



...NAL Operations crew achieving intensity record included: (L-R, Front) Karl Koepke, Operations Chief; Bob Angstadt, Operator; Bob Evans, Operations Assistant; Fritz Macheel, Operator; Bob Bauger, Duty Assistant. (L-R, Back) Don Rohde, Operator; Butch Bianchi, Mechanical Assistant; Jeff Gannon, Operations Chief; Dave Kindelberger, Bill Merz, Duane Plant, Doug Howard, Operators; Bob Mau, Crew Chief; Mark Koenig, Operator...

10¹³ Protons Per Pulse in NAL Main Ring 12:40 a.m. Wed., April 17, 1974

The NAL accelerator operators put it all together just after midnight on Wednesday, April 17, and by 12:40 a.m. 10^{13} (ten trillion) protons were whirling around the Main Ring every 22 microseconds, the highest intensity per pulse ever achieved in any synchrotron, proton or electron, in the world. This effort and success ranks second only to the March 1, 1972 achievement of the first 200 BeV operation in the accelerator.

The capacity to transfer and retain in the Main Ring the increased number -- or greater intensity -- of protons is of great importance to the success of the experimental program at the National Accelerator Laboratory. Higher intensities make it possible to investigate phenomena that happen less frequently in particle collisions and to do many experiments in a shorter time. Raising the accelerator intensity is equivalent to turning on extra lights in a dimly-lit room. Just as the additional light makes it easier to read a book, the extra protons make it easier to read Nature's story of the fundamental structure of matter.

The intensity of the beam is particularly vital to experiments involved in investigating neutrinos. Neutrino particles interact very weakly with matter; they are extremely difficult to detect. But neutrino interactions appear to be among the most important clues to the roots of matter, and recent discoveries in neutrino physics at NAL and at CERN have emphasized the importance of these studies. With the new NAL beam intensity, the presence of more protons in the beam will enable neutrino experiments to retrieve and study more neutrino interactions with an improved signal-to-noise ratio.

The increase in intensity has resulted from a combination of several factors. Over the last year, a major effort has been mounted to improve the stability of the Pre-Accelerator, the Linear



...Dave Kindelberger (standing), Duane Plant (L), and Karl Koepke tuning the Main Accelerator...



...Bob Angstadt (L), Don Rohde at Booster console in Main Control Room...

Accelerator, and the Booster Accelerator so that the protons generated in these first segments of the accelerator systems could be retained and reproducibly injected efficiently into the Main Ring during the 12 pulse injection period. In the last few months, a special effort was made to install improved magnets with a time-varying field so that a beam could be injected which would fill several turns, up to four, of the radial aperture in the Booster.

In both of these activities the combined efforts of the Linac Group, the Booster Group, and the Beam Diagnostics group of the Operations Department, under the leadership of Cy Curtis, Bob Goodwin, Ed Gray, Ed Hubbard, Fred Mills, Curt Owen, Bob Peters, Mike Shea, and Don Young and the technicians of these groups, were brought to bear on the problems. This phase of the intensity improvement effort was completed on April 4 when the new orbit-bump magnets, fabricated in the NAL Magnet Facility, were installed in the Booster. The new system was tuned, and at the time the intensity record came in the Main Ring, the Booster was injecting 1.6×10^{13} protons to the Main Ring -- 1/3 more than ever before.

During the same period of time, the Main Ring Group has been working to enlarge the useful area or "aperture" in the Main Ring so that the "fatter" Booster beam could be accepted by the Main Ring more effectively, capturing more of the increased number of protons coming from the Booster. Spearheaded by Rae Stiening, with the help of Ted Wilson (then on leave at NAL from CERN) and Shoroku Ohnuma of the Accelerator Theory Group, special correction magnets and improved diagnostic equipment, some loaned to NAL from CERN, were incorporated into the Main Ring to observe beam resonance phenomena and to cancel out beam resonances caused by errors in the injection field of the Main Ring magnets. In addition to the single particle resonance effects, collective effects were also observed for which compensation was needed. Special horizontal and vertical beam instability dampers were built and installed by the Research Services Department under the supervision of Quentin Kerns and Gerry Tool and their technicians, and by Ed Higgins and the RF Group of the Accelerator Support Department. Research Services has also provided some important diagnostic elements to support these studies.

During the first days of April, whenever the operation schedule permitted, the try for the bigger numbers of protons went on, and the results began to climb -- 0.82×10^{13} on Monday, April 15; 0.946 on Tuesday, April 16.

Jeff Gannon, Operations Chief in the Main Control Room on Tuesday night, decided to stay for awhile at the end of his 4-12 shift when Karl Koepke took over. Greg Urban, Operations Chief from 8-4 during the day on Tuesday, had watched things go well all day and came back in the evening to observe the record-making effort. Intensity was at 0.928 at midnight and things looked good, all systems functioning smoothly. At least fifteen people watched tensely as the crews set the Booster to inject 12 pulses of protons into the Main Ring on each Main Ring cycle... 0.959 and steady at 12:15. Then a decision between the Booster operators and the Main Ring operators to try 13 pulses from the Booster.... the record came just a few minutes later.



