Opportunities in COMPASS

Marcin Stolarski
LIP Lisboa
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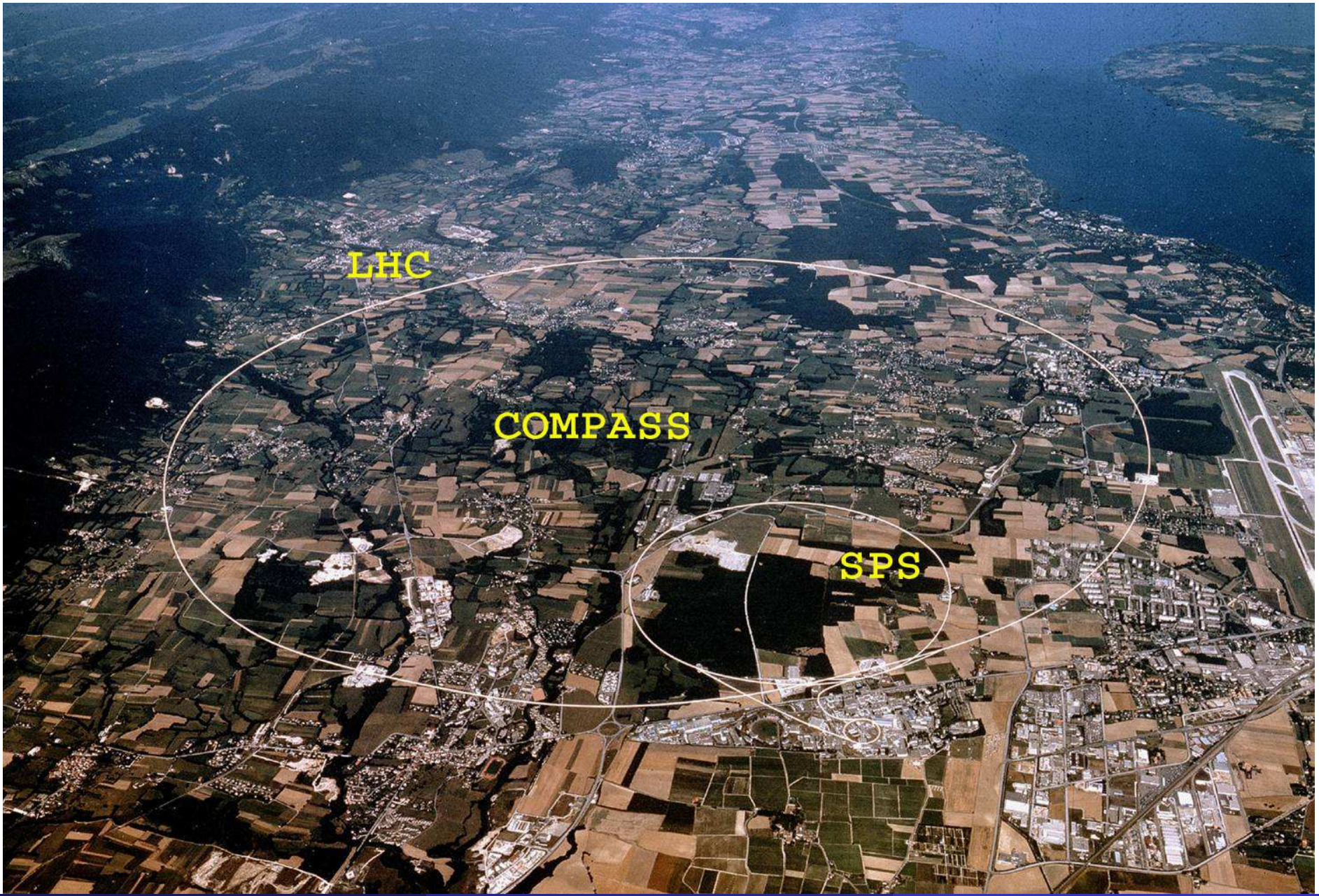
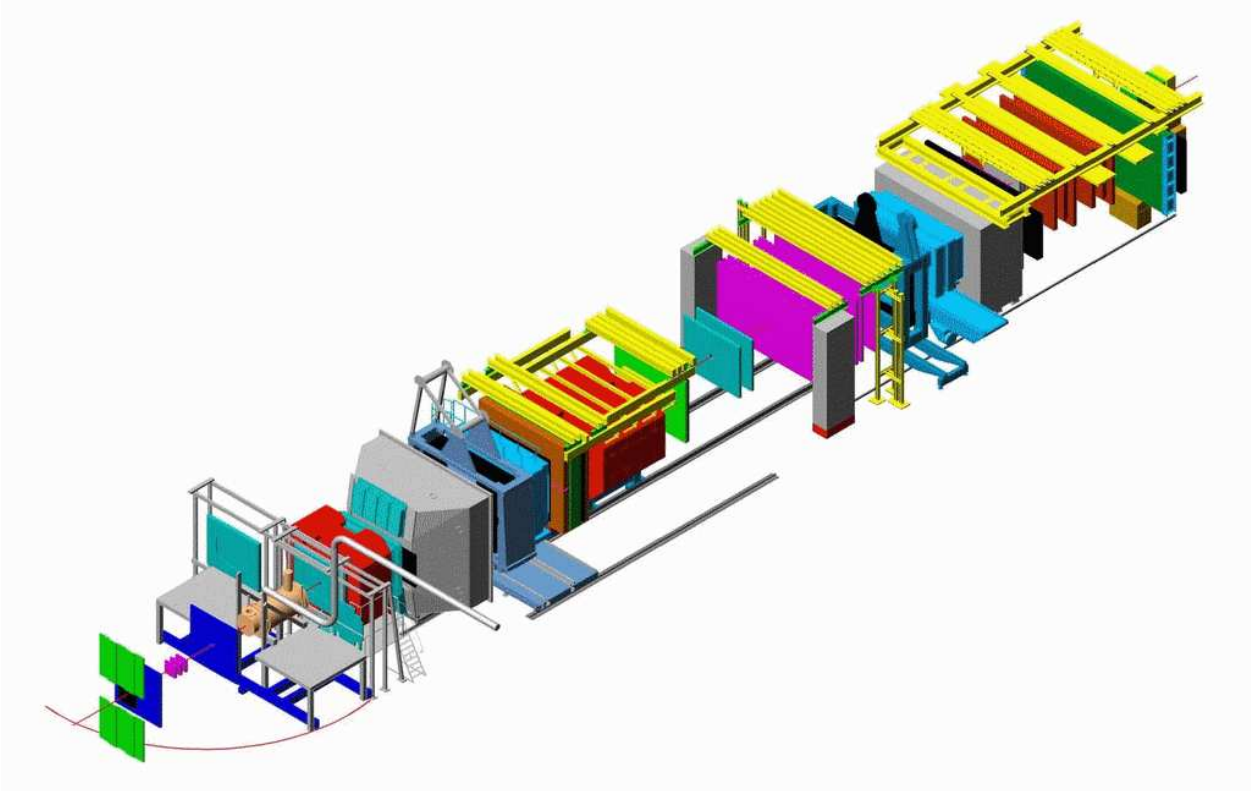
COMPASS LIP group

