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Electromagnetic Counterpart Identification of Gravitational-wave candidates using deep-learning

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As gravitational-wave (GW) detectors become more sensitive and probe ever more distant reaches, the number of detected binary neutron star mergers will increase. However, detecting more events farther away with GWs does not guarantee corresponding increase in the number of electromagnetic counterparts of these events. Current and upcoming wide-field surveys that participate in GW follow-up operations will have to contend with distinguishing the kilonova from the ever increasing number of transients they detect, many of which will be consistent with the GW sky-localization. We have developed a novel tool based on a temporal convolutional neural network architecture, trained on sparse early-time photometry and contextual information for Electromagnetic Counterpart Identification (El-CID). The overarching goal for El-CID is to slice through list of new transient candidates that are consistent with the GW sky localization, and determine which sources are consistent with kilonovae, allowing limited target-of-opportunity resources to be used judiciously. In addition to verifying the performance of our algorithm on an extensive testing sample, we validate it on AT2017gfo - the only EM counterpart of a binary neutron star merger discovered to date - and AT2019npv - a supernova that was initially suspected as a counterpart of the gravitational-wave event, GW190814, but was later ruled out after further analysis.

Author: Dr CHATTERJEE, Deep (Massachusetts Institute of Technology)

Presenter: Dr CHATTERJEE, Deep (Massachusetts Institute of Technology)

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