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Self-regulated AGN feedback of light jets in cool-core galaxy clusters

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Heating from active galactic nuclei (AGN) is thought to stabilize cool-core clusters, limiting star formation and cooling flows. We employ radiative magneto-hydrodynamic (MHD) simulations to model light AGN jet feedback with different accretion modes (Bondi-Hoyle-Lyttleton and cold accretion) in an idealised Perseus-like cluster. Independent of the probed accretion model, accretion efficiency, jet density and resolution, the cluster self-regulates with central entropies and cooling times consistent with observed cool-core clusters in this non-cosmological setting. We find that increased jet efficiencies lead to more intermittent jet powers and enhanced star formation rates. Our fiducial low-density jets can easily be deflected by orbiting cold gaseous filaments, which redistributes angular momentum and leads to more extended cold gas distributions and isotropic bubble distributions. In comparison to our fiducial low momentum-density jets, high momentum-density jets heat less efficiently and enable the formation of a persistent cold-gas disc perpendicular to the jet that is centrally confined. Cavity luminosities measured from our simulations generally reflect the cooling luminosities of the intracluster medium (ICM) and correspond to averaged jet powers that are relatively insensitive to short periods of low-luminosity jet injection. Cold gas structures in our MHD simulations with low momentum-density jets generally show a variety of morphologies ranging from discy to very extended filamentary structures. In particular, magnetic fields are crucial to inhibit the formation of unrealistically massive cold gas discs by redistributing angular momentum between the hot and cold phases and by fostering the formation of elongated cold filaments that are supported by magnetic pressure.

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