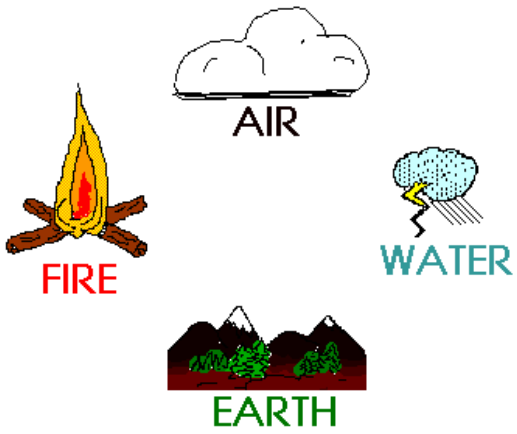
B. Golob, Fakulteta za matematiko in fiziko in
Inštitut Jožef Stefan

- (Zgodovinski) uvod
  zoologija osnovnih delcev
- Pospeševalniki
  veliiikiii mikroskopi
- Veliko in majhno
  (vesolje in delci)
- Bodočnost
  ….pripada vam!

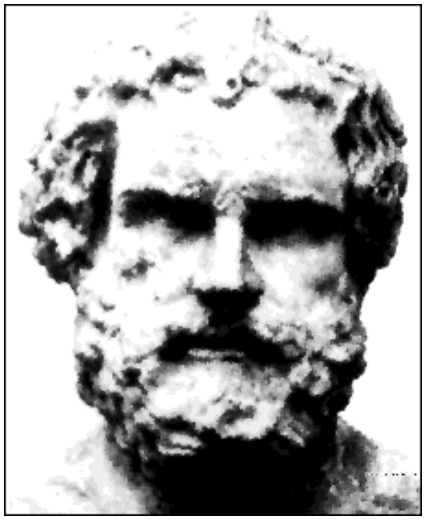
Nekaj zgodovine:

Pojem osnovnih delcev se je spreminjal v toku zgodovine, skladno s človeškim dojemanjem, kasneje opazovanjem, sveta.

