ACCESS IV: The quenching of star formation in a cluster population of dusty S0s

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We present an analysis of the mid-infrared (MIR) colours of 165 70um-detected galaxies in the Shapley supercluster core (SSC) at z=0.048 using panoramic Spitzer/MIPS 24 and 70um imaging. While the bulk of galaxies show f70/f24 colours typical of local star-forming galaxies, we identify a significant sub-population of 23 70micron-excess galaxies, whose MIR colours (f70/f24>25) are much redder and cannot be reproduced by any of the standard model infrared SEDs. These galaxies are found to be strongly concentrated towards the cores of the five clusters that make up the SSC, and also appear rare among local field galaxies, confirming them as a cluster-specific phenomenon. Their optical spectra and lack of significant UV emission imply little or no ongoing star formation, while fits to their panchromatic SEDs require the far-IR emission to come mostly from a diffuse dust component heated by the general interstellar radiation field rather than ongoing star formation. Most of these 70micron-excess galaxies are identified as ~L* S0s with smooth profiles. We find that almost every cluster galaxy in the process of star-formation quenching is already either an S0 or Sa, while we find no passive galaxies of class Sb or later. Hence the formation of passive early-type galaxies in cluster cores must involve the prior morphological transformation of late-type spirals into Sa/S0s, perhaps via pre-processing or the impact of cluster tidal fields, before a subsequent quenching of star formation once the lenticular encounters the dense environment of the cluster core. In the cases of many cluster S0s, this phase of star-formation quenching is characterised by an excess of 70um emission, indicating that the cold dust content is declining at a slower rate than star formation.

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