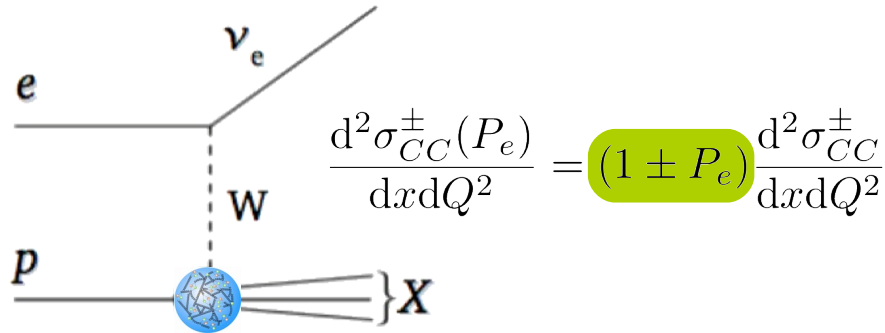# Polarized Charged Current DIS

Chared current DIS

- Exemplarily measured CC DIS cross section
  $Q^2 = 3000$ GeV^2 & y ~ 0.25

$$\frac{\mathrm{d}^2\sigma_{CC}^{\pm}(P_e)}{\mathrm{d}x\mathrm{d}Q^2} = \boxed{(1 \pm P_e)}\frac{\mathrm{d}^2\sigma_{CC}^{\pm}}{\mathrm{d}x\mathrm{d}Q^2}$$
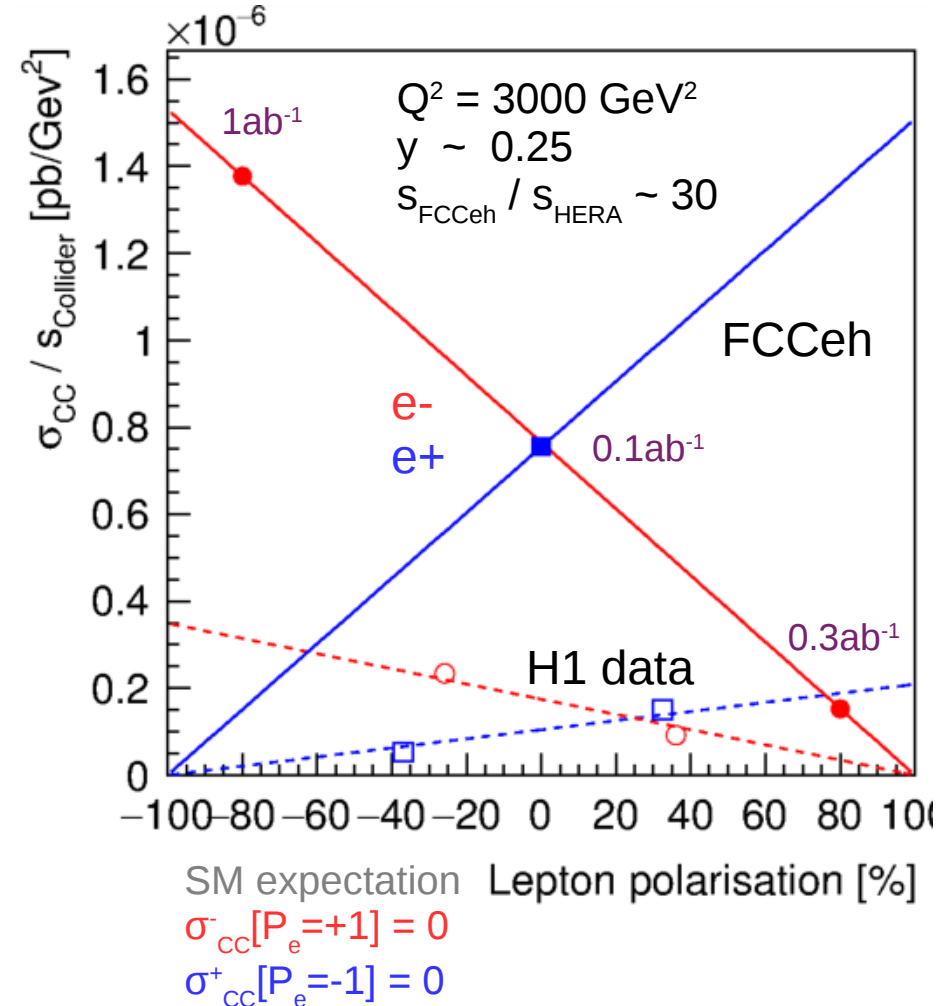
CC depends on *longitudinal polarisation* P_e

