Origin of very high energy emission in galaxy Clusters

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Clusters of galaxies have long been considered as possible candidates for the sources of TeV gamma rays emitted by protons and electrons accelerated at large-scale shocks or by a galactic wind or active galactic nuclei. We present the results of fifteen-year-long observations of the AGN NGC 1275, the central galaxy of Perseus cluster of galaxies, at energies 800 GeV – 40 TeV discovered by the SHALON telescope in 1996. Having analyzed the SHALON data, we have determined such characteristics of NGC 1275 as the spectral energy distributions and images at energies > 800 GeV for the first time. The emission regions of very high energy gamma-rays observed by SHALON from NGC 1275 well correlates with the photon emission regions viewed in X-rays by Chandra. Thus, the TeV gamma-ray emission recorded by SHALON has an extended structure with a distinct core centered at the source's position. To analyze the emission related to this core, we additionally identified the emission component corresponding to the central region of NGC 1275, and got spectral energy distribution of this component as a result. Also, the variations of TeV gamma-ray flux were found. The data obtained at very high energies, namely the images of the galaxy and its surroundings, and the flux variability indicate that the TeV gamma-ray emission is generated by a number of processes: in particular, part of this emission is generated by relativistic jets in the nucleus of NGC 1275 itself. The presence of an extended structure around NGC 1275 is evidence of the interaction of cosmic rays and magnetic fields generated in the jets at the galactic center with the gas of the Perseus cluster.