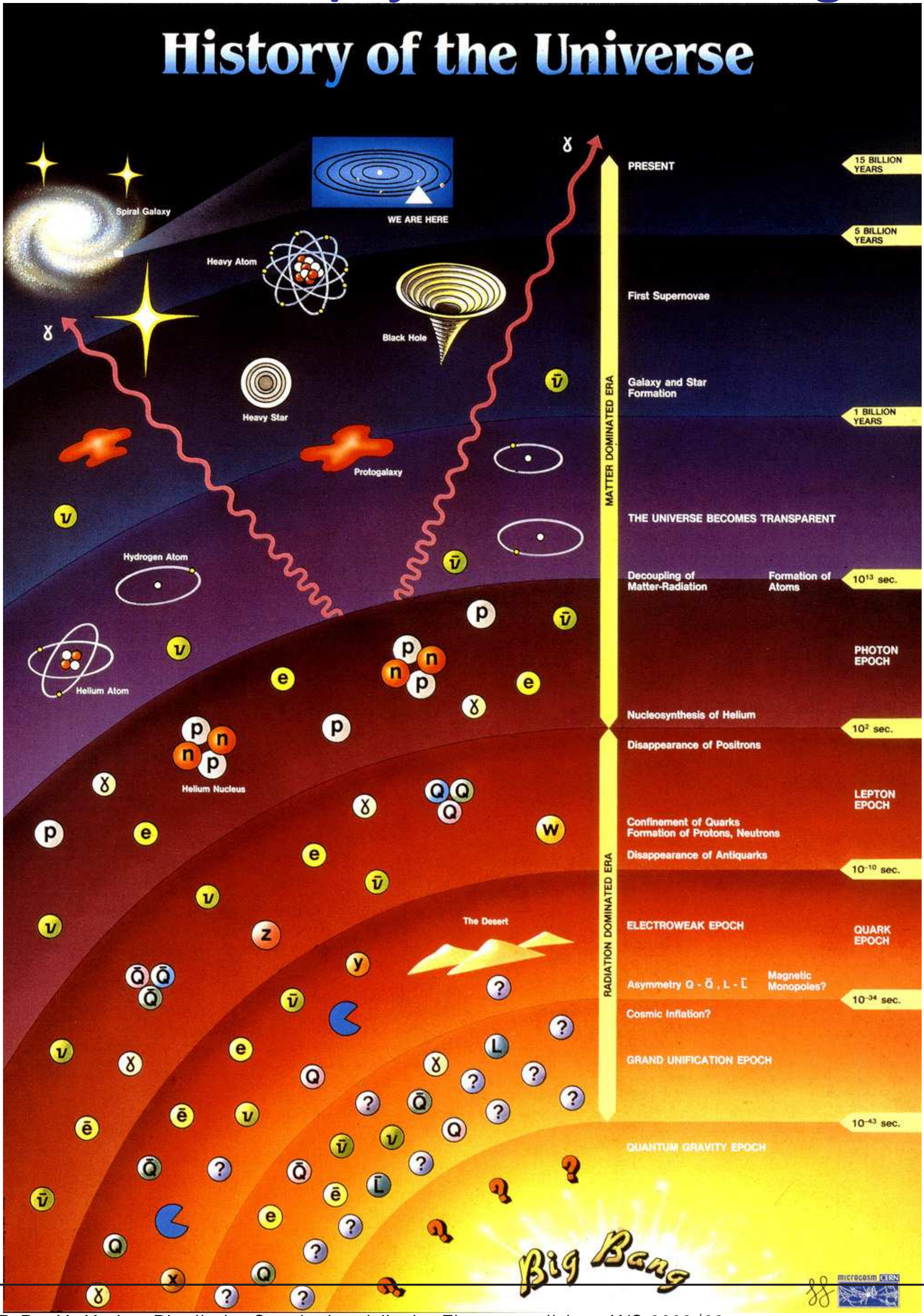
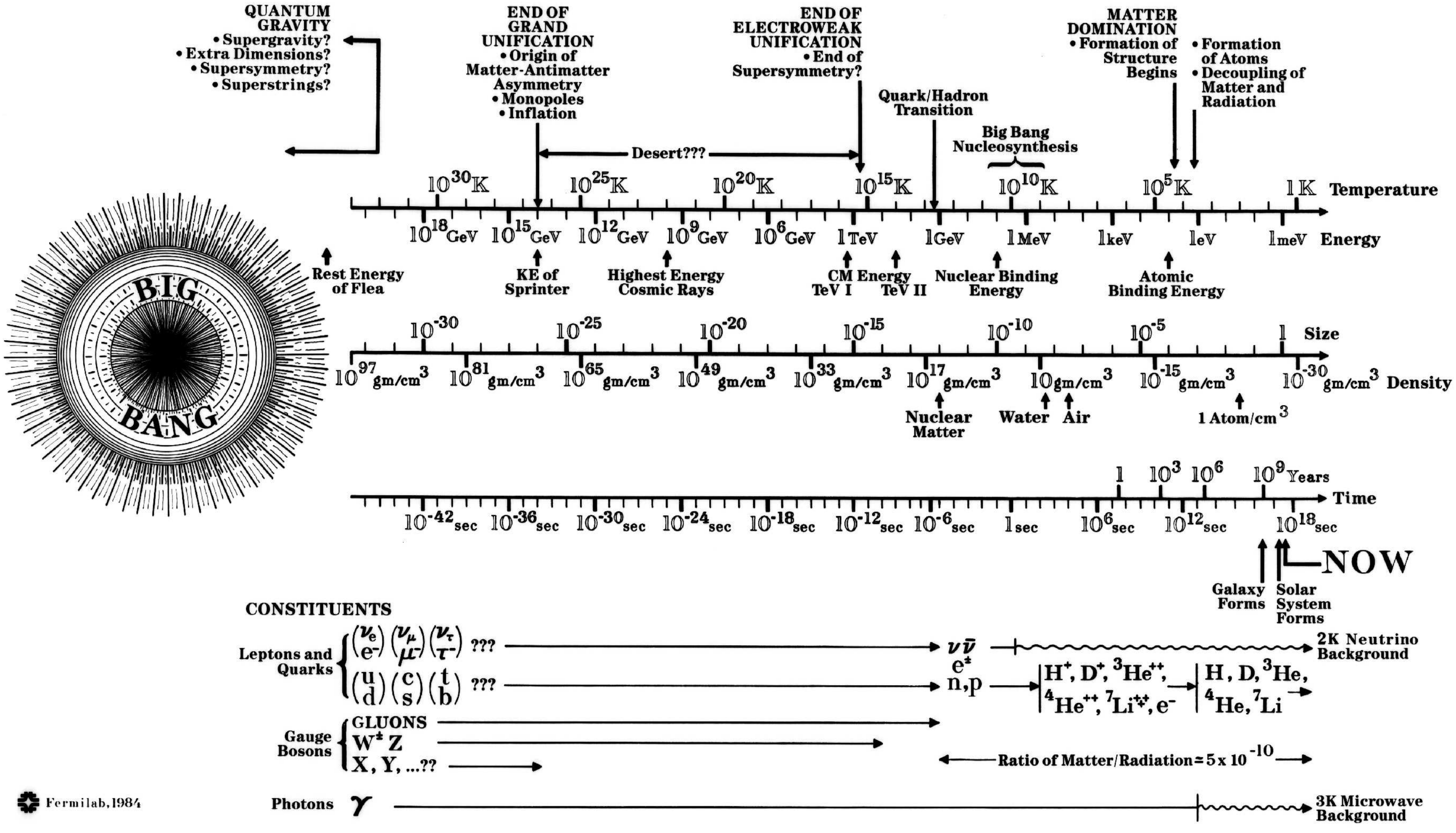
1.8 Teilchenphysik und Kosmologie



