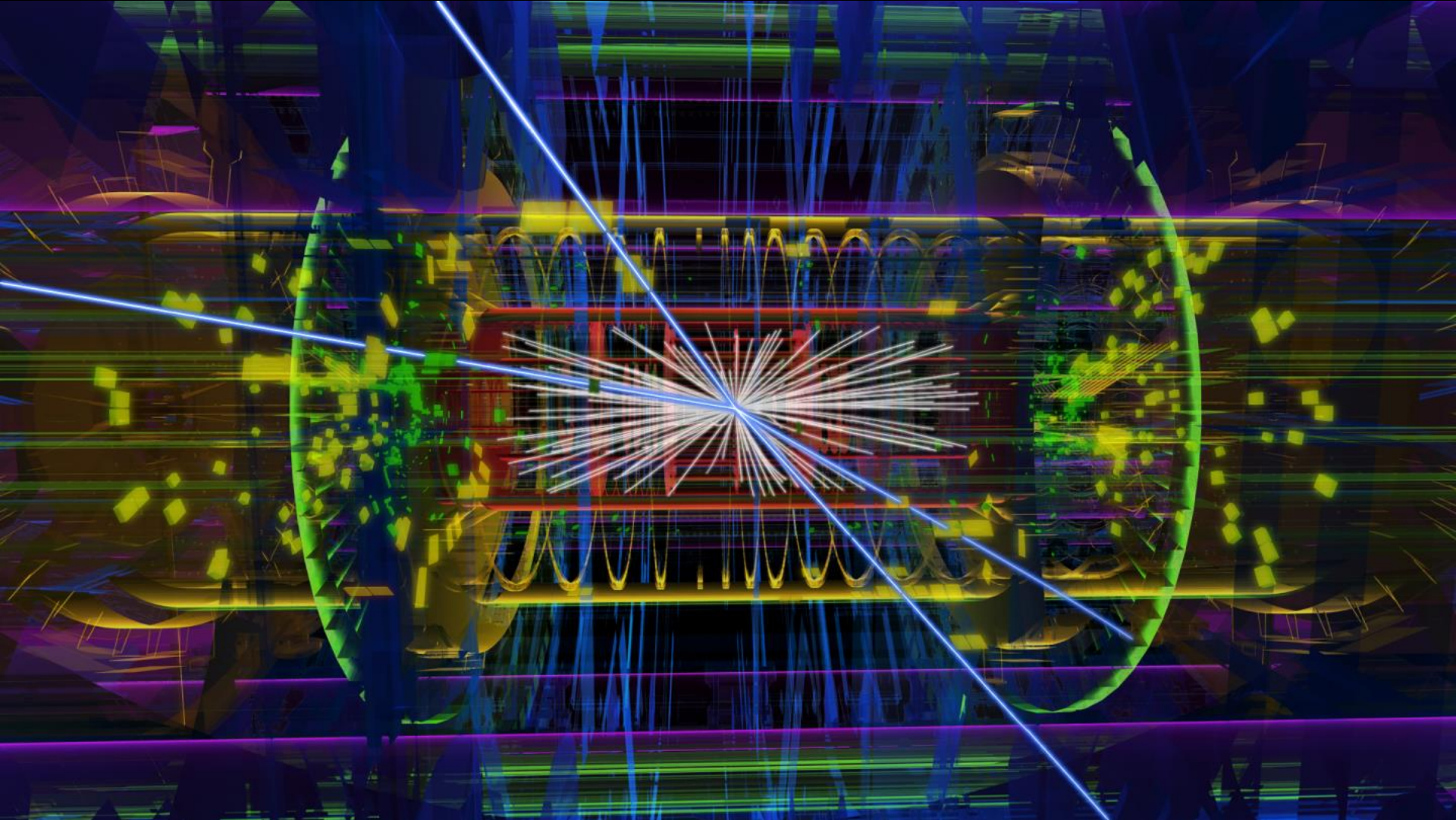
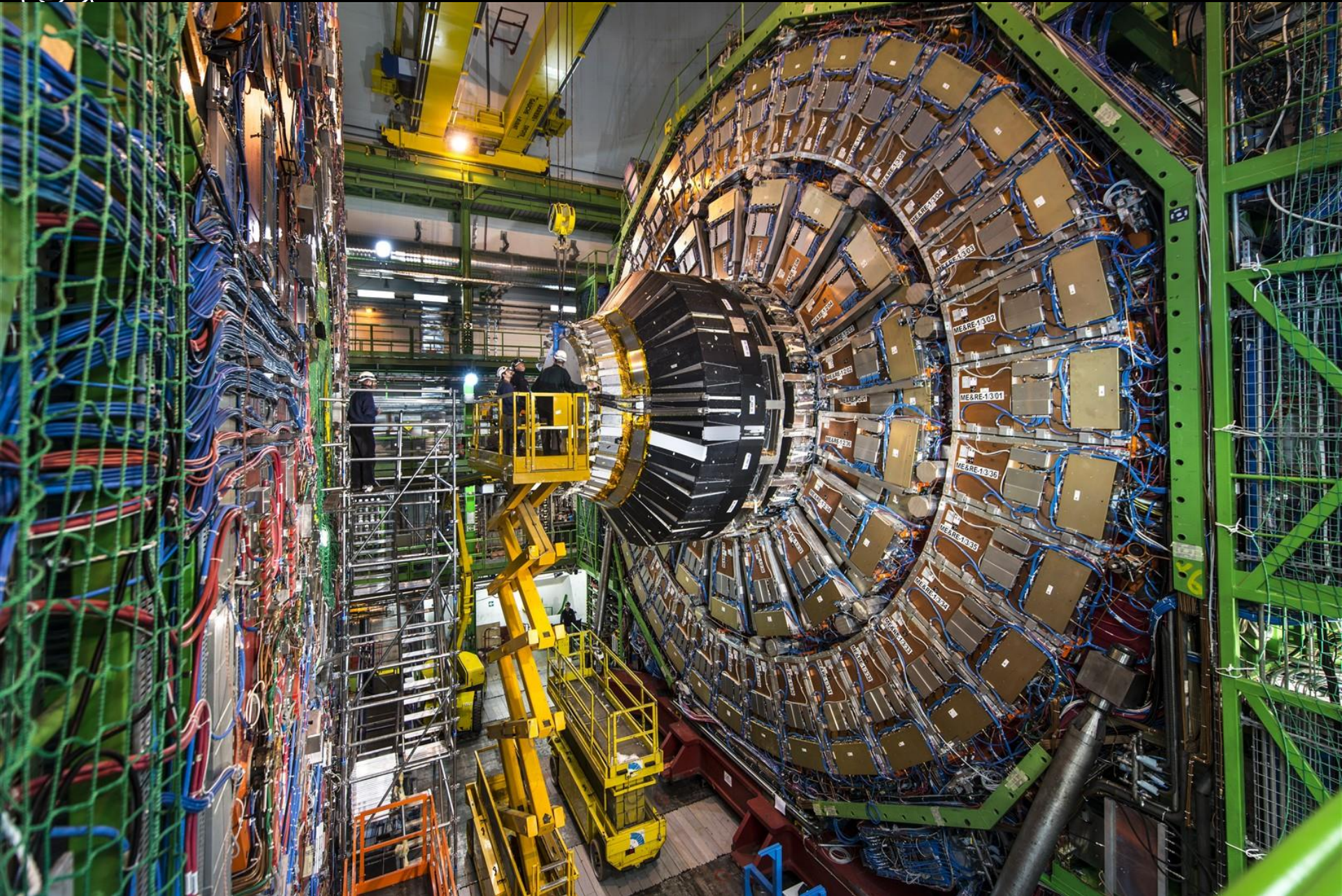


