**SHORT CIRCUITS IN MAGNETIC RECONNECTION: A ROUTE TO CHONDRULE FORMATION.**

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**Introduction:** Chondrule formation requires rapid heating to nearly 2000K, followed by cooling at 100-1000K/hr [1]. While shocks can heat protoplanetary disk material to such temperatures, it is not clear how shocks would be generated, nor is it clear that they would be adequately ubiquitous to explain the frequency of chondrules and the multiple heating events attested to by multiple igneous rims [2], nor how organic matter and presolar grains would survive in matrix if 'complementarity' is obeyed [3].

**Magnetic Reconnection:** An alternative heating source is the reconnection of magnetic fields. Disks have a vast reservoir of gravitational potential energy. This energy is released in the accretion flow, generally thought to be through the action of the magneto-rotational instability (MRI) [e.g., 4] which converts orbital kinetic energy into magnetic energy. For the observed accretion flows to occur, this energy must be exported from the disk, or the build-up of magnetic pressure will halt both the instability and the accretion flow.

This export of energy is accomplished through dissipation into heat through the reconnection of magnetic field lines, and subsequent radiative cooling. This magnetic reconnection involves the changing of the geometry of magnetic field lines from a tangled, high energy configuration to a smooth, low energy one. It is highly localized in space, intermittent in time, and occurs wherever disk accretion takes place [5,6]. Because of the localization in space and time, magnetic reconnection generates small regions of high temperature gas, although it remains to be seen where in a protoplanetary disk MRI turbulence and reconnection can achieve temperatures sufficient to form chondrules [1,7].

**Results:** In a recent theoretical advance, we have found that if magnetic reconnection occurs in regions with strong resistivity variation, the associated current sheet will preferentially travel through the low resistivity region in a phenomenon akin to an electrical short circuit. The bulk of protoplanetary disks are extremely neutral, so the resistivity can vary strongly with position if the charge also varies. We now calculate where and how position dependent resistivity can dramatically change the nature of magnetic dissipation, changing both the size of the reconnection regions and the temperatures reached. Such regions get both smaller, and hotter.

**Discussion:** Smaller and hotter, yet ubiquitous regions of heating are consistent with many meteoritic constraints on chondrule formation and accretion into chondrites. Complementary and rapid accretion of matrix and clasts, are thus within reach in the dramatic environments generated by MRI current sheets and their inevitable short-circuits.

**References:** [1] Desch & Connolly 2002 *Meteor. Planet. Sci.* 36:183 [2] Krot & Wasson 1995 *Geochim.Cosmochim. Acta* 59:4951 [3] Ebel et al., *this vol.* [4] Balbus & Hawley 1991 *Astrophys. J.* 376:214. [5] Joung et al. 2004 *Astrophys. J.* 606:532 [6] Oishi & Mac Low 2011 *Astrophys. J.* 740:18 [7] Ilgner & Nelson 2006 *Astron. & Astrophys.* 455:731.

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