

TABLE OF CONTENTS

Introductory Remarks — Maurice Goldhaber, Director, Brookhaven National Laboratory	iii
Editor's Preface — Albert G. Prodell, Brookhaven National Laboratory	iv
Introduction — John P. Blewett, Brookhaven National Laboratory	v

FIRST WEEK — SUPERCONDUCTING RF CAVITIES AND LINACS

Chairman: H.A. Schwettman, Stanford University

The Development of Low Temperature Technology at Stanford and its Relevance to High Energy Physics	1
H. Alan Schwettman, Stanford University	
Q Measurements on Superconducting Cavities at S-Band	13
H. Hahn, H.J. Halama, and E.H. Foster, Brookhaven National Laboratory	
Coupling Losses in Superconducting Cavities	18
H. Hahn and J.M. Miller, Brookhaven National Laboratory	
Fabrication of Niobium Rf Cavities	23
R.W. Meyerhoff, Union Carbide Corporation	
Fabrication of High Q Superconducting Niobium Cavities	32
I. Weissman, Varian Associates	
Materials Investigation for a Two-Mile Superconducting Accelerator	34
M.A. Allen and H.A. Hogg, Stanford Linear Accelerator Center	
Characterization of Residual Rf Losses in Superconductors	40
C.R. Haden, University of Oklahoma	
Technetium as a Material for ac Superconductivity Applications	49
S.H. Autler, NASA Electronics Research Center	
Applications of the Fountain Effect in Superfluid Helium	52
C.M. Lyneis, M.S. McAshan, and H.A. Schwettman, Stanford University	
Refrigeration at Temperatures Below the Boiling Point of Helium	59
S.C. Collins, 500 Incorporated	
Rf Amplitude and Phase Stabilization for a Superconducting Linear Accelerator by Feedback Stabilization Techniques	67
L.R. Suelzle, Stanford University	
Particle Motion in a Standing Wave Linear Accelerator	79
E.E. Chambers, Stanford University	
Sample Parameters of a Two-Mile Superconducting Accelerator	101
R.B. Neal, Stanford Linear Accelerator Center	
Consideration of the Use of Feedback in a Traveling-Wave Superconducting Accelerator	111
R.B. Neal, Stanford Linear Accelerator Center	
Summary of Recent Investigations of the Karlsruhe Group on Rf Properties of Superconductors and on Applications	127
W. Jüngst, Kernforschungszentrum Karlsruhe	

An Enriched Particle Beam using Superconducting Rf Deflectors	136
H.N. Brown, Brookhaven National Laboratory	
Design Problems in Superconducting Rf Beam Separators	150
H.J. Halama, Brookhaven National Laboratory	
Superconducting Rf Separator Research at the Rutherford Laboratory	165
A. Carne, B.G. Brady, and M.J. Newman, Rutherford Laboratory	
Beam Optics Design for a 600 MeV Microtron	169
D.C. Sutton and A.O. Hanson, University of Illinois	
High Stability UHF Oscillators using a Superconducting Cavity	171
F. Biquard, Nguyen Tuong Viet, and A. Septier, Institut d'Electronique Fondamentale, Orsay	
Summary of First Week of Summer Study	187
H. Alan Schwettman, Stanford University	

SECOND WEEK — CRYOGENICS
 Chairman: T.R. Strobridge, NBS, Boulder

Refrigeration at 4°K	193
T.R. Strobridge, National Bureau of Standards, Boulder	
European State of the Art in Cryogenics	205
G. Prast, Philips Research Laboratories	
Cryogenic Safety	229
M.G. Zabetakis, Bureau of Mines	
Cryopumping	230
C. Barnes, CVI Corporation	
Review of Heat Transfer to Helium I	249
R.V. Smith, National Bureau of Standards, Boulder	
An Examination of a Liquid Helium Refrigeration System for Superconducting Magnets in the 200 GeV Experimental Area	293
M.A. Green, Lawrence Radiation Laboratory, Berkeley, and G.P. Coombs and J.L. Perry, 500 Incorporated	
Cryogenic Electrical Leads	304
C.D. Henning, Lawrence Radiation Laboratory, Livermore	
Low Temperature Metals	311
A. Hurlich, General Dynamics/Astronautics	
Properties of Nonmetallic Materials at Cryogenic Temperatures	326
R. Mowers, Rocketdyne	
Review of the Cryogenics Session — Second Week of the Summer Study	368
T.R. Strobridge, National Bureau of Standards, Boulder	

THIRD WEEK - SUPERCONDUCTING MATERIALS
Chairman: A. Paskin, Brookhaven National Laboratory

