AMBER experiment at CERN

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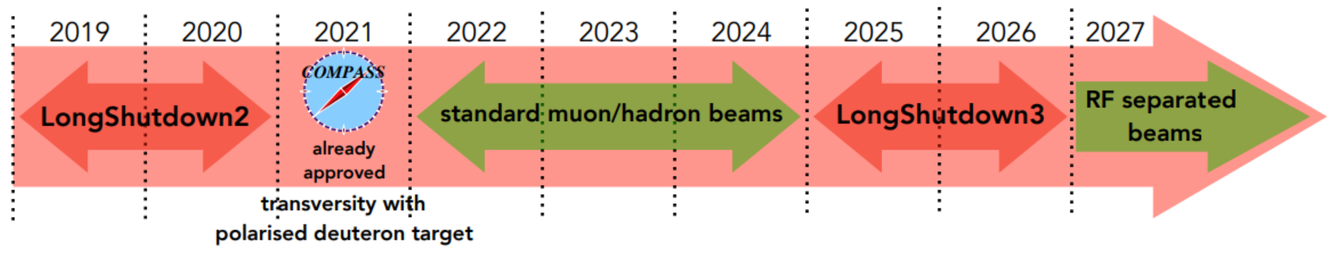
1. Introduction

The COMPASS++/AMBER (proto-) collaboration proposes to establish a "New QCD facility at the M2 beam line of the CERN SPS". The first-phase proposal (**CERN-SPSC-2019-022**) addresses three main subjects:

- proton charge radius measurement from muon-proton elastic scattering;
- structure of the pion: sea-valence separation;
- antiproton production cross sections as input for Dark Matter Searches.

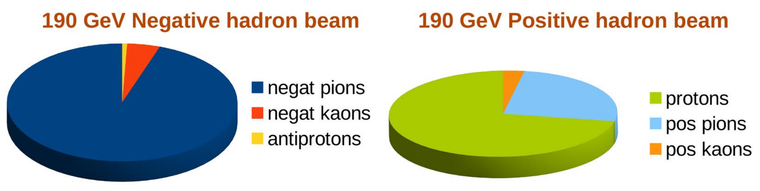


2. Muon and hadron beams

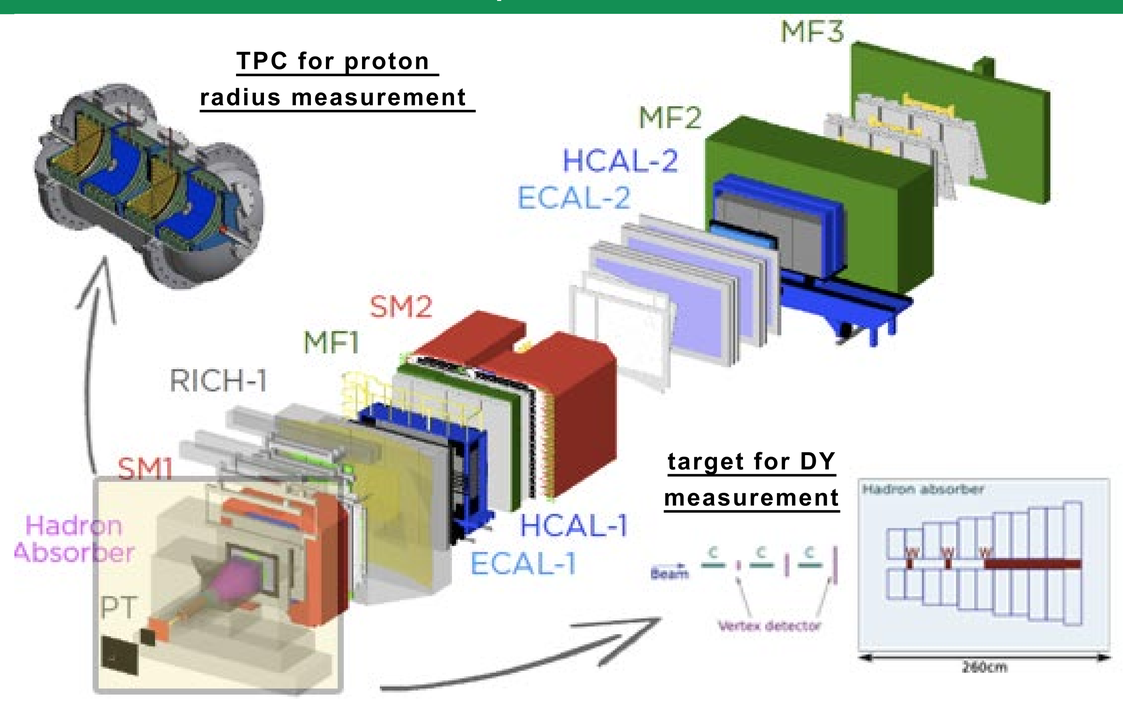
The M2 beam line can operate with muon or hadron beams:

- muon beam: study the average charged proton radius
- hadron beam: study the structure of pions

For the hadron beam, we have different compositions depending on its charge:

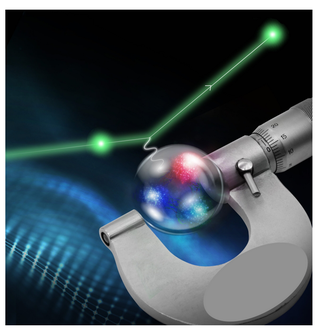


3. Spectrometer

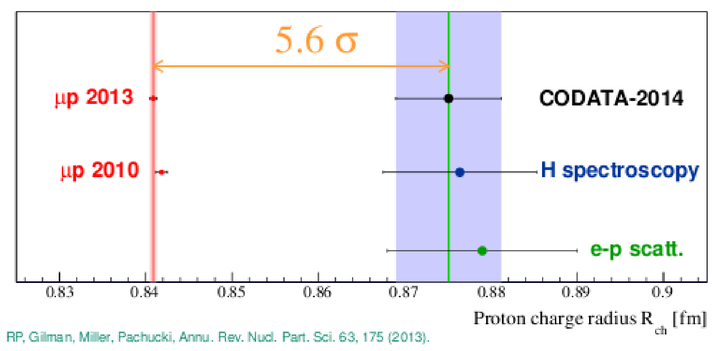


4. Proton charge radius

A muon-proton scattering experiment allows to study the proton radius charge.

