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Changing the way we look at the sky - computer vision astrophysics

Initiative: Freigeist-Fellowships

Ausschreibung: Freigeist Kollegium

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This project couples novel astronomical full-sky imaging with advanced computer vision for break-through knowledge on the astrophysics at play in our Universe. That entails to couple nascent intensity mapping measurements for multiple spectral lines (full imaging cubes of intensity fluctuations) with machine learning techniques for optimal treatment of such imaging. At the same time, picking up all the light that reaches us instead of resolving single sources as traditionally done in astronomy, the combined method can push further back in time to close the gap between lower redshift galaxy surveys and high-redshift constraints from the Cosmic Microwave Background, mapping out an unprecedented part of the uncharted >80% of the observable Universe. The project aims at key questions of present-day astrophysics by this leap to modernity in treating scientific imaging, i.e. how did the first stars and galaxies look like? How did the gaseous intergalactic medium as well as structures in general evolve? Can we fully map the Universe from present up to high redshifts of Reionisation, our Universe's last big phase transition? Specific goals are to learn about the full intensity emitted throughout cosmic times, the Universe in multi-colour, to machine learn this sky of intensity maps, and to prepare optimally for such measurements. The proposed project creates for benchmarking with traditional approaches, as well as for training of computer vision algorithms, massive large-scale structure signature simulations for multi-line intensity maps. Together with advanced methods such as deep convolutional architectures both astrophysical and cosmological properties are explored for direct inference and fast emulation of intensity fields. The project thus fuses intensity imaging in astronomy and computer vision to tackle key astronomical questions such as properties of the first galaxies with a novel way to look at the sky.

Projektbeteiligte

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Open Access-Publikationen

SKA Science Data Challenge 2: analysis and results
On the general nature of 21cm-Lyman- emitters cross-correlations during reionisation
Cosmology from LOFAR Two-metre Sky Survey Data Release 2: Angular Clustering of Radio Sources
Cosmology from LOFAR Two-metre Sky Survey Data Release 2: Cross-correlation with Cosmic Microwave Background