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# The accretion/ejection properties of Class 0 protostars studied with near-infrared spectroscopy

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Sun-like stars are thought to accrete most of their final mass during the protostellar phase, where the protostellar embryo is surrounded by an infalling dense envelope. The so-called Class 0 phase designates the youngest protostellar stage, where the accretion is the most vigorous. Because these objects are highly embedded, it is difficult to retrieve direct diagnostics from the accretion, whose observational imprint lie at small wavelengths, in the near-infrared and below. Therefore, little is known about the accretion properties and mechanisms occurring in the Class 0 phase because of high extinction. However, in rare cases the blueshifted cavity created by the outflow is sufficiently close to pole-on to liberate enough near-infrared scattered light for us to probe the immediate surroundings of the central object.

We present NIR observations of Class 0 protostars recently observed with Keck MOSFIRE and/or JWST NIRSpec. Br$\gamma$, several $H_2$ and CO overtone/fundamental ro-vibrational emission lines are detected and analyzed. The analysis of the numerous $H_2$ lines reveal the wind and shocks structures along the jet, which allow comparisons with shock models and robust estimation of the mass ejection rate. CO fundamental ro-vibrational emission lines seem to coincide with the base of the wind/jet system. Stellar CO overtone lines are seen in absorption in several sources either suggesting recent vigorous accretion episodes, or quiescent protostars. They also allow for the first time the exploration of the photospheric properties of these young protostellar embryos. CO overtone is seen in emission in half of the sources, tracing the dense inner accretion disk. Comparing these results with archival sample of Class I K-band spectra, we find that the CO and Br$\gamma$ emission lines are systematically more luminous in Class 0s, suggesting the accretion is on average more vigorous in the Class 0 phase. Typically associated with the heated inner accretion disk, the much higher detection rate of CO overtone emission in Class 0s indicate also that episodes of ExOr-type high accretion activity are more frequent in Class 0 systems. We modeled the CO overtone emission bands with analytical model of circumstellar disks and found the kinematics of the Class 0 CO overtone emission is consistent with either an accretion-heated inner disk, or material directly infalling onto the central nascent stellar embryo. The CO emission seems to be confined close to the central object surface (1-5 stellar radius). These results could point toward an accretion mechanism of different nature in Class 0 systems than the typical picture of magnetospheric accretion.

The sensitivity and wavelength coverage of JWST of these sources allow for much more precise extinction measurements, analysis of the excitation of molecular and atomic gas, and spatial mapping of the different spectral lines associated to the ejected and accreted material. These near- and mid-IR spectroscopy capabilities shall quantify the actual accretion/ejection properties of the youngest protostars.

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