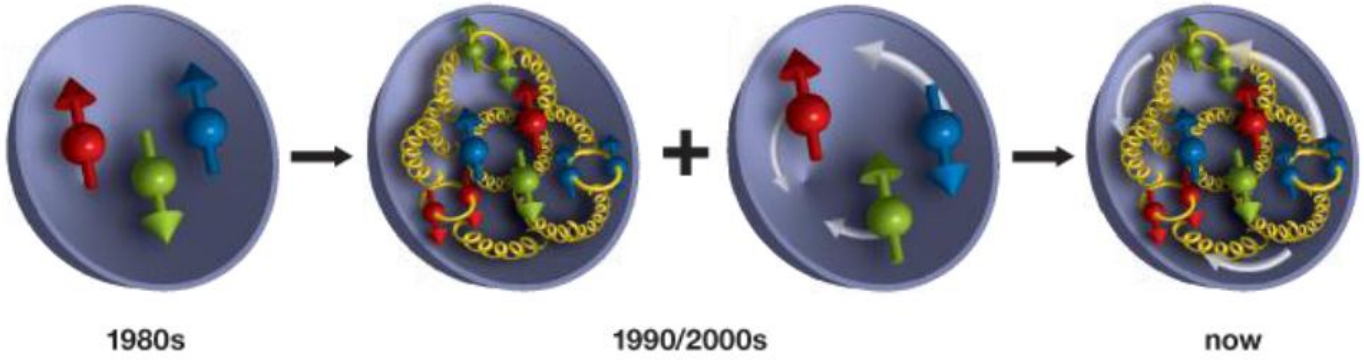
COMPASS – a facility to study QCD

C. Quintans, LIP-Lisbon

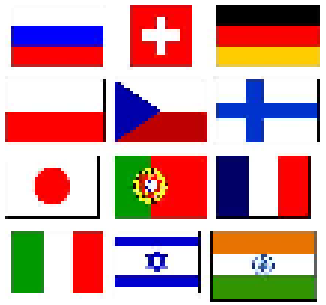
27^{th} February 2018, "Inside Views NFIST @ LIP"