An Introduction to Engineering at CERN

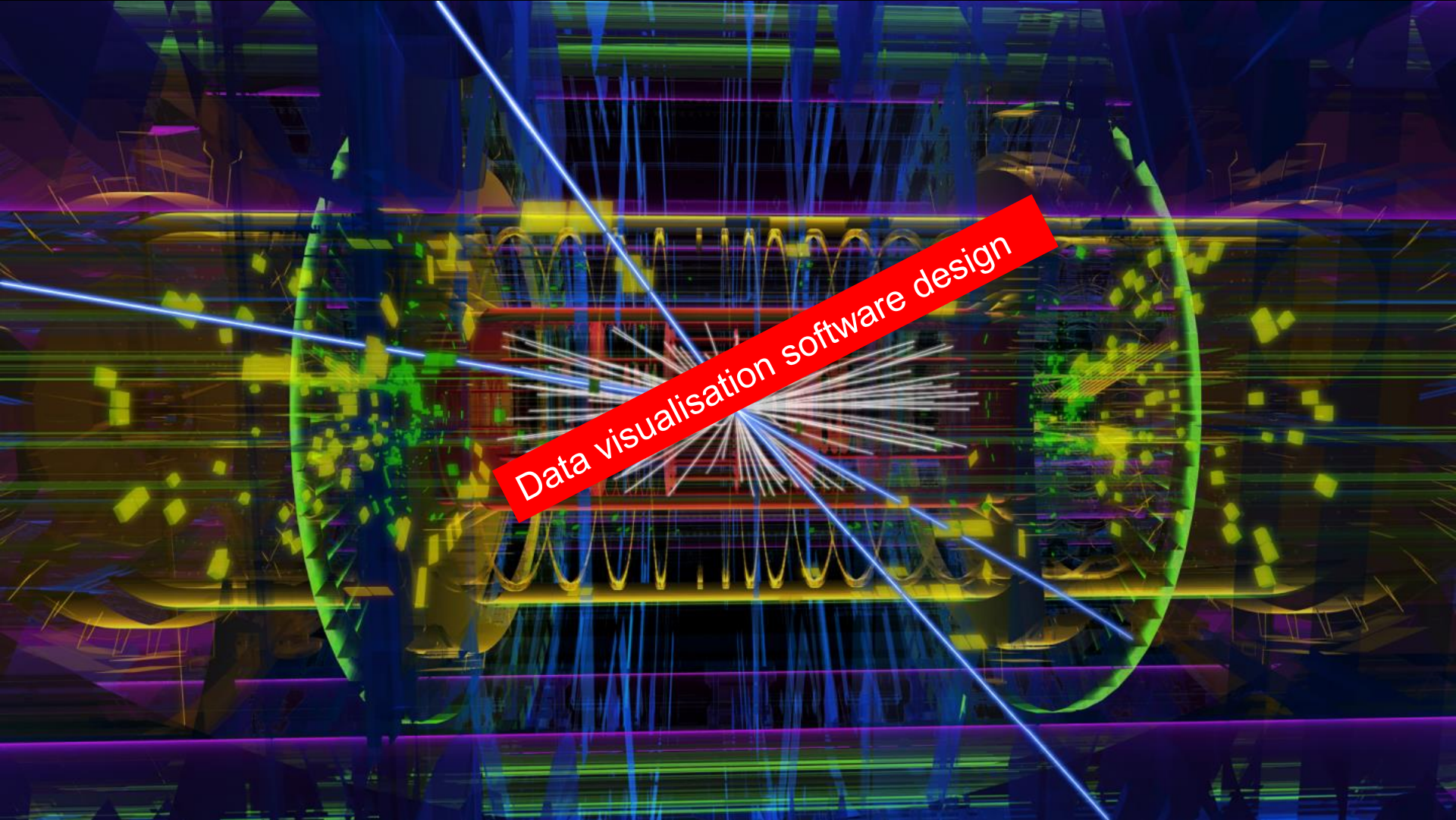
Ray Veness
CERN











Data visualisation software design



Computer hardware

Databases

Network Infrastructures



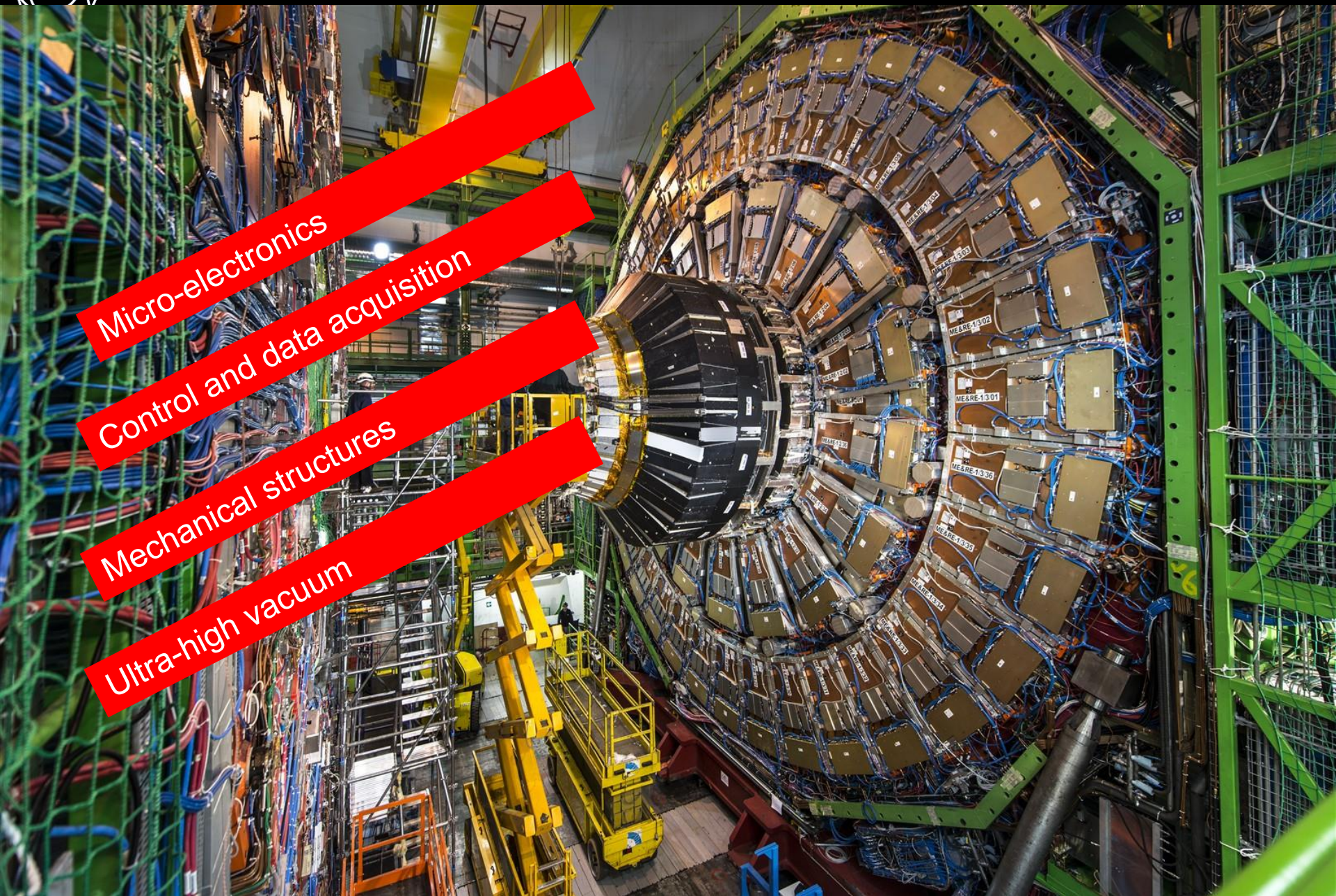
3/4/2013 4:10:16 pm
4:10 pm 4:20 pm

Running jobs: 259835
Transfer rate: 6.15 GiB/sec



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Image © 2013 GeoContent
Image © 2013 TerraMetrics
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
GOOGLE EARTH





