

ENTRY NO. FM-9

NAME OF MACHINE Nevis Synchrocyclotron DATE 8/14/78
 INSTITUTION Columbia University Physics Department
 ADDRESS Nevis Laboratories, Irvington, N.Y. 10533

IN CHARGE Prof. Derek W. Storm REPORTED by same

HISTORY AND STATUS

DESIGN, date 1965-71 MODEL tests same
 ENG. DESIGN, date start 1966
 CONSTRUCTION, date 9/70-6/75
 FIRST BEAM date (or goal) 1975
 MAJOR ALTERATIONS Many
 OPERATION, 100 hr/wk; On Target 80 hr/wk
 TIME DIST., in house 70 %, outside 30 %
 USERS' SCHEDULING CYCLE several weeks
 COST, ACCELERATOR \$6,500,000
 COST, FACILITY, total _____
 FUNDED BY NSF

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 4 ENGINEERS 2
 TECHNICIANS 8 CRAFTS 3
 GRAD STUDENTS involved during year 0
 OPERATED BY _____ Res staff or Operators
 BUDGET, op & dev 1.2 x 10⁶
 FUNDED BY NSF

RESEARCH STAFF, not included above

USERS, in house 10 outside 7
 GRAD STUDENTS involved during year 8
 RES. BUDGET, in house \$500,000
 FUNDED BY NSF

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed _____ m²
 movable _____ m²
 TARGET STATIONS 2 in 1 rooms
 STATIONS served at same time, max 2
 MAG SPECTROGRAPH, type none
 COMPUTER, model PDP-11, EMR 6130
 OTHER FACILITIES isotope production

REFERENCES/NOTES

MAGNET

POLE FACE diameter 432 cm; R extraction 195 cm
 GAP, min 1.9 cm; Field 19-26 kG } at 1.9 x 10⁶
 max 95 cm; Field 13.6 kG } ampere turns
 AVERAGE FIELD at R ext 20 kG
 CURRENT STABILITY 100 parts/10⁶; B_{max}/(B) 1.0-1.4
 NUMBER OF SECTORS 3; SPIRAL, max 35 deg
 POLE FACE COIL PAIRS: AVF none /sec;
 Harmonic correction none
 Rad grad none /sec or Circ coils _____
 WEIGHT: Fe 2300 tons; Coils 187 tons
 CONDUCTOR, Material and type copper
 STORED ENERGY ~ 25 MJ
 COOLING SYSTEM oil, demineralized water
 POWER: Main coils 910 kW max, kW
 Trimming coils 0 max, kW
 YOKE/POLE AREA 100 %
 SECTOR ANGLE (Sep Sec) _____ deg
 ION ENERGY (Bending limit) E/A = 550 q²/A² MeV
 (Focusing limit) E/A = 550 q/A MeV
 (protons only)

ACCELERATION SYSTEM

DEES, number 1 angle 180-130 deg
 BEAM APERTURE 2.5 cm; DC BIAS 2-5 kV
 TUNED by, coarse rotating fine capacitor
 RF 28. to 19.1 MHz, stable ± _____ /10⁶
 Orb F _____ to _____ MHz; GAIN, max 20-25 kV/turn
 HARMONICS, RF/Orb F, used 1
 DEE-Gnd, max 35 kV, min gap 1 cm
 STABILITY, (pk-pk noise)/(pk RF volt) _____
 RF PHASE stable to ± (FM cyclotron) deg
 RF POWER input, max 150 kW
 RF PROTECT circuit, speed 100 μsec
 Type bias current detector
 FREQUENCY MODULATION, rate 300 /sec
 MODULATOR, type series tube
 BEAM PULSE, width 20 μs

VACUUM SYSTEM

PUMPS, No., Type, Size 2 oil diffusion pumps
90 cm
 OPERATING PRESSURE 10 μTorr,
 PUMPDOWN TIME 2 hrs

ION SOURCES/INJECTION SYSTEM

internal, pulsed, hollow
cathode
 EXTRACTION SYSTEM magnetic septum
peeler regenerator; time
 CONTROL SYSTEM varying.
conventional mag bump

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CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	570	570
CURRENT		(μ A)	(μ A)
Internal			
External	p	15	4
Secondary	π	(part/s) $10 \times 10^7 \pi^+$	(part/s)
	μ	$18 \times 10^5 \mu^+$	

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	RF deg	μ A of MeV
Phase Exc, max	RF deg	μ A of MeV
Extract Eff	70 %	3 μ A of 570 MeV p
Res, $\Delta E/E$	1 %	μ A of MeV
Emittance		
(mm-mrad)	$\left\{ \begin{array}{l} 100 \text{ axial} \\ 100 \text{ radial} \end{array} \right\}$	3 μ A of 570 MeV p

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	90	%
Solid State Physics		%
Bio-Medical Applications		%
Isotope Production		%
Development	10	%
		%
		%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

The modification has resulted in an increase from 380 MeV to 570 MeV for protons, with the repetition rate increased from 60/sec to 300/sec. Operation to date has been at 150/sec. This energy increase was achieved by adding sector focusing and changing the field shape. This beam has no micro structure and about 75% macro duty factor. It is used with three secondary charged particle beam lines for simultaneous experiments with π^\pm , μ^\pm and scattered protons. Typical beam intensities have been 1.5 to 2.0 μ A on target. The accelerator was closed July 1978.