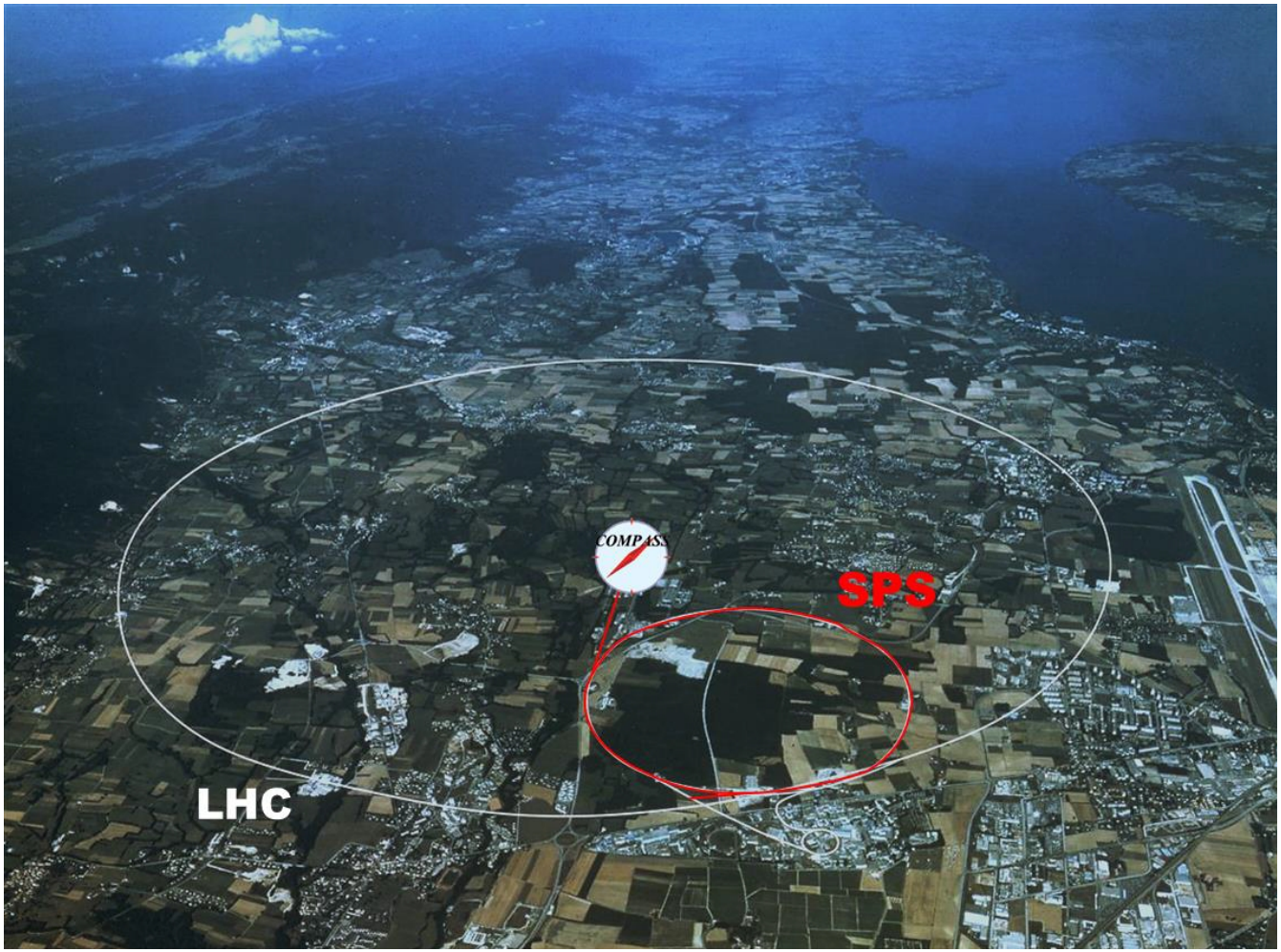


COMPASS @ CERN

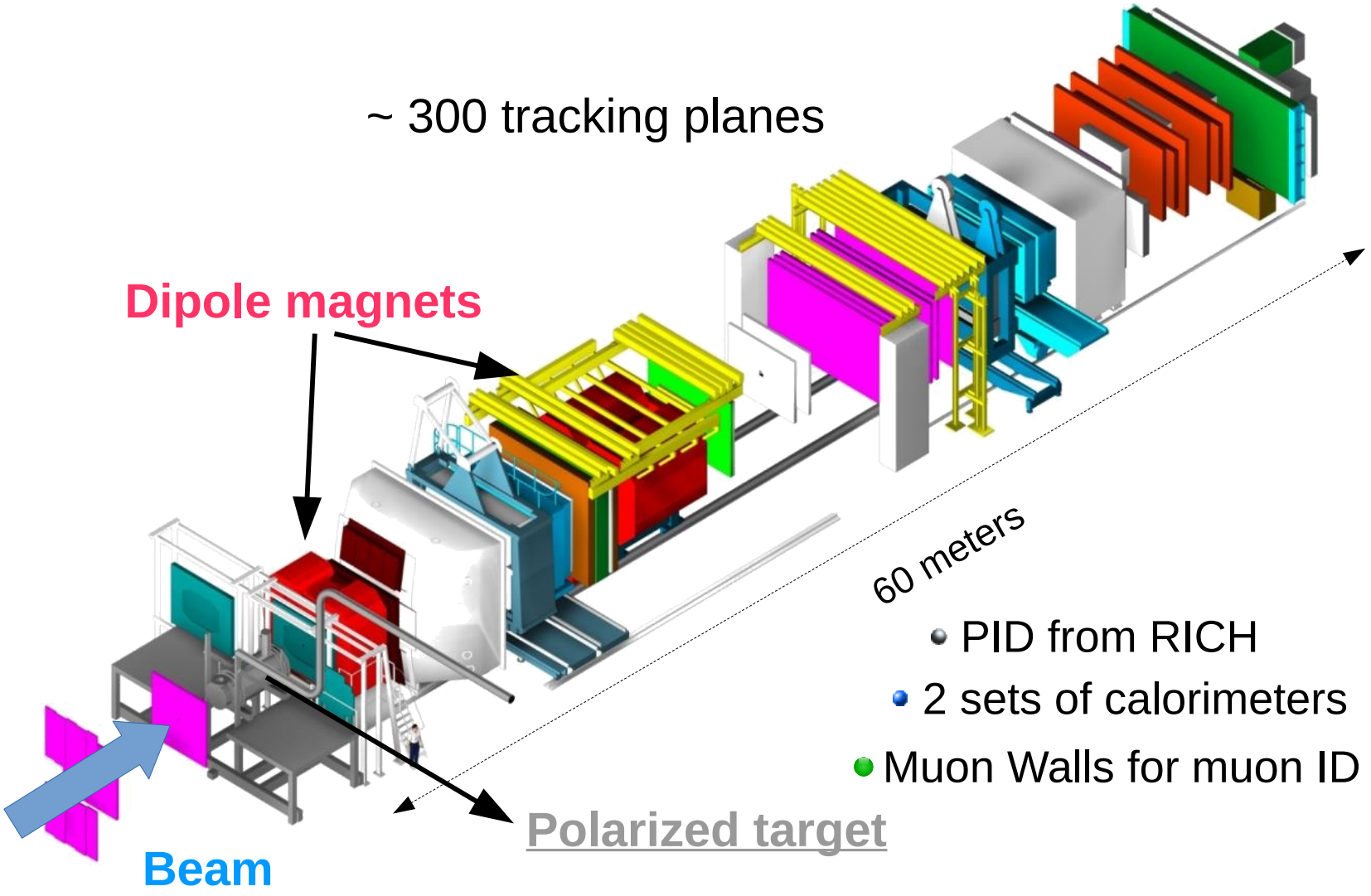
COmmon Muon and Proton Apparatus for Structure and Spectroscopy

230 physicists from 12 countries





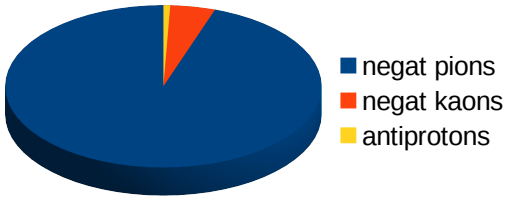
A fixed target experiment



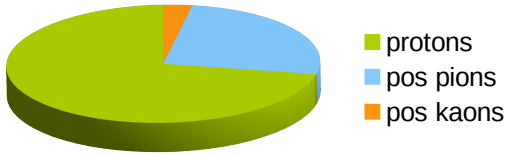
Diversity of beams available

- Positive hadron beams
- Negative hadron beams
- Positive or negative muon beams
- Beam momenta from 80 to 280 GeV

