Document Control Sheet

1. ISBN or ISSN	2. Type of Report Final report
3a. Report Title Measuring sloshing, merging and feedback velocities in Galaxy clusters	
3b. Title of Publication	
4a. Author(s) of the Report (Family Name, First Name(s)) Merloni, Andrea; Sanders, Jeremy; Gatuzz, Efrain	5.End of Project 2024-08-31
	6. Publication Date
4b. Author(s) of the Publication (Family Name, First Name(s))	7. Form of Publication
8. Performing Organization(s) (Name, Address) Max-Planck-Institut für extraterrestrische Physik Giessenbachstr.. 1 85748 Garching	9. Originator's Report No.
	10. Reference No. 50OR2207
	11a. No. of Pages Report XXXXXXXX
	11b. No. of Pages Publication XXXXXXXX
13. Sponsoring Agency (Name, Address) Deutsche Raumfahrtagentur im Deutschen Zentrum für Luft- und Raumfahrt e.V. Königswinterer Str. 522-524 53227 Bonn	12. No. of References XXXXXXXX
	14. No. of Tables
	15. No. of Figures
16. Supplementary Notes	
17. Presented at (Title, Place, Date)	

18. Abstract

We have developed a new method to correct the observed energy of X-ray photons in observations with the EPIC-pn detector on the XMM-Newton satellite. The method uses a large set of archival observations to capture the spatial and temporal variation of the detector based on the energy of background emission lines. Thanks to this method, it is possible to determine the velocity of flows in galaxy clusters with an accuracy of 100 km/s from the measurement of the redshift of the Fe-K line complex. Since the background lines are only present in the fringes of the detector, special offset observations are required to apply this technique, or large objects that fill the field of view can be studied. This method was successful when applied to archival observations of the Perseus and Coma galaxy clusters, and very long observations of the Virgo and Centaurus galaxy clusters with XMM-Newton were obtained in a previous project. Here, we report on a long observational campaign to observe the Ophiuchus galaxy cluster. We have updated our correction procedure to use the latest archival data set and the XMM-Newton analysis software version. The central part of the project, mapping the velocity structure in the Ophiuchus, was completed. We produced profiles and maps of the hot gas velocity in the cluster using the EPIC-pn data. We have found a large redshifted-blueshifted interface approximately 150 kpc eastward from the cluster core was identified, displaying indications of limited metal mixing and traced by discontinuities in X-ray surface brightness. These large observational campaigns also enable measuring velocity structure functions within the systems, representing the velocity variation with scale. In the case of Ophiuchus, there are hints of a multimodal probability distribution function. We also measured the abundances and their radial dependence. By modeling the X/Fe ratio profiles with a linear combination of type SNIa and SNcc, we determined that the SNIa ratio in the total cluster enrichment supports an early ICM enrichment scenario for all sources, with most metals produced before clustering. Our work has been successful and has resulted in five publications. The results of this project underline the power of our correction method, which has led to the acquisition of new deep data from the A3266 and A2029 clusters.

19.Keywords

X-rays, Galaxy Clusters, Diffuse Emission

20. Publisher	21. Price