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Current channel evolution in ideal Z pinch for general velocity profiles[1] IAN OCHS, Princeton University, CHRISTINE STOLLBERG, EYAL KROUPP, YITZHAK MARON, Weizmann Institute, AMNON FRUCHTMAN, Holon Institute of Technology, ELIJAH KOLMES, MIKHAIL MLODIK, NATHANIAL FISCH, Princeton University — Recent observations in gas-puff Z pinches, enabled by novel methods of diagnosing the magnetic field evolution, suggest an unexpected, radially-outward motion of the current channel, while the plasma moves radially-inward [C. Stollberg, Ph.D thesis, Weizmann Institute, 2019]. In this paper, a mechanism that could explain this current evolution is described. We examine the impact of advection on the distribution of current in a cylindrically symmetric plasma. In the case of metric compression, $|v_r| \propto r$, the current enclosed between each plasma fluid element and the axis is conserved, and so the current profile maintains its shape. We show that for more general velocity profiles, this simple behavior quickly breaks down, allowing for non-conservation of current in a compressing conductor, rapid redistribution of the current density, and even for the formation of reverse currents. In particular, a specific inward radial velocity profile is shown to result in radially-outward motion of the current channel, recovering the surprising current evolution discovered at the Weizmann Institute.

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