# The type D horizons and the Petrov type D spacetimes

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The type D equation with a cosmological constant $\Lambda$ can be imposed on pairs $(g, \omega)$: a metric tensor $g$ and a differential 1-form $\omega$ defined on a 2-dimensional manifold $S$. If $S$ is a space-like section of a non-extremal Killing horizon $H$ contained in a 4 dimensional vacuum spacetime with a cosmological constant $\Lambda$, then the equation ensures that the Petrov type of the Weyl tensor at the horizon is $D$. The horizon may admit a global section and have the trivial fibration $S \times \mathbb{R}$ structure or may admit local sections only and have the fibration structure of the Hopf bundle or more general Dirac monopole. We have found all the axially symmetric type D horizons of the trivial fibration structure and of the non-trivial fibration structure $S_3 \to S_2$, respectively. The trivial fibration horizons are all embeddable either in the Kerr/Kerr-dS/Kerr-AdS spacetimes or in the NHG spacetimes. However, the $S_3$ type D horizons, surprisingly, do not fit the Kerr-NUT spacetimes. Still, via the black hole holograph construction, every axisymmetric type D horizon must be embeddable in a Petrov type D vacuum solution to Einstein's equation with a cosmological (possibly vanishing) constant. All that puzzel will be presented and discussed in our talk.

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[1] D. Dobkowski-Ryłko, J. Lewandowski, T. Pawłowski, *The Petrov type D isolated null surfaces*, Class. Quantum Grav. **35** (2018) no.17, 175016
[2] D. Dobkowski-Ryłko, J. Lewandowski, T. Pawłowski,*Local version of the no-hair theorem*, Phys.Rev. **D98** (2018) no.2, 024008.
[3] J. Lewandowski, A. Szereszewski, *Axial symmetry of Kerr spacetime without the rigidity theorem*, Phys.Rev. **D97** (2018) no.12, 124067.
[4] D. Dobkowski-Ryłko, W. Kamiński, J. Lewandowski, A. Szereszewski; *The Petrov type D equation on genus* $> 0$ *sections of isolated horizons*, Phys. Lett. **B785** (2018) 381-385.
[5] D. Dobkowski-Ryłko, J. Lewandowski, *The Petrov type D horizons of the Hopf fibration structure*, to be submitted to arXiv soon (perhaps already is there) (2019).