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Host galaxies and local properties of a complete sample of short Gamma-Ray Bursts

Short gamma-ray bursts (SGRBs) represent a unique class of cosmic events offering valuable insights into the physics of compact object binary systems. From the combined detection of the gravitational wave (GW) event GW170817 with the corresponding electromagnetic counterparts - the kilonova AT2017gfo and the short GRB170817A - interest in compact object binary merger counterparts has significantly increased, leading to extensive follow-up campaigns by ground-based and space telescopes. The Neil Gehrels Swift Observatory (Swift) fast re-pointing capability and precise X-ray afterglow localization by the Swift X-Ray Telescope (XRT) have enabled to secure a noteworthy amount of quality data to perform population statistical studies and shed light on the formation, evolution, and merger of these systems. For this purpose, a sample of short GRBs - the S-BAT4 - has been set up, collecting properties from 2004 to 2022, by means of precise selection criteria in terms of flux limitation and completeness, in order to ensure minimal observational and redshift-related biases. In the talk, I will present the analysis of the environmental properties of S-BAT4 events, including host galaxy features, offsets, and neutral hydrogen column densities (NH) derived from Swift/XRT spectra. Host galaxy properties and magnitudes have been analysed in comparison to carefully selected samples of field galaxies, as well as typical galaxies of long GRBs (LGRBs), to investigate how the environment plays a role in the GRB progenitor systems. Host galaxies of SGRBs have been found to be consistent with bright, mainly star-forming galaxies, with significant differences from LGRB hosts. Specifically, SGRB hosts display higher masses and gas-phase metallicities, while exhibiting lower star formation rates. Offsets and NH have been computed for a significant fraction of S-BAT4 events and analyzed in relation to both host and afterglow properties to shed light on different formation channels for compact object binary systems.

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