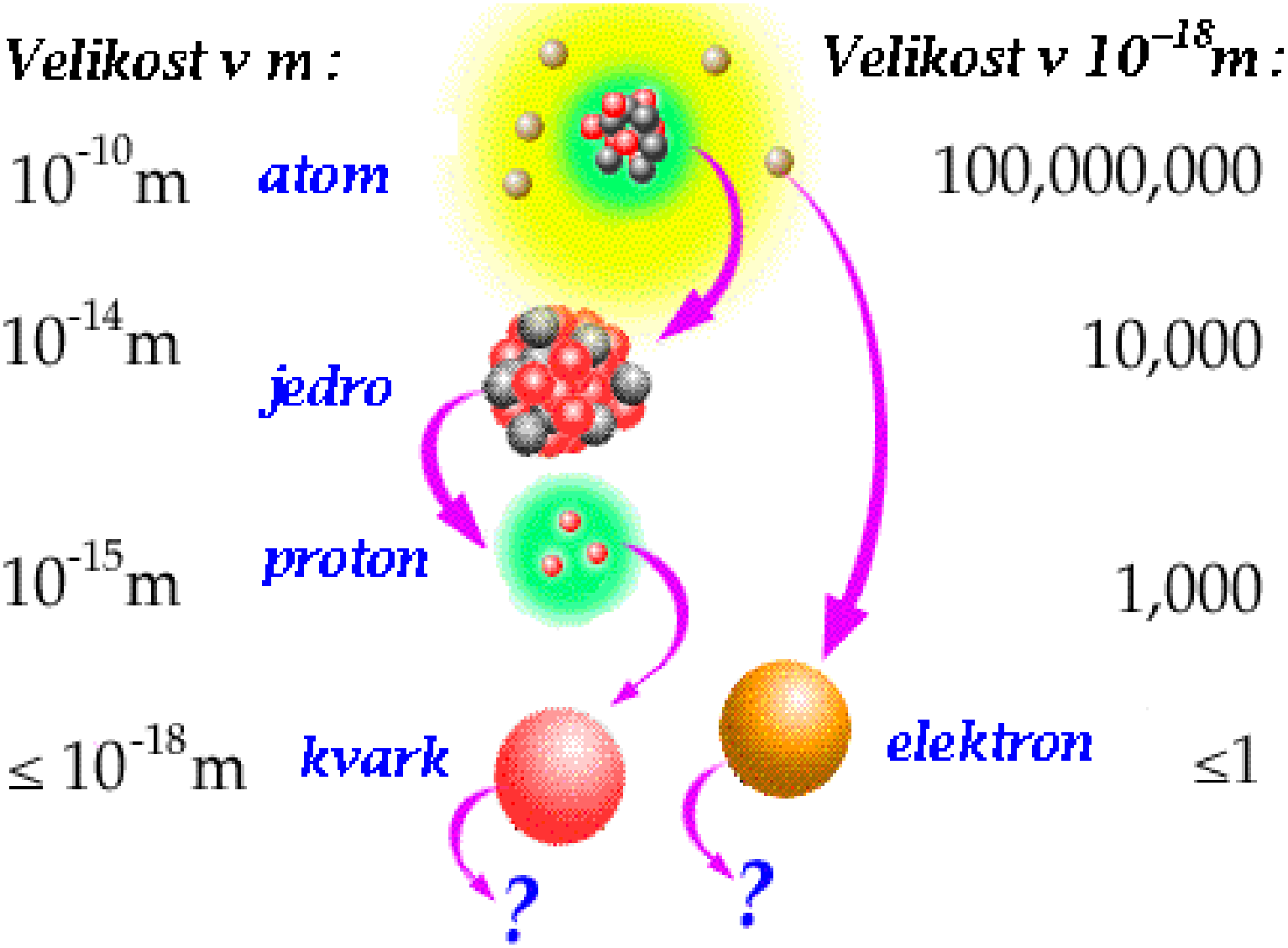


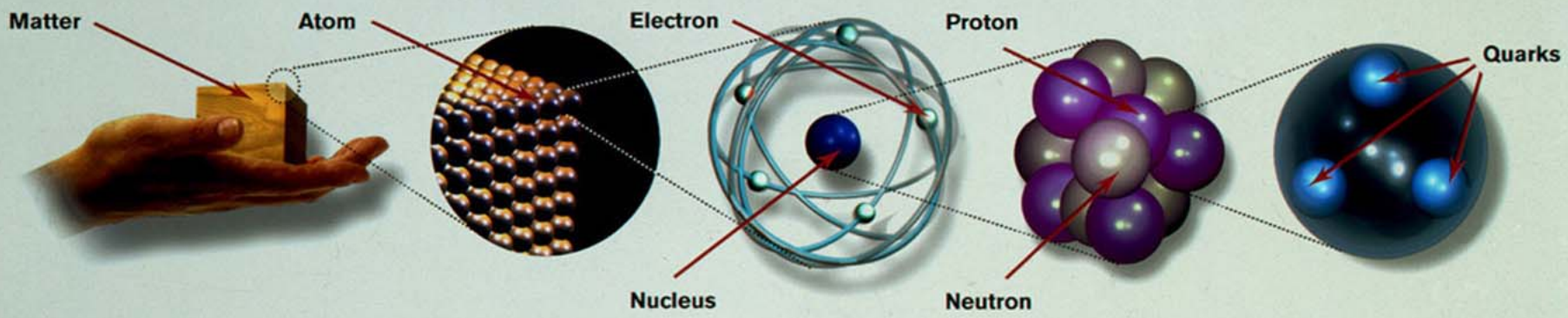
Stari Grki so verjeli, da je svet sestavljen iz 4 osnovnih elementov: zraka, ognja, vode in zemlje.

Demokrit, 4. stol. p.n.š.: svet je sestavljen iz najmanjših nedeljivih delov - atomov



Svet, kot ga vidimo dandanes:





Matter particles All ordinary particles belong to this group

These particles existed just after the Big Bang. Now they are found only in cosmic rays and accelerators

LEPTONS

FIRST FAMILY	**Electron** Responsible for electricity and chemical reactions; it has a charge of -1 e	**Electron neutrino** Particle with no electric charge, and possibly no mass; billions fly through your body every second ν_e
SECOND FAMILY	**Muon** A heavier relative of the electron; it lives for two-millionths of a second μ	**Muon neutrino** Created along with muons when some particles decay ν_μ
THIRD FAMILY	**Tau** Heavier still; it is extremely unstable. It was discovered in 1975 τ	**Tau neutrino** not yet discovered but believed to exist ν_τ

QUARKS

Up Has an electric charge of plus two-thirds; protons contain two, neutrons contain one u	**Down** Has an electric charge of minus one-third; protons contain one, neutrons contain two d
Charm A heavier relative of the up; found in 1974 c	**Strange** A heavier relative of the down; found in 1964 s
Top Heavier still t	**Bottom** Heavier still; measuring bottom quarks is an important test of electroweak theory b

Pa še več jih je,….

- vsak ima svoj anti-delec, npr. e^- in e^+
- kvarki sestavljajo težje delce hadrone, npr. p=uud

The forces in Nature

4 osnovne sile v naravi:

