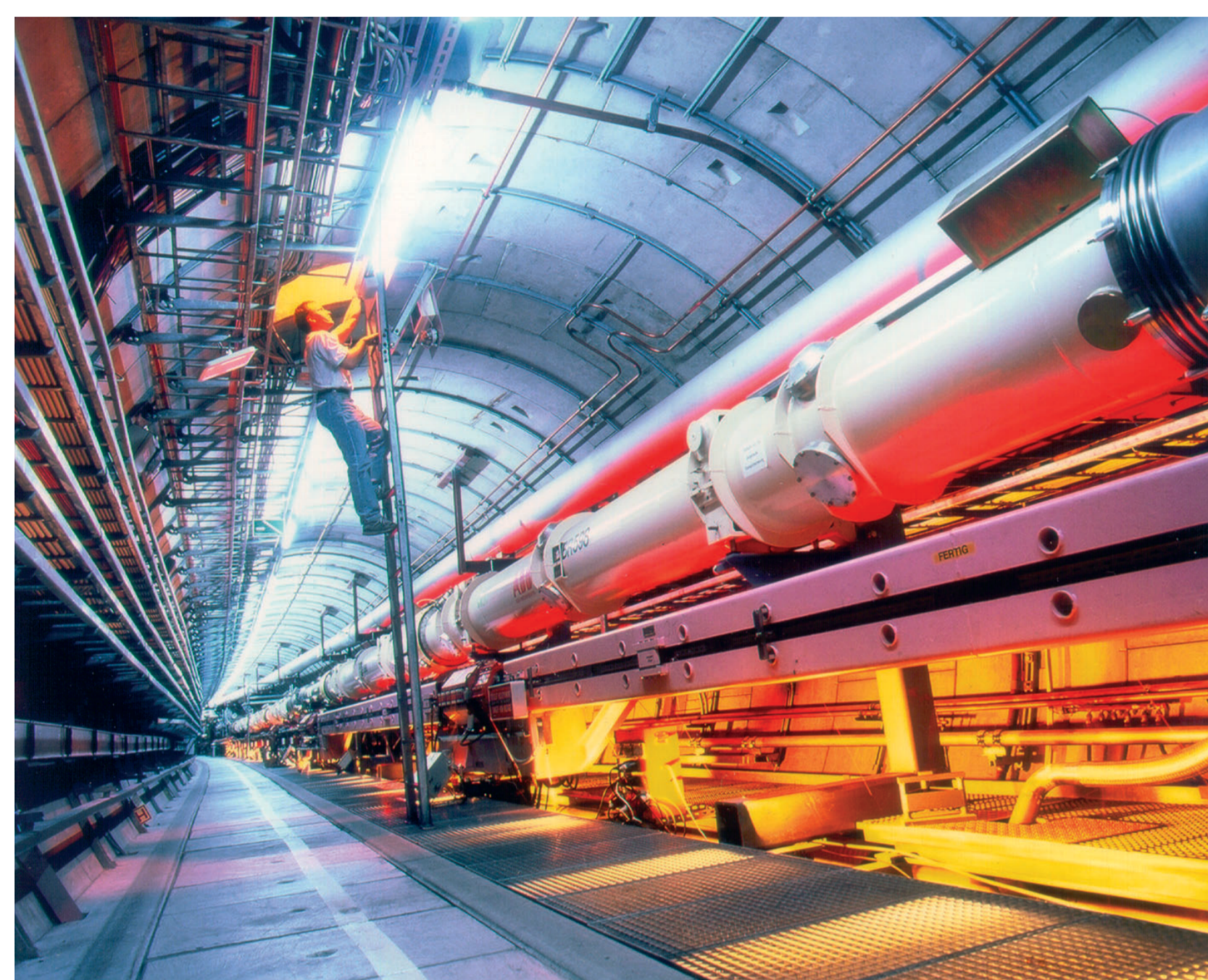


# HERA at DESY

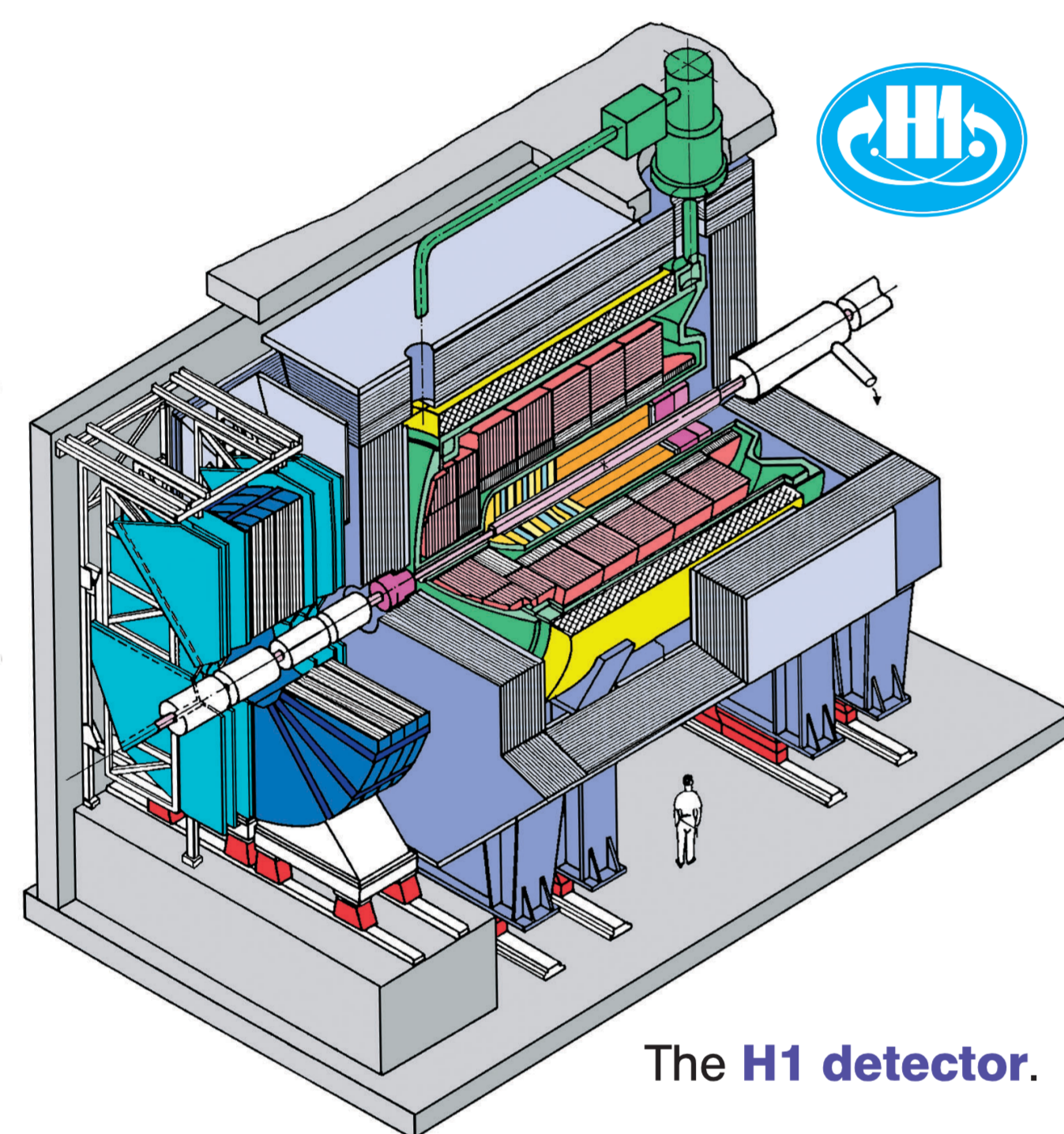


## Accelerator, Detectors and Physics at HERA

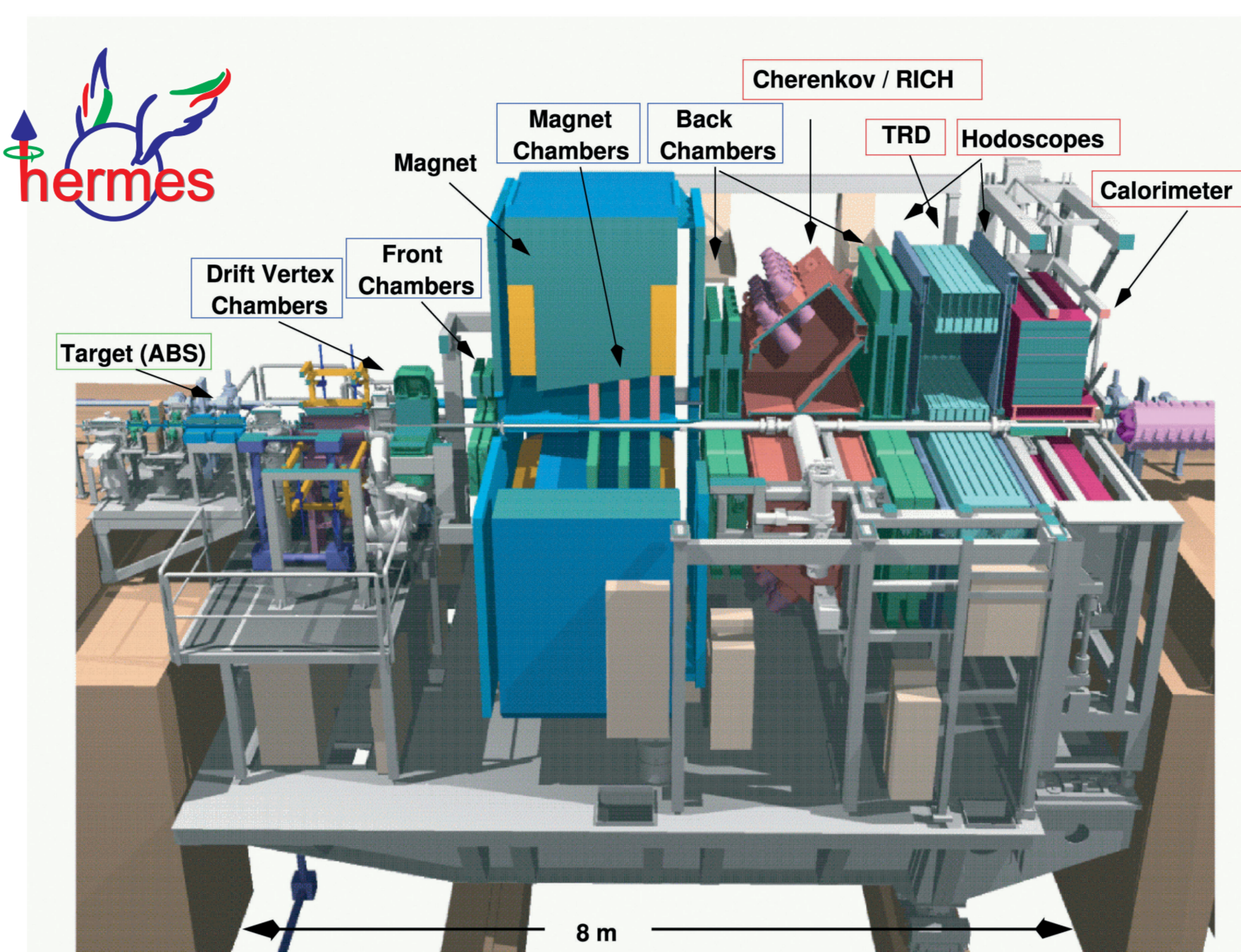