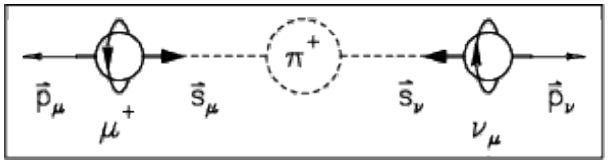
190 GeV Negative hadron beam



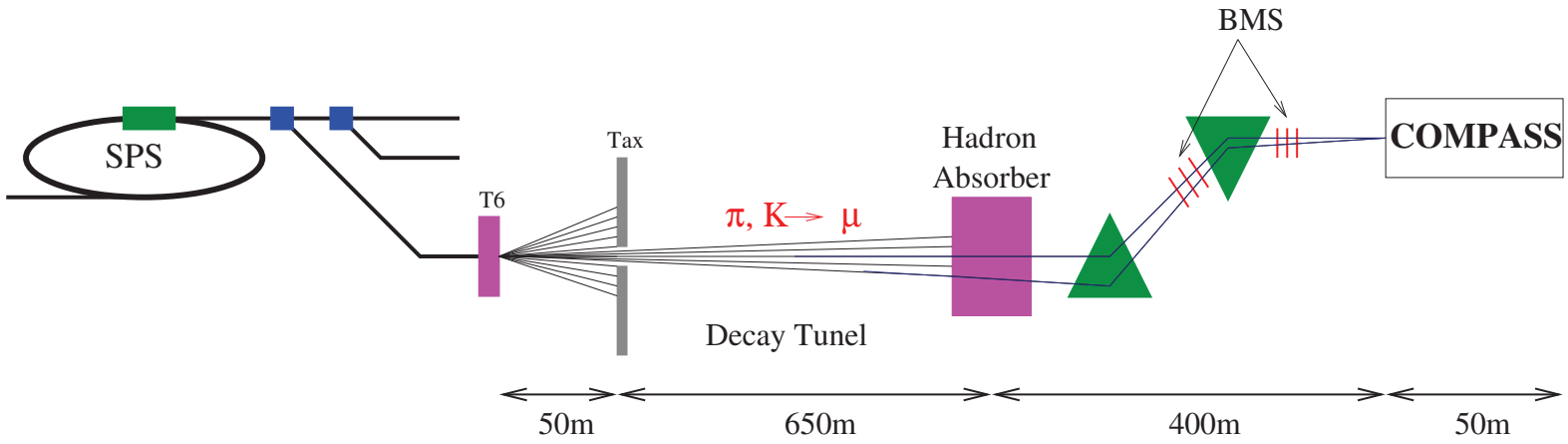
190 GeV Positive hadron beam



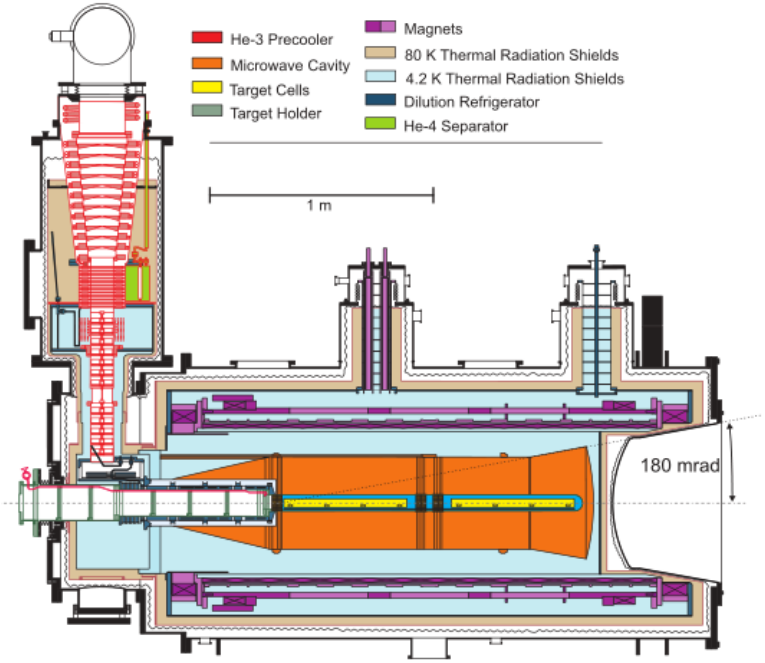
160/200 GeV muon beams



Muons from pion decays are **naturally polarised**

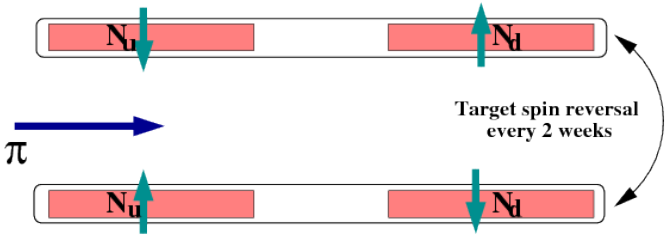


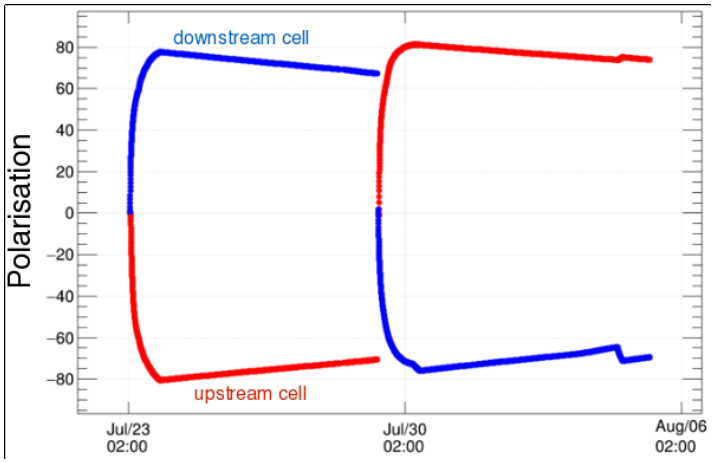
Polarized targets



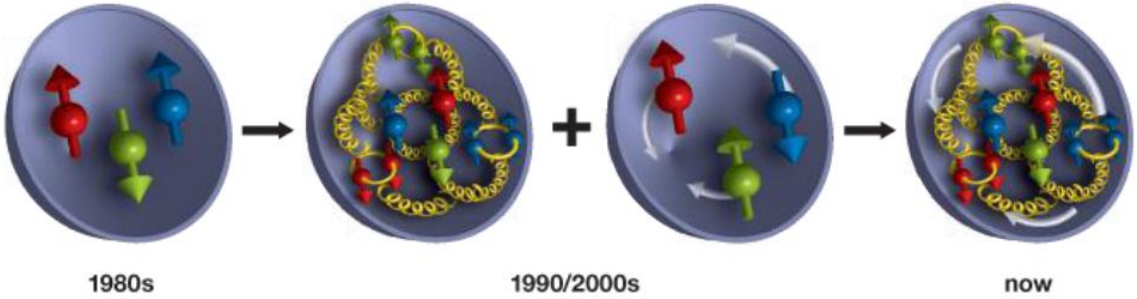
Beam →

- NH_3: polarised protons; ^6LiD: polarised deuterons
- Spin flips forced by applied microwave
- 2.5 T superconducting solenoid field to align
- 60 mK temperature to freze spin state



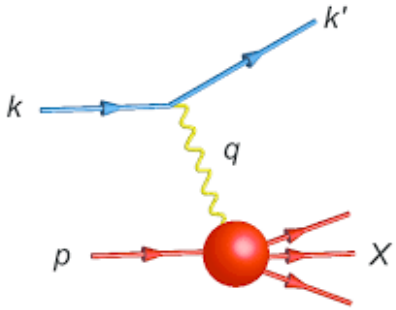


COMPASS: Unveiling QCD misteries

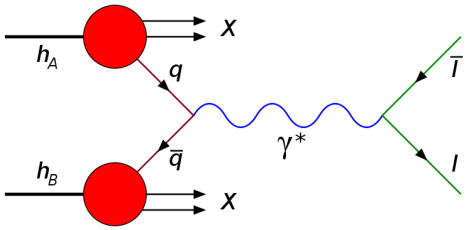


- The nucleon has a structure – quarks, gluons and their dynamics
- The nucleon has spin 1/2: how its contituents contribute to it?
- The nucleon mass is 1000 times larger than the pion mass. Why?

