

# AMBER experiment at CERN

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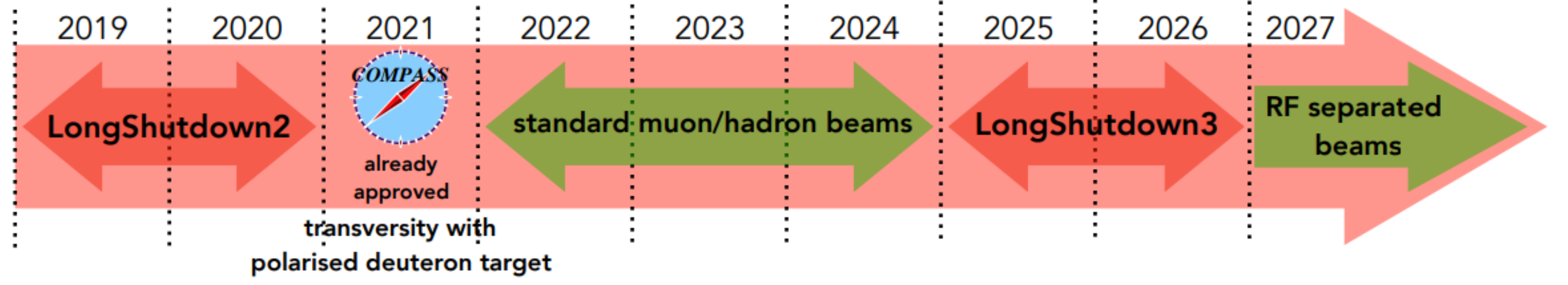
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## 1. Introduction

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.

