

ENTRY NO. 38

NAME OF MACHINE Variable Energy Cyclotron
 INSTITUTION Bhabha Atomic Research Centre
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 IN CHARGE A.S. DIVATIA REPORTED BY A.S. DIVATIA

HISTORY AND STATUS

DESIGN, date 1967 Model tests
 ENG DESIGN, date 1968-69
 CONSTRUCTION, date 1969-77
 FIRST BEAM, date (or goal) June 77 (Int.) July 78 (Ext.)
 MAJOR ALTERATIONS A driven RF system based on a 4648 tetrode in 1983.
 COST, ACCELERATOR \$ 3x10⁶
 COST, FACILITY, total \$ 11x10⁶
 FUNDED BY Department of Atomic Energy

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS 12 ENGINEERS 32
 TECHNICIANS 58 CRAFTS 131
 GRAD STUDENTS involved during year
 OPERATED BY Research staff or 12 Operators
 OPERATION 168⁺ hr/wk. On target hr/wk
 TIME DISTR. in house % , outside %
 BUDGET, op & dev \$ 2.5 x 10⁶
 FUNDED BY Department of Atomic Energy

RESEARCH STAFF, not included above

USERS, in house 7 groups outside 25 groups
 GRAD STUDENTS involved during year 10
 RESEARCH BUDGET, in house
 FUNDED BY Department of Atomic Energy

MAGNET

POLE FACE, diameter (compact) 224 cm, R-extraction 99 cm
 R injection cm
 GAP, min 19 cm, Field 21.0 kG
 max 30 cm, Field 14.1 kG at 0.56 x 10⁶
 AVERAGE FIELD at R ext 17.1 kG Ampere turns
 B max/

NUMBER OF SECTORS {compact 3 } Spiral, max 55 deg
 {separated }

SECTOR ANGLE (SSC) deg
 TRIMMING COILS 17 pairs

CONDUCTOR, material and type Cu
 STORED ENERGY (cryogenic) MJ
 POWER: main coils 525 max kW: current stability 0.01%
 trimming coils 460 max kW: current stability 0.01%
 WEIGHT: Fe 275 tons: coils 10 tons
 COOLING system LCW
 ION ENERGY (Bending limit) E/A = 140 q²/A² MeV/amu
 (Focusing limit) E/A = 70 q/A MeV/amu

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
 BEAM APERTURE 3.5 cm; DC Bias kV
 TUNED by, coarse M.P. fine VC
 RF 5.5 to 16.5* MHz, stable ± 1 in 10⁷
 Orb F 5.5 to 16.5 MHz
 HARMONICS, RF/Orb F, used 1 (at present)
 DEE-Gnd, max 60 kV, min gap 6.19 cm
 STABILITY, (pk-pk noise)/(pk RF volt)
 ENERGY GAIN, max 120 kV/turn
 RF PHASE, stable to ± deg
 RF POWER input, max 300* kW
 FREQUENCY MODULATION, rate /s
 modulator, type
 beam pulse, width

VACUUM SYSTEM

OPERATING PRESSURE 3 x 10⁻⁶ Torr or mbar
 PUMPS No, Type, Size Two 89 cm dia oil diffusion pumps;
 a 6000 l/s turbomolecular pump being added.

ION SOURCES PIC-hot filament

* Design value

INJECTION SYSTEM

Internal Ion Source

EXTRACTION SYSTEM

DC Electrostatic Deflector

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 226 m²; movable 535 m²
 TARGET STATIONS 9(3 at present) in 4 rooms
 STATIONS served at same time, max 1
 MAG SPECTROGRAPH, type QSD (under construction)
 COMPUTER model IRIS-80, NORSK DATA ND-560
 OTHER FACILITIES 915 mm scattering chamber, target, detector, electronics and radiochemistry.

CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV)		CURRENT (µA)	
	Goal	Achieved	Internal	External
He ⁺⁺	140	100	5	-
		85		1.5
		30	80	20
SECONDARY			(part/s)	

BEAM PROPERTIES

MEASURED	CONDITIONS	
	RF deg	µA of MeV He ⁺⁺ ions
PULSE WIDTH 10	1.1	µA of 40 MeV He ⁺⁺ ions
PHASE EXC. max	RF deg	µA of MeV ions
EXTRACT eff 35 %	15	µA of 30 MeV He ⁺⁺ ions
RESOL ΔE/E 1 %	10	µA of 30 MeV He ⁺⁺ ions
EMITTANCE		
(π mm-mrad) 19.9 axial		µA of MeV
28.6 rad		

OPERATING PROGRAMS, time distribution

BASIC NUCLEAR PHYSICS 75% SOLID STATES PHYSICS 14%
 BIOMEDICAL APPLICAT. ISOTOPE PRODUCTIONS 2.0%
 Beam Development 9%

REFERENCES/NOTES

- 1) International Cyclotron Conference proceedings
- 2) 1984, 1981, 1978, 1975 and 1972.

PLAN VIEW OF FACILITY, COMMENTS, ETC.

+ Operates 3 weeks round-the-clock followed by 1 week of maintenance, modifications etc.

An ECR source and external injection system funded. Being developed.