

ENTRY No. 32

NAME OF MACHINE Heidelberg Compact Cyclotron DATE  
INSTITUTION INSTITUTE FOR NUCLEAR MEDICINE - GERMAN CANCER RESEARCH CENTER  
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#### HISTORY AND STATUS

DESIGN, date 1967 Model tests 1968-69  
ENG DESIGN, date 1  
CONSTRUCTION, date Oct 71 - May 72  
FIRST BEAM, date (or goal) June 1972  
MAJOR ALTERATIONS  
COST, ACCELERATOR 1.5 MDM  
COST, FACILITY, total 10 MDM  
FUNDED BY Volkswagenwerk Foundations  
ACCELERATOR STAFF, OPERATION AND DEVELOPMENT  
SCIENTISTS 1 ENGINEERS 1  
TECHNICIANS 3 CRAFTS 3  
GRAD STUDENTS involved during year  
OPERATED BY Research staff or 4 Operators  
OPERATION .50 hr/wk, On target .25 hr/wk  
TIME DISTR. in house 90%, Outside %  
BUDGET, op & dev 300-500 kDM/a  
FUNDED BY Federal Government 90%, State 10%  
RESEARCH STAFF, not included above  
USERS, in house 4 outside 3  
GRAD STUDENTS involved during year  
RESEARCH BUDGET, in house  
FUNDED BY Federal Government 90%, State 10%

#### MAGNET

POLE FACE, diameter (compact) 109 cm, R extraction 49 cm  
R injection cm  
GAP, min 5.4 cm, Field 20 kG }  
max 17.5 cm, Field 8 kG } at 175,000  
AVERAGE FIELD at R ext 14 kG } Ampere turns  
B max/ <B> 1,43  
NUMBER OF SECTORS { compact 4 } Spiral, max 0 deg  
{ separated 43 }  
SECTOR ANGLE (SSC) deg  
TRIMMING COILS 4 pairs at 4 radii

#### CONDUCTOR, material and type

STORED ENERGY (cryogenic) Cu pipe MJ  
POWER: main coils 40 max, kW; current stability  $10^{-5}$   
trimming coils 0,8 max, kW; current stability  $10^{-4}$   
WEIGHT: Fe 24 tons, coils 2 tons  
COOLING system deionized water  
ION ENERGY (bending limit) E/A =  $q^2/a^2$  MeV/amu  
(focusing limit) E/A =  $q^2/a^2$  MeV/amu

#### ACCELERATION SYSTEM

DEES, number 2; angle 43 deg  
BEAM APERTURE 2,3 cm; DC Bias -- kV  
TUNED by, coarse 4/4 stub line variable capacitor  
RF 28,6 to 43 MHz, stable  $\pm 2,5 \times 10^{-6}$   
Orb F 10,5 to 21 MHz  
HARMONICS, RF/Orb F, used 2/4  
DEE - Gnd, max .50 kV, min gap 5 cm  
STABILITY, (pk-pk noise)/(pk RF volt)  $5 \cdot 10^3$   
ENERGY GAIN, max 165 kV/turn  
RF PHASE, stable to  $\pm$  not measured deg  
RF POWER input, max 60 kW  
FREQUENCY MODULATION, rate /s  
modulator, type  
beam pulse, width

#### VACUUM SYSTEM

OPERATING PRESSURE  $2 \times 10^{-5}$  Torr or mbar  
PUMPS, No, Type, Size 2 x 450 ltr/s  
vertical turbomolecular pumps

#### ION SOURCES

Livingston type

#### INJECTION SYSTEM

#### EXTRACTION SYSTEM

DC electrostatic deflector + magnetic channel

#### FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 16x18 m<sup>2</sup>; movable m<sup>2</sup>  
TARGET STATIONS 10 in 3 rooms  
STATIONS served at same time, max 2  
MAG SPECTROGRAPH, type  
COMPUTER model  
OTHER FACILITIES D<sub>2</sub>-Target for fast d-D neutrons  
vertical beam downwards

#### CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV)		CURRENT ( $\mu$ A)	
	Goal	Achieved	Internal	External
p	22	21.5	$\leq 1000$	30
d	11	10.6	$\leq 1000$	70
<sup>3</sup> He <sup>++</sup>	28	28	$\leq 50$	15
	22	21.5	$\leq 50$	15

#### SECONDARY

n  $E_n = 8.5$  MeV ( $\mu$ A/deg)  
 $6 \times 10$

#### BEAM PROPERTIES

	MEASURED	CONDITIONS
PULSE WIDTH	RF deg	$\mu$ A of MeV ions
PHASE EXC, max	RF deg	$\mu$ A of MeV ions
EXTRACT eff	%	$\mu$ A of MeV ions
RESOL $\Delta E/E$	%	$\mu$ A of MeV ions
EMITTANCE		
( $\pi$ mm. mrad)	{ axial } { rad }	$\mu$ A of MeV ions

#### OPERATING PROGRAMS, time distribution 2)

BASIC NUCLEAR PHYSICS -- SOLID STATES PHYSICS --  
BIOMEDICAL APPLICAT. 10% ISOTOPE PRODUCTIONS 90%

#### REFERENCES/NOTES

- 1) H. Liesem, Nucl. Instr. Meth. 105, 329, 1972
- 2) G. Wolber et al., 7th Int. Conf. on Cycl. and Their Applications, SIN, Aug. 1975

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