

Report of MERIT Long-Term Dispatch

Dept. of Advanced Materials Science

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1, Abstract

Period : 2015/08/14 ~ 2015/11/12

Hosting research institute : École Polytechnique Fédéral de Lausanne (EPFL)

Supervisor : Prof. Henrik M. Rønnow

Research project : Multiferroicity on $\text{Ba}_2\text{MnGe}_2\text{O}_7$ investigated by measuring magnetization and magnetoelectric susceptibility

2, Research result

In the laboratory for Quantum Magnetism (LQM), which is my hosting research institute, they study quantum phenomena on spin system by measuring magnetization at very low temperature, neutron scattering, and so on. Prof. Rønnow was a visiting professor at Institute for Solid State Physics at The University of Tokyo. Since he collaborated with our group during the stay, I proposed this dispatch to him and it was realized. I show research results during the dispatch as follow.

Coexistence of magnetic and electric orders, multiferroicity, has been actively researched for a decade since it is expected to be applied to low energy devices. I focus on a multiferroic compound $\text{Ba}_2\text{MnGe}_2\text{O}_7$. Although instability of magnon in $\text{Ba}_2\text{MnGe}_2\text{O}_7$ was investigated under high magnetic field so far, any study under low magnetic field has not been investigated yet. In the low magnetic field thermal fluctuation is not negligible because energy of the magnetic field is comparable with the thermal fluctuation around $T = 2$ K. Thus we tried to measure magnetization at very low temperature using a dilution fridge to remove the thermal fluctuation. On the other hand, magnetic property under electric field has not been identified yet even though dielectric properties under magnetic field was studied. We tried to measure magnetoelectric susceptibility to investigate relationship between the magnetization and electric polarization in this compound. The magnetoelectric susceptibility measurement is performed to measure magnetization by SQUID magnetometer applying alternating current of electric field.

In measurement of magnetization at very low temperature, it was very difficult to obtain data during my stay because we had some trouble of experiment. However we found an unknown phenomenon when we were preparing sample setting for the measurement. I discussed this

phenomenon with Prof. Rønnow and LQM members a lot of times. As a result, we decided to study it again in Japan after finishing my stay. In measurement of the magnetoelectric susceptibility, we obtained characteristic and good data. I will complete this result as a joint paper after analyzing data more in detail.

3, Life of the dispatch

École Polytechnique Fédéral de Lausanne (EPFL) is one of top class university ranked with ETH at Zurich in Switzerland. It looked a modernized university as there many new buildings. Most of graduate students and researching staffs are from foreign countries. LQM members also has diverse nationality; UK, India, Croatia, China, and Korea. It was very interesting to talk about various topic of each country in break times. I felt that people enjoyed their lives other than researching. It was fun that we talked about what we did in the weekend on Mondays. I also enjoyed hiking with the laboratory members.

I presented a poster in European Conference on Neutron Scattering during the dispatch. Europe has a big community for the neutron facility compared with Japan. I was stimulated a lot from hot topics and state-of-the-art technology on the neutron scattering experiment. In my presentation I discussed my research topic with a researcher who was researching same compounds. It was precious experience to get a fruitful opinion about this research topic from him.

Acknowledgement

I thank Dr M. Jeong, Mr. P. Huang for mainly supporting my research. I thank Dr. I. Zivkovi, Dr. P. Babkevich, Mr. I. Kovacevic and other LQM members for giving me many fruitful advices. I appreciate to Prof. Masuda and Prof. Okamoto for letting me challenge this dispatch. I appreciate Prof. Rønnow for supervising during the dispatch. Finally, I would like to express sincere gratitude to MERIT program for giving me the opportunity and supporting the dispatch.



Photo : View around Lac Lemman