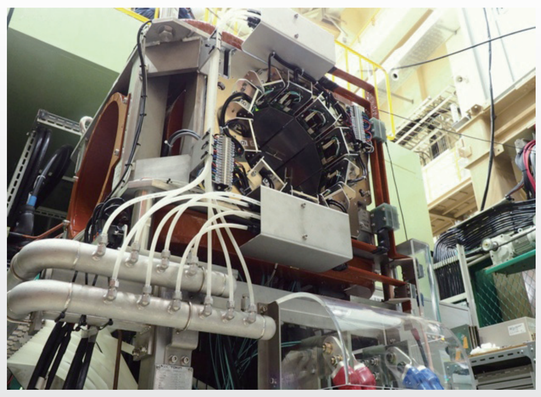
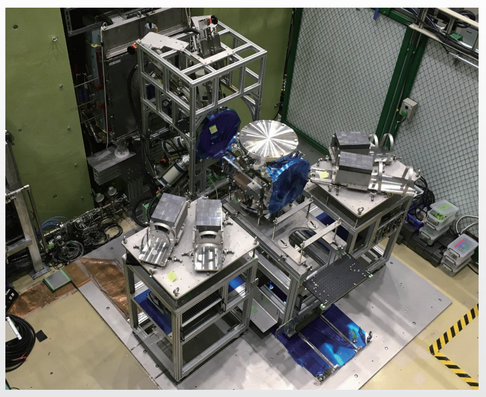
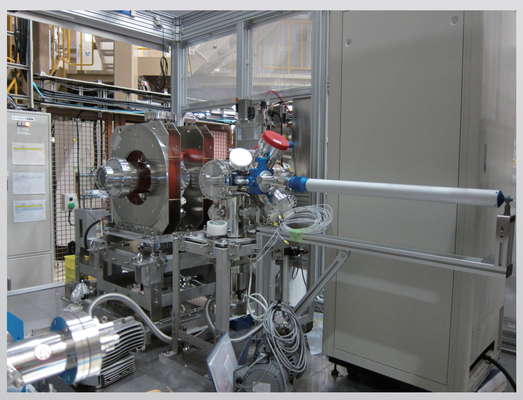
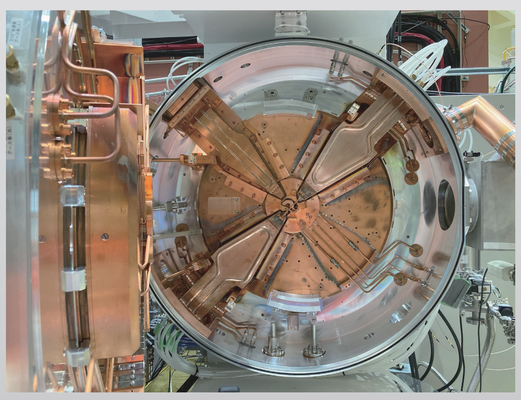
J-PARC MLF
Muon Science Establishment

D line has two experimental areas, D1 and D2. It provides 28 MeV/c positive muon beam (surface muon) as well as momentum tunable 5-100MeV/c positive and negative muon beam (decay muon). A positive muon plays the role of a sensitive magnetic probe and is applied in material science. A positive muon is also used as a probe to simulate isolated hydrogen like that in semiconductors. Injecting a negative muon in a material, a muonic atom is formed. A characteristic X-ray from a muonic atom has high energy, 200 times higher than a normal atom, and can penetrate a thick material. Using this feature, a negative muon is adopted for non-destructive elemental analysis. The new detector, Kalliope, is installed to utilize the world's highest-intensity muon beam effectively.


