Overview of Tri Alpha Energy's Experimental Program and Recent Progress on Transport Analysis

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Tri Alpha Energy's experimental program has demonstrated reliable field-reversed configuration (FRC) formation and sustainment, driven by fast ions via high-power neutral-beam (NB) injection. The world's largest compact-toroid experimental devices, C-2 [1] and C-2U [2], have successfully produced a well-stabilized, sustainable FRC plasma state with NB injection (input power, P_{NB} ~10+ MW; 15 keV hydrogen) and end-on coaxial plasma guns. Changes to beam parameters and magnetic field profiles have synergistically led to improved confinement and stability of FRC plasmas and larger fast-ion build up. Our zero-dimensional power balance analysis detailing loss channel characteristics and plasma timescales show substantial improvements in equilibrium and transport parameters, in which electron energy confinement time strongly correlates with electron temperature, T_e; i.e., showing scaling with a positive power of T_e scaling for the confinement time in our experimental device.

This advanced beam-driven FRC state has been produced and sustained for up to 5+ ms in C-2U, which is longer than all characteristic system time scales and only limited by hardware and electric supply constraints such as NB and plasma-gun power supplies. To further improve the FRC performance the C-2U device is being replaced by C-2W featuring higher injected NB power, longer pulse duration as well as enhanced edge-biasing systems and substantially upgraded divertors. Main C-2U experimental results including recent transport analysis as well as key features of C-2W will be presented.

[1] M.W. Binderbauer *et al.*, Phys. Plasmas **22**, 056110 (2015).
[2] M.W. Binderbauer *et al.*, AIP Conference Proceedings **1721**, 030003 (2016).