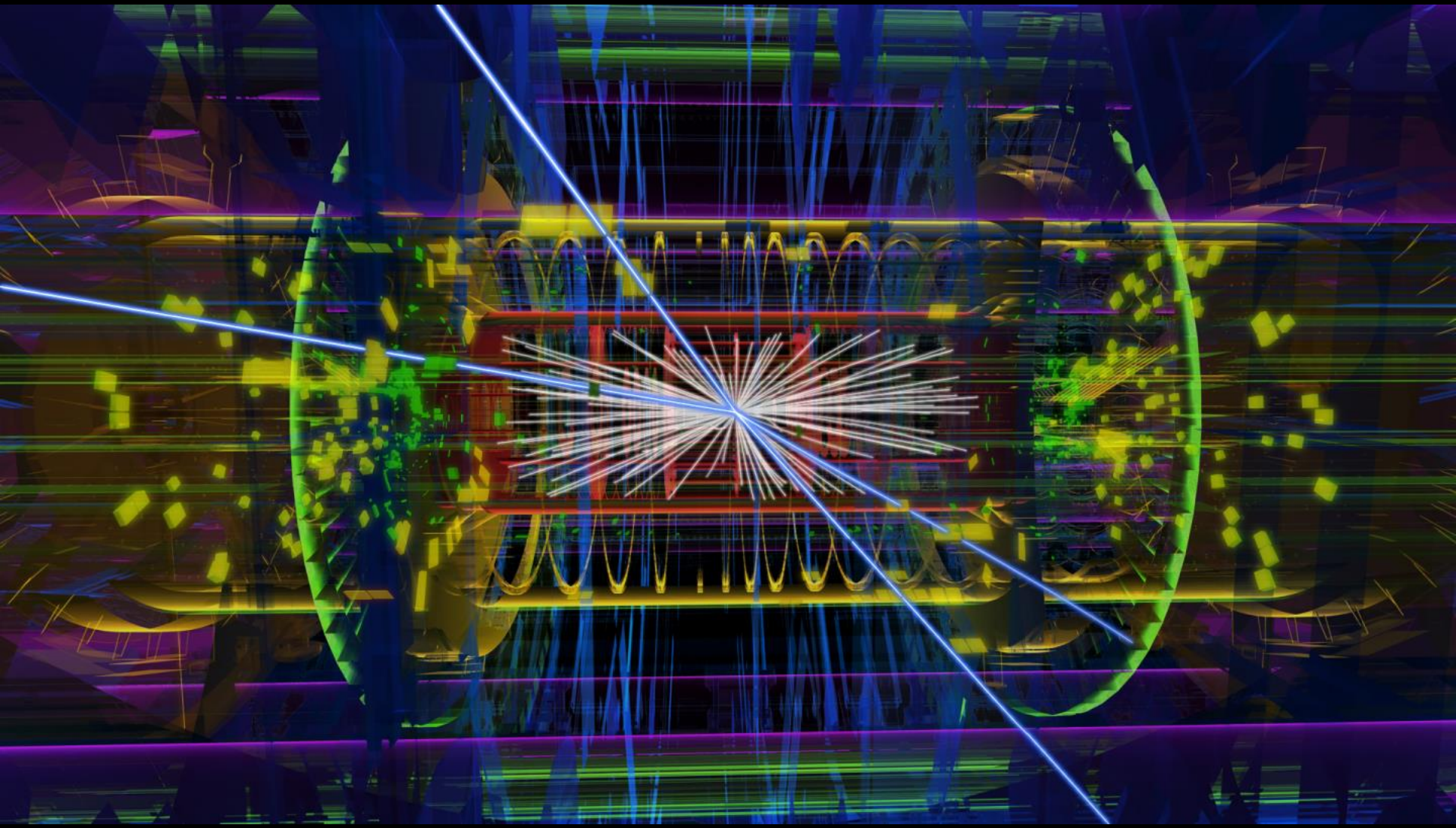
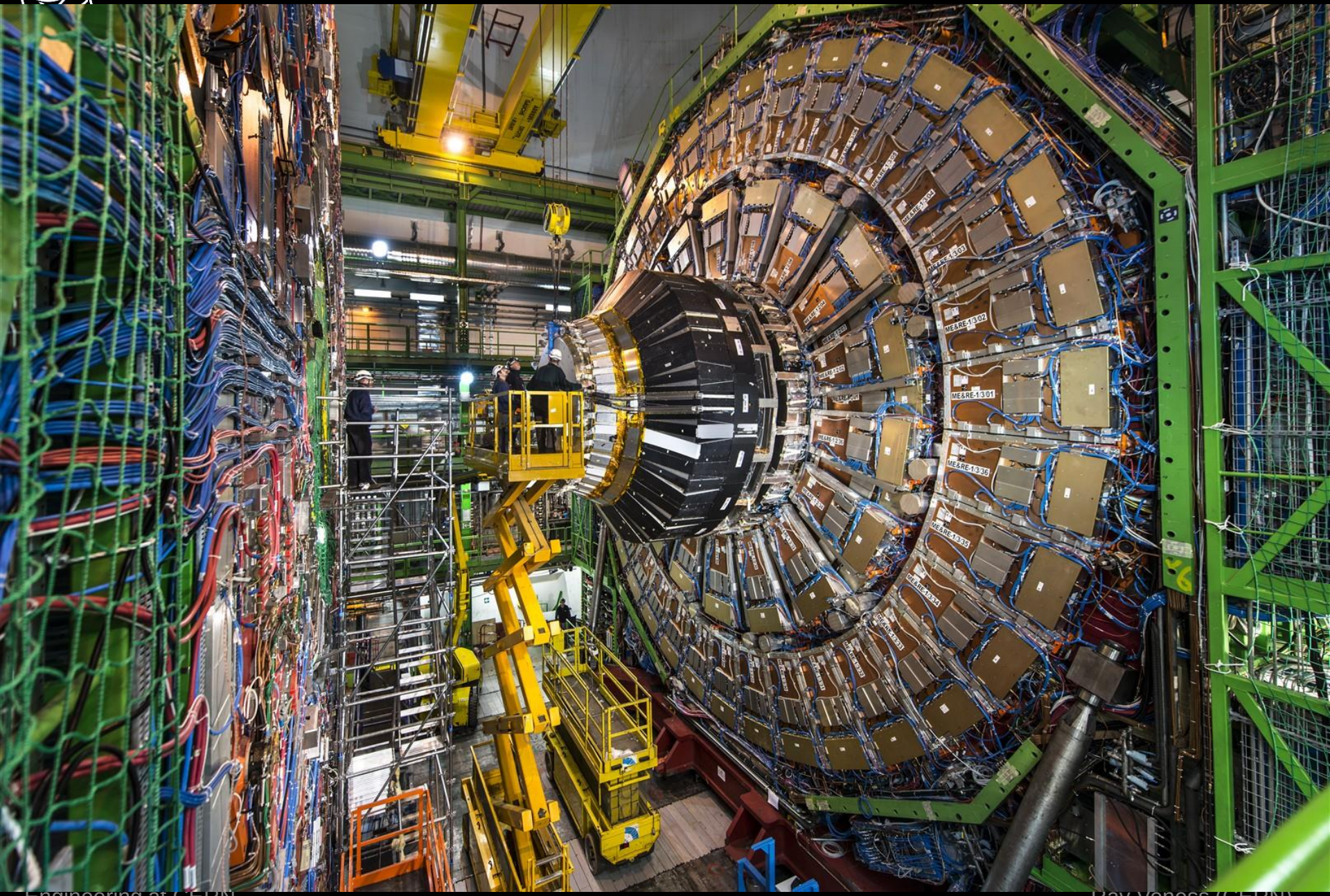
An Introduction to Engineering at CERN