Structure and Properties of High-Field Superconductors	377
J.D. Livingston, General Electric Company	
Instability Comments	393
S.L. Wipf, Atomics International	
Critical Current Behavior of Hard Superconductors	396
W.W. Webb, Cornell University	
Critical Fields of Type II Superconductors	405
G. Cody, RCA Laboratories	
The Effect of Radiation on the Properties of Superconducting Materials	437
G.W. Cullen, RCA Laboratories	
Niobium Tin and Related Superconductors	449
R.B. Britton, Brookhaven National Laboratory	
Composite Materials	465
A.D. McInturff, Brookhaven National Laboratory	
Materials and Conductor Configurations in Superconducting Magnets	477
H. Brechta, Stanford Linear Accelerator Center	

FOURTH WEEK - AC EFFECTS AND FLUX PUMPS
Chairman: S.L. Wipf, Atomics International

Ac Losses in Superconductors	511
S.L. Wipf, Atomics International	
Use of Superconductors in High Energy Physics	544
J.P. Blewett, Brookhaven National Laboratory	
Electrical Loss Measurements in a NbTi Magnet	550
F. Voelker, Lawrence Radiation Laboratory, Berkeley	
Ac Losses in Magnets made of Nb ₃ Sn Ribbon	559
G.H. Morgan and P.F. Dahl, Brookhaven National Laboratory	
Dynamic Resistivity of Hard Superconductors in a Perpendicular Time Varying Field	567
R. Altorfer, F. Caimi, and J.M. Rayroux, Oerlikon Engineering Company	
Magnetic Instabilities and Solenoid Performance: Applications of the Critical State Model	571
H.R. Hart, Jr., General Electric Company	
Magnetic and Thermal Instabilities Observed in Commercial Nb ₃ Sn Superconductors	601
G. del Castillo and L.O. Oswald, Argonne National Laboratory	

Observations of Flux Jump Behavior Related to Various Changes of Geometry, and Thermal and Electrical Environment	612
A.D. McInturff, Brookhaven National Laboratory	
Instabilities and Flux Annihilation	619
S.L. Wipf, Atomics International	
Superconducting Transmission Lines - Communication and Power	622
N.S. Nahman, National Bureau of Standards, Boulder	
Recent Developments in Superconductivity in Japan	628
Presented by N. Takano, Tokyo Shibaura Electric Company	
The Case for Flux Pumps and Some of Their Uses	632
S.L. Wipf, Atomics International	
Design Principles and Characteristics of the G.E. Flux Pump	654
R.L. Rhodenizer, General Electric Company	
Flux Pumps as Power Supplies in Comparison with Alternatives	667
M.S. Lubell and K.R. Efferson, Oak Ridge National Laboratory	
Flux Pump Work at Los Alamos	673
H. Laquer, Los Alamos Scientific Laboratory	
60 Hz Flux Pumps	679
R.B. Britton, Brookhaven National Laboratory	
Proposal for a Flux Pump Utilizing the Inverse Ettingshausen Effect in Hard Type II Superconductors in the Mixed State	681
W.H. Bergmann, Argonne National Laboratory	
Summary of the Fourth Week - Ac Losses, Instability and Flux Pumps	683
S.L. Wipf, Atomics International	

FIFTH WEEK - SUPERCONDUCTING MAGNETS
 Chairman: W.B. Sampson, Brookhaven National Laboratory

Stress Problems Associated with Superconducting and Cryogenic Magnets	709
P.G. Marston, Magnetic Engineering Associates	
Stresses in Magnetic Field Coils	714
W.F. Westendorp and R.W. Kilb, General Electric Company	
Very High Field Hybrid Magnet Systems	727
D. Bruce Montgomery, J.E.C. Williams, N.T. Pierce, R. Weggel, and M.J. Leupold, Francis Bitter National Magnet Laboratory	
Principles of Stability in Cooled Superconducting Magnets	748
Z.J.J. Stekly, R. Thome, and B. Strauss, Avco Everett Research Laboratory	
The 1.8 Tesla, 4.8 m i.d. Bubble Chamber Magnet	765
J.R. Purcell, Argonne National Laboratory	

