

# Differential Characters (Lecture Notes in Mathematics)

Lecture Notes in Mathematics 2202

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## Cauchy Problem for Differential Operators with Double Characteristics

Non-Effectively Hyperbolic Characteristics

Combining geometrical and microlocal tools, this monograph gives detailed proofs of many well/ill-posed results related to the Cauchy problem for differential operators with non-effectively hyperbolic double characteristics. Previously scattered over numerous different publications, the results are presented from the viewpoint that the Hamilton map and the geometry of bicharacteristics completely characterizes the well/ill-posedness of the Cauchy problem.

A doubly characteristic point of a differential operator  $P$  of order  $m$  (i.e. one where  $P_m = dP_m = 0$ ) is effectively hyperbolic if the Hamilton map  $F_{P_m}$  has real non-zero eigenvalues. When the characteristics are at most double and every double characteristic is effectively hyperbolic, the Cauchy problem for  $P$  can be solved for arbitrary lower order terms.

If there is a non-effectively hyperbolic characteristic, solvability requires the subprincipal symbol of  $P$  to lie between  $-\Sigma\mu_j$  and  $\Sigma\mu_j$ , where  $i\mu_j$  are the positive imaginary eigenvalues of  $F_{P_m}$ . Moreover, if 0 is an eigenvalue of  $F_{P_m}$  with corresponding  $4 \times 4$  Jordan block, the spectral structure of  $F_{P_m}$  is insufficient to determine whether the Cauchy problem is well-posed and the behavior of bicharacteristics near the doubly characteristic manifold plays a crucial role.

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