia

(from Latin ingenium, meaning "cleverness" and ingeniare, meaning "to contrive, devise") is *the application of scientific, economic, social, and practical knowledge in order to invent, design, build, maintain, research, and improve structures, machines, devices, systems, materials and processes.*

So engineering means…

- Make something real out of dreams
  - Creativity!
- Discussion, negotiation, consensus:
  - Communication!
- Need to be ready for lifelong learning:
  - particle and accelerator physics, material science, leadership, commerce, Russian…
- Based, of course, on good science:
  - Start from first principles
  - But don’t re-invent the wheel… unless you need to!
  - Good engineering design
- Get it done, on time and on budget!

CERN

- CERN is a particle physics facility
  - But we employ very few particle physicists
  - Most theoretical and experimental scientists work for our member institutes
- …but most of what we do is “Engineering”
  - 2/3 of our staff are engineers, applied scientists or technicians
  - Work together, we can produce the most amazing, complex and beautiful things

…and can I just ask you

- You are seeing some incredible examples of engineering
  - CMS, CCC, Data centre,
  - Neutrino platform, AD/LEIR
- Give your students a different impression of what a career in engineering might mean
  - CERN, along with the economies of all our countries, needs more engineers, both female and male!

Thank you!

…and please feel free to take some of our enthusiasm for engineering home with you!

Backup

Ray Veness, in a nutshell

- Born and schooled in London, England
- Studied Mechanical Engineering at Leicester University
  - PhD in Solid Mechanics at Leicester University
- 2 years working on fusion energy technology at Culham Laboratory, Oxfordshire, UK
- Recruited as a CERN staff in 1992
  - Worked as a Section Leader in 5 different departments
- Responsible for many parts of the LHC design, including all experimental vacuum systems
  - Co-author of the ATLAS Higgs discovery publication(!)
- Currently Section Leader and Deputy Group Leader for Beam Instrumentation (Accelerator Systems Department)