



4th International Symposium on
Energy **C**hallenges & **M**echanics
- working on small scales

11-13 August 2015
Aberdeen, Scotland, UK

Non-centrosymmetric Superconductors

Sungkit Yip^{1*}

¹*Institute of Physics, Academia Sinica, Taipei 115, Taiwan*

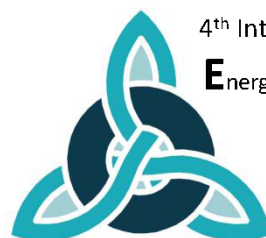
Accepted for publication on 27th February 2015

The unusual physics of non-centrosymmetric superconductors is introduced. Non-centrosymmetric systems are those where spatial inversion symmetry is absent. Usually, superconductors are describable by the Bardeen, Cooper, Schrieffer theory. They consist of Cooper pairs with their spin part being singlet and the orbital part being s-wave. On the other hand, in non-centrosymmetric superconductors, the Cooper pairs are neither spin singlets nor triplets, and the orbital parts are neither s- nor p-wave. Contrary to what one might believe, non-centrosymmetric superconductors are actually very common and examples would be given.

We explain how the unusual properties of these superconductors can arise provided the relevant materials have strong spin-orbit coupling. Strong spin-orbit coupling gives rise to spin-splitting of the Fermi surface, and the gap magnitudes on these Fermi surfaces are also in general unequal. Either one would be sufficient to generate the following exotic properties. Magneto-electric couplings, e.g., the coupling between magnetic field and electric current, occur naturally due to the lack of inversion symmetry. For example, in a two-dimensional system, an in-plane Zeeman field can induce and therefore control a supercurrent in the perpendicular direction. In general, dissipationless spin-supercurrents can also arise, in particular near sample boundaries. These spin-currents may have applications to the field of spintronics. We explain how these boundary spin-currents are related to what have been recently discussed in topological insulators, a type of materials also currently being hotly pursued in spintronics. Non-centrosymmetric superconductors can also fall into distinct topological classes, as for topological insulators versus trivial band insulators, but spin supercurrents can exist in either class of non-centrosymmetric superconductors.

We provide examples of bulk materials where the above exotic properties can be realized. We discuss other candidates such as superconducting films deposited on materials with strong spin-orbit couplings, superconducting artificial superlattices, and superconductivity at interfaces.

Keywords: non-centrosymmetric superconductors, spin-currents



4th International Symposium on
Energy **C**hallenges & **M**echanics
- working on small scales

11-13 August 2015
Aberdeen, Scotland, UK

能源挑战与力学国际研讨会摘要模板

John Smith^{1*}, 張三², 李四³

¹*School of Engineering, University of Aberdeen, Aberdeen AB24 3UE, UK*

²*Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign,
Urbana, IL 61801, USA*

³ *中国 北京清华大学工程力学系, 北京 100084*

文件定义了摘要的各个组成部分，包括标题和全部作者，以及每个作者的所在单位、单位地址和电邮地址。作者列表中标有*号的为报告作者。请不要改变文件书写风格，包括字体、文字大小和段落间距；不要在文件中使用特殊字符，符号或方程。

摘要将以英中文双语出现在研讨会文集里。美式和英式英文，简体和繁体中文都被认可。作者可以用英文或英中文双语（首选）提交摘要；如果只收到英文版本，我们将提供论文摘要的中文翻译。在英文版本的摘要中，单词总数必须在 250 到 350 之间。

论文摘要的版权属于作者。北海期刊会议有限公司有权将摘要发表在会议网页上。

关键词：摘要；模板；英文；中文（最多 5 个关键词）