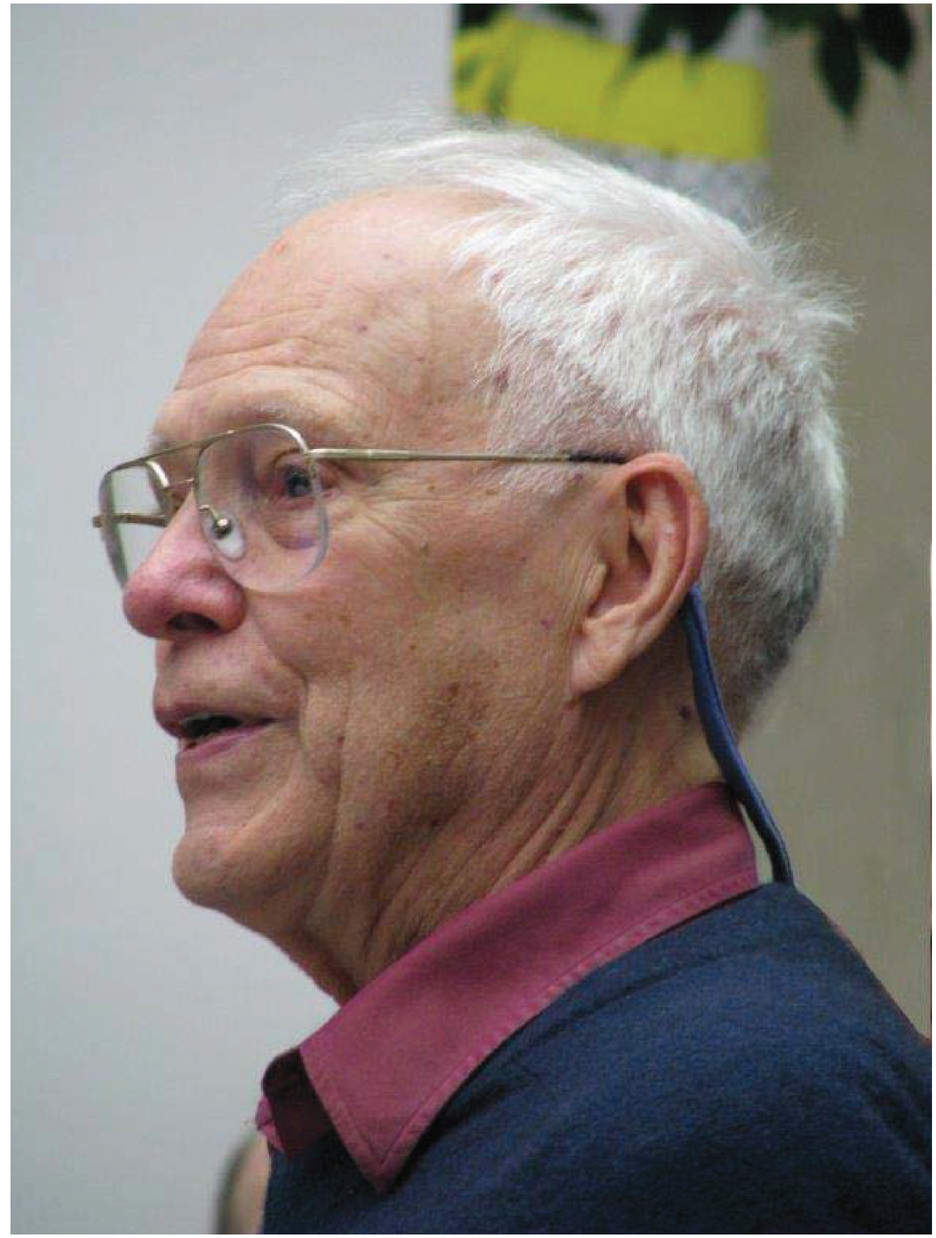
Henry Blosser

1928-2013



Prepared by Felix Marti (NSCL)
Presented by Michael Craddock (UBC & TRIUMF)

Henry Blosser

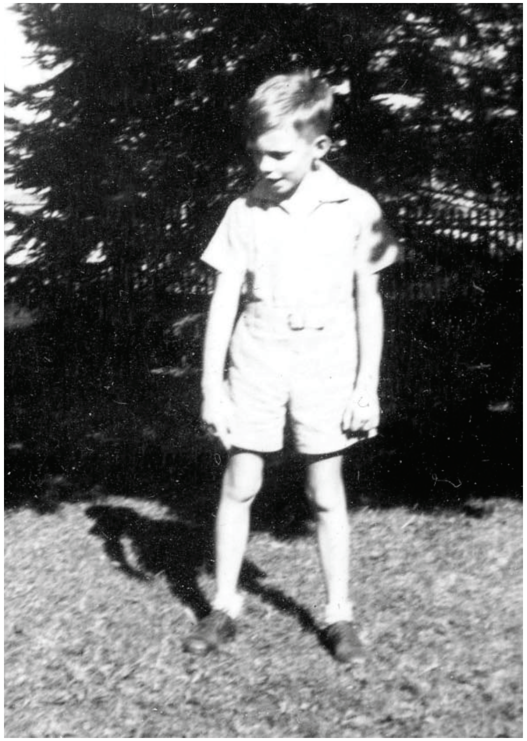
- Greatest cyclotron builder of the late 20th century
- the first to convert the basic tool of the pioneers into a precision instrument, turning an art into a science!

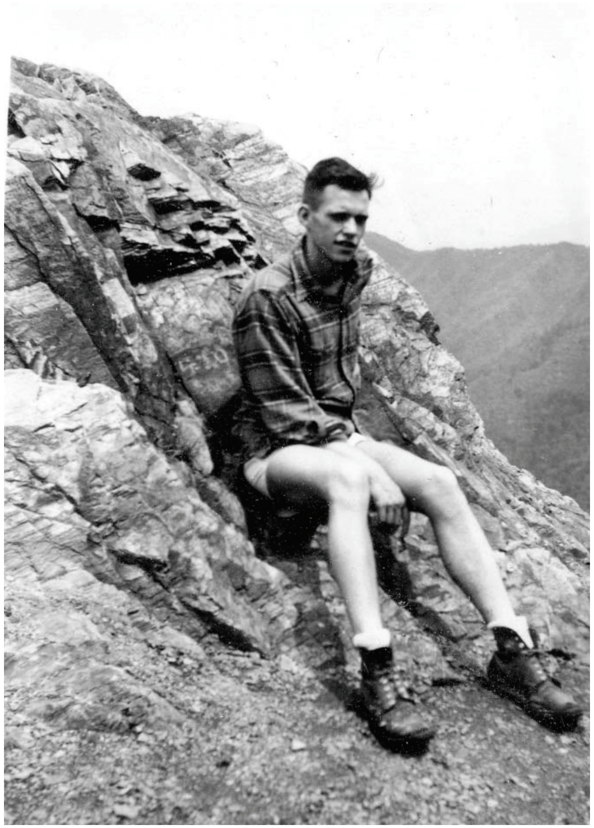
His cyclotrons provide an extraordinary catalogue of excellence and innovation:

- Analog I - reached $\beta(e^-) = 0.69$ in 1958 !
- K50 - first precision cyclotron
- K500 - first operating superconducting cyclotron
- K1200 - most powerful heavy-ion cyclotron
- K500-K1200 - Coupled Cyclotron Project
- Harper K100 - first flying cyclotron for neutron therapy
- Varian/ACCEL/NSCL K250 - for proton therapy
- 8-T magnet test stand → Mevion (Monarch) S250 synchrocyclotrons

