

# JITCP Seminar

THE UNIVERSITY OF HONG KONG  
HKU-UCAS JOINT INSTITUTE OF THEORETICAL AND COMPUTATIONAL PHYSICS  
HK INSTITUTE OF QUANTUM SCIENCE & TECHNOLOGY  
[Thursday afternoon, 4:00 pm, In Person]

## Power and control of internal loop currents in an exotic quantum state

**Prof. Gang CAO**

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Colossal magnetoresistance is an extraordinary enhancement of the electric conductivity in the presence of a magnetic field, an important property of matter that has been studied for decades. It is conventionally associated with a magnetic-field-induced spin polarization, which drastically reduces spin scattering, thus electric resistance. Our earlier studies uncover an intriguing exception to this rule in that the electric resistivity in a magnetic insulator is reduced by up to 7 orders of magnitude only when a spin polarization is absent <sup>[1]</sup>. Here I report a newly identified quantum state in a honeycomb material where internal loop currents flowing along edges of crystal unit cells dictate electric conductivity, providing a key element driving the novel colossal magnetoresistance <sup>[2]</sup>. The unique nature and control of the exotic quantum state, along with implications of this discovery, will be presented and discussed after a brief review of conventional colossal magnetoresistance and loop currents in other materials.

References:

1. *Colossal magnetoresistance via avoiding fully polarized magnetization in ferrimagnetic insulator  $Mn_3Si_2Te_6$* , Yifei Ni, Hengdi Zhao, Yu Zhang, Bing Hu, Itamar Kimchi and Gang Cao, *Letter of Phys. Rev. B* **103**, L161105 (2021); DOI:10.1103/PhysRevB.103.L161105
2. *Control of chiral orbital currents in a colossal magnetoresistance material*, Yu Zhang, Yifei Ni, Hengdi Zhao, Sami Hakani, Feng Ye, Lance DeLong, Itamar Kimchi, and Gang Cao, *Nature* **611**, 467-472 (2022); DOI: 10.1038/s41586-022-05262-3

**In Person Seminar**

**Thursday, March 30, 2023, 4:00 pm**

Room 522, 5/F, Chong Yuet Ming Physics Building,  
The University of Hong Kong

Host: Professor Gang CHEN, The University of Hong Kong

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HK Institute of Quantum Science & Technology

Phone: 28592360, Fax: 25599152. Anyone interested is welcome to attend.