

The Village Crier

 national accelerator laboratory

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WHY DOES NAL USE RADIO FREQUENCY?

What is the function of the Radio-Frequency section in developing the world's largest basic research instrument at the National Accelerator Laboratory? Are the R-F staff members a bunch of "ham operators"? In a sense, they are the catalysts who provide the sophisticated equipment to push the protons at fantastic speeds in the Booster ring and then in the Main Ring. The Village Crier asked Quentin Kerns, R-F Section Leader, to write an article on the activities of his group. Among other accomplishments, Kerns holds more than 40 patents in the field of particle accelerator electronics. His article follows:

Achievement of the first 500 GeV accelerated protons will be a unique event for N.A.L. It is eagerly anticipated by the Radio Frequency Section, whose task is to provide equipment to push the protons forward as they circulate, first in the Booster Ring and later in the Main Ring.

Why do we use Radio Frequency? Since the work of E.O. Lawrence with the cyclotron in the thirties, it has been known that a series of properly-timed small pushes constitutes a practical means of delivering a large total energy to charged particles.

Electrical force between a field and a particle is the nature of the push we apply to protons, and the pushes are applied at a rate of thirty to fifty-three million times a second on the N.A.L. machine.

Radio enthusiasts will recognize that this is in the VHF region, wherein lie amateur, mobile, fixed, and radio astronomy bands.

N.A.L., however, does not want to broadcast its Radio Frequency power into space, but rather wants to concentrate it within hollow copper enclosures or "cavities" where the radio waves can act on and give energy to the passing protons. The Main Ring R.F. system is special in that it occupies only a small portion of the complete ring, the R.F. Straight Section.

As protons circulate in the Main Ring, they travel more than four miles each time they complete a turn. Although guided accurately by magnets, they are coasting for more than 99 $\frac{1}{2}$ % of this distance. In the R.F. Straight Section, the protons pass through sixteen Radio Frequency cavities in a row, receiving sixteen successive pushes, and in this process each proton gains an energy of three million electron volts. After repeating this path about 170,000 times,



--- Quentin A. Kerns ---

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K.C. Cahill, working on computer control equipment.



Ferrite test set up for cavity tuner. Jim Vesely in foreground, Terry Hendricks in background.



Mark Augustine, constructing an R.F. Power amplifier.

WHY DOES NAL USE RADIO FREQUENCY? (Continued from page 1)

they have achieved an energy of 500 billion electron volts.

Consider some noteworthy features of the Radio Frequency system. For one thing, there is considerable power involved. To deliver the necessary quota of force times velocity to the protons, a continuous R.F. power of over one million watts must be generated. Some of the power is lost in heating, but about a million watts (=1300 horsepower) is delivered to the beam.

Power supplies, controls, interconnections to the computer, and the power amplifiers themselves have been developed through the efforts of the R.F. Section. The power amplifiers resemble compact radio transmitters: they are simultaneously FM and AM, although they have more stringent delay requirements than a transmitter, for the following reason.

One essential difference between the accelerator R.F. System and a radio transmitter is that for the well-adjusted radio transmitter, little of the power sent to the antenna ever comes back; most is radiated out into space. In contrast, the accelerator R.F. System puts its power into moving protons. They circulate again and again through the accelerating cavity, where they continue to interact with the R.F. energy as well as deliver additional energy at harmonic frequencies.

The interaction which is greatest with high-intensity beams must be properly controlled. Thus, one of the main efforts of the R.F. Section has been the design of a suitable power amplifier and its related control circuits, which in turn are computer monitored and controlled.

The design of the Booster Radio Frequency cavities that couple the generated power to the proton beam involves high-vacuum, water-cooling, precision copper and ceramic assemblies, and contains contributions from most of the people in the section. Presently we are working with two firms on the development of prototype Main Ring cavities.

Accurate timing (i.e. tuning) of the Radio Frequency waves is essential. The waves must increase frequency to keep step with the protons as they gain speed in their circular paths.

Ferrite is a hard, brittle, black ceramic, (iron, nickel, zinc, and oxygen) whose electromagnetic properties can be varied by an electric current. Tuning of both Booster and Main Ring systems is accomplished electronically by precise power supplies that magnetize ferrite rings. At present in the R.F. Lab, more than 1,000 rings 8 inches in diameter and 1 inch thick, have been weighed, measured, and evaluated electrically. These rings after selection are installed in the cavity tuners that permit frequency modulation of the R.F. System.

In the late summer, we shall have an opportunity to observe the behavior of the first Booster R.F. Station as protons from the Linac are injected into the Booster Ring and circulate through the pair of cavities. Will there be some surprises? Look in on us then to find out.

NAL SITE OPEN TO FAMILIES ON JUNE 14

NAL will be host at a "Family Day" to be held on the site Sunday, June 14, between 2:00 and 5:00 p.m.