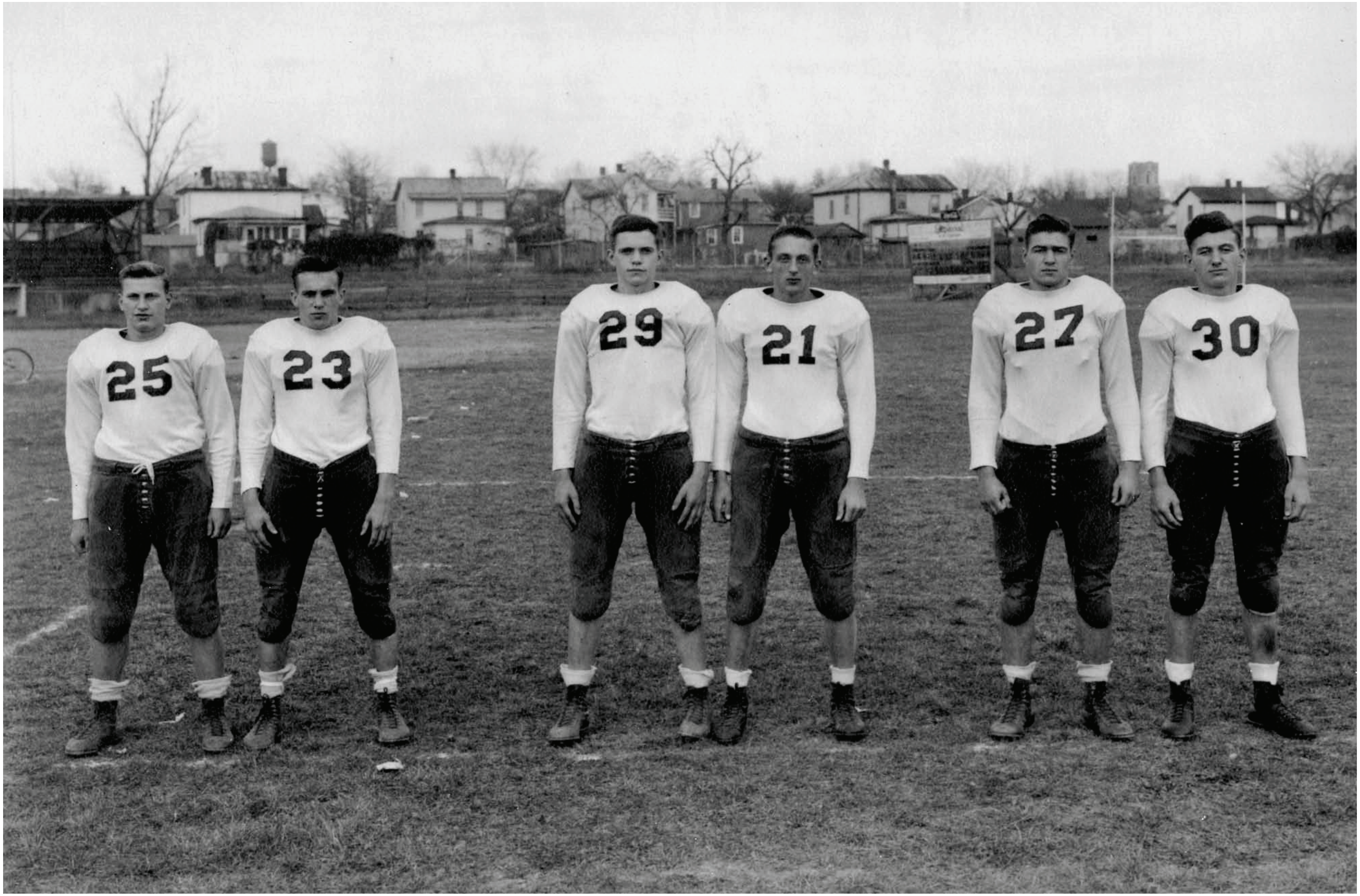
As a direct result of his work:

- MSU has become the leading university nuclear physics lab in the US
- MSU has produced an impressive stream of talented accelerator physicists

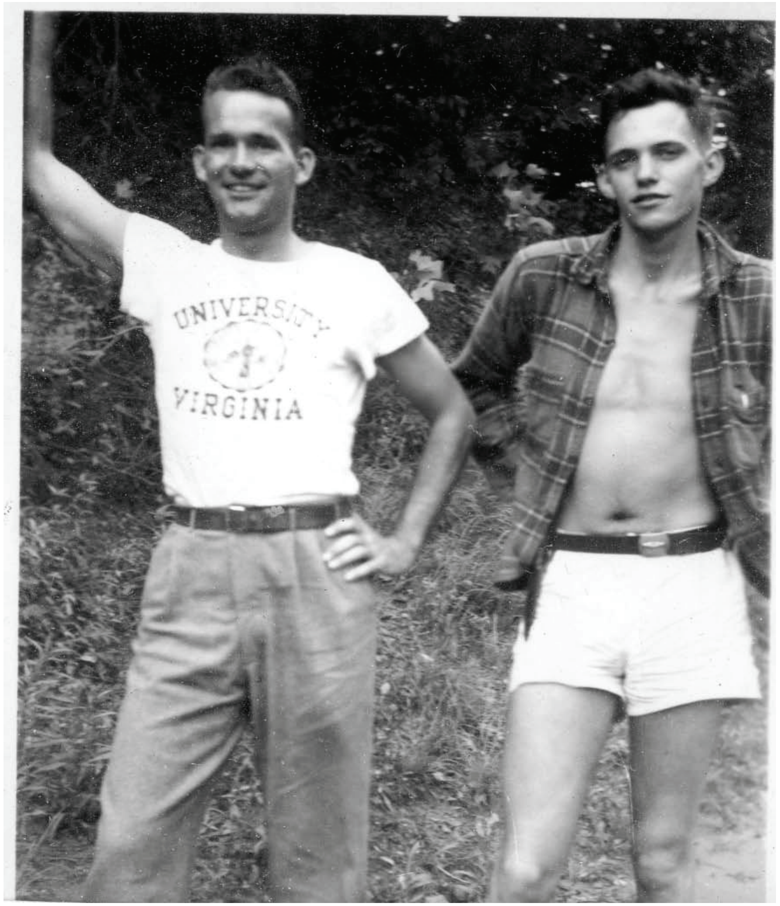




Young hiker



Henry is #29 High School (1944)



University of Virginia

Sailor

THE
REVIEW OF SCIENTIFIC
INSTRUMENTS

VOLUME 29, NUMBER 10 *OCTOBER, 1958*

Four-Sector Azimuthally Varying Field Cyclotron

H. G. Blosser,* R. E. Worsham, C. D. Goodman, R. S. Livingston,
J. E. Mann, H. M. Moseley,† G. T. Trammel, and T. A. Welton
Oak Ridge National Laboratory,‡ Oak Ridge, Tennessee

(Received July 14, 1958)

An electron model relativistic fixed-frequency cyclotron of the azimuthally varying field type has been constructed for the purpose of testing the orbit dynamics of such a device. An iterative technique used in designing an acceptable magnetic field shape is described in some detail. A brief description of the various components of the device is given as well as an account of the beam phenomena observed in the initial period of operation. Results strongly indicate the feasibility, from an orbit dynamics standpoint, of large proton machines of this type.

Henry's first cyclotron, this same year (1958) he moved from ORNL to MSU

NATIONAL SCIENCE FOUNDATION

WASHINGTON, D.C. 20550

Oct. 4, 1961

Dr. John A. Hannah, President
Michigan State University
East Lansing, Michigan

Grant NSF-G19978

Dear Dr. Hannah:

I am pleased to inform you that the sum of $700,000 is hereby granted by the National Science Foundation to the Michigan State University of Agriculture and Applied Science for support of the "Construction of a 40-MeV cyclotron," under the direction of Henry G. Blosser, Department of Physics and Astronomy, for a period of approximately three years, effective October 1, 1961. Payments under this grant will be scheduled on a periodic basis upon notification to the Foundation by the grantee of the need for funds and the estimated timing of financial requirements.