### HERA Accelerator



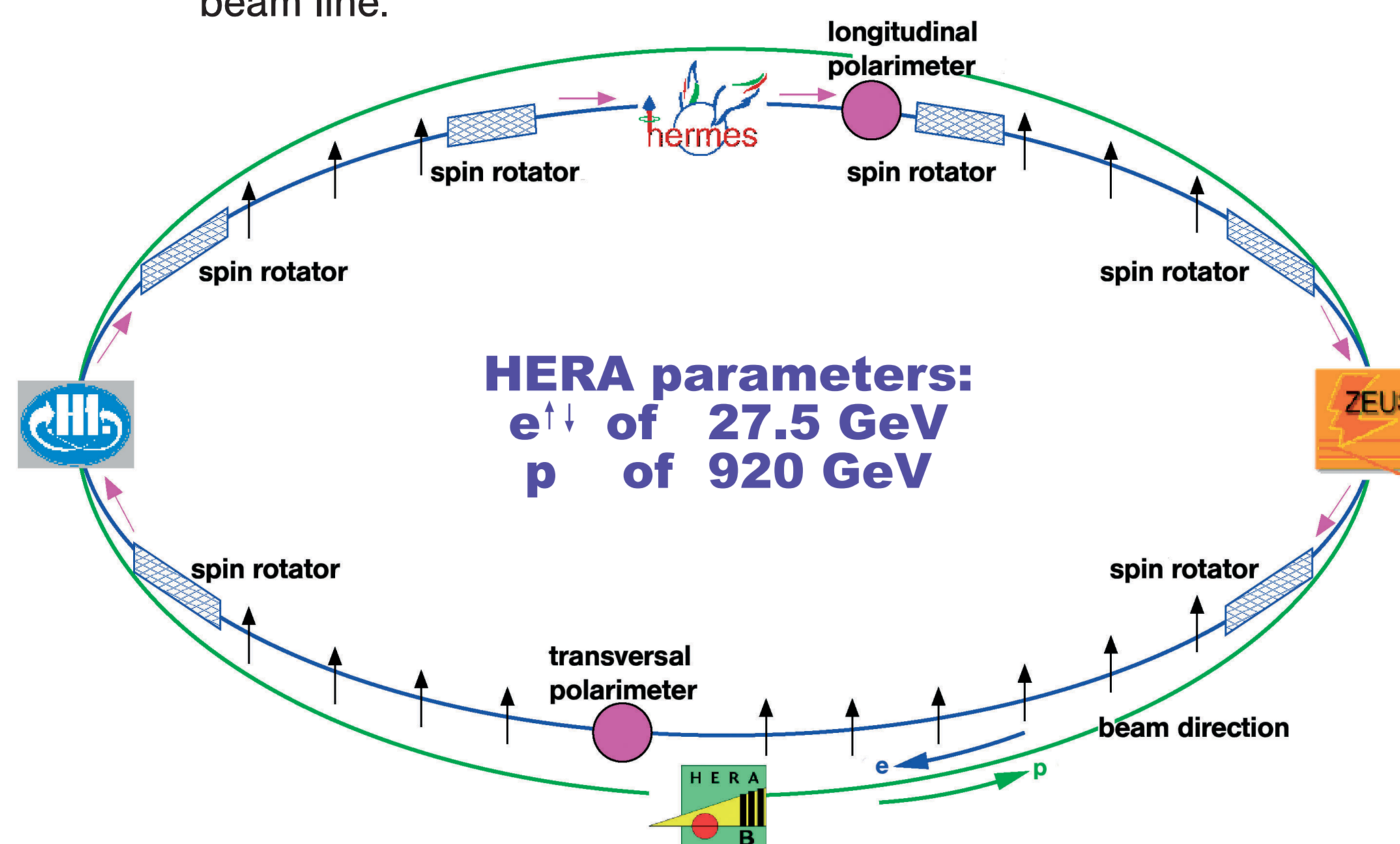
The **HERA tunnel** showing the proton ring with its superconducting magnets above the positron ring.



