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Jets created from accretion onto supermassive black holes release relativistic particles on large distances. These strongly affect the intracluster medium when located in the center of a brightest cluster galaxy. On the other hand, the hierarchical merging of subclusters and groups, from which cluster originate, also generates perturbations into the intracluster medium through shocks and turbulence, constituting a potential source of reacceleration for these particles. In this talk, I will present an overview of the deep multi-scale low radio frequency observations of the Perseus cluster obtained from the Karl G. Jansky Very Large Array, probing the non-thermal emission from the old particle population of the AGN outflows. Our observations of this nearby relaxed cool core cluster have revealed a multitude of new structures associated with its radio lobes, mini-halo as well as the bent-jet radio galaxies harboring the cluster. Indeed, new hints of sub-structures appear in the inner radio lobes of the brightest cluster galaxy NGC 1275. Moreover, the unveiled irregular morphology of its mini-halo seems to have been influenced both by the AGN activity and by the sloshing motion of the cluster's gas. It has a filamentary structure similar to that seen in radio relics found in merging clusters. I will also explore the potential connection between the mini-halo and the wide-angle tail radio galaxy NGC 1272 as well as newly resolved structures linked to this galaxy. For the first time, two distinct, narrowly-collimated jets are visible in IC 310, consistent with a highly-projected narrow-angle tail radio galaxy infalling into the cluster. I will show how this interpretation is also in agreement with its blazar-like behavior, which implies that blazars and bent-jet radio galaxies are not mutually exclusive. The filamentary structures present across the entire tail of NGC 1265 and seen in other cluster's radio sources such as relics and radio lobes, indicate that there may be a fundamental connection between all these radio structures. These results show how such high-quality images at low radio-frequencies can bring a whole new dimension to our understanding of a galaxy cluster and add new constraints on the complex nature of diffuse radio emission in these environments.