A toolset for parton densities

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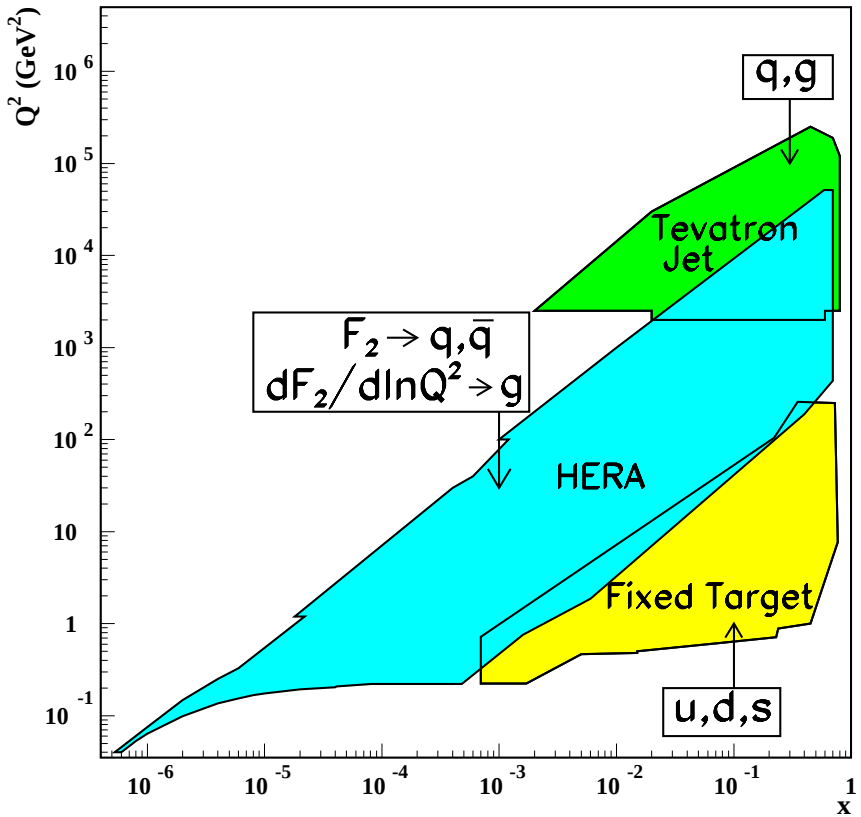
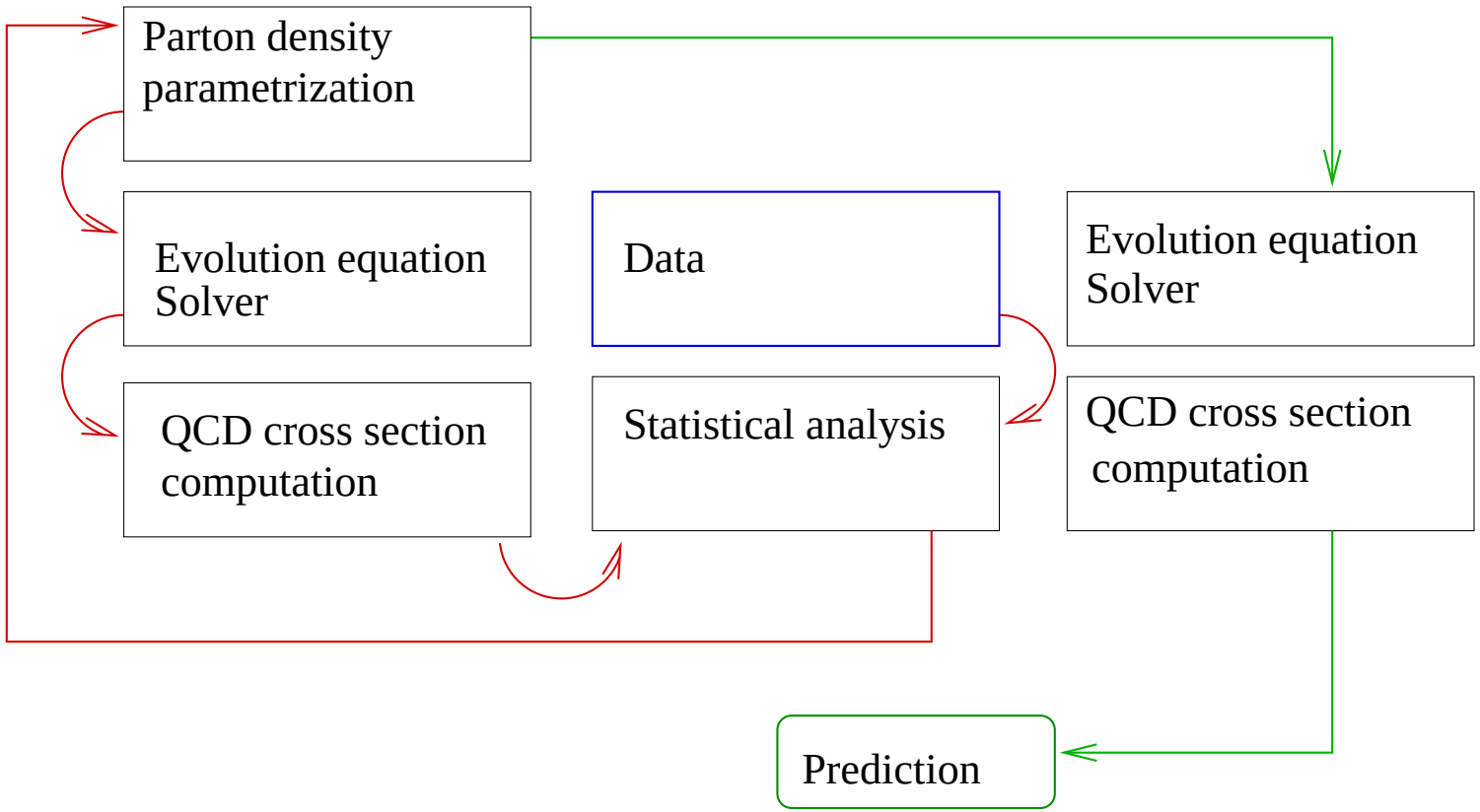
Outline

