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# Exact Models of Charged Black Holes
## II. Axisymmetric Stationary Horizons

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**Abstract.** Using the formalism developed in the preceding paper, all axisymmetric stationary horizons are described. It is found that the bifurcate-type horizons (such as Schwarzschild) are as numerous as about four functions of one variable, while the extreme-type ones (such as extreme Kerr) only as about two functions of one variable. On the other hand, there is exactly one axisymmetric stationary space-time containing a given bifurcate-type horizon, in comparison to a whole family (at least as numerous as two functions of one variable) of such space-times for a given extreme-type one.

The total mass $m$ and angular momentum $am$ of the corresponding black hole could in principle be computed from the invariants describing the bifurcate-type horizons, because the horizons determine their space-time uniquely, but a definite way of computation will probably be difficult to find. On the other hand, the Kerr-Newman-like parameters $m$ and $a$ are easily defined and computed for any extreme-type horizon, but their physical meaning remains so far obscure.

### 1. Introduction and Summary

In the previous paper [1], a simple classification of symmetry properties of the perfect horizons [2] has been achieved. In the present paper, we find all horizons of the first few most symmetric classes which can be imbedded in electrovacuum space-times. We use the notation introduced in [1]; this paper will be referred to as I hereafter [e.g., the Eq. ($x$) of [1] will be denoted I($x$)].

In Section 2, the spherically symmetric horizons are investigated. They are found to form a three-parameter family that contains the Reissner-Norstrøm horizons with $m^2 > e^2 + h^2$ ($m$ is the mass, $e$ the electric and $h$ the magnetic charge) and bifurcates in two two-parameter subfamilies at $m^2 = e^2 + h^2$, the first being the extreme Reissner-Nordstrøm one, and the second being formed by the horizons in the homogeneous space-times $S_m^2 \times P_m^2$. Here $S_m^2$, $P_m^2$ is the 2-sphere and 2-pseudosphere, respectively, of radius $m$ and $\times$ denotes the Cartesian product

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