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Cosmic ray heating in cool core clusters

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Feedback by active galactic nuclei appears to be critical in balancing radiative cooling of the low-entropy gas at the centers of galaxy clusters and in mitigating the star formation of the brightest cluster galaxies. I consider a model where the heating is provided by the damping of Alfvén waves that are excited by streaming cosmic rays (CRs). Recent radio observations of M87 by LOFAR suggest effective mixing of CRs with the cluster gas and the amount of CRs necessary to explain the observed gamma rays by Fermi and HESS is just right to balance the radiative cooling observed in the X-rays, providing a natural explanation for the observed temperature floor as shown by a thermal instability analysis. I will show first AREPO simulations of the non-linear interplay of CRs that are coupled to magneto-hydrodynamics with the goal to support this picture.

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