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The cosmic ray positron fraction measurement with AMS: Its implications on dark matter, local pulsars and near-by supernova remnant sources

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Abstract: The AMS experiment onboard the International Space Station has confirmed the cosmic ray (CR) positron fraction rise above 10 GeV, as first observed with high confidence by PAMELA. This rise implies a large flux of high energy positrons injected into the local volume of the Galaxy. Using the updated data, I revisit the question of the origin of these high energy positrons. While dark matter models annihilating directly to electrons or muons no longer appear to be capable of accommodating these data in combination with other recent measurements of the CR electrons and positrons; dark matter models with a mass ~1-3 TeV annihilating to unstable intermediate states could still be responsible for the observed signal. In addition, using the high quality AMS data, we can place stringent limits on dark matter with masses below ~300 GeV, annihilating or decaying to leptonic final states, essentially independent of the origin of the positron fraction's rise. The improvement of the existing constraints, is in some cases by up to two orders of magnitude. Alternative to dark matter explanations for the rise of the positron fraction have included, injection of high energy electron positron pairs from nearby pulsars and acceleration of secondary CRs in close-by supernovae remnants. The up-dated observation of the positron fraction, can still be accommodated by pulsars within reasonable assumptions on their properties; while the recent Boron to Carbon ratio measurements place strong constraints to the case of near-by supernovae remnants.

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