The MUonE Project

Plans of the test activities 2022

23 February 2023

Communication to the SPSC

We sent a memorandum to the SPSC to summarize the status of MUonE as today:
(cite)

The revised time profile of the project would therefore depend on the following factors.

- The availability of 2S modules to MUonE during 2023. We received a few days ago updated information from CMS and it seems reasonable to count on two stations, one for the incoming muon direction (≥ 4 modules), and the other fully equipped (6 modules). Therefore, we expect to return to the SPSC with final information in spring 2023, when CMS will confirm this situation, allowing us to establish which milestones we can achieve and with how much beam time.

At the moment we envisage a test programme based on having only two stations available in 2023 and results of the test run in 2022 (whose results MUonE will communicate to the SPSC referees soon). The data taken in 2022 is providing a lot of interesting information and identifies some aspects to be investigated more deeply.

i) One concerns the large amount of data to be acquired, and how much should be stored and processed, in view of the potentially very large storage and CPU requirements. This requires a detailed study of a real time trigger, implemented in FPGA firmware, to keep only essential events, signal and background channels such as pair production and bremsstrahlung events.

Communication to the SPSC

From the memorandum to the SPSC:
(cite)

Real-time data selection algorithms will become necessary as the experiment scales. While the data collected in 2022 has been sufficient to start online track reconstruction and filtering development efforts, these efforts will greatly benefit from a more realistic multi-station detector configuration.

ii) The need to keep systematics very low implies that the main backgrounds must be measured using the data itself. The simulation has made good progress, therefore MUonE will soon be able to quantify how much data will be necessary for an adequate statistical study of background channels.

iii) The selection efficiency of the elastic scattering must be carefully studied. The incoming muon direction is a crucial element in order to construct the variables necessary to separate signal from background.

- If the hardware for three stations does become available and more requested time will be allocated, the possibility to measure, even with an uncertainty of few percent, the leptonic corrections to the running of α, will demonstrate the capability of the detector concept to make the complete physics measurement of the hadronic corrections to α (the main goal of MUonE and more than a factor of 10 smaller than the leptonic corrections in the MUonE kinematical range).

