Planet-induced spirals in the circumbinary disk of GG Tauri A

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Context. ALMA high angular resolution observations of the dust and CO emission have already revealed signatures of protoplanets embedded in protoplanetary disks. These detections are around single T Tauri stars, while exoplanet surveys reveal that planets can also form in binary (or multiple) systems, either in circumstellar or circumbinary orbits. Aims. We searched for indirect evidence for planet formation in the multiple system GG Tau A, which harbors the most massive circumbinary disk among T Tauri stars. Methods. We performed CO(2-1) ALMA Cycle 6 observations of GG Tau A at 0.3? resolution. The images confirm the "hot spot"detected at higher frequencies, but also reveal prominent spiral-like features. We modeled these features using the analytic prescription for the linear perturbation regime induced by low-mass planets. Results. The brightest spiral is well reproduced by a density wave excited by a protoplanet (GG Tau Ac) at the hot-spot location (290 au), just outside the dust ring. The absence of a clear gap (in gas or dust) at the planet location implies that its mass is significantly lower than that of Jupiter, i.e., of about the mass of Neptune or

lower. Furthermore, other prominent (trailing) spiral patterns can be represented by adding one (or more) planet(s) at larger orbital radii, with the most obvious candidate located near the 2:1 mean-motion resonance with GG Tau Ac. Conclusions. The (proto-)planet GG Tau Ac appears to externally confine the ring in a stable configuration, explaining its high mass. Our results also suggest that planets similar in mass to Neptune may form in dense circumbinary disks orbiting (wide) binary stars. In the GG Tau case, orbital resonances appear to play an important role in shaping this multiple circumbinary planet system. © ESO 2020.

Circumstellar matter

Protoplanetary disks

Radio lines: stars

Stars: individual: GG Tau A

Dust

Interplanetary flight

Planets

Stars

High angular resolutions

Higher frequencies

Linear perturbations

Mean motion resonances

Multiple systems

Orbital resonances

Planet formation

Protoplanetary disks

Orbits