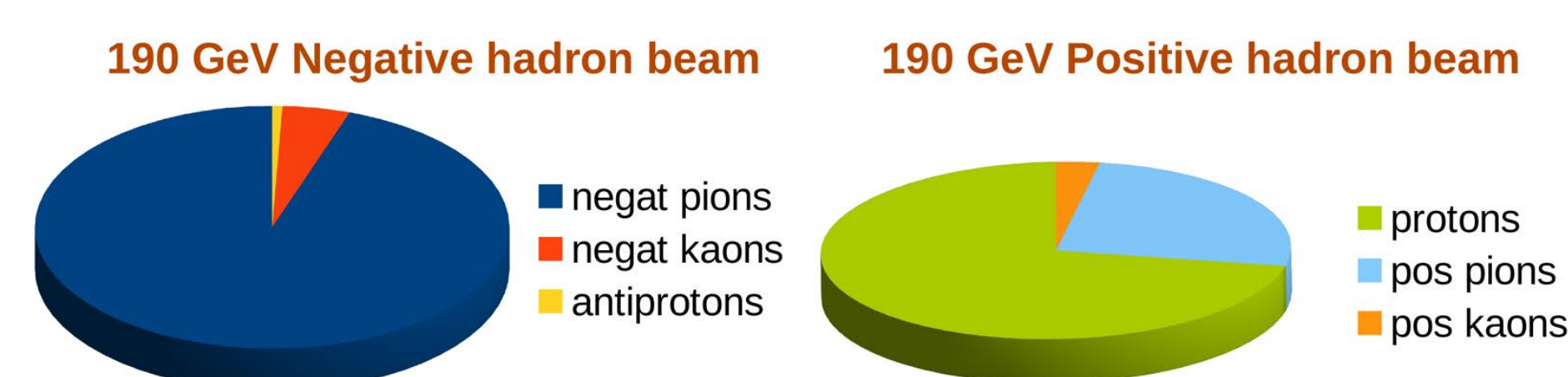


## 2. Muon and hadron beams

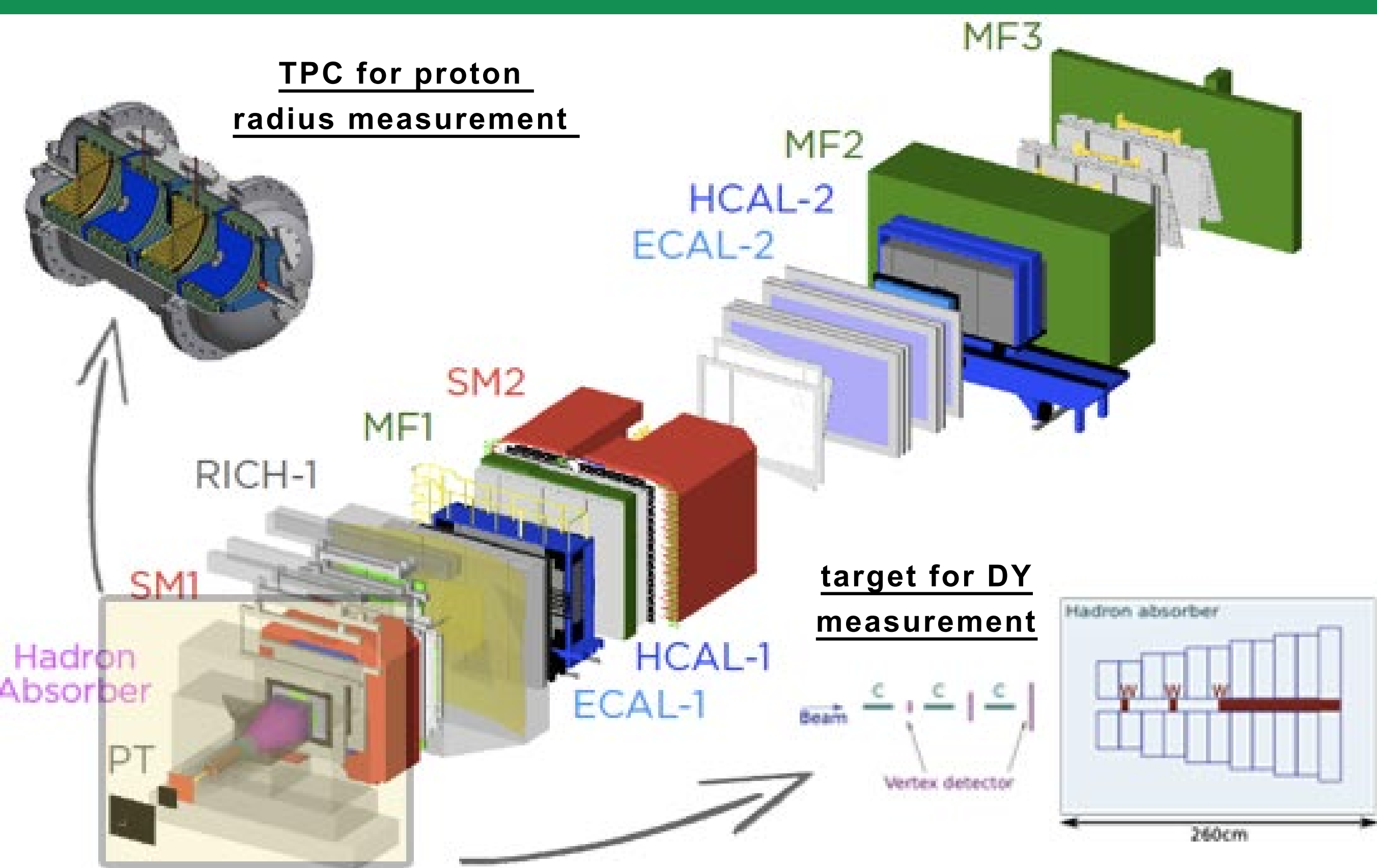
The M2 beam line can operate with muon or hadron beams:

- 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:

