§3. A Level Transition of Environmental Atmospheric Tritiated Gas Activities in 2004 – 2009 at Toki Site

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Considering the environmental radiation safety issue, atmospheric tritium monitoring will be useful for the future experiments of LHD deuterium plasma discharges. The variation of environmental tritium level at Toki site should be understood previous to the deuterium experiments and the tritium level will be monitored in routine when the experiment is started.

Atmospheric tritium mainly consists of three different chemical forms HTO, HT and carbon hydrate like CH_3T. Conventional technique of atmospheric tritium sampling is discriminate oxidization of tritiated species followed by collection of water with molecular sieve beds. For the practical use of this technique, we developed the air sampling system[1)] and accumulated the atmospheric tritium concentration data for 6 years, 2004 - 2009.

i) Sampling and radiation measurements

The air was collected about 20 m^3 at a rate of 500 ~ 2000 cm^3/min once a month at the second flour of plasma diagnostic building in NIFS Toki site. The height of sampling point was about 6 m. The sampling time spent to 168 hours until 2005 and 300 ~ 650 hours from 2006. After collecting the air, water samples were recovered from the molecular sieves beds, which were regenerated at 400°C, passing through N_2 gas for 3.5 hours.

Radioactivity of tritium was counted by a low background liquid scintillation counter (LB-III or LB-V, Aloka). The stocked water samples (65 g for HTO, 10 g for HT and CH_3T) were mixed with the same amount of liquid scintillator (Ultima Gold LLT, Perkin Elmer). Twenty ml of vials were used for counting the HT and CH_3T fractions while the HTO fractions were measured in 135 ml vials. Counting time was 1500 minutes for each sample, where measurements of 50 minutes were replicated for 15 times and the cycle was repeated twice.

ii) Results of measurements

The measured data of tritium concentrations from 2004 to 2009 are shown in Fig. 1 with respect to each species. The atmospheric CH_3T concentration level was too small to discuss the seasonal variation. The results of atmospheric HTO in Fig. 1(a) show that the peak exists from June to August, and the minimum lies between November and February, because it depends mainly on humidity in air. On the other hand the seasonal tendency of HT concentration seems to be high in autumn and spring as shown in Fig. 1(b), and the minimum lies in summer. Especially increasing trend in spring is known as spring peak. Except the spring peak, we know the reason of seasonal fluctuation as the following[2)]; the climate of Japan from June to September is generally oceanic. Therefore, it might be considered the influence of an oceanic air mass, which will dilute the impact of tritium. Around the winter season, it might be influenced by a migratory air mass from the Asian continent such as China, and a seasonal wind blowing out from a cold, dry air mass overlying Siberia, which contains relatively high tritium than the oceanic air mass[3)].

As a tendency in environmental gaseous tritium for recent a few years, it seems to become almost the same pattern. However, to observe precisely the trend curve is drawn in Fig.1. The half time of decreasing rate is estimated as 19.4 years. It is larger than the half time of radioactivity decay 12.32 years. It seems that there are some tritium exhausting sources except natural sources like cosmic-ray interaction. Another environmental tritium data required are those of river water and plants. It is important to accumulate in long time. Also the continuous monitoring would be effective to know the trend of level transition and to find the mechanism of environmental tritium levels fluctuation.

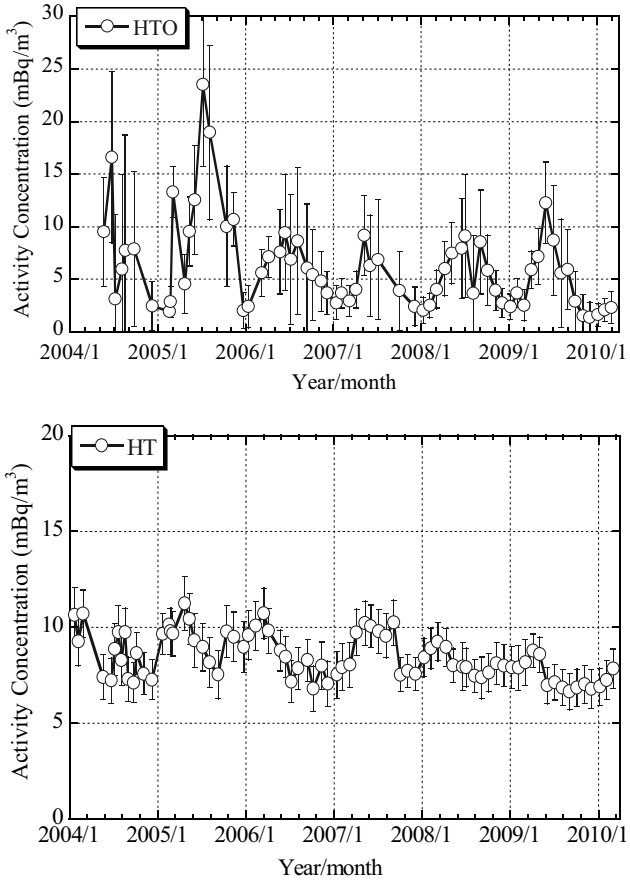

Fig. 1: Atmospheric tritium concentration in 2004-2009 at NIFS Toki site; (a) HTO, (b) HT

1) Uda. T, *et al.*, Fusion Engineering and Design, **81**, (2006), 1385.
2) Uda. T, *et al.*, Fusion Science and Technology, **54**, (2008), 281.
3) Uda. T, *et al.*, J. Plasma Fusion Res., **85**, (2009), 423.