Contents

Prologue and Summary 1

1 Relativistic Fluids and Nonlinear Wave Equations.
The Equations of Variation 23

2 The Basic Geometric Construction 39

3 The Acoustical Structure Equations 53

4 The Acoustical Curvature 85

5 The Fundamental Energy Estimate 99

6 Construction of the Commutation Vectorfields 139

7 Outline of the Derived Estimates of Each Order 169

8 Regularization of the Propagation Equation for $\not{d}\mathrm{tr}\chi$.
Estimates for the Top Order Angular Derivatives of χ 203

9 Regularization of the Propagation Equation for $\not{\Delta}\mu$.
Estimates for the Top Order Spatial Derivatives of μ 275

10 Control of the Angular Derivatives of the First Derivatives of the x^i.
Assumptions and Estimates in Regard to χ 329
Part 1: Control of the angular derivatives
of the first derivatives of the x^i 329
Part 2: Bounds for the quantities ${}^{(i_1\dots i_l)}Q_l$ and ${}^{(i_1\dots i_l)}P_l$ 403

11 Control of the Spatial Derivatives of the First Derivatives of the x^i.
Assumptions and Estimates in Regard to μ 473
Part 1: Control of the spatial derivatives of the
first derivatives of the x^i 473
Part 2: Bounds for the quantities ${}^{(i_1\dots i_l)}Q'_{m,l}$ and ${}^{(i_1\dots i_l)}P'_{m,l}$ 589

12 Recovery of the Acoustical Assumptions. Estimates for Up to the Next
to the Top Order Angular Derivatives of χ and Spatial Derivatives of μ . . . 665

13 The Error Estimates Involving the Top Order Spatial Derivatives of the Acoustical Entities. The Energy Estimates. Recovery of the Bootstrap Assumptions. Statement and Proof of the Main Theorem: Existence up to Shock Formation 741
Part 1: Derivation of the properties C1, C2, C3 741
Part 2: The error estimates of the acoustical entities 757
Part 3: The energy estimates 831
Part 4: Recovery of assumption J. Recovery of the bootstrap assumption. Proof of the main theorem 874

14 Sufficient Conditions on the Initial Data for the Formation of a Shock in the Evolution 893

15 The Nature of the Singular Hypersurface. The Invariant Curves. The Trichotomy Theorem. The Structure of the Boundary of the Domain of the Maximal Solution 927

Epilogue 977

Bibliography 987

Index 989