Ray Veness

CERN

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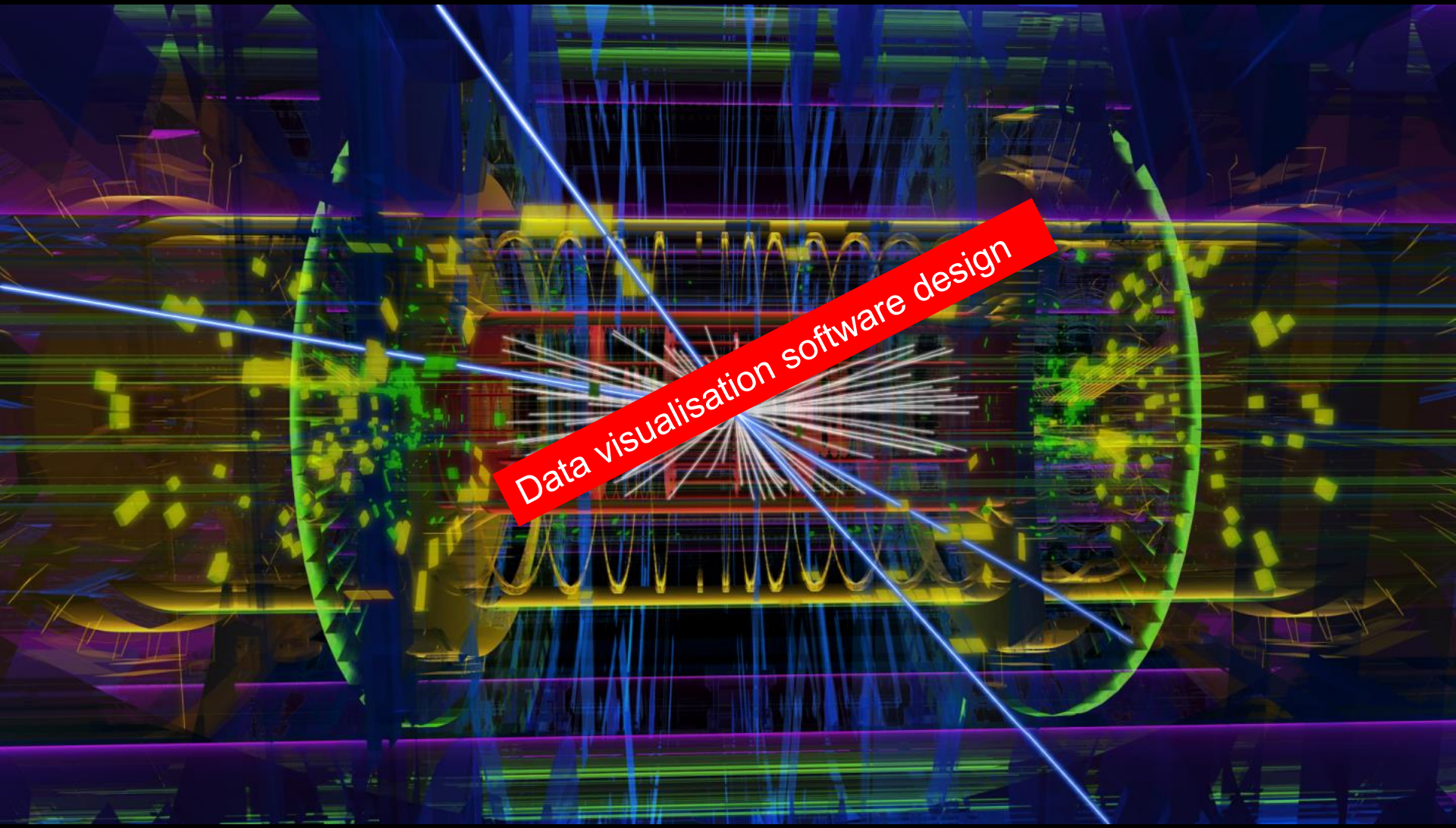
Data visualisation software design


Computer hardware
Databases
Network Infrastructures


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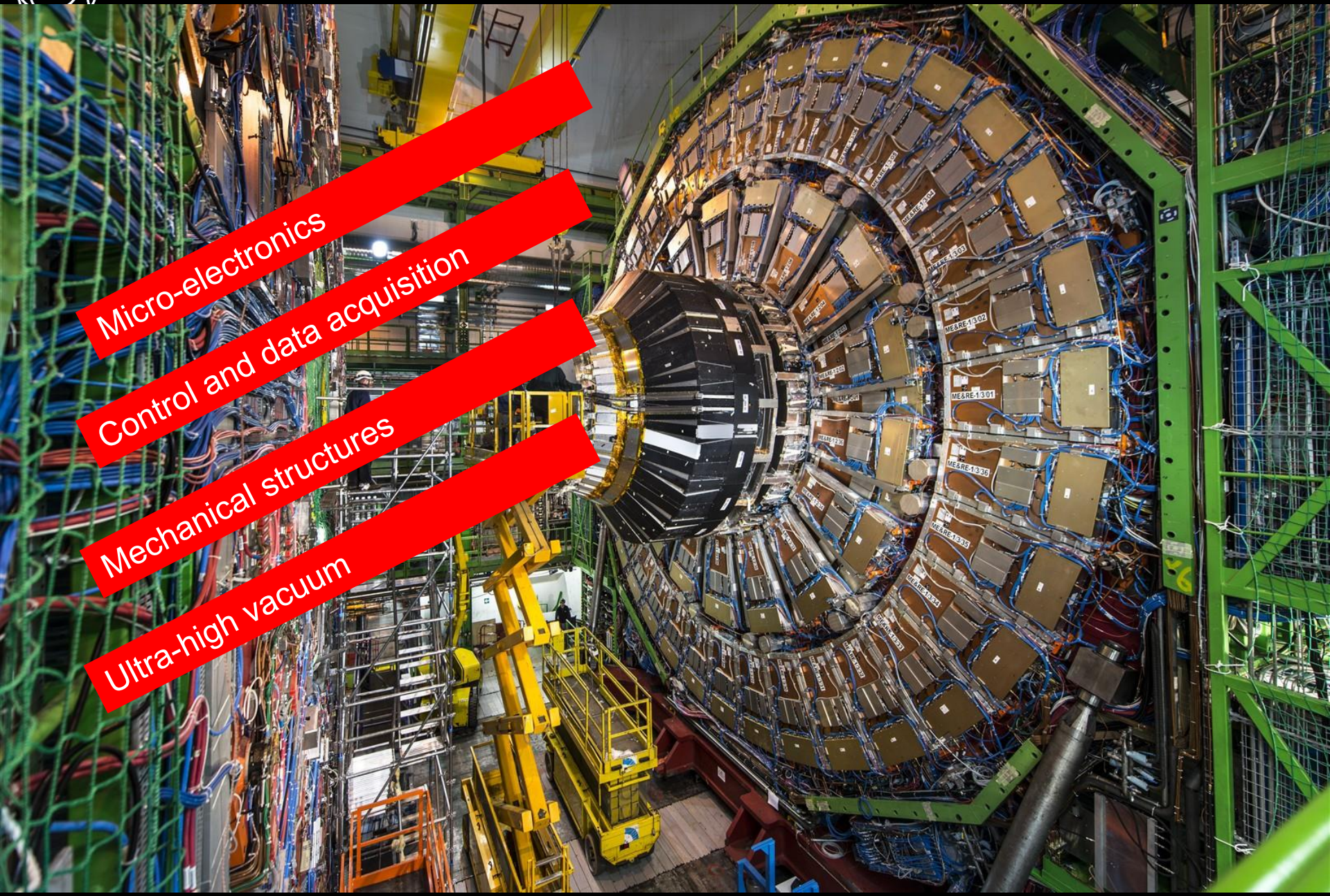
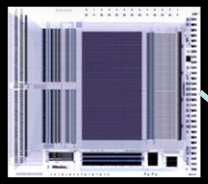
4:10 pm
4:20 pm
UKI-NORTHGRID-LIV-HEP
UKI-NORTHGRID-SHEF-HEP
UKI-SOUTHGRID-BHAM-HEP
UKI-SOUTHGRID-CAM-HEP
UKI-SOUTHGRID-OX-HEP
UKI-SOUTHGRID-BRIS-HEP
EFDA-JET
RAL-LCG2
UKI-LT2-IC-HEP
UKI-LT2-QMUL
UKI-SOUTHGRID-SUSX
RUG-CIT
NIKHEF-ELPROD
SARA-MATRIX
GOEGRID
UNI-DORTMUND
WUPPERTALPROD
UNI-SIEGEN-HEP
UNI-BONN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