-> W-boson couples only to left-handed particles
(right-handed anti-particles)

LHeC and FCC

- Huge increase of cross section due to √s
- For fixed (Q2,y), additional increase due lower x values
  -> Gluon induced process become dominating
  -> Helicity effects become important at high-x
- Most data will be taken with electrons with P~-80%
- P~+80% CC cross section is reduced by factor ~9

$Q^2 = 3000$ GeV^2
y ~ 0.25
s_{FCCeh} / s_{HERA} ~ 30

FCCeh

e-
e+

H1 data

SM expectation
$\sigma^-_{CC}[P_e=+1] = 0$
$\sigma^+_{CC}[P_e=-1] = 0$

Weak-boson masses

Weak boson masses from EW+PDF fit to inclusive NC&CC DIS data

- All other masses expected to be known
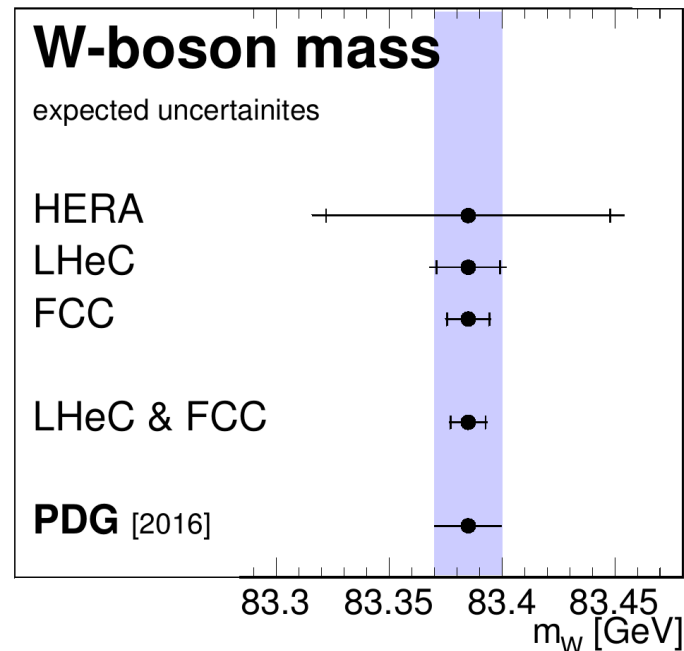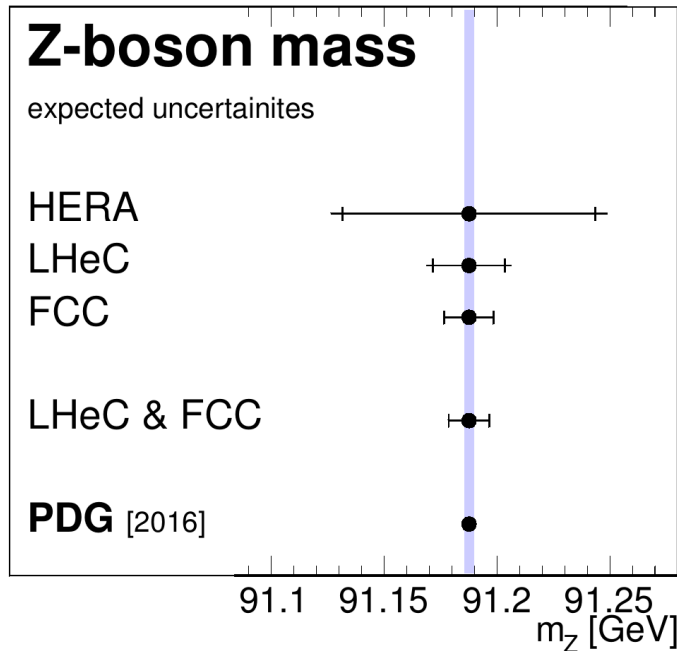
HERA prospects (1987)
$m_W \sim \pm$ 80-100 MeV
Our HERA value
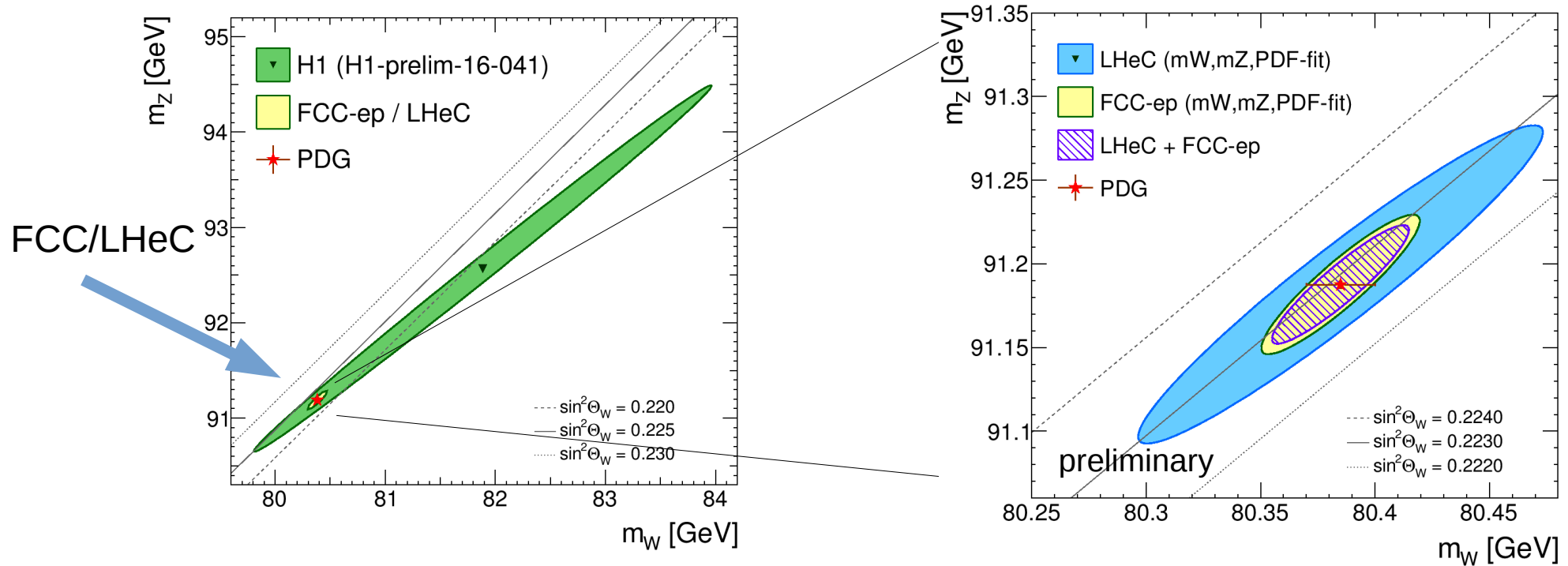$m_W \sim \pm 63_{(exp)}29_{(PDF)}$