Entwicklung des Universums



Materiedichte des Universums

$\boldsymbol{\Omega}$ = Energiedichte/ kritische Dichte

Beobachtungen:

- $\Omega_{\rm tot} = 1$ (flaches Universum, Inflation: Isotropie der kosmischen Hintergrundstrahlung).

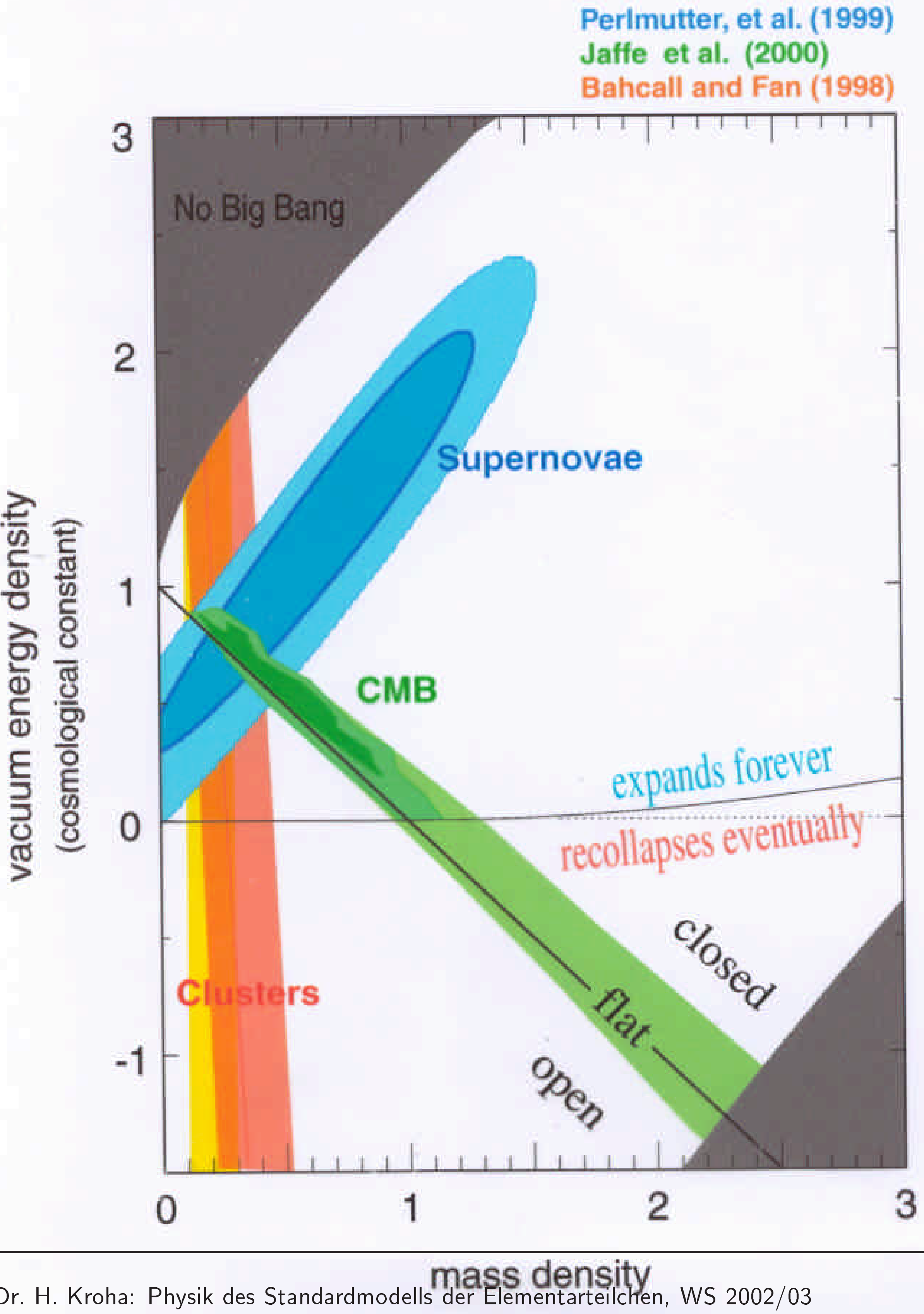
- Materiedichte $\Omega_M \approx 30\%$ (Gravitationseffekte: Galaxienbewegung, Gravitationslinsen).

- Baryonische Materie (Elemente) $\Omega_B \approx 5\%$ (Nukleosynthese).