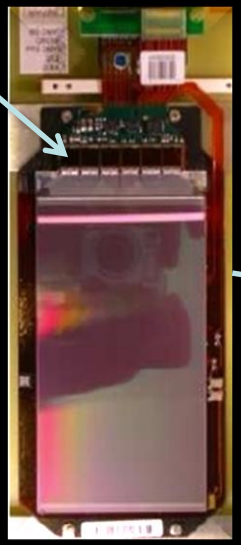

Micro-electronics
Control and data acquisition
Mechanical structures
Ultra-high vacuum

Microchips for Megastructures

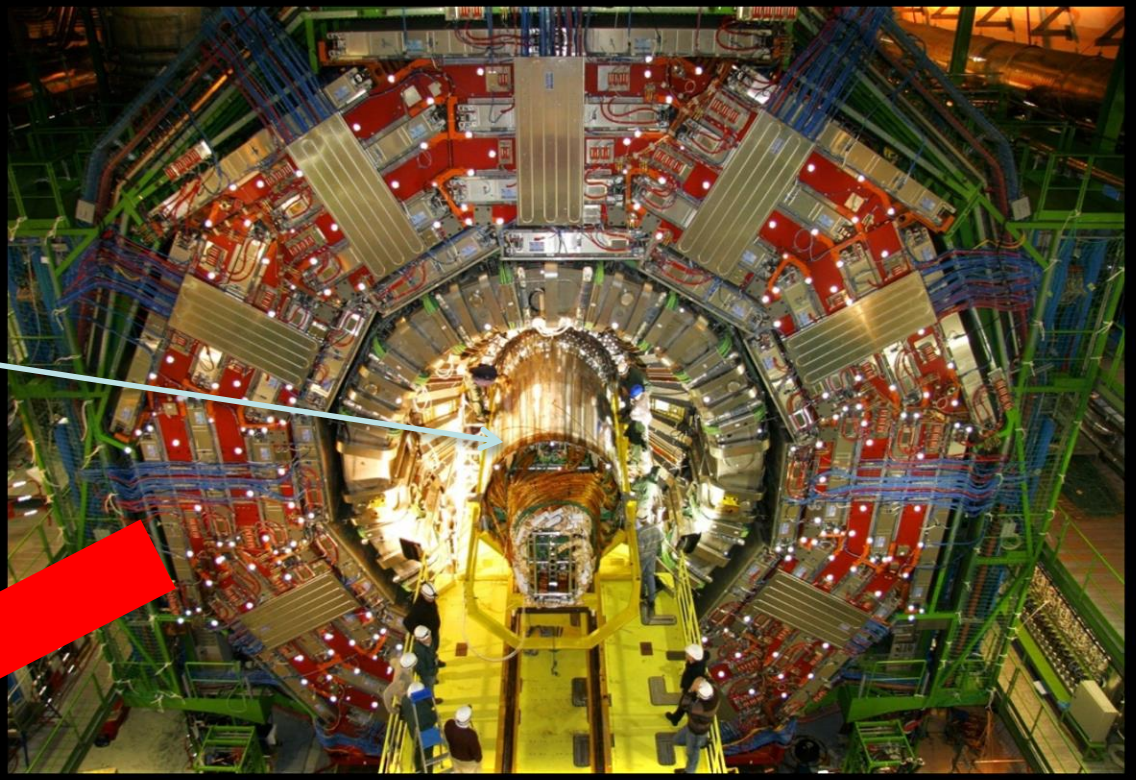
Front-End ASIC



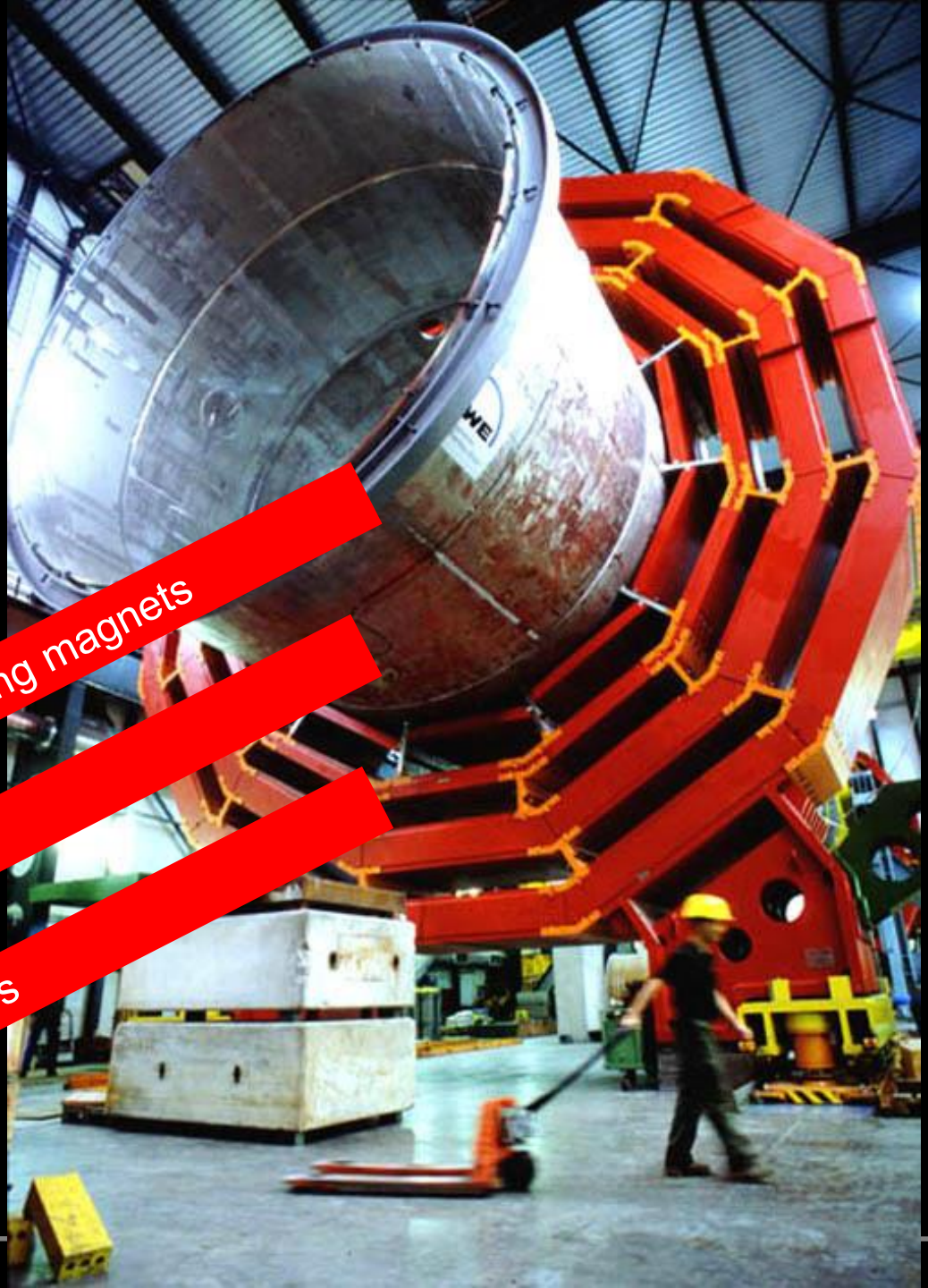
Silicon Tracker Hybrid

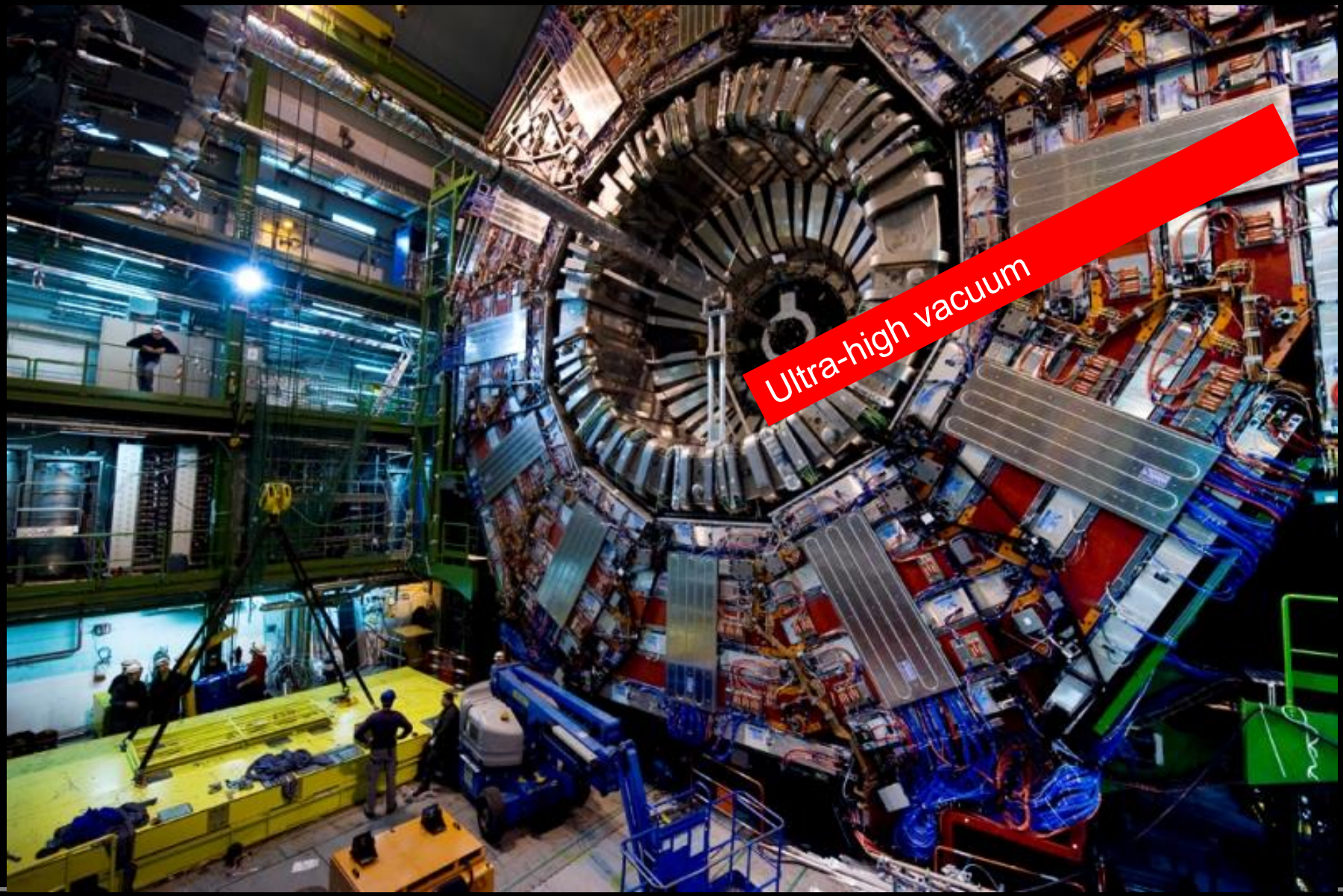


CMS experiment on the LHC accelerator at CERN



