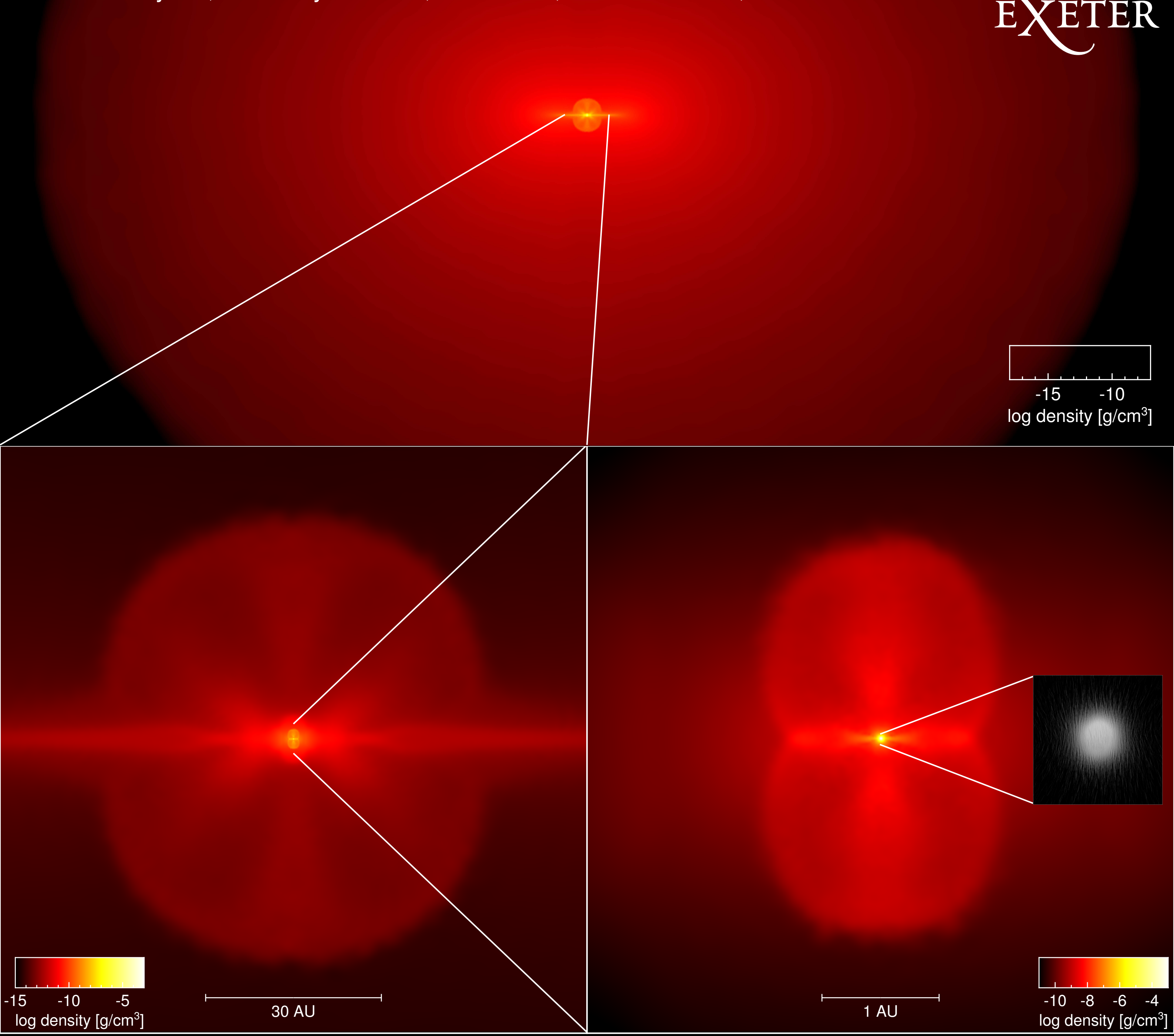
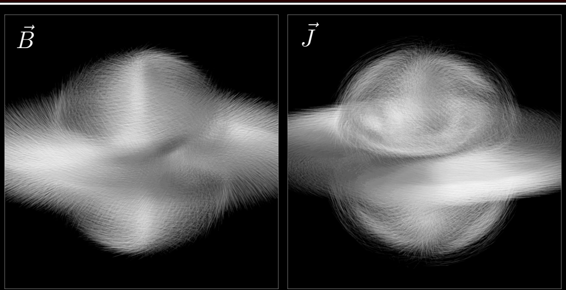
Collapse to stellar densities with radiation and magnetic fields: Outflows from the first and second hydrostatic cores

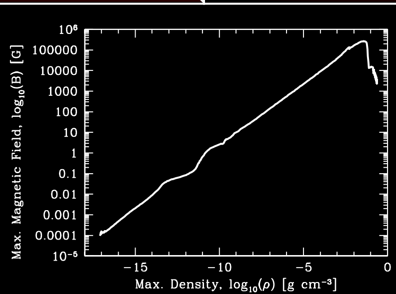
Daniel Price[1], Matthew Bate[2], and Terrence Tricco[1]
[1]Monash Centre for Astrophysics, Monash University, Melbourne, Vic 3800, Australia
[2]School of Physics, University of Exeter, Stocker Rd, Exeter EX4 4QL, UK

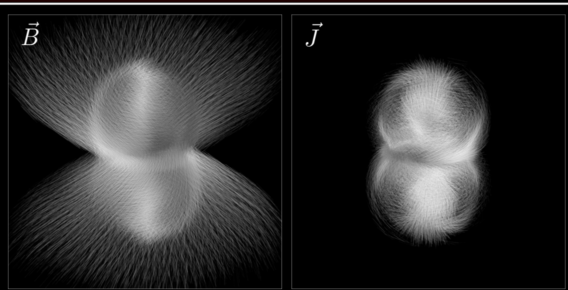
MoCA Monash Centre for Astrophysics
UNIVERSITY OF EXETER





Magnetic field and current in the first core outflow (100 x 100 AU)





Magnetic field and current in the second core outflow (10 x 10 AU)

We have used Smoothed Particle Radiation Magnetohydrodynamics to simulate the collapse of a rotating molecular cloud core from a density of 7 x10^{-18} g/cm^3 through to the formation of a protostar with densities of ~1 g/cm^3. We capture the formation of the first and second hydrostatic cores, including the outflows launched by a combination of magnetic fields and thermal feedback from each of these stages. We follow the stellar core for several years after formation until it grows to around 20 Jupiter masses with a size of 3 solar radii. We find that magnetic fields of > 10kG can be implanted in low mass stars at birth, with a mainly poloidal geometry consistent with the magnetic field entrained from the surrounding medium. See Bate, Tricco & Price (2013).