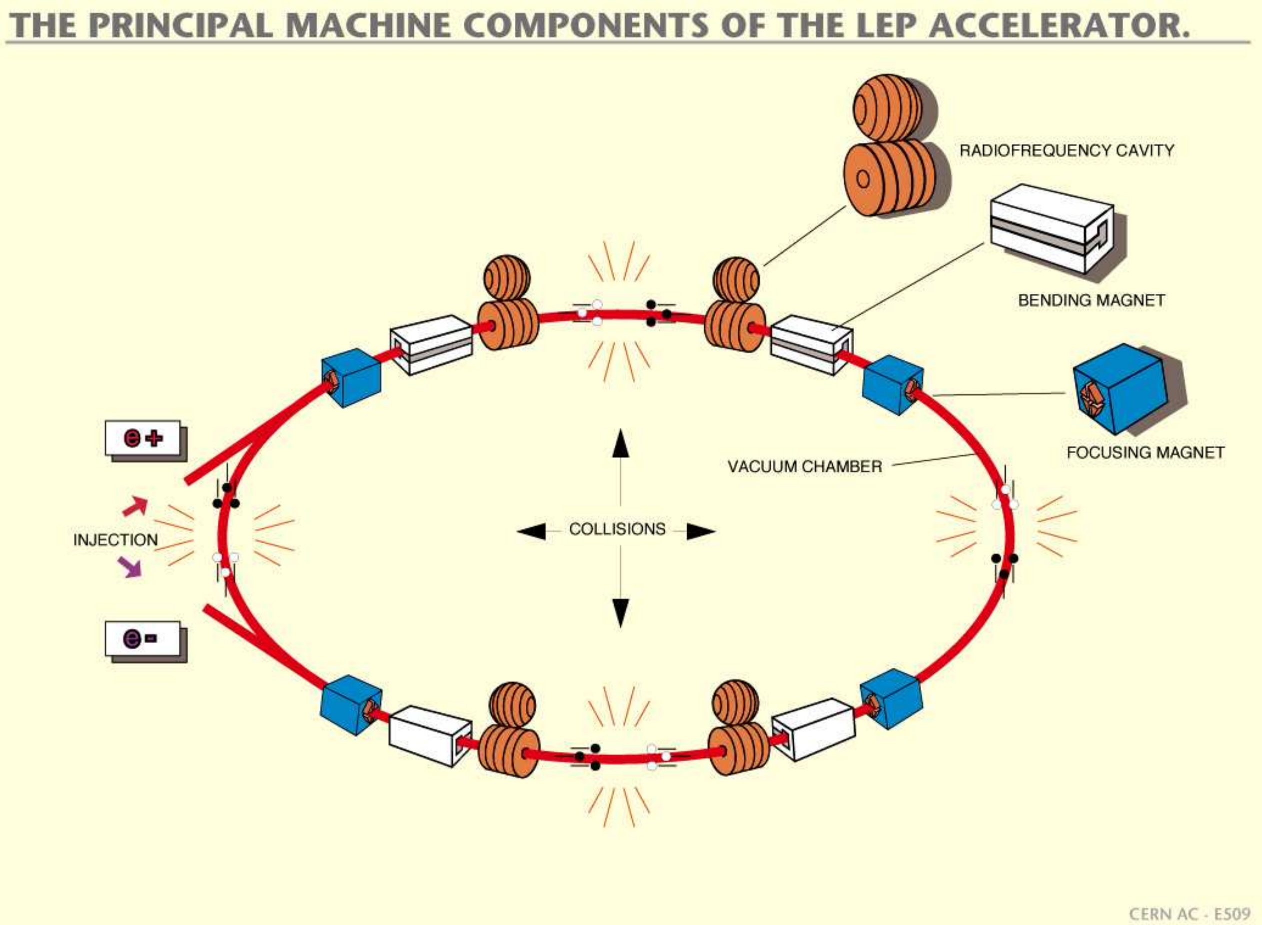
- Sichtbare Materie (Sterne) $\Omega_{\rm lum} \approx 0.4\%$.

$\Longrightarrow$ Nicht-baryonische "Dunkle Materie": $\Omega_{DM} \approx 30\%$ (massive Neutrinos, Axionen, SUSY-Teilchen,...?).

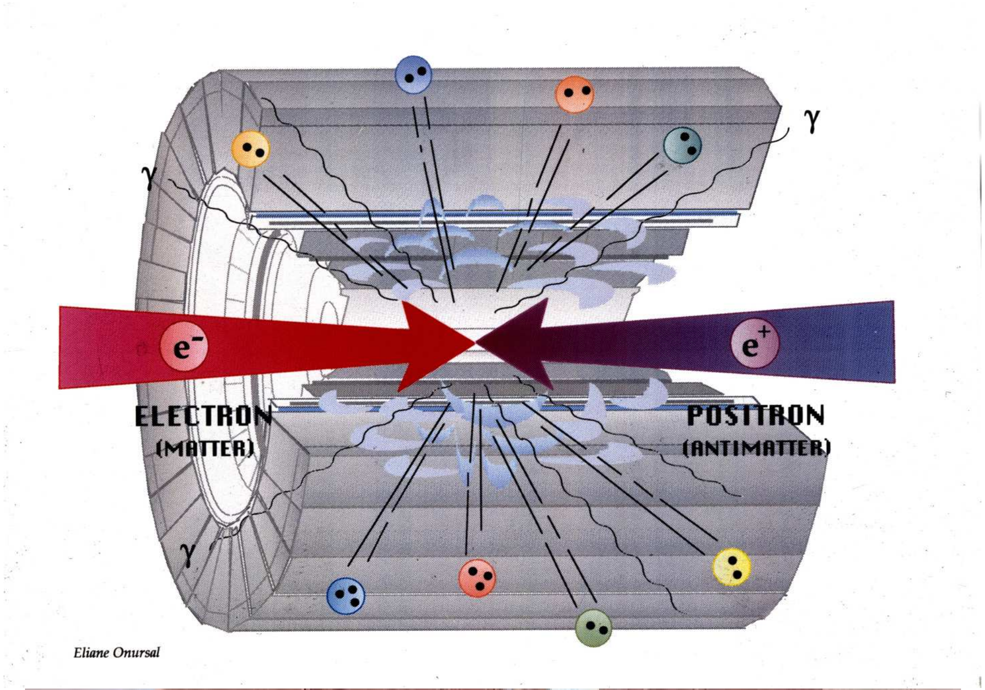
- "Dunkle Energie": $\Omega_\Lambda \approx 70\%$ (kosmologische Konstante Λ der ART, Vakuumenergie, beschleunigte Expansion des Universums: Supernovae-Rotverschiebung).

