Are ICM Magnetic Fields Generated from Scratch by Cosmic Rays?\textsuperscript{1} MIKHAIL MEDVEDEV, University Of Kansas, OLGA ZAKUTNYAYA, Space Research Institute, Russia — The origin of the micro-Gauss magnetic fields in galaxy clusters is one of the outstanding problem of modern cosmology. The intra-cluster medium (ICM) plasma is not static, as is seen in cosmological simulations and deduced from observational data. The motions are turbulent and supersonic with a number of merger and accretion shocks. We propose here that cosmic rays (CR) accelerated by the shocks are a natural and inevitable source of magnetic fields which are produced due to the CR streaming motion via a Weibel-type plasma instability. We develop a self-similar model of a CR foreshock and demonstrate that, in contrast to the conventional lore, the generated magnetic fields (i) are large-scale (of order the shock curvature radius, $\sim$ tens of kpc or more) hence they are effectively decoupled from dissipation and are long-lived on the Hubble time and (ii) are strong enough, of order of a fraction of the CR pressure, to meet observational constraints. Unlike other shock-related models of the field generation (e.g., via the Bell instability or the Richtmeyer-Meshkov vorticity instability), our model does not require preexisting seed fields; the fields are generated in the ICM at essentially a few cluster light-crossing times.

\textsuperscript{1}Supported by AST-0708213, NNX-08AL39G, DE-FG02-07ER54940.