Contribution ID: **58** Type: **Poster**

Blind source separation in 3rd generation gravitational-wave detectors

The Einstein Telescope (ET) and Cosmic Explorer (CE), as next-generation gravitational-wave (GW) observatories, will achieve unprecedented sensitivity, detecting an immense number of GW signals across an extended frequency range. This improvement introduces a fundamental challenge: the presence of overlapping GW events in both time and frequency, complicating signal extraction and parameter estimation. Existing search pipelines assume isolated signals, but with BBH detection rates expected to reach 10^5–10^6 events per year, advanced signal processing techniques will be required to disentangle these overlaps effectively.
This work explores the application of Blind Source Separation (BSS) techniques—such as Independent Component Analysis (ICA), Non-Negative Matrix Factorization (NMF), and machine learning approaches—to gravitational-wave data. BSS methods, widely used in telecommunications and biomedical signal processing, offer a promising avenue for separating multiple overlapping sources without prior knowledge of their individual waveforms. We assess the feasibility of integrating these methods into next-generation GW data pipelines, considering constraints such as detector noise, real-time computational demands, and the evolving spectral characteristics of GW signals.
By adapting and optimizing BSS methods for the specific challenges of ET and CE we could enhance parameter estimation accuracy, mitigate biases in source characterization, and improve multi-messenger follow-up strategies. This study highlights the need for hybrid approaches combining BSS with traditional GW search algorithms to fully exploit the scientific potential of future GW observatories.

Primary authors: CHINCARINI, Andrea; BANERJEE, Biswajit; BADARACCO, Francesca (Unige); BRANCHESI, Marica

Presenter: BADARACCO, Francesca (Unige)

Session Classification: Poster Session

Track Classification: Observational Science (OSB): Other