The **H1 detector**.

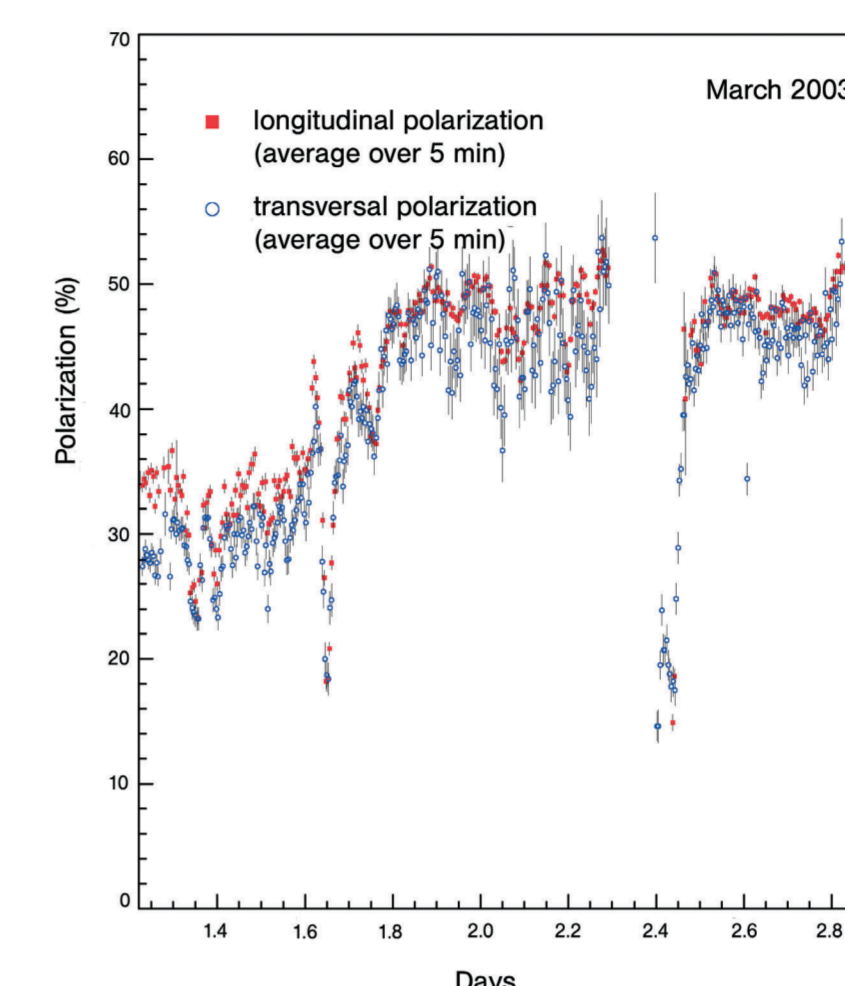


The **HERMES experiment** studies interactions of polarized electrons with a polarized gas target placed in the electron beam line.

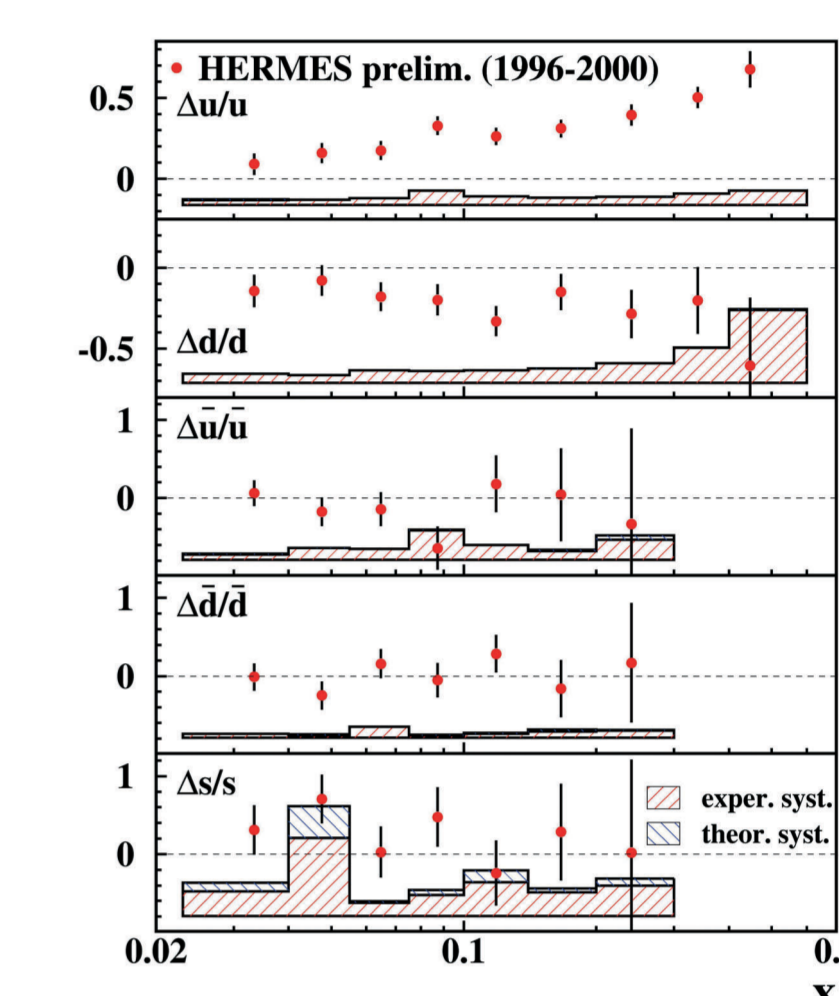


HERA collides 920 GeV protons with 27.5 GeV electrons. The spin rotators at three interaction regions make longitudinally polarized beams available for experiments. HERMES utilizes the electron beam. High protons impinge on wire targets in the HERA-B target chamber energy.