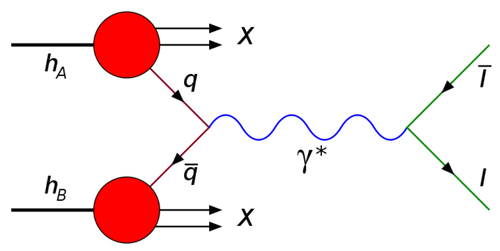


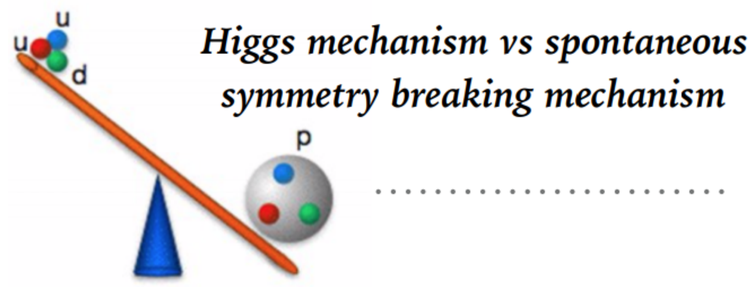
There is a big discrepancy between the values obtained for proton charge radius, by different experiments.

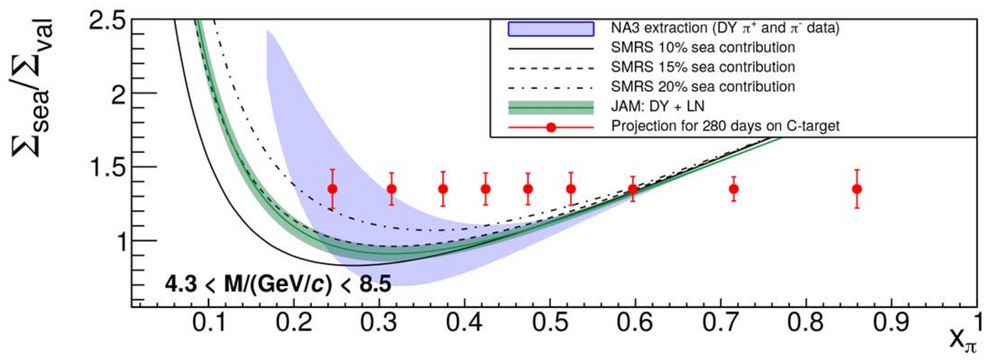


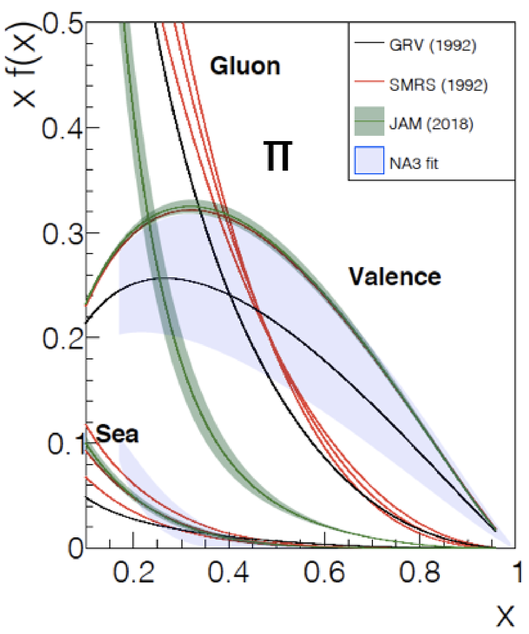
5. Pion structure

- Hadron beams allow to study the Drell-Yan process.
- The PDF's are essential to study the pion structure and to help to understand the origin of the hadronic mass.







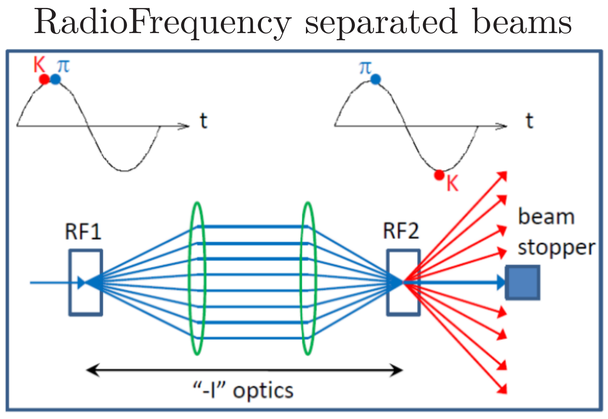


6.Physics with kaons

In the second phase of the experiment it is intended to study the interactions with a kaon beam. This will allow to study several topics, such as:

- kaon structure from Drell-Yan and direct photon production;
- kaon polarisabilities from Primakoff reactions;
- kaon spectroscopy: a dozen predicted states from kaon sector still to be observed.

RadioFrequency separated beams



All details on the AMBER project can be found at https://nqf-m2.web.cern.ch