- The Group
  - P. Bordalo, C. Quintans, S. Ramos (researchers)
  - C. Franco, M. Quaresma, L. Silva, M. Stolarski (post-docs)
  - A.S. Nunes, (PhD student)
  - Ch. Pires (engineer)
- Responsibilities:
  - Various data analysis tasks
  - Detector Control System of the COMPASS experiment
- contact: mstolars@cern.ch

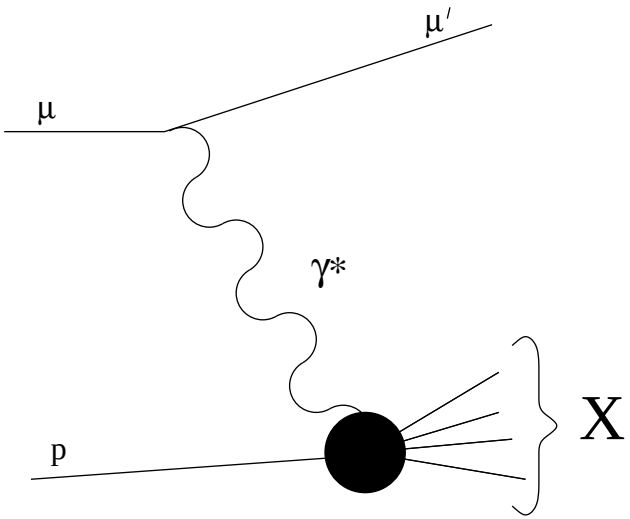
COMPASS CERN



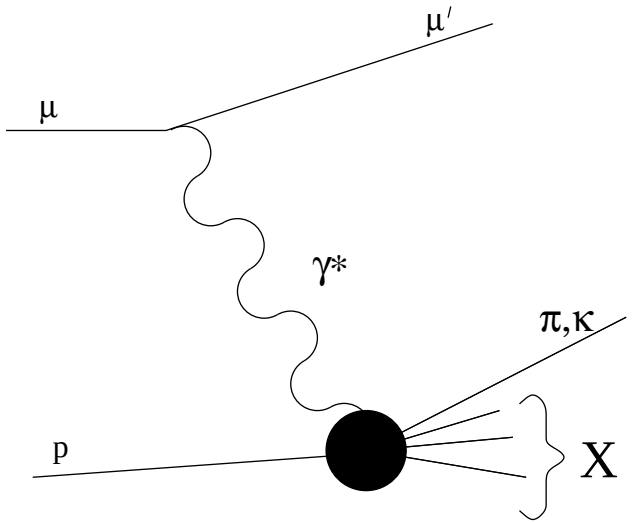


- COLLABORATION
  - about 210 physicists
  - 13 Countries
- DETECTOR
  - 60 m length
  - 2 (3) magnets
  - about 350 detector planes
- BEAM
  - μ beams 80-200 GeV
  - π, p, K beams
- TARGET
  - polarised LiD, NH_3
  - unpolarised LH, Tungsten, Pb, Ni, Cu...

