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Properties of a class of spherically symmetric polymer black holes

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In this talk, we shall present our studies of a recently-proposed model of spherically symmetric polymer black/white holes by Bodendorfer, Mele
and M\”unch (BMM), which generically possesses five free parameters. However, we find that, out of these five parameters, only three independent combinations
of them are physical and uniquely
determine the local and global properties of the spacetimes. After exploring the whole 3-dimensional (3D) parameter space, we show that the model has very rich
physics, and depending on the choice of these parameters, various possibilities exist, including: (i) spacetimes that have the standard black/white hole structures, (ii) Spacetimes that have wormhole-like structures, and (iii) Spacetimes that still possess curvature singularities, which can be either hidden inside trapped regions or naked. However, such spacetimes correspond to only some limit cases. In particular, the necessary (but not sufficient)
condition is that at least one of the two polymerization” parameters vanishes. These results are not in conflict to the Hawking-Penrose singularity theorems, as the effective energy-momentum tensor, purely geometric and resulted from thepolymerization” quantization, satisfies none of the three (weak, strong or dominant) energy
conditions in any of the two asymptotically flat regions for any choice of the three independent free parameters, although they can hold at the throat and/or at the two
horizons for some particular choices of them. In addition, it is true that quantum gravitational effects are mainly concentrated in the region near the throat, however,
in this model even for solar mass black/white holes, such effects can be still very large at the black/white hole horizons, again depending on the choice of the parameters.
Moreover, in principle the ratio of the two masses (for both of the black/white hole and wormhole spacetimes) can be arbitrarily large.

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