Abstract Submitted
for the DPP19 Meeting of
The American Physical Society

Current channel evolution in ideal Z pinch for general velocity profiles
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NIAL FISCH, Princeton University — Recent observations in gas-puff Z pinches,
enabled by novel methods of diagnosing the magnetic field evolution, suggest an un-
expected, radially-outward motion of the current channel, while the plasma moves
radially-inward [C. Stollberg, Ph.D thesis, Weizmann Institute, 2019]. In this pa-
per, 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 main-
tains 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 con-
ductor, 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.

This work was supported by NNSA 83228-10966 [Prime No. DOE (NNSA) DE-
NA0003764], by NSF PHY-1506122, by the BSF 2017669, by the Air Force Office
of Scientific Research (USA), and by the DOE CSGF fellowship (DOE DE-FG02-
97ER25308).

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Date submitted: 03 Jul 2019