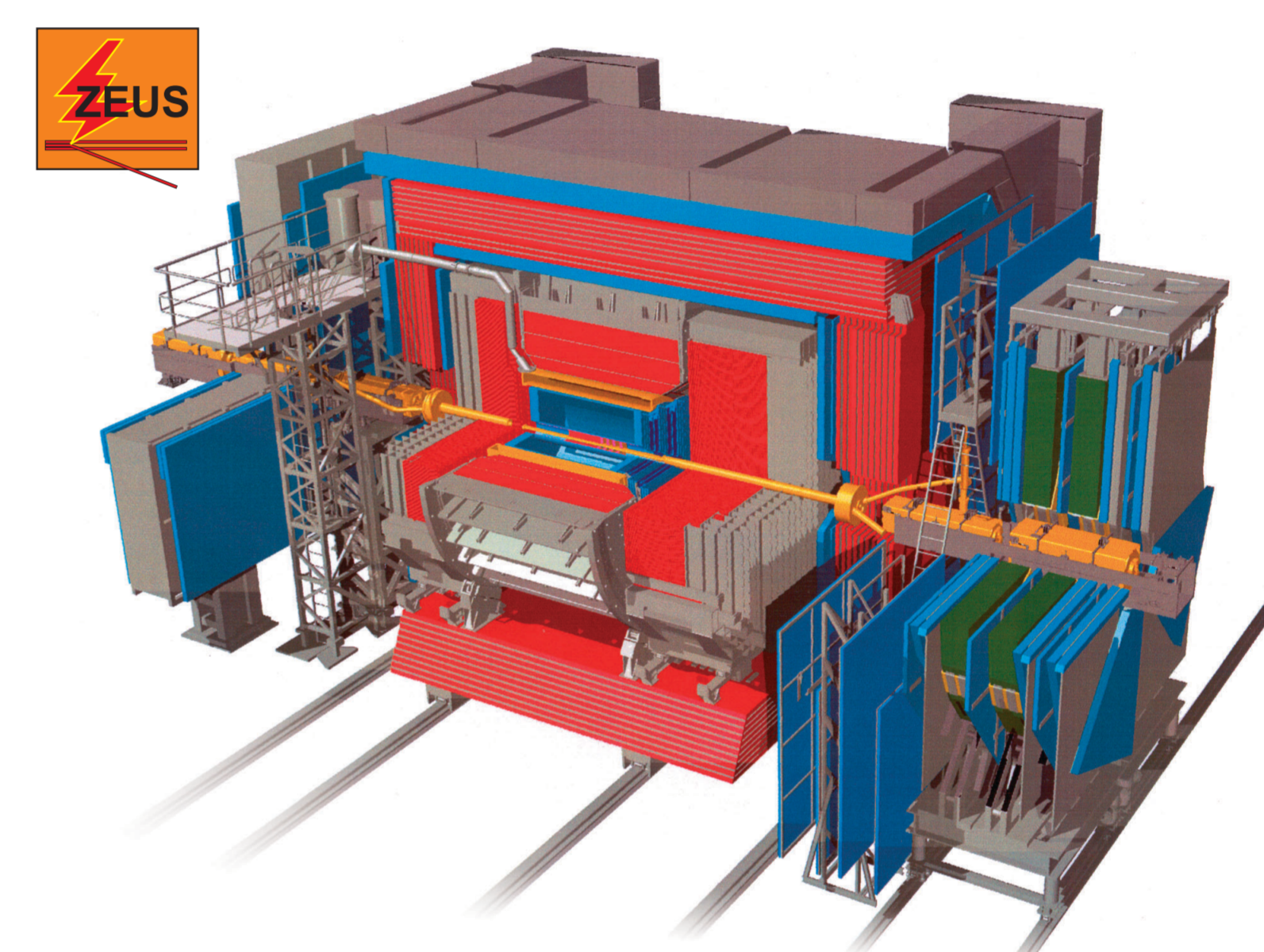
### Polarized Electrons



Polarization of the electron beam has been routinely employed at the HERMES gas target experiment. Since March 2003 collisions of longitudinally polarized electrons with protons are achieved at the collider experiments H1 and ZEUS.

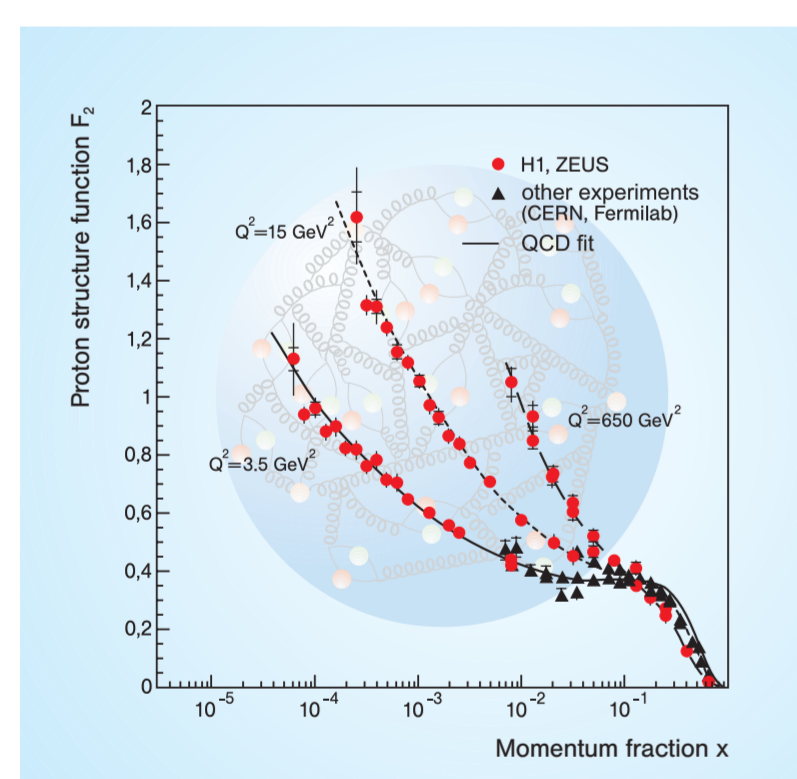


**Polarization of the quark flavours** measured by the HERMES collaboration by scattering the polarized electron beam off a polarized gas target.

