



# “What can HERA still provide?”

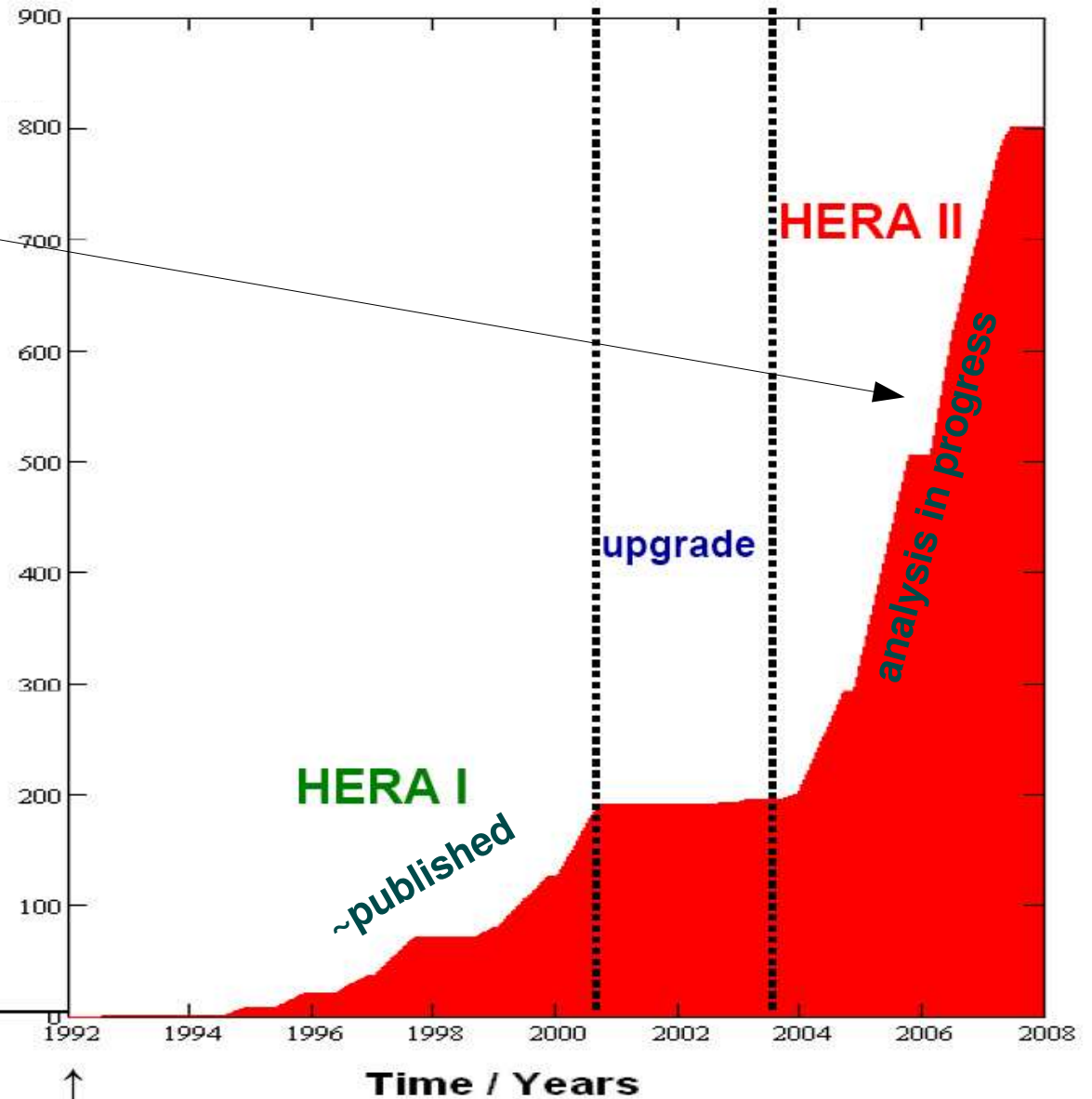
(is that the question?)