Construction of the K50 approved in 1961

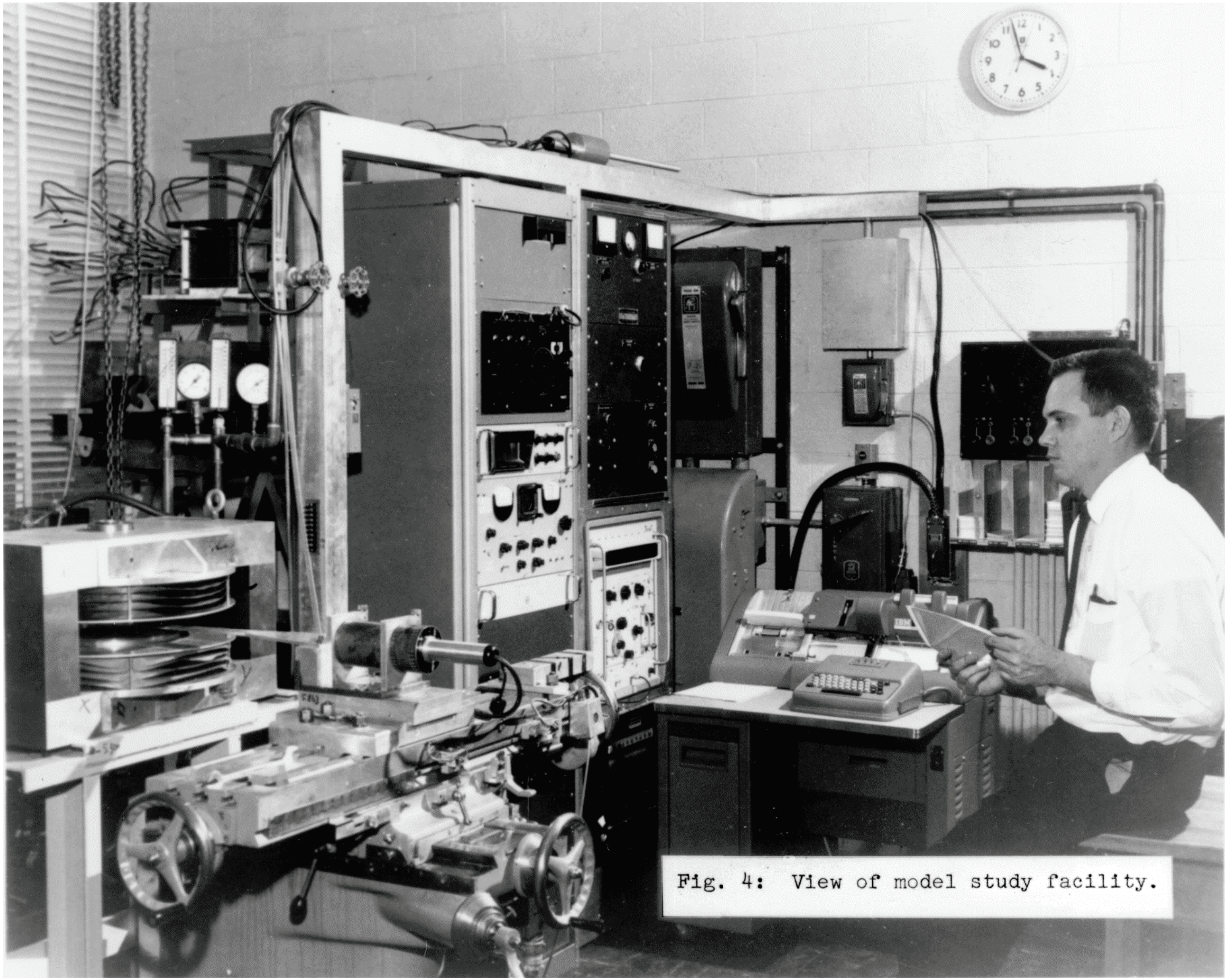


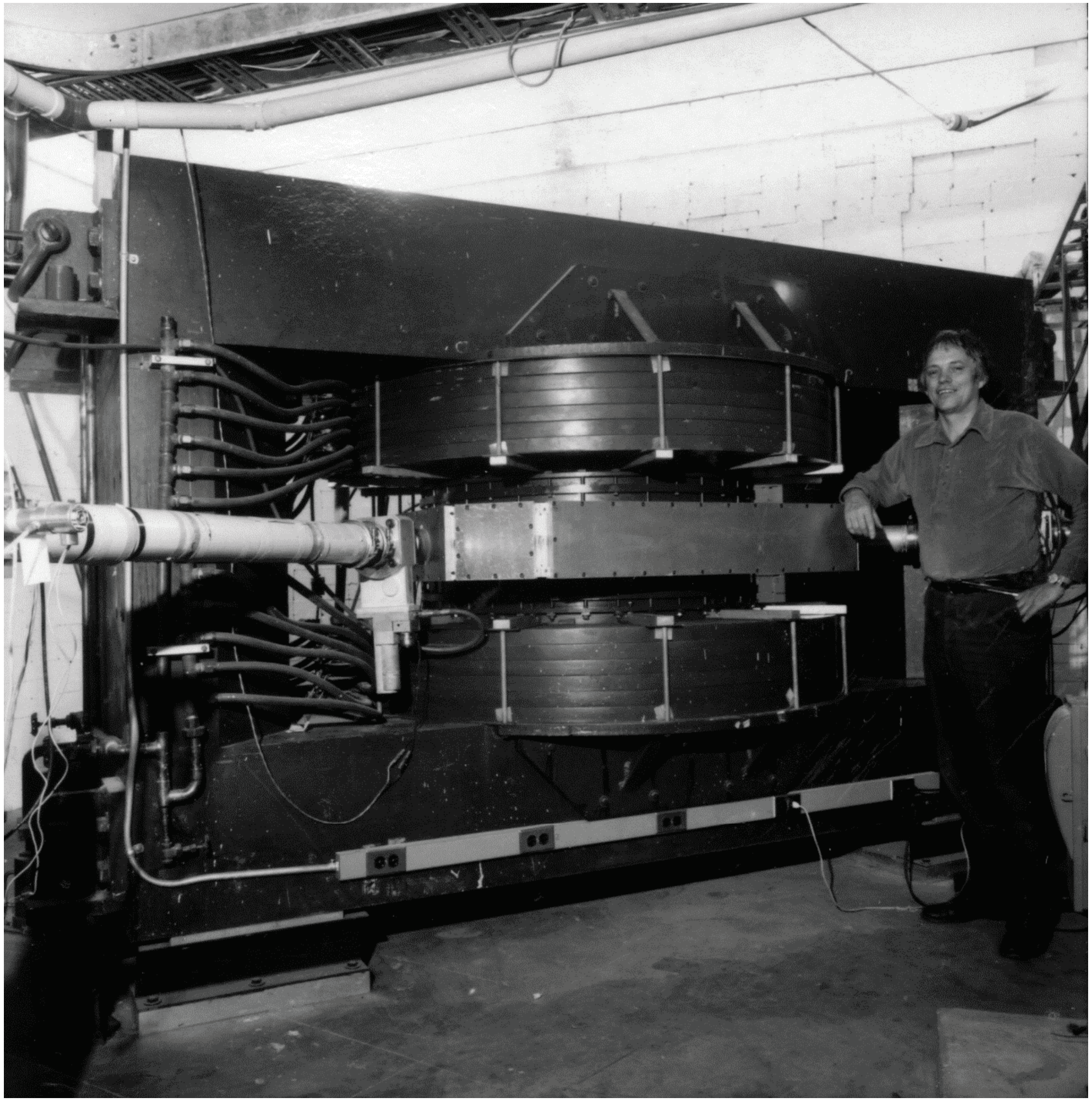
Fig. 4: View of model study facility.

K50 model magnet measurement (early 1960s)

Checking alignment of the K50 Cyclotron

standing, left to right:
Mort Gordon, theoretical development
Henry Blosser, magnet and overall director
Bill Johnson, RF system
Martin Reiser, central region

K50 cyclotron



K50

THE TEACHER

"…At one of our meetings in his house, we complained about how hard it was to tune the K50. There were no operators or instruction manuals at the time. He told us that the phenomena we were observing were not possible because they violated Liouville's theorem. In the discussion that followed it became clear to Henry that we knew absolutely nothing about beam dynamics. What resulted from this was a series of lectures which he gave to us weekly. They were excellent lectures, and I kept my notes for years. It is too bad Henry never became a teacher …"

W. Benenson (MSU Faculty)

THE HANDS-ON PHYSICIST!

Henry often invited groups to his house in East Lansing, sometimes for lab business and sometimes for socializing. One evening in the 1970's there was a party at his house, and the conversation got around to difficulties with getting the cyclotron running. This was the 50 MeV original room temperature machine. At that time, the faculty and staff researchers operated the cyclotron themselves to perform their experiments. Henry felt that the cyclotron settings needed to run it were reproducible, and those that needed to be tuned were few enough and within a range that was easy to tune to optimum. He stated that he, unassisted, could get a beam within half an hour of starting from "Off." Everyone knew that the cyclotron was not running at that time. He suggested that he would do it then. A number of witnesses followed him to the lab to watch.

He turned on the control power for the machine and began clearing interlocks and presetting power supplies. Once the main magnet current was up he wanted to get the rf running, but in dismay he said that he had forgotten about the warm-up delay interlock for the rf system. After some minutes the delay time interlock cleared and he could proceed. In the end he succeeded in having proton beam current extracted from the cyclotron by half an hour from starting.

Reported by P. Miller (MSU Physicist)

Henry wasn't infallible !

Reviewing the prospects for "Future Cyclotrons" at the 1972 Cyclotron Conference in Vancouver, Henry discussed superconductivity for magnets and rf cavities at some length, concluding:

size of the new large synchrotrons has reached the proportions of a critical problem. The size of cyclotrons is however much less of a problem and the virtues of making cyclotrons smaller are at best mixed. On the positive side there would be savings in building and shielding costs, both tending to go as the square of the size. On the other hand reducing the space available for the beam is a definite disadvantage—space charge effects are increased, extraction is more difficult, and the design of the central region (or the inflection mechanism) is more difficult. Use of super conducting

and

phase control. Superconductivity then seems unlikely to make a contribution to cyclotrons in the foreseeable future primarily because there is no overriding problem which would thereby be solved such as is the case for synchrotrons and linacs.

But he certainly redeemed himself later!

Beginnings of the superconducting cyclotron development at MSU

Historical Outline of
MSU Superconducting Cyclotron Program

1962-63 Computer study of coil design for superconducting cyclotron (and experiments on small coil) conclude that available conductor is not adequate.

June 1973 Chalk River visitors report on their studies and tell of low-cost, high-quality conductor.

Nov. 1973 Studies of 400 MeV superconducting magnet begin.

July 1974 Proposal to build prototype K400 superconducting cyclotron magnet submitted to NSF.

