 <b>MLF Experimental Report</b>	提出日 Date of Report 2014/7/17
課題番号 Project No. 2014A0225 実験課題名 Title of experiment Hydration effect on electron transfer process in cytochrome <i>c</i> and DNA probed by muon labelling method 実験責任者名 Name of principal investigator Yoko Sugawara 所属 Affiliation Kitasato University	装置責任者 Name of responsible person Yasuhiro Miyake 装置名 Name of Instrument/(BL No.) Muon D1 実施日 Date of Experiment 2014/5/17 9:00 – 2014/5/19 9:00

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。(適宜、図表添付のこと)  
 Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.
a) Cytochrome <i>c</i> (104 amino acid residues with a heme from horse heart) b) Lysozyme (129 amino acid residues form hen egg white) Water contents of both samples were adjusted to approximately 5 % (a dry sample) and 20% (a wet sample).

2. 実験方法及び結果 (実験がうまくいかなかった場合、その理由を記述してください。) Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.
<p>In order to investigate a hydration effect on the electron transfer process of biosystem, we measured the <math>\mu</math>SR time spectra of the following fore samples.</p> <ol style="list-style-type: none"> <li>1. Dried sample of cytochrome <i>c</i> (water content approximately 5 %)</li> <li>2. Wetted sample of cytochrome <i>c</i> (water content approximately 20 %)</li> <li>3. Dried sample of lysozyme (water content approximately 5 %)</li> <li>4. Wetted sample of lysozyme (water content approximately 20 %)</li> </ol> <p>Cytochrome <i>c</i> is one of the members of the respiratory chain, and lysozyme is selected as a reference protein which does not participate in electron transfer system.</p> <p>In order to obtain information just after a pulse radiation, we used the single pulse by removing the second pulse arriving at 600 ns after the first pulse. The <math>B_{\text{ext}}</math> dependence of the longitudinal relaxation parameter (<math>\Gamma</math>) obtained in the fitting of the observed <math>\mu</math>SR time spectrum by the Risch-Kehr function was measured in the region from 0 G to 3000 G at 300 K – 100 K.</p>

## 2. 実験方法及び結果(つづき) Experimental method and results (continued)

Last year, we measured longitudinal  $\mu$ SR time spectra of the wet and dry samples of cytochrome *c* under the longitudinal fields of 0 - 1.4 kG, at 300 K - 150K (Proposal No. 2013A0145). This year, we collected the data in wider magnetic field range of 0 - 3000 G using a new spectrometer. In addition, we carried out the data collection of dry cytochrome *c* at 100K.

Two data sets (2013A0145 and 2014A0225) of cytochrome *c* were consistent, and we concluded:

1. On the basis of the zero field data (Figure 1) and the plots of  $B_{\text{ext}}$  dependence of  $\Gamma$  which showed explicit temperature dependence, three-dimensional electron diffusion would occur at room temperature, and it was suppressed below 200 K in the case of the wet sample. Mobility of proteins and hydration water would be essential to optimize the structure which promotes inter-molecular three-dimensional electron transfer.

2. Temperature dependence of the dry sample is small, and at low temperature the relaxation was slow compared with that of the wet data (Figure 1). The efficiency of one dimensional electron diffusion would be slightly smaller than that of the wet sample.

There were differences between the time dependence spectra of cytochrome *c* and lysozyme, but the precision of lysozyme data was insufficient to be analyzed quantitatively because conditioning of the new detector system had not been completed at the beam time of our experiment. We are going to carry out remeasurements of lysozyme.

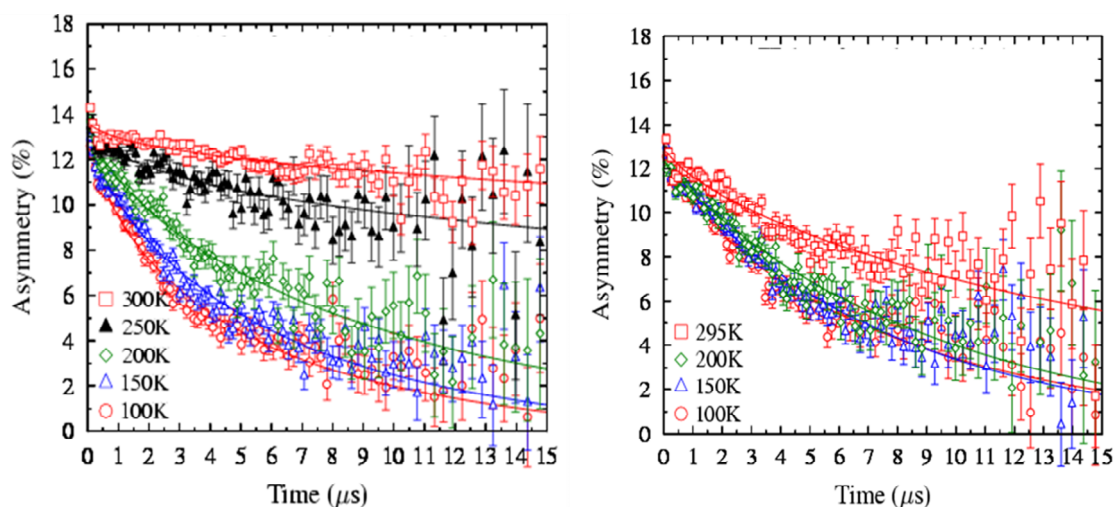


Fig.1 Temperature dependence of the zero field data of cytochrome *c*.

(a) Wet sample (water content approximately 20%) (b) Dry sample (water content approximately 5%)