

ENTRY No. 55

NAME OF MACHINE RCNP AVF Cyclotron DATE 1st May, 1989  
INSTITUTION Research Center for Nuclear Physics, Osaka University  
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IN CHARGE M. Kondo REPORTED BY T. Itahashi

### HISTORY AND STATUS

DESIGN, date Model tests 1966-69  
ENG DESIGN, date 1970-1972  
CONSTRUCTION, date 1971-1973  
FIRST BEAM, date (or goal) 1974  
MAJOR ALTERATIONS  
COST, ACCELERATOR \$3.5x10<sup>6</sup>  
COST, FACILITY, total \$9x10<sup>6</sup>  
FUNDED BY Ministry of Education, Science and Culture  
ACCELERATOR STAFF, OPERATION AND DEVELOPMENT  
SCIENTISTS 8 ENGINEERS 8  
TECHNICIANS 8 CRAFTS 8  
GRAD STUDENTS involved during year  
OPERATED BY X Research staff or X Operators  
OPERATION 144 hr/wk, On target 120 hr/wk  
TIME DISTR. in house % Outside %  
BUDGET, op & dev ~\$1x10<sup>6</sup>  
FUNDED BY Ministry of Education, Science and Culture  
RESEARCH STAFF, not included above  
USERS, in house 8 outside ~200  
GRAD STUDENTS involved during year 3  
RESEARCH BUDGET, in house ~\$1x10<sup>6</sup>  
FUNDED BY Ministry of Education, Science and Culture

### MAGNET

POLE FACE, diameter (compact) 230 cm, R extraction 100 cm  
R injection cm  
GAP, min 20.7 cm, Field 19.5 kG }  
max 34.7 cm, Field 12.0 kG } at 0.4x10<sup>6</sup>  
AVERAGE FIELD at R ext 16.0 kG } Ampere turns  
B max / < B > 1.2

NUMBER OF SECTORS { compact 3 } Spiral, max 52 deg  
{ separated 3 }

SECTOR ANGLE (SSC) deg  
TRIMMING COILS Harmonic coil 5/sec  
and Circular, 16

CONDUCTOR, material and type Copper, Hollow  
STORED ENERGY (cryogenic) MJ

POWER: main coils 450 max, kW; current stability 3x10<sup>-5</sup>  
trimming coils 265 max, kW; current stability 10<sup>-4</sup>

WEIGHT: Fe 400 tons; coils 13 tons  
COOLING system Demineralized water

ION ENERGY (bending limit) E/A = 140 q<sup>2</sup>/a<sup>2</sup> MeV/amu  
(focusing limit) E/A = 85 q<sup>2</sup>/a<sup>2</sup> MeV/amu

### ACCELERATION SYSTEM

DEES, number 1; angle 180 deg  
BEAM APERTURE 4,4 cm; DC Bias 0 kV  
TUNED by, coarse MS fine VG, auto  
RF 6 to 18 MHz, stable ± 0.05/10<sup>6</sup>  
Orb F 1.2 to 18 MHz  
HARMONICS, RF/Orb F, used 1, 3, 5  
DEE - Gnd, max 80 kV, min gap cm  
STABILITY, (pk-pk noise)/(pk RF volt) 1x10<sup>-4</sup>  
ENERGY GAIN, max 160 kV/turn  
RF PHASE, stable to ± 1 deg  
RF POWER input, max 430 kW  
FREQUENCY MODULATION, rate /s  
modulator, type  
beam pulse, width

### VACUUM SYSTEM

OPERATING PRESSURE 6x10<sup>-7</sup> Torr or mbar  
PUMPS, No, Type, Size 3 Diffusion pumps (one 55 cm,  
two 90 cm)

### ION SOURCES

Internal, axial, hooded arc  
Internal, axial, pulsed PIG  
External, polarized, atomic beam

### INJECTION SYSTEM

Electrostatic Focusing and dc mirror Inflector

### EXTRACTION SYSTEM

DC Electrostatic with Magnetic Channel

### FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 1130 m<sup>2</sup>; movable m<sup>2</sup>

TARGET STATIONS 12 in 5 rooms

STATIONS served at same time, max 1

MAG SPECTROGRAPH, type ODDO (RAIDEN)

COMPUTER model FACOM M-380R, PDP11/44, 70, VAX-11/730

OTHER FACILITIES Polarization Spectrograph (DUMAS)

Recoil Mass Separator (CARP), Triple Focusing

Electron Spectrometer (AGNES)

### CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV)		CURRENT (pA)	
	GcaI	Achieved	Internal	External
p	≤75	85	50	50
α	≤120	120	20	20
D	≤75	85	1	1
Ne <sup>6+</sup>	216	216	0.2	0.2

SECONDARY (part/s)

### BEAM PROPERTIES

MEASURED CONDITIONS  
PULSE WIDTH 12 RF deg 0.1 pA of 40 MeV p. ions  
PHASE EXC, max 5 RF deg 1.2 pA of 90 MeV q. ions  
EXTRACT eff 90 % 1.2 pA of 65 MeV p. ions  
RESOL ΔE/E 0.2 % 1.2 pA of 90 MeV q. ions  
EMITTANCE  
(π mm. mrad) { .10 axial } .12 pA of 90 MeV ions  
{ .20 rad }

OPERATING PROGRAMS, time distribution

BASIC NUCLEAR PHYSICS 85% SOLID STATES PHYSICS 1%  
BIOMEDICAL APPLICAT. 1% ISOTOPE PRODUCTIONS 2%  
DEVELOPMENT 6% ATOMIC PHYSICS AND  
EDUCATION 2% OTHER FIELDS 3%

### REFERENCES/NOTES

- 1) M. Kondo, Eighth Internat. Conf on Cyclotrons and their Applications, Bloomington, (1978), pp.1904-1911
- 2) RCNP Annual Report (1987)

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

- 1) Intensity of polarized proton and deuteron beam is increased up to 600 nA at target.
- 2) Horizontally polarized proton and deuteron beam are used in experiments.
- 3) <sup>6</sup>Li<sup>3+</sup> (E<210 MeV), <sup>7</sup>Li<sup>3+</sup> (E<180 MeV) and <sup>40</sup>Ca<sup>7+</sup> (≤147 MeV) are supplied using back bombard method with LiF and CaF<sub>2</sub> crystals.
- 4) The B-beam line is equipped with polarization spectrograph (DUMAS), and the J-beam line is equipped with recoil mass separator (CARP).
- 5) The cyclotron cascade project has been under construction. The six sector ring cyclotron as a booster of the present cyclotron will be completed in March 1990.