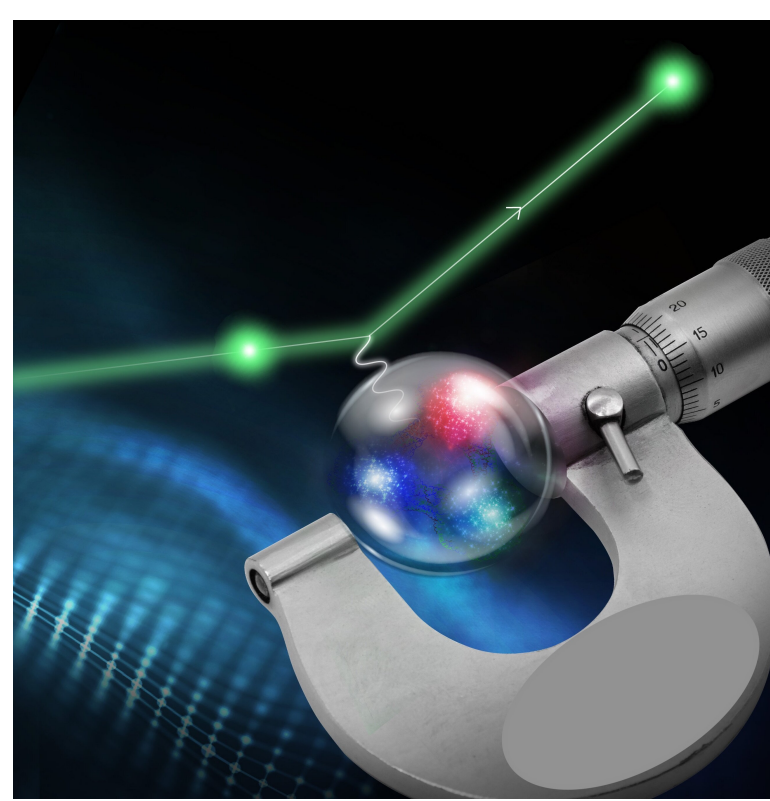


## 3. Spectrometer

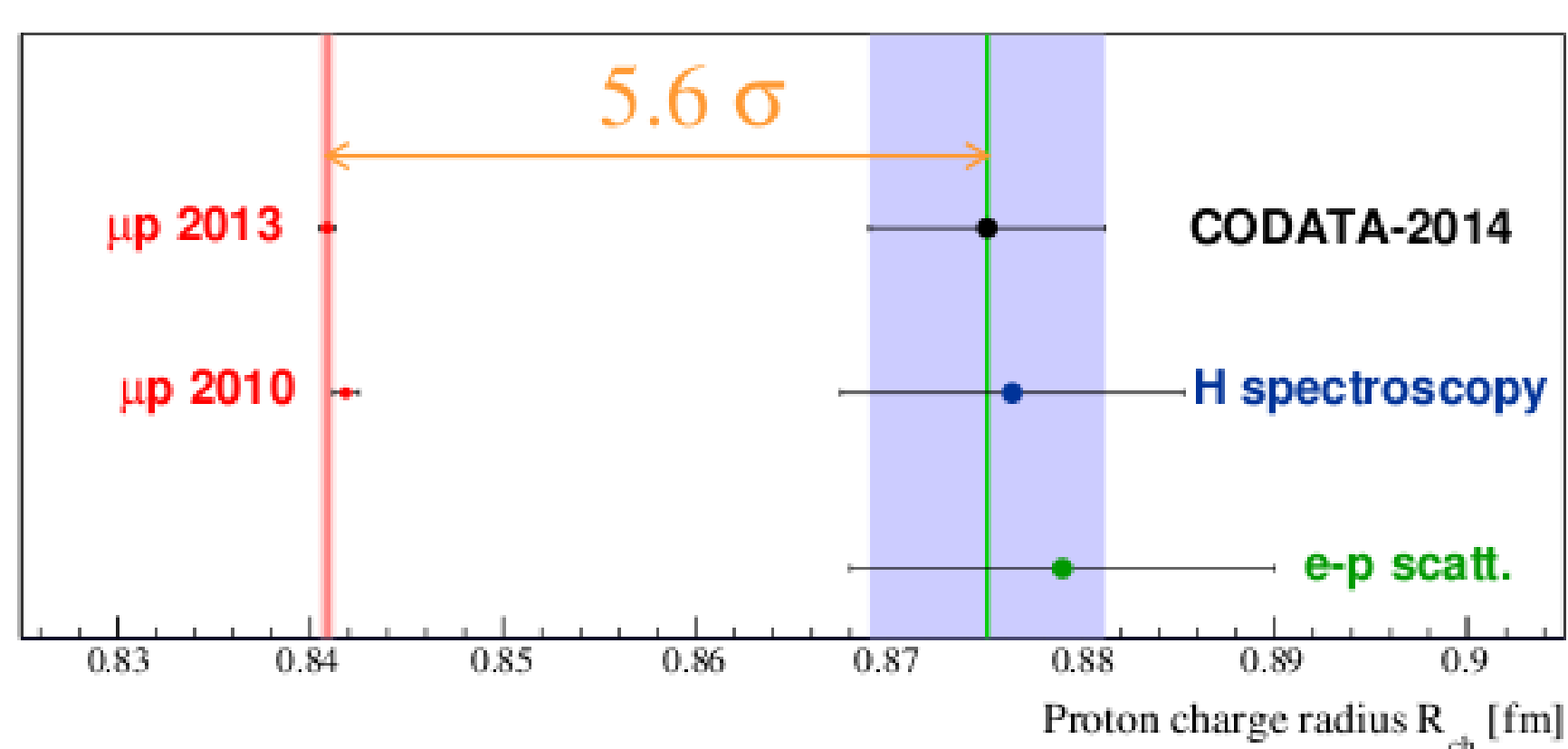


