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Gaussian Polytopes: A cumulant-based approach

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Random polytopes are among the most classical and popular models considered in geometric probability and their study has become a rapidly developing branch of mathematics at the borderline between geometry and probability.

We investigate the case where the underlying random polytope is given by the convex hull generated by a Poisson point process in $\mathbb{R}^d$ whose intensity measure is a multiple of the standard Gaussian measure on $\mathbb{R}^d$. Random polytopes of this type are central objects considered in stochastic geometry and are also of importance in convex geometric analysis or coding theory, for example.

Based on bounds on cumulants and the general large deviation theory of Saulis and Statulevičius, our purpose is to invent a new viewpoint on these Gaussian polytopes. More precisely, among other results we are able

1. to derive new and powerful concentration inequalities and
2. to prove Marcinkiewicz-Zygmund-type strong laws of large numbers

for the volume and the face numbers of such Gaussian polytopes.