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CPP Marseille & DESY

# HERA Program: time-like gauge

Integrated Luminosity



60% of the data sample  
in the last 18 (running) months

+brand new physics capabilities:  
polarisation, trigger, tracking

1981      1984

\*

\*

↑

startup

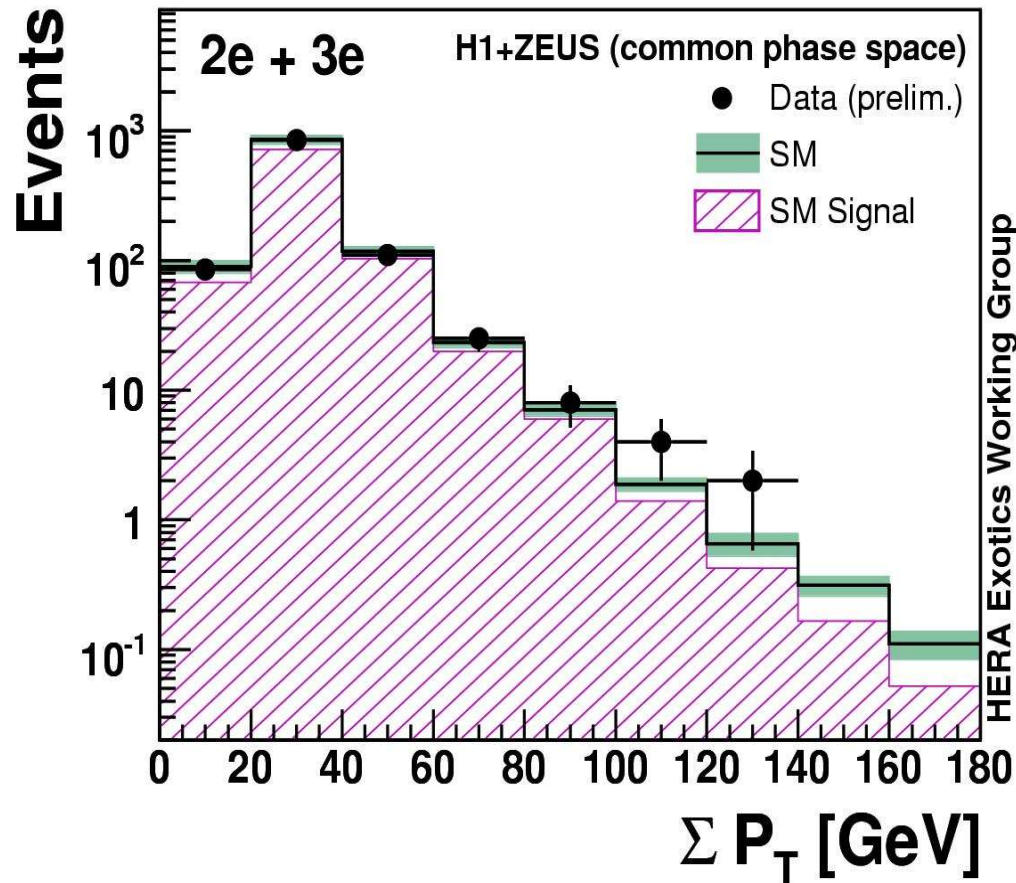
Time / Years

↑      ↑  
proposal approval

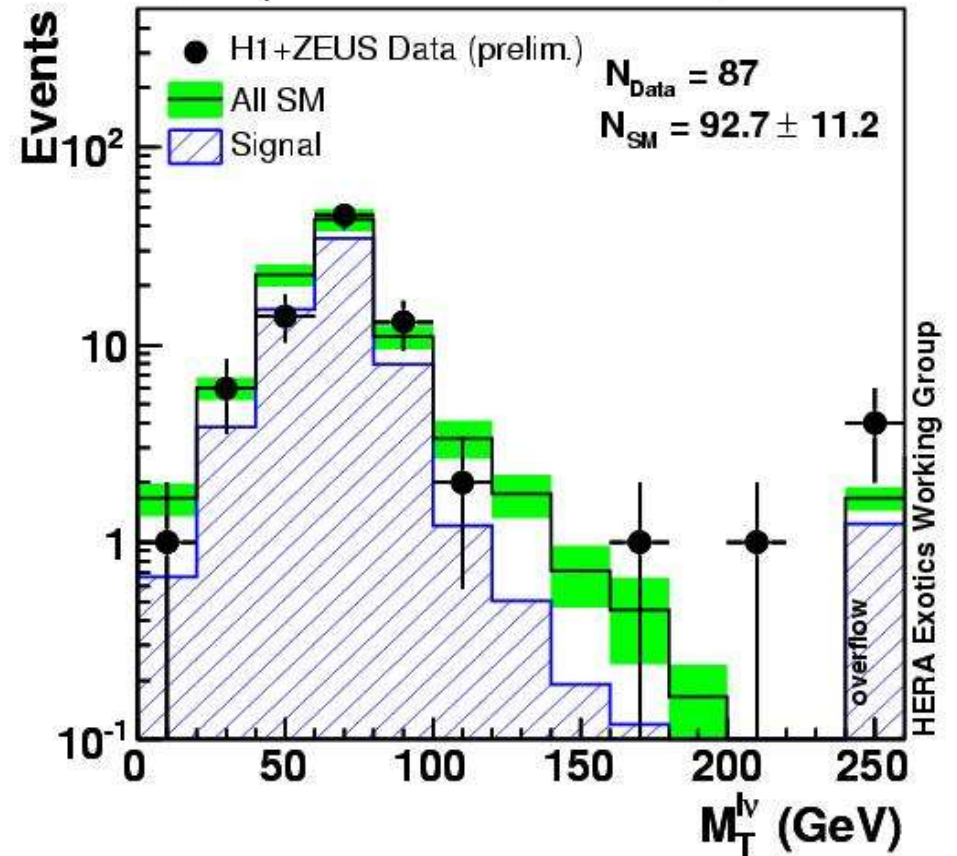
# The energy frontier: the final word on searches

