

ENTRY NO. 22

NAME OF MACHINE Bonn Isochronous Cyclotron DATE July 78  
 INSTITUTION University of Bonn, Institut für Strahlen-u. Kernphysik  
 ADDRESS Nussallee 14-16, D-5300 Bonn, Germany

IN CHARGE T. Mayer-Kuckuk REPORTED BY H. Wahl

**HISTORY AND STATUS**

DESIGN, date 1965 MODEL tests 1966-67  
 ENG. DESIGN, date 1966-67  
 CONSTRUCTION, date 1967-69  
 FIRST BEAM date (or goal) Dec. 1968  
 MAJOR ALTERATIONS none

OPERATION, 160 hr/wk; On Target ~140 hr/wk  
 TIME DIST., in house 98 %, outside 2 %  
 USERS' SCHEDULING CYCLE ~1 weeks  
 COST, ACCELERATOR ~5 · 10<sup>6</sup> DM  
 COST, FACILITY, total ~8 · 10<sup>6</sup> DM  
 FUNDED BY Bundesminister für Bildung und Wissenschaft

**ACCELERATOR STAFF, OPERATION and DEVELOPMENT**

SCIENTISTS 4 ENGINEERS 3  
 TECHNICIANS 5 CRAFTS 1  
 GRAD STUDENTS involved during year 15  
 OPERATED BY Res staff or X Operators  
 BUDGET, op & dev 1,8 · 10<sup>6</sup> DM  
 FUNDED BY Land NRW

**RESEARCH STAFF, not included above**

USERS, in house ~80 outside ~2  
 GRAD STUDENTS involved during year ~20  
 RES. BUDGET, in house 4,5 · 10<sup>5</sup> DM  
 FUNDED BY Land NRW und Bundesminister für Forschung und Technologie

**FACILITIES FOR RESEARCH**

SHIELDED AREA, fixed 415 m<sup>2</sup>  
 movable -- m<sup>2</sup>  
 TARGET STATIONS 12 in 4 rooms  
 STATIONS served at same time, max 1  
 MAG SPECTROGRAPH, type split pole (Scanditron)  
 COMPUTER, model PDP9 (on line), PDP 9E, PDP 15, XVM 200  
 OTHER FACILITIES Isotope production  
Orange spectrometer  
Time-of-flight-study  
off-line mass separation

**REFERENCES/NOTES**

Jahresberichte ISKP 1965-1977  
 IEEE Trans. Nucl. Sci., 18 (1971) 319  
 K. Euler et al., 7th Int. Conf. on  
 Cyclotrons and their applications  
 (1975) 92  
 further references see 2<sup>nd</sup> sheet

**MAGNET**

POLE FACE diameter 200 cm; R extraction 91 cm  
 GAP, min 8,4 cm; Field 18,5 kG } at 0,14 × 10<sup>6</sup>  
 max 24 cm; Field 7,0 kG }  
 AVERAGE FIELD at R ext 12,7 kG } ampere turns  
 CURRENT STABILITY 10 parts/10<sup>6</sup>; B<sub>max</sub>/(B) 1,46  
 NUMBER OF SECTORS 3; SPIRAL, max 0 deg  
 POLE FACE COIL PAIRS: AVF \_\_\_\_\_ /sec;  
 Harmonic correction \_\_\_\_\_  
 Rad grad 7 /sec or Circ coils \_\_\_\_\_  
 WEIGHT: Fe ~200 tons; Coils ~5 tons  
 CONDUCTOR, Material and type copper  
 STORED ENERGY ~0,3 MJ  
 COOLING SYSTEM demineralized water  
 POWER: Main coils 40 max, kW  
 Trimming coils 5 max, kW  
 YOKE/POLE AREA 100 %  
 SECTOR ANGLE (Sep Sec) - deg  
 ION ENERGY (Bending limit) E/A = 60 q<sup>2</sup>/A<sup>2</sup> MeV  
 (Focusing limit) E/A = ~30 q/A MeV

**ACCELERATION SYSTEM**

DEES, number 3 angle 40 deg  
 BEAM APERTURE 2,4 cm; DC BIAS 0 kV  
 TUNED by, coarse capacity fine loops  
 RF 20,4 to 28,5 MHz, stable ± 10 /10<sup>6</sup>  
 Orb F 6,4 to 9,5 MHz; GAIN, max 200 kV/turn  
 HARMONICS, RF/Orb F, used 3 (9)  
 DEE-Gnd, max 45 kV, min gap 2,3 cm  
 STABILITY, (pk-pk noise)/(pk RF volt) ~5 · 10<sup>-4</sup>  
 RF PHASE stable to ± 43 deg  
 RF POWER input, max 30 kW  
 RF PROTECT circuit, speed 1 μsec  
 Type ignitron  
 FREQUENCY MODULATION, rate \_\_\_\_\_ /sec  
 MODULATOR, type \_\_\_\_\_  
 BEAM PULSE, width \_\_\_\_\_

**VACUUM SYSTEM**

PUMPS, No., Type, Size 1 diffusion pump  
60 cm  
 OPERATING PRESSURE 2 μTorr,  
 PUMPDOWN TIME 1 hrs

ION SOURCES/INJECTION SYSTEM :int.: Penning  
 ext.: Penning for ions e/m ≥ 1/3;  
I. S. for polarized p, d; electrostat. inj. syst.