Micro-electronics

Control and data acquisition

Mechanical structures

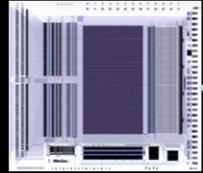
Ultra-high vacuum



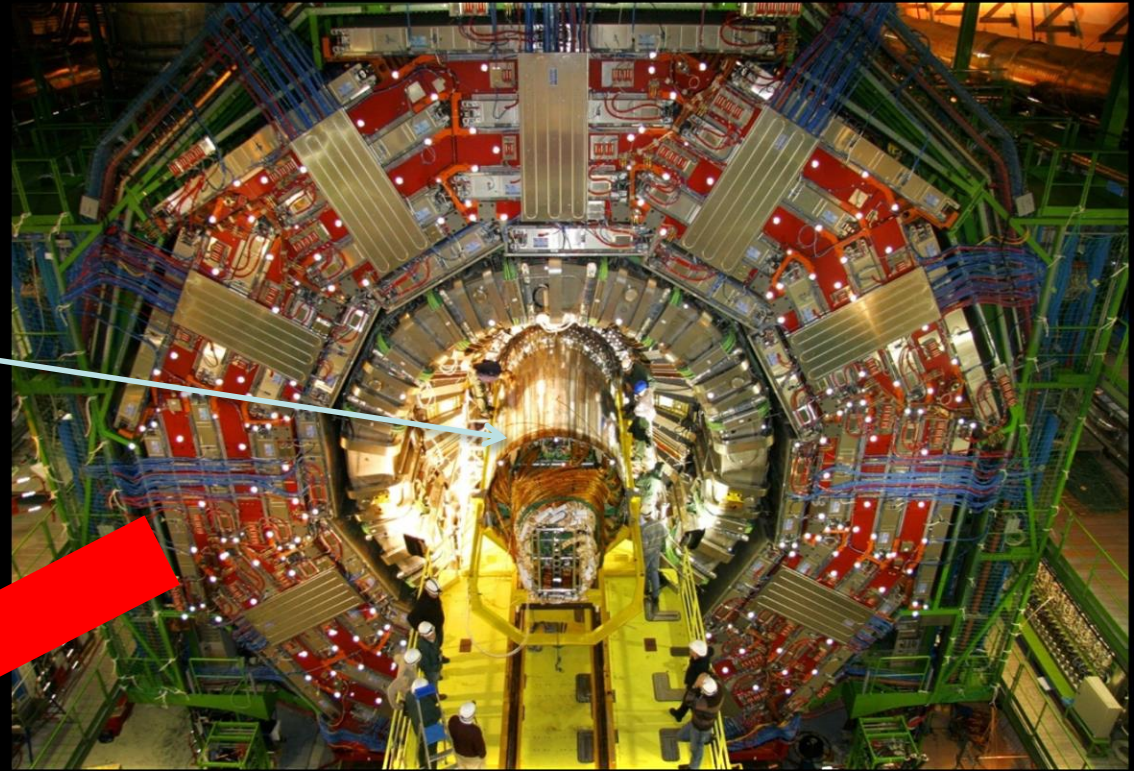
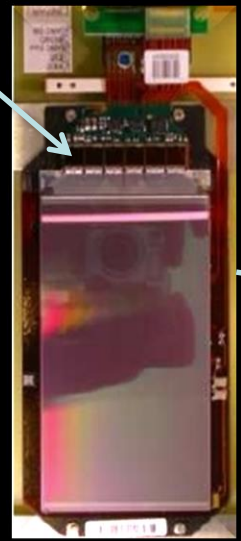
Microchips for Megastructures

Front-End ASIC

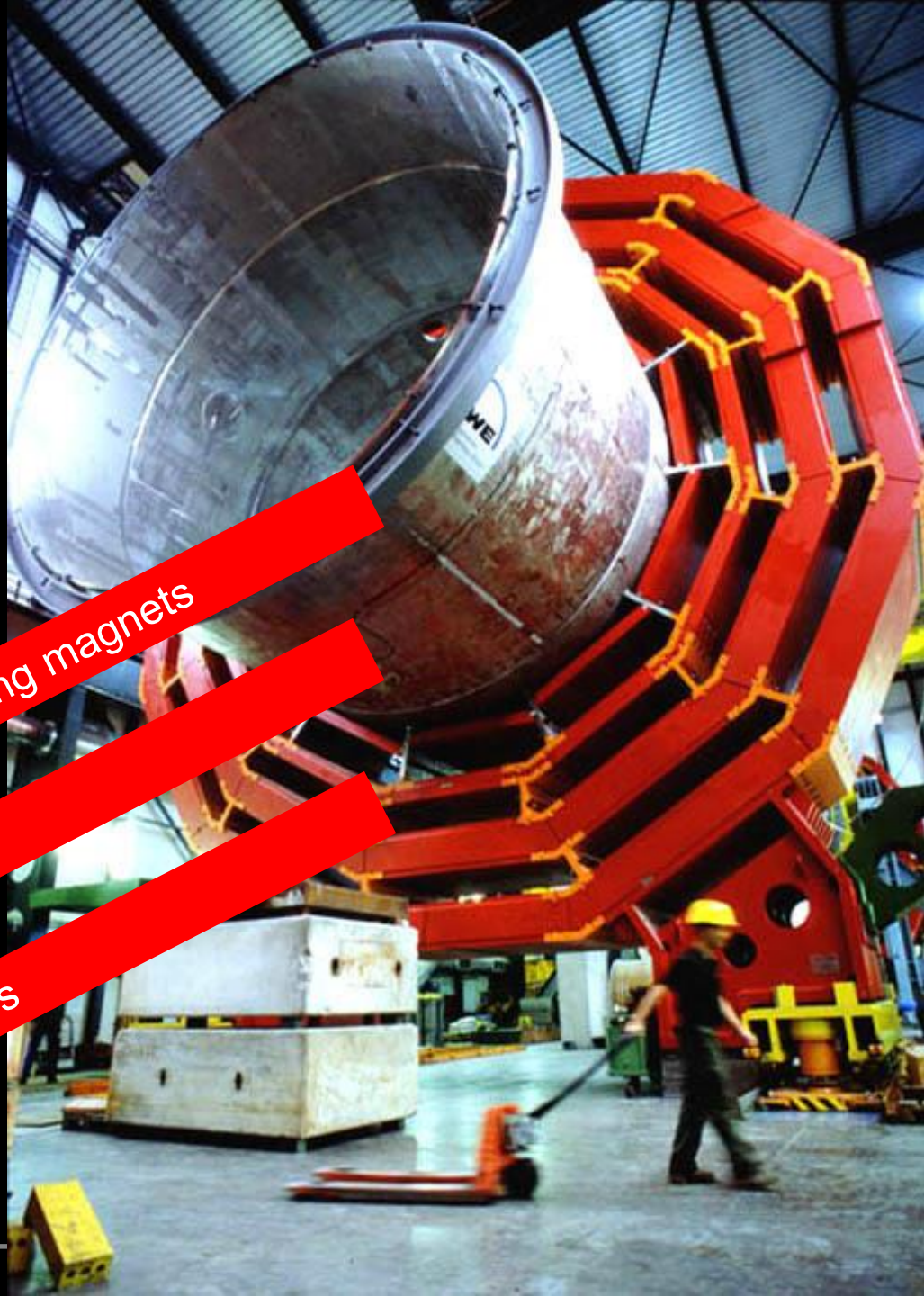
CMS experiment on the LHC accelerator at CERN