...Bob Mau selecting program at the Main Ring console...



...(L-R) Doug Howard, Fritz Macheel, Bill Merz tuning beam through switchyard to experimental areas...



...Operations chiefs Jeff Gannon (L), Karl Koepke who, with Greg Urban, guided NAL accelerator crews to intensity record...

"It was about the same as getting the 200 BeV two years ago," according to Gannon who was also at the Main Ring controls for the 200 BeV event. "It was tense and exciting." Frank Cole, Head of the Operations Group, speaks high praises of the morale among the operators.

Paul Reardon, Head of the Accelerator Division, observes, "Although this has been a team effort all the way, in the end it was the diligence of the operators and the proper functioning of the new systems that established the record. Our operators and our systems people are both competent and dedicated, and although the systems people know how to build the improved apparatus, the operators know how to get the most out of them."

The recent intensity success is part of a continuing program in the NAL Accelerator Division to improve the operation of the NAL facility for experimenters who come from all over the world. At present, there are 31 experiments installed at NAL, with 14 being carried out simultaneously along the three external beam lines and at the two target stations in the Internal Target Area.



...Operating crews and friends and champagne at 2:30 a.m. after achieving intensity record in NAL Main Ring... (Photos, courtesy of Luke Mo, David Kindelberger, Greg Urban, Tim Fielding)

FURTHER PLANS FOR NAL DEDICATION

Plans are nearing completion for the formal Dedication of the Laboratory on Saturday, May 11, at 3:30 p.m.

The program tentatively includes Dr. Robert F. Bacher, President of URA; Representative Melvin Price (D.Ill.), Chairman of the Congressional Joint Committee on Atomic Energy; Professor Leon Lederman, Columbia University; Dr. Dixy Lee Ray, Chairman, U.S. Atomic Energy Commission; Mrs. Enrico Fermi, and Dr. Robert R. Wilson, Director of NAL.

Invitations to all employees are about to be mailed. Although not explicitly stated in the invitations, employees' families are most welcome at the ceremony. It should be noted, however, that the Dedication Ceremony is rather formal and will probably last more than an hour. For that reason, it may not be appropriate to bring young children. The Laboratory plans a general Open House a month or so after the Dedication, and on that occasion, all children of employees will be most welcome.

In celebration of the NAL Dedication, the Laboratory's Auditorium Committee has planned the first program in its Arts Series in the NAL Auditorium on Friday, May 10, at 8:30 p.m. This program will be an evening of dance (including performances of ballet, modern, character, and jazz dance) by a group headed by Richard Arve and including members of the Chicago Ballet Company.

Arve is a Chicago-based dancer and choreographer. He has won particular recognition for his work entitled, "In Memoriam For My Friend Henry Saia," which will be featured on the program at NAL.

The Auditorium Committee has tentatively set the price for tickets for the Arts Series at \$3.00 per ticket for each performance. However, in honor of the Dedication, Universities Research Association will underwrite the cost of tickets for the May 10 program and tickets will be issued without charge on a request basis for this occasion. Tickets may be requested by calling Marilyn Paul, Ext. 3211.

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...Employees Lecture Series, "The NAL Accelerator -- How it Works," Friday, April 26, 1974 at 11:00 a.m. Dr. D. Jovanovic, Accelerator Division, "Internal Target."

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CLASSIFIED ADS

FOR SALE - 72 Caprice-Classical, executive driven, garage kept, 20,000 mi., power + AM/FM stereo & tape deck. Excel. condition. Call Dick, Ext. 3619 or 852-5134 evenings.

FOR SALE - 72 Vega-Hatchback, with AM radio, white wall tires, low mileage, \$1,300. Call John Bockmier, Ext. 3259.

FOR SALE - 19" RCA color TV set, table model, brand new, still in case w/warranty, delivered, \$245. Call Dan Moline, Ext. 3986.

FOR SALE - 18 mos. old Sears refrig, \$200, a Kelvinator stove, \$100, both gold tone. Call K. Borneman, Ext. 3222 or 879-1844.

FOR SALE - A 16 cub. ft. upright freezer, not frost free, key lock on door. Like new, used four months, \$200 (cash and carry). Call Karl Schmidt, 695-3579.

FOR SALE - Two audio Dynamics Corp., high fidelity loud speakers. Mint condition, \$150 for both, save \$60. Call Vince Zernoski, Ext. 3580.

FOR SALE - Green drapes, new (never used), 7'H X 8'W, \$45. Call Dick Figlik, Ext. 3281/584-9172.

FOR SALE - Luggage rack, 40 x 48 x 14", gray cover, used one summer. Call Barb, Ext. 3674.

FOR SALE - Alaskan Malamutes, A.K.C., O.F.A. registered show quality, champion line, black and white with racoon type mask. Call Greg Lawrence, Ext. 3677.

WANTED - A G.M. Infant Loveseat (for newborn). Call Ulla Baker, 231-0339.

WANTED - A tennis partner to play a quick set at lunch or after work. Good to very good. Call Mary Ann at Ext. 3324.

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