



KERR BLACK HOLES WITH SYNCHRONISED SCALAR HAIR AND HIGHER AZIMUTHAL HARMONIC INDEX

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Kerr black holes with synchronised scalar hair and azimuthal harmonic index $m > 1$ are constructed and studied. The corresponding domain of existence has a broader frequency range than the fundamental $m=1$ family; moreover, larger ADM masses, M and angular momenta J are allowed. Amongst other salient features, non-uniqueness of solutions for fixed global quantities is observed: solutions with the same M and J co-exist, for consecutive values of m , and the ones with larger m are always entropically favoured. Our analysis demonstrates, moreover, the qualitative universality of various features observed for $m=1$ solutions, such as the shape of the domain of existence, the typology of ergo-regions, and the horizon geometry, which is studied through its isometric embedding in Euclidean 3-space.