Silicon Tracker Hybrid



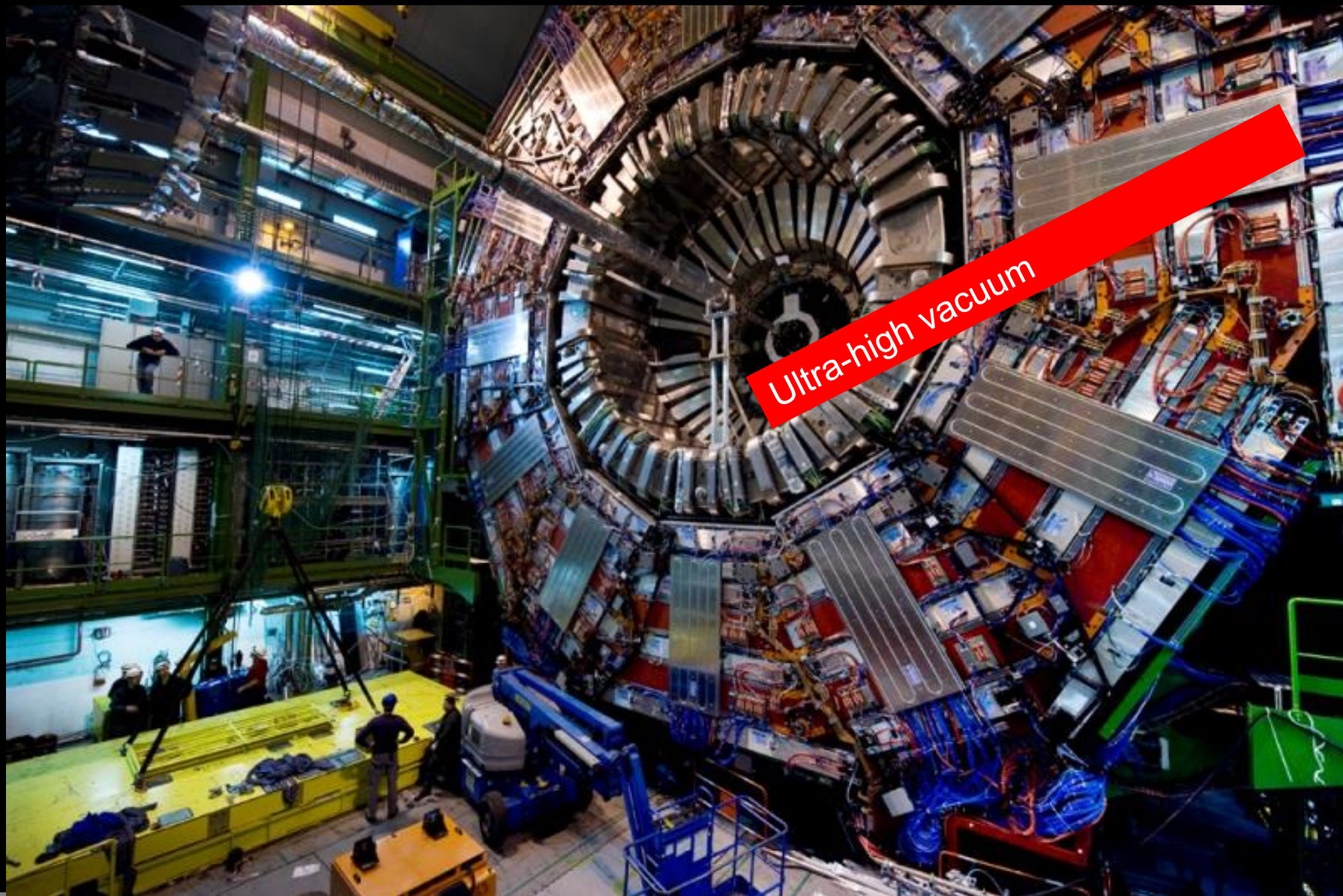
Micro-electronics



Superconducting magnets

Cryogenics

Power supplies



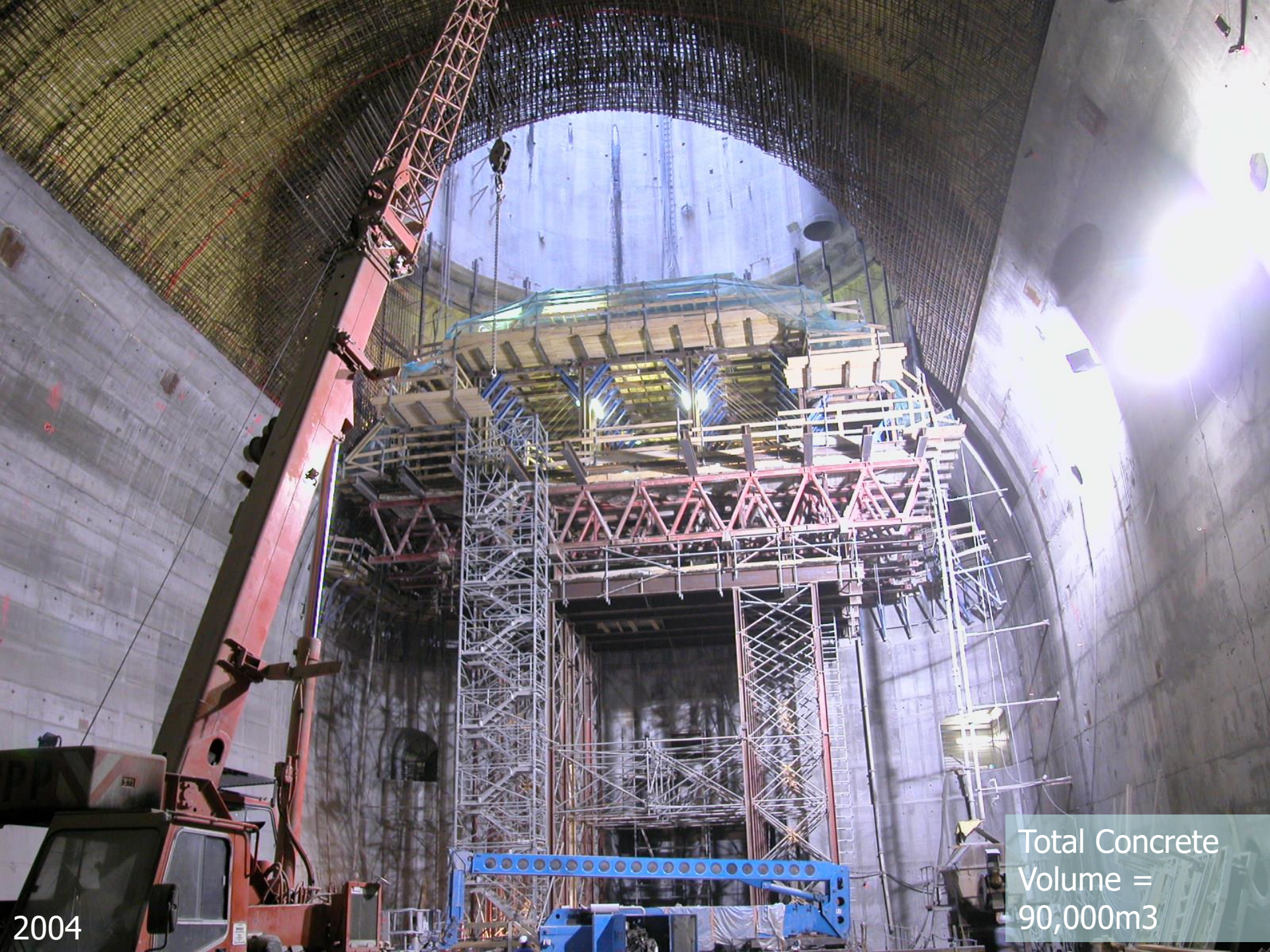
