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A nonabelian Brunn-Minkowski inequality

Henstock and Macbeath asked in 1953 whether the Brunn-Minkowski inequality can be generalized to nonabelian locally compact groups; questions in the same line were also asked by Hrushovski, McCrudden, and Tao. We obtain here such an inequality and prove that it is sharp for helix-free locally compact groups, which includes real linear algebraic groups, Nash groups, semisimple Lie groups with finite center, solvable Lie groups, etc. As an application, we obtain a characterization of sets with nearly minimal measure expansion in noncompact locally compact groups, answering another question by Tao.