

Proceedings of the Third Cryocooler Conference

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Boulder, Colorado
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Edited by:

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DEDICATION TO THE MEMORY OF PROFESSOR WILLIAM E. GIFFORD

The 3rd Cryocooler Conference on Refrigeration for Cryogenic Sensors and Electronic Systems is dedicated to our late colleague, Professor William E. Gifford of Syracuse University, for his valuable contributions to the field of cryorefrigeration. He was one of our pioneers, an inventor of practical systems, a dedicated teacher who inspired his students, and founder of an organization to carry on the development and manufacturing of cryorefrigeration machinery.

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This document contains the proceedings of the Third Cryocooler Conference, held at the National Bureau of Standards, Boulder, Colorado, on September 17-18, 1984. About 140 people from 10 countries attended the conference and represented industry, government, and academia. A total of 26 papers were presented orally at the conference and all appear in written form in this document. The emphasis in this conference was on small cryocoolers in the temperature range of 4 - 80 K. Mechanical and nonmechanical types were discussed in the various papers. Applications of these small cryocoolers include the cooling of infrared detectors, cryopumps, small superconducting devices and magnets, and electronic devices.

Key words: conference; cryocoolers; cryogenics, cryopumps; helium; infrared detectors; refrigeration; superconductors.

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INTRODUCTION AND SUMMARY

This document contains the proceedings of the Third Cryocooler Conference, which was held at the National Bureau of Standards, Boulder, Colorado, on September 17-18, 1984.

This series of conferences began in 1977 when about 40 invited speakers and participants assembled at the National Bureau of Standards in Boulder to discuss cryocoolers for small superconducting devices. Proceedings of that meeting are available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. as NBS Special Publication 508, entitled "Applications of Closed-Cycle Cryocoolers to Small Superconducting Devices". Since it was open only to invited participants, it may be considered conference number zero.

Because the scientific and engineering community showed great interest in a conference on cryocoolers, the first open conference, consisting mostly of contributed papers, was held in 1980 at the National Bureau of Standards, Boulder, with about 115 in attendance. The emphasis in that First Cryocooler Conference still was on the temperature range below 20 K. Proceedings of that conference are available from the U. S. Government Printing Office as NBS Special Publication 607, entitled "Refrigeration for Cryogenic Sensors and Electronic Systems". In response to a questionnaire, participants favored holding such a conference every two years and that trend has been followed.

The Second Cryocooler Conference was held in 1982 at NASA Goddard Space Flight Center, Greenbelt, Maryland. At that time the scope of the conference was expanded by considering temperatures up to 80 K, but it still emphasized small cryocoolers. The broadened scope brought in more participants and it was found that many concepts and techniques used at 80 K were common to lower temperature coolers as well. It was here that the scope of these series of conferences seemed to jell.

The scope of this Third Cryocooler Conference was the same as the second - small cryocoolers of about 10 W or less and temperatures below 80 K. However, any studies on devices or concepts outside this range that would have applications within the range were still considered. About 140 participants from 10 countries attended the conference. The two-year interval for the Cryocooler Conferences has meshed well with the Cryogenic Engineering Conference held on the alternate years. Sessions on small cryocoolers at the Cryogenic Engineering Conference are attended by the general cryogenic engineering community. The Cryocooler Conferences attended by specialists allow for a more in depth focus on cryocoolers.

Twenty-six papers were presented at the Third Cryocooler Conference and the written versions of all appear in this document. Three invited review papers were given on areas of widespread interest. A survey of the papers presented here as well as those in past conferences shows considerable progress in this area of high reliability as indicated by the papers on the Stirling cryocooler with magnetic bearings. The split Stirling cryocooler is well represented and shows advances in the area of a more reproducible drive for the displacer. Interest and progress in non-mechanical refrigeration techniques, such as magnetic refrigeration and absorption compressors for Joule-Thomson coolers, are evident from the number of papers in that session. Significant advances were made in the modeling of cryocoolers and in the understanding of regenerator behavior. Considerable work on cryocoolers is now being done in China and we are pleased to have had for the first time at these Cryocooler Conferences two papers from Chinese authors.

Applications of cryogenics depend intimately on the development of efficient, reliable, and inexpensive cryocoolers. We feel that the cryocooler progress represented by the papers that follow will have a significant impact on the development of cryogenics.

The Editors