Ultra-high vacuum





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





Total Concrete
Volume =
90,000m³

2004







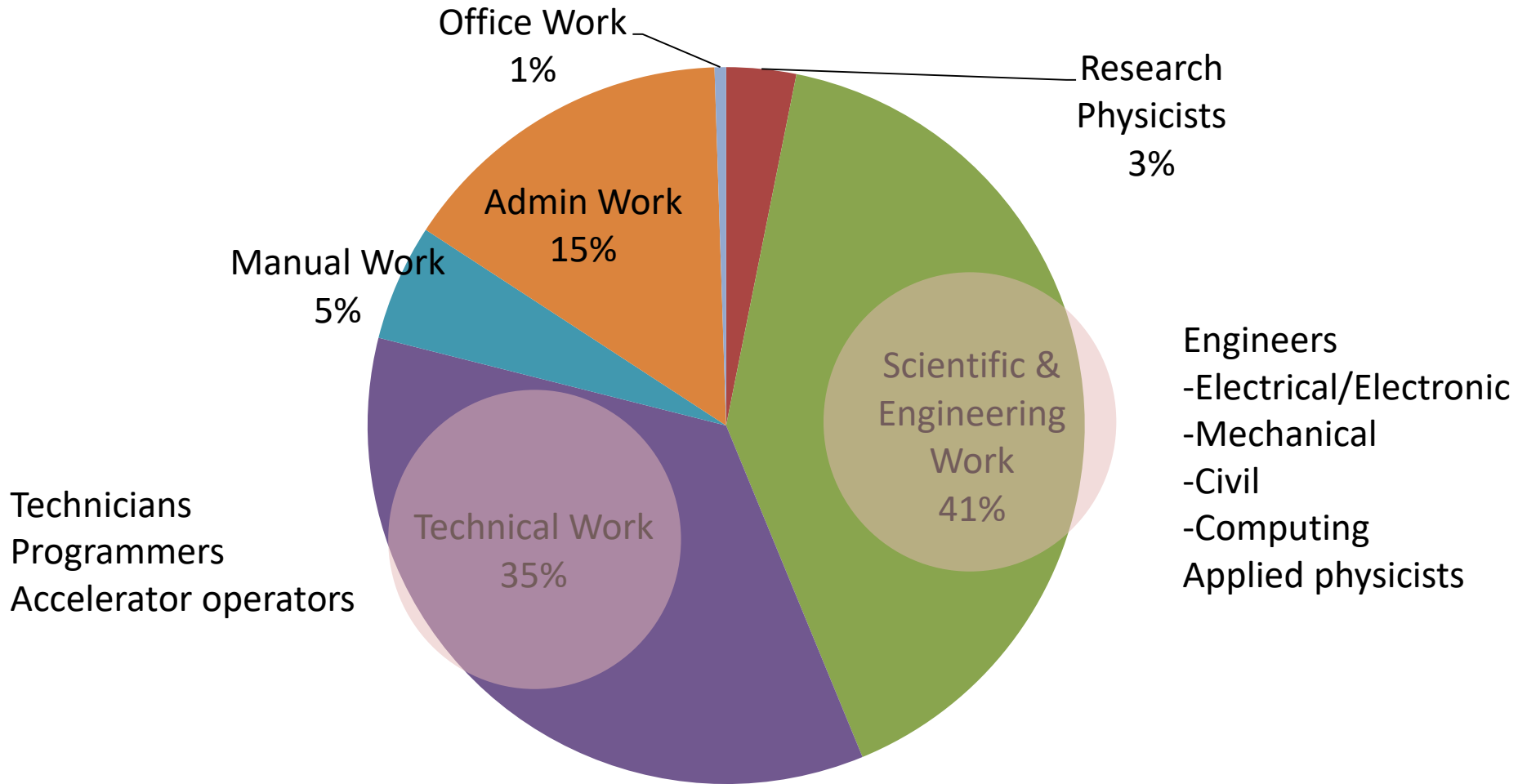
Ray Veness (CERN)