## 4. Proton charge radius

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



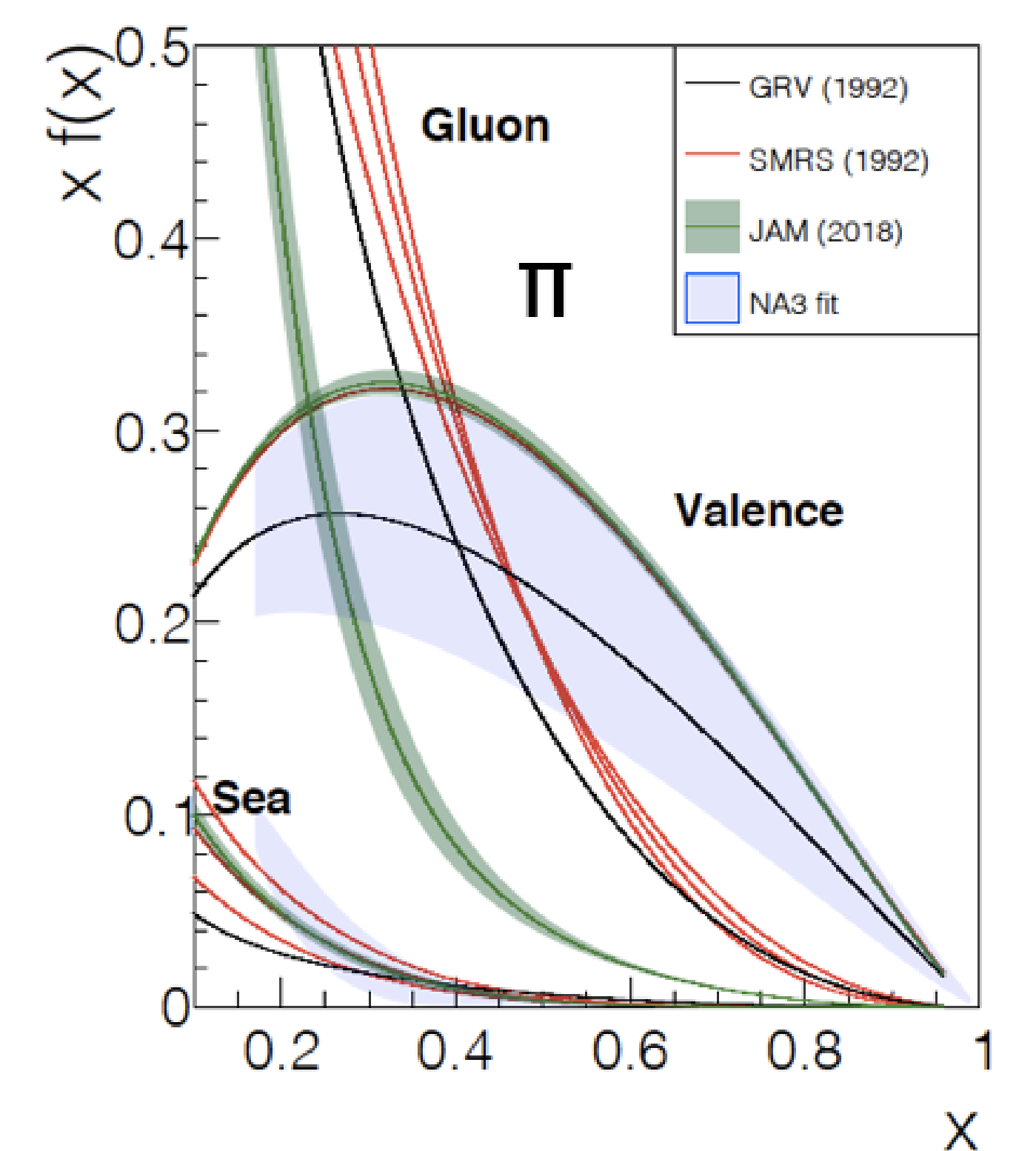
