

Gravitational Waves

Thursday, 21.08.2025, Room Erika Weinzierl Saal

Time	ID	GRAVITATIONAL WAVES I <i>Chair: Philippe Jetzer, Universität Zürich</i>
14:00	461	<p style="text-align: center;">Overview of Austrian and Swiss GW communities</p> <p style="text-align: center;"><i>Gianluca Inguglia, Institut für Hochenergiephysik der Österreichischen Akademie der Wissenschaften</i> <i>Steven Schramm, Université de Genève</i></p> <p>This contribution will provide an overview of the Austrian and Swiss gravitational-wave science communities, with the aim of identifying common interests and fostering future collaborations.</p>
14:20	462	<p style="text-align: center;">Challenges and opportunities of the Einstein Telescope</p> <p style="text-align: center;"><i>Ulyana Dupletsa, Institute of High Energy Physics - Austrian Academy of Sciences, Vienna, Austria</i></p> <p>The Einstein Telescope (ET) is a European project for a next-generation gravitational-wave detector designed to increase the sensitivity of current interferometers significantly. Its reference design features a triangular configuration of three nested detectors with 10 km arms, each hosting a 'xylophone' setup of two interferometers: one optimized for high frequencies, the other, cryogenic, for low frequencies. This design will significantly expand the observable volume of the Universe and improve source parameter estimation.</p> <p>In this contribution, we outline the key scientific objectives of the ET, and discuss the main detection and data analysis challenges. In particular, we focus on the role of machine learning techniques, such as anomaly detection for noise discrimination and fast inference methods for parameter estimation.</p>
14:40	463	<p style="text-align: center;">Preparing for computing at the Einstein Telescope</p> <p style="text-align: center;"><i>Steven Schramm, Université de Genève</i></p> <p>The Einstein Telescope is set to revolutionise gravitational-wave science, with an anticipated signal rate 10^4 times higher than that of the current LVK sensitivity. Moreover, the signals will remain in band much longer due to increased sensitivity at lower frequency, thus the signal extraction computing cost will grow considerably. A naive scaling of current approaches could require quadrillions of CPU hours per month of data-taking [arXiv:2412.02651], which is not feasible. This contribution will provide an overview of the Einstein Telescope computing challenges, which must be overcome in order for the Einstein Telescope science programme to be feasible.</p>
15:00	464	<p style="text-align: center;">Anomaly Detection of Gravitational Waves at the Einstein Telescope</p> <p style="text-align: center;"><i>Gianluca Inguglia, Institut für Hochenergiephysik der Österreichischen Akademie der Wissenschaften</i></p> <p>We present the implementation and preliminary results of a weakly supervised anomaly detection algorithm based on convolutional autoencoders for the detection of gravitational waves. The study is performed in the context of the Einstein Telescope and focuses on intermediate-mass black hole mergers. Incoming gravitational waves are assumed to be anomalies in the noise data. Using synthetic data produced by Einstein Telescope Collaboration, we show that such a tool can efficiently detect gravitational waves as anomalies in the data of an interferometer, with a recovery efficiency of the signal injected of up to 100 %, paving the way to further optimizations, refinement and the development of a fully automated search pipeline based.</p>
15:20		
15:30		Coffee Break

Time	ID	GRAVITATIONAL WAVES II <i>Chair: Gianluca Inguglia, ÖAW</i>
	465	<i>cancelled</i>
16:00	466	<p>Identification and parameter estimation of gravitational-wave signals from extreme-mass-ratio inspirals with LISA</p> <p><i>Stefan Strub¹, Lorenzo Speri², Domenico Giardini¹</i> ¹ <i>ETH Zurich, Switzerland,</i> ² <i>European Space Agency, Noordwijk, Netherlands</i></p> <p>We present an innovative search method for gravitational wave signals from EMRIs. With the precise identification of the signal we are able to compute the posterior distribution of EMRI signals. This leads the path to the global fit of EMRI signals overlapping with other sources of gravitational wave signals.</p>
16:20	467	<p>Deep source separation meets deep source inference: Toward a unified learning pipeline for high-dimensional gravitational-wave data</p> <p><i>Niklas Houba, ETH Zürich, Switzerland</i></p> <p>LISA will detect overlapping gravitational-wave signals embedded in complex, nonstationary noise. Disentangling these signals and estimating their source parameters - known as the global fit problem - is a key challenge in LISA data analysis. We present a prototype deep learning pipeline that combines source separation and inference in a unified framework. Adapting techniques from audio processing, we use a multichannel autoencoder to recover clean waveforms from noisy TDI data. Compact latent embeddings are then passed to an ensemble of neural spline flows for fast, simulation-based parameter inference. Frequency-domain MCMC sampling is used for validation and comparison. Applied to synthetic LISA data, the approach shows early promise for scalable signal recovery and calibrated inference in future data analysis pipelines.</p>
16:40	468	<p>Exploring nanoHz gravitational waves with pulsar timing arrays</p> <p><i>Michele Vallisneri, ETH Zürich, Switzerland</i></p> <p>Two years ago, pulsar timing arrays reported evidence of a gravitational-wave background consistent with emission from supermassive black hole binaries at the centers of galaxies, although more intriguing sources have been proposed by many. I celebrate the surprising opportunity of nanoHz gravitational-wave detection via pulsar timing, discuss our quest for statistical evidence and the fight against systematics, present new AI-inspired tools and methods for pulsar-timing-array data analysis, and speculate about future milestones.</p>
17:00		END
		Transfer to Dinner
19:30		Conference Dinner