ENTRY No. 40

NAME OF MACHINE Variable Energy Cyclotron DATE May 1989

INSTITUTION Bhabha Atomic Research Centre

ADDRESS 1/AF, Bidhan Nagar, Calcutta-700 064, INDIA

TEL 37-1230 TELEX CA4526

IN CHARGE Dr. Bikash Sinha REPORTED BY N.K. Mukhopadhyay

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 pm RCA 4648 tetrode in 1983

COST, ACCELERATOR $ 3 x 10^6

COST, FACILITY, total $ 11 x 10^6

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 $ 3.6 x 10^6

FUNDED BY Department of Atomic Energy

RESEARCH STAFF, not included above

USERS, in house 7 groups outside 33 groups

GRAD STUDENTS involved during year

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 0.56×10^6 Ampere turns

AVERAGE FIELD at R ext 17.1 kG

B max/ <B>

NUMBER OF SECTORS compact 3 / separated

Spiral, max 55 deg

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 q^2/a^2 MeV/amu

(focusing limit) E/A = 70 q^2/a^2 MeV/amu

ACCELERATION SYSTEM

DEES, number 1 ; angle 180 deg

BEAM APERTURE 5.5 cm ; DC Bias kV

TUNED by, coarse M.P. fine VC

RF 5.5 to 16.5* mHz, stable $\pm$ 1 in 10^7

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 $\pm$ 300* deg

RF POWER input, max kW

FREQUENCY MODULATION, rate /s

modulator, type

beam pulse, width

VACUUM SYSTEM

OPERATING PRESSURE 3×10^{-6} Torr or mbar

PUMPS, No, Type, Size 89 cm oil diffusion pump

10 inches dia diff stack on DT near extraction

ION SOURCES PIG - Hot filament

* Design value

\+ Operates 6-8 weeks round-the-clock followed by 1 week of maintenance, modifications etc.

INJECTION SYSTEM

Internal Ion Source

EXTRACTION SYSTEM

DC Electrostatic Deflector

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 226 m^2 ; movable 535 m^2

TARGET STATIONS 3 in 2 rooms

STATIONS served at same time, max 1

MAG SPECTROGRAPH, type

COMPUTER model NORSK DATA ND-560

OTHER FACILITIES 915 mm Scattering chamber, target, detector, electronics and radiochemistry. An ISOL system is under construction.

CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV) Goal	Achieved	CURRENT (pμA) Internal	External
He^{++}	140	100	3	
		86.5	5	1.5
		60	70	15
d^+		25		20
SECONDARY			(part/s)	

BEAM PROPERTIES

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

OPERATING PROGRAMS, time distribution

BASIC NUCLEAR PHYSICS 70% SOLID STATES PHYSICS 14%

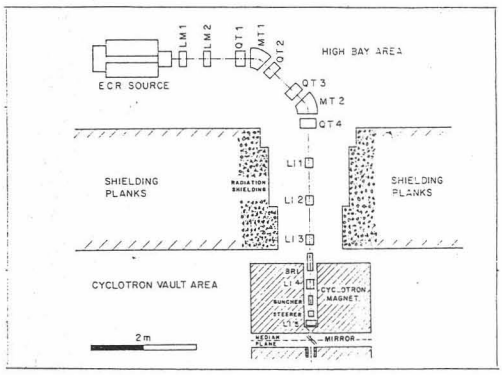
BIOMEDICAL APPLICAT. ... ISOTOPE PRODUCTIONS ...

Beam Development 11%

REFERENCES/NOTES

1) International Cyclotron Conference proceedings · 1986, 1984, 1981, 1978, 1975 and 1972

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, COMMENTS



A room temperature ECR source and the injection line are being developed for VEC for obtaining heavy ion beams in 1991.