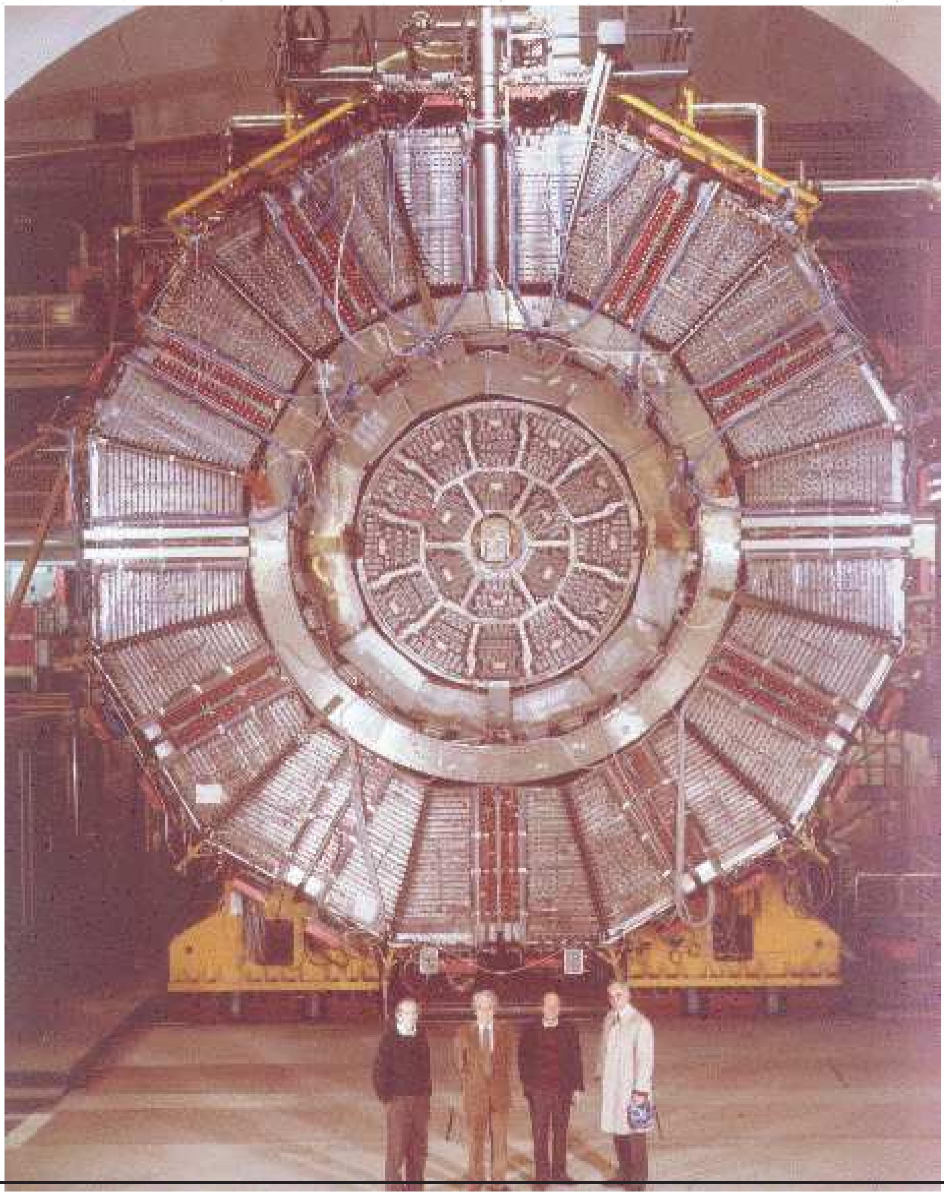

Perlmutter, et al. (1999)
Jaffe et al. (2000)
Bahcall and Fan (1998)
No Big Bang
Supernovae
CMB
expands forever
recollapses eventually
closed
flat
open
Clusters
vacuum energy density
(cosmological constant)
mass density
3
2
1
0
-1
0
1
2
3