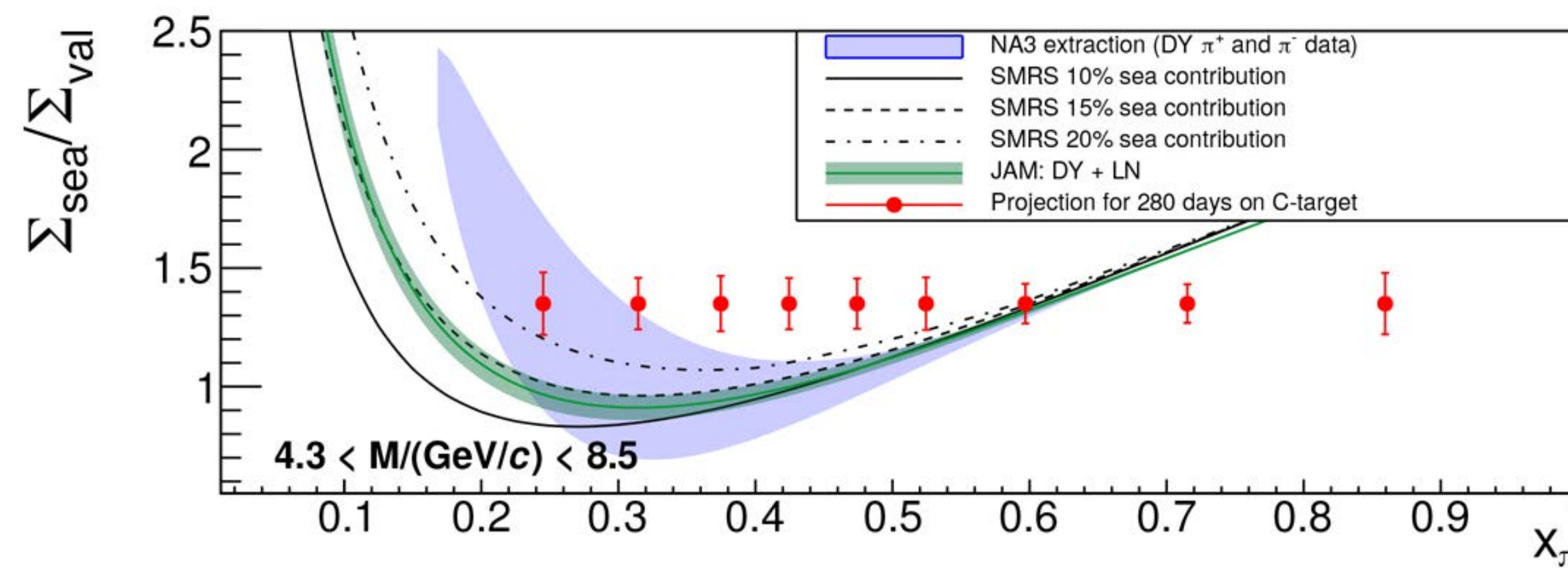
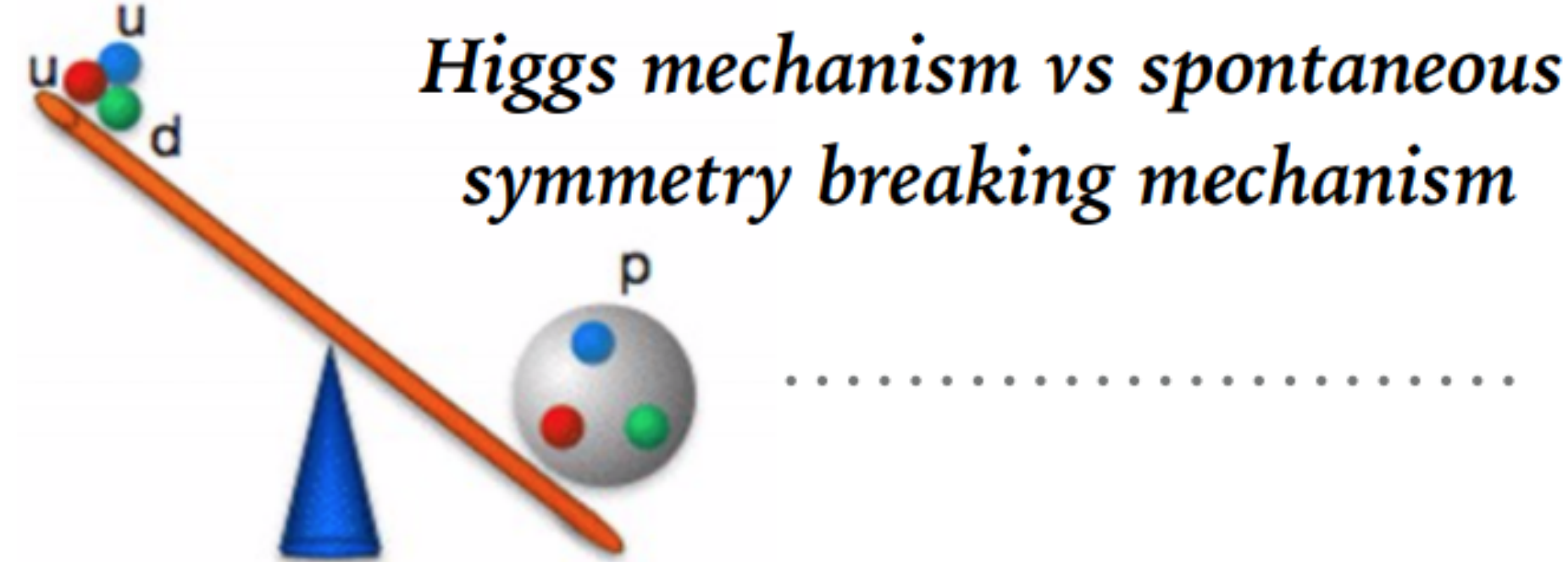
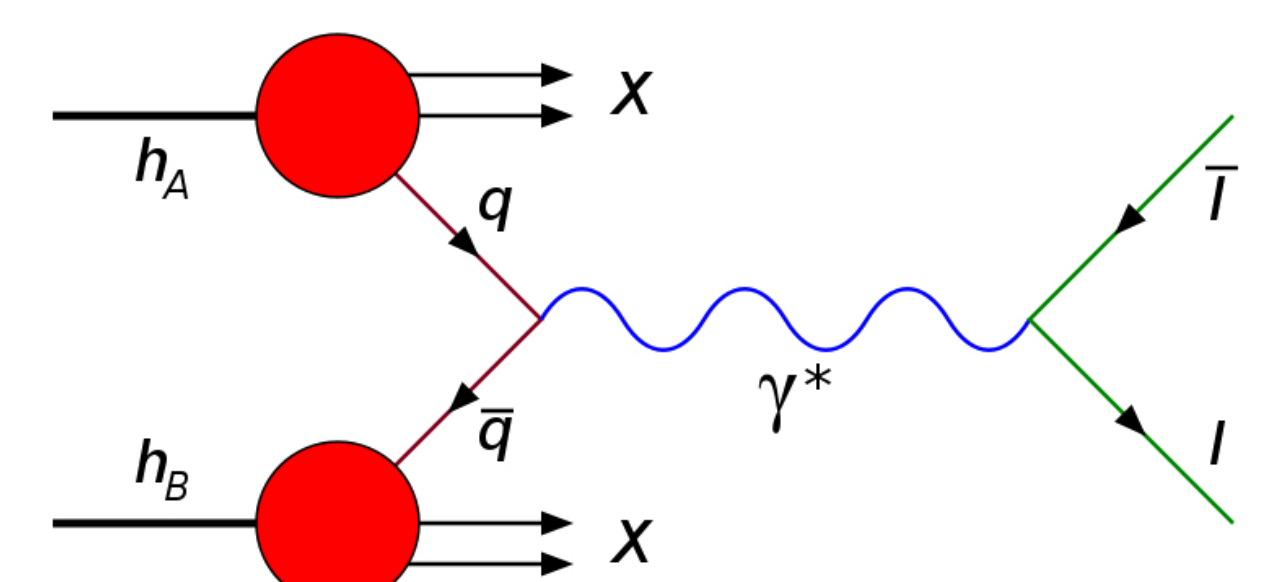
There is a big discrepancy between the values obtained for proton charge radius, by different experiments.