Studied Processes

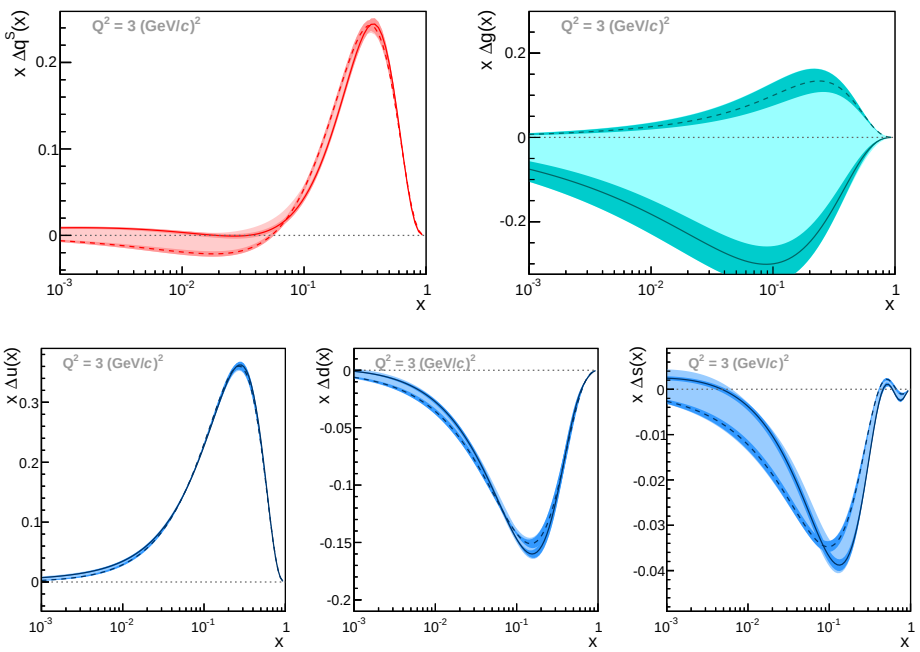


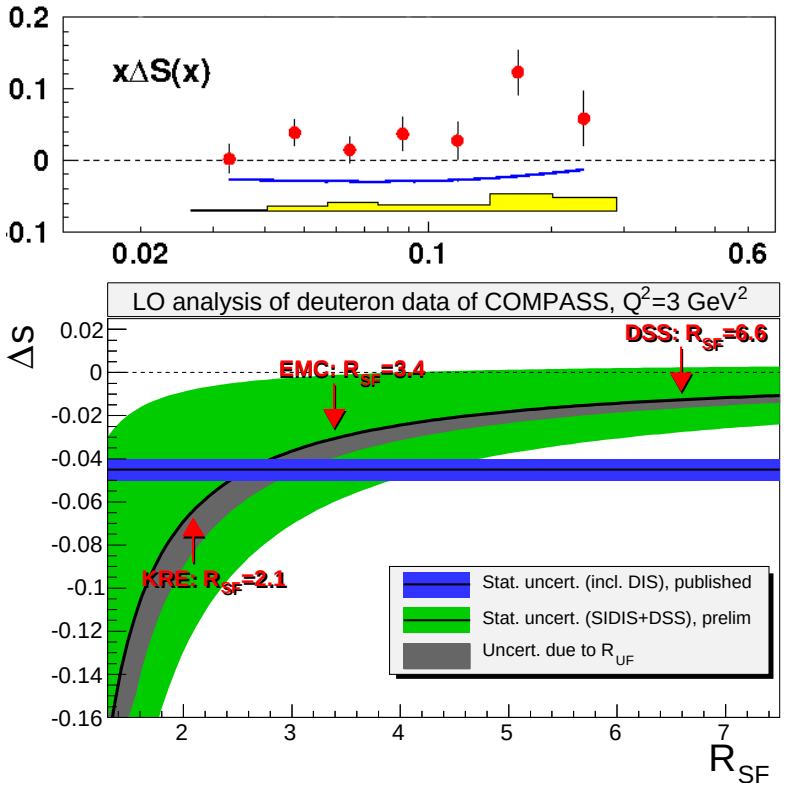
- **D**eep **I**nelastic **S**cattering- (**DIS**)
- incoming and outgoing muon four-momenta are measured
- the target mass is known
- the final state X is not looked at
- the cleanest measurement



- **S**emi-**I**nclusive **D**eep **I**nelastic **S**cattering (**SIDIS**)
- the difference w.r.t. DIS: the final state is look at
- additional complication arise: what is probability that a quark of type q fragments into a hadron type h?
- a new non perturbative object needed - Fragmentation Functions

Strange Quark Polarisation Puzzle





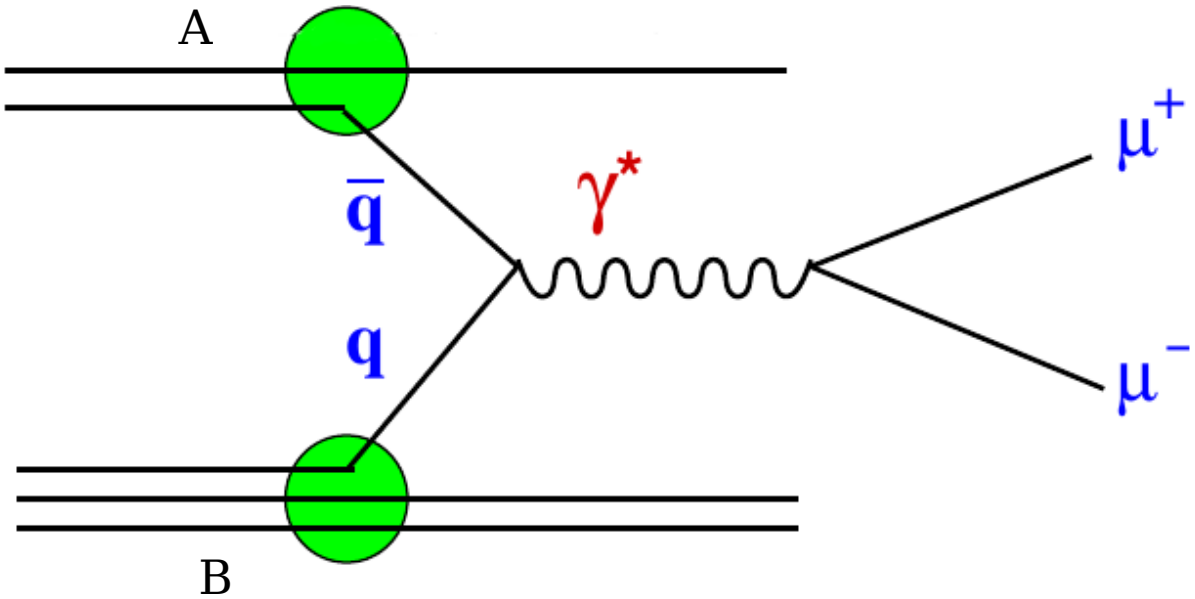
TWO method of extraction of ΔS give inconsistent results!