What from where



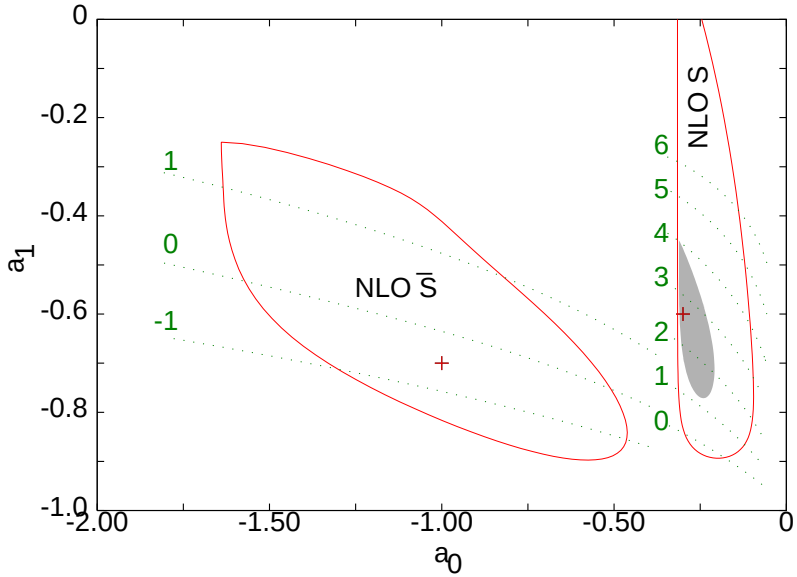
Jets	q, g
DIS	q, g
Drell-Yan	$\overline{q}$
Direct photons	g

