# Colloqui della Classe di Scienze

Anno Accademico 2018/2019

**Sala Stemmi | Palazzo della Carovana**
**Scuola Normale Superiore**
**Piazza dei Cavalieri, 7 - PISA**

## 15 MAGGIO 2019

Please take note of the unusual time 14:00


## LEE ROBERTS

Boston University


## Exploring *Terra Incognita* with the World's Largest Penning Trap


ABSTRACT:

The Standard Model provides a very precise prediction of the muon's magnetic anomaly $a_\mu = (g_\mu - 2)/2$, the deviation from 2 of the gyromagnetic ratio $g_\mu$.In his seminal 1926 paper, P.A.M. Dirac predicted that for electrons $g_e = 2$, but experiments then revealed that $g_e$ was slightly larger than 2. The reason was to be found in Quantum Mechanics, and the first radiative correction to $g_e$, calculated by Julian Schwinger, explained a deviation of order 0.1 %. Today, the Standard Model predicts the value of $a_\mu$ to a precision of ± 0.3 parts per million (ppm). Dedicated experiments have measured $a_\mu$ to ± 0.54 ppm precision. Therefore, precision measurements of the anomaly provide a stringent test of the Standard Model's completeness, since Nature knows about all forces that could contribute to the muon's magnetism, including those from New Physics that has not yet been discovered.

I will review the intellectual history that began with the discovery of spin and the *g*-factor of the electron and its role on the development of Modern Physics. Then I will focus on the measurements of the muon magnetic anomaly, which include particle counting techniques, and nuclear magnetic resonance (NMR) around the 45 m circumference of the ring to monitor and measure the precision magnetic field. A new experiment with a precision goal of ± 0.14 ppm is now in progress now at Fermilab, which should clarify whether or not differences that have surfaced between theory and experiment are statistically significant at the five standard deviation level.



ELABORAZIONE A CURA DEL SERVIZIO COMUNICAZIONE E RELAZIONI ESTERNE | SNS

SCUOLA NORMALE SUPERIORE

Info: Area Ricerca e Didattica - classi@sns.it