Inverse Problems on Electric Fields

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Abstract of Poster: The electrical field due to a finite set of point charges (EF) can be determined from the superposition of the inverse square field generated by each charge. Our research concerns the inverse of this problem. We ask, given knowledge of an EF on a subset T of space, what can be inferred about the EF in all space? It is not too surprising that the answer to our problem on EFs depends on the dimension we are considering. We will show how knowledge of an EF on a non-empty open set, which does not contain any of the charges, completely determines the field in all space. Thus knowledge of the EF on such a set will give a unique distribution of point charges that created the EF. In three dimensions this follows because the potential of the EF is harmonic, but in one and two dimensions a different argument is needed (e.g. in two dimensions Vandermonde determinants can be used). Our problem amounts to considering the zeros of EFs. It is clear that in the one dimensional case the zeros of an EF consist of a finite and bounded set of points determined by the naturally associated polynomial. We believe that in two dimensions an EF can only be zero at a finite and bounded set of points as well. But, a description of the zeros of an EF in three dimensions is much harder, and a few simple examples tell us that the zeros can be infinite and unbounded.