AMOC measurement for OH radical study in water

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Positron annihilation age-momentum correlation (AMOC) measurement is a strong tool to investigate chemical reactions of positron and positronium (Ps). However, the count rate of AMOC measurement is usually very low because AMOC is a triple coincidence method. We succeeded to make the AMOC count rate higher than 10 cps, which is almost one million counts a day, by use of four scintillation detectors for 1.27MeV start signal from ^{22}Na [1].

Quantum beats of *S*-parameter, the periodic change of the shape of the annihilation gamma-rays energy distribution, was observed in water by AMOC with 0.9 cps count rate in 2009 [2]. This beat frequency shows the hyperfine coupling constant of OH radicals in water. However, the water structure change makes the change of the beat frequency, because the OH-water molecule complex structure changes the hyperfine coupling constant of OH radical [3]. Therefore, the observation of the beats is difficult in some cases probably because of the nonuniformity of water structure for space and time, such as a long measurement time [4]. Fig. 1 shows the measured result having quantum beats with the higher count rate AMOC.

AMOC measurements on OH radical in water show one more interesting phenomenon on the reaction of OH and *ortho*-Ps because there are two kinds of OH radical. One of them has a spin correlation on the electrons in the *ortho*-Ps and the OH radical. The other has no spin correlation. The spin conversion reaction between the spin-correlated pair gives 33% more yield of *para*-Ps. Hence, it is possible to study OH radical behavior in water by AMOC. Indeed, water liquid structure probably affects the OH radical behavior.

I am going to show some of the experimental results showing these effects.

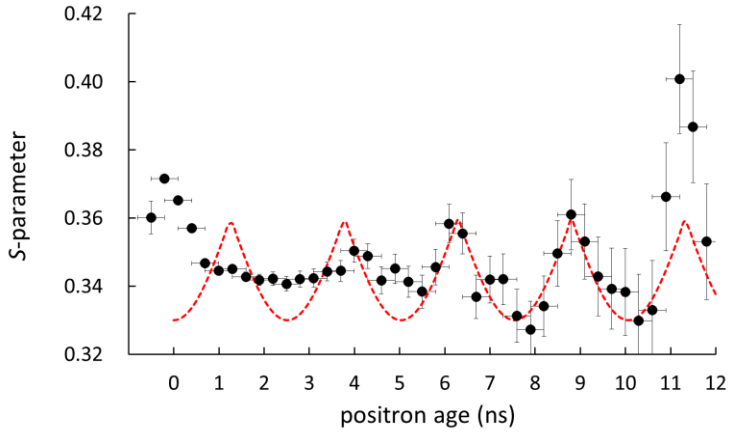

Fig.1. Positron age dependence of *S*-parameter measured in 0.5 ºC water. Dashed line indicates the expected position of quantum beats with OH radical hyperfine coupling constant of 14.2 mT.

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