Some favorites for probing the nucleon:

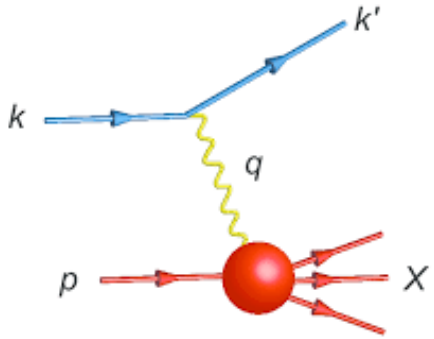


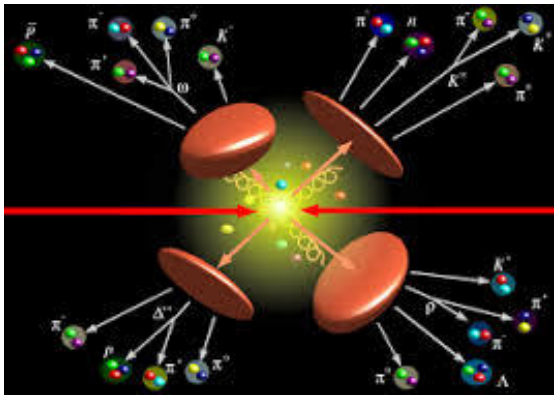
Deep Inelastic Scattering



Drell-Yan

Quarks fragmenting into hadrons





Fragmentation Function: probability that a **quark** i fragments into a **hadron** h carrying a fraction z of the parent's momentum.

In COMPASS we compare the amounts of charged kaons and pions produced, to access these fragmentation functions.

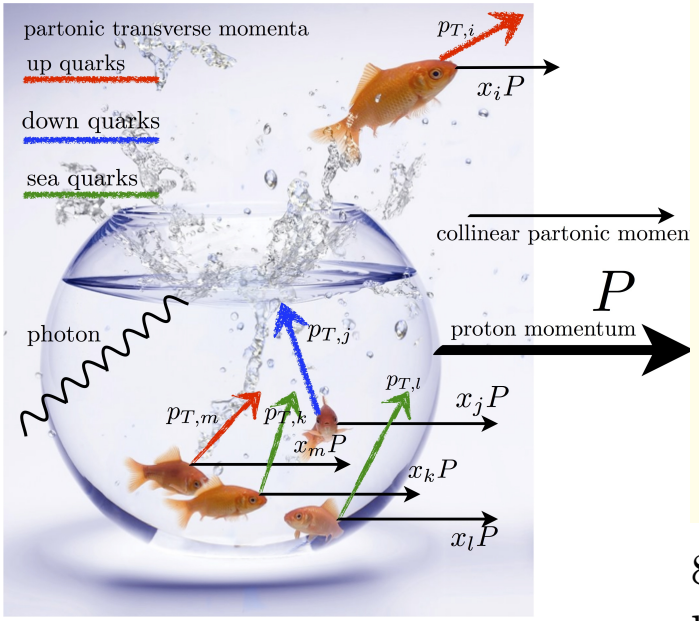
COMPASS data taken in 2016 and 2017 with $\mu^{\pm}$ beams on a liquid hydrogen target to be analysed.

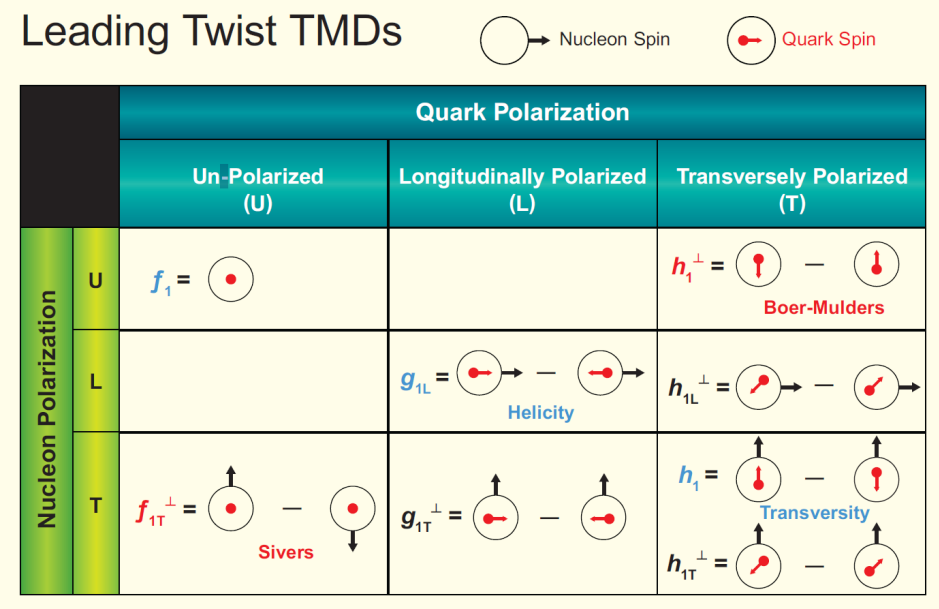
$\hookrightarrow$ Come and join this effort!