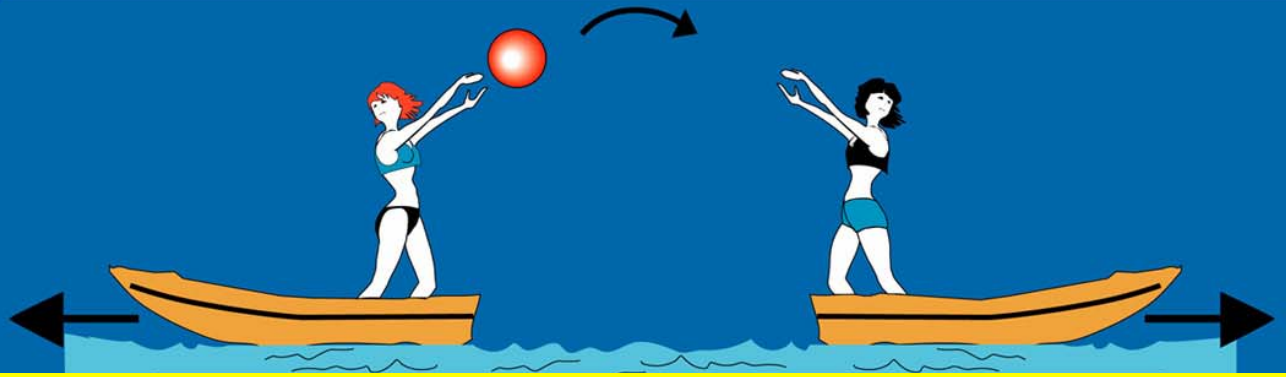
TYPE	INTENSITY OF FORCES (DECREASING ORDER)	BINDING PARTICLE (FIELD QUANTUM)	OCCURS IN :
STRONG NUCLEAR FORCE	~ 1	GLUONS (NO MASS)	ATOMIC NUCLEUS
ELECTRO -MAGNETIC FORCE	~ 10^{-3}	PHOTONS (NO MASS)	ATOMIC SHELL ELECTROTECHNIQUE
WEAK NUCLEAR FORCE	~ 10^{-5}	BOSONS Z^0 , W+ , W- (HEAVY)	RADIOACTIVE BETA DESINTEGRATION
GRAVITATION	~ 10^{-38}	GRAVITONS (?)	HEAVENLY BODIES

Gluoni

Fotoni

Bozoni $W^{\pm}, Z^0$

Gravitoni(?)



Delca si izmenjujeta nosilce sile in s tem občutita silo

In kako ta (subatomski) svet opazujemo:

majhno

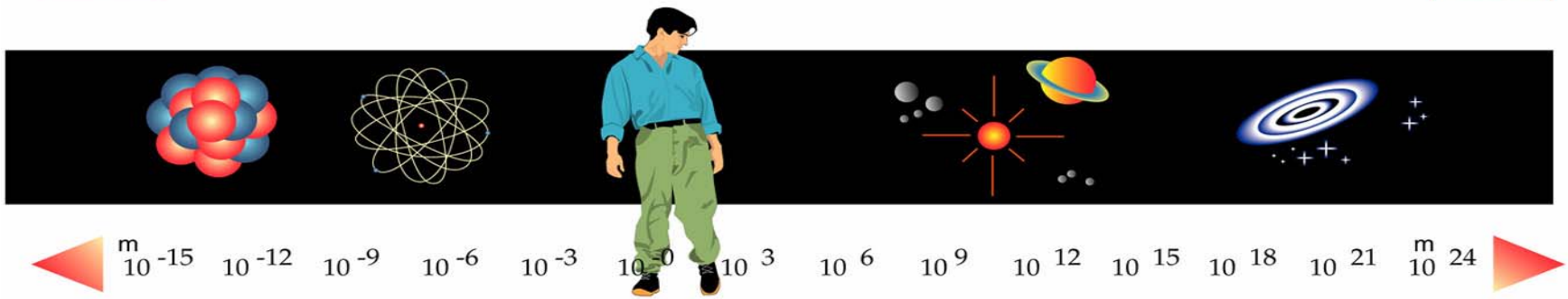
veliko

La physique des particules étudie la matière dans ses dimensions les plus petites.

Particle physics looks at matter in its smallest dimensions.

L'astrophysique étudie la matière dans ses dimensions les plus grandes.

Astrophysics looks at matter in its largest dimensions.



m
10^{-15} 10^{-12} 10^{-9} 10^{-6} 10^{-3} 10^{0} 10^{3} 10^{6} 10^{9} 10^{12} 10^{15} 10^{18} 10^{21} m 10^{24}