1.9 Teilchenphysik mit Beschleunigern

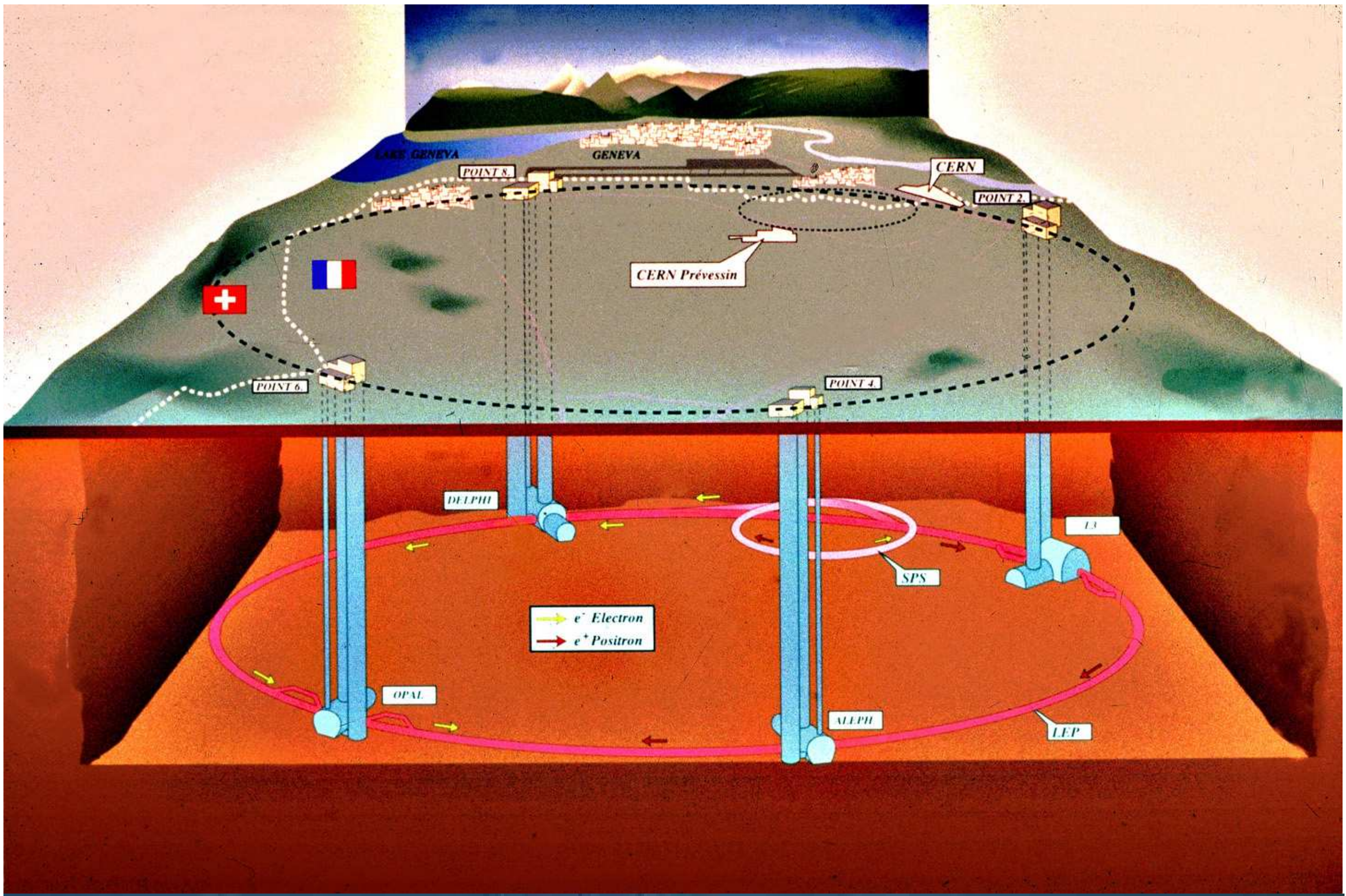


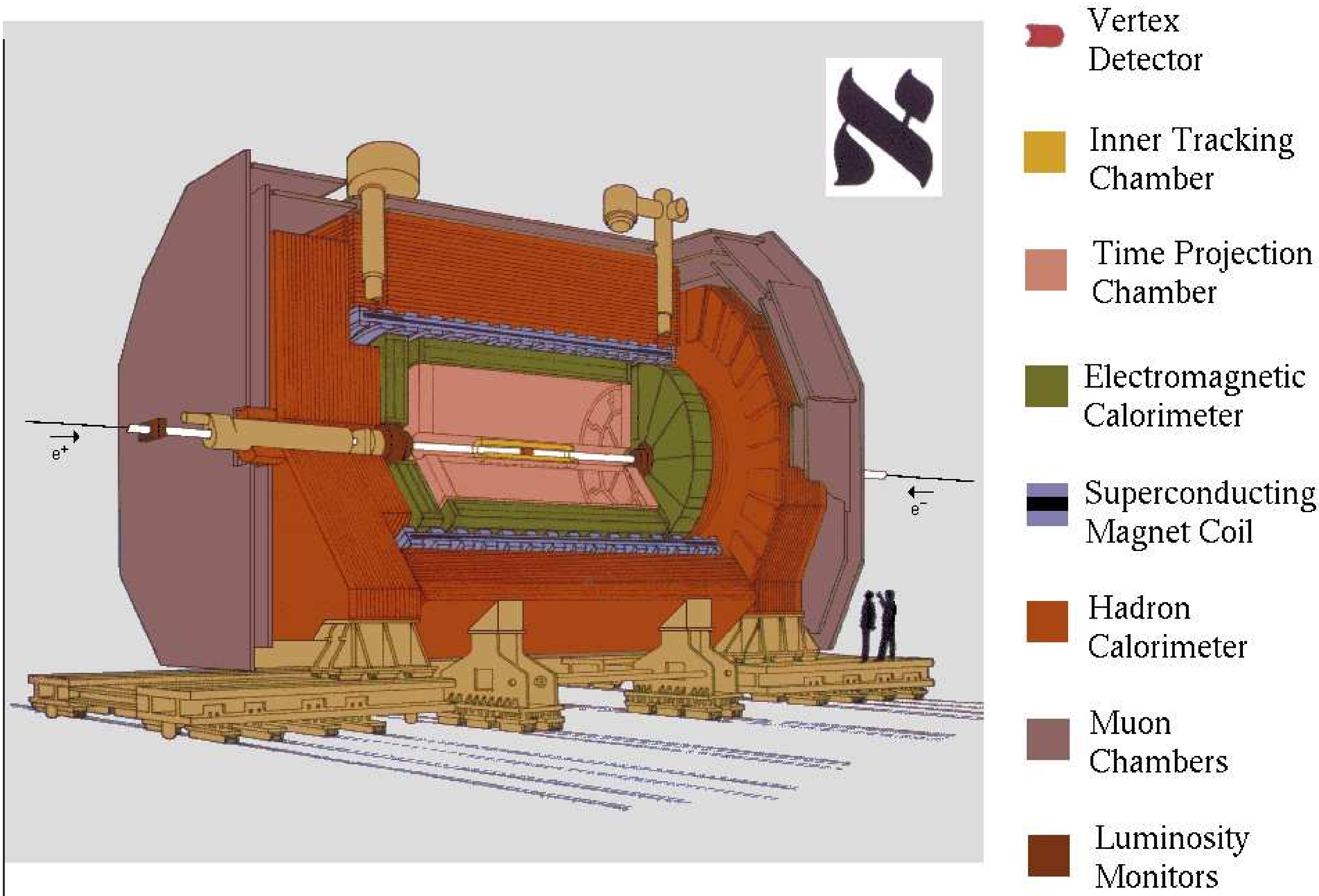
Teilchendetektoren





Beschleunigeranlagen

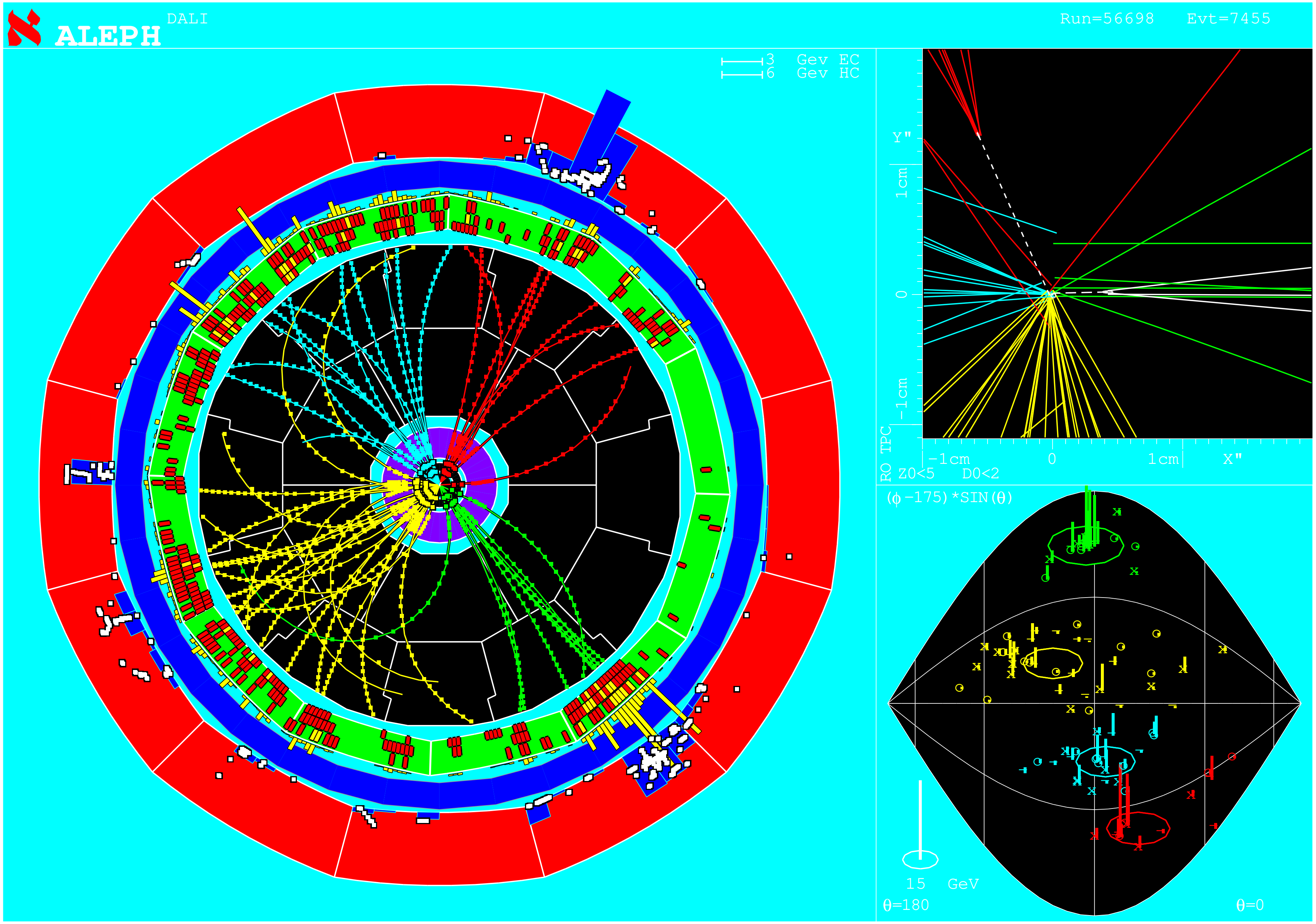




