Cooling Flows in Clusters of Galaxies

A.C. Fabian ARAA 32, 277-318 (1994)
and recent progress

Cooling Flows In Clusters And Galaxies

Patrick Koch

Cooling Flows In Clusters And Galaxies:

Cooling Flows in Clusters and Galaxies A.C. Fabian,2012-12-06 X ray astronomers discovered the diffuse gas in clusters of galaxies about 20 years ago It was later realized that the central gas density in some clusters and in elliptical galaxies is so high that radiative cooling is a significant energy loss The cooling time of the gas decreases rapidly towards the centre of the cluster or galaxy and is less than a Hubble time within the innermost few hundred kiloparsecs This results in a cooling flow in which the gas density rises in order to maintain pressure to support the weight of the overlying gas The rate at which mass is deposited by the flow is inferred to be several hundreds of solar masses per year in some clusters The fraction of clusters in which cooling flows are found may exceed 50 per cent Small flows probably occur in most normal elliptical galaxies that are not in rich clusters The implications of this simple phenomenon are profound for we appear to be witnessing the ongoing formation of the central galaxy In particular since most of the gas is undetected once it cools below about 3 million K it appears to form dark matter There is no reason why it should be detectable with current techniques if each cooling proton only recombines once and the matter condenses into objects of low mass Cooling Flows in Clusters and Galaxies A C Fabian,1988-05-31 Cooling Flows in Clusters and Galaxies A.C. Fabian,1988-05-31 X ray astronomers discovered the diffuse gas in clusters of galaxies about 20 years ago It was later realized that the central gas density in some clusters and in elliptical galaxies is so high that radiative cooling is a significant energy loss The cooling time of the gas decreases rapidly towards the centre of the cluster or galaxy and is less than a Hubble time within the innermost few hundred kiloparsecs This results in a cooling flow in which the gas density rises in order to maintain pressure to support the weight of the overlying gas The rate at which mass is deposited by the flow is inferred to be several hundreds of solar masses per year in some clusters The fraction of clusters in which cooling flows are found may exceed 50 per cent Small flows probably occur in most normal elliptical galaxies that are not in rich clusters The implications of this simple phenomenon are profound for we appear to be witnessing the ongoing formation of the central galaxy In particular since most of the gas is undetected once it cools below about 3 million K it appears to form dark matter There is no reason why it should be detectable with current techniques if each cooling proton only recombines once and the matter condenses into objects of low mass **Cooling Flows in Clusters of Galaxies** Avery Abraham Meiksin,1988 *The Simulation of Cooling Flows in Clusters of Galaxies* Nasser Mohamed Ahmed,2007 **A Study of Cooling Flows in Poor Clusters of Galaxies** National Aeronautics and Space Administration (NASA),2018-06-28 We observed three poor clusters with central dominant galaxies AWM 4 MKW 4 and MKW 3 s using the Position Sensitive Proportional Counter on the ROSAT X ray satellite The images reveal smooth symmetrical X ray emission filling the cluster with a sharp peak on each central galaxy The cluster surface brightness profiles can be decomposed using superposed King models for the central galaxy and the intracluster medium The King model parameters for the cluster portions are consistent with previous observations of these clusters The newly measured

King model parameters for the central galaxies are typical of the X ray surface brightness distributions of isolated elliptical galaxies Spatially resolved temperature measurements in annular rings throughout the clusters show a nearly isothermal profile Temperatures are consistent with previously measured values but are much better determined There is no significant drop in temperature noted in the innermost bins where cooling flows are likely to be present nor is any excess absorption by cold gas required All cold gas columns are consistent with galactic foreground absorption We derive mass profiles for the clusters assuming both isothermal temperature profiles and cooling flow models with constant mass flow rates Our results are consistent with previous Einstein IPC observations by Kriss Cioffi Canizares but extend the mass profiles out to 1 Mpc in these poor clusters Kriss Gerard A and Dillingham Stephen Unspecified Center NAG5 1952 **Cooling Flows in Clusters of Galaxies** Patrick Koch,1999 **The Simulation of Cooling Flows in Clusters of Galaxies** Nasser Mohamed Ahmed Mohamed Ismail,2007 Optical and X-ray Studies of Cooling Flows in Clusters of Galaxies John Agrel Culver,1983 Cooling Flows and Cold Gas in Clusters of Galaxies Stuart Daines,1994 **Photoionization of Intergalactic Gas and Cooling Flows in Clusters of Galaxies** Megan E. Donahue,1990 **Galactic and Cluster Cooling Flows** Noam Soker,1997 Evidence for Cool Gas and Star Formation in Cluster Cooling Flows Brian Robert McNamara,1991 Magnetic Fields in the Clusters of Galaxies with Extreme Cooling Flows Jing Ping Ge,1991 Particle Acceleration in Clusters of Galaxies and Physical Connection Between Cooling Flows and Radio Mini-halos Myriam Gitti,2002*

Lighthouses of the Universe: The Most Luminous Celestial Objects and Their Use for Cosmology Marat Gilfanov,Rashid Sunyaev,Eugene Churazov,2002-08-06 The book reviews the present status of understanding the nature of the most luminous objects in the Universe connected with supermassive black holes and supermassive stars clusters of galaxies and ultraluminous galaxies sources of gamma ray bursts and relativistic jets Leading experts give overviews of essential physical mechanisms involved discuss formation and evolution of these objects as well as prospects for their use in cosmology as probes of the intergalactic medium at high redshifts and as a tool to study the end of dark ages The theoretical models are complemented by new exciting results from orbital and ground based observatories such as Chandra XMM Newton HST SDSS VLT Keck and many others **X-ray Spectroscopic Constraints on Cooling-flow Models for Clusters of Galaxies** John Peterson,2003 Literature 1987, Part 2 U. Esser,H. Hefele,I. Heinrich,W. Hofmann,D. Krahn,V. R. Matas,L. D. Schmadel,G. Zech,2013-11-11 Astronomy and Astrophysics Abstracts aims to present a comprehensive documen tation of the literature concerning all aspects of astronomy astrophysies and their border fields It is devoted to the recording summarizing and indexing of the relevant publications throughout the world Astronomy and Astrophysics Abstracts is prepared by a special department of the Astronomisches Rechen Institut under the auspices of the International Astronomical Union Volume 44 records literature published in 1987 and received before February 15 1988 Some older documents which we received late and which are not surveyed in earlier volumes are inc1uded too We acknowledge with thanks contributions

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X-ray and Radio Structures in Cooling Flow Clusters Zhenping Huang,2002

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