Federico Armato

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Research Activity

During my second year of doctoral studies, I furthered my research on the noise related to charge deposition on the Test Mass (TM) for Virgo, as well as the study of magnetic noise for Einstein Telescope (ET).

The Charge Problem:

Regarding the charge problem, I continued developing an efficient and minimally invasive monitoring system. The system consists of a discrete set of sensors that measure the electric potential generated by the charge distribution on the TM, along with neural networks specifically trained to determine the charge distribution from the measured potentials.

Some preliminary results are presented in the article *"Charge Monitoring of Test Masses in Gravitational Waves Interferometers"*, which demonstrates this procedure using simulated Gaussian charge distributions on the TM.

A more detailed discussion on the same topic will be featured in an upcoming monograph on the use of neural networks, which is currently in preparation.

MANET:

In my research on magnetic noise, my primary contribution has been participating in the design of MANET (MAgnetic Noise test facility for ET).

MANET is a facility that will be built and tested here at the University of Genova by the end of 2024 and then transported and used at Virgo (Cascina, Pisa). Its purpose, as mentioned in the article *"Future gravitational wave detectors: Phase noise investigation and magnetic noise mitigation strategies"*, is to magnetically characterize various components that will be used in ET.

MANET includes a rotating table, where the object to be characterized is placed, along with a series of sensors that measure the magnetic field components at different points in space. This setup allows us to determine the first orders of the multipole expansion of the magnetic object and accurately calculate its magnetic moment.

Additionally, MANET is equipped with three pairs of Helmholtz coils, enabling us to analyze how components respond to external magnetic fields and assess the effectiveness of different mitigation strategies.

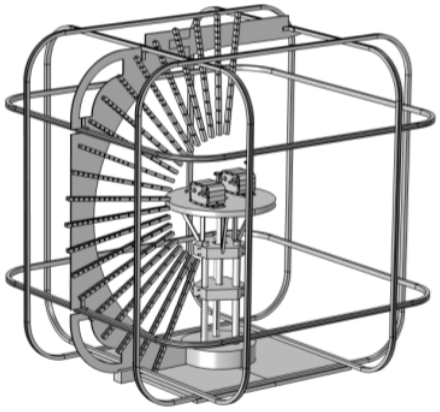

Figure 1: CAD drawing of MANET.

Attended Courses

- **Observational Astronomy (3CFU)**

  Teacher(s): Lorenzo Cabona
  Status: not given yet

Courses of the Previous Year

- **Gravitational Waves (6CFU)**

  Teacher(s): Andrea Chincarini, Gianluca Gemme, Fiodor Sorrentino
  Status: passed

- **Physics of Cosmic Structures (6CFU)**

  Teacher(s): Marco Raveri
  Status: not given yet

Schools and conferences

- **SIGRAV International School 2024 - Measuring Gravity (3CFU)** 19-23 Feb. 2024
  https://agenda.infn.it/event/38520/
- **16th Pisa Meeting on Advanced Detectors** May 2024 - poster
  Charge Monitoring of Test Masses in Gravitational Waves Interferometers
  https://agenda.infn.it/event/37033/contributions/227308/

Publications

- **Charge Monitoring of Test Masses in Gravitational Waves Interferometers.**
  https://doi.org/10.1016/j.nima.2024.169833
- **Future gravitational wave detectors: Phase noise investigation and magnetic noise mitigation strategies.**
  https://doi.org/10.1016/j.nima.2024.169629

Collaboration Papers

- **Observation of Gravitational Waves from the Coalescence of a 2.5–4.5M_e Compact Object and a Neutron Star.**
  https://iopscience.iop.org/article/10.3847/2041-8213/ad5beb
- **Ultralight vector dark matter search using data from the KAGRA O3GK run.**
  https://journals.aps.org/prd/abstract/10.1103/PhysRevD.110.042001