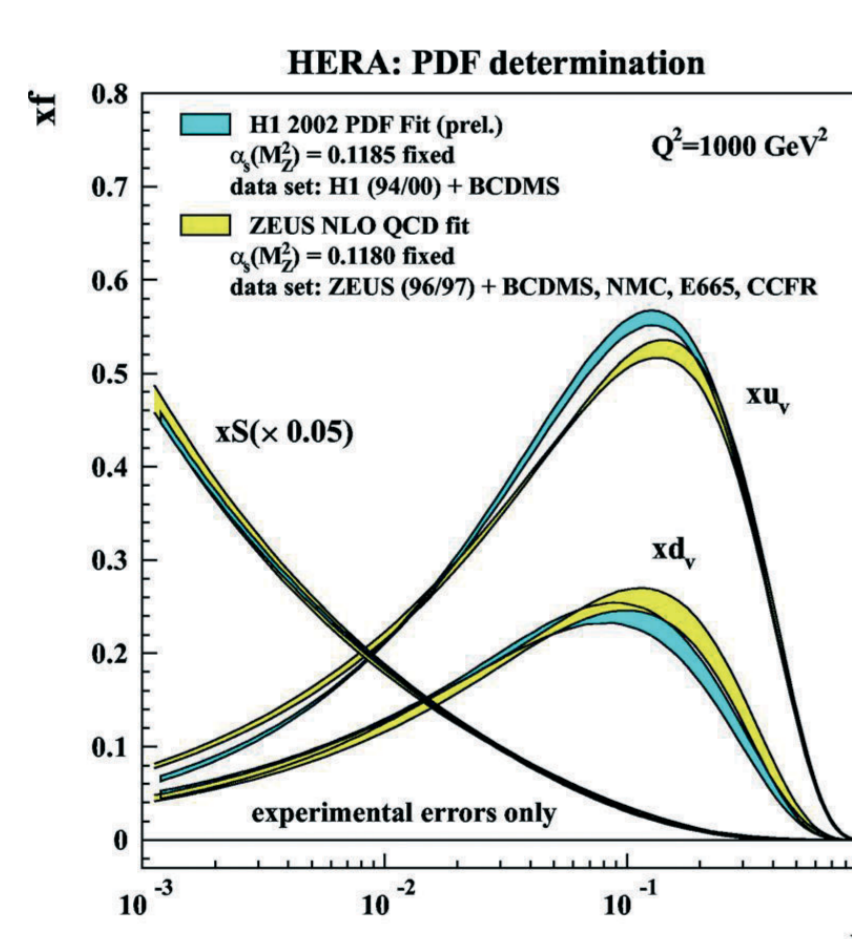


The **ZEUS detector**.

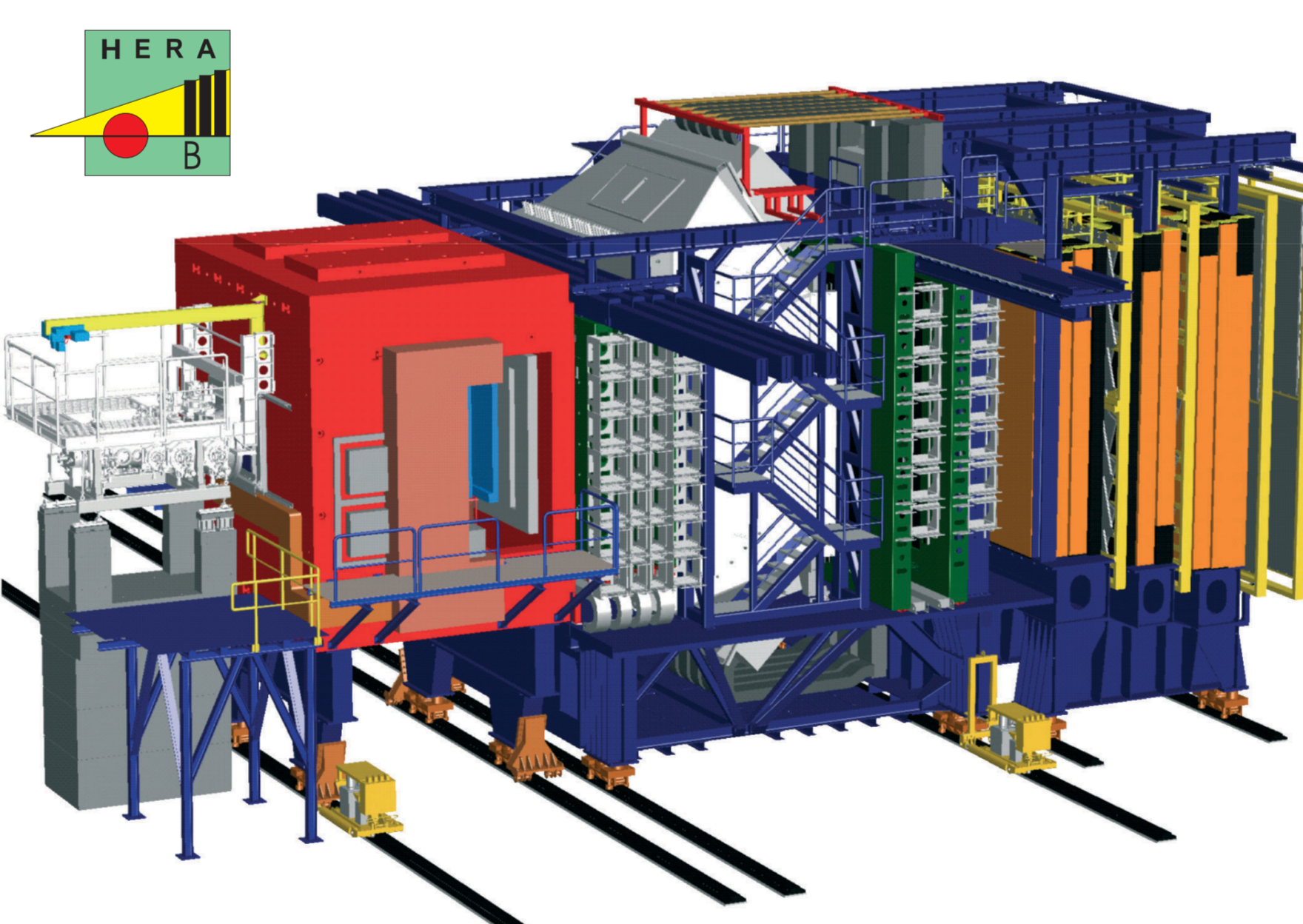
### Proton Structure Function



The measurement of the **structure function  $F_2$**  at HERA. The variation of the number of scattering centers with  $Q^2$  is clearly visible.