Families and employees of NAL, DUSAF and sub-contractors are invited to visit both the Village and the Construction site on that day. In case of rain, the alternate date will be Sunday, June 21.

Purpose of the outing is to acquaint employees and their families with the work being carried on in the development of the Laboratory. The program will include:

1. An 18-minute color movie titled "Atom Smashers" -- a survey of the principles, purpose and methods of particle accelerators, popularly known as atom smashers. The movie will be shown in the newly-renovated Barn in the NAL Village every half hour starting at 2:00 p.m.

2. A walk-around tour of the Village -- visit any or all of the following laboratories and buildings: (1) Beam Transfer; (2) Booster; (3) Main Ring; (4) Radio Frequency; (5) Model Shop; (6) Fire Barn; (7) Exhibit Hall; (8) Machine Shop; (9) Linac and (10) The Curia.

3. Bus tour of the construction site -- a tour of the Linear Accelerator Building, the temporary Control Room and the Booster Enclosure. Buses will leave from the Exhibit Hall, 18 Sauk Blvd., every 20 minutes.

4. A tour for young children to see the NAL buffalo grazing at a nearby farm. The youngsters will be returned to the Village recreation area to be claimed by their parents.

5. Punch and cookies will be served in the NAL Cafeteria during the afternoon.

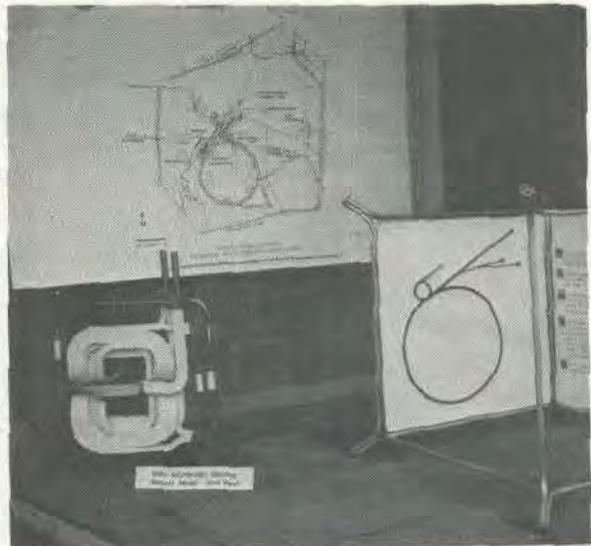
When driving onto the site, please go directly to the NAL Village on Batavia Road, using Sauk Boulevard as the entrance road. Attendants will direct you to parking areas. Please do not drive private cars to the construction site for this event.

If you have any questions or suggestions, please telephone Mrs. Helen Severance, Public Information, Extension 351.

NAL JOINS IN BELVIDERE'S GREEN FESTIVAL

A store-front window display describing the progress and plans of NAL was a feature of the three-day Memorial Day week-end of the annual Green Festival celebration held at Belvidere, Illinois, near Rockford. Most of the photographs, components and other display material came from the NAL Exhibit Hall for this occasion.

Rep. John B. Anderson, (R-Rockford) a member of the Joint Congressional Committee on Atomic Energy, was among the speakers. Also present were U.S. Sen. Ralph T. Smith, Lt. Gov. Paul Simon and State Sen. Dennis J. Collins.



...NAL on display at Belvidere...

THE CLASS OF 1970 FROM THE NAL FAMILY

The maturing and growing NAL family has a number of Spring, 1970, graduates from public and private high schools and colleges. These pages are devoted to photographs and listings of the young men and women who are graduating this year. Some weeks ago, the Editors of the Village Crier made an appeal for photographs of the sons and daughters of NAL employees who would be graduating in May and June. We are publishing the photos of those which were sent in response to this request. We wish the entire Class of 1970 the best of luck in the years to come.

Leslie A. Cole, daughter of Francis T. Cole (Director's Office) from Wheaton Central High School



Cole

Jeffrey S. DeShong, son of James DeShong (Physics Research) from York Community.



DeShong

Theresa J. Downs, daughter of Richard Downs (Main Accelerator) from Wheaton Central.



Downs

Thomas G. Gavin, son of Phil Gavin (Radio Frequency) from Glenbard East.



Gavin

Laurie M. Hann, daughter of Harold Hann (Material Services) from Wheaton North.



Hann

David Hinterberger, son of Henry Hinterberger (Technical Services) from Batavia High.



Hinterberger

Karen J. Hoffman, daughter of Delbert Hoffman (Beam Transfer) from Hinsdale Central.



Hoffman

Julie Johnson, daughter of Dwaine Johnson (Main Ring) from Batavia High.



Johnson

Barbara Kraft, daughter of Bob Kraft (Construction) from Proviso East.