RP, Gilman, Miller, Pachucki, Annu. Rev. Nucl. Part. Sci. 63, 175 (2013).

## 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.

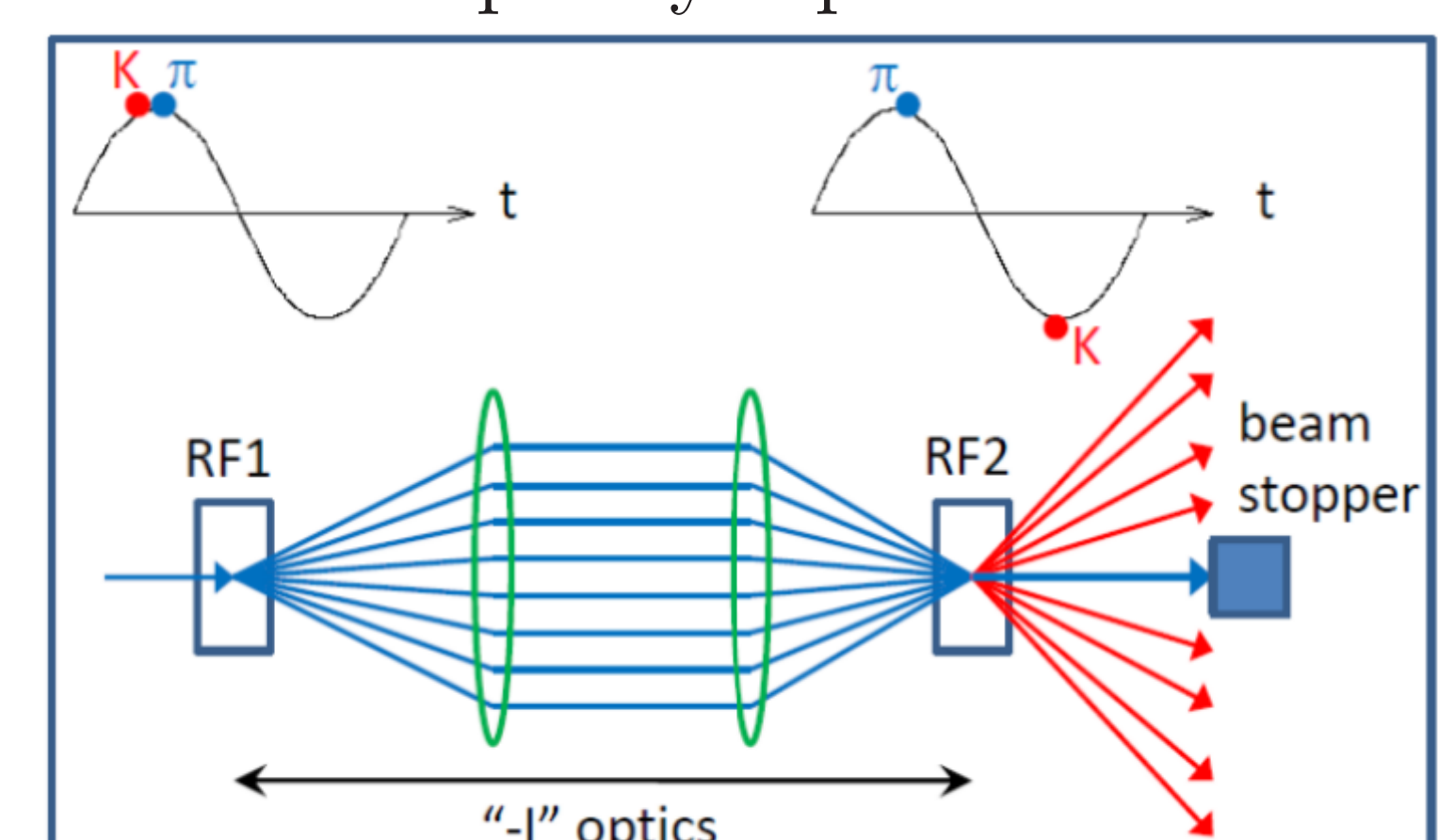


## 6. Physics with kaons

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>