Fitting procedure



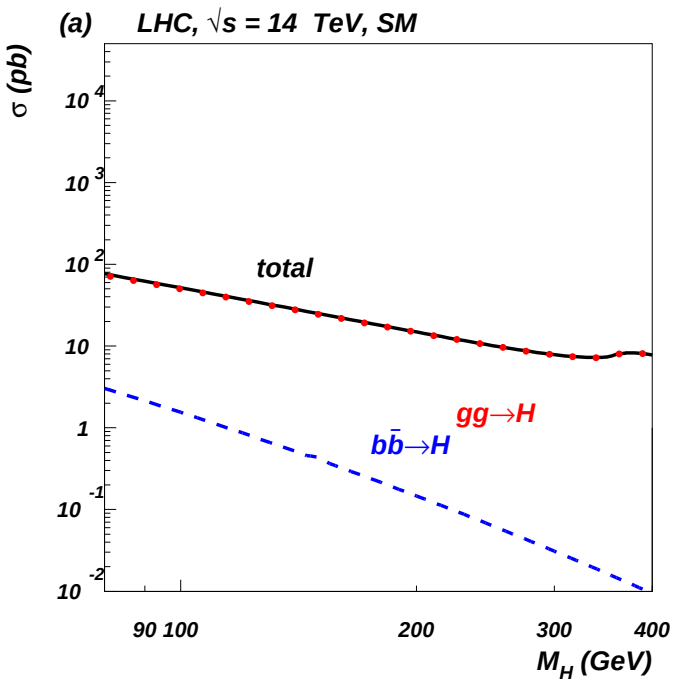
Iterative fitting of parton density parametrizations to experimental data yields a best fit pdf set which is used to give predictions for new experiments.

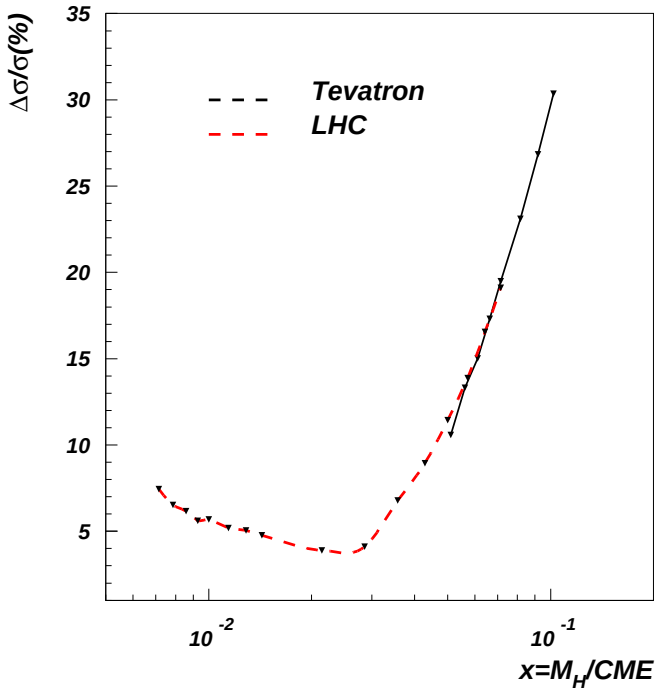
Uncertainties in the fit



Errors in data propagate to errors in fitted parameters. Example: polarized gluon density $\widetilde{g}(x, Q_0^2) = a_0 x^{a_1}(1-x)^{a_2}(1+a_3 x)$ with a_2 and a_3 fixed at the best-fit value. Two different sets give disjoint best-fit and 1σ errors. Grey: fake data, generated with NLO S set, added 10% random noise, errors of 20-30% and refit. Shows effect of improvement in statistics for $g_1(x)$ with $x < 0.1$ and HERA acceptance. Ghosh, SG, Indumathi, Phys.Rev.D62:094012,2000 [hep-ph/0001287]