The Superconducting Magnet for the Proposed 25-foot Cryogenic Bubble Chamber	786
A.G. Prodell, Brookhaven National Laboratory	
The Superconducting Magnet for the Brookhaven National Laboratory 7-foot Bubble Chamber	794
D.P. Brown, R.W. Burgess, and G.T. Mulholland, Brookhaven National Laboratory	
A 70 Kilogauss Magnet for the Proposed Rutherford Laboratory 1.5 m Diameter Hydrogen Bubble Chamber	815
P.T.M. Clee, D.B. Thomas, and C.W. Trowbridge, Rutherford Laboratory	
Development Program for the Magnet of the European 3.7 m Bubble Chamber	828
Presented by F. Wittgenstein, CERN	
A Possible Source of Instability in "Fully Stabilized" Magnets	839
P.F. Smith, M.N. Wilson, and J.D. Lewin, Rutherford Laboratory	
Analytical Design of Superconducting Multipolar Magnets	843
Richard A. Beth, Brookhaven National Laboratory	
Superconducting Magnetic Dipoles	860
G. Parzen, Brookhaven National Laboratory	
Superconducting Quadrupole Focusing Lens - Part I: Analytical Design and Full-Scale Copper-Wound Pole	866
A. Asner, CERN	
Superconducting Quadrupole Focusing Lens - Part II: Construction and Preliminary Tests	880
D.N. Cornish, Culham Laboratory	
Quadrupole Focusing Magnet	886
J.D. Rogers, W.V. Hassenzahl, H.L. Laquer, and J.K. Novak Los Alamos Scientific Laboratory	
The Rutherford Laboratory Bending Magnet	888
M.N. Wilson, R.V. Stovold, and J.D. Lawson, Rutherford Laboratory	
Brookhaven Superconducting dc Beam Magnets	893
R.B. Britton, Brookhaven National Laboratory	
Pulsed Superconducting Magnets	908
W.B. Sampson, Brookhaven National Laboratory	
Intrinsically Stable Conductors	913
P.F. Smith, M.N. Wilson, C.R. Walters, and J.D. Lewin, Rutherford Laboratory	
Superconducting Magnets for Controlled Thermonuclear Research	920
C.E. Taylor, Lawrence Radiation Laboratory, Livermore	
On Helium II Microstabilization of Nb ₃ Sn	926
W.H. Bergmann, Argonne National Laboratory	
Progress on the IMP Facility	929
D.L. Coffey and W.F. Gauster, Oak Ridge National Laboratory	

Standardized Tests for Superconducting Materials	944
W.F. Gauster, Oak Ridge National Laboratory	
Superconducting Magnets for the 200 GeV Accelerator Experimental Areas	946
R.B. Meuser, Lawrence Radiation Laboratory, Berkeley	
Construction of a Superconducting Test Coil Cooled by Helium Forced Circulation. .	953
M. Morpurgo, CERN	
Summary of Fifth Week of Summer Study	962
W.B. Sampson, Brookhaven National Laboratory	
 SIXTH WEEK - ACCELERATORS AND STORAGE RINGS USING SUPERCONDUCTING OR CRYOGENIC MAGNETS	
Chairman: J.P. Blewett, Brookhaven National Laboratory	
Superconducting Synchrotrons	967
P.F. Smith, Rutherford Laboratory	
Economic Factors Involved in the Design of a Proton Synchrotron or Storage Ring with a Superconducting Guide Field	981
M.A. Green, Lawrence Radiation Laboratory, Berkeley	
A 2000 GeV Superconducting Synchrotron	998
W.B. Sampson, Brookhaven National Laboratory	
Synchrotron Power Supplies using Superconducting Energy Storage	1002
P.F. Smith, Rutherford Laboratory	
Some ac Loss Determinations by an Electrical Multiplier Method	1007
W.S. Gilbert, Lawrence Radiation Laboratory, Berkeley	
Radiation Effects on Superconducting Magnets	1011
H. Brechne, Stanford Linear Accelerator Center	
Iron Shielding for Air Core Magnets	1042
J.P. Blewett, Brookhaven National Laboratory	
Superconducting FFAG Accelerators	1052
G. Parzen, Brookhaven National Laboratory	
Calculations Concerning Superconducting Accelerators	1059
P. Gerald Kruger and J.N. Snyder, University of Illinois	
Preliminary Steps for Applying Superconductors to FFAG Accelerators	1075
G. del Castillo, R.J. Lari, and L.O. Oswald, Argonne National Laboratory	
A Superconducting SLAC with a Recirculating Beam	1089
W.B. Herrmannsfeldt, Stanford Linear Accelerator Center	
Properties and Preparation of High-Purity Aluminum	1095
V. Arp, National Bureau of Standards, Boulder	
Synchrotron Magnets with Cryogenic Exciting Coils	1115
G.T. Danby, J.E. Allinger, and J.W. Jackson, Brookhaven National Laboratory	
Summary of Sixth Week of Summer Study	1127
J.P. Blewett, Brookhaven National Laboratory	