# Precision Measurements at HERA

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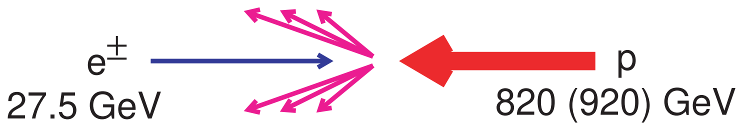
## Outline

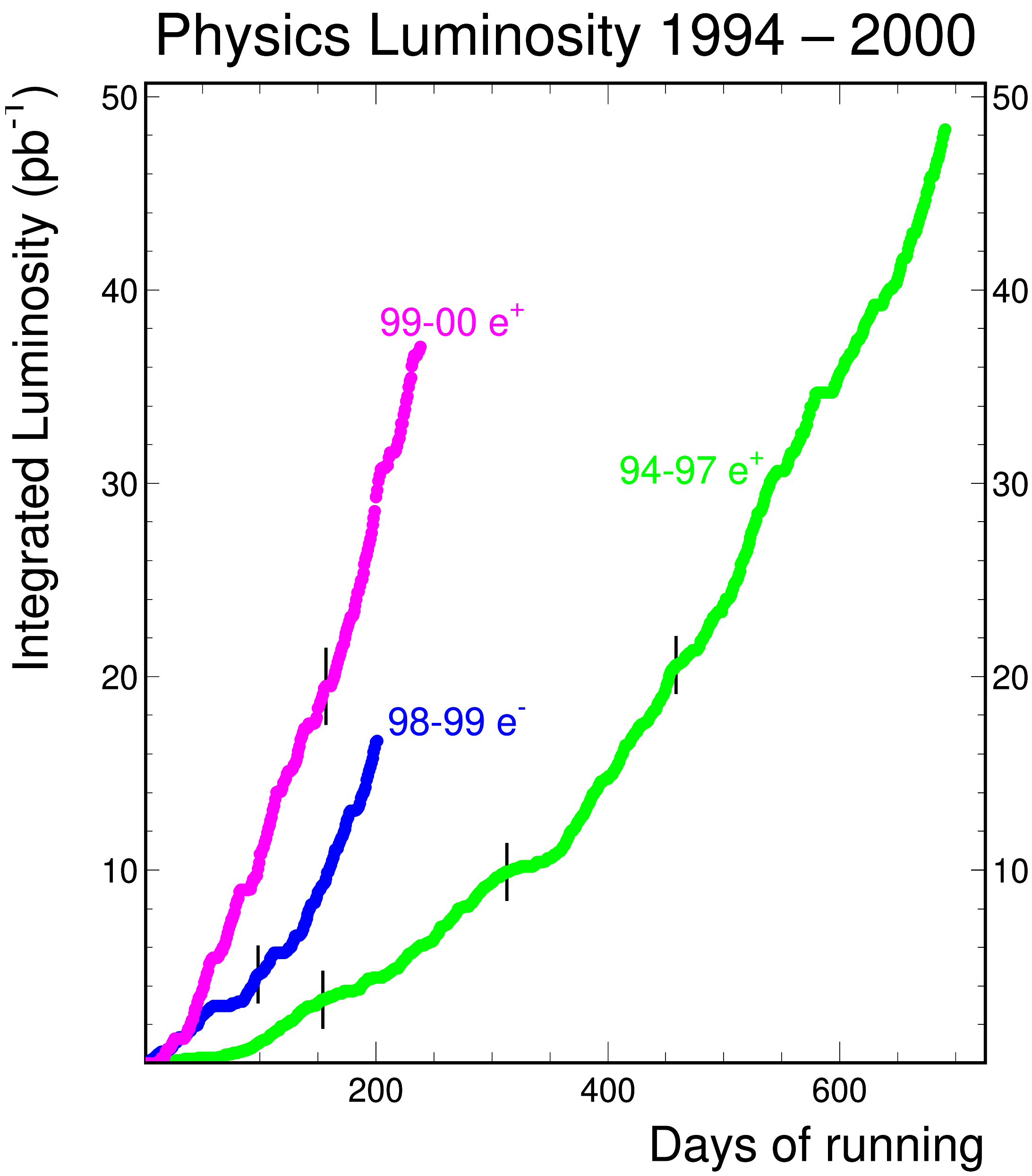
- Introduction
- Real Photon: Structure and "Matrix Element"
  - ▷ Resolved and Direct Photon
  - ▷ Prompt Photon Production
  - ▷ Resolved/Direct vs $Q^2$
- Proton Structure
  - ▷ $F_2$ from lowest to medium $Q^2$
  - ▷ x- and $Q^2$-slopes and gluon momentum density
  - ▷ Charm Contribution to $F_2$
  - ▷ DVCS
- Couplings, Evolution, ...
  - ▷ Jets in DIS events
  - ▷ $\alpha_s$ from Jets (!) and from Event Shapes (?)
  - ▷ "Forward" region
- Highest Momentum transfer
  - ▷ Neutral Currents
  - ▷ Deviations from Standard Model?
  - ▷ Charged Currents
- Summary and Outlook