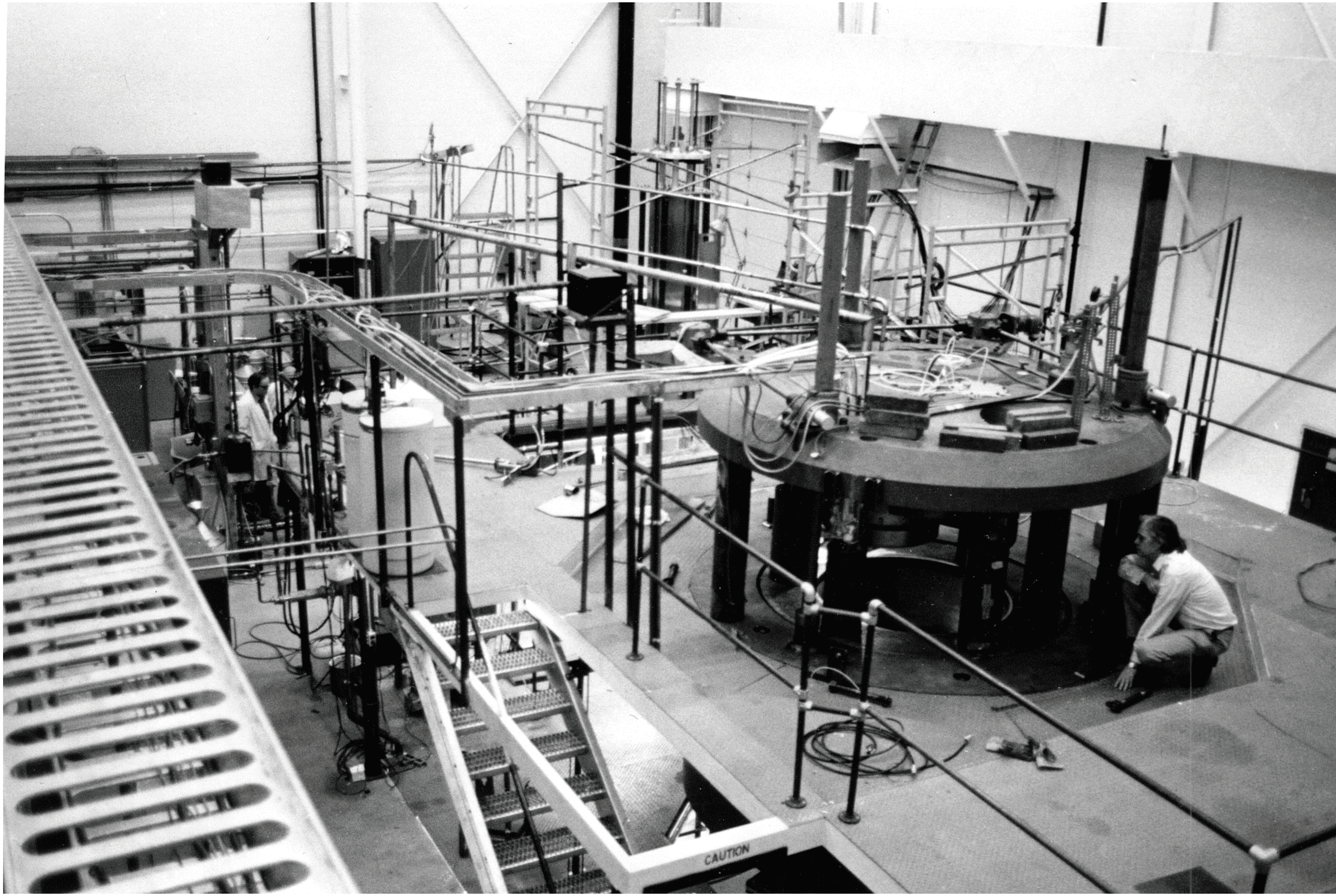
July 1975 Grant received from NSF for constructing prototype magnet.

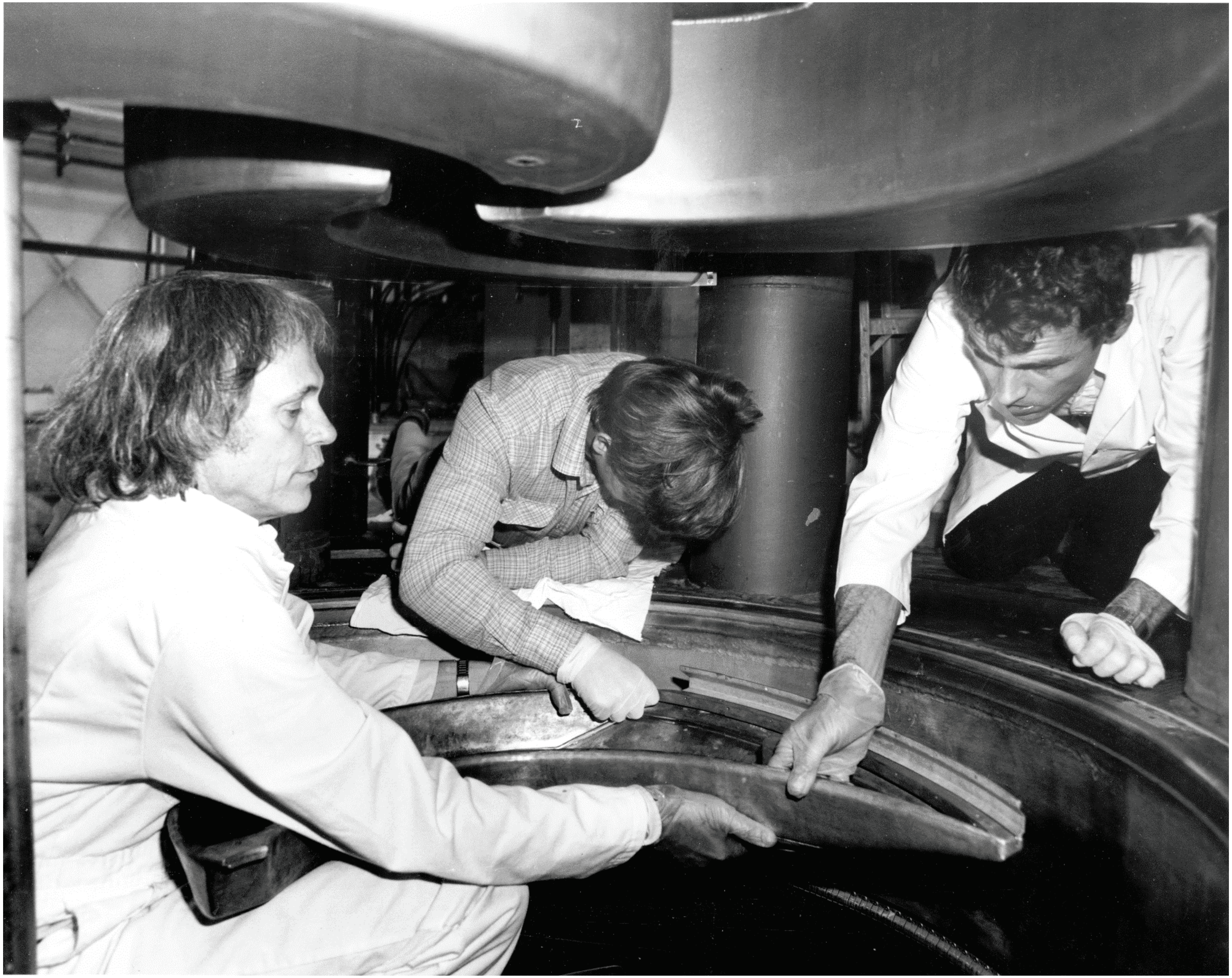
May 1977 The prototype magnet operates at full field (K=500) and an amended proposal (Phase I) requesting funds to build a complete cyclotron is submitted to NSF. Beamlines and experimental areas for this "Phase I" program are to consist of rearranged equipment from the K50 cyclotron program.

Aug. 1977 Grant received for Phase I.