Micro-electronics

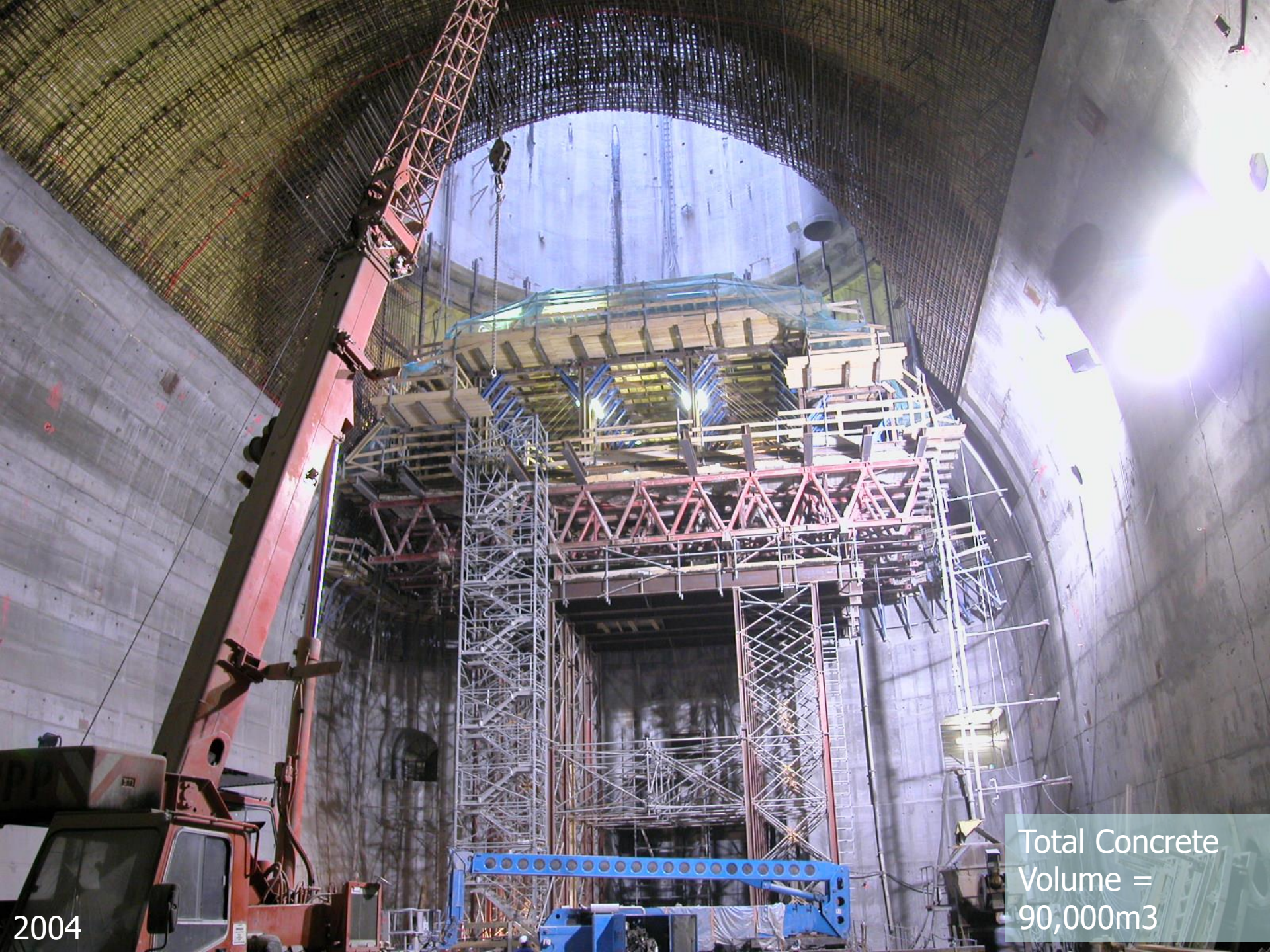

Superconducting magnets
Cryogenics
Power supplies


Ultra-high vacuum


Underground Civil structures
Cooling and ventilation
Heavy handling

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

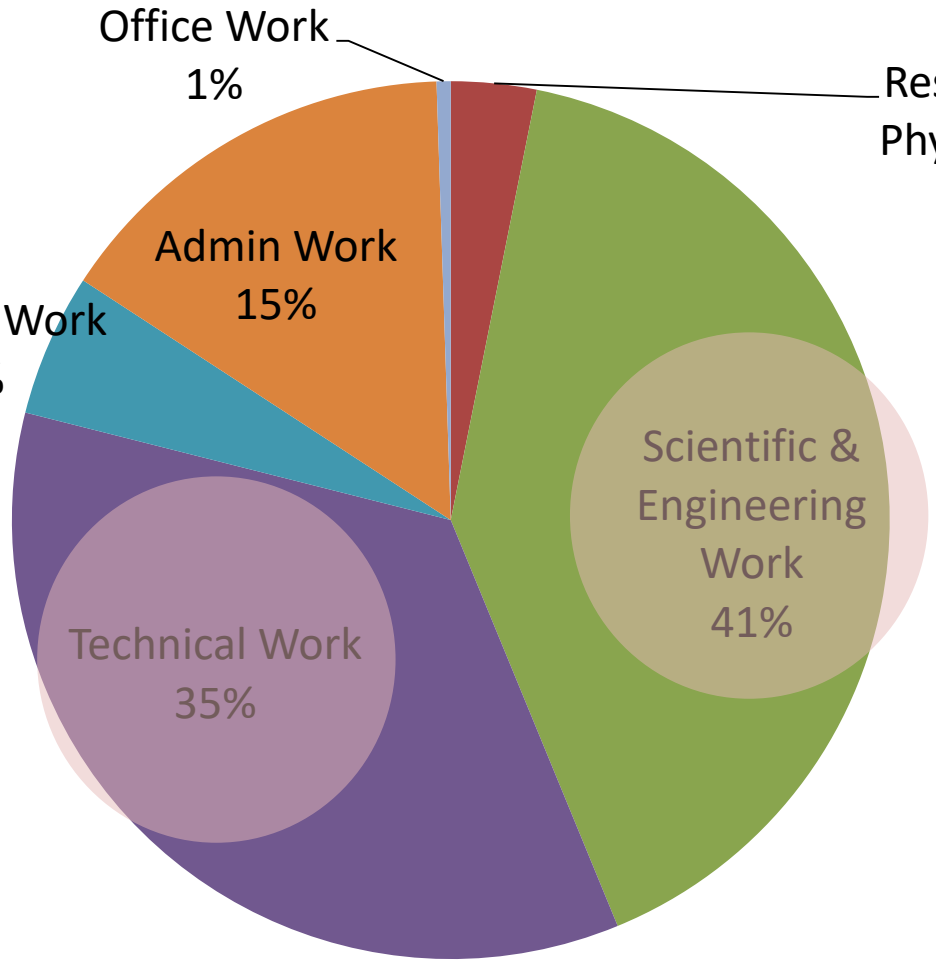

PAOLO DE NICOLA


Total Concrete Volume = 90,000m3
2004

Ray Veness (CERN)