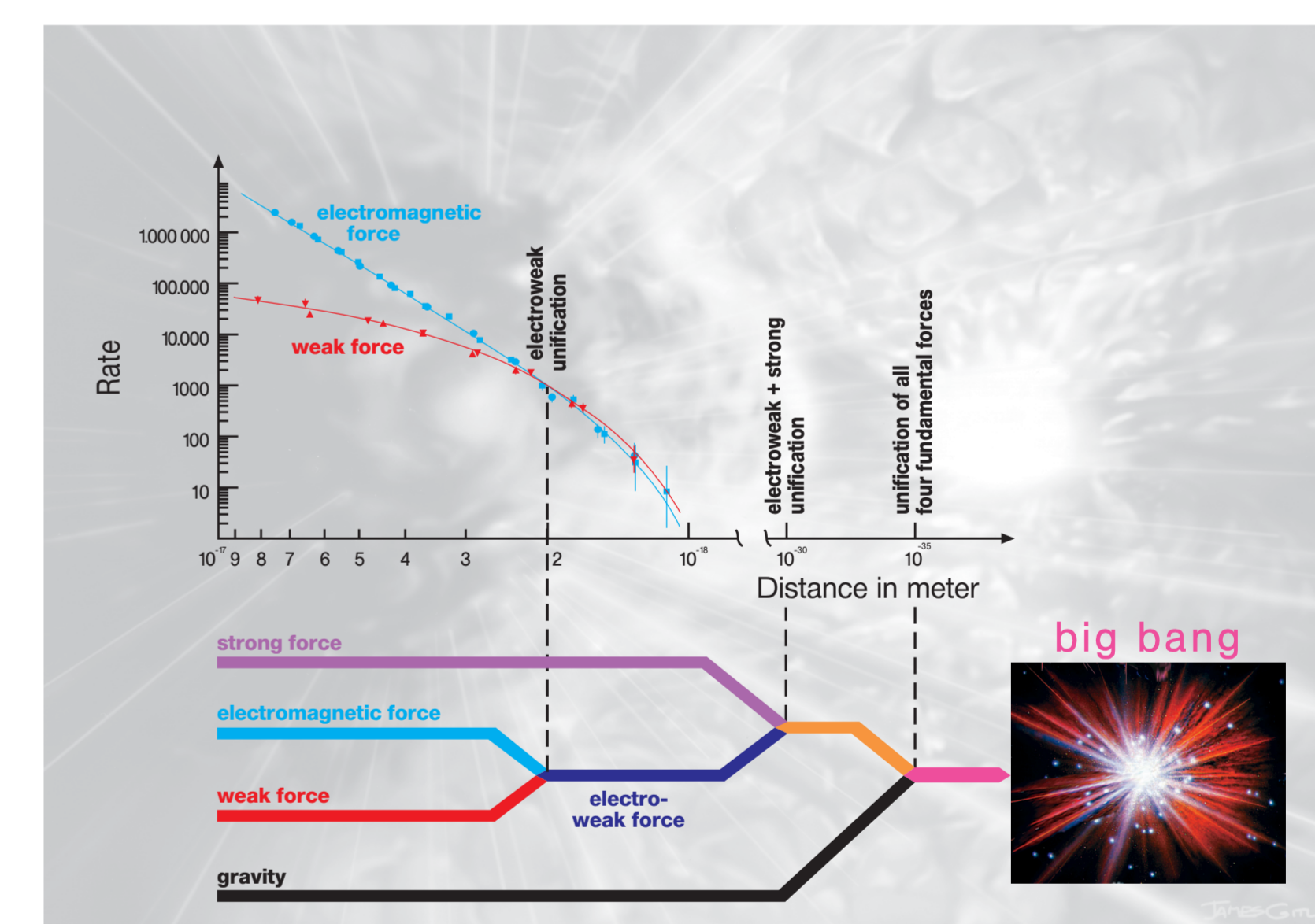


The **quark densities** as extracted from the measured proton structure function.



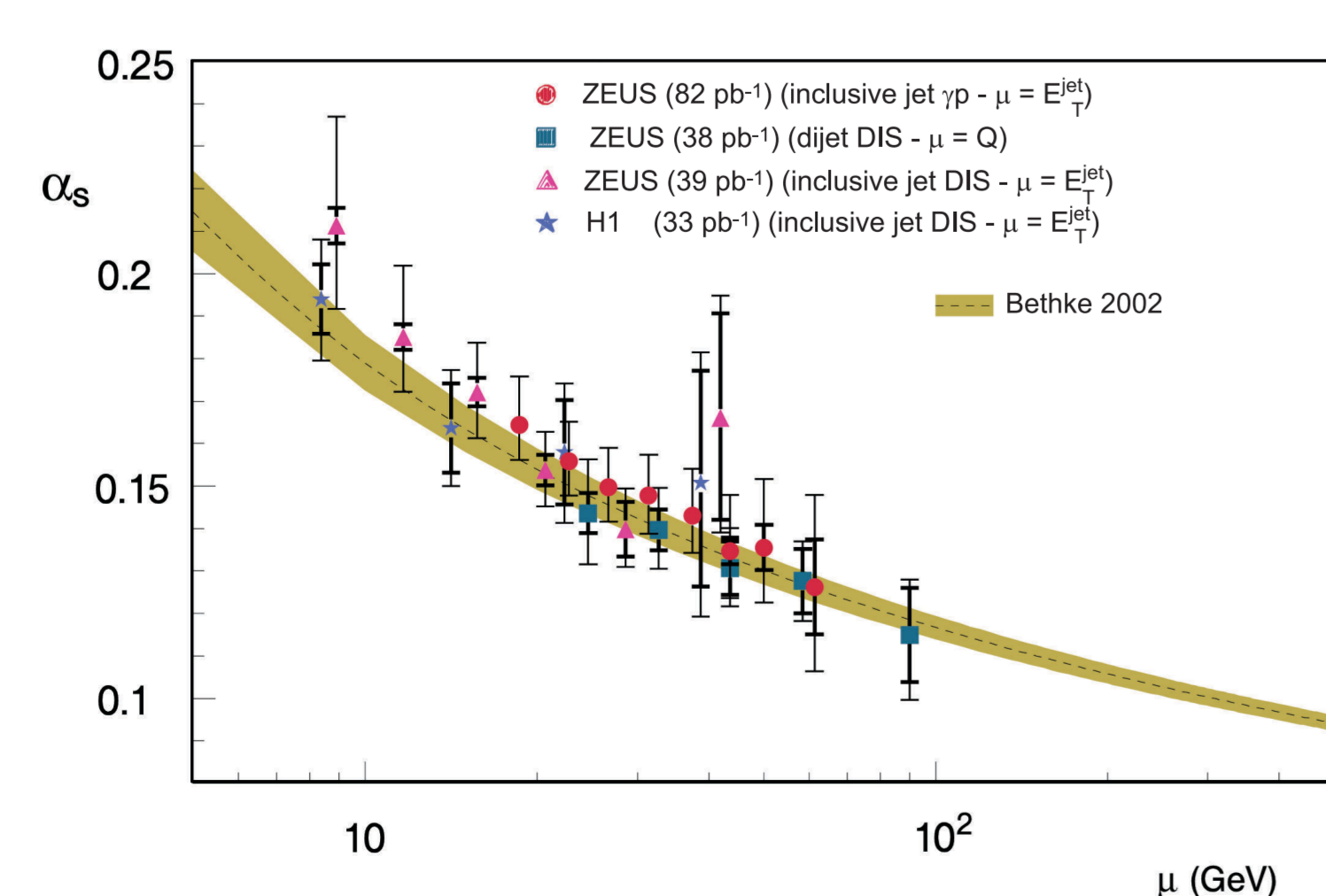
The **HERA-B experiment** uses wire targets to produce pN scattering events in the 920 GeV p-beam. The b-quark cross section has been measured and the attenuation of charmonium states in nuclear matter is being studied.