Full statistics, first round of final analyses from HERA

Multi-electrons, HERA I+II ( $e^+p$ ,  $0.94 \text{ fb}^{-1}$ )



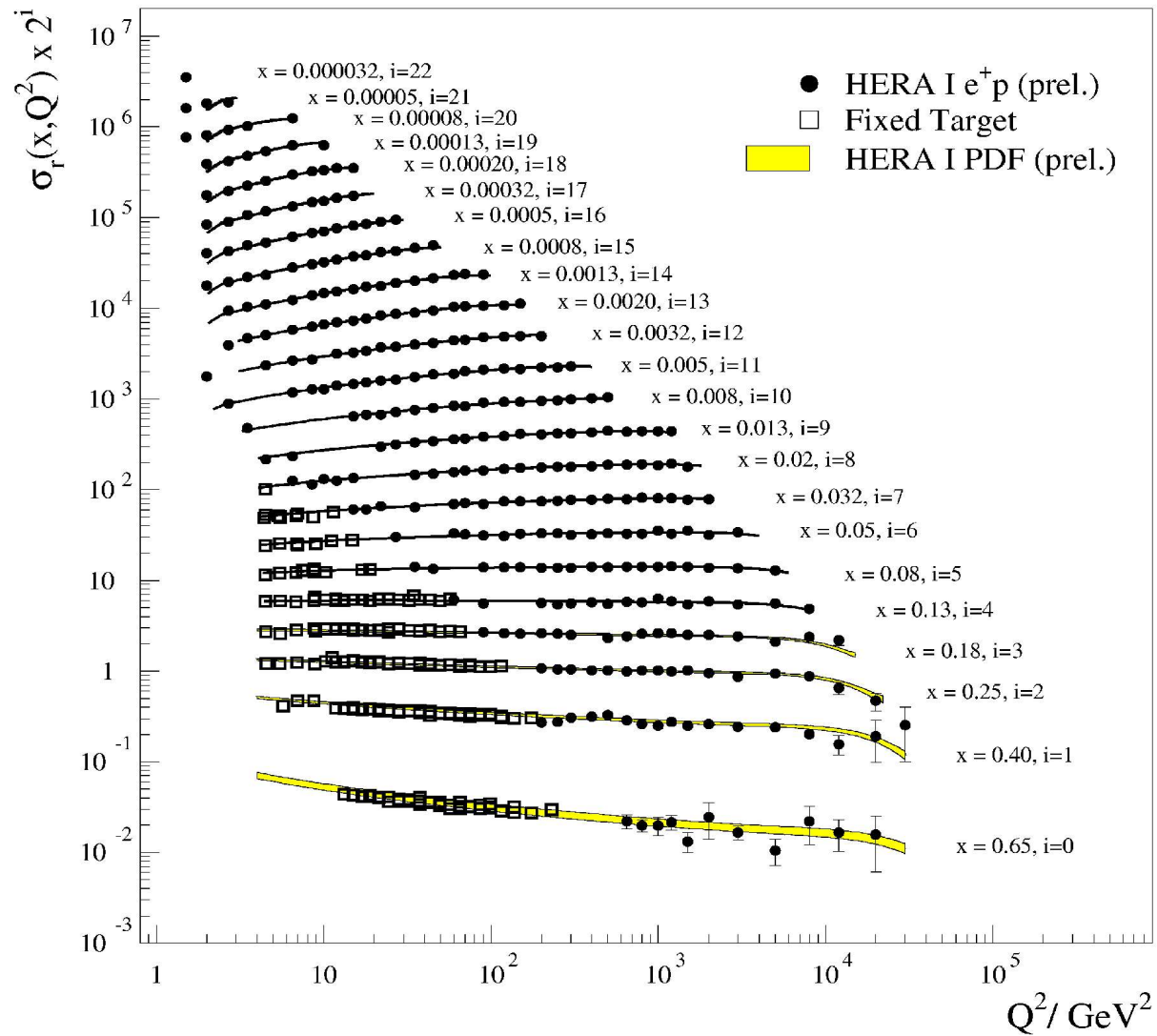
$e, \mu + P_T^{\text{miss}}$  events at HERA I+II ( $e^+p$ ,  $0.97 \text{ fb}^{-1}$ )



