



### Seminar

### Spin Mechatronics

### - Prof. A. Einstein meets Spintronics

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**Time: 4:00pm, Aug. 9, 2018 (Thursday)**

**时间: 2018年08月09日 (周四) 下午4:00**

**Venue: Room W563, Physics building, Peking University**

**地点: 北京大学物理楼, 西563会议室**

### Abstract

Albert Einstein together with his young colleague, de Haas, showed the equivalence of magnetism and mechanical rotation in 1915 [1]. In the same year, Barnett found that mechanical rotation can generate a magnetic field even in a body with no electric charge [2]. The year, 1915, was that of the discovery of the general relativity by A. Einstein. These phenomena are caused by the angular momentum conservation between electron spin and mechanical rotation, which is proved in the general relativistic quantum mechanics [3].

The recent progress of nano-technology has made it possible to extend the coupling of electron spin and mechanical motion to Spin-electronics, i.e., "Spintornics". We examine a variety of novel spintronics phenomena. In particular, the coupling between nuclear spin and mechanical rotation is demonstrated [4]. We also observe the generation of spin current by the flow of liquid metals [5] and that of liquid <sup>3</sup>He [6]. Combining the coupling with the spin Hall effect [7], the spin-hydrodynamic generation of electricity is obtained [5].

The mechanical generation of spin and spin current opens a door from "Spintronics" to "Spin-Mechatronics".

[1] A.Einstein and W.J.de Haas, *Verhandl.Deut.Physik.Ges*, **17**,154 (1915).

[2] S.J.Barnett, *Phys. Rev.* **6**, 239 (1915).

[3] See, for example, M.Matsuo, J.Ieda and S.Maekawa, *Phys. Rev. Lett.* **106**, 076601 (2011).

[4] H.Chudo, M.Ono, K.Harii, M.Matsuo, J.Ieda, R.Haruki, S.Okayasu, S.Maekawa and E.Saitoh, *Appl. Phys. Express* **7**, 063004 (2014).

[5] R.Takahashi, M.Ono, K.Harii, S.Okayasu, M.Matsuo, J.Ieda, S.Takahashi, S.Maekawa and E.Saitoh, *Nature Phys.* **12**, 52 (2015).

[6] Y. Tsutsumi, *et al.*, to be published.

[7] *Spin Current*, eds. S. Maekawa *et al.* (Oxford University Press, 2012).

### About the speaker

**Education:** April 1975, Dr. Sc., Tohoku University

**Position Held:**

- 2018-present Senior Advisor, RIKEN Center for Emergent Matter Science
- 2018-present Visiting Chair Professor, Kavli Institute for Theoretical Sciences, University of Chinese Academy of Sciences
- 2018-present President, Honda Memorial Foundation,
- 2010-2018 Director, Advanced Science Research Center, Japan Atomic Energy Agency
- 2010-present Professor Emeritus, Tohoku University
- 2006-2008 Deputy Director, Institute for Materials Research, Tohoku University
- 1997-2010 Professor, Institute for Materials Research, Tohoku University
- 1988-1997: Professor, Department of Applied Physics, Nagoya University