Uncertainties in predictions

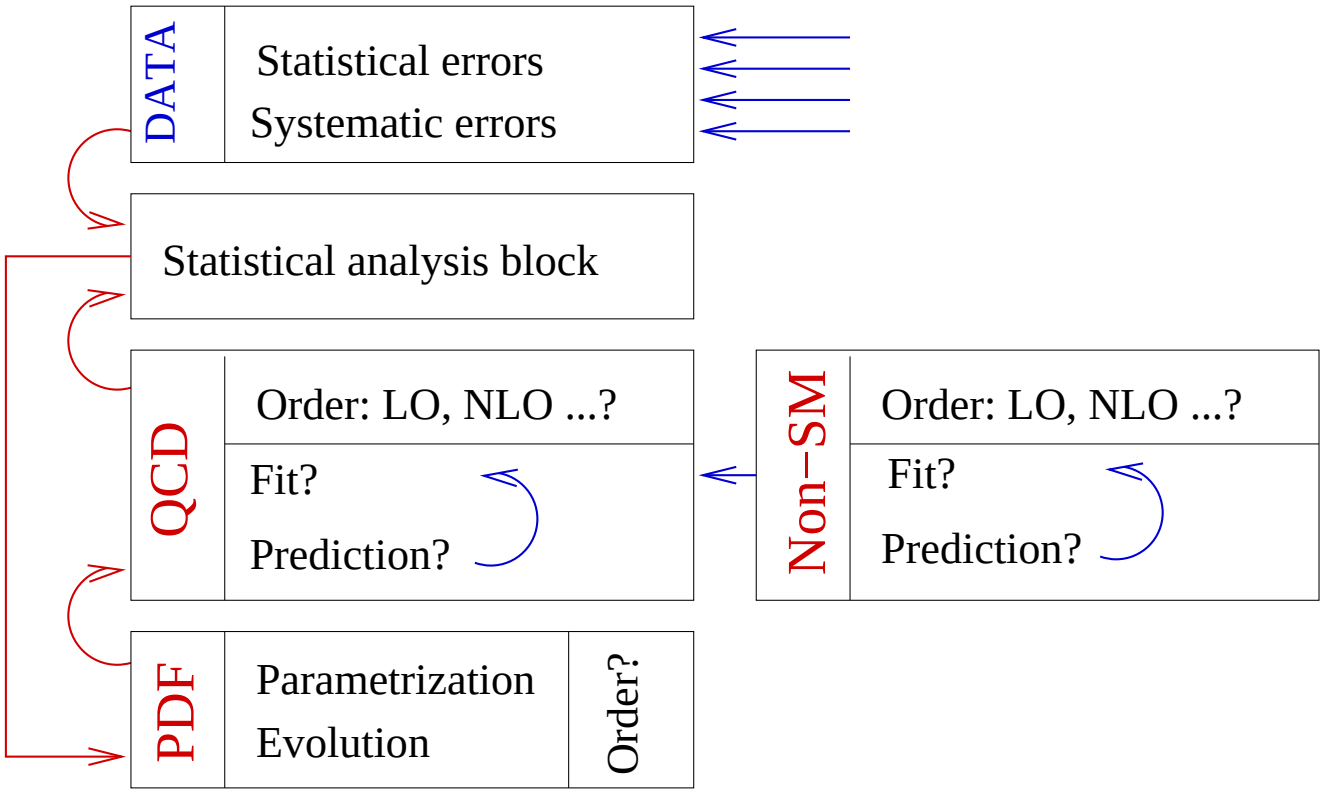




Uncertainties in pdfs translate to uncertainties in predictions. The uncertainty in SM Higgs production rate at the LHC is under control. The main uncertainty is from the pdfs. Belyaev, Pumplin, Tung, Yuan, JHEP 0601:069,2006 [hep-ph/0508222]

Outline

A scheme


DATA
Statistical errors
Systematic errors
Statistical analysis block
QCD
Order: LO, NLO ...?
Fit?
Prediction?
Non−SM
Order: LO, NLO ...?
Fit?
Prediction?
PDF
Parametrization
Evolution
Order?

Expected behaviour of blocks

DATA block comes with treatment of statistical and systematic errors. Need to define objects called experimental data sets with private methods for treatment of errors. Flexibility is required for adding (and removing) data sets.

QCD block contains SM processes which have as input pdfs and give as outputs cross sections. Each process can be overloaded by order: LO, NLO, and beyond. Also, each contains parameters which control the scale choice. Flexibility is provided by common interfaces which allows processes to be moved between fitted set and predicted set. Re-usability is the main requirement.

Non-SM block is conceptually the same as the QCD block.

STAT block contains methods for treatment of best-fit and errors. Many methods proposed in the last few years for statistical treatment. Urgent need to systematize interface. Re-usability is the main requirement.

PDF block contains standardized definitions of parton densities and their evolution. May be overloaded: x-space and Mellin-moment evolution.

Project definition

- The project is **not** a new pdf fitting scheme.
- It is an attempt to define interfaces to allow inter-operability of programs.
- The main attempt will be to provide standards for data exchange between hadron collider physics programs, probably instantiated as C++ wrappers.
- First (simplest) step of the project: survey available QCD cross sections in order to systematize the **QCD** and **PDF** blocks.
- People involved at present: A. K. Datta, R. Godbole, M. Guchait, SG, D. Indumathi, M. C. Kumar, G. Majumder, P. Mathews, V. Ravindran, A. Tripathy, N. Tripathy.
- Need maximum flexibility for wide acceptance of such a toolbase. A large user forum for discussion of standards would help.