K^+/K^- Multiplicity Ratio

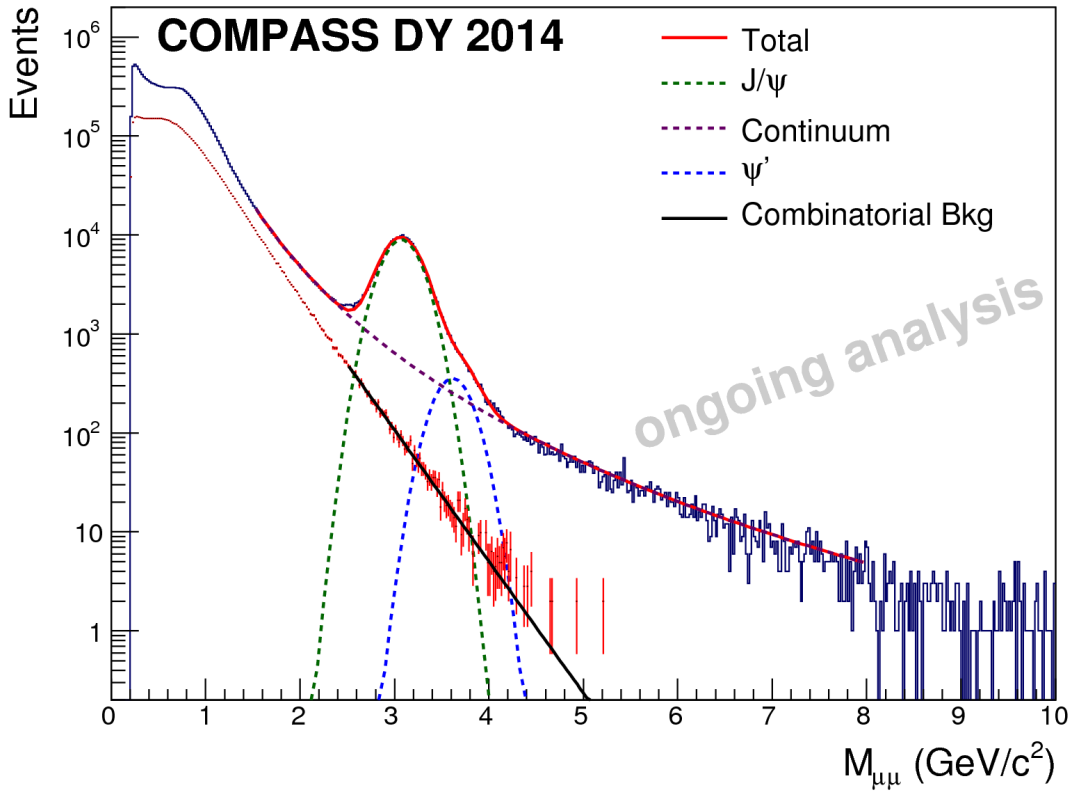
- To try to solve the puzzle we need to know kaon fragmentation functions i.e. probability that given quark fragments into kaon.
- Fragmentation functions can be extracted from measurements of kaon multiplicities, i.e. number of kaons per DIS event
- In case of troubles one tries to simplifies things e.g. a lot of systematic and theoretical uncertainties cancel in the ratio
- under quite reasonable assumptions one can conclude that QCD predicts that:
- $$\frac{M^{K^+}}{M^{K^-}} < \frac{u}{\bar{u}} \ ,$$
  where u, $\bar{u}$ are probabilities to find u and $\bar{u}$ in the nucleon.
- Does this inequality is fulfilled in nature?