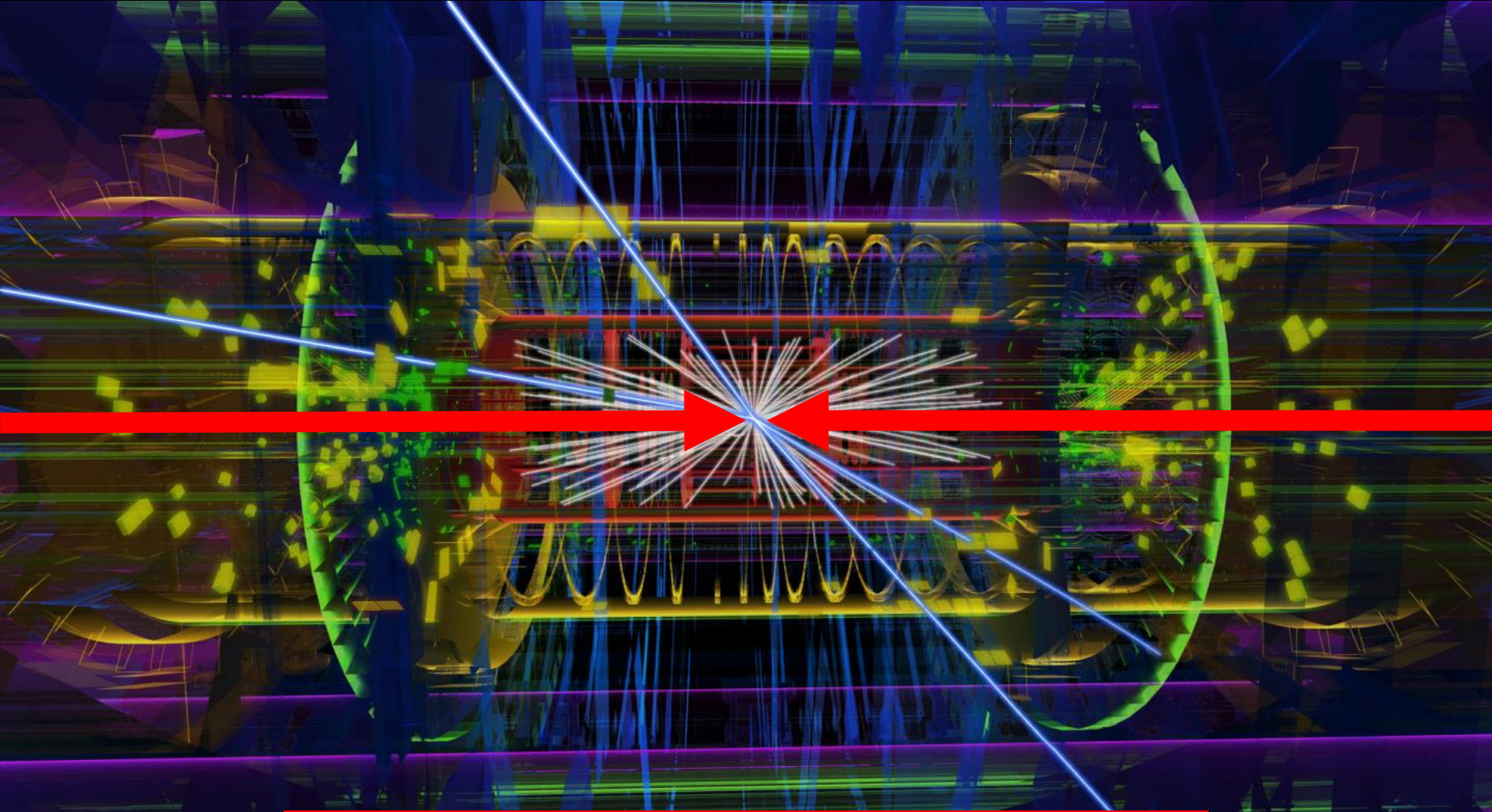


ROSS
THE BOILER
ENGINEER

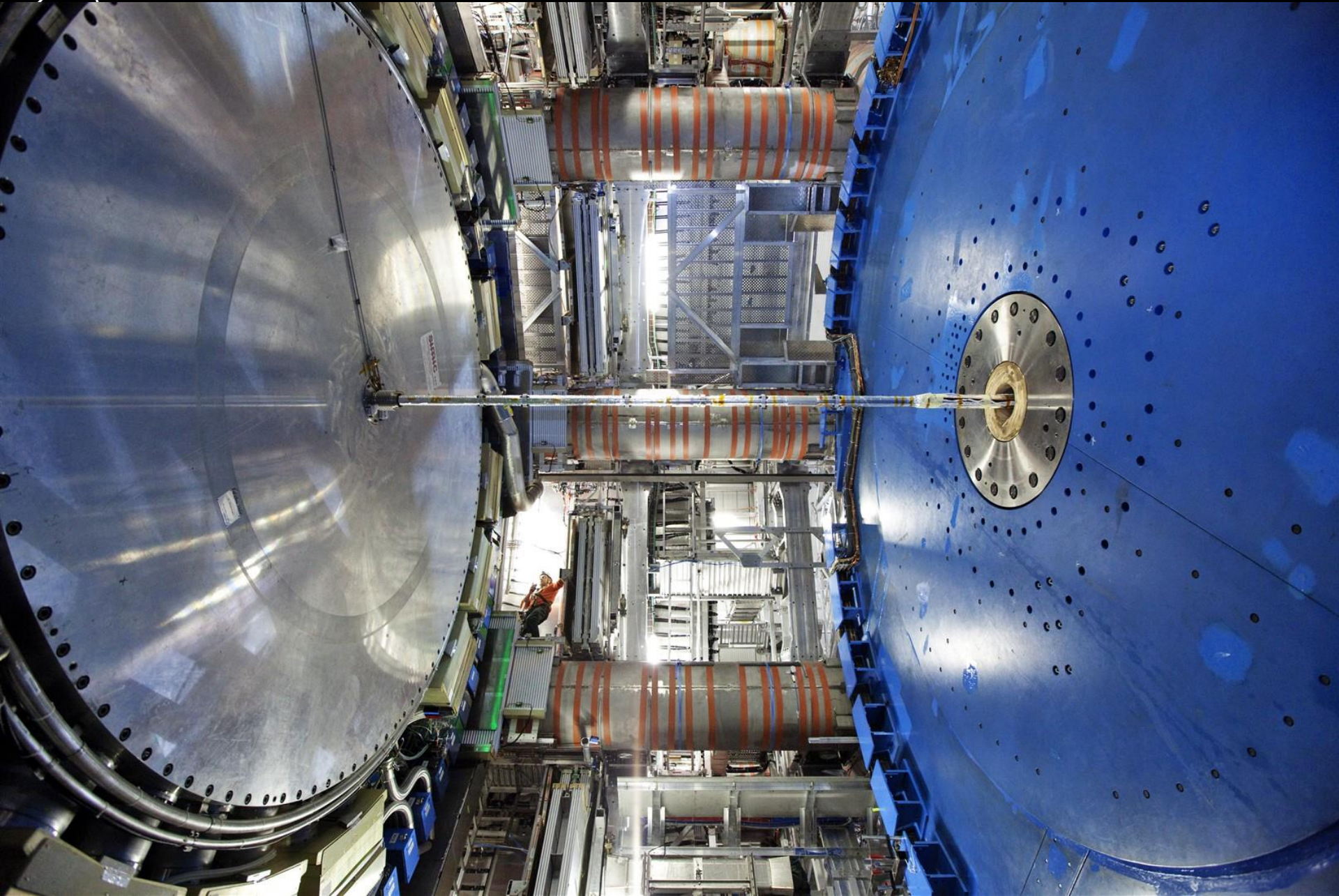
Image courtesy British Gas

CERN Staff by job description





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!

Periodic Table of the Elements

1	2											10																						
3	4	5	6	7	8	9	10											18																
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36									
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103			
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113												