The ALEPH Detector

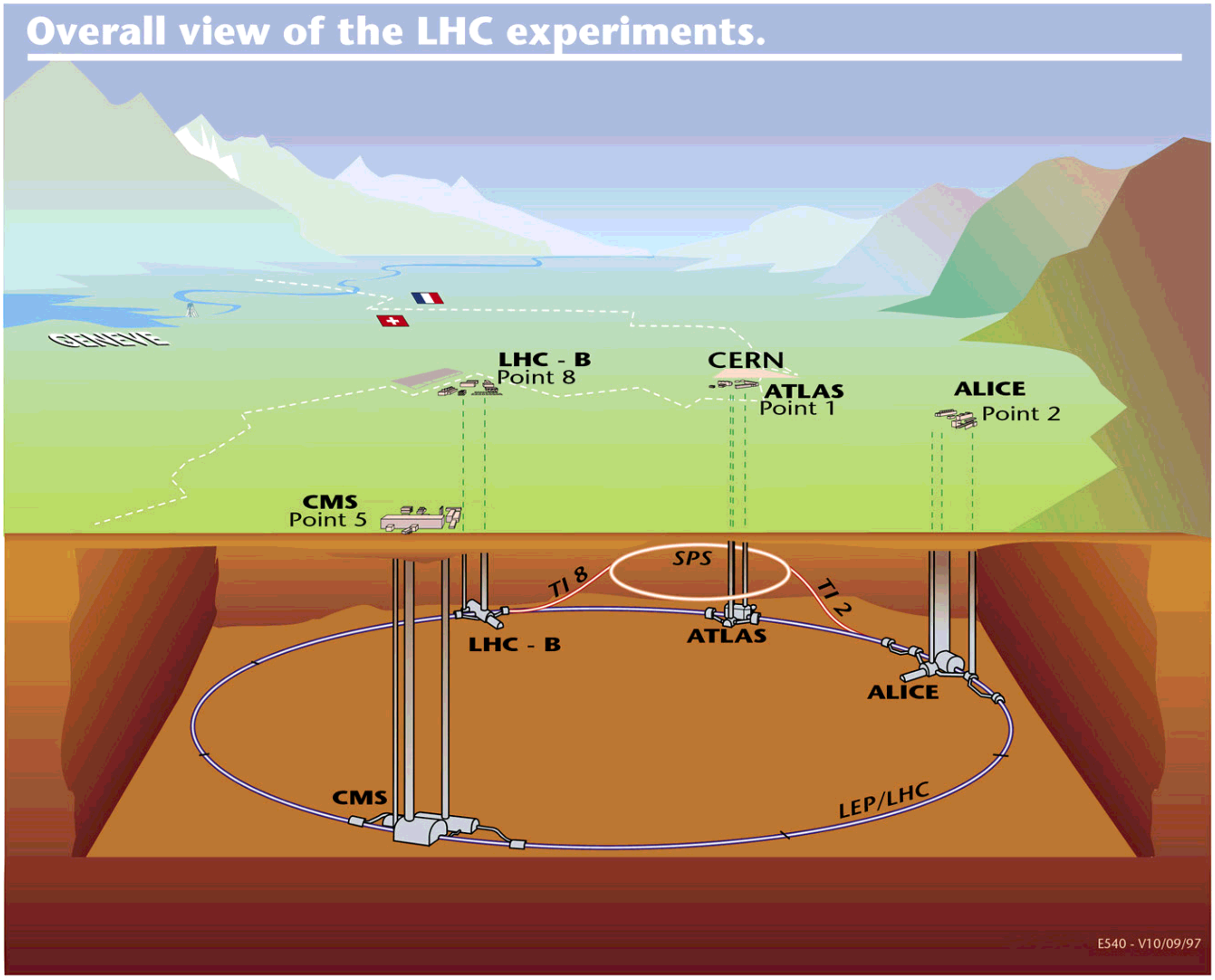
“Ereignisse” im ALEPH-Detektor

$$e^+e^- \longrightarrow Z^0 \ \textbf{Higgs} \longrightarrow (b\bar{b})(b\bar{b}) \longrightarrow \textbf{(Hadr.)(Hadr.)}$$



