

## **Lecture series on Magnetic Reconnection**

**27 - 31 March 2017**

**Physics Department**

**American University of Beirut**

Magnetic reconnection is a ubiquitous mechanism by which magnetic energy is converted to particle energy. It operates throughout the universe, in neutron stars, in solar flares, and in man-made controlled laboratory experiments. While theoretical and observational aspects of this process have already been established over the last few decades, several outstanding questions remain. These include the small-scale structure of the reconnection region, particle acceleration processes, and plasma heating. In magnetic reconnection, macro-scale and microscale plasma physics simultaneously come together, forming an essential research topic of nonlinear plasma physics that spans the disciplines of laboratory research, space physics, and astrophysics.

We invite you to attend a lecture series on the fundamentals of magnetic reconnection. The lecture series is a joint collaboration between the space research department at Southwest Research Institute (SwRI) and the physics department at the American University of Beirut (AUB). The effort is jointly sponsored by the American Physical Society (APS) and the Académie des Sciences du Liban (ASL). This announcement is open to undergraduate and graduate students.

Lecturers:

Dr. Maher Dayeh (Southwest Research Institute)

Dr. Ghassan Antar (American University of Beirut)

Dr. Mounib El-Eid (American University of Beirut)

Public lecture  
***The Dark Side of the Sun: Solar Storms***  
(Dr. Maher Dayeh)

**Abstract:**

The Sun is continuously affecting the Earth by a host of interconnected dynamic physical processes. These processes are among the principal threats to the modern human technology that our society is progressively becoming dependent on. Coronal Mass Ejections (CMEs) and solar flares are gigantic outbursts of magnetized plasma that sweep through the interplanetary space bypassing Earth. These events often lead to geomagnetic storms that sometimes wreck havoc on technological platforms such as orbiting satellites, power grids, communication cables, pipelines, and railway signaling, among others. The term *Space Weather* was specifically introduced to describe and forecast these solar-terrestrial effects.

In this talk, I will first review the Sun-Earth connection within the context of solar storms and discuss the impact of these storms on ground-based technology. I will then examine the state-of-art procedures currently used to predict these events and the ways to ultimately mitigate their consequences.

**Date:** Tuesday, March 28, 2017

**Time:** 4:30 p.m.

**Place:** SLH, Biology Bldg.

## Lecture series program

**Day 1, March 29 2017 (Physics Dept., Rm. 310):**

**Lecture I at 4:00PM:** *Introduction to Plasma Physics* [Dr. Antar]

Topics covered:

- Plasma description and properties
- Particle transport in plasma
- Magnetohydrodynamics (intro) and Plasma Waves (intro)
- Real-life applications of plasmas

**Coffee break**

**Lecture II at 5:30PM:** *Introduction to magnetic reconnection* [Dr. El-Eid]

Topics covered:

- What is magnetic reconnection?
- Physical description and spatial scales
- Magnetohydrodynamics (cont'd)-The Frozen-In condition
- Generalized Ohm's law

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**Day 2, March 30 2017 (Physics Dept., Rm. 310):**

**Lecture III at 4:00PM:** *Fundamentals of Magnetic Reconnection* [Dr. Dayeh]

Topics covered:

- Instabilities and the reconnection process
- The Hall Effect
- The black box: diffusion region

**Coffee break**

**Lecture IV at 5:30PM:** *Magnetic reconnection in space and laboratory experiments* [Dr. Dayeh]

Topics covered:

- Universality of magnetic reconnection
- Reconnection in astrophysical plasmas
- Reconnection in interplanetary space and planetary magnetospheres
- Reconnection in laboratory plasmas

**Round table discussion:** *Open questions in magnetic reconnection* [Faculty and students]