EXTRACTION SYSTEM  
electrostat. deflector, 2 magn. channels  
 CONTROL SYSTEM  
conventional

ENTRY NO. 22 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	d	14-28	14-30
	$^{12}\text{C}^{4+}$	28-56	28-60
	$^{14}\text{N}^{5+}$	85	85
CURRENT		( $\mu\text{A}$ )	( $\mu\text{A}$ )
	Internal		
	d	50	50
External	$\alpha$	10	20
	$^{14}\text{N}^{5+}$	4	0, 2
	d	40	50
	$\alpha$	8	15
Secondary	$^{14}\text{N}^{5+}$	2	0, 1
		(part/s)	(part/s)

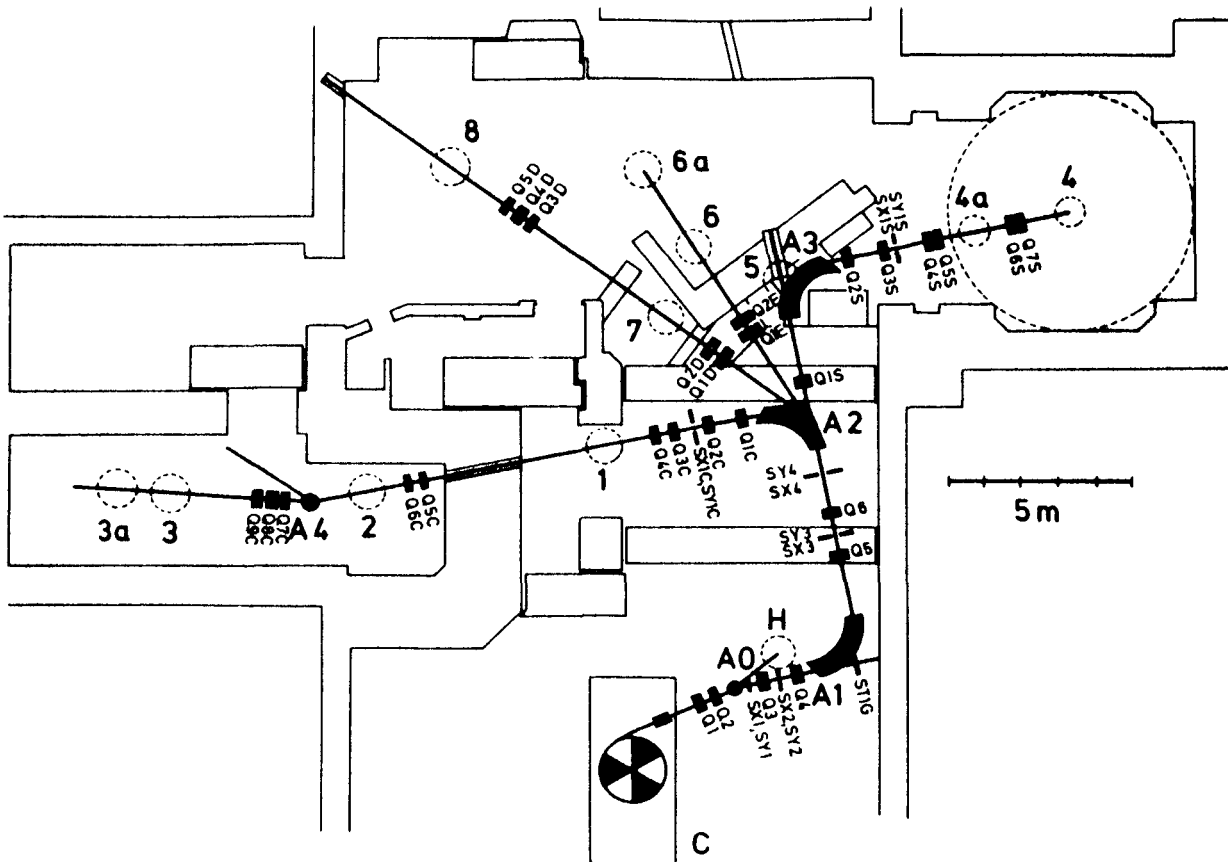
BEAM PROPERTIES

	Measured	Conditions
Pulse Width	$\sim 5$ RF deg	$\sim 1$ $\mu\text{A}$ of 21-28 MeV d
Phase Exc, max	90 RF deg	$\mu\text{A}$ of 28 MeV d
Extract Eff	90 %	25 $\mu\text{A}$ of 28 MeV d
Res, $\Delta E/E$	0, 1 %	5 $\mu\text{A}$ of 25 MeV d
Emittance	$(\text{mm-mrad}) \left\{ \begin{array}{l} <10 \text{ axial} \\ <10 \text{ radial} \end{array} \right\} 10 \mu\text{A of } 14-30 \text{ MeV d}$	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	70 %
Solid State Physics	4 %
Bio-Medical Applications	- %
Isotope Production	8 %
Development	16 %
archeometric applications	2 %

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



References: A.Scholzen et al., Nucl.Instr. 123 (1975) 327  
 H.Hinterberger et al., Nucl.Instr. 130 (1975) 335  
 " " " " " " " 130 (1975) 347  
 " " " " " " " 133 (1976) 1  
 M.Agena et al., these Proceedings