Made on 30-Aug-2000 17:24:02 by konstant with DALI_F1.
Filename: DC056698_007455_000830_1723.PS

Large Hadron Collider



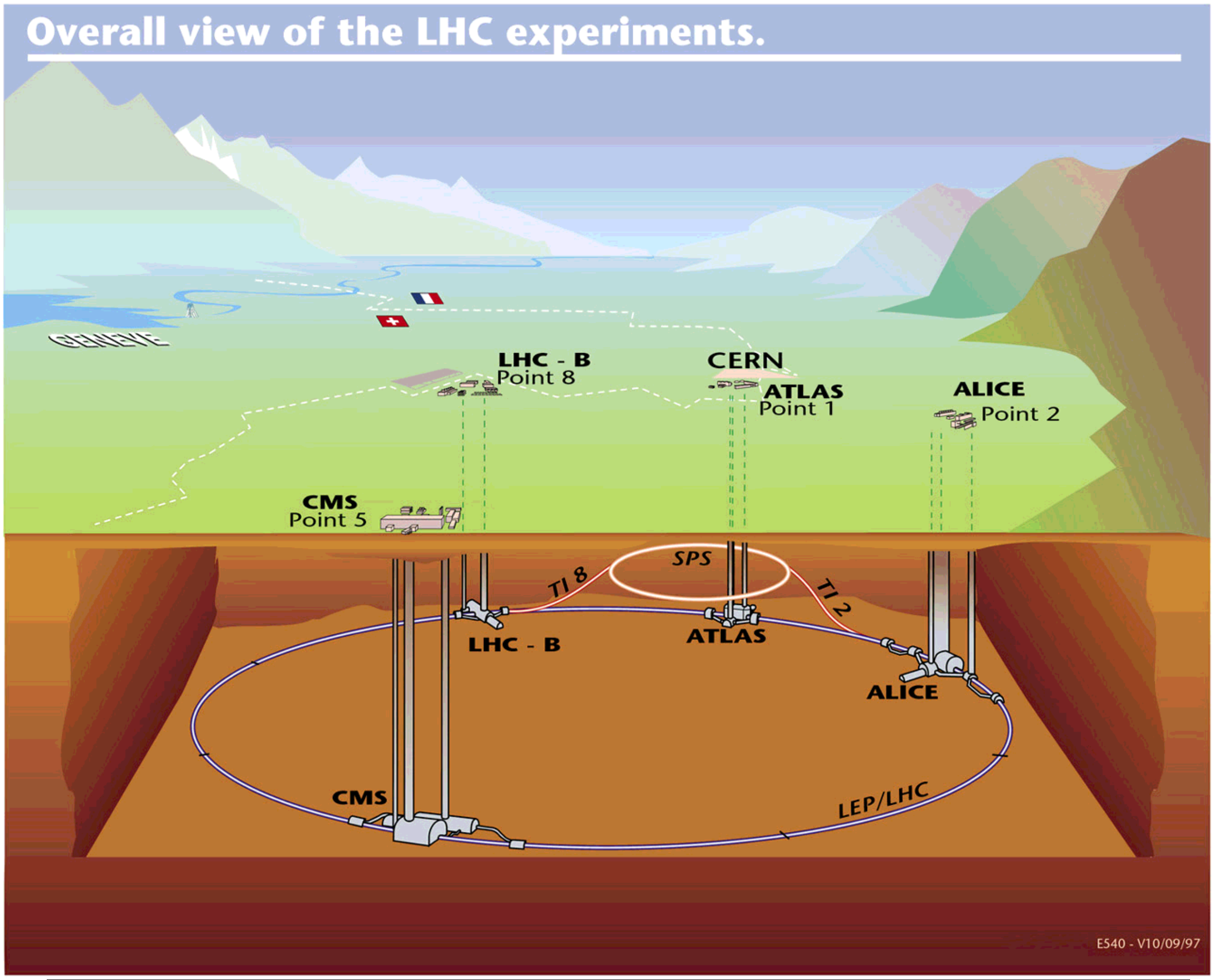
- pp-Kollisionen mit $E_{\mathrm{cms}} = 14$ TeV.
- 40 MHz Kollisionsrate (alle 25 ns).
- Hohe Luminosität: $10^{33} - 10^{34}$ cm^{-2}s^{-1}

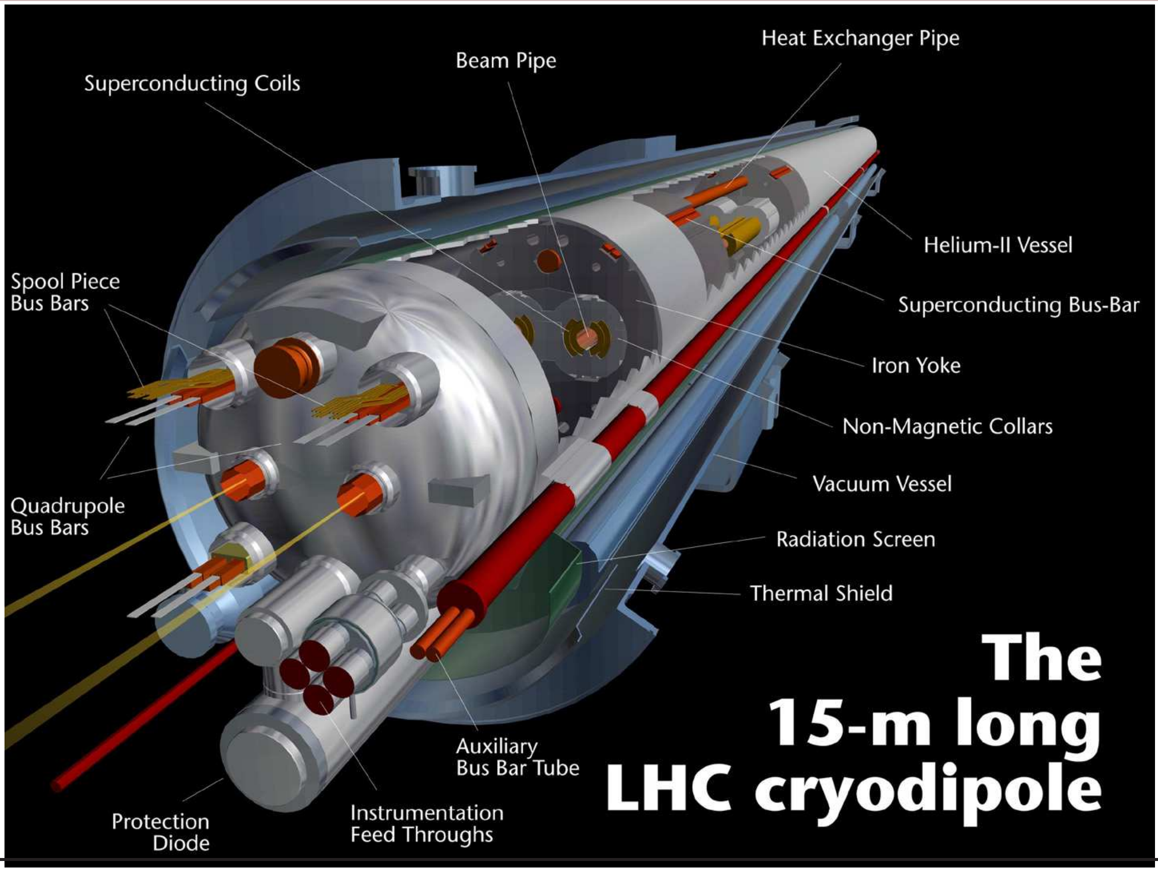
  Im Mittel 18 pp-Reaktionen und 1000 Teilchen pro Kollision.

