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Design of a Multi-channel Polarimeter-interferometer system for EAST using Terahertz solid-state diode sources

H.Q. Liu[1], Z.Y. Zou[1], S.X. Wang[1], H. Lian[2], W. M. Li[1], Y. Yao[1], W.X. Ding[3], D.L. Brower[2], Y.X. Jie[1], and L.Q. Hu[1]

[1] *Institute of Plasma Physics, Chinese Academy of Sciences, Hefei, Anhui 230031, P.R. China*
hqliu@ipp.ac.cn

[2] *Department of Physics and Astronomy, University of California Los Angeles, Los Angeles, CA 90095, USA*

[3]*University of Science and Technology of China, Hefei, Anhui 230026, P.R. China*

Plasma position play a critical role in fusion plasma performance, any loss of the plasma position control is not acceptable for safe fusion device operations. Faraday effect-based polarimetry can measure the plasma position non inductively in real-time with fast time response [1,2].

A novel single-pass, vertical-viewing, multichannel faraday effect-based Terahertz polarimeter/interferometer (T-POINT) system is under development for current density and electron density measurements in the EAST tokamak, in vertically-viewing can be utilized to get the radial position as the vertical magnetic field should be zero in plasma center. To combine the T-POINT system and POINT system for vertical position measurement[2], the plasma position can be measured non inductively with fast time response up to a few microseconds, which can be integrated into the PCS for plasma position control on EAST.

The T-POINT on EAST utilizes three independent solid-state diode sources (SSDS) based frequency multiplier (X48), which provide an Intermediate Frequency (IF) with wide range, the highest IF is up to ~10 MHz. Compared with the traditional FIR laser used in the interferometer system, the SSDS provide much less output power, approximately 2 mW at 0.65THz. VDI Mixers optimized for high sensitivity, typical 750 V/W, will be used to assist the realization of the T-POINT with a low phase noise. A Digital Phase Detector with 1MHz bandwidth has been developed for use on the T-POINT system for real-time output for use in plasma control. A three-chord system will be installed in this year on the core region of EAST plasmas. Preliminary design and bench test results will be presented. In the bench test, a sensitivity of $\overline{n_e}_min = 1 \times 10^{17}$ m^{-2} and a temporal resolution of 0.1 μs have been successfully achieved. The techniques presented here will provide a new solution for future plasma position control system on steady state operation with turn-key operation, compact size and easy maintenance.

References

[1] W. X. Ding, et al., Rev Sci Instrum, 2018, 89:10B103
[2] H. Q. Liu, et al., Rev Sci Instrum, 2016, 87:11D903

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