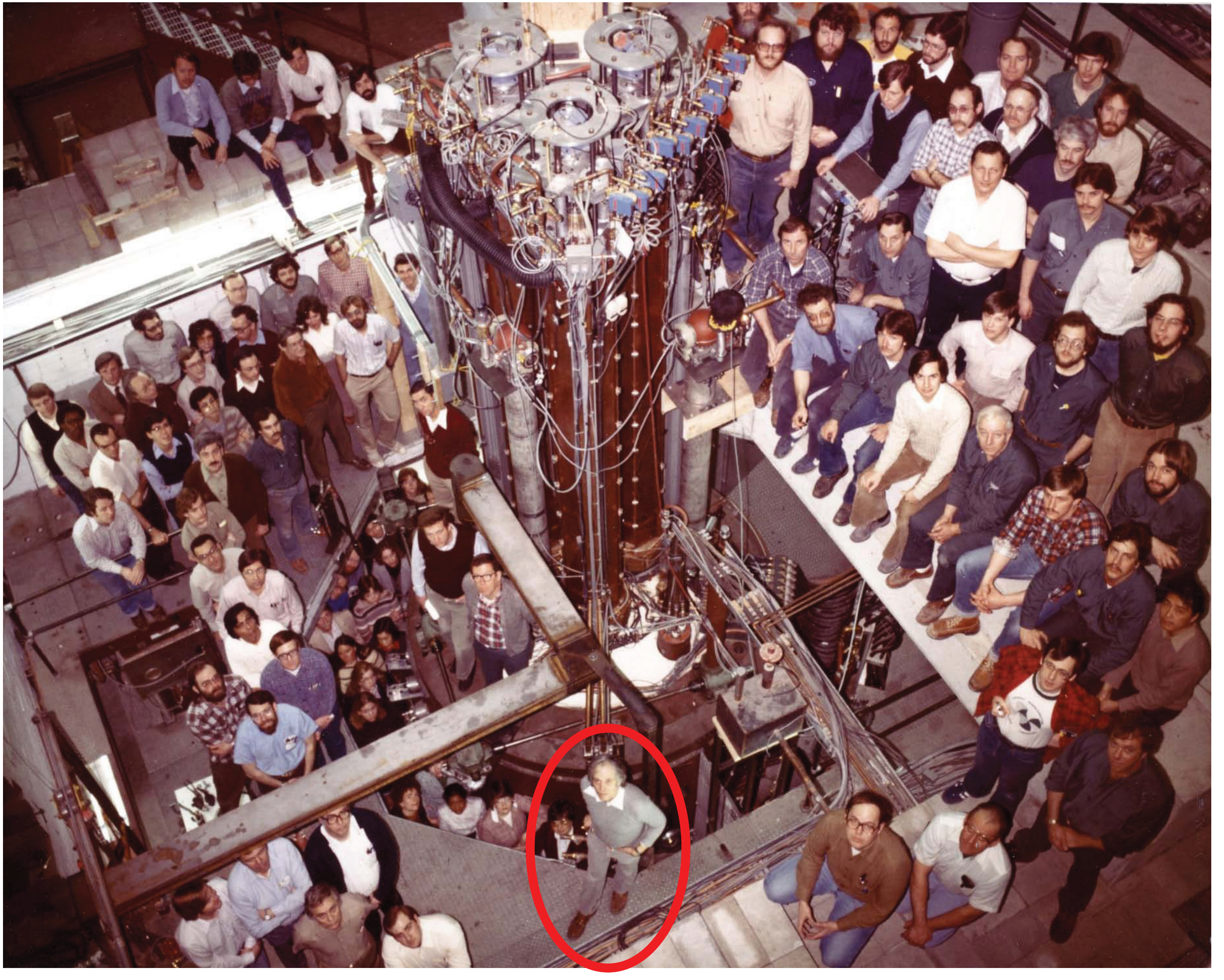
Checking the superconducting coil

He loved to operate the 40 ton crane


CAUTION



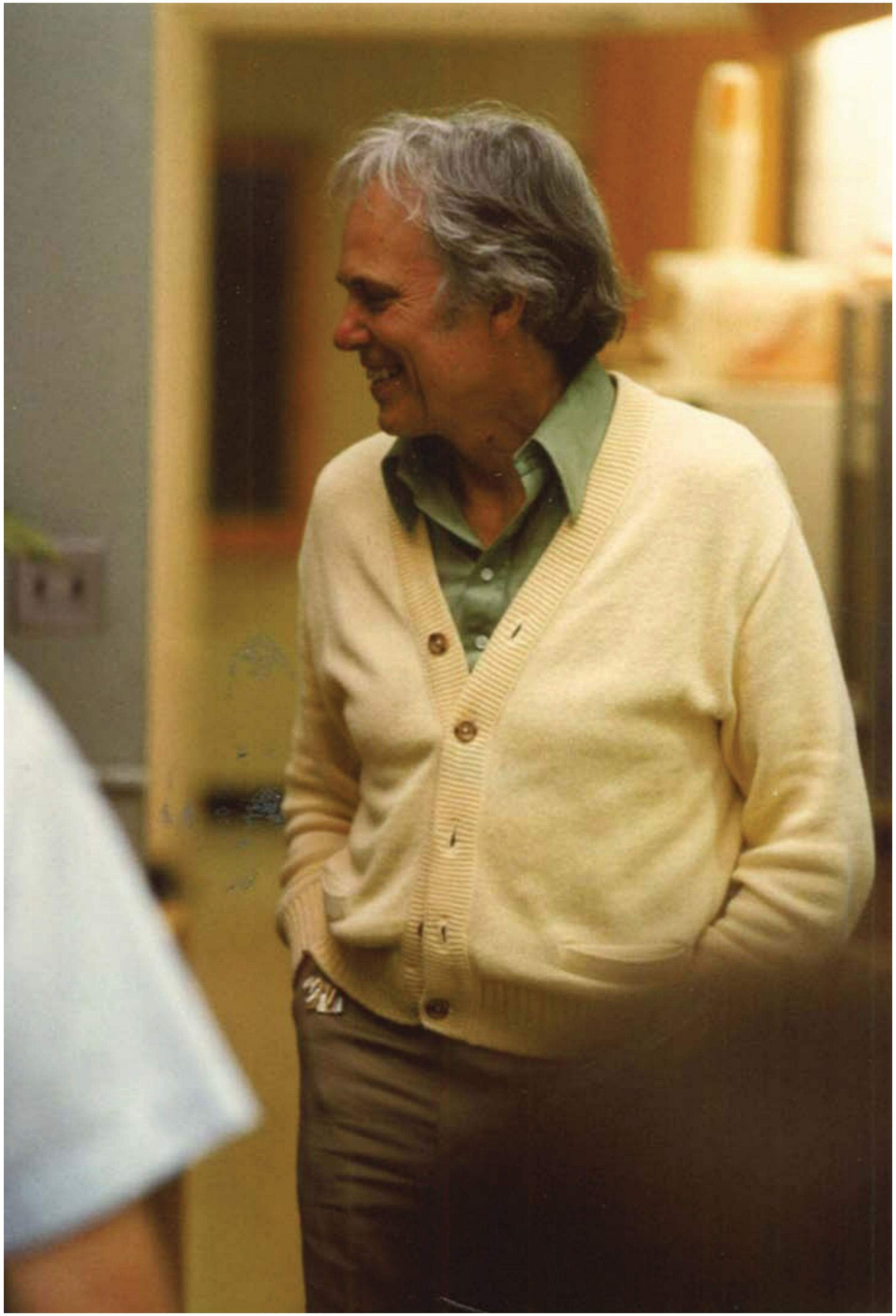
Inside the K500 cyclotron beam chamber adjusting the dees,