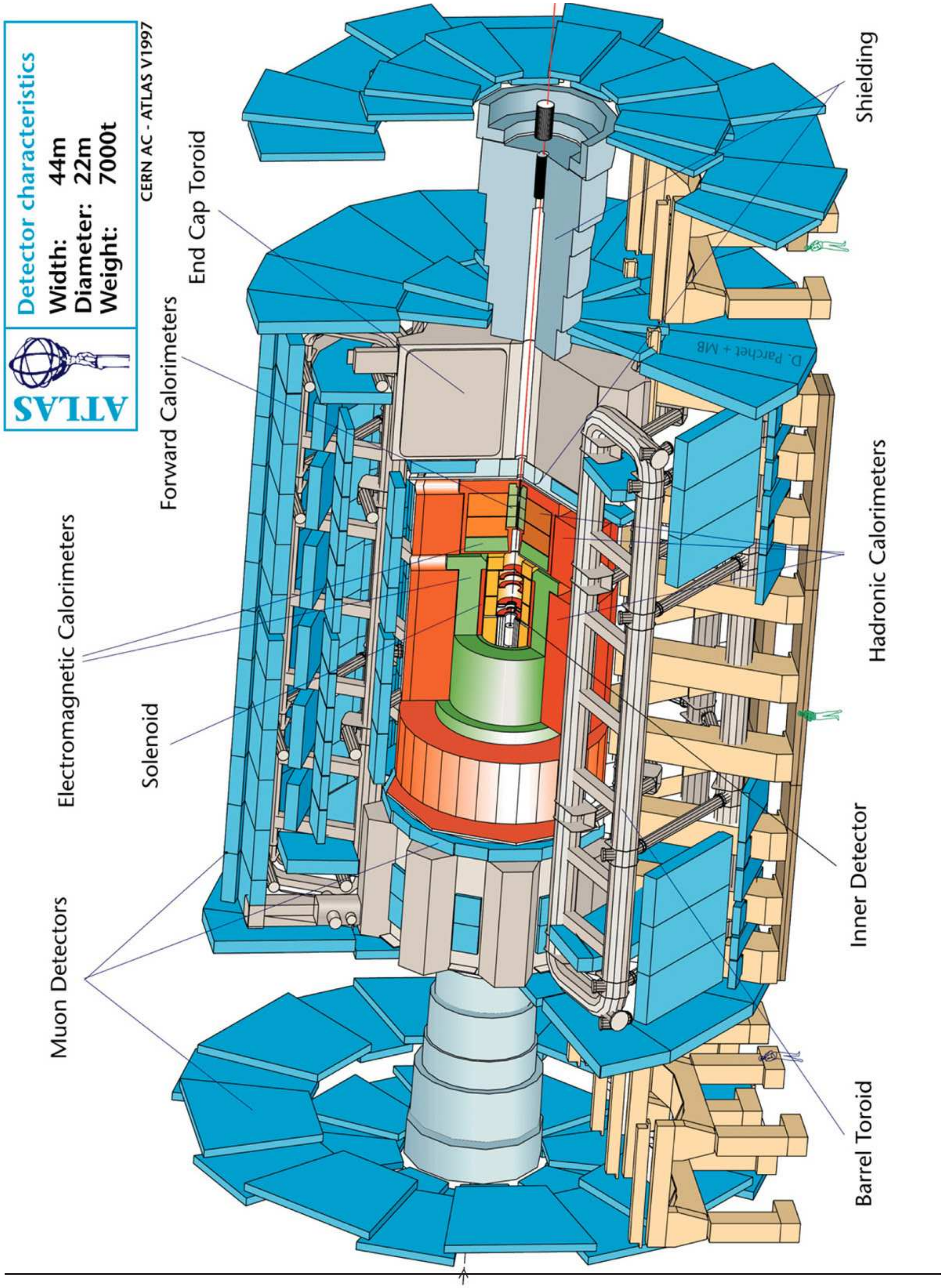
- Hohe Strahlendosen:

  Innerer Spurdetektor: $2 \cdot 10^{14}$ Protonen /cm^2
  Äußerer Myondetektor: 10^{11} Neutronen/cm^2

Der LHC Beschleuniger






ATLAS
Detector characteristics
Width: 44m
Diameter: 22m
Weight: 7000t
CERN AC - ATLAS V1997
End Cap Toroid
Forward Calorimeters
Electromagnetic Calorimeters
Solenoid
Muon Detectors
Shielding
Hadronic Calorimeters
Inner Detector
Barrel Toroid
D. Parchet + MB

Higgs-Zerfall im ATLAS Detektor

Computersimulation des Zerfalls eines Higgs-Teilchens im ATLAS Detektor am LHC:

$$\textbf{Higgs} \longrightarrow Z^0 Z^0 \longrightarrow (\mu^+\mu^-)(\mu^+\mu^-)$$