Extreme AGN Feedback and Cool Core Destruction in the X-ray Luminous Galaxy Cluster MACS J1931.8-2634

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We report on a deep, multiwavelength study of the galaxy cluster MACS J1931.8-2634 using Chandra X-ray, Subaru optical, and VLA 1.4 GHz radio data. This cluster (z=0.352) harbors one of the most X-ray luminous cool cores yet discovered, with an equivalent mass cooling rate within the central 50 kpc is approximately 700 solar masses/yr. Unique features observed in the central core of MACSJ1931.8-2634 hint to a wealth of past activity that has greatly disrupted the original cool core. We observe a spiral of relatively cool, dense, X-ray emitting gas connected to the cool core, as well as highly elongated intracluster light (ICL) surrounding the cD galaxy. Extended radio emission is observed surrounding the central AGN, elongated in the east-west direction, spatially coincident with X-ray cavities. The power input required to inflate these `bubbles' is estimated from both the X-ray and radio emission to reside between 4 and 14e45 erg/s, putting it among the most powerful jets ever observed. This combination of a powerful AGN outburst and bulk motion of the cool core have resulted in two X-ray bright ridges to form to the north and south of the central AGN at a distance of approximately 25 kpc. The northern ridge has spectral characteristics typical of cool cores and is consistent with being a remnant of the cool core after it was disrupted by the AGN and bulk motions. It is also the site of H-alpha filaments and young stars. The X-ray spectroscopic cooling rate associated with this ridge is approximately 165 solar masses/yr, which agrees with the estimate of the star formation rate from broad-band optical imaging (170 solar masses/yr). MACS J1931.8-2634 appears to harbor one of most profoundly disrupted low entropy cores observed in a cluster, and offers new insights into the survivability of cool cores in the context of hierarchical structure formation.

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