More analyses in common phase space: check coherence, keep memory of deviations (LHC signals ?)

# H1+ZEUS: the power of love

## H1 and ZEUS Combined PDF Fit



April 2008

HERA Structure Functions Working Group

**Coherent data sets combined:  
vast coverage of the proton “map”  
dramatic increase in precision**

# What love got to do with it?

## H1 and ZEUS Combined PDF Fit

**Breakthrough and challenge:**

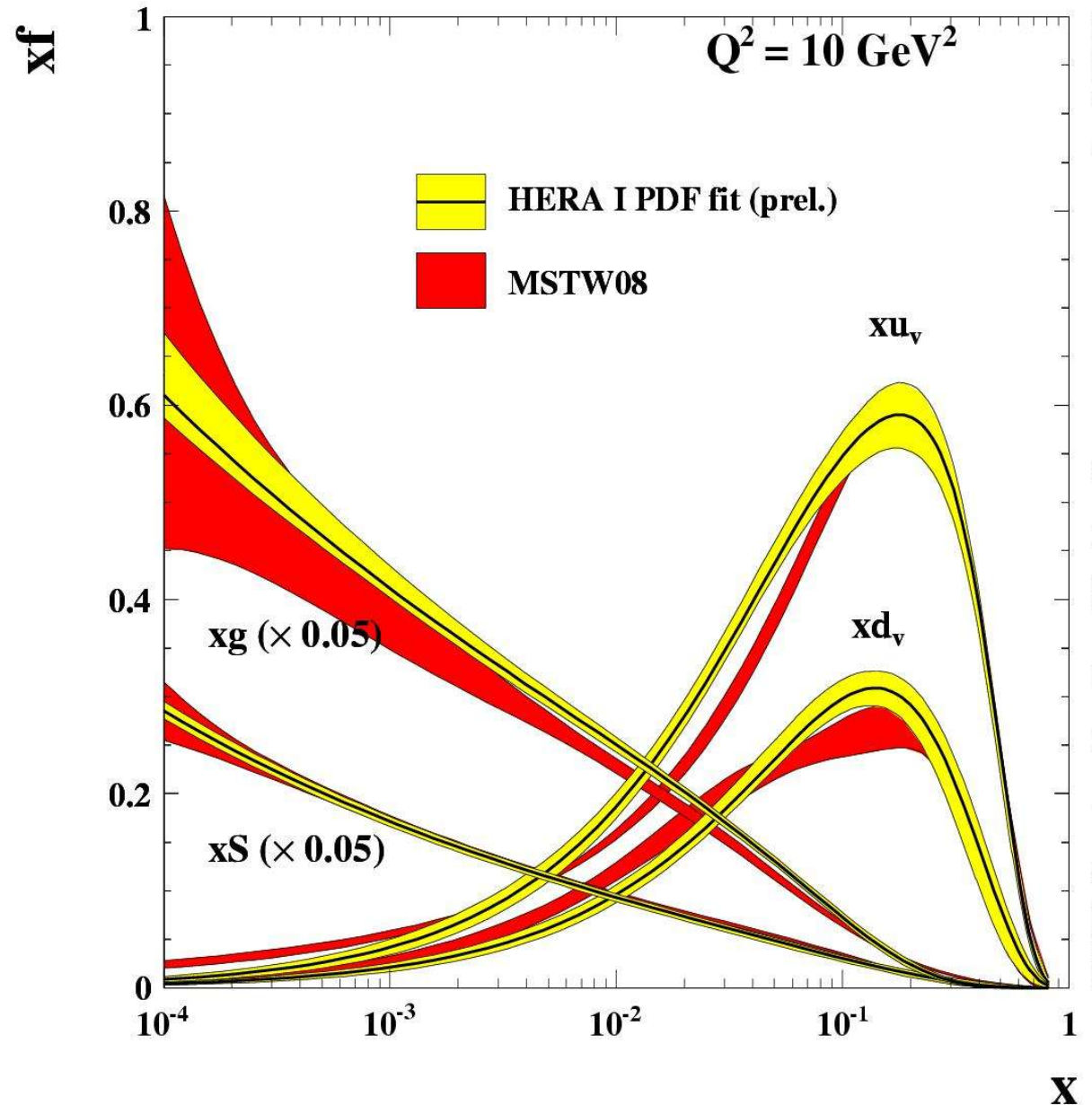
Constrain proton structure with  
HERA data only?