Kraft

Debra M. Lewis, daughter of Gerry Reid (Construction) from Proviso East.



Lewis

Geary Olsen, son of June Olsen (Personnel) from Wheaton Central.



Olsen

John R. Ramus, son of John Ramus (Technical Services) from Batavia High.



Ramus



Semmelman



Vineyard



Wilkas

Patricia A. Semmelman, daughter John Semmelman (Radio Frequency) from U. of I.

Mark E. Vineyard, son of Dorothy Vineyard (Accounting) from Wheaton Central.

Irene B. Wilkas, daughter of Bernice Wilkas (Accounting) from St. Charles High.



Wilkas



Young



Moore

Lenore R. Wilkas, daughter of Bernice Wilkas (Accounting) from U. of Wisconsin.

Linda Young, daughter of Don Young (Linac) from Downers Grove North.

Barbara Moore, daughter of Fred Moore (Maintenance), from Bradley University, Peoria. (Picture received as Crier went to press, hence not in order.)

Other graduating students are:

Louis Broccolo, son of Filomena Broccolo (Purchasing) from U. of I.

William J. Daniels, son of Robert Daniels (Beam Transfer) from Downers Grove North.

Jean A. Ecker, daughter of Helen Ecker (Technical Services) from St. Charles High.

Thomas Lindberg, son of Jack Lindberg (Beam Transfer) from York High.

Christen S. Michelassi, daughter of Gianmaria Michelassi (Booster) from Thornridge High.

Peter Palmer, son of Maxwell Palmer (Linac) from Geneva High.

Debra Riggs, daughter of Mae Riggs (Cafeteria) from Joliet Township High.

Timothy Williams, son of Kennard Williams (E.E.O.) from Willowbrook High.

Joan Maute, who works in the NAL Public Information office, and her husband, Mark Maute, both received degrees from North Central College, Naperville, at the commencement exercises on Sunday, May 31.



Maute

A REMINDER

TO EMPLOYEES AND OTHERS WHO RECEIVE THE VILLAGE CRIER:
If you have moved recently, please advise us of your new address and telephone number. To keep our mailing lists up to date, we must have your current address on file. Send the information to The Village Crier, Public Information Office, P.O. Box 500, Batavia, Illinois, 60510, or phone 231-6600, Ext. 351.

NEW NAL EMPLOYEES - May, 1970

ACCELERATOR THEORY

Alan Algustymak, Programmer II
Downers Grove, Ill.

Kenneth Sowinski, Programmer II
Chicago, Ill.

Melvin Storm, Programmer III
Naperville, Ill.

ACCOUNTING

Paul Davis, Accountant
Naperville, Ill.

BEAM TRANSFER

Armand Bianchi, Sr. Tech. Aide
Lockport, Ill.

BOOSTER

Ed Barsatti, Engineer I
Lockport, Ill.

Jon Sauer, Physicist I

CONTRACTS

Lawrence Vanasch, Contract Admin.
Wheaton, Ill.

FARM MANAGEMENT

Leonard Feiza, Groundsman
Maple Park, Ill.

LINAC

Gerald Erickson, Technician I
Odell, Ill.

James Mc Dade, Lab Technician
Aurora, Ill.

Richard Parry, Engineer I
Aurora, Ill.

MAIN ACCELERATOR

Daniel Thompson, Lab Assistant
Chicago, Ill.

PHYSICS RESEARCH

Richard Bingham, Sr. Technical Aide
Addison, Ill.

PLANT MANAGEMENT

Edward Gallagher, Engineer II
Oak Lawn, Ill.

RADIO FREQUENCY

Douglas Maxwell, Draftsman
Aurora, Ill.

TRANSPORTATION

Thomas Blachford, Driver
Batavia, Ill.

David Wall, Telephone Operator
Aurora, Ill.

NEW ARRIVALS IN MAIN RING FAMILIES

[REDACTED] John and Mary
Lou Satti, Naperville.

[REDACTED] Dave and Darlene Sutter, Naperville,
[REDACTED]

[REDACTED] George and Jeanne
Biallas, Geneva.

Congratulations and good wishes to both families!!!

CLASSIFIED ADS

FOR SALE - 1970 Maverick, radio, heater, white walls, auto. trans., good condition.
Make offer to Ron Podboy, 231-6600, Ext. 345.

FOR SALE - Sailboat. Excellent family boat -- trailer. extras. Reasonably priced.
Call 388-0509 after 6 p.m.

GARAGE SALE - June 5-6-7. TV, air cond.,
stereo, misc. hshld. items. 921 S. Iowa,
Addison. Phone 279-2822.

FOR SALE - 1963 Ford 9 psgr. country
squire. \$300. 879-1123. Tom Larson.

FOR SALE - Roper gas range. 2 yrs old.
\$65. Call Don Wendt, Ext. 321 or 629-
2698.

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