

**ENTRY No. 86**

NAME OF MACHINE Princeton AVF Cyclotron DATE July 8, 1981  
 INSTITUTION Princeton University, The Joseph Henry Laboratory of Physics  
 ADDRESS Princeton, New Jersey 08544 (USA)  
 TEL (609) 452-4425 TELETYPE  
 IN CHARGE Prof. Frank Calaprice REPORTED BY Dr. R.T. Kouzes/Dr. W. Moore

**HISTORY AND STATUS**

DESIGN, date 1965 Model tests  
 ENG DESIGN, date 1966-1967  
 CONSTRUCTION, date 1967-1968  
 FIRST BEAM, date (or goal) December 1968  
 MAJOR ALTERATIONS None (Design based on Michigan State University Cyclotron)  
 COST, ACCELERATOR \$1.45 x 10<sup>6</sup>  
 COST, FACILITY, total \$3.0 x 10<sup>6</sup>  
 FUNDED BY Accel. and 70% of Lab. by Univ. (Balance AEC)

**ACCELERATOR STAFF, OPERATION AND DEVELOPMENT**

SCIENTISTS 1 ENGINEERS 0  
 TECHNICIANS 2 CRAFTS 0  
 GRAD STUDENTS involved during year 0  
 OPERATED BY X Research staff or Operators  
 OPERATION ~.55 hr/wk, On target ~.50 hr/wk  
 TIME DISTR. in house 90. % Outside 10. %  
 BUDGET, op & dev \$100K  
 FUNDED BY NSF

**RESEARCH STAFF, not included above**

USERS, in house 9 outside ~15  
 GRAD STUDENTS involved during year 9  
 RESEARCH BUDGET, in house \$600K  
 FUNDED BY NSF

**MAGNET**

POLE FACE, diameter (compact) .175 cm, R extraction .75 cm  
 R injection cm  
 GAP, min .17 cm, Field 19.5 kG }  
 max .50 cm, Field 8 kG } at 0.5 x 10<sup>6</sup>  
 AVERAGE FIELD at R ext .15 kG } Ampere turns  
 B max/ <B> .1.3

NUMBER OF SECTORS { compact 3 } Spiral, max ~ 0 deg  
 { separated }  
 SECTOR ANGLE (SSC) deg  
 TRIMMING COILS 8 Pancake

CONDUCTOR, material and type Cu  
 STORED ENERGY (cryogenic) MJ  
 POWER: main coils 1.75 max, kW; current stability  
 trimming coils .20 max, kW; current stability  
 WEIGHT: Fe 100 tons; coils 1.6 tons  
 COOLING system Water  
 ION ENERGY (bending limit) E/A = .67.5 q<sup>2</sup>/a<sup>2</sup> MeV/amu  
 (focusing limit) E/A = q/a MeV/amu

**ACCELERATION SYSTEM\***

DEES, number 2; angle 138 deg  
 BEAM APERTURE 4.5 cm; DC Bias 0 kV  
 TUNED by, coarse movable panel fine None  
 RF 11.2 to 24.5 MHz, stable ± 0.1/10<sup>6</sup>  
 Orb F 5.6 to 20.6 MHz  
 HARMONICS, RF/Orb F, used 1, 2, 4  
 DEE - Gnd, max .70 kV, min gap cm  
 STABILITY, (pk-pk noise)/(pk RF volt) 0.0005  
 ENERGY GAIN, max 250 kV/turn  
 RF PHASE, stable to ± deg  
 RF POWER input, max 300 kW  
 FREQUENCY MODULATION, rate 0 /s  
 modulator, type  
 beam pulse, width

**VACUUM SYSTEM**

OPERATING PRESSURE 3 x 10<sup>-6</sup> Torr or mbar  
 PUMPS, No, Type, Size 1-Diffusion-32 inch

**ION SOURCES**

Hooded Arcs Cold Cathode

\*(Obtains single turn extraction by means of internal phase selection.)

**INJECTION SYSTEM**

Internal Source Only

**EXTRACTION SYSTEM**

DC Electrostatic followed by laminated, compensated magnetic deflector.

**FACILITIES FOR RESEARCH**

SHIELDED AREA, fixed 0 m<sup>2</sup>; movable 325 m<sup>2</sup>  
 TARGET STATIONS 8 in 4 rooms

STATIONS served at same time, max 1  
 MAG SPECTROGRAPH, type 14.5 msr QDDD (p/Δp = 1x10<sup>4</sup>)

COMPUTER model Data General Eclipse S/230 Δp  
 OTHER FACILITIES Scattering Chambers 150, 50, 30 cm;  
 On-Line Recirculating Gas Targets; Orange Spectrometer;  
 Pair Spectrometers; On-Line Atomic Beams Machine (On-line)

**CHARACTERISTIC BEAMS** isotope separator: M/ΔM > 3 x 10<sup>3</sup>

PARTICLE	ENERGY (MeV)		CURRENT (pA)	
	Goal	Achieved	Internal	External
p	50	50	>1000	25
d/α	30/60	30/58	200/30	18/10
<sup>3</sup> He	80	85	>100	10
<sup>6</sup> Li	38	38	0.15	0.04
<sup>12</sup> C	80	76	0.20	0.05

**BEAM PROPERTIES**

MEASURED CONDITIONS  
 PULSE WIDTH 1.6 RF deg 1 pA of 28 MeV p ions  
 PHASE EXC, max RF deg pA of MeV ions  
 EXTRACT eff >95 % 1 pA of 42 MeV p ions  
 RESOL ΔE/E 0.05 % 1 pA of 42 MeV p ions  
 EMITTANCE

(π mm. mrad) { .20 axial }  
 { .5 rad } 1 pA of 42 MeV p ions

**OPERATING PROGRAMS, time distribution**

BASIC NUCLEAR PHYSICS 95% SOLID STATES PHYSICS 1%  
 BIOMEDICAL APPLICAT. 0 ISOTOPE PRODUCTIONS 4%

**REFERENCES/NOTES**

Pollock, R.E., Proceedings of the Fifth International Cyclotron Conference (1969), p. 120.

**PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, COMMENTS**