μSR spectrometer in D1

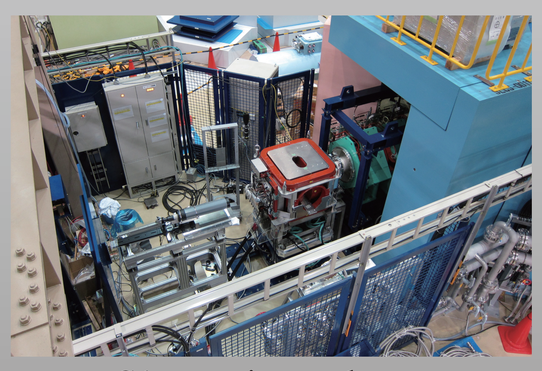

Elemental analysis chamber

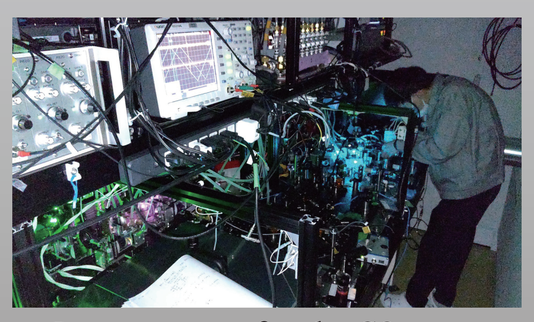

Spectrometer of U1A

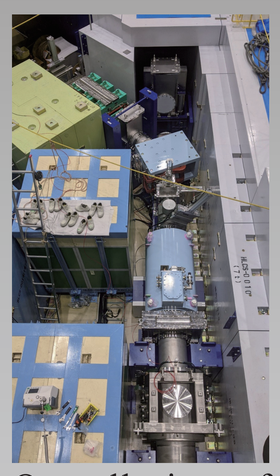

Cyclotron for muon acceleration

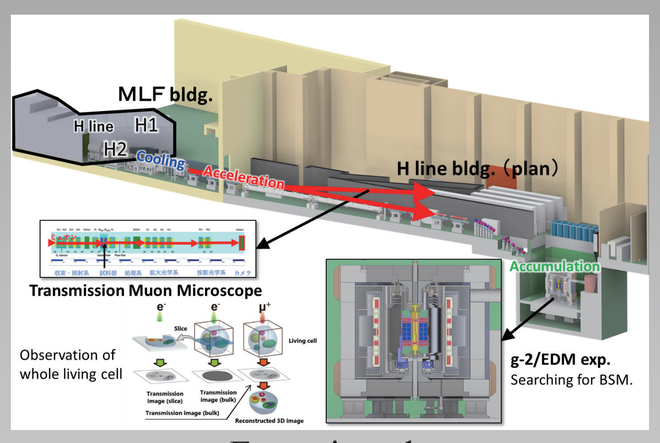
U line is a surface muon source dedicated to producing Ultra Slow Muon (USM). USM beam has characteristic features, such as low and tunable kinetic energy, small beam size, and short time distribution, compared to a conventional muon beam. Therefore, the muon spin relaxation/rotation/resonance (μSR) technique using a USM beam at the U1A area, enables us to investigate the magnetic and electronic properties of the surface, interface, and small-size sample. Furthermore, we plan to reaccelerate USM to 5 MeV by a cyclotron at the U1B area to realize Muon Transmission Microscopy. It has not only an advantage of transmittance capability over electrons, but also this will be the first experiment using the wave property of an elementary particle, muon.

S line provides 28 MeV/c positive muon (surface muon) beam simultaneously to two experimental areas S1 and S2. In the S1 area, a spectrometer for the μSR technique is facilitated for material science. In the S2 area, high precision measurement of muonium (a binding state of positive muon and electron) 1s-2s level is performed to test the QED. Another two branches are planned in the S line, i.e., simultaneous operation of 4 areas in total. It is expected in each experimental area to achieve advanced research in various scientific fields.


