

ENTRY NO. 27

NAME OF MACHINE Heidelberg Compact Cyclotron DATE July 1978  
 INSTITUTION German Cancer Research Center-Inst. for Nuclear Medicine  
 ADDRESS Heidelberg-West Germany

IN CHARGE Prof. Dr. W. J. Lorenz / Dr. G. Wolber REPORTED BY Dr. G. Wolber

**HISTORY AND STATUS**

DESIGN, date 1967 MODEL tests 1968-69  
 ENG. DESIGN, date \_\_\_\_\_  
 CONSTRUCTION, date Oct. 1971-May 1972  
 FIRST BEAM date (or goal) June 14th, 1972<sup>+</sup>  
 MAJOR ALTERATIONS \_\_\_\_\_  
 OPERATION, min. 35 hr/wk; On Target 20 hr/wk  
 TIME DIST., in house 80 %, outside 20 %  
 USERS' SCHEDULING CYCLE 1 weeks  
 COST, ACCELERATOR 1,5x10<sup>6</sup> DM  
 COST, FACILITY, total 10<sup>7</sup> DM  
 FUNDED BY Volkswagenwerk Foundation

**ACCELERATOR STAFF, OPERATION and DEVELOPMENT**

SCIENTISTS 1 ENGINEERS 1  
 TECHNICIANS 6 CRAFTS \_\_\_\_\_  
 GRAD STUDENTS involved during year 1  
 OPERATED BY \_\_\_\_\_ Res staff or 2 Operators  
 BUDGET, op & dev \_\_\_\_\_  
 FUNDED BY Federal Government 90%  
Government of State 10%

**RESEARCH STAFF, not included above**

USERS, in house 4 outside 3  
 GRAD STUDENTS involved during year 2  
 RES. BUDGET, in house \_\_\_\_\_  
 FUNDED BY Federal Government > 90%

**FACILITIES FOR RESEARCH**

SHIELDED AREA, fixed 16 x 18 m<sup>2</sup>  
 movable \_\_\_\_\_ m<sup>2</sup>  
 TARGET STATIONS 6 in 3 rooms  
 STATIONS served at same time, max 1  
 MAG SPECTROGRAPH, type \_\_\_\_\_  
 COMPUTER, model \_\_\_\_\_  
 OTHER FACILITIES \_\_\_\_\_

fast neutron target for radiation therapy

**REFERENCES/NOTES**

- + ) End of tests: April 30th, 1973.  
Fixed schedule for experiments since 1975
- 1) Liesen, H.: Nucl. Instr. Meth. 105, 1972, 329-332
- 2) Wolber, G. et al.: 7th Int. Conf. on Cyclotrons and their Applications, Zurich, Switzerland, Aug. 19-22, 1975

**MAGNET** 1)

POLE FACE diameter 109 cm; R extraction 49 cm  
 GAP, min 5,4 cm; Field 20 kG } at 0,175 X 10<sup>6</sup>  
 max 17,5 cm; Field 8 kG } ampere turns  
 AVERAGE FIELD at R ext \_\_\_\_\_ kG  
 CURRENT STABILITY ± 50 parts/10<sup>6</sup>; B<sub>max</sub> / <B> 1,43  
 NUMBER OF SECTORS 4; SPIRAL, max 0 deg  
 POLE FACE COIL PAIRS: AVF 4 /sec;  
 Harmonic correction \_\_\_\_\_  
 Rad grad \_\_\_\_\_ /sec or Circ coils \_\_\_\_\_  
 WEIGHT: Fe 24 tons; Coils 2 tons  
 CONDUCTOR, Material and type Cu pipes  
 STORED ENERGY ~ 0,1 MJ  
 COOLING SYSTEM Water  
 POWER: Main coils 40 max, kW  
 Trimming coils 0,8 max, kW  
 YOKE/POLE AREA 102 %  
 SECTOR ANGLE (Sep Sec) 45 deg  
 ION ENERGY (Bending limit) E/A = \_\_\_\_\_ q<sup>2</sup>/A<sup>2</sup> MeV  
 (Focusing limit) E/A = \_\_\_\_\_ q/A MeV

**ACCELERATION SYSTEM** 1)

DEES, number 2 angle 43 deg  
 BEAM APERTURE 2,3 cm; DC BIAS - kV  
 TUNED by, coarse Manual fine VC (Auto)  
 RF 28,6 to 43 MHz, stable ± 50 /10<sup>6</sup>  
 Orb F 10 to \_\_\_\_\_ MHz; GAIN, max 165 kV/turn  
 HARMONICS, RF/Orb F, used 2/4  
 DEE-Gnd, max 50 kV, min gap \_\_\_\_\_ cm  
 STABILITY, (pk-pk noise)/(pk RF volt) 5x10<sup>-3</sup>  
 RF PHASE stable to ± not measured deg  
 RF POWER input, max 60 kW  
 RF PROTECT circuit, speed \_\_\_\_\_ μsec  
 Type \_\_\_\_\_  
 FREQUENCY MODULATION, rate \_\_\_\_\_ /sec  
 MODULATOR, type \_\_\_\_\_  
 BEAM PULSE, width \_\_\_\_\_