More to come from HERA II

(low  $x$ , high  $Q^2$ ,  $F_L$ ....)

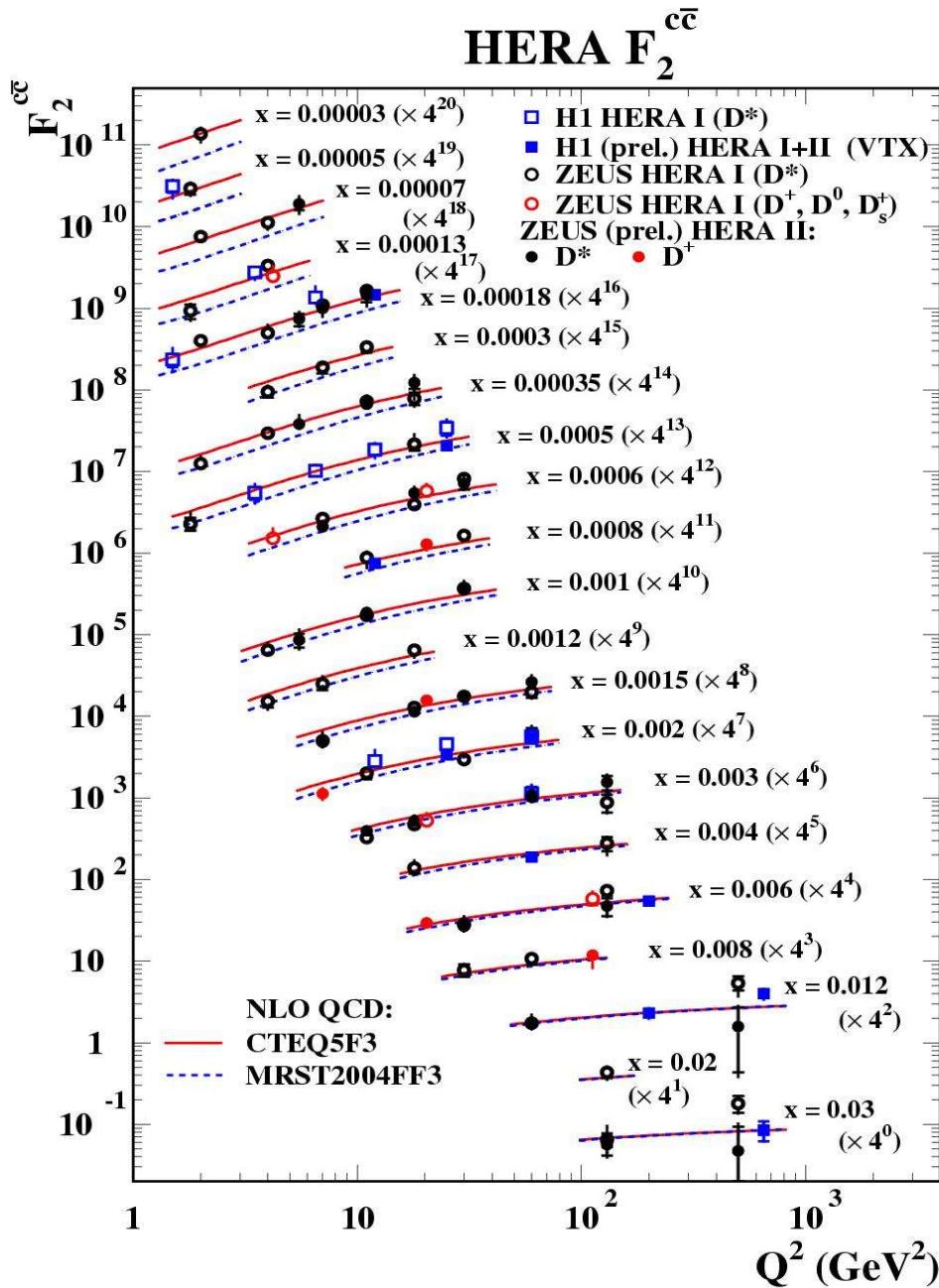
Data precision impact on the  
parameterisation issues?

