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Title:	Hot gas and galaxies in large-scale structures: a case study of two clusters and a supercluster
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Abstract:	Abstract Matter in the Universe is arranged in a network consisting of dense and long filaments (� 10 Mpc 1) of gas, galaxies, and invisible dark matter. These filaments are interspersed with gigantic cosmic voids (diameter d 10–100 Mpc) and host massive galaxy clusters (d 1–10 Mpc) at their intersection sites. This large-scale network of structure is popularly known as the ‘cosmic web’. The location of a galaxy within the cosmic web strongly influences its properties. For example, galaxies situated in higher density regions tend to be redder, have lower star forma- tion rates, and lower neutral Hydrogen gas content, indicating that some physical mechanisms triggered in relatively high-density environments are responsible for transforming galaxy prop- erties. Clusters of galaxies, the densest parts of the cosmic web, are home to hundreds to thou- sands of galaxies immersed in vast amounts of multi-million-degree hot ionized gas, dubbed the ‘intracluster medium’ (ICM). They are important sites to study the complex effects of envi- ronment on galaxies. These enormous objects grow by accreting matter from the surrounding cosmic web. The study of mergers in galaxy clusters is thus crucial to our understanding of how these large-scale objects form and evolve. In this thesis, we present the first detailed studies of the thermodynamic properties of the hot X-ray emitting gas in two nearby galaxy clusters – Abell 2151 and Abell 1569. We investigate the presence of substructure, merging activity, and cool cores, in these two systems. The study of Abell 1569 focuses on examining the interaction between the central radio galaxies and the surrounding intracluster gas. Both Abell 2151 and Abell 1569 show significant substructure. We confirm the bimodal X-ray structure of the cen- tral subcluster of Abell 2151 (A2151C). The two gas clumps in A2151C have notably different gas properties, confirming they are distinct galaxy groups. The brighter of the two groups ex- hibits the morphology of a relaxed system and hosts a cool core. The fainter group appears to be in the process of formation. In the northern subcluster of Abell 1569 (A1569N), we detect a pair of cavities carved out due to the displacement of the intracluster gas by the radio lobes of the central galaxy 1233+169. There is also some indication of cavity-induced heating of the ICM in A1569N. The southern subcluster of Abell 1569 (A1569S) shows strong evidence of merging activity which explains the bending of the tails of the central radio galaxy 1233+168. A separate study using optical data to explore the statistical trends in the luminosity-weighted age and stellar metallicity (Z) of galaxies in the Coma supercluster as a function of their stellar mass and large-scale environment, viz. clusters/groups, filaments, and voids, also constitutes a part of this thesis. Galaxies residing in clusters are older and more metal-rich than their coun- terparts in filaments and voids. Further, we observe an anti-correlation between age and Z of galaxies in the Coma supercluster. A key finding of this study is that Z is 0.02–0.03 dex lower for galaxies at the spine of the filament relative to their counterparts � 1 Mpc away from it, suggesting that large-scale cosmic filaments play a significant role in the evolution of galaxies. 1 1 parsec (pc) = 3.086 × 10 16 m
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