Balancing current drive and heating in DIII-D high noninductive current fraction discharges through choice of the toroidal field

J.R. Ferron[1], C.T. Holcomb[2], T.C. Luce[1], P.A. Politzer[1], F. Turco[3], J.C. DeBoo[1], E.J. Doyle[4], Y. In[5], R.J. La Haye[1], M. Murakami[6], M. Okabayashi[7], J.M. Park[6], T.W. Petrie[1], C.C. Petty[1], and H. Reimerdes[8]

[1]General Atomics, PO Box 85608, San Diego, California 92186-5608, USA
[2]Lawrence Livermore National Laboratory, 7000 East Ave, Livermore, California 94550, USA
[3]Oak Ridge Associated Universities, PO Box 117, Oak Ridge, Tennessee 37831-0117, USA
[4]University of California-Los Angeles, PO Box 957099, Los Angeles, California 90095-7099, USA
[5]FAR-TECH, Inc., 10350 Science Center Dr., San Diego, California 92121-1136, USA
[6]Oak Ridge National Laboratory, PO Box 2008, Oak Ridge, Tennessee 37831, USA
[7]Princeton Plasma Physics Laboratory, PO Box 451, Princeton, New Jersey 08543-0451, USA
[8]Columbia University, 2960 Broadway, New York, New York 10027-6900, USA, Present address: CRPP-EPFL, CH-1015 Lausanne, Switzerland

Abstract.

In order to maintain stationary values of the stored energy and the plasma current in a tokamak discharge with all of the current driven noninductively, the sum of the α-heating power and the power required to provide externally-driven current must be equal to the power required to maintain the pressure against transport losses. In a study of high noninductive current fraction discharges in the DIII-D tokamak, it is shown that in the case of present-day tokamaks with no α-heating, adjustment of the toroidal field strength (B_T) is a tool to obtain this balance between the required current drive and heating powers with other easily modifiable discharge parameters (β_N, q_{95}, discharge shape, n_e) fixed at values chosen to satisfy specific constraints. With all of the external power sources providing both heating and current drive, and β_N and q_{95} fixed, the fraction of externally-driven current scales with B_T with little change in the bootstrap current fraction, thus allowing the noninductive current fraction to be adjusted.

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