

## **The Intracluster Medium**

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The discovery of hot gas between galaxies within clusters of galaxies has provided new information on how galaxies form and evolve. But there remain a number of difficulties in understanding the state of this gas, despite the many probes of its physical properties that have been used. New X-ray data from the Chandra and XMM missions shows evidence for thermal substructures suggestive of shock fronts and other discontinuities in the atmospheres. The rapid cooling of the densest parts of the clusters predicted in "cooling flows" is largely absent, despite temperature gradients of the correct type. Voids seen in some atmospheres are thought to be filled by bubbles of relativistic plasma, rising away from active galaxies, and suggest methods by which the cooling gas is reheated and circulated within the cluster cores.

There is also evidence of non-thermal activity in some clusters, as revealed both in the X-ray and radio wavebands. Ordered magnetic fields with significant energy density are seen by Faraday rotation probes. A population of relativistic particles is present in some clusters, as seen either by a component of hard X-ray emission or by low-frequency radio synchrotron radiation. The origin of the relativistic particles that produce these emissions is obscure, although a model for their injection and maintenance will be described.