This article is considered as one of the series of studies on black hole solutions in supergravity theories in terms of the classification of nilpotent orbits. Such a classification method is recently developed in [1] for spherically symmetric black-hole solutions in three-dimensional $\mathcal{N} = 2$ supergravity models. To be more technical, in [1] the problem of classification of nilpotent orbits for the pseudo-quaternionic coset manifolds obtained in the $\mathcal{N} = 2$ supergravity models is considered, and it is shown that the problem can be reduced to that of the so-called Tits-Satake universality class for the models of interest.

In this article the above classification method is applied to the four-dimensional $\mathcal{N} = 2$ supergravity model, with the special Kähler scalar manifold specified by $\frac{Sp(6,\mathbf{R})}{U(3)}$. By use of the results in [1], the static four-dimensional extremal black hole solutions are then identified by geodesics on the pseudo-quaternionic coset manifold $\frac{F_{4(4)}}{SL(2,\mathbf{R})\times Sp(6,\mathbf{R})}$. The main results of this article, in mathematical as well as physical terms, are that the classification of nilpotent orbits for the coset manifold $\frac{F_{4(4)}}{SL(2,\mathbf{R})\times Sp(6,\mathbf{R})}$ is carried out in a rigorously algebraic manner.

References

[1] P. Fre, A. S. Sorin and M. Trigiante, "Black Hole Nilpotent Orbits and Tits Satake Universality Classes," arXiv:1107.5986 [hep-th].