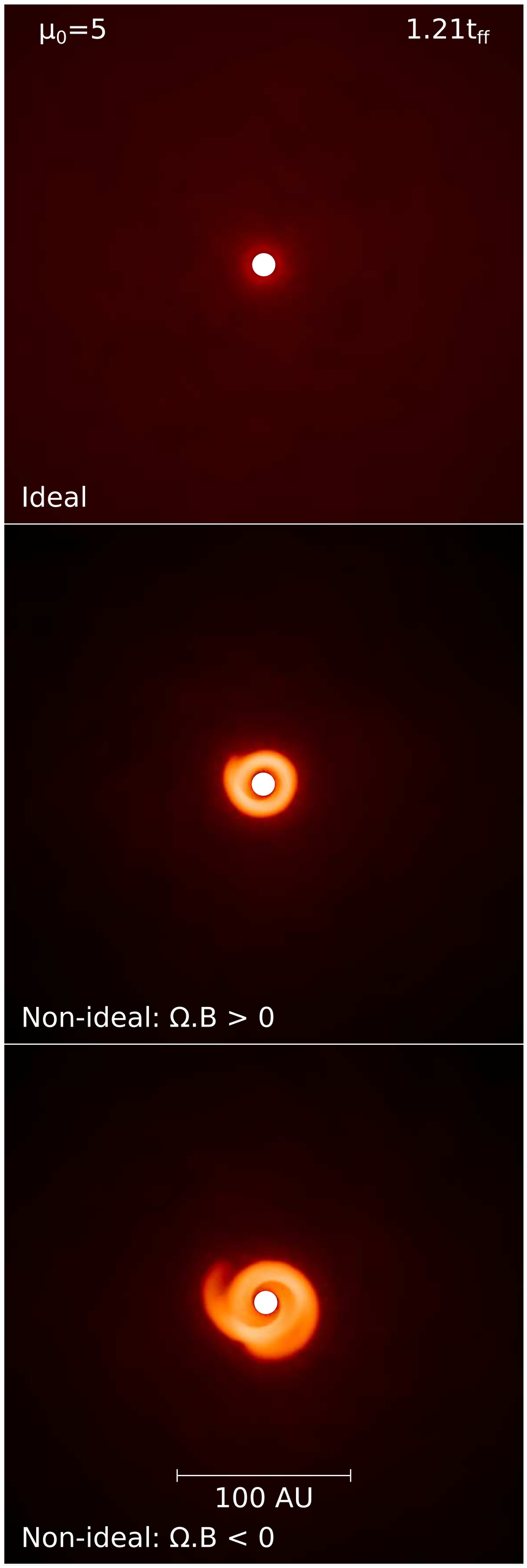
Bring Back the Disc!

James Wurster[1]*, Daniel Price[1] & Matthew Bate[1,2]
[1] Monash Centre for Astrophysics, School of Physics & Astronomy, Monash University
[2] School of Physics, University of Exeter, Stocker Rd, Exeter EX4 4QL, UK
*james.wurster@monash.edu

MONASH University
MoCA
Monash Centre for Astrophysics



The Magnetic Braking Catastrophe:

Numerical simulations cannot form discs in the presence of strong, ideal magnetic fields. This contradicts observations.

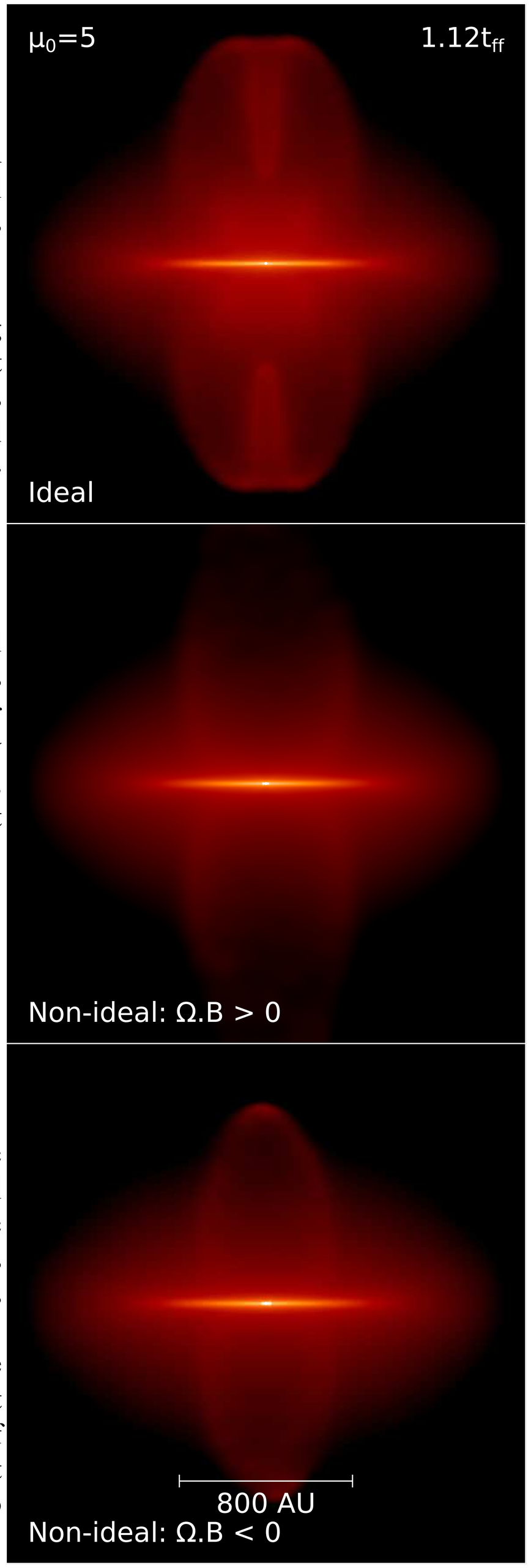
We model the collapse of a rotating $1M_{sun}$ gas cloud until the first hydrostatic core is formed. This is done in the presence of a vertical magnetic field with an initial mass-to-flux ratio of 5 times critical.

A Partial Solution:

A ~20AU disc forms when non-ideal MHD is included. Bipolar outflows are partially suppressed. Similar results are obtained when only ambipolar diffusion is included, indicating that it is the dominant effect.

A Better Solution:

Due to the Hall effect, a ~30 AU disc forms when the direction of the initial magnetic field is reversed. This disc is large enough to form sprial arms due to gravitational instabilities, thus planet formation is possible. Although ambipolar diffusion is the dominant effect, the Hall effect influences the final characteristics of the disc, impliying that the Hall effect does not need to be strong in order to yield an observable result.



References: Wurster, Price & Bate (submitted):
Can non-ideal magnetohydrodynamics prevent the magnetic braking catastrophe?

http://users.monash.edu.au/~jwurster/