# HERA → Physics Luminosity

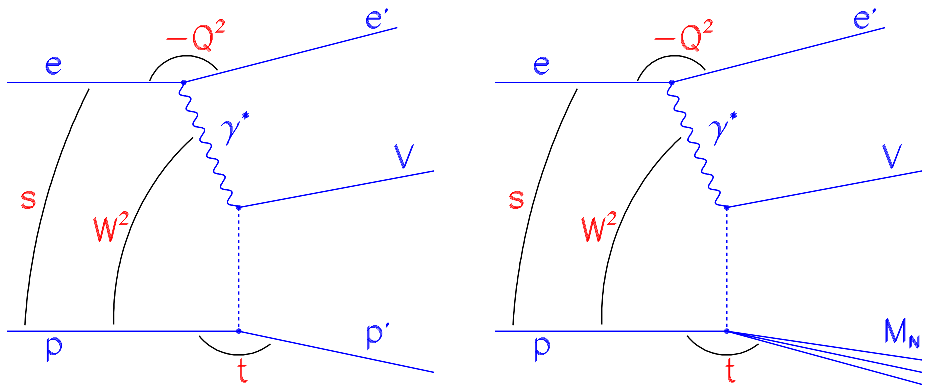



$\sqrt{s}$ = 300 GeV

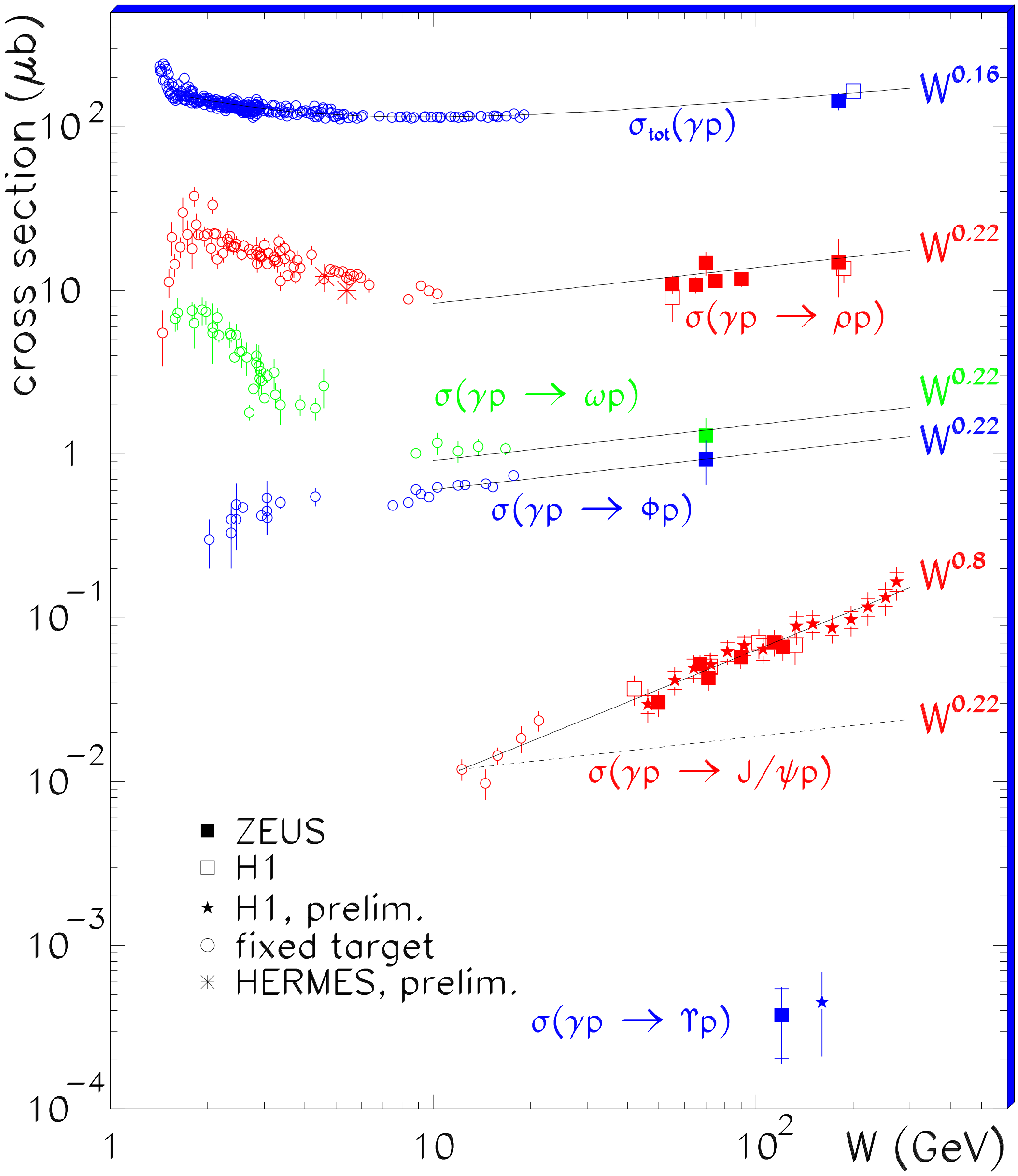
→ equivalent to 50 TeV fixed target energy



# Real Photon



e
$-Q^2$
e′
$\gamma^*$
V
s
$W^2$
p
t
p′
$M_N$

cross section (μb)
$10^2$
10
1
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
1
10
$10^2$
W (GeV)
$W^{0.16}$
$\sigma_{tot}(\gamma p)$
$W^{0.22}$
$\sigma(\gamma p \to \rho p)$
$\sigma(\gamma p \to \omega p)$
$W^{0.22}$
$W^{0.22}$
$\sigma(\gamma p \to \phi p)$
$W^{0.8}$
$W^{0.22}$
$\sigma(\gamma p \to J/\psi p)$
ZEUS
H1
H1, prelim.
fixed target
HERMES, prelim.
$\sigma(\gamma p \to \Upsilon p)$

# Resolved Photon