

ENTRY NO. 13

NAME OF MACHINE Minicyclotron MC-20 DATE 7/25/78  
INSTITUTION Department of Physics, University of Jyväskylä  
ADDRESS Nisulankatu 78, SF-40720 Jyväskylä 72, Finland

IN CHARGE Teuvo Poikolainen REPORTED by Teuvo Poikolainen

**HISTORY AND STATUS**

DESIGN, date 1968-69 MODEL tests 1968-69  
ENG. DESIGN, date 1969-71  
CONSTRUCTION, date 1969-73  
FIRST BEAM date (or goal) 1974  
MAJOR ALTERATIONS \_\_\_\_\_

OPERATION, ~70 hr/wk; On Target ~60 hr/wk  
TIME DIST., in house † %, outside † %  
USERS' SCHEDULING CYCLE ~5 weeks  
COST, ACCELERATOR \$ 550 000  
COST, FACILITY, total \$1000 000  
FUNDED BY Government of Finland

**ACCELERATOR STAFF, OPERATION and DEVELOPMENT**

SCIENTISTS \_\_\_\_\_ ENGINEERS 3  
TECHNICIANS 1 CRAFTS 4  
GRAD STUDENTS involved during year 2  
OPERATED BY X Res staff or \_\_\_\_\_ Operators  
BUDGET, op & dev \$ 250 000  
FUNDED BY Government of Finland

**RESEARCH STAFF, not included above**

USERS, in house 20 outside 15  
GRAD STUDENTS involved during year 10  
RES. BUDGET, in house \$ 200 000  
FUNDED BY Government of Finland

**FACILITIES FOR RESEARCH**

SHIELDED AREA, fixed 100 m<sup>2</sup>  
movable - m<sup>2</sup>  
TARGET STATIONS 5 in 2 rooms  
STATIONS served at same time, max 1  
MAG SPECTROGRAPH, type \_\_\_\_\_  
COMPUTER, model PDP 11/45  
OTHER FACILITIES In-beam Gamma Ray and  
Electron spectrometers,  
On-Line Mass Spectrometer  
Helium-Jet Recoil Transport

**REFERENCES/NOTES**

† No distinction has been made between  
"In-house" and "outside" users.

**MAGNET**

POLE FACE diameter 90 cm; R extraction 38-39 cm  
GAP, min 6.5 cm; Field 20.5 kG } at 0.3 × 10<sup>6</sup>  
max 16.5 cm; Field 13.7 kG } ampere turns  
AVERAGE FIELD at R ext 17.1 kG  
CURRENT STABILITY 20 parts/10<sup>6</sup>; B<sub>max</sub>/(B) 1.2  
NUMBER OF SECTORS 4; SPIRAL, max 48 deg  
POLE FACE COIL PAIRS: AVF 2 /sec;  
Harmonic correction 2/sector  
Rad grad \_\_\_\_\_ /sec or Circ coils 8  
WEIGHT: Fe 19.5 tons; Coils 1 tons  
CONDUCTOR, Material and type Copper  
STORED ENERGY \_\_\_\_\_ MJ  
COOLING SYSTEM Demineralized water  
POWER: Main coils 90 max, kW  
Trimming coils 6 max, kW  
YOKE/POLE AREA 112 %  
SECTOR ANGLE (Sep Sec) - deg  
ION ENERGY (Bending limit) E/A = 20 q<sup>2</sup>/A<sup>2</sup> MeV  
(Focusing limit) E/A = \_\_\_\_\_ q/A MeV

**ACCELERATION SYSTEM**

DEES, number 2 angle 90 deg  
BEAM APERTURE 1.8 cm; DC BIAS 0 kV  
TUNED by, coarse MS fine VC  
RF 10.5 to 25.6 MHz, stable ± \_\_\_\_\_ /10<sup>6</sup>  
Orb F 5.3 to 25.6 MHz; GAIN, max 120 kV/turn  
HARMONICS, RF/Orb F, used 1,2  
DEE-Gnd, max 30 kV, min gap 1 cm  
STABILITY, (pk-pk noise)/(pk RF volt) 0.001  
RF PHASE stable to ± 0.5 deg  
RF POWER input, max 50 kW  
RF PROTECT circuit, speed 1 μsec  
Type Series tube  
FREQUENCY MODULATION, rate 0 /sec  
MODULATOR, type -  
BEAM PULSE, width -

**VACUUM SYSTEM**

PUMPS, No., Type, Size 2 oil diffusion  
pumps (2x2500 1/s; with baffles)  
OPERATING PRESSURE 10 μTorr,  
PUMPDOWN TIME 5-7 hrs

**ION SOURCES/INJECTION SYSTEM**

Internal cold cathode penning,  
biased

**EXTRACTION SYSTEM**

Electrostatic defl.+magn.channel

**CONTROL SYSTEM**

Conventional.

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CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	2.5-20	4.8-20.2
	d	1.5-10	6-10
	<sup>3</sup> He	2.5-27	12-27.5
	α	2.5-20	6-20.5
CURRENT		e (μA)	e (μA)
Internal	p	200	100
	d	200	300
	α	100	10
External	p	100	4
	d	100	10
	α	50	1.5
Secondary		(part/s)	(part/s)

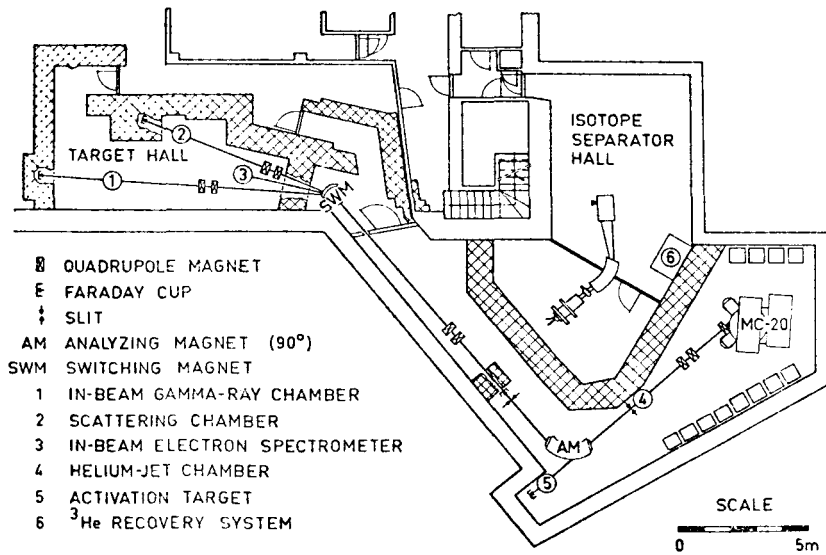
BEAM PROPERTIES

	Measured	Conditions
Pulse Width	RF deg _____ μA of _____ MeV	
Phase Exc, max	RF deg _____ μA of _____ MeV	
Extract Eff	35 %	4 μA of 13 MeV p
Res, ΔE/E	0.5 %	2 μA of 20 MeV α
Emittance	(mm-mrad) { _____ axial } _____ μA of _____ MeV	
	{ _____ radial }	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	90	%
Solid State Physics		%
Bio-Medical Applications	5	%
Isotope Production		%
Development	5	%
		%
		%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES



The control room of the cyclotron and the measuring room are placed above the target hall.