Microscopes
Microscopes

Jumelles
Binoculars

Telescopes optiques & radio
Optical & radio telescopes

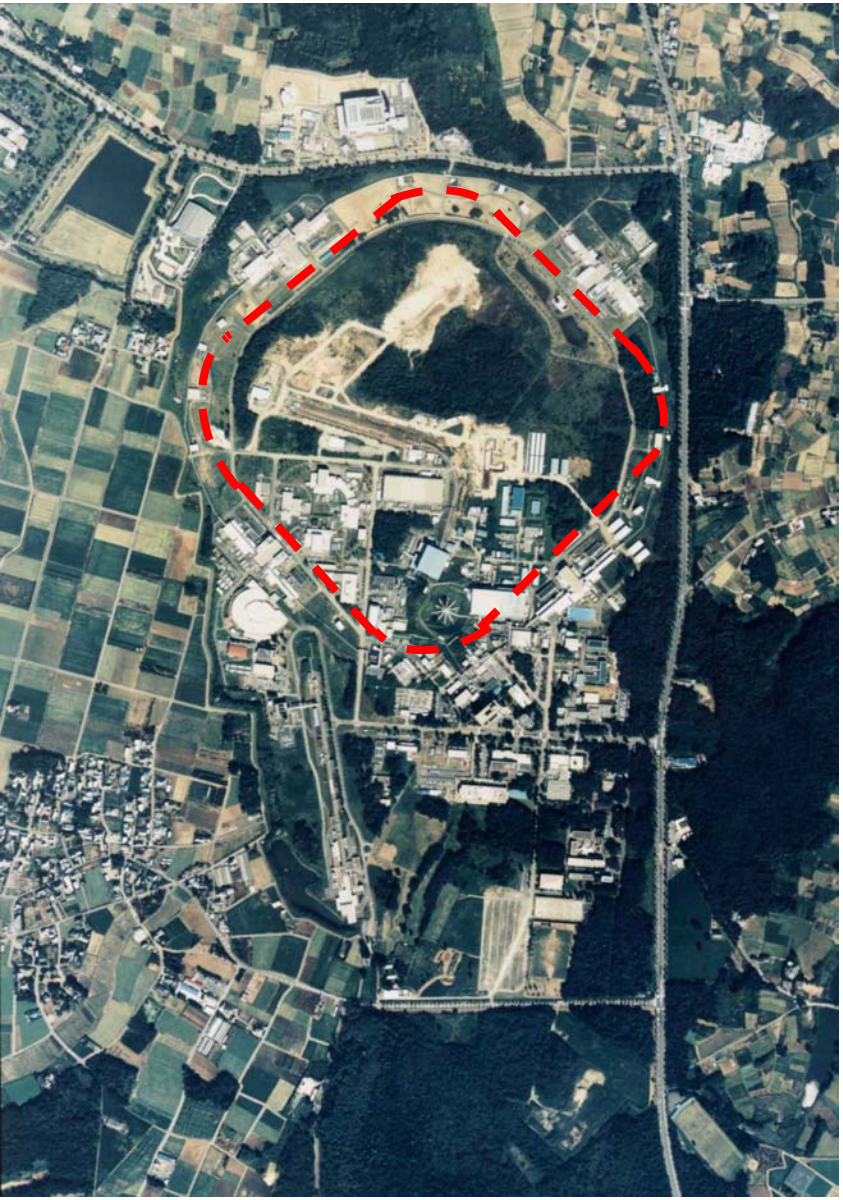
L'oeil nu.
Naked eye

Accélérateurs et détecteurs
Accelerators and detectors

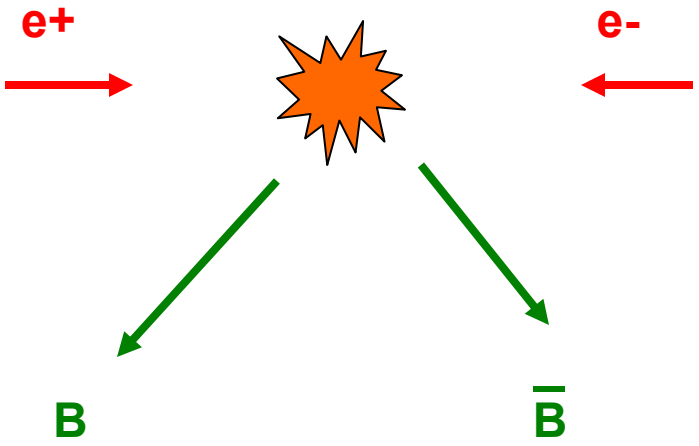
THE TWO FRONTIERS OF PHYSICS

LES DEUX FRONTIERES DE LA PHYSIQUE

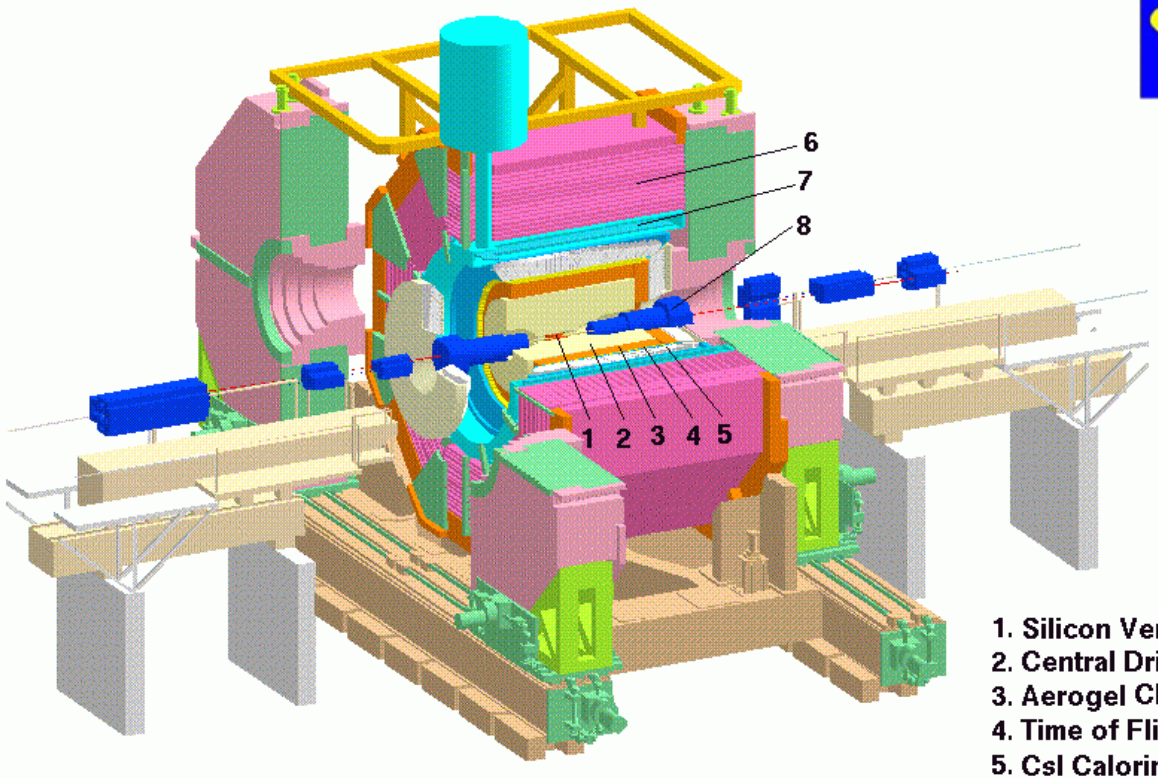
Laboratorij za fiziko delcev, Tsukuba, Japonska:



