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Electrostatic field with finitely many charges: the sharp estimates of the size of the level sets

There are many interesting problems about the electrostatic potential of finitely many charges. We (Eiderman, Nazarov and myself) consider one of them concerning the magnitude of the field. We want to give a sharp estimate of the size of the set of points where this field is large. Of course we want the estimate to be sharp in number N of charges. The size will be measured by the Hausdorff content with various gauge functions. Such a setting allows us to consider a wide class of measures (not necessarily with finitely many charges). The main technique will be Calderón-Zygmund capacities and nonhomogeneous Calderón-Zygmund operators. We establish a relationship between various types of capacities with singular kernels (e. g. analytic capacity, lipschitz harmonic capacity, etc) and non-linear capacity from the theory of potential á la Adams, Hedberg, Havin, Maz'ya, Wolff. “Capacitary” part of the talk extends the theorem of Mateu, Prat and Verdera [J. reine und angew. Math., 578 (2005), 201–223]. “Size estimates” part of the talk extends the theorem of M. Anderson and V. Eiderman [Annals of Math., 163 (2005), 1057–1076]. The difficulty lies in the fact that we cannot use Menger’s curvature anymore because we are working in spaces of dimension bigger than two.