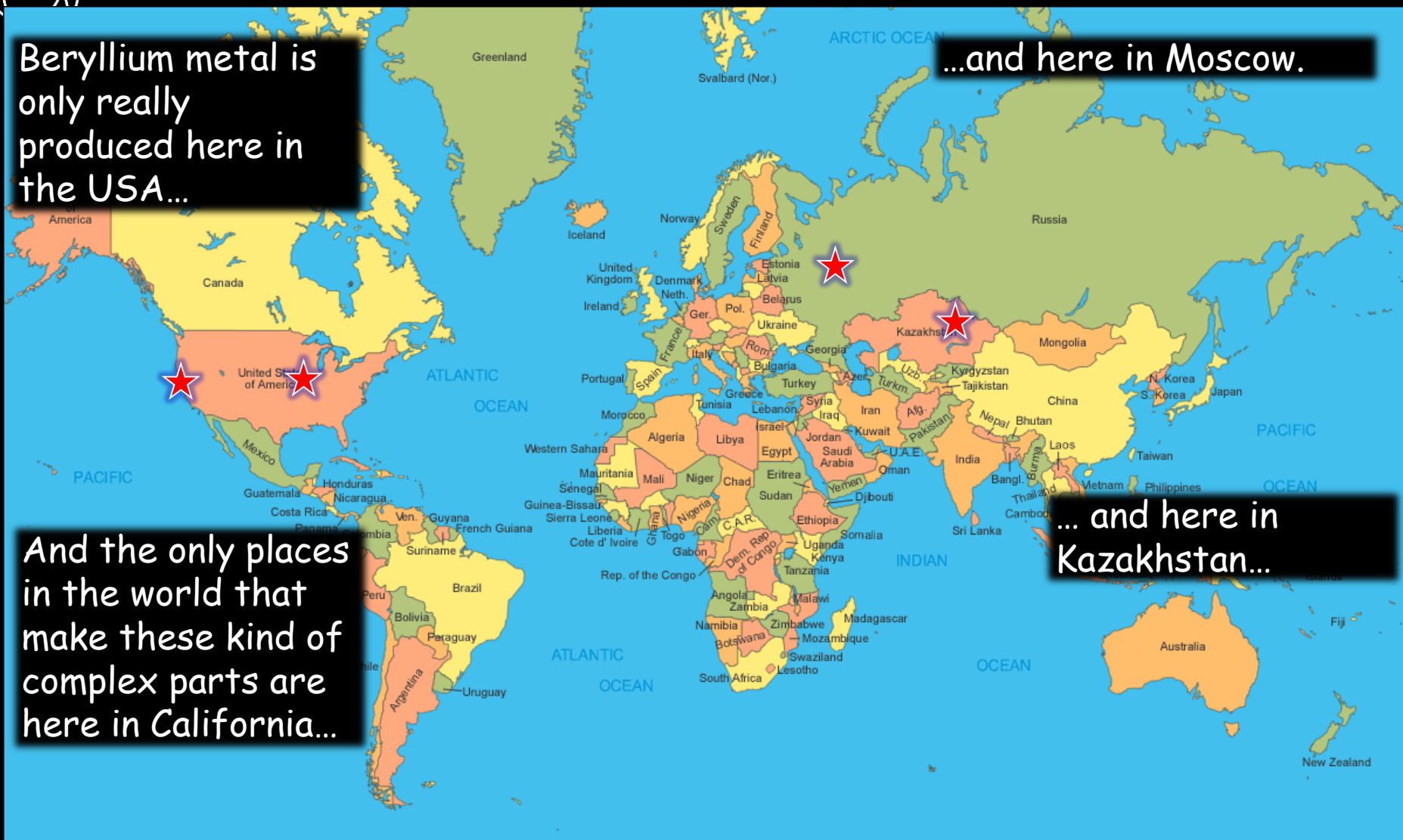
* Lanthanide Series
 + Actinide Series

Beryllium metal is only really produced here in the USA...

...and here in Moscow.

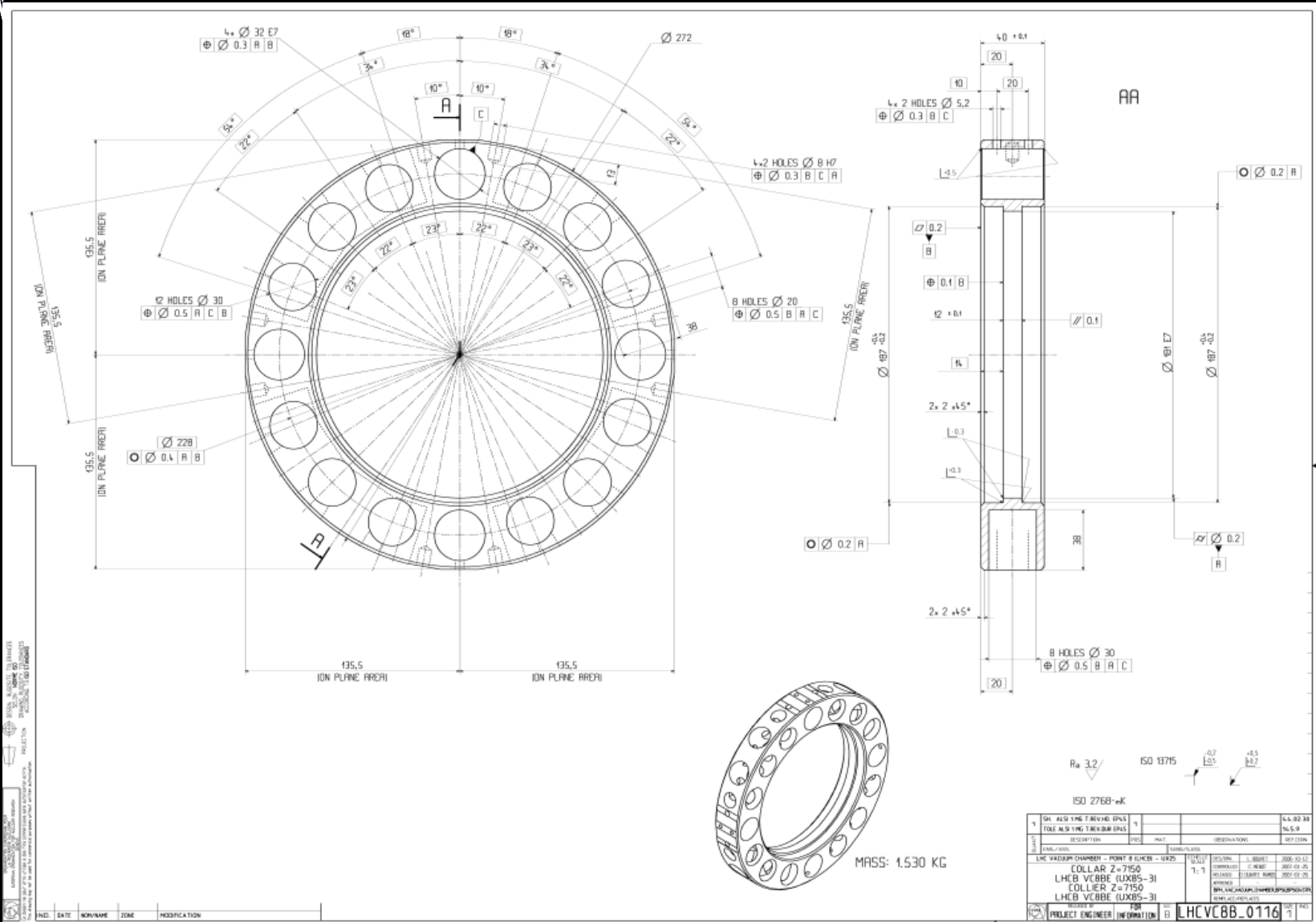
And the only places in the world that make these kind of complex parts are here in California...

... and here in Kazakhstan...



