Contribution ID: **298** Type: **Talk in a parallel session**

A quantitative framework to study: Two-screen scattering effects in FRBs

Thursday, 11 July 2024 18:15 (15 minutes)

Fast Radio Bursts are known to exhibit scintillation and scattering phenomena , often attributed to the interaction of multiple screens. A common argument is that two screens, when appearing "pointlike" to each other, scintillate on both scales. This condition is commonly invoked to constrain scattering to FRB host galaxies. In this study, we explore this regime through simulations, revealing that two scales of scintillation persists even with the screens partially resolve each other.

The project's primary goal is to understand the appearance of the pulse when the screens resolve each other. The dynamic spectra of the pulse in this context unveil two distinct scales of scintillation, contradicting the argument the scattered image formed by the first screen should be unresolved by the second screen to observe 2-screen diffractive scintillation, commonly used to set an upper limit on the host screen distance from the FRB source.

Our investigation has revealed that as the screens resolve each other , the scintillation pattern changes along the scattering tail, a phenomenon absent when the screens remain unresolved. Our study also shows how specific FRB structures can arise from particular image distributions within the scattering screen. Additionally, we investigate the alterations in observables, such as modulation index, scintillation time scale, and bandwidth, as the screens resolve. We also demonstrate through simulations that the quenching phenomenon can be used to locate the host galaxy screen, thereby probing the host galaxy ISM at AU scales.

The work also introduces a new theoretical model and a novel simulation tool to study multi-screen scattering, which can be easily adapted to study images arising from gravitational lensing and microlensing from CGM clouds.

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Session Classification: Fast radio bursts

Track Classification: Fast Radio Bursts (FB): Fast radio bursts