Dynamics of cold pulses induced by super-sonic molecular beam injection in the EAST tokamak

Yong Liu1, Yuejiang Shi2, Tao Zhang1, Chu Zhou3, Xiaolan Zou4, Hailin Zhao1, Ahdi Liu3, Tianfu Zhou1, Xiang Liu1, Shoubiao Zhang1, Bin Cao1 and Volker Naulin5

1 Institute of Plasma Physics, Chinese Academy of Sciences, Hefei 230031, People’s Republic of China
2 Department of Nuclear Engineering, Seoul National University, Seoul, Korea, Republic of
3 University of Science and Technology of China, Hefei 230026, China
4 CEA, IRFM, F-13108 Saint-Paul-lez-Durance, France
5 Department of Physics, Technical University of Denmark (DTU), DK-2800 Kgs. Lyngby, Denmark

E-mail: liuyong@ipp.ac.cn

One of the most provocative phenomenons in plasma transport is the so called non-local heat transport: the core temperature increases in response to edge cooling. This was observed for the first time in the TEXT experiment in 1995, and was reproduced in many tokamaks (TFTR, Tore Supra, RTP, ASDEX-U, JET, HL-2A, Alcator C-Mod, KSTAR, J-TEXT) and helical devices (LHD).

In EAST non-local heat transport has been observed recently during plasma edge cooling induced by super-sonic molecular beam injection (SMBI) [1]. The non-local heat transport occurs for discharges with plasma current $I_p = 450$ kA ($q_{95} \approx 5.55$), and electron density $n_{e0}$ below a critical value of $(1.35 \pm 0.25) \times 10^{19}$ m$^{-3}$. In contrary to the response of core electron temperature and electron density (roughly 10 ms after SMBI), the electron density fluctuation in the plasma core increases promptly after SMBI and reaches its maximum around 15 ms after SMBI. The electron density fluctuation in the plasma core begins to decrease before the core electron temperature reaches its maximum (roughly 30 ms). It was also observed that the turbulence perpendicular velocity close to the inversion point of the temperature perturbation changes sign after SMBI.


This work was supported by the Innovative Program of Development Foundation of Hefei Center for Physical Science and Technology, and the National Natural Science Foundation of China under Grant Nos. 11405211, 11575248. This work was also partly supported by National Magnetic Confinement Fusion Science Program of China under Contract Nos. 2015GB101003 and 2015GB103002, Basic Science Research Program through the National Research Foundation (NRF) funded by the Ministry of Science and ICT of Republic of Korea (No. 2018R1A2B2008692).