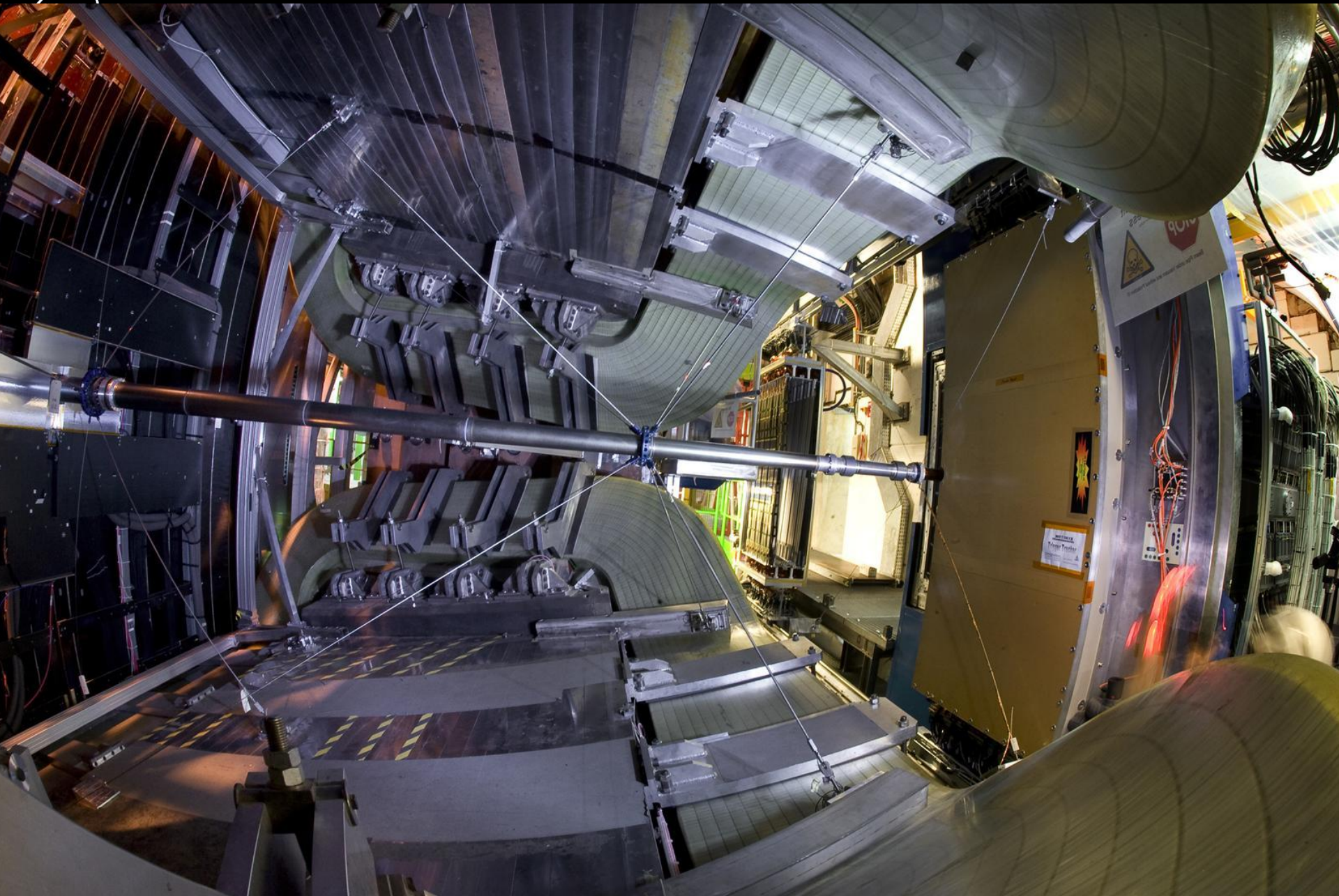


A photo I took of a CERN colleague, as we waited to cross the Khasakh-Russian border in 2004...



PROJECT: LHC VACUUM CHAMBER - POINT 9 UPLINER - U929
 DRAWING NO.: 2007-02-12
 DATE: 2007-02-12
 AUTHOR: [Name]
 CHECKED: [Name]
 APPROVED: [Name]
 PROJECT ENGINEER: [Name]

1		QA	ADD TIME T REVISED	SPAS	1			6.4.02.01
2		TOLE	MS D 1 MG 1	REVISED	SPAS			14.5.9
ITEM NO.	DESCRIPTION	QTY	UNIT	OPERATIONS	REVISIONS	DATE	BY	
LHC VACUUM CHAMBER - POINT 9 UPLINER - U929	COLLAR Z=7150 LHEB VCBBE (UXB5-3) COLLAR Z=7150 LHEB VCBBE (UXB5-3)	1						
REVISED	REASON	DATE	BY	APPROVED				
PROJECT ENGINEER	INFORMATION	IT						
LHCVCBB_0116		1						





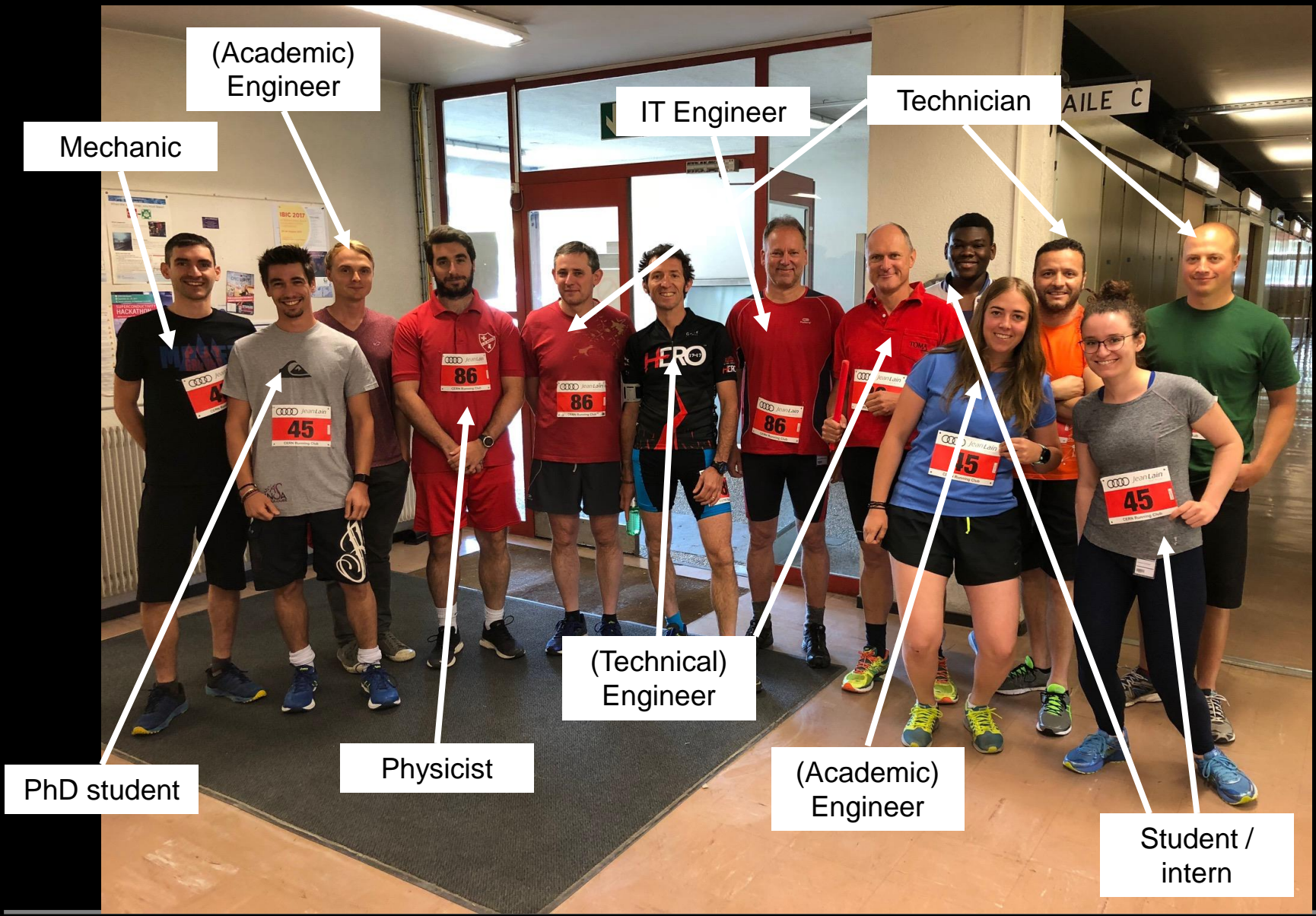
Engineering at CERN



Ray Veness (CERN)



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 enjoy your visits over the 2 weeks
- You will see some incredible examples of engineering
 - CMS, neutrino factory,
 - Antimatter factory,
- 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!