Pospeševalnik KEK-B
11 m pod površjem;
obseg 3 km;
hitrost e-: 0,999999996 x hitrost svetlobe



Kako jih opazimo (delce namreč):

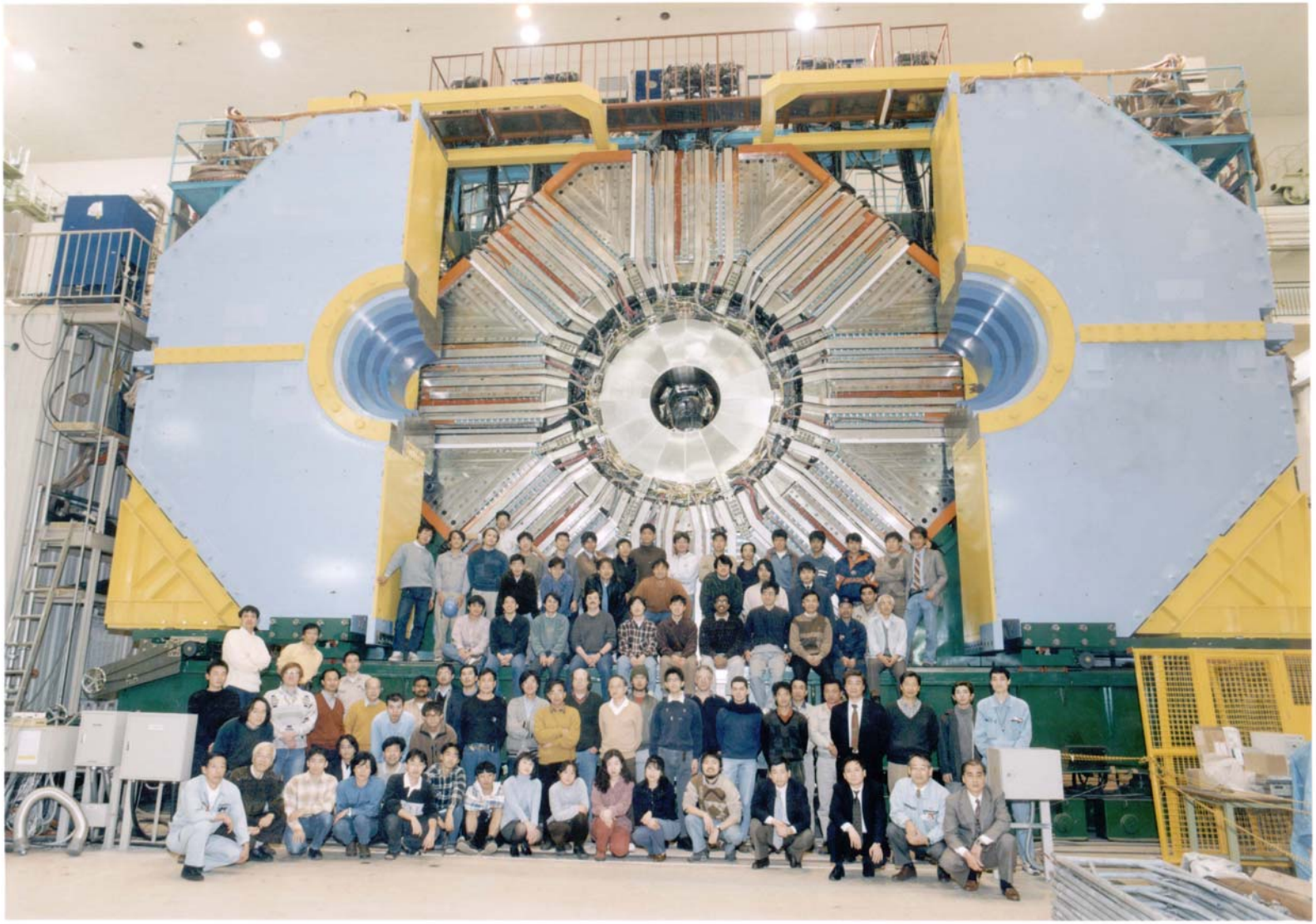


1. Silicon Vertex Detector
2. Central Drift Chamber
3. Aerogel Cherenkov Counter
4. Time of Flight Counter
5. CsI Calorimeter
6. KLM Detector
7. Superconducting Solenoid
8. Superconducting Final Focussing System

