Fire it up: using accretion outbursts to study the chemistry of protoplanetary disks

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Planets form in the midplanes of young protoplanetary disks, inheriting the chemical composition of their birth environments. As the central protostar evolves and the mass accretion rate decreases, the disk cools, and molecules such as water and complex organic molecules freeze out onto dust grains. Astrochemical observations at radio frequencies depend on the gas phase of these molecules, so as young stars evolve, it becomes harder to study the chemistry of their disks. However, protostars undergo episodic surges of accretion, during which accretion increases by a few orders of magnitudes for months to years. During these events, known as accretion outbursts, disk temperatures rise, sublimating the molecules that were frozen onto the dust grains. For planet-forming disks, accretion outbursts alter the spatial distribution and chemical composition of the gas available for dust growth and planet formation. For astronomers, they offer a unique oportunity to study the chemical composition of protoplanetary disks.

In this presentation, I will discuss our studies on the chemical effects of accretion outbursts in young protostellar disks. I will show the serendipitous ALMA discovery of compact hot emission from multiple complex organic molecules in four protostars currently experiencing, or have recently experienced, accretion outbursts. I will put these results into context through a comparison of our targets and other outbursting young stars from the literature with protostars considered to be in quiescence. I will conclude with recommendations for designing future astrochemical studies targeting young stars in outburst.