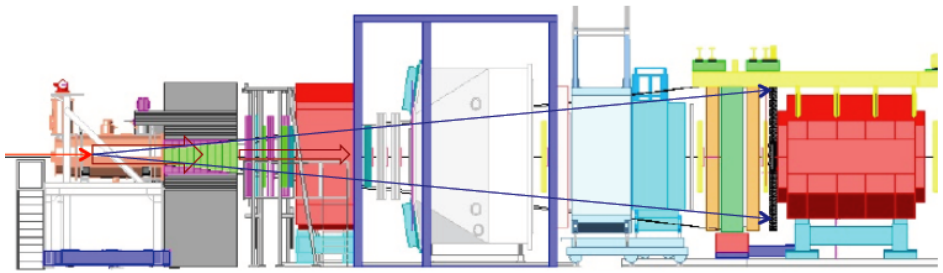
Drell-Yan Process

- Quark-anitquark annihilation with production of leptons in the final state
- COMPASS took data in 2014, 2015
- Dedicated run is foreseen for 2018



Drell-Yan Process



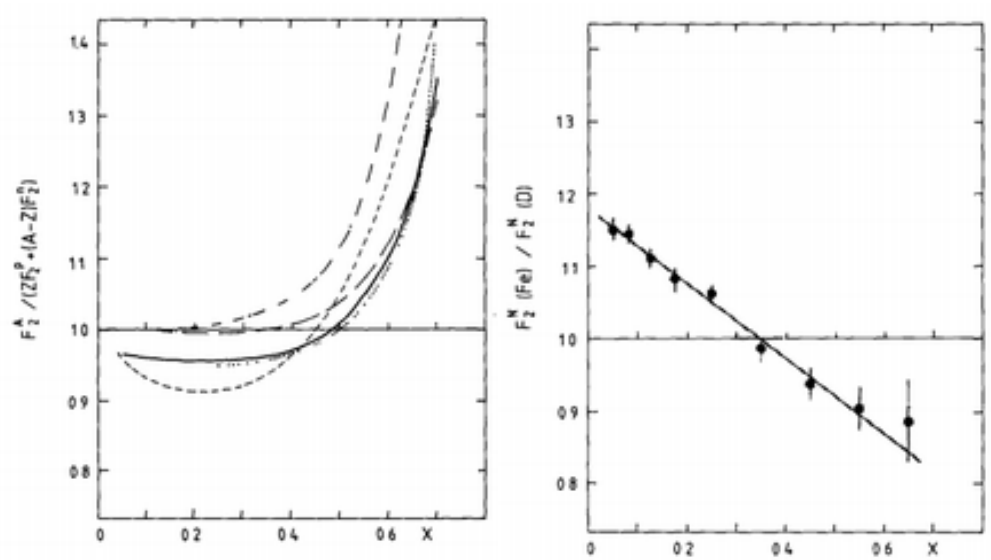


J/Ψ production

- J/Ψ was discovered in 1974 in e^+e^- annihilation
- It discovery confirmed existence of quarks (Nobel price in 1976)
- J/Ψ is also produced in hh collisions via. $q\bar{q} \to J/\Psi$, $gg \to J/\Psi$ and $qg \to J/\Psi$
- But the production mechanism is still not known!

EMC Effect, Phys. Lett. B. 123B (1983) 275

- Confined quark in the nucleon + uncertainty principle = quark Fermi motion in the nucleon
- Does Fermi motion of quarks in free nucleon is different than in nuclei???
- Indeed some differences were expected, but experimental results contradicted all predictions
- 34 years later the matter is still under discussion...
- COMPASS DY data can add additional information



Thank you!