

# Preparation for the tutorials

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## General remarks

We have to leave the villa at 1800 each day

The villa cannot be accessed during the weekend, though Milan is only a 40 minute train ride away!

# Schedule

## Week 1

### Lecture topics:

- Quantum Chromodynamics
- Machine Learning techniques

### Tutorial topics:

1. Code installation
2. (NLO) theory predictions
3. DGLAP evolution
4. ML 101: regression and classification
5. ML for HEP (jets and PDFs)

## Week 2

### Lecture topics:

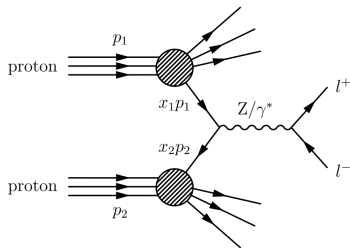
- Bayesian methods and data analysis
- Quantum Machine Learning

### Tutorial topics:

1. Bayesian statistics
2. Quantum Computing
3. Quantum Machine Learning
4. Monte Carlo sampling
5. No tutorial on Friday

## Factorization: a quick reminder

**High-energy scattering experiments** such as performed at the LHC involves processes with **hadrons in the initial state**

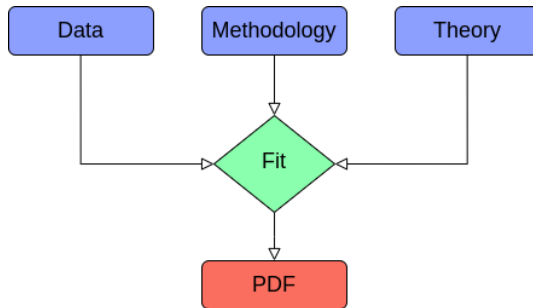


Total cross-section is **factorized** into a **hard part**,  $\hat{\sigma}$ , and process-independent **parton distribution functions (PDFs)**,  $f_{i/h}$ , providing the distribution of partons inside the hadron  $h$ :

$$\sigma = \sum_{i,j} \int_0^1 dx_1 dx_2 f_{i/h_1}(x_1, \mu_F^2) f_{j/h_2}(x_2, \mu_F^2) \hat{\sigma}_{ij \rightarrow X}(x_1 p_1, x_2 p_2, \mu_F^2)$$

**How are PDFs determined?**

## PDF determination



- **Theory:** partonic cross-sections and DGLAP (Tuesday and Wednesday)
- **Methodology:** regression and neural nets (Thursday and Friday)
- **Data:** From experiments

## Preparing your laptops

Requirements as stated in the e-mail:

- Ubuntu 20.04 or higher / macOS 11 or higher
- Working LHAPDF installation (hopefully)
- Python 3.8, 3.9, or 3.10

The goal for this afternoon is to set up the environments for the next two weeks

# Preparing your laptops

1. Clone/download the repository <https://github.com/NNPDF/como-2023>
2. Set up the environments
  - This can be done by initializing a virtual environment (in this case theory) using

```
$ python -m venv $REPO/envs/theory
```

then activating it:

```
$ source $REPO/envs/theory/bin/activate
```

and finally install the required packages:

```
$ pip install -r $REPO/envs/theory/requirements.txt
```

Alternative environment managers are also fine
  - If you used conda to install LHAPDF, you can use this environment as the machine learning (ml) environment:

```
$ conda install --file $REPO/envs/ml/requirements.txt
```
  - Make sure the LHAPDF installation can be found inside your environments paths
3. Test the environments by running example notebooks

```
$ jupyter lab [jupyter notebook]
```
4. To save time tomorrow we can compile eko ahead of time by running

```
$ python Como-2023/w1t3-rge-pdfs/compile.py
```

**If this is successful, we'll see you again tomorrow!**