

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The RESEARCH LABORATORY *of* ELECTRONICS

PROGRESS REPORT

NO. 132

JANUARY 1–DECEMBER 31, 1989



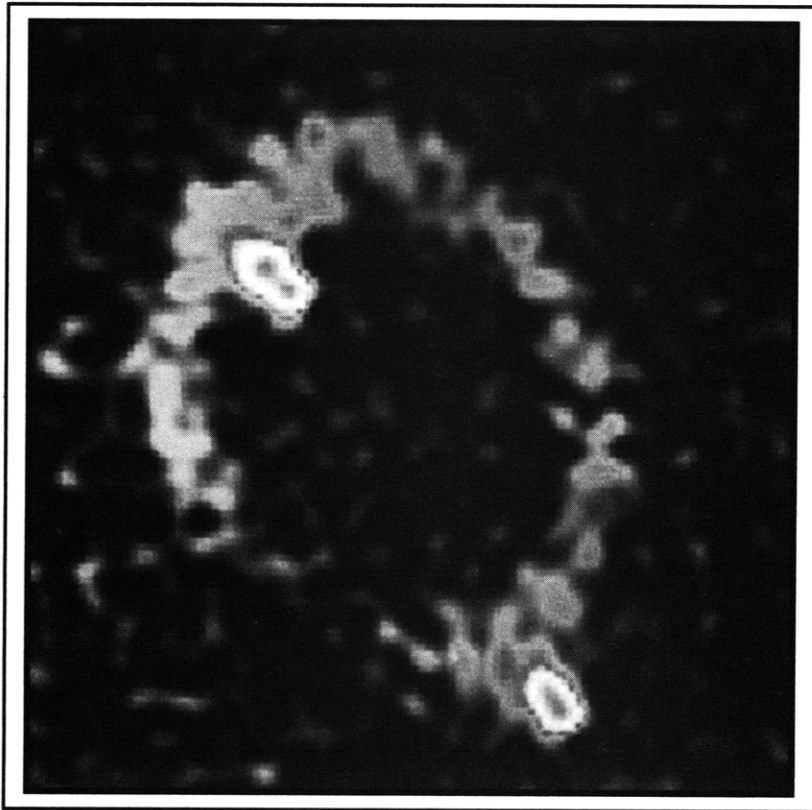
RLE Progress Report

No. 132

January 1 - December 31, 1989

Submitted by

Professor Jonathan Allen
Professor Daniel Kleppner



**Research Laboratory of Electronics
Massachusetts Institute of Technology
Cambridge, MA 02139 USA**

RLE Progress Report No. 132

Cover and title page: Shown is the image of an Einstein ring gravitational lens. The data represented in blue was acquired with a Very Large Array (VLA) telescope operated by the National Radio Astronomy Observatory in New Mexico. The line drawing on top is a calculation of the appearance of an Einstein ring based on light propagation through a gravitational field. Symmetry of a ring makes a system such as this one particularly attractive as an astrophysics laboratory. Some of Professor Jacqueline N. Hewitt's research is aimed at exploiting this (see page 231 of this report).

Our special thanks to the following staff members of the RLE Communications Group: Mary J. Ziegler for her exceptional editing, formatting, and scanning; Mary S. Greene for proofreading and preparation of the publications and personnel chapters; and Rita C. McKinnon for her help with proofreading. We also want to thank David W. Foss, Manager of the RLE Computer Facility, for his technical assistance and Donna M. Ticchi, RLE Administrative Officer, for her help with the personnel sections of this report.

We thank the faculty, staff, and students of RLE for their generous cooperation.

Editor:	Barbara Passero
Design and Illustration:	Robert H. Priest
Printer:	CSA Press, Hudson, Massachusetts
Photography:	John F. Cook
Typesetting:	This report was produced with IBM's BookMaster Software. Mylar negatives were printed on an IBM 4250-II electro-erosion printer.

©Massachusetts Institute of Technology. 1990. All rights reserved.

Introduction

The Research Laboratory of Electronics

The Research Laboratory of Electronics (RLE) was established in 1946 as the Institute's first interdepartmental laboratory. Originally organized under the joint sponsorship of the Departments of Physics and Electrical Engineering, RLE has broadened its interests to cover a wide range of research.

The RLE environment provides both the freedom of action essential in an academic institution and the availability of large-scale laboratory facilities and services required by researchers. RLE's interdisciplinary setting offers many opportunities for creative and collaborative research. By fostering this powerful combination of research and education, RLE effectively penetrates beyond the horizon of new ideas and information.

RLE Progress Report

RLE Progress Report Number 132 describes research programs at RLE for the period January 1 through December 31, 1989. Each chapter of the *Progress Report* contains both a statement of research objectives and a summary of research efforts for research projects listed. Faculty, research staff, students and others who participated in these projects are identified at the beginning of each project, along with sources of funding.

There are three appendices at the end of the report: Appendix A is a bibliography of RLE publications and papers presented by RLE staff during 1989; Appendix B is a roster of current RLE staff; and Appendix C is an index of RLE sponsors. In addition, the Project Staff and Subject Index provides access to the information in this report.

RLE Progress Report Number 132 was produced by the RLE Communications Office. Further inquiries may be addressed to:

Research Laboratory of Electronics
Communications Office
Building 36-412
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139
(617) 253-2566