Coherent, precise data set =>  
LHC predictions



# Potential for performance

## Example I: Charm and beauty



**A breakthrough is also expected:**

- the detector improvements will pay (tracking)
- combinations H1/ZEUS
- down to the gluon?

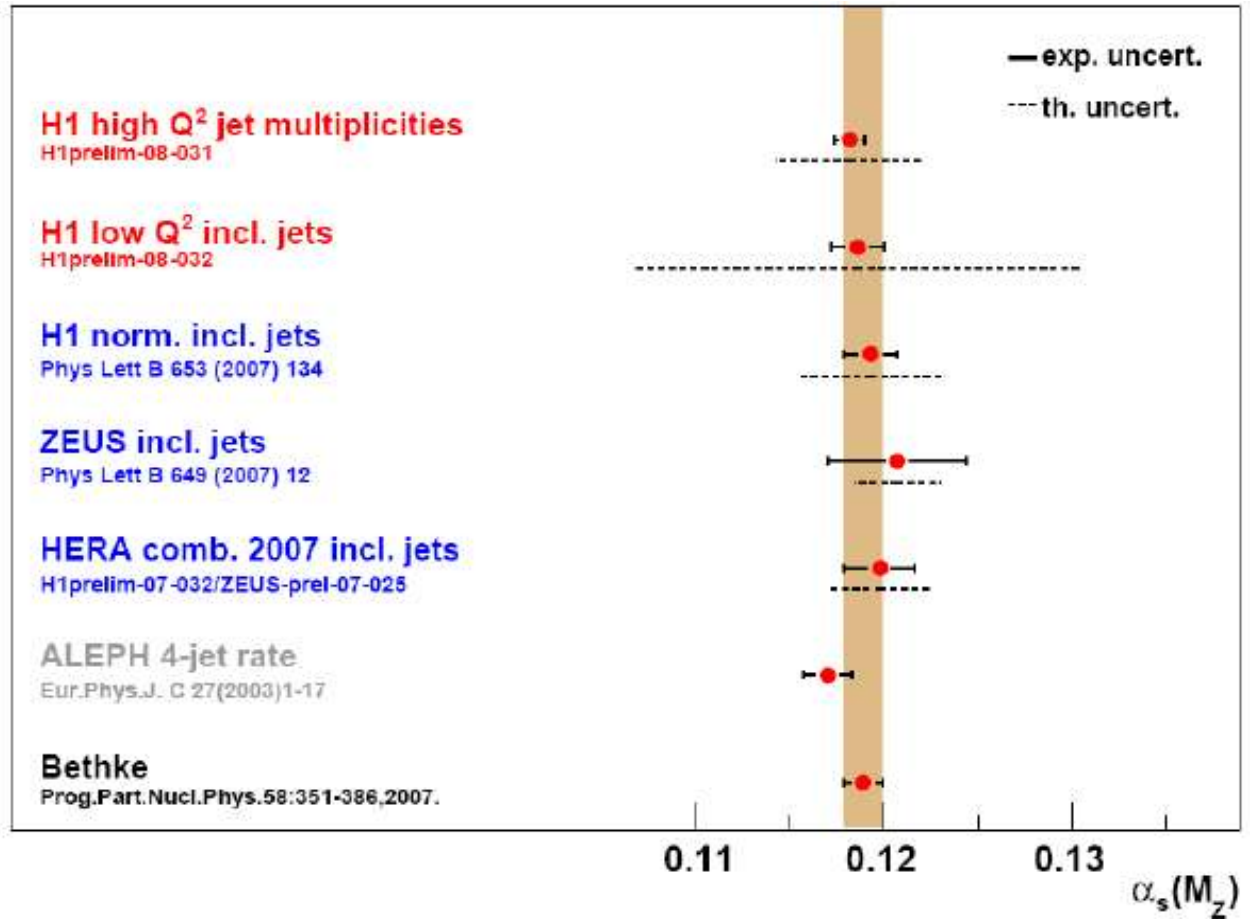
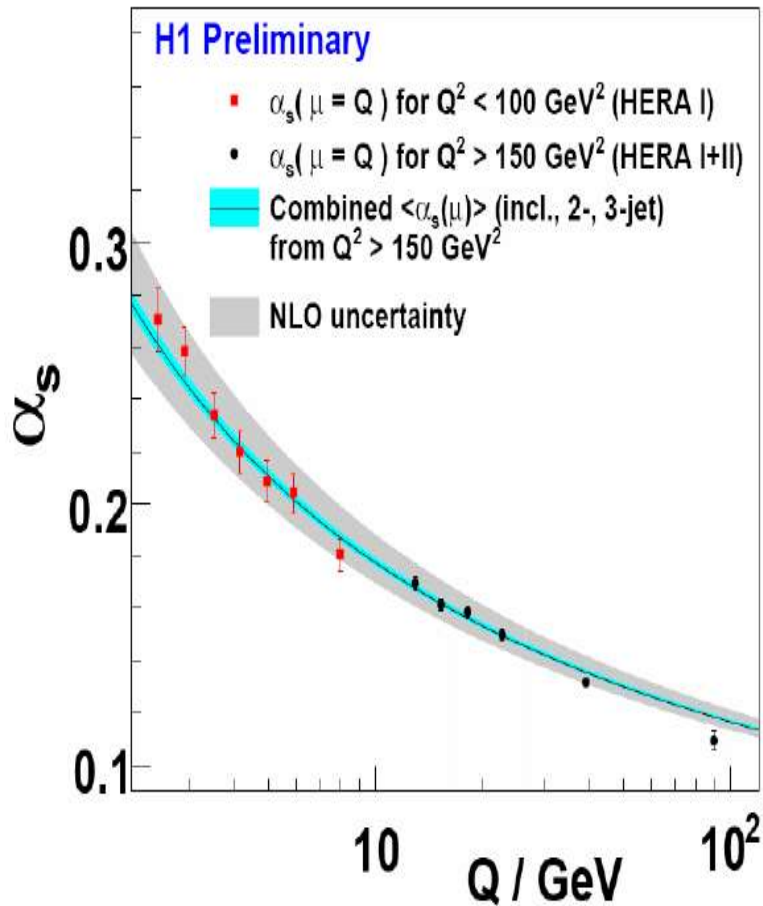
(the same, or even more, for b's)