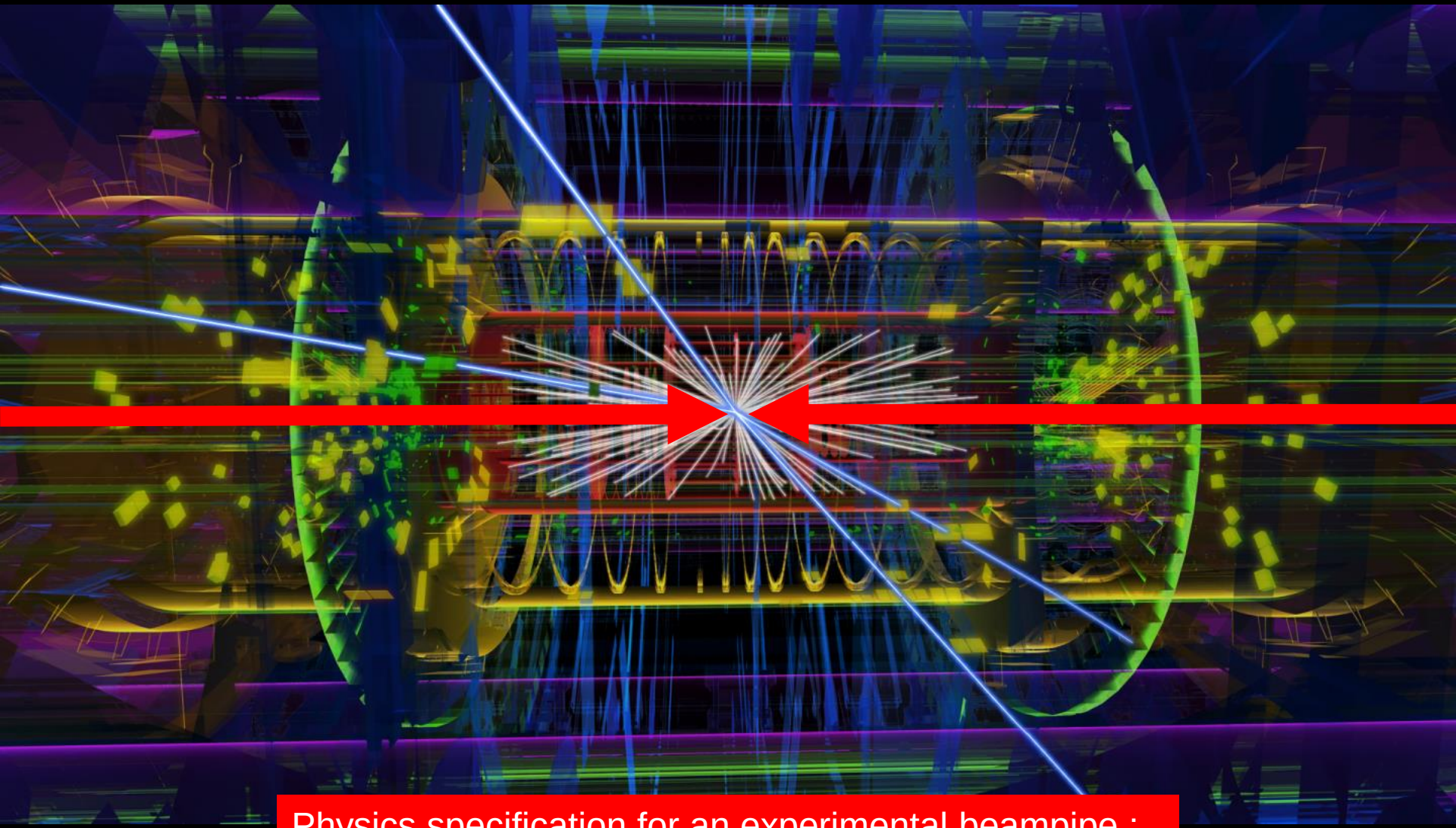
Image courtesy British Gas

CERN Staff by job description

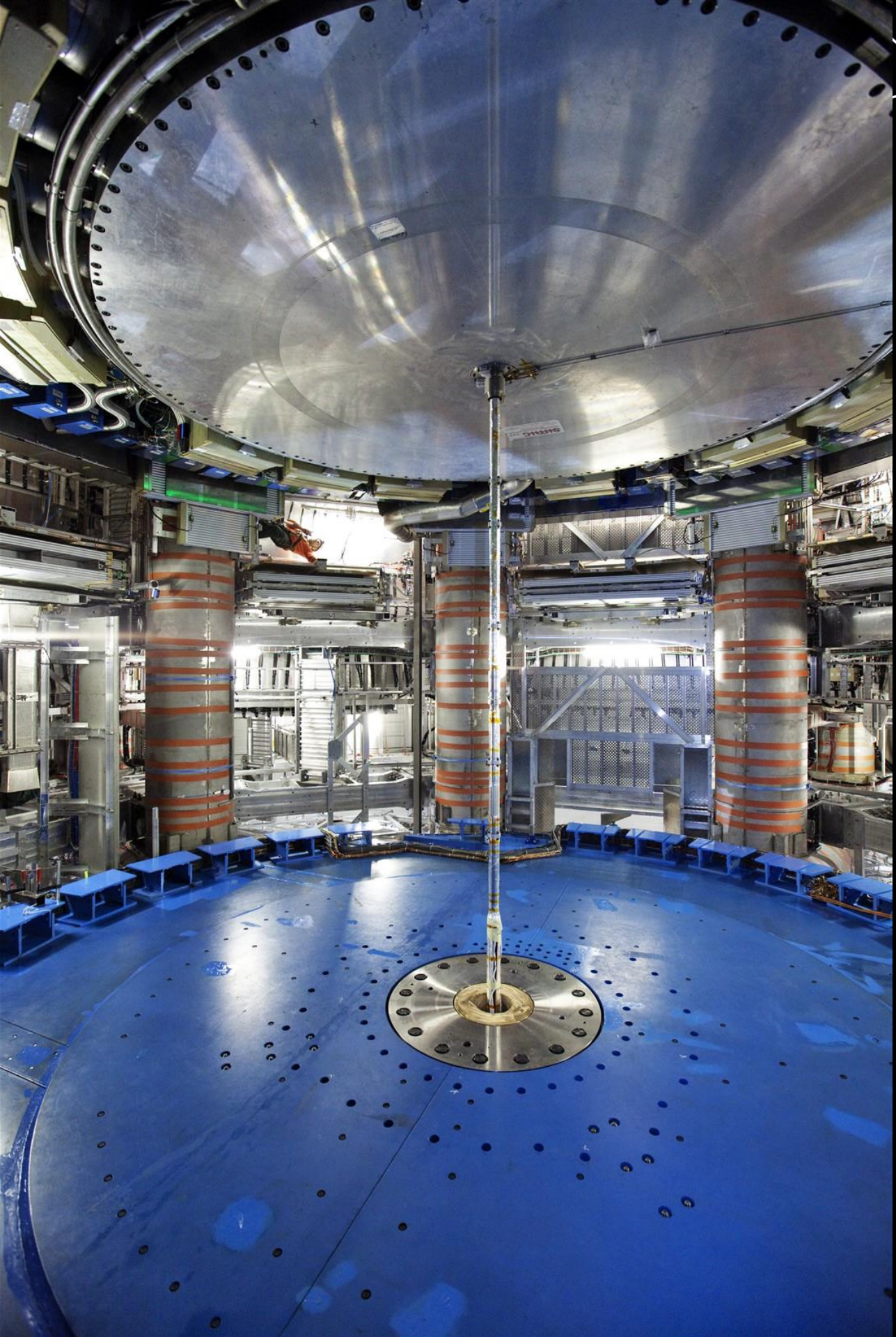


Engineers
-Electrical/Electronic
-Mechanical
-Civil
-Computing
Applied physicists