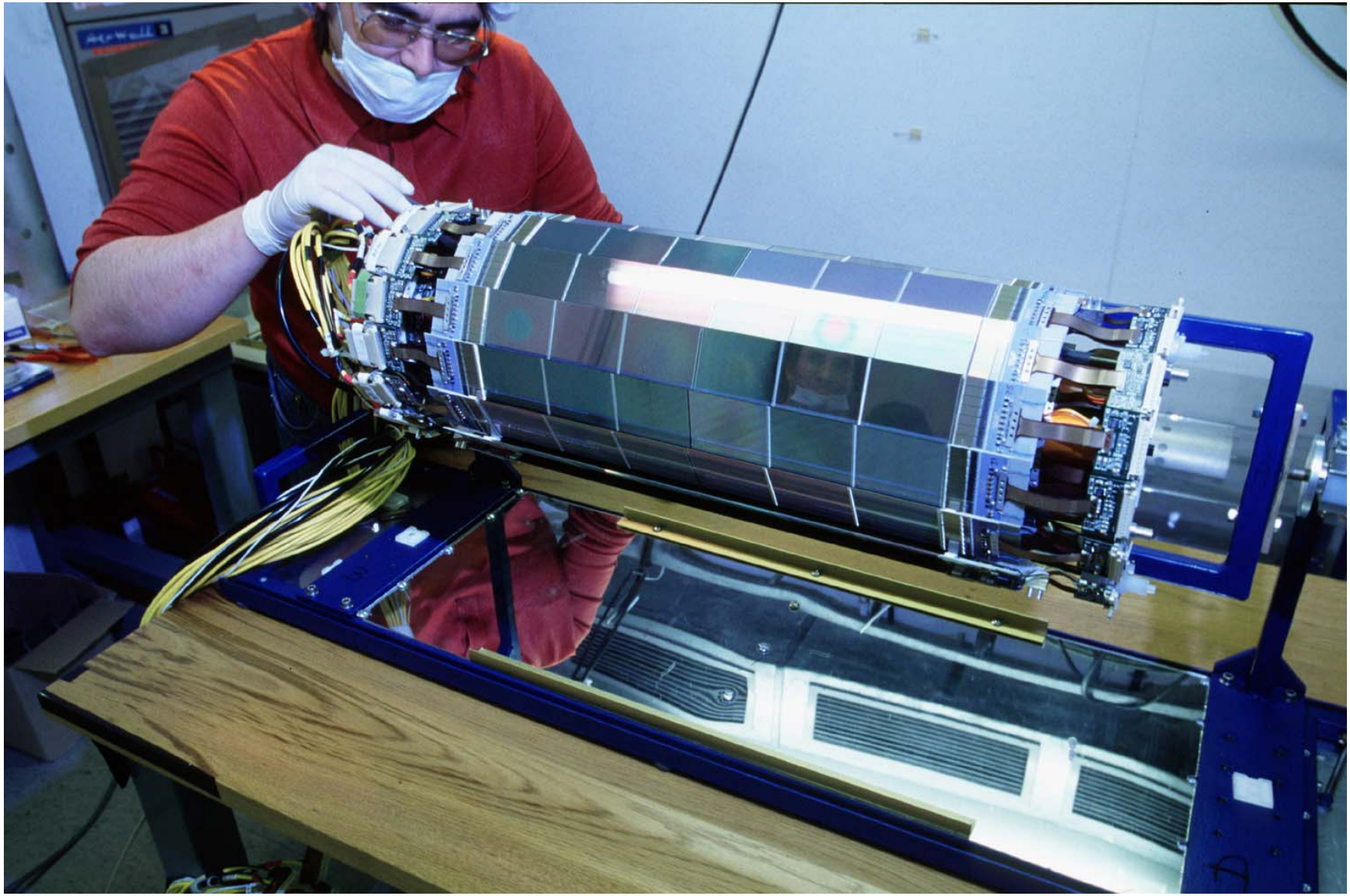
Detektorji delcev

modularna sestava – merimo energijo, gibalno količino, maso nastalih delcev

Naprava ni le naslikana:



Hi-tech "kirurgija"

