§ 2. Vertical Scanning in Time-of-Flight Neutral Particle Analyser System

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Fig. 1. The photograph of NPA system.
The stainless balancer compensates the weight of the analyzer. High speed scan of 1 degree per second can be achieved.

The vertical scanning system is realized by adding a movable mechanism to a current horizontal scanning system (Fig. 1).¹ The analyzer slides along three stainless steel rails, which are arcs of the radii of 4 m. One of rails defines the accurate position of the analyzer. Another rail, which is settled at the front of the rail, fixes the vertical position and the other rail, which is settled at the side, fixes the side position. Therefore, the smooth and non-vibrated vertical driving can be obtained. The two chains and the gears, which are connected with the motor, hang up the analyzer. Two stainless blocks are set on the opposite side of the chain in order to balance the weight (700kg) of the analyzer and reduce the load for the motor. Therefore very high speed of one degree per second can be obtained. To avoid the tilting of the bellow at the pivot point, there are two different bellows for the horizontal and for the vertical scans. Both scannings are performed by the remote control with a personal computer. While acting as the monitor of the position with a CCD camera, the time history of an exact position is read using the position detector, and stored in the personal computer.

The time history of an ion temperature profile can be obtained by changing the vertical position shot by shot. The plasma poloidal section is varied by changing the toroidal position. We choose the horizontal position of the center pitch angle of 60 degrees to avoid the observation at the diverter region where there is much background neutral. The time history of the ion temperature profile can be obtained. The ion temperature profile is comparatively flat and a central temperature is low observed as compared with other measurement. Since the main component of this plasma is the argon, the contribution of the charge exchange between lower ionized argon and proton should be considered. The lower ionized argon exists near the plasma outer region. Therefore the observed ion temperature may be affected by the contribution of the neutral flux contribution at the outer region rather than at the portion of the smallest plasma radius of the sight. In calculation, these cross sections are too small, the contribution for the neutral flux. Neutral particle scattering with high-Z plasma may be one reason of the profile flattening.

It is possible to obtain the poloidal profile of the neutral particle flux or the ion temperature profile by vertical scanning the analyzer during the single long discharge. Fig. 2 shows the typical ion temperature profile by vertical scanning the analyzer from +9 to -9 degrees with the scanning speed of 1 degree per second during 40-second discharge. Time change corresponds to an observation position. Horizontal measurement positions are at the central pitch angles of 60 degrees. The fluctuation of the ion temperature at $\rho = 0 - 0.5$ may reflect the charge exchange neutral from the dense background neutral at the diverter region.

¹Ozaki, T., proc. of 30th EPS (2003).