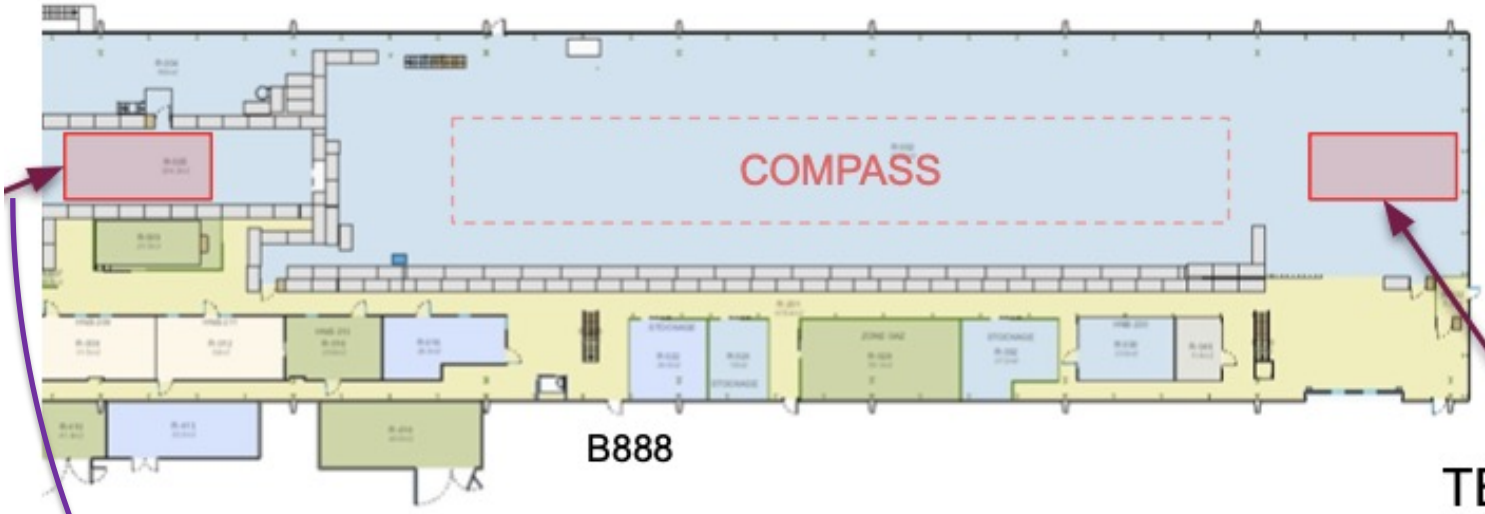
Comments

Due to the (yet unknown) tracking modules delivery, we prefer to have the beamtime as late as possible ➡ September 2023

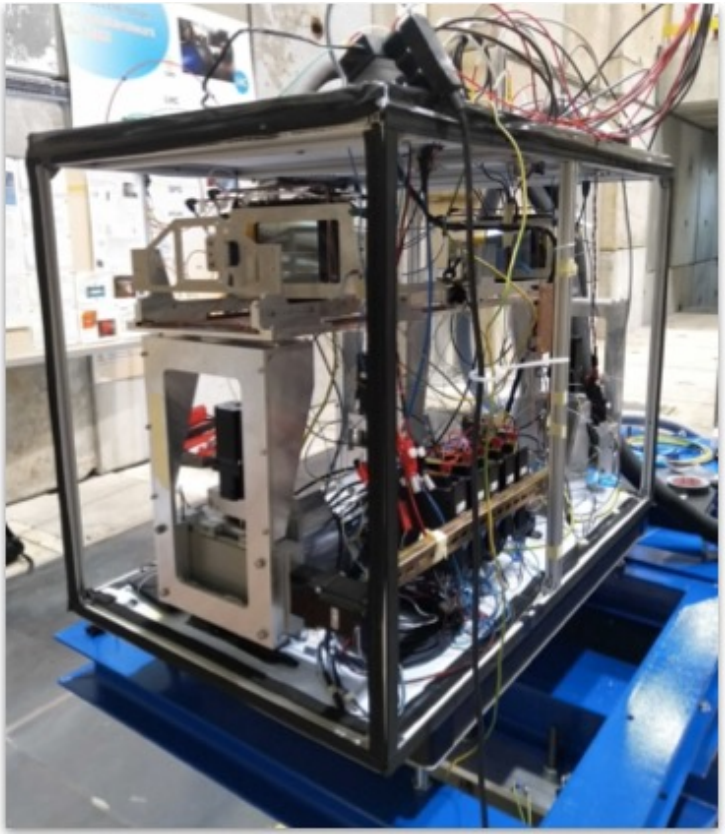
It is implicit that, as soon as we will have a confirmation by CMS that if we can have in hands the modules for 2 stations before, we will consider to run end of august-beginning of September.

➡ **A request:**

Is it envisageable and feasible that we run parasitically and intermittently (as last year we did with COMPASS) with one tracking station ??
This would allow MUonE to do the commissioning, optimizing the operation conditions of the modules. If this is possible, could we discuss the detailed conditions ?



TB 2022
(2 stations, 1 for Interferometry tests)



Preliminary request for 2023

Motivations to request 23 days of M2 beam (6-28 September 2023):

MUonE foresees, after having commissioned the hardware with muons (about 2-3 days) and aligned the silicon sensors (1 day), to run with muons to collect data to perform the milestones declared to SPSC and , if enough beam time will be allocated to collect enough data, a very first physics measurement will be made: the aim will be to measure the leptonic corrections to the running of alpha. If the data collection with muons will have been satisfactory, we plan to test in the last days (1 day for mounting the piece of hardware and half day of data taking), with pions, a system of two thin targets to calibrate precisely the distance in z of the tracking planes of a station. The extremely precise knowledge of the distance in z is related to the systematic of MUonE, and is therefore crucial for performing the final experiment. This system has been designed and is being built by the accelerator division. This test, which has by the time being, a less priority than running with muons, is devoted to preliminary checks that the method planned can be valid. The data to perform this calibration will be requested and taken at a later time, and not before 2024 and on another beam line than M2.

Thank you for the attention