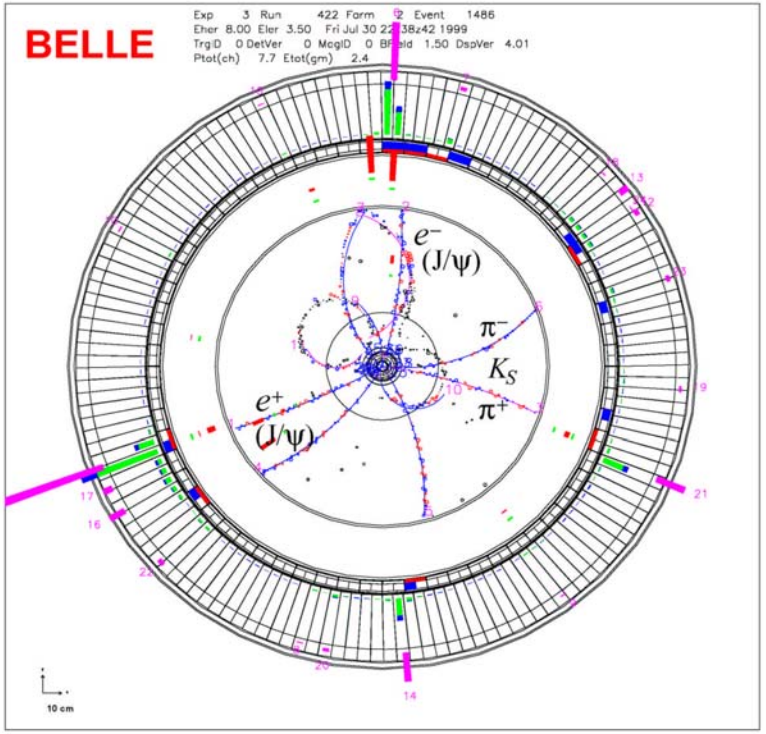


In kaj npr. ugotovimo iz podatkov?

