中華民國天文學會
The Astronomical Society of the Republic of China (Taiwan)

Contribution ID: **151** Type: **Poster**

FRB detection pipeline development and validation using simulated and observed data with FAST

Fast radio bursts (FRBs) are millisecond-duration, coherent radio transients with unknown origins. They are generally classified into two types: repeating and non-repeating FRBs. These two categories are believed to arise from different physical mechanisms—for instance, starquakes on neutron stars for repeaters, and binary mergers for non-repeaters. Therefore, determining whether an FRB is a repeater is crucial to understanding its origin. However, due to instrumental limitations and restricted observational time, most detected FRBs appear non-repeating observationally, although they might be misclassified. To overcome this problem, machine learning (ML) has become a powerful tool to predict which non-repeating FRBs may eventually exhibit a repeating behavior. FRB 20190110C is one of such repeater candidates selected by ML (Chen et al. 2022). This FRB was later confirmed by the CHIME/FRB team, marking a significant validation of the ML method. Following this, we conducted an 11-day monitoring campaign of FRB 20190110C with a 10-minute exposure each day, totaling 110 min, with the Five-hundred-meter Aperture Spherical Telescope (FAST). I led the development of the data analysis pipeline, which involved RFI mitigation using sigpyproc and candidate searching with heimdall. From our observations, we identified 2,095 candidates. Although none were confirmed as detections after manual inspection, we validated our pipeline using simulated FRB signals, which showed clear detections. This confirms the reliability and effectiveness of our pipeline for future FRB detection efforts. Additionally, based on our non-detection results, we placed constraints on the repeating rate of FRB 20190110C and estimated the Weibull clustering parameter, providing further insight into the source's repeating behavior.

Section

Galaxy/Extragalactic

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Session Classification: Poster-EA