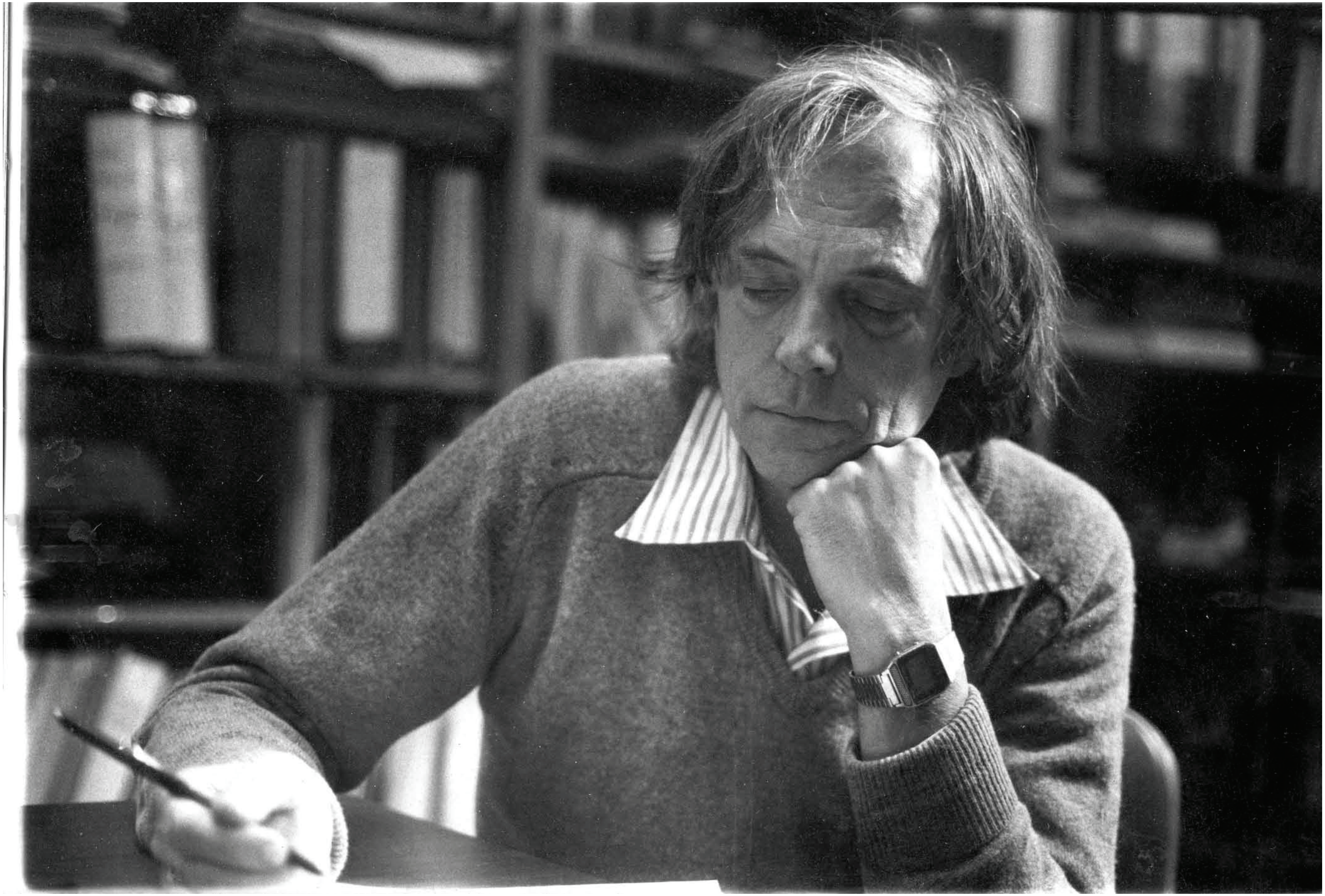


K500 is finished!   1981

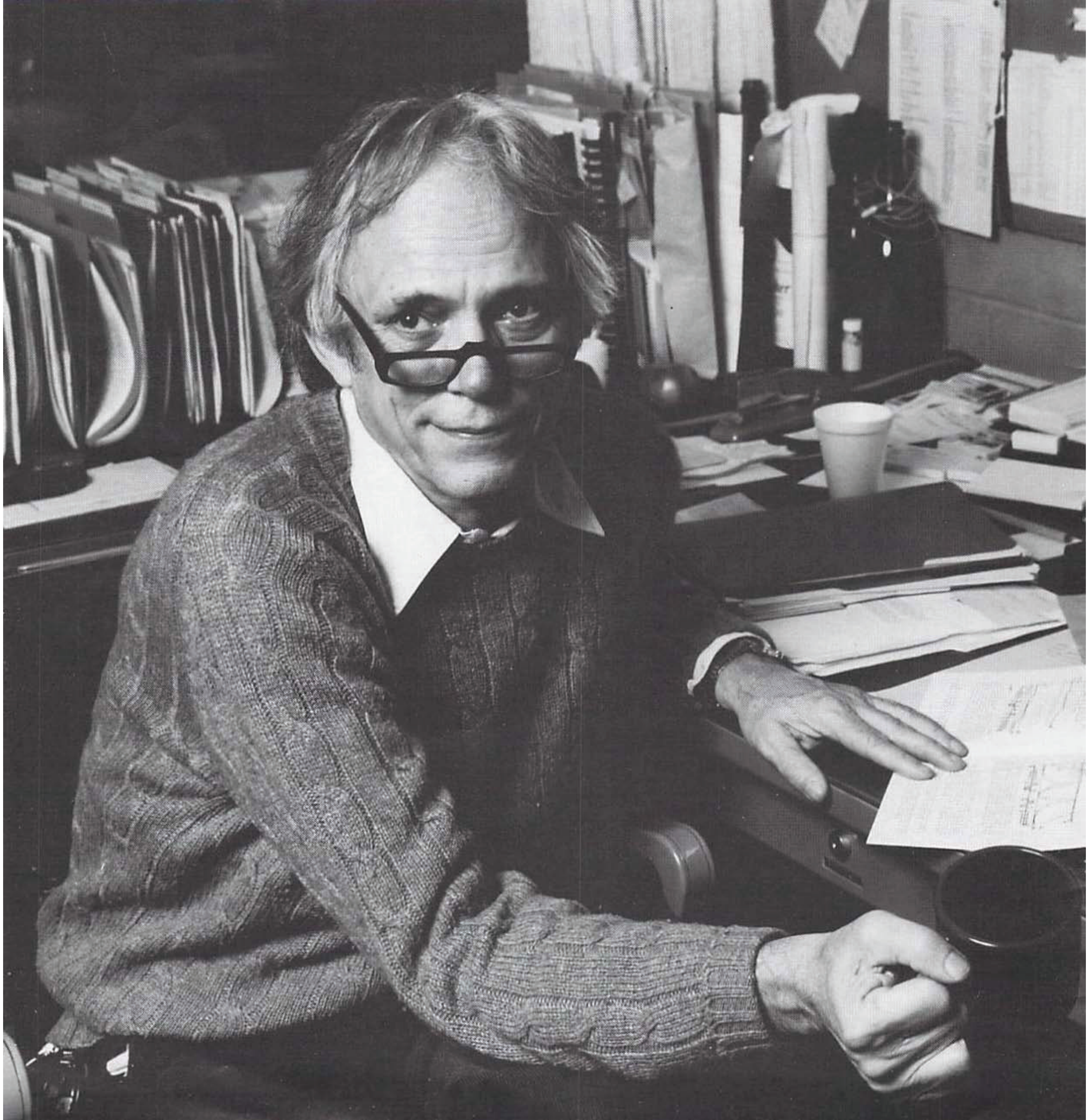
Time to celebrate!!!
1981

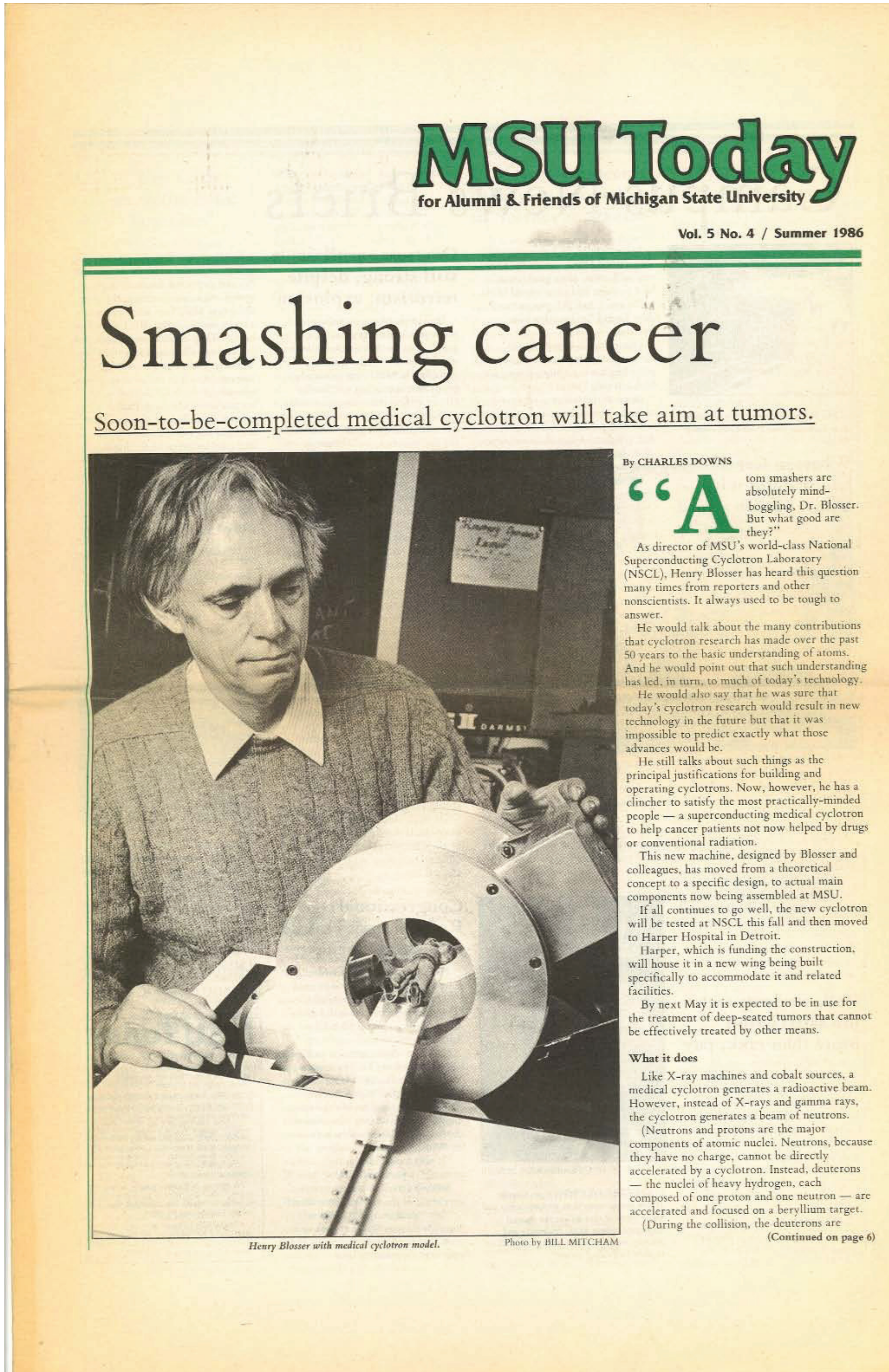
Inside K1200





In deep thoughts…





MSU Today
for Alumni & Friends of Michigan State University
Vol. 5 No. 4 / Summer 1986

Smashing cancer

Soon-to-be-completed medical cyclotron will take aim at tumors.

Henry Blosser with medical cyclotron model. Photo by BILL MITCHAM

By CHARLES DOWNS

"Atom smashers are absolutely mind-boggling, Dr. Blosser. But what good are they?"

As director of MSU's world-class National Superconducting Cyclotron Laboratory (NSCL), Henry Blosser has heard this question many times from reporters and other nonscientists. It always used to be tough to answer.

He would talk about the many contributions that cyclotron research has made over the past 50 years to the basic understanding of atoms. And he would point out that such understanding has led, in turn, to much of today's technology.

He would also say that he was sure that today's cyclotron research would result in new technology in the future but that it was impossible to predict exactly what those advances would be.

He still talks about such things as the principal justifications for building and operating cyclotrons. Now, however, he has a clincher to satisfy the most practically-minded people — a superconducting medical cyclotron to help cancer patients not now helped by drugs or conventional radiation.

