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Physics application software for FRIB: from commissioning to operational excellence

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The physics application software is a critical part of the FRIB accelerator's control and beam tuning infrastructure. Development of high-level applications (HLAs) and online modeling tools began well before initial beam commissioning to support early machine setup, diagnostics, and operational readiness. As the accelerator transitioned to routine beam delivery, a broader suite of applications was developed and iteratively refined through close collaboration between physicists, control system engineers, and software developers. These applications leverage model-based control techniques, online beam dynamics simulations, and automated optimization algorithms to enhance tuning efficiency and improve beam delivery reliability across a wide range of operating conditions. Robust data management has also become essential, enabling the capture, organization, and rapid access to operational and diagnostic data critical for real-time decision-making and post-run analysis. This paper presents an overview of the current software ecosystem, highlights key applications for lattice characterization, beam tuning, and outlines future directions, including expanded automation, tighter integration with machine learning frameworks, and improvements in scalability and maintainability.

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Footnotes

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