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New capabilities and upgrade path for the DIII-D neutral beam heating system

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The Neutral Beam Injection System (NBI) on the DIII-D tokamak includes eight ion sources operating nominally at 75-80 kV, each capable of injecting up to 2.5 MW for plasma heating and current drive. As DIII-D physics experiments evolve to explore new regimes in fusion energy research, the capabilities of the NBI systems are being improved to help provide the necessary tools.
One of the NBI projects well underway is the systematic upgrade of all beamline internal components and high voltage systems, allowing an increase in the injected power as well as an extension of the pulse length for all beam systems. The ability to smoothly vary beam energy and perveance has also recently been developed and a new algorithm that combines variable beam energy (VBE) and variable beam perveance (VBP) has been written and successfully tested. In addition, an extensive new project is underway to modify one beamline to inject off-axis beams in either the co- or counter-plasma current direction, adding significant flexibility to the system. Also, the MACE device (Miniature Arc Chamber Experiment) has recently been constructed and commissioned, allowing research into several issues that affect ion source operations and specifically targeting an improvement in reliability during helium beam operations. Finally, exploration of the edge physics in tokamaks has benefited from a new capability to inject very low energy beams (15-20 kV), driving current at the edge of the plasma.
A description of these new capabilities and some results from experiments will be presented here.

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