Spin and transverse momentum of quarks in the proton

Parton distribution functions give the probability to find a **quark** i inside a **nucleon** N carrying a fraction x of its parent's momentum.

But quarks and gluons might not be collinear with the proton: a **transverse momentum** k_T

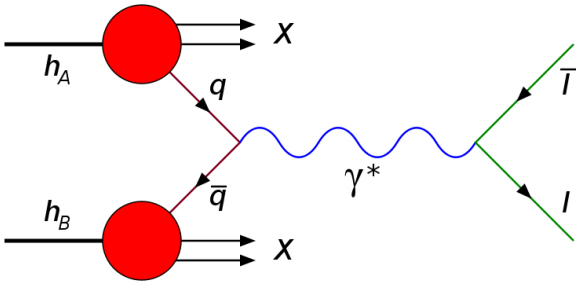


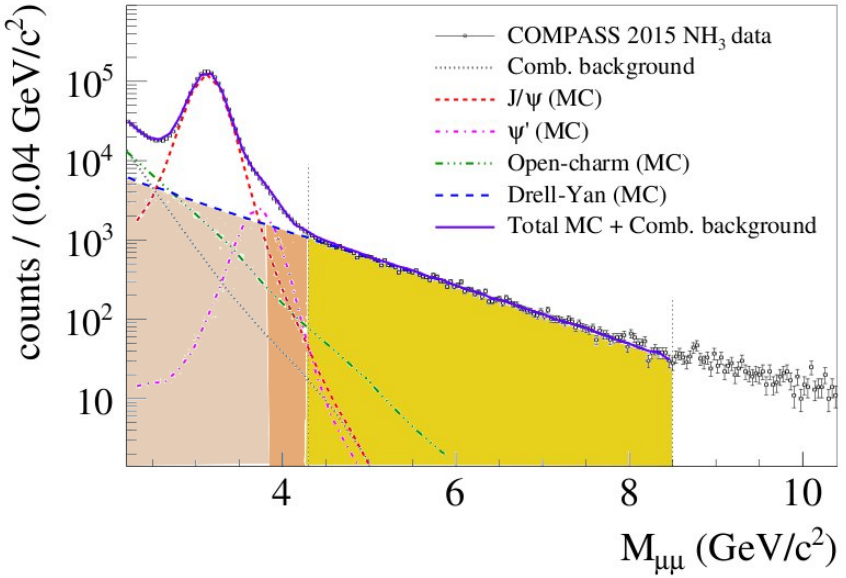


8 quark TMD PDFs of the proton: correlations between spin of the nucleon, spin of the quarks, and transverse momentum.

TMDs: the dynamics inside the proton

Drell-Yan: $q\bar{q} \rightarrow \gamma^* \rightarrow \mu^+\mu^-$





- From **April to November**: COMPASS polarized Drell-Yan measurements
- Access 4 TMD PDFs – and from this, test the TMD approach of QCD
- Learn also how quarks distributions inside the pion behave differently from those inside the proton

↪ Lots of new data, come join this effort!