

# Proceedings of the XVI<sup>th</sup> International Symposium on NQI Spectroscopy

Hiroshima, Japan  
September 9–14, 2001

Edited by  
H. Ohki, K. Yamada, and T. Okuda

VERLAG DER ZEITSCHRIFT FÜR NATURFORSCHUNG  
TÜBINGEN 2002



*Detlef Brückner*

# NQI Award 2001

*presented to*

***Professor Detlef Brinkmann,***

*Professor Emeritus, Physics Department, University of Zürich, Zürich, Switzerland  
on Wednesday, 12th September 2001 at the University of Hiroshima, Hiroshima (Japan)*

Professor Brinkmann had his scientific education at the University of Göttingen and the University of Zürich, where he obtained his Ph.D. in 1961 under the supervision of Professor H. H. Staub. After his post doctoral research with Professors H. Y. Carr and H. C. Torrey at Rutgers University (USA) and habilitation in Zürich he has joined the physics department of the University of Zürich in 1968, where he is now Professor Emeritus.

NMR/NQR techniques have been his main themes throughout his illustrious career. The range of his interests in the solid state is truly amazing. His ability to perform challenging experiments is the key to his success. His prolific work on superionic conductors started in 1970's, and his breathtaking high pressure experiments upto 8 GPa, using a diamond anvil, on NMR in non-hydrogen materials like Li, Na, Cs around the 90's. The Ag NMR work, resulting in the measurement of very small Ag diffusion coefficients (a record at that time) and the Ag relaxation at high pressure upto 7 kbar using compressed helium gas at low temperatures, or his more recent NMR/NQR experiments on high temperature superconductors (HTSC) (being carried out for over a decade) all point to his skill and capacity for developing the necessary experimental techniques with the associated instrumentation, coupled with a strong will to succeed.

His experiments on HTSC (mainly Cuprate HTSC) and their anti-ferromagnetic parent compounds using NMR/NQR stand out for their breadth, depth and thoroughness. All relevant and feasible NMR/NQR techniques have been applied to determine relaxation times ( $T_1$ ,  $T_2$ , and  $T_{2G}$ ), line widths and various types of frequency shifts, using temperature, pressure, substitution and ion-exchange as parameters.

Professor Brinkmann, as Chairman of the International Committee on Nuclear Quadrupole Interactions (NQI) has done yeoman service to the NQI community. His enthusiastic presence at the NQI symposia and his involvement in their organization and success stand testimony to his emotional attachment to the cause of NQI. His presence here today is a source of inspiration for all of us.

With all his achievements, he remains an unassuming, cheerful and friendly person who is always ready to extend his helping hand. We are privileged and proud to have him as one of us in the NQI family. The NQI committee congratulates Prof. Brinkmann and has great pleasure in presenting him the NQI award 2001.

Hiroshima  
12th September 2001

J. Ramakrishna (IISc India)  
Chairman  
International Committee on  
Nuclear Quadrupole Interactions

## **International Committee on Nuclear Quadrupole Interactions 1999–2001**

T. J. BASTOW	Australia
D. BRINKMANN	Switzerland
T. BUTZ	Germany
S. H. CHOH	Korea
G. S. COLLINS	U.S.A.
C. FORTE	Italy
P. J. GRANDINETTI	U.S.A.
H. HAAS	Germany
K. KUMAGAI (Local Co-Chairman)	Japan
D. MASSIOT	France
T. OKUDA (Local Chairman)	Japan
H. M. PETRILLI	Brazil
J. RAMAKRISHNA (Chairman)	India
J. A. S. SMITH (Deputy Chairman)	Great Britain
A. F. VOLKOV	Russia

## **International Committee on Nuclear Quadrupole Interactions 2002–2003**

D. C. AILION	U.S.A.
T. A. BABUSHKINA	Russia
T. J. BASTOW	Australia
P. BLAHA	Austria
S. H. CHOH	Korea
G. S. COLLINS	U.S.A.
H. HAAS	Germany
K. KUMAGAI	Japan
T. OKUDA	Japan
H. M. PETRILLI	Brazil
J. RAMAKRISHNA (Chairman)	India
J. ROOS	China
J. A. S. SMITH	Great Britain
W. TRÖGER	Germany
G. WULFSBERG	U.S.A.

# Preface

The XVIth International Symposium on Nuclear Quadrupole Interactions was held at the University of Hiroshima from September 9 to 14, 2001. It was attended by nearly 120 scientists from 16 countries (50 Foreign and 70 Japanese). About 120 research papers were presented (invited, oral and poster). The scientific coverage was wide, including theoretical and experimental contributions, and the techniques discussed were versatile: NQR, NMR, PAC, ESR, Mössbauer effect,  $\beta$ -ray angular distribution.

The symposium was hosted by Prof. Tsutomu Okuda, Graduate School of Science, Hiroshima University. The co-chairman was Prof. Kenichi Kumagai, Graduate School of Science, Hokkaido University. The local Organizing Committee consisted of

Prof. Ryuichi Ikeda	Tsukuba University
Prof. Nobuo Nakamura	Osaka University
Prof. Haruo Niki	Ryukyu University
Prof. Hironori Nishihara	Ryukoku University
Prof. Masuo Takeda	Tokyo University

and the secretariat of

Prof. Yoshihiro Furukawa	Hiroshima University
Prof. Koji Yamada	Hiroshima University
Prof. Satoru Nakashima	Hiroshima University
Dr. Hiroshi Ohki	Hiroshima University

The local organizing committee gratefully acknowledges support and sponsorship from the Hiroshima University, the Inoue Foundation for Science, the Electric Technology Research Foundation of Chugoku, and from Professor Emeritus Hisao Negita.

The special issue of *Zeitschrift für Naturforschung* contains 64 original contributions presented at the symposium. They have been reviewed following normal refereeing procedures.

The papers are grouped under the following headings:

- A) Advanced Techniques in NQR and NMR (5 papers)
- B) Bonding and Structure (6 papers)
- C) Phase Transitions and Dynamics (23 papers)
- D) Properties of Solids (7 papers)
- E) Theory and Calculation (5 papers)
- F) Perturbed Angular Correlations, Mössbauer Spectroscopy and Nuclear Physics (18 papers)

We are grateful to the Editor of the *Zeitschrift für Naturforschung*, Prof. A. Klemm, for his excellent cooperation, and to the Managing Editor, Mrs. T. Littmann, for her efficient and swift handling of the papers and for her patience.

Tsutomu OKUDA  
Higashi-Hiroshima, April 2002

# Contents

	Page
A) <i>Advanced Techniques in NQR and NMR</i>	289
B) <i>Bonding and Structure</i>	320
C) <i>Phase Transitions and Dynamics</i>	353
D) <i>Properties of Solids</i>	479
E) <i>Theory and Calculation</i>	518
F) <i>Perturbed Angular Correlations, Mössbauer Spectroscopy and Nuclear Physics</i>	544

The articles have also appeared in *Zeitschrift für Naturforschung* **57a** (2002) with the same pagination.

© Verlag der Zeitschrift für Naturforschung, Tübingen, Fed. Rep. of Germany, 2002.

Set and printed by Triltsch, Print und digitale Medien GmbH, Ochsenfurt-Hohestadt, Fed. Rep. of Germany.