Classification and Analysis of Radio Transients

Postdoc

Laboratory: IRFU/DAP/CosmoStat, CEA Paris-Saclay

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Context

The 21st century has seen the dawn of a multi-messenger age of astrophysics. In recent years gravitational wave interferometers, such as LIGO and Virgo, have pushed astronomical observations beyond the electromagnetic spectrum. This has made it possible to detect the interaction of distant neutron stars and black holes. With follow up studies in e.g. optical, X-ray and radio bands, it has become possible to probe deeper into the origins and intricacies of these extreme astronomical phenomena.

Radio wavelengths provide a complementary and independent probe of various astronomical sources. Radio astronomy provides the advantage of probing higher redshifts, having a deterministic point spread function (PSF) and being less sensitive to PSF anisotropies [1]. Cross-correlations between radio and optical surveys can additionally alleviate systematics effects such as intrinsic alignments for cosmological analysis [2-3]. Upcoming radio surveys, such as the Square Kilometre Array (SKA), are designed to reach an order of magnitude greater sensitivity and survey speed than existing instruments. SKA has the potential to greatly expand our understanding of the Universe given the vast sky area it will cover (~75%). This, however, comes at the cost of having to manage extremely large scales of data and complicated image reconstruction. SKA is expected to produce ~1 TB of data every second. With typical observations taking ~6h and a total lifespan of 15 years, SKA will produce data in the Exabyte (10^{18} bytes) scale [4], making it one of the biggest data management problems in modern science.

The upcoming ARGOS project aims to propel radio into the multi-messenger domain by carrying out continuous wide-field imaging of the sky at centimetre wavelengths and providing real time data and alerts. The combination of a wide field of view and high spatial resolution will enable ARGOS to detect millions of transient sources, such as fast radio bursts, supernovae, gamma-ray bursts and pulsars. These transient sources will enable

ARGOS to investigate the nature of dark matter and dark energy, the properties of extreme gravity, the origin of fast radio bursts and to provide follow up studies of gravitational wave events.

The CosmoStat lab is made up of a diverse team with expertise in theoretical and observational cosmology, signal processing and machine learning, and scientific software development. This combination of backgrounds makes the team well suited to prepare for the analysis of upcoming radio survey data as well as its scientific exploitation.

Project

The CosmoStat lab of CEA Paris-Saclay proposes a 3-year postdoctoral research position to explore the classification and analysis of transient sources in radio data. The postdoc will be part of the ARGOS project, where other members of the CosmoStat team will be developing cutting-edge 2D and 3D radio image reconstruction tools. The successful candidate will be expected to work closely with the reconstructed images to further the interpretation and maximise the scientific exploitation of these data.

The postdoc will have the opportunity to travel to meetings with the other ARGOS nodes in Greece and Germany and will be encouraged to attend international cosmology conferences to present results.

Environment

CEA Paris-Saclay is located 20 km south of Paris, France, in the vicinity of various universities and other research centres. The CosmoStat group is a diverse and multi-disciplinary team of researchers working on various topics in cosmology and data science. Our group is committed to diversity and equality, and encourages applications from women and underrepresented minorities. We support a flexible and family-friendly work environment. Benefits for this position include retirement, health care, parental leave, vacation and sick days, subsidised meals, discount for public transport, sport and culture, and French language classes.

References

[1] Brown et al., Weak gravitational lensing with the Square Kilometre Array, AASKA14, 2015
[2] Casas et al., Linear and non-linear Modified Gravity forecasts with future surveys, Physics of the Dark Universe 18, 2017
[3] Harrison et al., SKA Weak Lensing I: Cosmological Forecasts and the Power of Radio-Optical Cross-Correlations, MNRAS 463, 2016
[4] Scaife, Big telescope, big data: towards exascale with the Square Kilometre Array, Philos. Trans. R. Soc A, 2020