Federico Armato

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Research Activity

In the third year of my doctoral studies, I advanced my research on magnetic noise for the Einstein Telescope (ET) and progressed the development of a non-invasive charge monitoring system to investigate charge deposition on the Test Mass (TM) in Virgo. In addition, I continued my work on the Effective Field Theory of Dark Energy, a line of research I had first pursued in my master's thesis.

Magnetic Noise:

My contribution to the study of magnetic noise has developed along two complementary directions. First, I continued my involvement with the development of MANET, the facility dedicated to the magnetic characterization of components, which is scheduled for final installation at EGO in spring 2026 (Figure 1). In parallel, I carried out research on mitigation strategies, with the goal of effectively reducing the impact of magnetic noise (see *"Magnetic Noise Mitigation Strategies for the Einstein Telescope Infrastructure"*, *"Magnetic noise mitigation for upcoming Gravitational Waves detectors"* and *"Einstein Telescope: Ferromagnetic Shielding for Magnetic Noise Mitigation"* in the **Publications** section).

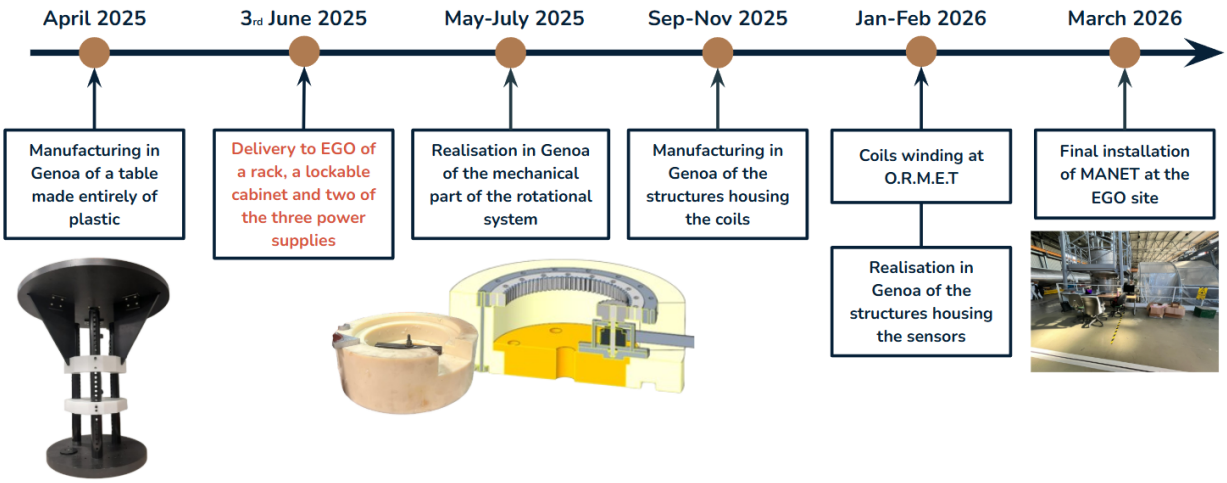

Figure 1: Timeline of the development and implementation of the MANET facility.

Charge Monitoring System:

Regarding the development of the monitoring system, I devised a method capable of determining the charge distribution of a system by exploiting the potentials measured by a set of sensors. A remarkable feature of this approach is its flexibility: the same procedures can be applied to different geometries. Thus, although the monitoring system was originally designed for charge measurements in the Virgo TM, this methodology can also be applied to other geometries (see *"AI-Powered Charge Monitoring in Interferometers"* in the **Publications** section).

Effective Field Theory of Dark Energy:

In the context of the Effective Field Theory of Dark Energy, a formalism designed to capture the dynamics of a wide class of modified gravity theories, I established a criterion for unambiguously selecting a basis to describe the cosmological background (see *"A continuity equation compatible basis for Effective Field Theory of Dark Energy"* in the **Publications** section).

Courses and Schools of the Previous Years

- **Gravitational Waves (6CFU)**

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

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

  Teacher(s): Marco Raveri
  Status: passed

- **Observational Astronomy (3CFU)**

  Teacher(s): Lorenzo Cabona
  Status: passed

- **SIGRAV International School 2024 - Measuring Gravity (3CFU)**

Conferences

- **Incontri di Fisica delle Alte Energie 2025 (IFAE 2025)** April 2025
  Einstein Telescope: sfide e soluzioni per il rumore magnetico - **PRESENTATION**
  Modelli di gravità modificata: la Teoria di Campo Efficace dell'Energia Oscura - **POSTER**

- **XV ET Symposium** May 2025
  Magnetic noise mitigation for Einstein Telescope: optimization of ferromagnetic shielding - **POSTER**
  GALILEO Infrastructures for Einstein Telescope - **POSTER**

Publications

- **Magnetic Noise Mitigation Strategies for the Einstein Telescope Infrastructure**, (2025).
  Galaxies. DOI:10.3390/galaxies13010009

- **Magnetic noise mitigation for upcoming Gravitational Waves detectors**, (2025).
  Nuclear Instruments and Methods in Physics Research Section A. DOI:10.1016/j.nima.2025.170637

- **AI-Powered Charge Monitoring in Interferometers**
  In *Gravitational Wave Science with Machine Learning (pp 85–100)*. Springer. DOI:10.1007/978-981-96-1737-1

- **Einstein Telescope: Ferromagnetic Shielding for Magnetic Noise Mitigation**, (2025).
  PREPRINT - arXiv:2508.06631

- **A continuity equation compatible basis for Effective Field Theory of Dark Energy**, (2025).
  PREPRINT - arXiv:2507.18526

Collaboration Papers

- Search for Eccentric Black Hole Coalescences during the Third Observing Run of LIGO and Virgo, 2024. *The Astrophysical Journal*.
- A Search Using GEO600 for Gravitational Waves Coincident with Fast Radio Bursts from SGR 1935+2154, 2024. *The Astrophysical Journal*.
- Swift-BAT GUANO Follow-up of Gravitational-wave Triggers in the Third LIGO–Virgo–KAGRA Observing Run, 2025. *The Astrophysical Journal*.
- Search for Continuous Gravitational Waves from Known Pulsars in the First Part of the Fourth LIGO-Virgo-KAGRA Observing Run, 2025. *The Astrophysical Journal*.
- Search for Gravitational Waves Emitted from SN 2023ixf, 2025. *The Astrophysical Journal*.
- Optical characterization of the Advanced Virgo gravitational wave detector for the O4 observing run, 2025. *Applied Optics*.