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Geometric structure in the representation theory of p-adic groups

Let G be a reductive p-adic group. Examples are $\mathrm{GL}(n, Q_p)$, $\mathrm{SL}(n, Q_p)$, etc., where Q_p is the field of p-adic numbers. The smooth dual of such a group G is (by definition) the set of equivalence classes of irreducible smooth representations of G. A conjecture—due to A.-M. Aubert, P. F. Baum, and R. J. Plymen—states that this smooth dual is a countable disjoint union of complex affine varieties. These varieties are explicitly identified. BC (Baum–Connes) is known to be true for these groups. The new conjecture can be viewed as a much more precise and geometric version of BC. A general principle of NCG appears to play a role here, which is that in many interesting C^* algebras there is a naturally arising dense sub-algebra (which is not holomorphically closed) whose purely algebraic periodic cyclic homology is isomorphic (after tensoring with the complex numbers) to the K-theory of the original C^* algebra.