# Strong coupling: a sub-percent perspective?

jets: improvements in hadronic energy scale -> 1%ish?

$\alpha_s$  from Jet Cross Sections

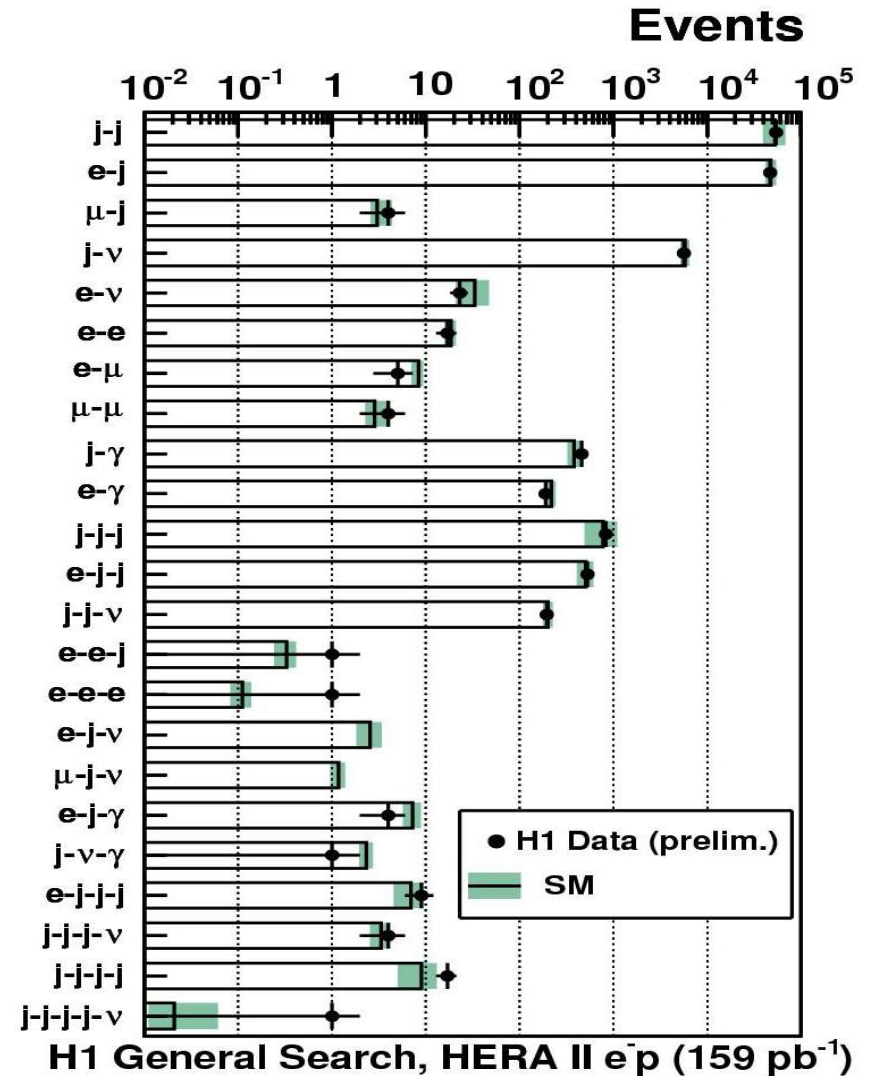
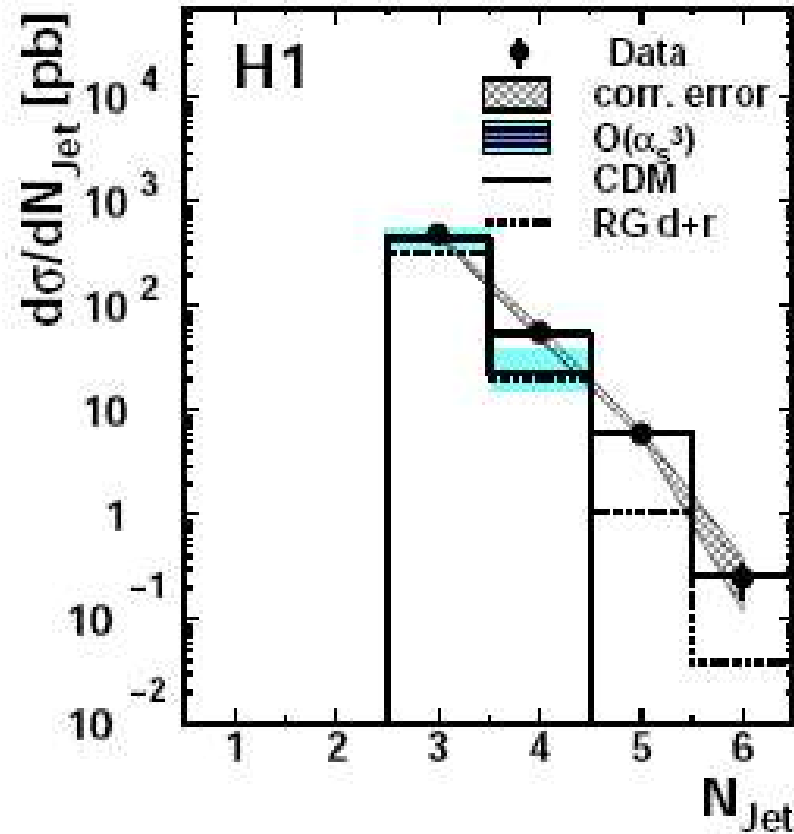


**NNLO theory is an absolute necessity now**

Scales variation arbitrariness? Theory errors?



# The HERA Physics and the Monte Carlo



Can the Monte Carlo industry profit from the HERA QCD laboratory (and vice-versa)?

## The HERA Physics and the data sets perenity

This is an unique data sets, with an immense potential

- 1Gevents/expt. say ~500 Tb (+simulations) - easy
- conserve the knowledge (much more difficult)**
- initiate the long term analysis/computing strategy (LHC-Grid)

## HERA data is a (full) gold mine:

proton map, QCD laboratory, energy frontier searches

- **improvement in precision still expected: alignements, calibrations**
  - **significant steps in all HERA physics subjects expected in the next years.**
- **H1/ZEUS combinations => one step further in the precision**
- **Technically:**
  - **We need:**
    - **reliable/improved theory in a few topical areas: fits, alpha\_s... {GOTO N++LO }**
    - **Monte Carlo machinery improvements...**
  - **We offer:**
    - **coherent data sets to tune MC predictions**
- **HERA immersion into LHC physics should be powered!**
  - **experimental issues may become very important and they should/can be treated in a common frame**

# Q:What can HERA still provide?

## A: All final results with best precision

(i.e. ~everything)

- The row of final analyses in progress now!
- Stay Tuned!

