The subject of study of this thesis is the Kerr–Newman–(anti-)de Sitter space-time, a rotating and charged exact black-hole solution of the Einstein–Maxwell equations with a non-zero cosmological constant. In the first part of the thesis we examine admissible extremal configurations, present the corresponding Penrose diagrams, and investigate the effects of frame-dragging. In the second part, we follow the motion of charged particles via the Lagrangian formalism, focusing on the equatorial plane and the axis where we arrived at some analytic results concerning the trajectories. Static particles, effective potentials and – in the case of the equatorial plane – stationary circular orbits are examined. We also perform numerical simulations of particle motion to be able to check our analytic results and also to foster our intuition regarding the behaviour of the test particles. The last part concerns quantum tunnelling of particles through the space-time's horizons, specifically the null geodesic method. The main goal of these computations is to obtain horizon temperatures, in which we succeed up to a constant multiplicative factor. We discuss various pitfalls of the method and stake out a possible approach when applying it to the extreme horizons present in KN(a)dS.