Outflow feedback on star formation: wind-driven or jet-driven ?

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A long-standing open question in star formation is the process responsible for its low efficiency on parsec scales (a few %), and for shifting down the IMF to only ~ 30% of the prestellar core mass distribution. The most recent numerical simulations show that neither turbulence nor magnetic fields can, alone, reproduce these low efficiencies, and that *feedback by protostellar outflows must play a crucial role* by disrupting accretion streams, expelling material from cores, and/or sustaining turbulence (see eg. [1] for a review).

Unfortunately, the *magnitude* of outflow feedback (affected cloud volume, injected momentum, entrained mass, impact on the disk and infalling envelope) depends strongly on the underlying protostellar wind geometry, which remains uncertain and heavily debated [2]: a fast wide-angle "X-wind", a slower MHD disk wind, a narrow jet ? Clearly, if we want to reliably assess the role of outflow feedback in star formation, it is of utmost importance to determine which wind geometry is the most realistic (and/or which one can be excluded).

As a new contribution towards this goal, we present numerical predictions for outflows "shells" driven by a narrow jet in a prestellar core, that we compare against recent ALMA observations and analogous predictions for a wide-angle X-wind [3]. Our simulations are the first to combine jet variability, ambient density-stratification, and long timescales up to 10,000 yr (typical of young outflows) on scales up to 0.1 pc. We find that the predicted widths, position-velocity diagrams, and mass-velocity distribution, show striking resemblance with ALMA observations of CO outflows such as HH46-47 and CARMA-7, and often in closer agreement than models based on a wide-angle "X-wind". Implications and future tests will be briefly discussed.

Références

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