S1 experimental area

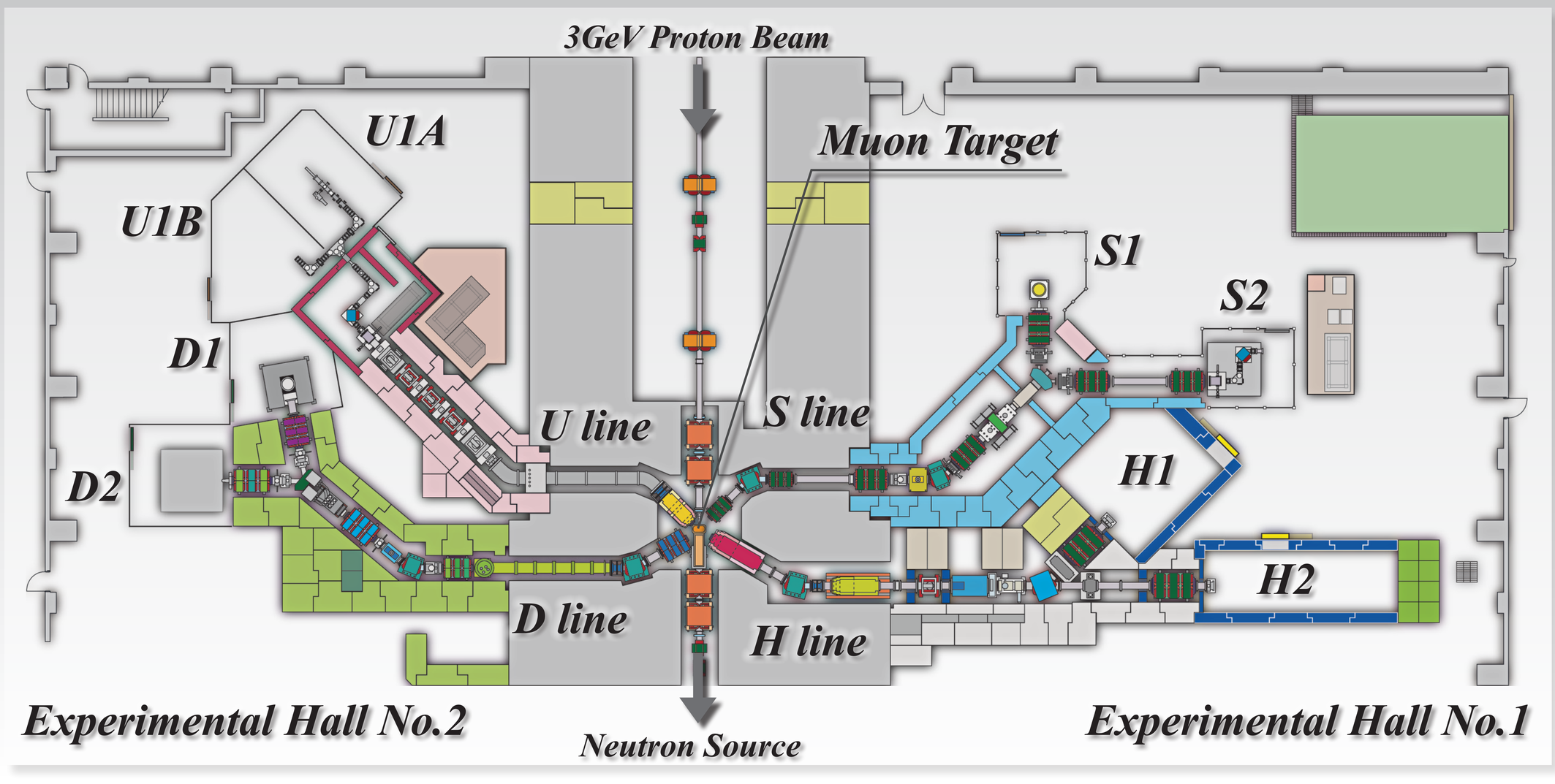

Laser system for the S2 area


Overall view of the H line



Extension plan

H line is the 4th beamline constructed in MUSE. The H line provides a high-intensity muon beam for generic purposes with a wide range of momentum tunability. H line aims to meet the demands of particle physics experiments that require high statistics, i.e. long-term occupancy of a high flux beamline. Therefore, such studies are incompatible with short-term user programs for the material sciences performed in the other existing beamlines. The proposed studies in H line are "high precision measurement of muonium hyperfine structure (MuSEUM)" and "muon to electron conversion search (DeeMe)" in the first branch (H1), and then "muon g-2 and EDM measurement (g-2/EDM)" and "transmission muon microscope" in the extension line.



MUSE
Muon Science