# World Facilities, Capabilities, and Needs

At the moment of writing (2013) there are four muSR facilities in operation worldwide: two in Europe (PSI and ISIS), one in North America (TRIUMF), and one in Asia (J-PARC). Two facilities (PSI, TRIUMF) are based on the pseudo-continuous muon sources, while ISIS and J-PARC are pulsed. Both continuous and pulsed beams have their pros and cons as discussed in the previous section.

Key parameters of the existing facilities are summarized in the table below.

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| Facility | Muon beams | Time structure | Beam parameters | Upgrade plans |
| PSI | High energy (4-50 MeV), surface (4 MeV), low energy (0-30 keV) | Pseudo-continuous (CW),  MORE available | 600 MeV, 2.2mA ≅  1.4 e16 p/sec  ~6.5e8 surface +/sec at the most intense beamline  LEM: 1.5e8 +/sec, 4500 +/sec to sample | N/A |
| ISIS | High energy (20-120 MeV/c) surface (27 MeV/c) | Double pulse ~80 ns/300ns separated every 20 ms (50 Hz) | 800 MeV protons, 200 uA, 2.5e13 protons/pulse  surface (27 MeV/c): 1.5e6 mu+/sec  decay (60 MeV/c): 4e5 mu+/sec, 7e4 mu-/sec | N/A |
| TRIUMF | High energy, surface | Pseudo-continuous (CW) | Cyclotron,  1.5-2e6 +/sec  e4 +/sec useful?) | N/A |
| JPARC | High energy, surface | Pulsed, ~50 ns pulse every 20 ms | Cyclotron, 1.8e6 +/sec (2009) at 120 kW, planned 1.5e7 +/sec at 1 MW | 3 more beamlines under construction (one is low energy muons) |

All of the facilities are heavily used by physicists from all-over the world with a significant (~20-30%) US-based researcher fraction.

## Paul Scherrer Institute (PSI), Switzerland

Paul Scherrer Institute is a leading Swiss research institution with multiple facilities including neutron source, synchrotron light source, and muon source.

For the Laboratory for Muon Spectroscopy (LMU): typically / year: ~ 360 visits, ~200 new proposals, >700 beam days for users (overbooking factor 2 - 3.5)

6 instruments @ 5 beam lines, sample environment (17 cryostats, 2 furnaces, special setups for pressure, photon irradiation, E-Fields)

Personnel: 9 Staff (tenure and tenure track), 4 Post Docs, 5 PhD, 1.8 Technicians, 0.8 Computer support

## ISIS

The ISIS pulsed neutron and muon source at the Rutherford Appleton Laboratory in Oxfordshire, UK is a world-leading centre for research in the physical and life sciences.

Muon spectroscopy recent proposal rounds:

19 different countries (UK + 11 European + 7 outside Europe)

67 separate research groups

738 days applied for: 417 available (1.8 oversubscription)

~35% of applicants are regular neutron users

## TRIUMF, Vancouver, Canada

Muon spectroscopy: 2.5 beamlines, 7 spectrometers, 7 cryostats, 2 furnaces

Recently added two new beamlines (M9A, M20).

Synergy with beta-NMR (analogous to low energy muons), beam time extremely limited (~ 1-2 weeks/year)

Personnel: 2 man-years by TRIUMF, 6 provided by MFA grant

## JPARC

MUSE operational, 3 more beamlines under construction. Low energy muons are intended to be produced by another technique (laser-based).

Hard to extract user info.

**Overview of current and expected needs**

Both pulsed and CW muSR facilities are in high demand as evidenced by an average factor of 2 overbooking at all of the facilities with as high as 3.5 factors reported at PSI for low energy muons. Therefore, another state-of-the-art facility is likely to be of high international demand even without extending the existing user base. If the new facility is beyond state-of-the-art it is expected to be of extremely high demand.

Even though mesoscale phenomena at surfaces and interfaces is one of the fastest developing branches of the condensed matter physics and material science, there is only one low energy muon facility in operation world-wide (PSI). An obvious need exists to extend this application of muSR.

**Considerations specific to North America**

USA represents a world’s largest solid state physics community with the current share of about 20% of all muSR experiments worldwide. However, no state-of-the-art muSR facility is present on the US soil.