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Studies of Ultra-Slow Muon Production for the J-PARC Muon g-2/EDM Experiment

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The ultra-slow muon (USM), developed for the J-PARC muon g-2/EDM experiment, is produced by laser ionization of thermal muonium using 122 nm and 355 nm laser pulses, a process known as muon cooling. Since late 2025, two beam tests have been conducted using the new high-intensity surface muon beamline dedicated to the J-PARC muon g-2/EDM experiment. During these beam tests, extensive studies of the USM production process have been carried out.

This presentation reports recent progress in the USM production study based on these beam tests. A dedicated laser diagnostic system has been developed to characterize and monitor the laser parameters relevant to USM production. Beam-test measurements, including laser parameter scans and long-term stability studies, are presented together with relevant simulation studies to improve the understanding of the USM production process and guide future optimization.

Based on the laser commissioning results, upgrades toward improved performance are underway, including enhanced operational stability, mitigation of laser optics degradation, and improved laser alignment and control strategies. Finally, the future roadmap toward achieving the design laser performance and ionization efficiency will be outlined.

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