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Towards sampling theory on spacetime

The ultraviolet divergencies of quantum field theories and several quantum gravity arguments suggest the existence of an ultraviolet cutoff on the modes of physical fields in nature. Such an ultraviolet cutoff for fields on a spacetime manifold must be fully covariant since physical laws are independent of the choice of co-ordinate system. In this talk we consider a covariant ultraviolet cutoff which generalizes the space of bandlimited functions (Paley–Wiener space) to curved manifolds. We show that, generalizing Shannon sampling theory, the space of fields obeying this ultraviolet cutoff or 'bandlimit' can possess a finite density of degrees of freedom on one and two dimensional hypersurfaces. Recent results for expanding FRW spacetimes are discussed in detail.