An unbiased NOEMA 2.6 to 4 mm survey of the GG Tau ring: First detection of CCS in a protoplanetary disk

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Abstract

Context. Molecular line surveys are among the main tools to probe the structure and physical conditions in protoplanetary disks (PPDs), the birthplace of planets. The large radial and vertical temperature as well as density gradients in these PPDs lead to a complex chemical composition, making chemistry an important step to understand the variety of planetary systems. Aims. We aimed to study the chemical content of the protoplanetary disk surrounding GG Tau A, a well-known triple T Tauri system. Methods. We used NOEMA with the new correlator PolyFix to observe rotational lines at ∼2.6 to 4 mm from a few dozen molecules. We analysed the data with a radiative transfer code to derive molecular densities and the abundance relative to 13CO, which we compare to those of the TMC1 cloud and LkCa 15 disk. Results. We report the first detection of CCS in PPDs. We also marginally detect OCS and find 16 other molecules in the GG Tauri outer disk. Ten of them had been found previously, while seven others (13CN, N2H+, HNC, DNC, HC3N, CCS, and C34S) are new detections in this disk. Conclusions. The analysis confirms that sulphur chemistry is not yet properly understood. The D/H ratio, derived from DCO+/HCO+, DCN/HCN, and DNC/HNC ratios, points towards a low temperature chemistry. The detection of the rare species CCS confirms that GG Tau is a good laboratory to study the protoplanetary disk chemistry, thanks to its large disk size and mass. © ESO 2021.

Author keywords

Astrochemistry; Molecular data; Protoplanetary disks; Stars: individual: GG Tau A