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Every Nearby Pulsar is Surrounded by Inhibited Diffusion

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The electron + positron cosmic-ray flux recently released by the H.E.S.S. telescope shows a remarkable behaviour: It breaks at around 1 TeV and falls off quickly, following a smooth powerlaw. This is in tension with simple pulsar models, which predict a much harder electron spectrum at tens of TeV. However, in two-zone diffusion models, propagation of high-energy electrons is inhibited in a region around the pulsar (consistent with pulsar wind nebulae and TeV halos), causing the spectral hardening to soften the high-energy spectrum in agreement with observations. We find that there are a tens of known pulsars that would individually overproduce the H.E.S.S. TeV flux, allowing us to conclude that every nearby pulsar must be surrounded by a zone of inhibited diffusion.

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