Technicians
Programmers
Accelerator operators



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



Nothing, contained by nothing!

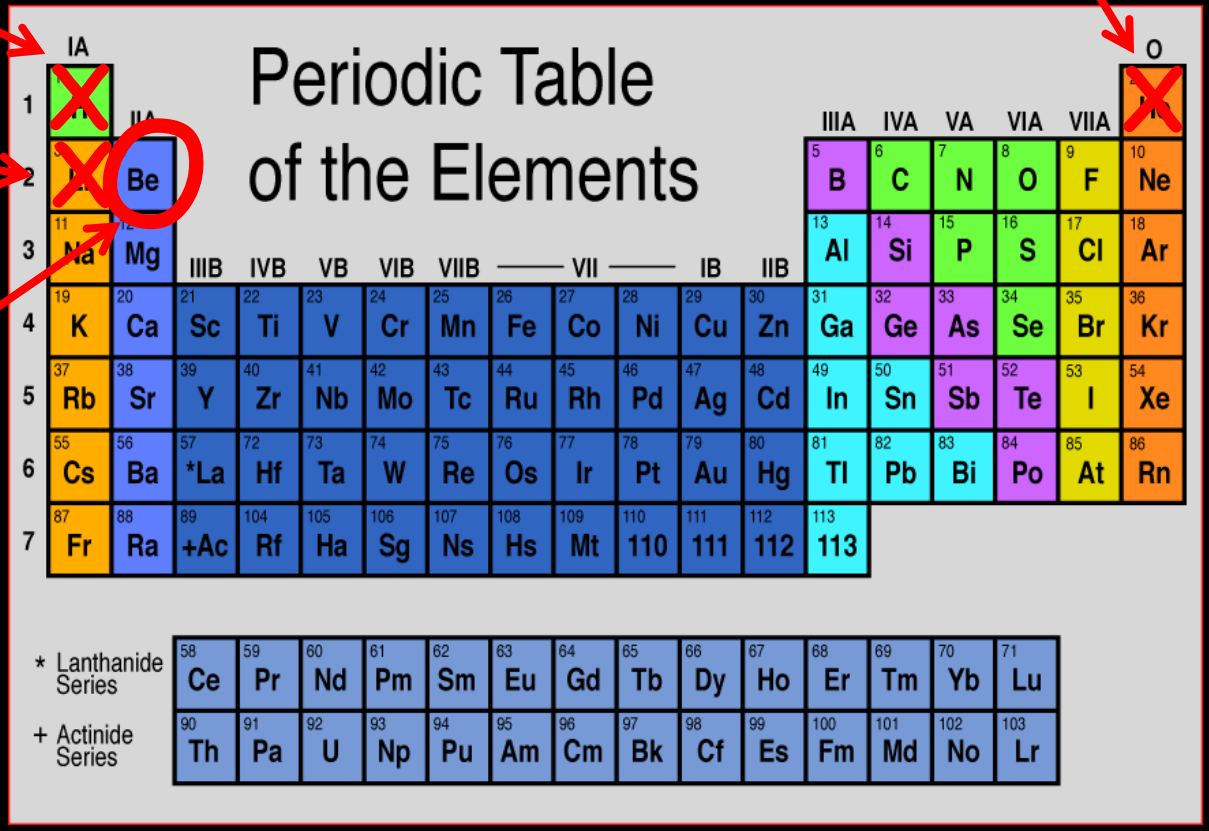
Hydrogen is a gas at room temperature!

