

ENTRY No. 109  
 NAME OF MACHINE K500 DATE MAY 1989  
 INSTITUTION MICHIGAN STATE UNIVERSITY  
 ADDRESS NSCL/CYCLOTRON LABORATORY, EAST LANSING, MICHIGAN 48824-1321 USA  
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 IN CHARGE S. AUSTIN REPORTED BY P. MILLER

**HISTORY AND STATUS**

DESIGN, date 74-79 Model tests 75-77  
 ENG DESIGN, date 75-81  
 CONSTRUCTION, date 77-81  
 FIRST BEAM, date (or goal) 8/82  
 MAJOR ALTERATIONS

COST, ACCELERATOR \$2,900,000  
 COST, FACILITY, total \$3,500,000  
 FUNDED BY National Science Foundation

**ACCELERATOR STAFF, OPERATION AND DEVELOPMENT**  
 SCIENTISTS ENGINEERS  
 TECHNICIANS CRAFTS

GRAD STUDENTS involved during year  
 OPERATED BY Research staff or Operators  
 OPERATION hr/wk, On target hr/wk  
 TIME DISTR. in house %, Outside %  
 BUDGET, op & dev  
 FUNDED BY

RESEARCH STAFF, not included above  
 USERS, in house outside  
 GRAD STUDENTS involved during year  
 RESEARCH BUDGET, in house  
 FUNDED BY

**MAGNET**  
 POLE FACE, diameter (compact) 142 cm, R extraction 67. cm  
 R injection cm  
 GAP, min 6.35 cm, Field 58 kG } at 4,681,600  
 max 91.4 cm, Field 43 kG }  
 AVERAGE FIELD at R ext 49.5 kG } Ampere turns  
 B max/ <B>

NUMBER OF SECTORS { compact 3 } Spiral, max 120 deg  
 separated }  
 SECTOR ANGLE (SSC) deg  
 TRIMMING COILS 14 (1 circular, 13 hill)

CONDUCTOR, material and type NbTi in Cu  
 STORED ENERGY (cryogenic) 18 MJ  
 POWER: main coils 0 max, kW; current stability 1/10<sup>5</sup>  
 trimming coils 80 max, kW; current stability 5/10<sup>4</sup>  
 WEIGHT: Fe 100 US tons; coils 8 US tons  
 COOLING system Helium Bath  
 ION ENERGY (bending limit) E/A = 520 q<sup>2</sup>/a<sup>2</sup> MeV/amu  
 (focusing limit) E/A = 160 q<sup>2</sup>/a<sup>2</sup> MeV/amu

**ACCELERATION SYSTEM**

DEES, number 3; angle 53 deg  
 BEAM APERTURE 2.5 cm; DC Bias kV  
 TUNED by, coarse sliding short fine capacitive blade  
 RF 9.0 to 27.5 MHz, stable ± 1/10<sup>7</sup>  
 Orb F 1.3 to 27.5 MHz  
 HARMONICS, RF/Orb F, used 1.2  
 DEE - Gnd, max 100 kV, min gap 1.0 cm  
 STABILITY, (pk-pk noise)/(pk RF volt) 1/10,000  
 ENERGY GAIN, max 600 kV/turn  
 RF PHASE, stable to ± 0.5 deg  
 RF POWER input, max 3 x 140 kW  
 FREQUENCY MODULATION, rate /s  
 modulator, type  
 beam pulse, width

**VACUUM SYSTEM**

OPERATING PRESSURE 3 x 10<sup>-6</sup> Torr or mbar  
 PUMPS, No, Type, Size 2 cryopumps 4.5K (charcoal)  
 100 K shield 20 x 50 cm mounted in dee +  
 3 turbo-molecular pumps

**ION SOURCES**

ECR (2 + supercond. under const.), beam switchyard.

**AXIAL**

**INJECTION SYSTEM**

BUNCHER AND SPIRAL DC INFLECTOR

**EXTRACTION SYSTEM**

PRECESSIONAL & 2 ELECTROSTATIC DEFLECTORS

**FACILITIES FOR RESEARCH**

SHIELDED AREA, fixed m<sup>2</sup>; movable 1300 m<sup>2</sup>  
 TARGET STATIONS 6 in 6 rooms  
 STATIONS served at same time, max 1

MAG SPECTROGRAPH, type S320, \$800  
 COMPUTER model Vax. 750, a. 8530, microVax workstations  
 OTHER FACILITIES Reaction Product Mass Separator, 4 pi array, 92" scattering chamber

**CHARACTERISTIC BEAMS**

PARTICLE	ENERGY (MeV)		CURRENT (pA)	
	Goal	Achieved	Internal	External
4 He ++		215	.1	.05
14 N 4+		700	.01	.007
40 Ar 12+		1400	.004	.0002
86 Kr 19+		1720	.00026	.0001

SECONDARY (part/s)

**BEAM PROPERTIES**

MEASURED CONDITIONS  
 PULSE WIDTH .35 RF deg .04 pA of 420 MeV<sup>14</sup>N<sup>4+</sup> ions  
 PHASE EXC, max RF deg pA of MeV ions  
 EXTRACT eff .50 % .05 pA of 490 MeV<sup>14</sup>N<sup>4+</sup> ions  
 RESOL ΔE/E % pA of MeV ions  
 EMITTANCE  
 (π mm. mrad) { axial } pA of MeV ions  
 { rad }

**OPERATING PROGRAMS, time distribution**  
 BASIC NUCLEAR PHYSICS 90% SOLID STATES PHYSICS 0%  
 BIOMEDICAL APPLICAT. 0% ISOTOPE PRODUCTIONS 0%  
 Facility Development 10%

**REFERENCES/NOTES**

- IEEE Trans. on Nuc. Sci. NS-26 (1979) 2040
- MSU Annual Reports 1974-1985

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

