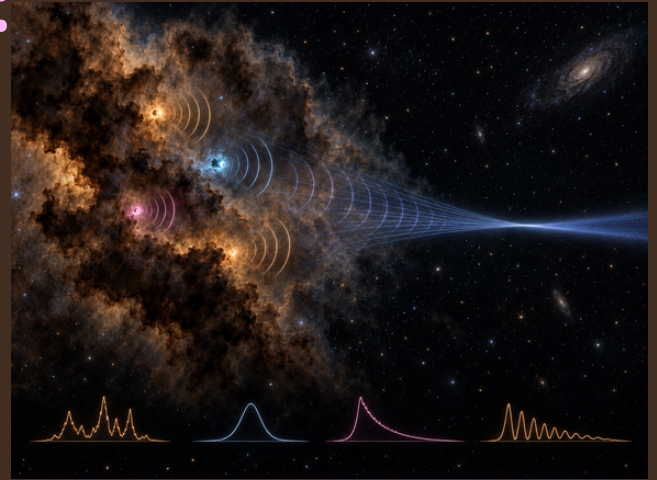


TSI SEMINARS - FALL 2026

The Radio Sky in Sync: Coherence, Maser Flares, and Superradiant Bursts

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Abstract: Some astronomical maser flares brighten by factors of hundreds or even thousands, with their radio emission rising much faster than changes in the pump—the energy input that maintains the conditions for maser emission. In a quasi-steady maser, the flare generally follows the pump in shape and duration. Dicke superradiance offers a fast-transient alternative based on phase coherence: through their shared radiation field, many molecules develop coordinated emission and release their stored energy collectively as a rapid, intense burst.

Using the Maxwell–Bloch equations, I will show how nonlinear feedback between matter and radiation connects familiar maser amplification to fast-transient superradiance. I will discuss applications to methanol, water, and OH emission and show how this framework can account for a range of flare morphologies, from nearly symmetric pulses and sharp-rise/slow-decay bursts to periodic flares, multiple peaks, and ringing. The observed light curve need not simply copy the pump: similar pumping can produce different delays, durations, and profiles because the flare reflects the dynamical response of the emitting gas. More broadly, coherence and nonlinearity can transform a modest or slowly varying change in the pump into a rapid and exceptionally bright radio burst.



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3:30 PM



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