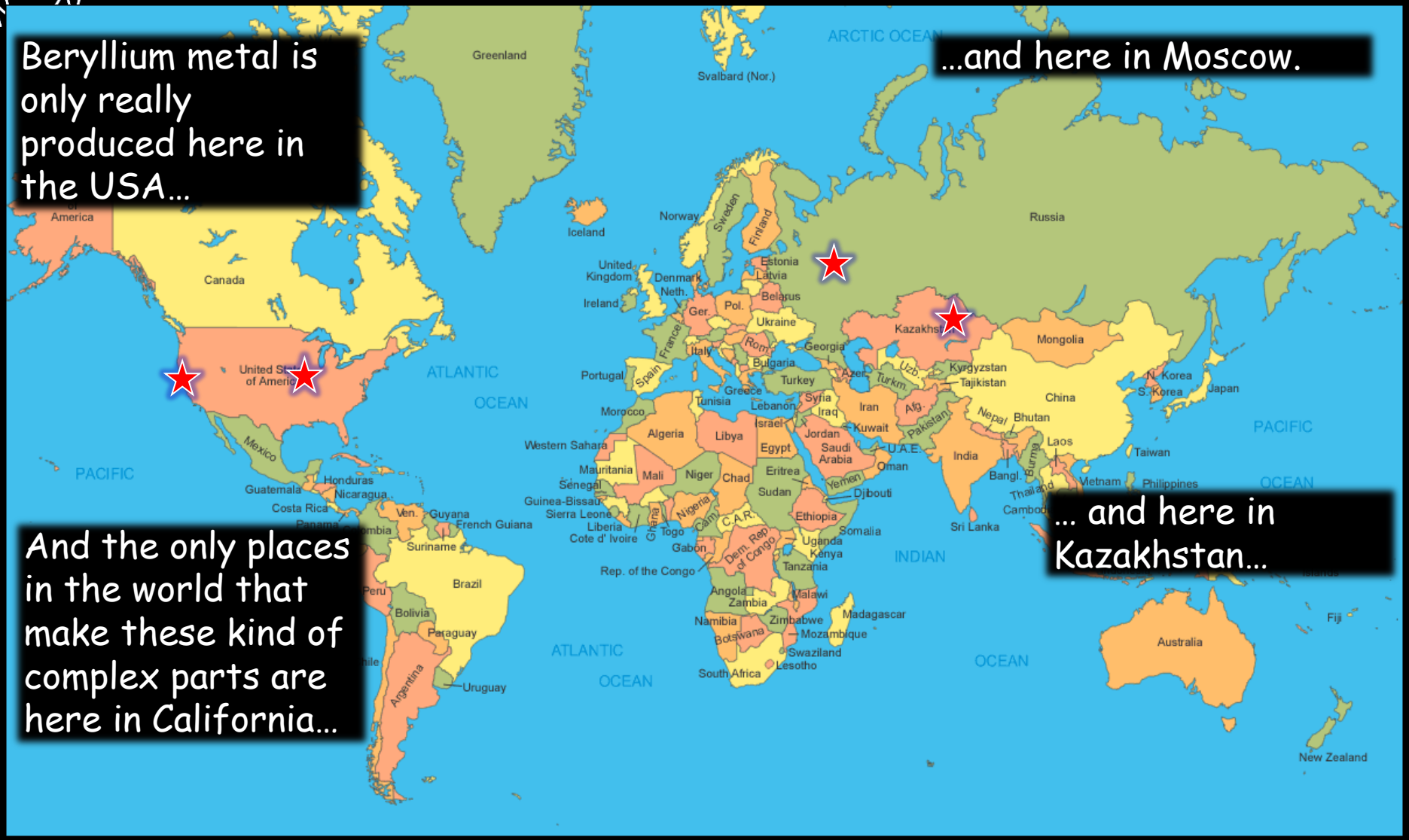
So is helium…

Lithium explodes in air… not so good

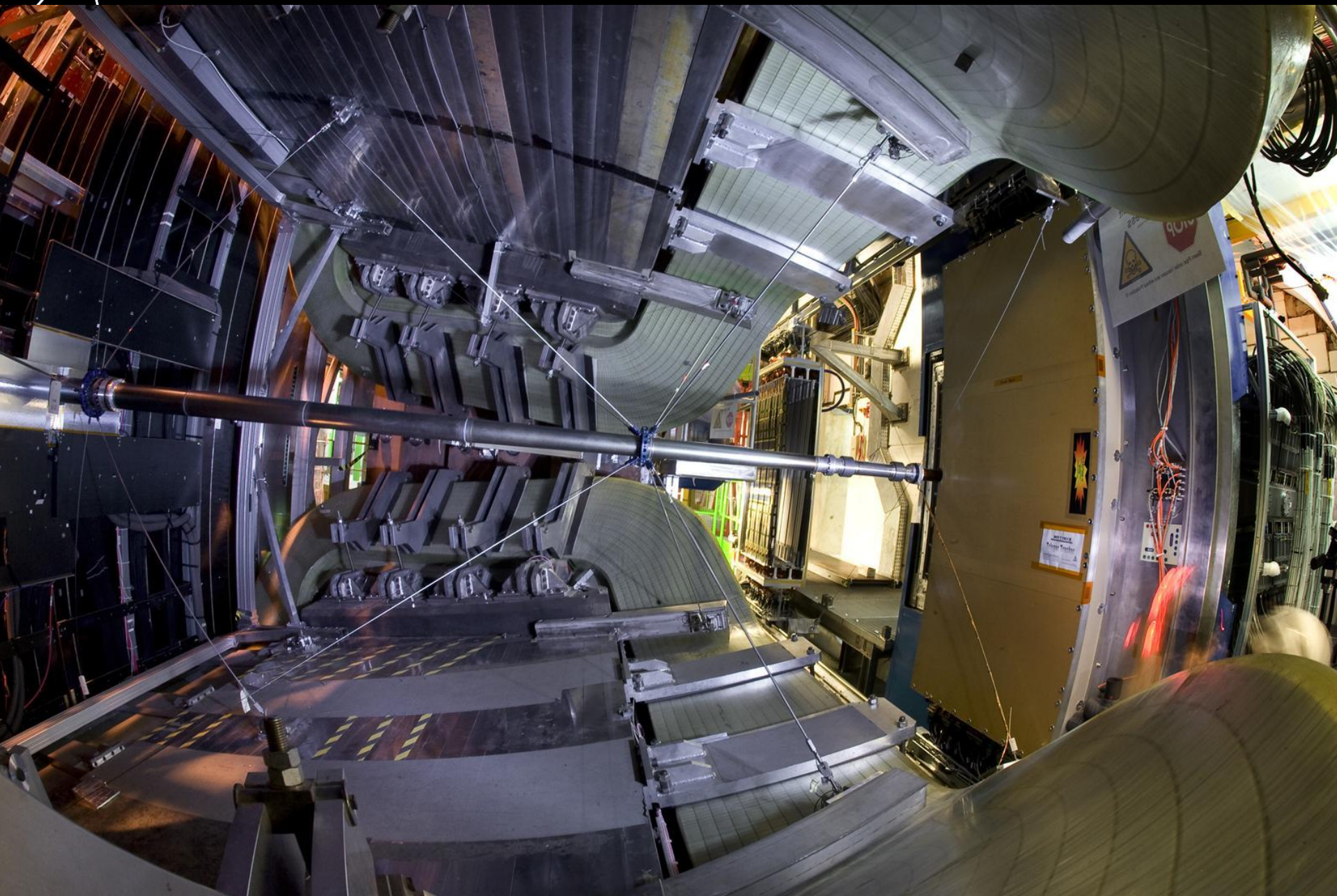
Beryllium… that would be good!

…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 the only places in the world that make these kind of complex parts are here in California…
… and here in Kazakhstan…
ARCTIC OCEAN
Greenland
Svalbard (Nor.)
Russia
Iceland
Norway
Sweden
Finland
Canada
United States of America
Mexico
Guatemala
Honduras
Nicaragua
Costa Rica
Panama
Ven.
Guyana
Suriname
French Guiana
Brazil
Peru
Bolivia
Paraguay
Argentina
Uruguay
Chile
ATLANTIC OCEAN
PACIFIC
United Kingdom
Ireland
Denmark
Neth.
Ger.
Pol.
Belarus
Ukraine
Estonia
Latvia
France
Spain
Portugal
Italy
Rom.
Bulgaria
Greece
Turkey
Georgia
Azer.
Uzb.
Turkm.
Kyrgyzstan
Tajikistan
Kazakhstan
Mongolia
China
N. Korea
S. Korea
Japan
Morocco
Western Sahara
Algeria
Tunisia
Libya
Egypt
Lebanon
Israel
Syria
Iraq
Iran
Afg.
Kuwait
Jordan
Saudi Arabia
U.A.E.
Oman
Yemen
Pakistan
Nepal
Bhutan
India
Laos
Taiwan
Bangl.
Burma
Thailand
Cambod.
Vietnam
Philippines
Sri Lanka
Mauritania
Mali
Niger
Chad
Eritrea
Djibouti
Sudan
Senegal
Guinea-Bissau
Sierra Leone
Liberia
Cote d' Ivoire
Ghana
Togo
Nigeria
Cam.
C.A.R.
Ethiopia
Somalia
Gabon
Dem. Rep. of Congo
Uganda
Kenya
Tanzania
Rep. of the Congo
Angola
Zambia
Malawi
Namibia
Zimbabwe
Mozambique
Madagascar
Botswana
Swaziland
Lesotho
South Africa
INDIAN OCEAN
Australia
Fiji
New Zealand

