

ENTRY NO. 32

NAME OF MACHINE Variable Energy Cyclotron DATE Aug. 78
INSTITUTION Bhabha Atomic Research Centre
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IN CHARGE C. Ambasankaran REPORTED BY A.S. Divatia and Santimay Chatterjee

HISTORY AND STATUS

DESIGN, date 1967 MODEL tests -
ENG. DESIGN, date 1968-69
CONSTRUCTION, date 1969-77
FIRST BEAM date (or goal) Jun '77(Int); Jul '78
MAJOR ALTERATIONS - (Ext)

OPERATION, - hr/wk; On Target - hr/wk
TIME DIST., in house - %, outside - %
USERS' SCHEDULING CYCLE - weeks
COST, ACCELERATOR $\$3.03 \times 10^6$
COST, FACILITY, total $\$10.67 \times 10^6$
FUNDED BY Dept. of Atomic Energy

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 11 ENGINEERS 37
TECHNICIANS 58 CRAFTS 122
GRAD STUDENTS involved during year -
OPERATED BY - Res staff or - Operators
BUDGET, op & dev $\$1.05 \times 10^6$ (1978-79)
FUNDED BY Dept. of Atomic Energy

RESEARCH STAFF, not included above

USERS, in house 17 outside -
GRAD STUDENTS involved during year -
RES. BUDGET, in house $\$0.70 \times 10^6$ (1978-79)
FUNDED BY Dept. of Atomic Energy

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 226 m²
movable 535 m²
TARGET STATIONS 9 in 4 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type OSD
COMPUTER, model Unichannel-15
OTHER FACILITIES Target, Detector,
Electronics, Radio-chemistry,
Irradiation.

REFERENCES/NOTES

1. C. Ambasankaran and D.Y. Phadke, Proc. Particle Accl. Conf., San Fransisco: IEEE Trans. Nucl. Sc., NS-20, No.3(June 1973) p.236.

MAGNET

POLE FACE diameter 224 cm; R extraction 99 cm
GAP, min 19 cm; Field 21 kG } at 0.56×10^6
max 30 cm; Field 14.1 kG } ampere turns
AVERAGE FIELD at R ext 17.1 kG
CURRENT STABILITY +10 parts/ 10^6 ; B_{max}/(B) 1.22
NUMBER OF SECTORS 3; SPIRAL, max 55 deg
POLE FACE COIL PAIRS: AVF - /sec;
Harmonic correction 5
Rad grad - /sec or Circ coils 17
WEIGHT: Fe 275 tons; Coils 10 tons
CONDUCTOR, Material and type Cu
STORED ENERGY - MJ
COOLING SYSTEM LCW
POWER: Main coils 525 max, kW
Trimming coils 460 max, kW
YOKE/POLE AREA 100 %
SECTOR ANGLE (Sep Sec) - deg
ION ENERGY (Bending limit) E/A = 140 q²/A² MeV
(Focusing limit) E/A = 70 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 3.5 cm; DC BIAS - kV
TUNED by, coarse MP fine VC
RF 5.5 to 16.5 MHz, stable \pm 1 / 10^6
Orb F - to - MHz; GAIN, max ≤ 140 kV/turn
HARMONICS, RF/Orb F, used -
DEE-Gnd, max 70 kV, min gap 6.19 cm
STABILITY, (pk-pk noise)/(pk RF volt) -
RF PHASE stable to \pm - deg
RF POWER input, max 400 (DC) kW
RF PROTECT circuit, speed 2 μ sec
Type Ignitron crowbar
FREQUENCY MODULATION, rate - /sec
MODULATOR, type -
BEAM PULSE, width -

VACUUM SYSTEM

PUMPS, No., Type, Size Two 89 cm. dia
and one 30 cm dia
OPERATING PRESSURE 10 μ Torr,
PUMPDOWN TIME 3-4 hrs

ION SOURCES/INJECTION SYSTEM
PIG

EXTRACTION SYSTEM
DC Electrostatic Deflector

CONTROL SYSTEM
Manual

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CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	6-60	
	d	12-65	
	α	25-130*	50
CURRENT		(μ A)	(μ A)
	Internal	α 1000	2
	External	α 100	Nominal
Secondary		(part/s)	(part/s)

BEAM PROPERTIES

	Measured	Conditions
Pulse Width	RF deg	μ A of MeV
Phase Exc, max	RF deg	μ A of MeV
Extract Eff	%	μ A of MeV
Res, $\Delta E/E$	%	μ A of MeV
Emittance	(mm-mrad) { axial } μ A of MeV	
	{ radial }	

OPERATING PROGRAMS, time dist

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

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

Fabrication of all components of the Variable Energy Cyclotron was completed and internal beam obtained on June 16, 1977. Studies on beam diagnostics were conducted till August, 1977. The deflector was assembled, tested, installed and commissioned. External beam was obtained on July 8, 1978.

One switching magnet and two quadrupole magnets have been installed. 160° analysing magnet is under construction. 915 mm diameter scattering chamber is ready. Unichannel-15 computer for on-line data acquisition has been commissioned and is under operation. One IRIS-80 computer system is also planned to be installed within the next year. Other facilities for research like target, detector and electronics have been started. Fabrication of magnetic spectrometer has started. The Variable Energy Cyclotron will operate as a national facility available to all scientists all over India.

REFERENCES/NOTES (Contd...)

2. C. Ambasankaran, et al., Proc. 7th Int.Conf. on Cyclotrons and their Applications (Birkhauser, Basel, 1975), p.84-87.
3. A.S. Divatia, Proc. VII Int.Conf. on Few Body Problems in Nucl. and Part.Phys, Delhi, 1976(North-Holland)p.1-13.
4. VEC Staff (Presented by A.S. Divatia): Int. Conf. on Nucl. Phys. at Cyclotron Energies, Calcutta 1977 Proc. to be published.