This new machine, designed by Blosser and colleagues, has moved from a theoretical concept to a specific design, to actual main components now being assembled at MSU.

If all continues to go well, the new cyclotron will be tested at NSCL this fall and then moved to Harper Hospital in Detroit.

Harper, which is funding the construction, will house it in a new wing being built specifically to accommodate it and related facilities.

By next May it is expected to be in use for the treatment of deep-seated tumors that cannot be effectively treated by other means.

What it does

Like X-ray machines and cobalt sources, a medical cyclotron generates a radioactive beam. However, instead of X-rays and gamma rays, the cyclotron generates a beam of neutrons.

(Neutrons and protons are the major components of atomic nuclei. Neutrons, because they have no charge, cannot be directly accelerated by a cyclotron. Instead, deuterons — the nuclei of heavy hydrogen, each composed of one proton and one neutron — are accelerated and focused on a beryllium target.

(During the collision, the deuterons are

(Continued on page 6)

Turning attention to social needs. Planning the K100 neutron therapy cyclotron

SUCCESS!!!

THE MSU News-Bulletin

Vol. 20, No. 24
April 20, 1989

Published for faculty and staff at Michigan State Univ...

An insert from the College of Human Ecology is included for distribution in this issue of the *MSU News-Bulletin*. Comments on its contents should be directed to ... college information coordinator, 355-...

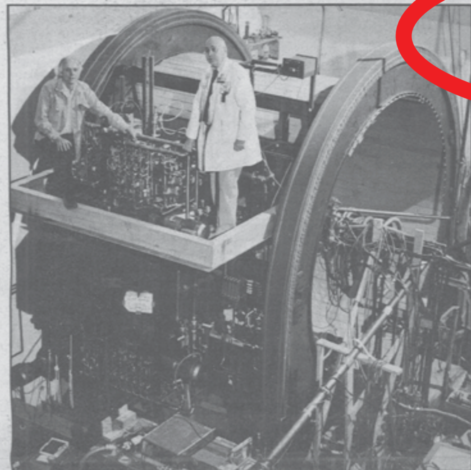


Photo by Bill Mitcham

The two principals in the development of the world's first superconducting cyclotron for cancer therapy survey their brainchild at the National Superconducting Cyclotron Laboratory on campus. MSU's Henry Blosser (left) became the chief designer after William Powers of Harper Hospital in Detroit suggested the concept.

Cancer-treatment cyclotron passes final test at MSU

...ARLES DOWNS

The world's first super... cyclotron for the treatment of cancer has passed its final major test at the National Superconducting Cyclotron Laboratory (NSCL) at MSU.

The "miniaturized" 26-ton medical cyclotron used a tight beam of heavy hydrogen nuclei (deuterons) to produce an intense neutron beam, thus achieving the major design goal.

"This means we will be ready to deliver and install the cyclotron at Harper Hospital in Detroit in about two months," said its chief designer, Henry Blosser.

William Powers, head of the Gershenson Radiation Oncology Center at Harper Hospital and chairperson of the Department of Radiation Oncology at Wayne State University, said physicians at Harper are "anxiously waiting" to use the neutron beam to treat cancer patients, particularly patients whose tumors are not expected to respond well to conventional radiation therapy.

Although a cyclotron was used for cancer therapy as far back as 1938, the technique has never been widely used for very practical reasons.

Earlier cyclotrons built for research have many limitations when used for cancer therapy. Newer room-temperature cyclotrons built specifically ... are very large, heavy and cumbersome as well as expensive ...

'U' makes bid for recycling funds

MSU may implement a Universitywide recycling program by October that could pay for itself by 1994-95.

University officials April 17 submitted two grant proposals to the state of Michigan under its Quality of Life Bond Program for Solid Waste Alternatives for start-up costs of a program that would annually recycle about 1,000 tons of white paper waste, said Thomas Kehler, director of Campus Park and Planning and chairperson of the University's Ad Hoc Waste Management Task Force, a group formed in early 1989 to look into such a program.

The proposals are for a white paper recycling program only because white paper yields a higher return than other recyclable materials and is most feasible for the University at present, he said.

University officials will know by late summer if the grants will be funded.

If approved, the state would provide MSU funds to implement the program, paying for 75 percent, or $227,588, of the two grants proposals — one for capital costs to get the program started and the other to provide for "recycling" education critical to make the program a success. MSU would fund the remaining 25 percent, or $75,862.

MSU would also provide $92,476 for start-up operational costs, bringing the total cost of the recycling project for the first year to $395,926, Kehler said.

Though MSU will provide about $140,400 to support the program after the first year, benefits to the University could be $30,000 in the first year and about $68,000 in the second. Revenue from the program will break even with the investment by about 1994-54, he said.

At full operation, the program would work like this:

Employees in 50 key administrative and academic buildings would place white paper waste in a convenient container, which would be emptied into a central bin. The paper would be emptied into a bulk container and taken to the Salvage Yard, which would process it for resale, Kehler said. The process should recycle about 1,000 tons of white waste paper annually.

Only employees from 30 buildings will participate in the first year, which should generate about 450 tons of white paper.

University officials have not yet determined which administrative office would oversee the program and a new Office of Waste Minimization and Recycling, which will administer the white waste paper and other recycling programs.

The grant proposals are only the beginning of the University's future in the recycling business, Kehler said.

In creating the grant proposals, through the Office of the Vice President for Finance and Operations and Treasurer in conjunction with the Office of the Provost,

(continued on page 4)

United Way trophy stays

When MSU won a traveling trophy last year from the Big Ten United Way for being the most generous institution in the conference, MSU campaign leaders noted that the trophy's only "traveling" in the coming year would be round-trip.

They kept their word.

MSU-United Way Campaign officials, for the second year since the trophy has been awarded, accepted the honor on behalf of the University. The trophy was presented at the Big Ten United Way annual meeting, held in Illinois. Illinois.

"We felt really good," said Colleen Hennessy, MSU-United Way Campaign student affairs representative, "but we were also sweating bullets."

Hennessy made the trip with Cindy Parks, Capital Area United Way associate director-campaign, and Fred Whims, assistant to the vice provost/dean for management support services, College of Agriculture and Natural Resources, and MSU's new MSU-United Way Campaign chairperson. Whims replaces Robert Underwood, assistant vice president for housing and food services.

MSU's per capita contribution in the 1988-89 MSU-United Way Campaign was $47.19, Hennessy said. The second-place finisher, Northwestern University, was not far behind with a $46.77 per capita contribution.

MSU's total 1988-89 campaign netted $414,119, Hennessy said, well above its goal of $400,000.

The third largest per capita contributor to the United Way in the Big Ten was Ohio State, with a $40.86 per capita contribution. The University of Michigan finished eighth, with a $31.20 per capita contribution.