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



ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Laboratoire Européen pour la Physique des Particules
European Laboratory for Particle Physics

Group Code.: AT-VAC/EN/RV
EDMS No.: 944616
LHC Project document No.: LHC-VC8B-ES-0001

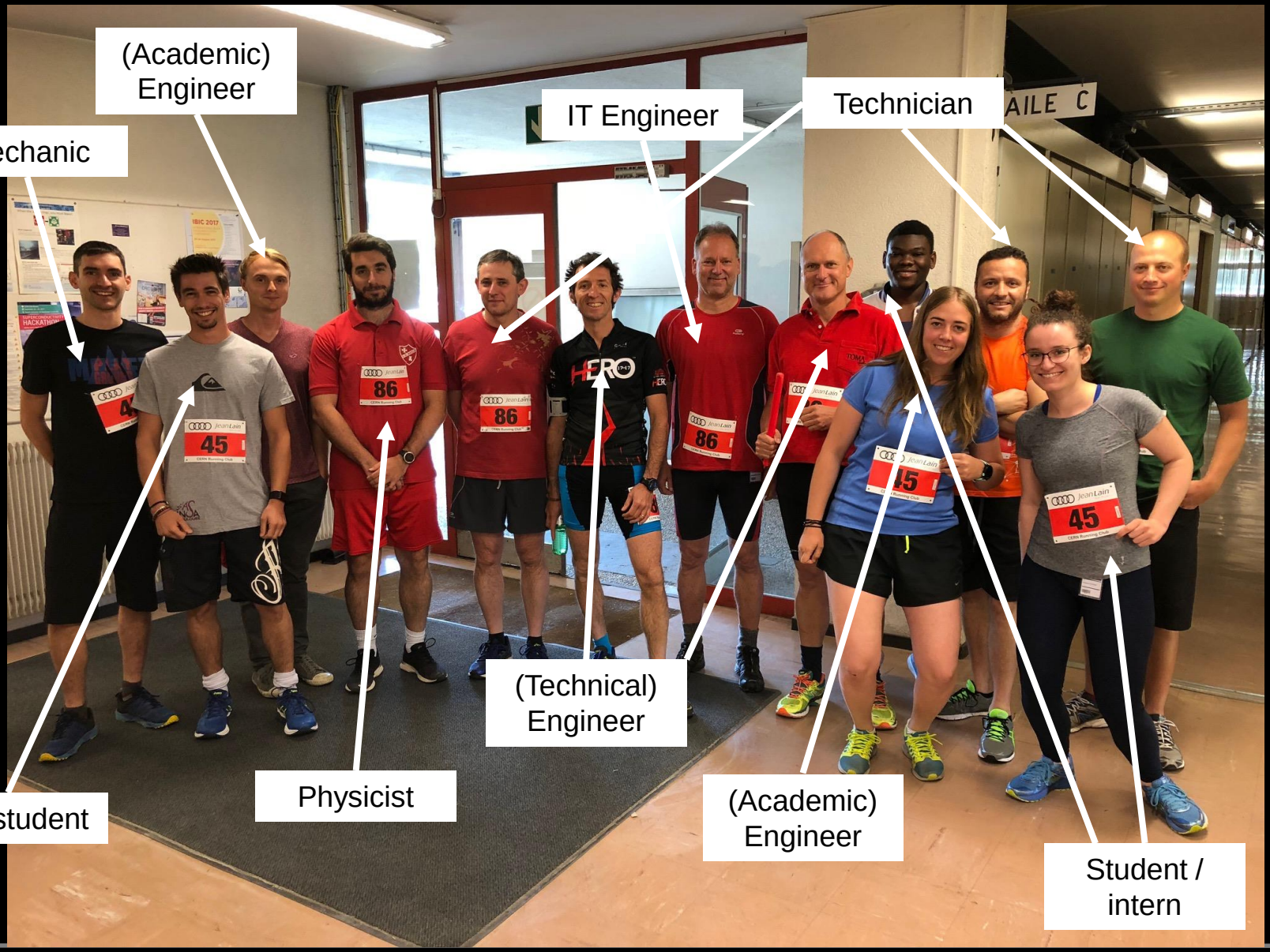
The Large Hadron Collider Project *IT-3601/AT*

Technical Specification for a Beryllium Beam Pipe for LHCb

Abstract

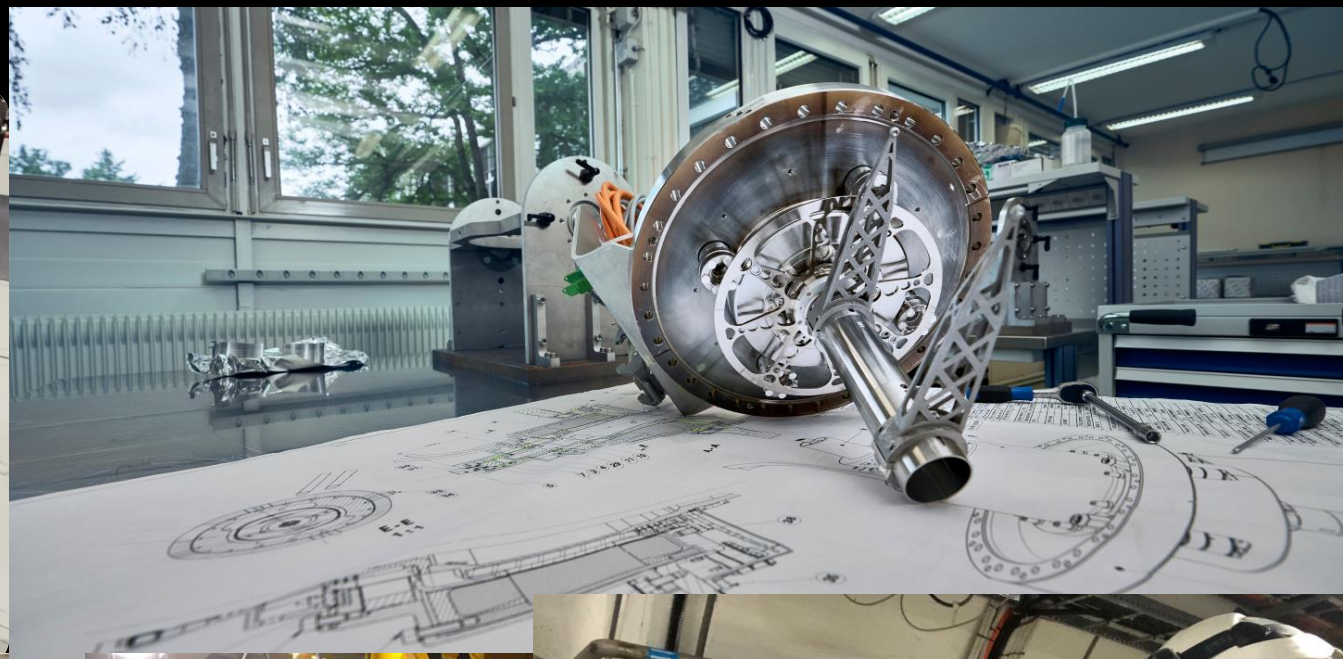
This specification concerns the supply of an ultra-high vacuum conical beam pipe for the LHCb experiment to be housed in point 8 of the LHC ring. It is to be manufactured principally from beryllium with transitions to aluminium and stainless steel. Final delivery is expected 42 weeks after the placement of the contract.

Beam instrumentation Mechanics (2018)



One slide on the long shutdown

More than 150 new beam instruments built and installed



"…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

- I hope you are enjoying your visits over these 2 weeks
- You are seeing some incredible examples of engineering
  - CMS, ALICE control room, 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…

Thank you!

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