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Discovery of a Shock Front in the merging cluster of galaxies ACO2163

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ACO2163 is one of the hottest Abell galaxy clusters which has been observed countless times through different wavelengths and has always shown remarkable properties. We report a detection of a shock front in ACO2163 through the use of the X-ray and radio observations which were combined to determine the shock location in relation to the radio emission and other specific parameters inherent to the shock front. We used XMM-Newton observations and extracted spectra to determine the luminosity and temperature in the area around the edge of the cluster. From a temperature jump we obtain a Mach number of 2.2±0.3, which is a typical value for shocks in merging galaxy clusters.
The radio study has been conducted using the VLA data where we have done a spectral analysis of the halo region. We find that the south-western region of the cluster where the shock is located is globally flat, indicating the presence of energised electrons in this region.
To explain the electrons at the shock we invoke the Kang & Ryu model where shock acceleration occurs in a cloud of fossil relativistic electrons which can be provided by a radio galaxy.
Interestingly, we observe a radio galaxy in the region of the shock. If the shock is interacting with the electron cloud then the shock is currently re-accelerating the fossil relativistic electrons in the cloud, and will exit out of the cloud at cloud crossing time of ~54 Myr.
Another alternative explanation suggests a complex scenario in ACO2163 where a simultaneous compression and re-acceleration of pre-existing relativistic fossil electrons at the shock location could be taking place. We also consider simpler alternatives to explain the shock accelerated electrons.

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