Indirect determiations
$m_t \sim \pm 3$ GeV
$m_H \sim \pm 20$ GeV

Competitive W-boson mass

- Since CC kinematics can be fully measured (no missing ET needed!)
- Outer error bars PDF uncertainties: beome negligibly small

(Indirect) determination of boson masses

W- and Z-boson masses: Most important input parameters to EW calculation

FCC/LHeC

- LHeC & FCC: Greatly improved precision as compared to HERA
  - Benefit from increadibly higher cross sections than HERA
  - Correlation between m_W and m_Z will be reduced with increasing scale (FCC) -> higher precision
- HERA with large uncertainty due to m_W-m_Z correlation (H1-prelim-16-041)
- PDFs will not be the limiting factor for EW physics !

Light quark couplings at LHeC and FCC-eh

LHeC with very high precision !
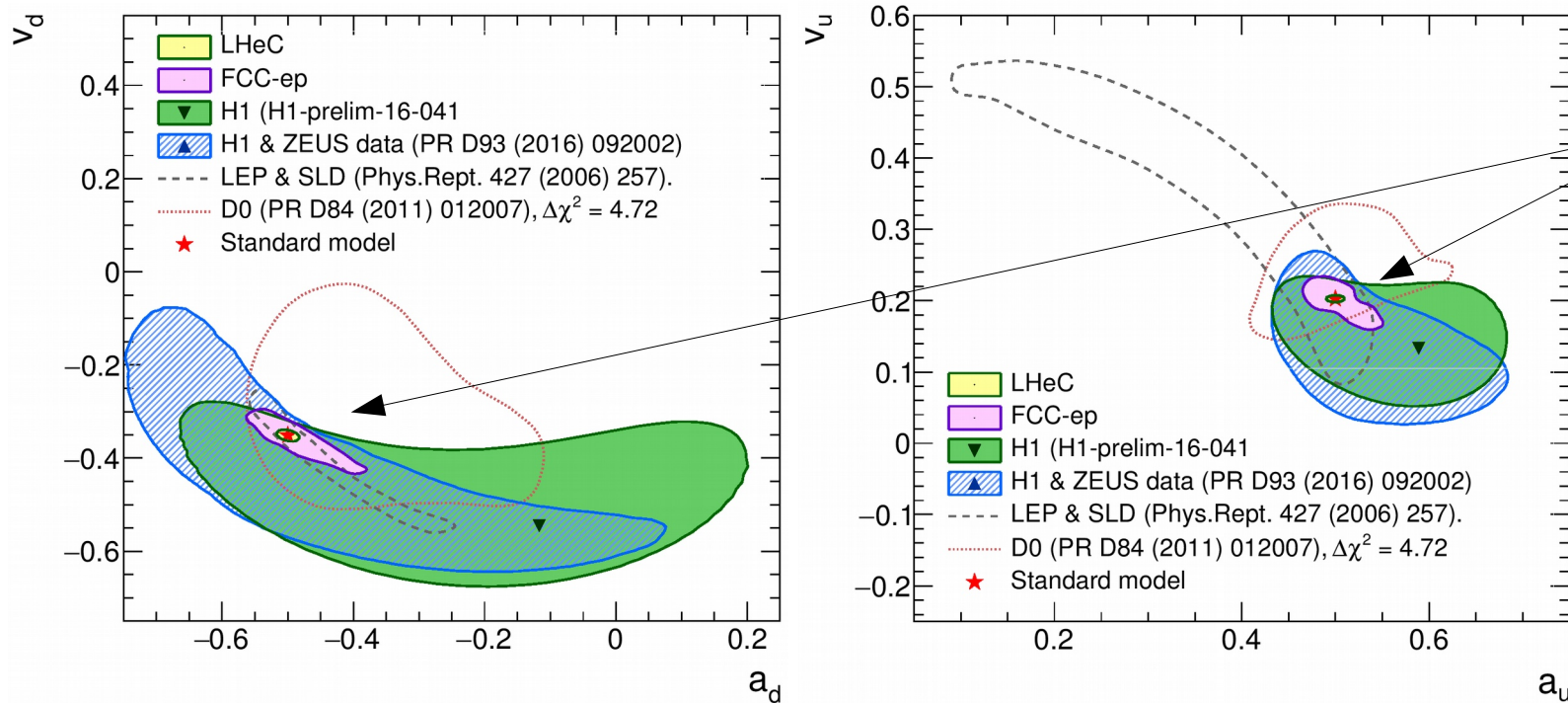
LHeC and FCC-ep

- Polarisation of lepton beam ($P_e \sim \pm 80\%$) improves precision
- Precise measurements of weak light-quark couplings feasible

Precision test of electroweak sector of Standard Model

Weak mixing angle

Weak mixing angle
- Define sin²θ$_w$ in on-shell scheme

$$\sin^2\theta_W = 1 - \frac{m_W^2}{m_Z^2}$$

- No scale dependence in this definition

On-shell value can be translated
- into 'effective' weak mixing angle
- into MS-bar definition

Weak mixing angle
- Expected precision:

```
LHeC:  ±0.0003(exp) 0.0002(PDF)
FCC:   ±0.0004(exp) 0.0003(PDF)
```

- Inclusive data will only be somewhat competitive with the direct extractions at the Z-pole, but:

- Scale-dependence of EW physics is studied up to TeV range
- Inclusive DIS data from LHeC and FCC probes scale dependence of EW theory in impressive range from 10 GeV up to highest accessible scales