### Electroweak Unification

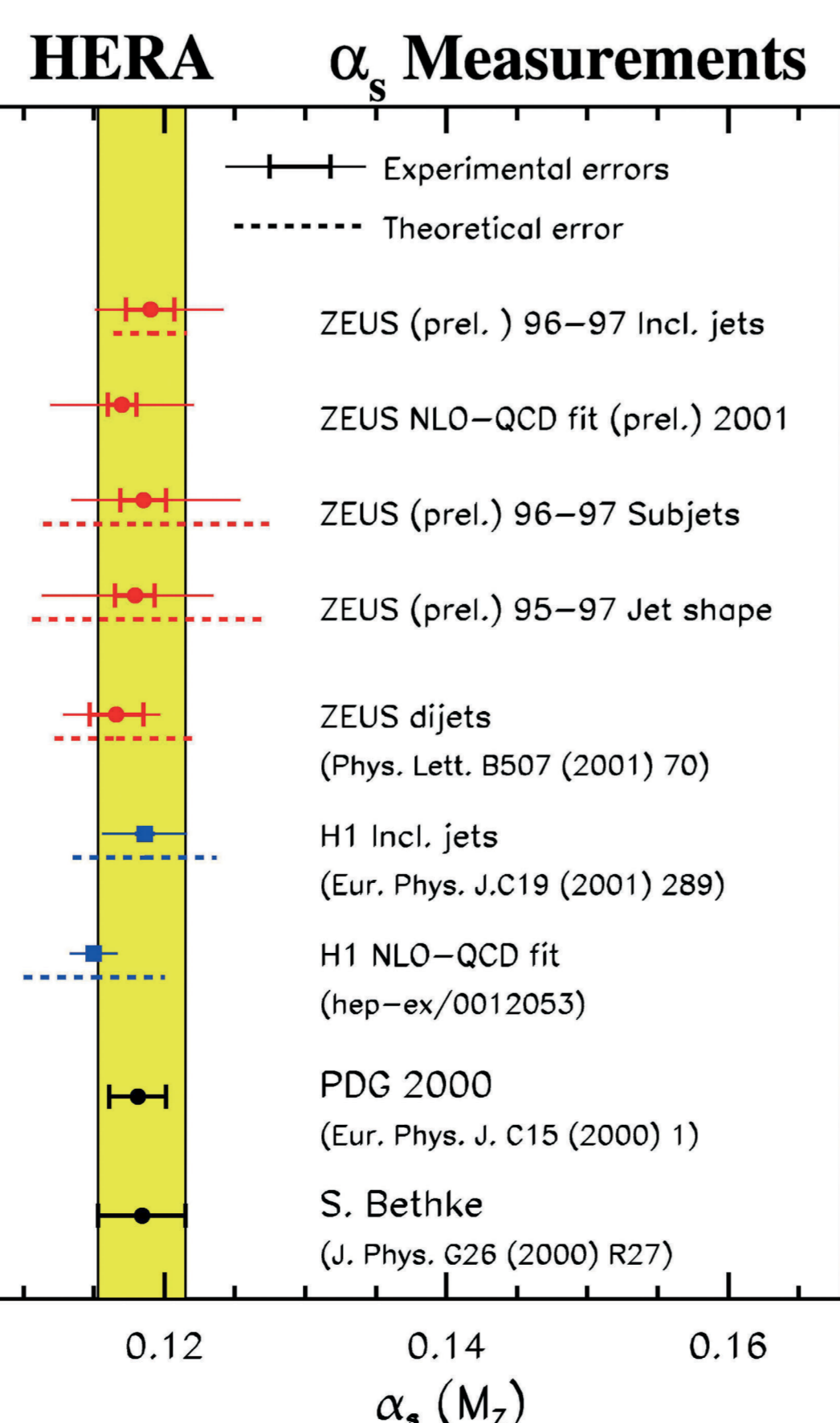


**Direct demonstration of the unification of the electromagnetic and weak forces.** At small distances (large  $Q^2$ ) the rates of neutral and charged current scattering become equal.