$B^0 \rightarrow J/\psi\ Ks$ candidate

B razpada nekoliko drugače

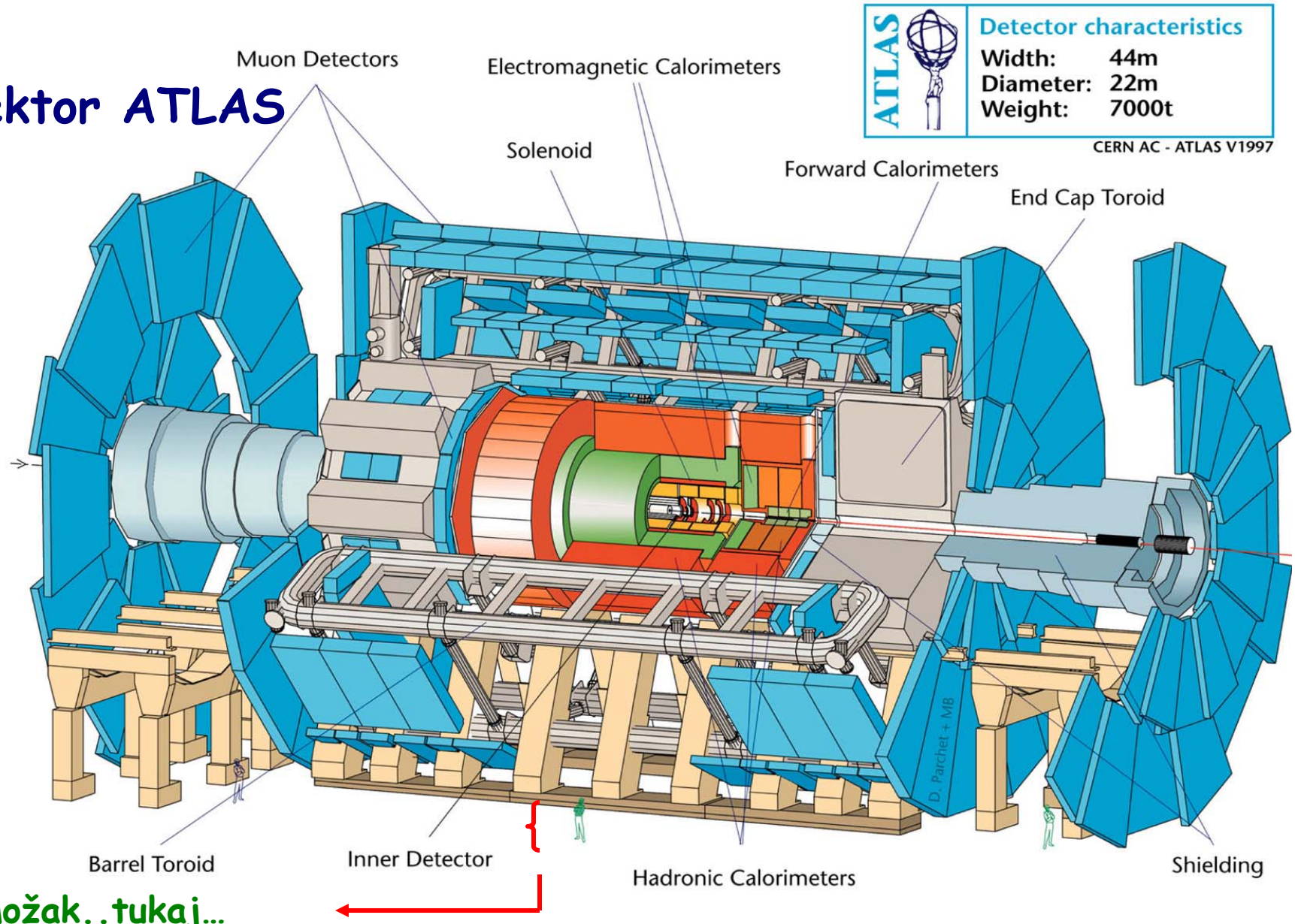
kot $\overline{B}$



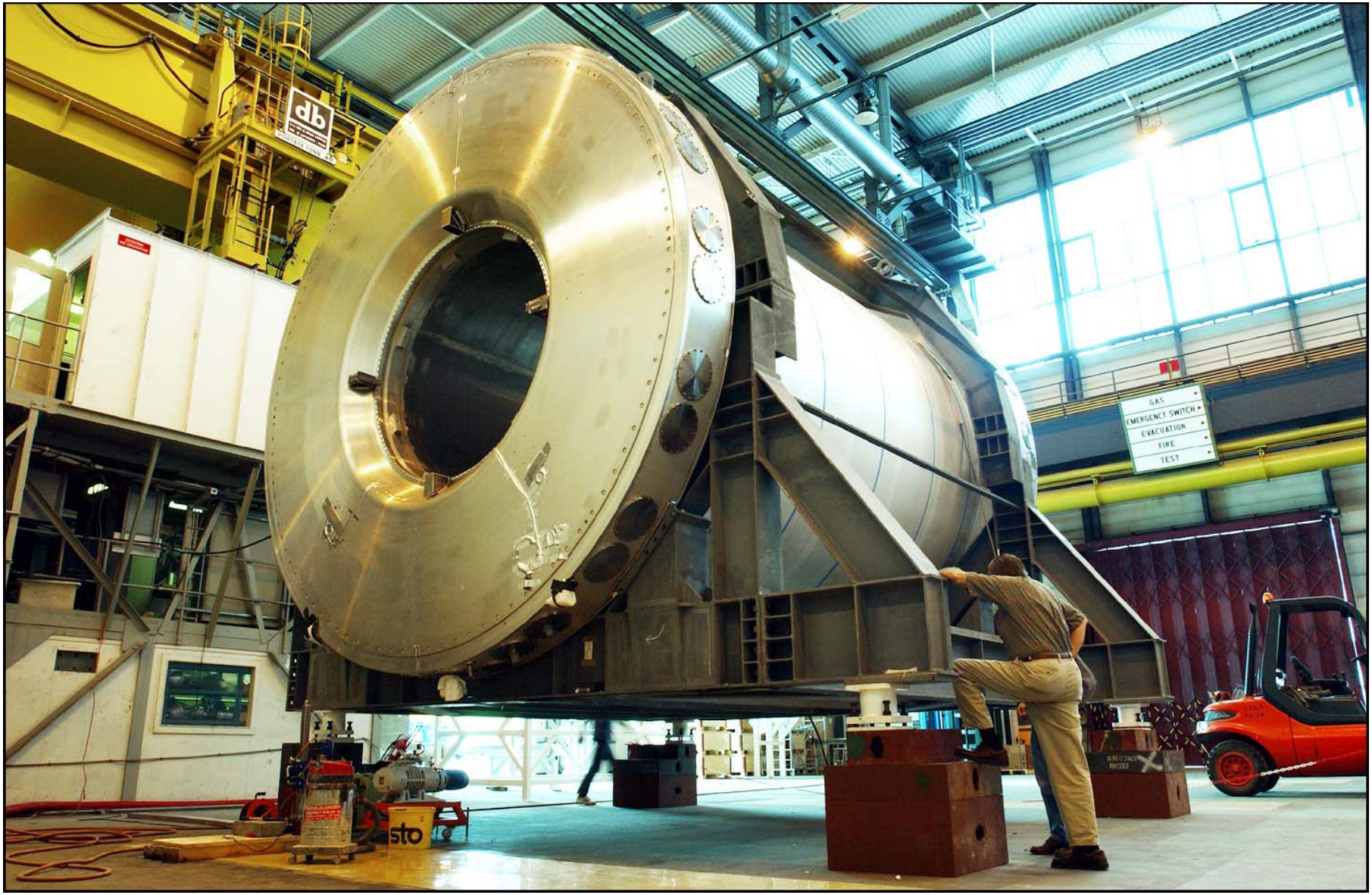
Delci razpadajo malenkost drugače kot anti-delci;

v dolgem razvoju vesolja je morda prav ta malenkost povzročila, da obstajamo v obliki, v kakršni smo: celotno vesolje je namreč sestavljeno iz snovi (delcev) in ne anti-snovi (anti-delcev)

Detektor ATLAS



možak..tukaj...



Kriostat za hlajenje kalorimetra detektorja ATLAS.

Namesto zaključka

Jack Steinberger, Nobelova nagrada 1988 za odkritje mionskega nevtrina
(skupaj z L. Ledermanom in M. Schwartzom),
v pokoju….
"Stare stvari so res drage…"

Potrebujemo mlade fizike,

ki bodo nekoč stari Nobelovi nagrajenci!