**VACUUM SYSTEM**

PUMPS, No., Type, Size 2 x 450 ltrs/sec  
VERTICAL TURBO PUMPS  
 OPERATING PRESSURE 20 μTorr,  
 PUMPDOWN TIME 0,5 hrs

**ION SOURCES/INJECTION SYSTEM**

Livingstone Type

EXTRACTION SYSTEM DC Electrostatic Defelctor and Focusing Magnet Channel

**CONTROL SYSTEM**

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CHARACTERISTIC BEAMS 2)

	Particle	Goal (MeV)	Achieved (MeV)	
ENERGY	p/ <sup>4</sup> He		21,5	
	d		10,6	
	<sup>3</sup> He		28	
CURRENT		(μA)	(μA)	
	Internal		1000	
	External	<sup>3</sup> He, <sup>4</sup> He		50
		p		53,5
d			100	
Secondary		(part/s)	(part/s)	
	n		6x10 <sup>7 3)</sup>	

BEAM PROPERTIES

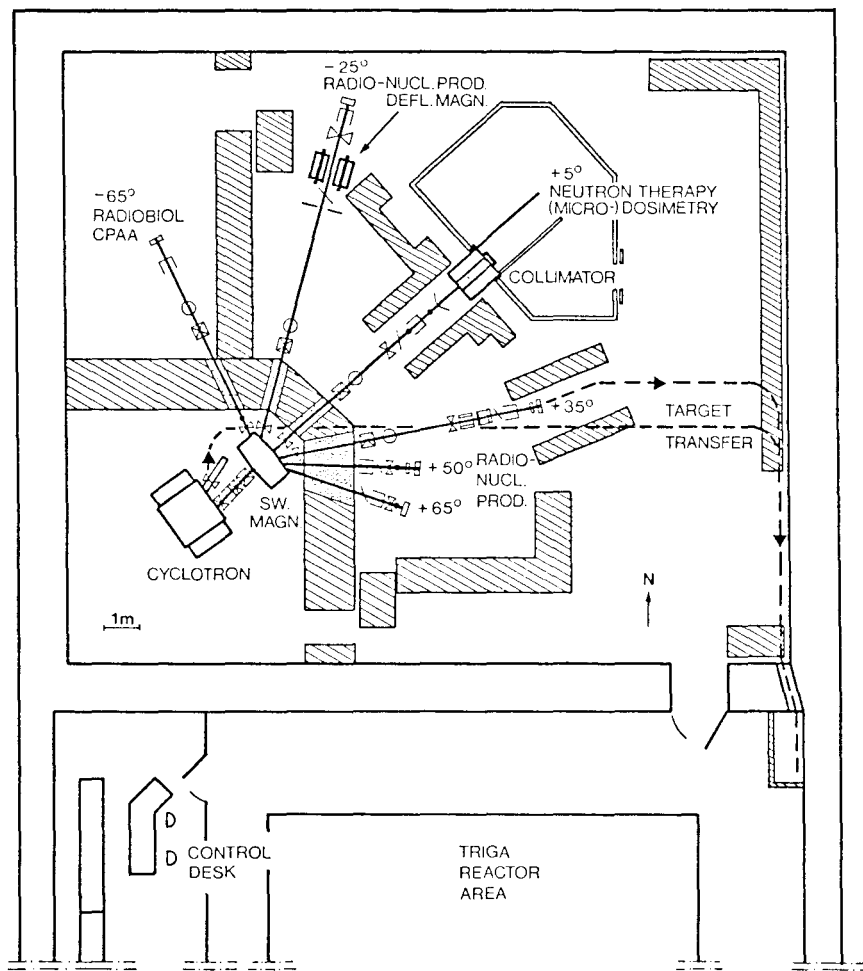
	Measured	Conditions
Pulse Width	RF deg _____ μA of _____ MeV	
Phase Exc, max	±30 RF deg 45 μA of 10,6 MeV	d
Extract Eff	50-70 % _____ μA of 10,6 MeV	d
Res, ΔE/E	0,5 % _____ μA of _____ MeV	
Emittance	not measured	
	(mm-mrad) { _____ axial } _____ μA of _____ MeV	
	{ _____ radial }	

OPERATING PROGRAMS, time dist<sup>2)</sup>

Basic Nuclear Physics	—	%
Solid State Physics	—	%
Bio-Medical Applications	40	%
Isotope Production	60	%
Development		%

3)  $\bar{E}_n = 8,5$  MeV, dose rate ~20 rad/min at FSD=120 cm and 50 μA d

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



THE  
HEIDELBERG  
COMPACT CYCLOTRON  
LABORATORY