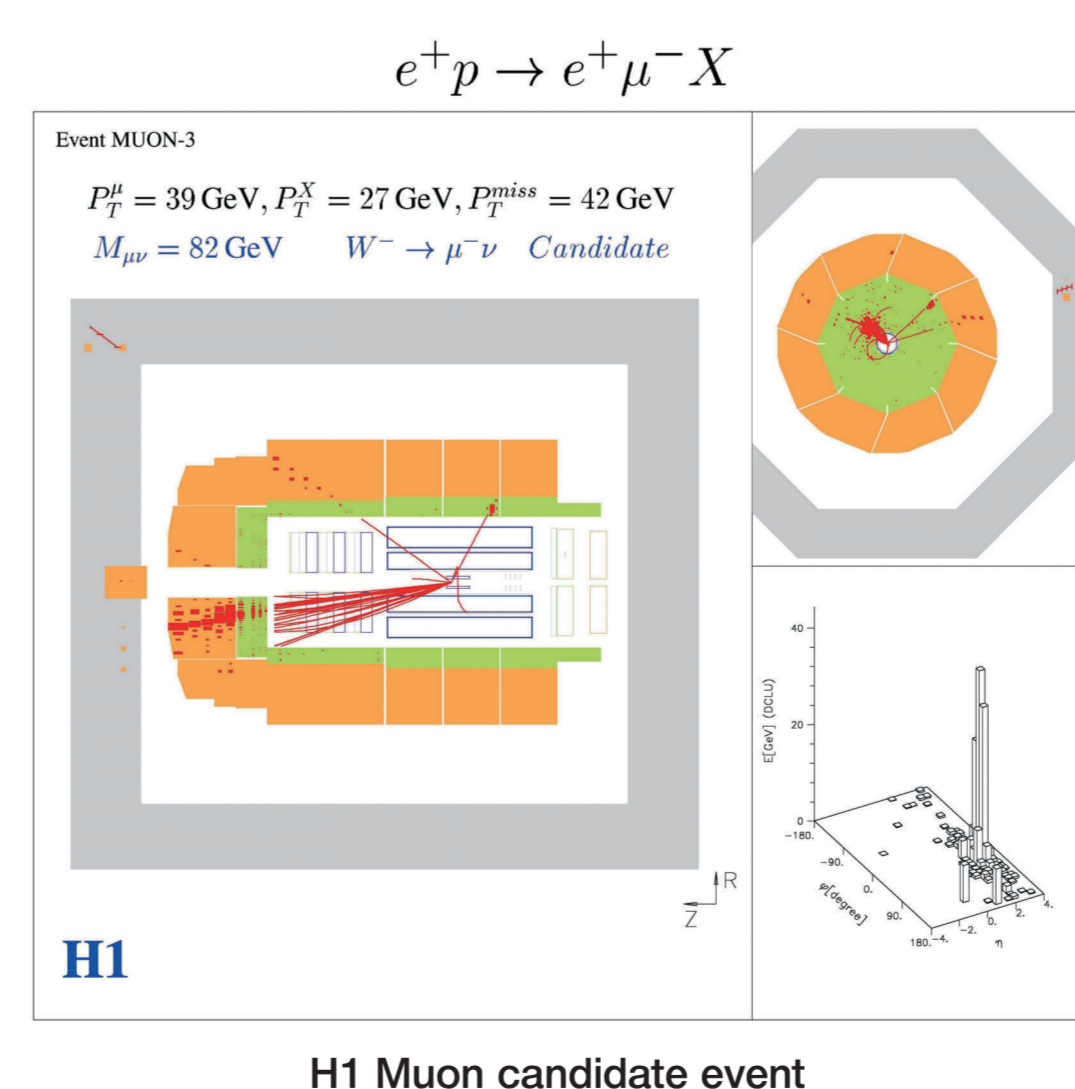
### Strong Coupling Constant



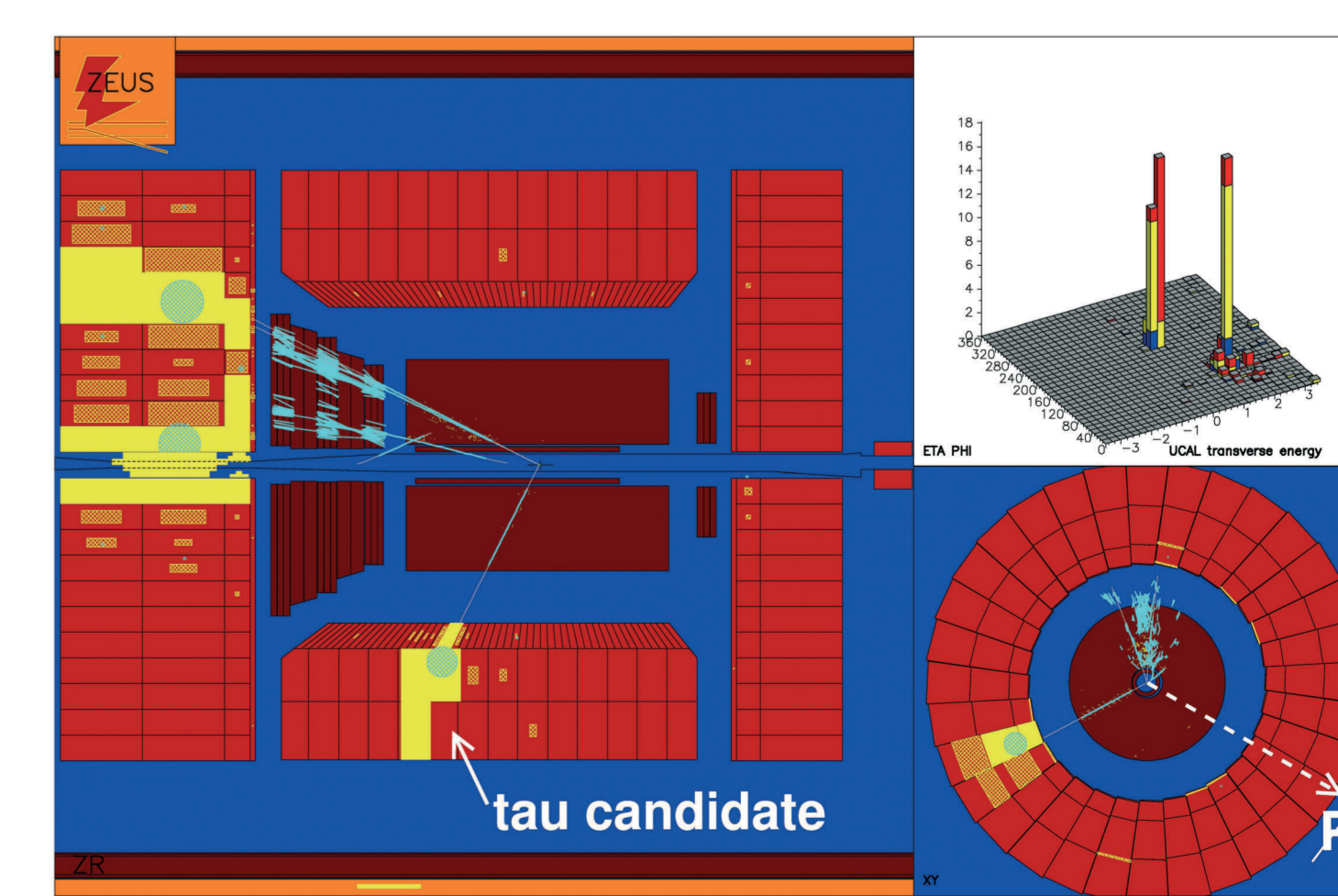
The HERA measurements of  $\alpha_s$  are among the most precise in the world. Nonetheless,  $\alpha_s$  remains the least well known of the fundamental couplings. Improving these measurements is one of the goals of future HERA running.



### Beyond the Standard Model



H1 Muon candidate event



ZEUS Tau candidate event

H1 and ZEUS have high sensitivity to possible new phenomena beyond the Standard Model of particle physics - for example, sub-structure of quarks or electrons with sizes as small as  $10^{-18}$  m or new forces acting over similar distances. The two events with a muon (left) / a tau (right) together with an unobserved neutrino may be a hint of such exotic physics. Around 10 such events have been observed so far, more than the Standard Model predicts.