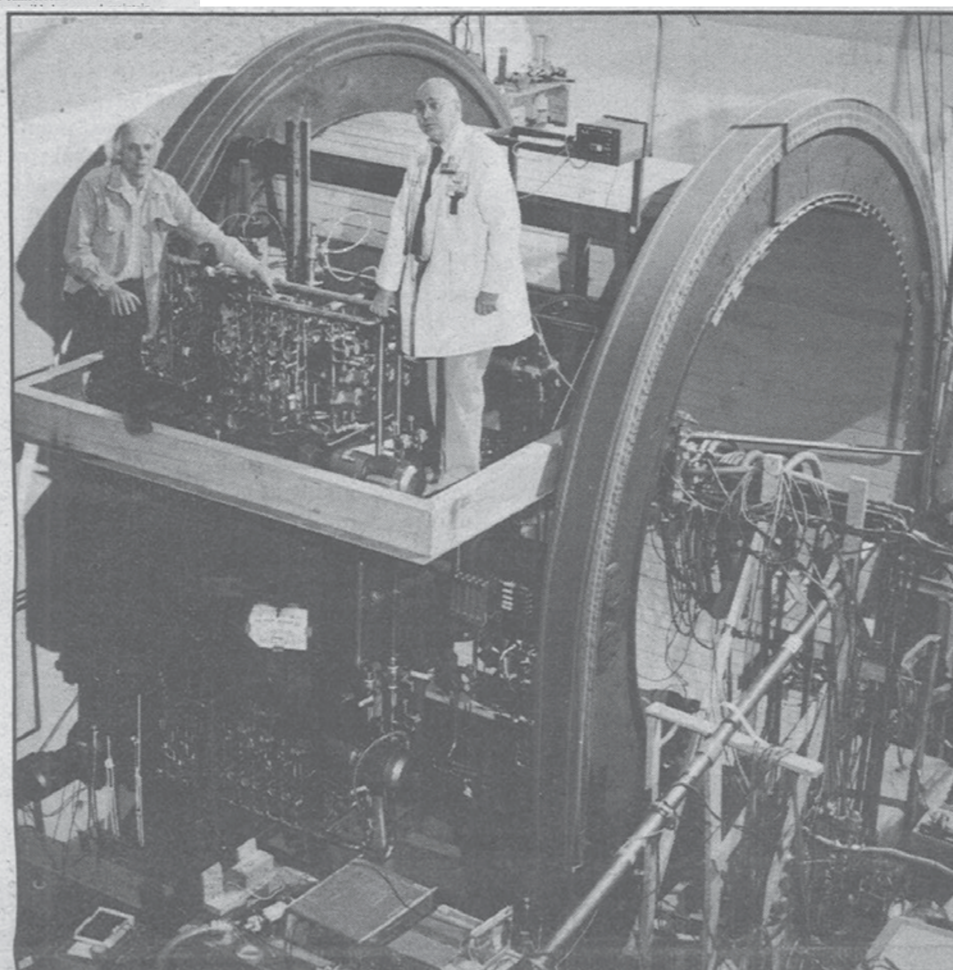


Photo by Bill Mitcham

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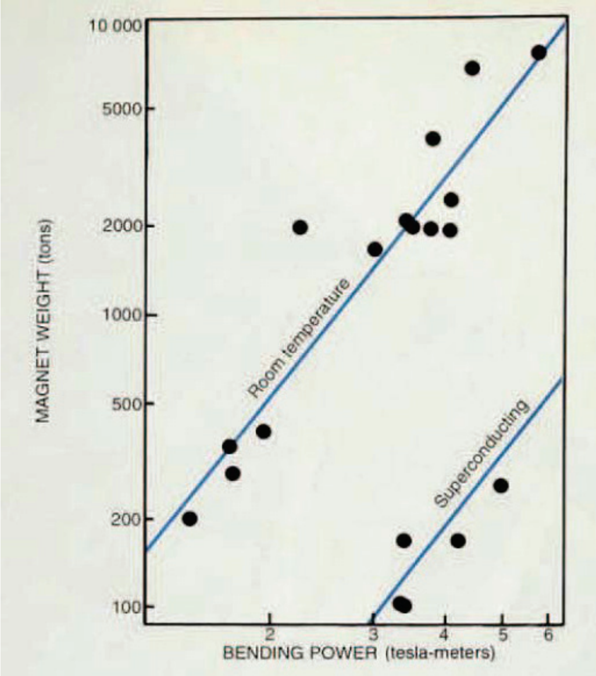
MEDICAL CYCLOTRONS

In 1932 Ernest Lawrence and Stanley Livingston envisaged a device for basic research on the atomic nucleus; today modern versions of their device provide healing radiations at many medical centers.

Henry G. Blosser

70 PHYSICS TODAY OCTOBER 1993

Comparison of magnet weight vs bending power for the large cyclotron magnets of the world. I have drawn trend lines through points for room temperature and superconducting cyclotrons. For a given bending power, the trend lines differ by a factor of 17, illustrating the great impact of superconductivity in reducing the weight of cyclotrons. **Figure 4**



Cyclotrons and Their Applications 2007, Eighteenth International Conference

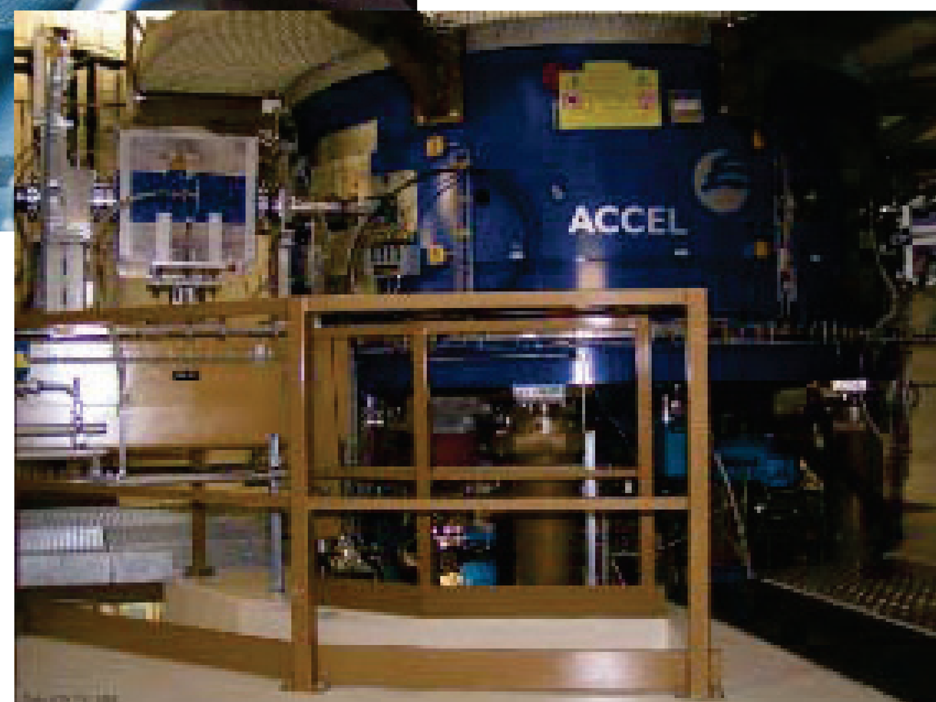
COMMISSIONING OF THE ACCEL 250 MEV PROTON CYCLOTRON

A.E. Geisler, J. Hottenbacher, H.-U. Klein, D. Krischel, H. Röcken,
M. Schillo, T. Stephani, J.H. Timmer,
Accel Instruments GmbH, Bergisch Gladbach, Germany

C. Baumgarten, now at PSI, Villigen, Switzerland

the PSI machine is in routine operation. The design of the compact machine, proposed by Henry Blosser and his team [1] and further developed and manufactured by ACCEL, proved to be very successful in operation with

Proton therapy superconducting cyclotron proposed in 1993 but it did not get support from the funding agencies.
Revived when ACCEL became interested and eventually developed into the 250 MeV PSI COMET cyclotron (2007)



Working on the ACCEL- PSI medical cyclotron
2005

CONSTRUCTION OF 8 T MAGNET TEST STAND FOR CYCLOTRON STUDIES*

J. Kim, H. Blosser, S. Hickson†, L. Lee, F. Marti, J. Schubert, G. Stork, and A. Zeller
National Superconducting Cyclotron Laboratory
Michigan State University
East Lansing, MI, 48824, USA

Abstract–A superconducting magnet designed to study cyclotron central regions and ion sources is under construction. Two split coils are used to provide an approximately flat field in the range of 2-8 tesla. The coils are epoxy potted and banded by stainless steel wire, and the winding form is removed from the coil to reduce the shear stresses. The horizontal and vertical support links are attached to the median plane structure, and the pairs of the coils are weakly connected for independent excitations. The stresses in the coils and quench protection have been studied to ensure coil safety.

I. INTRODUCTION

Compact cyclotrons whose acceleration energy depend on magnetic rigidity (Br) become more economical at the high magnetic field since the overall mass decreases as the cube of radius. However, the first orbit of ion is so small that the central region is difficult to design, and the internal ion source may behave differently.

In achieving fields up to 8 tesla our main concern was the high internal stresses in the coil. The main two options studied were 'tightly banded coil', and 'free coil'[1,2]. With strong preloads on the winding and banding, the coil could

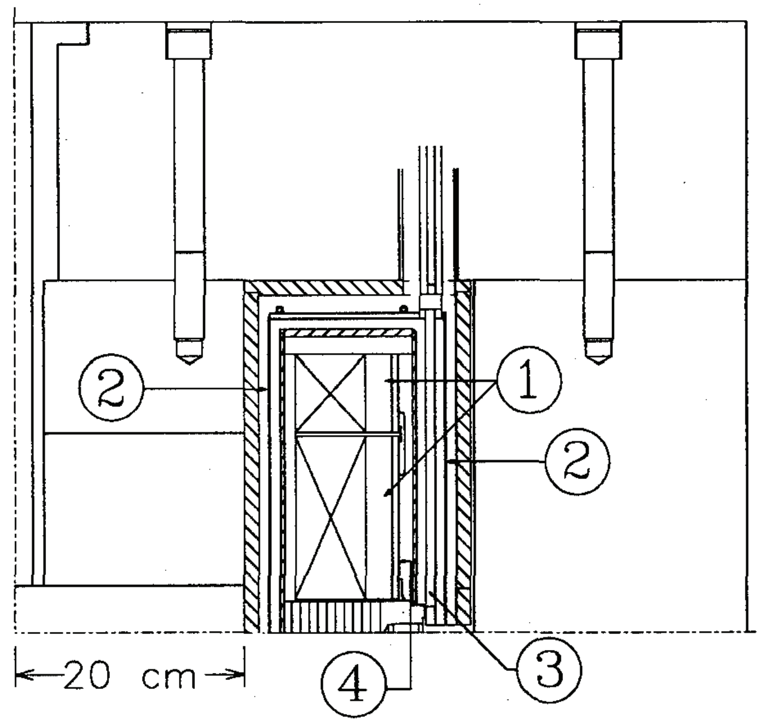


Fig. 1. Schematic view of a quarter of the magnet. The two section coil is shown with an 'X'; numbered elements are, 1)stainless steel banding, 2) 77K heat shield, 3) vertical support link, and 4) welded shell composed of three sections to maintain the cyclotron symmetry.

For a full obituary, see:
Henry Gabriel Blosser
by Sam Austin
Physics Today, August 2013, p.57

2007, 79th birthday