

§27. Electron Density Measurements with Pulsed Radar Reflectometer

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Microwave reflectometry becomes a popular diagnostic for density measurements in magnetically confined plasma. Recently, the pulsed radar reflectometry, as the novel approach to such kind of measurements, was introduced [1, 2]. We have constructed a pulsed radar reflectometer for the Compact Helical System (CHS) [3]. This was the first attempt to use pulsed radar system for the helical systems.

Preliminary free space time measurements have been done to calibrate the timing electronics. Instead of the plasma cut-off layer, a metallic mirror is used and moved by 0.5-0.9m in front of antenna. A spatial resolution of 3×10^{-3} m has been reached, that comes from the accuracy of TAC output reading.

As a wave polarity, ordinary and extraordinary modes are launched. We probed the plasma with microwave pulses of 1.9nsec. The plasmas were initiated by IBW (Ion Bernstein Wave) or ECH and heated by NBI and ECH. These measurements were done for discharges with the magnetic field from 0.85T to 1.76T and maximum electron density up to $6 \times 10^{20} \text{m}^{-3}$.

Figure 1 shows the typical traces for the time delay of the reflected microwave pulses. The time behavior of the time delay agrees with the calculation of this scenario by assuming the parabolic density profile. For time to position inversion instead of assuming the whole profile, we assume a linear profile between the plasma edge and the cut off. Then the estimated position of the cut off layer coincides well with Thomson scattering measurements (Figure 2). The spatial accuracy of the determination of the position of the reflected layer (spatial accuracy of the density profile reconstruction) during plasma measurements becomes about $5 - 8 \times 10^{-3}$ m.

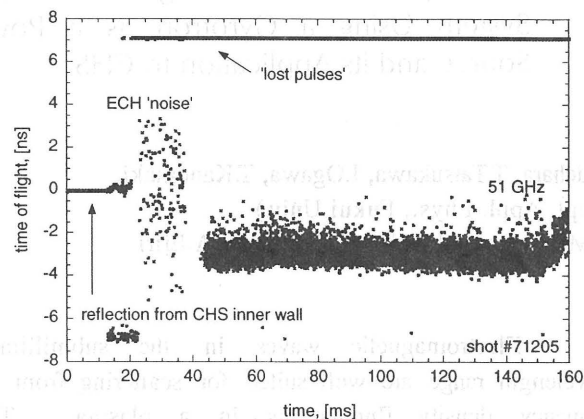


Figure 1: Time of flight evolution during CHS plasma discharge for the shot #71205

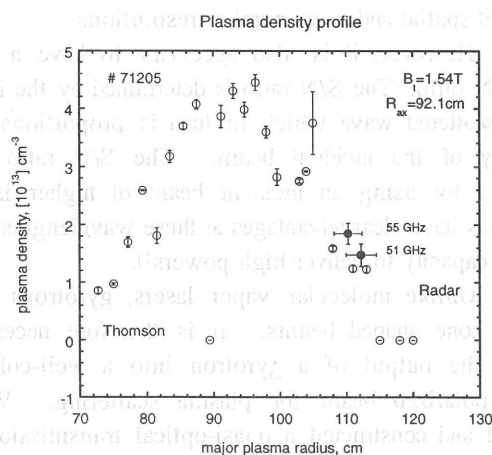


Figure 2: Comparison of density profiles from the Thomson scattering system and from pulsed radar for the same discharge (shot #71205)

References

- [1] Hugengoltz, C.A.J and Heijnen, S.H. : Rev. Sci. Instrum. **62**(1991)1100.
- [2] Pavlichenko, R. et al. : Ann. Rep. NIFS(1995-1996)241.
- [3] R.Pavlichenko, et al. : J.Plasma Fusion Res. Series 1(1998)378