

ENTRY NO. 23

NAME OF MACHINE Isochronous Cyclotron CV 28 DATE 8/30/78  
 INSTITUTION Physikalisch-Technische Bundesanstalt  
 ADDRESS Bundesallee 100, 3300 Braunschweig, W.Germany  
 IN CHARGE Hein Jürgen Brede REPORTED by H.J. Brede

**HISTORY AND STATUS**

DESIGN, date \_\_\_\_\_ } MODEL tests \_\_\_\_\_  
 ENG. DESIGN, date \_\_\_\_\_ } The Cyclotron Corp.  
 CONSTRUCTION, date) \_\_\_\_\_  
 FIRST BEAM date (or goal) 1974  
 MAJOR ALTERATIONS New pumping system  
1977  
 OPERATION, \_\_\_\_\_ hr/wk; On Target \_\_\_\_\_ hr/wk  
 TIME DIST., in house \_\_\_\_\_ %, outside \_\_\_\_\_ %  
 USERS' SCHEDULING CYCLE \_\_\_\_\_ weeks  
 COST, ACCELERATOR \$ 1.5 x 10<sup>6</sup>  
 COST, FACILITY, total \$ 1.4 x 10<sup>7</sup>  
 FUNDED BY Bundeswirtschaftsmini-  
sterium

**ACCELERATOR STAFF, OPERATION and DEVELOPMENT**

SCIENTISTS 1 ENGINEERS 1  
 TECHNICIANS 1 CRAFTS 1  
 GRAD STUDENTS involved during year 0  
 OPERATED BY \_\_\_\_\_ Res staff or X Operators  
 BUDGET, op & dev \_\_\_\_\_  
 FUNDED BY Bundeswirtschaftsmini-  
sterium

**RESEARCH STAFF, not included above**

USERS, in house 9 outside 3  
 GRAD STUDENTS involved during year 0  
 RES. BUDGET, in house \$ 300 000/year  
 FUNDED BY Bundeswirtschaftsmini-  
sterium

**FACILITIES FOR RESEARCH**

SHIELDED AREA, fixed 24 x 30 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 15-, PDP 11-  
 OTHER FACILITIES Time-of-Flight-  
Spectrometer, 3.75 MV Van de  
Graaff Generator with internal  
pulsing system

**REFERENCES/NOTES**

H.J. Brede et al.,  
 Nucl. Instr. & Meth. to be  
 published

**MAGNET**

POLE FACE diameter 96.5 cm; R extraction 41 cm  
 GAP, min 5.08 cm; Field 22.1 kG } at 0.23 x 10<sup>6</sup>  
 max 11.64 cm; Field 14.2 kG } ampere turns  
 AVERAGE FIELD at R ext 17.5 kG }  
 CURRENT STABILITY 10 parts/10<sup>6</sup>; B<sub>max</sub>/(B) \_\_\_\_\_  
 NUMBER OF SECTORS 3; SPIRAL, max \_\_\_\_\_ deg  
 POLE FACE COIL PAIRS: AVF \_\_\_\_\_ /sec;  
 Harmonic correction 1 per sector  
 Rad grad \_\_\_\_\_ /sec or Circ coils 3  
 WEIGHT: Fe 22 tons; Coils \_\_\_\_\_ tons  
 CONDUCTOR, Material and type \_\_\_\_\_  
 STORED ENERGY \_\_\_\_\_ MJ  
 COOLING SYSTEM DeminerIALIZED water  
 POWER: Main coils 60 max, kW  
 Trimming coils 15 max, kW  
 YOKE/POLE AREA \_\_\_\_\_ %  
 SECTOR ANGLE (Sep Sec) \_\_\_\_\_ 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**

DEES, number 2 angle 82 deg  
 BEAM APERTURE 2.04 cm; DC BIAS 0.7 kV  
 TUNED by, coarse Short. Pl. fine Trim Cap.  
 RF 6.5 to 26 mHz, stable ± 30 /10<sup>6</sup>  
 Orb F 6.5 to 26 mHz; GAIN, max 110 kV/turn  
 HARMONICS, RF/Orb F, used 1  
 DEE-Gnd, max 35 kV, min gap 1.5 cm  
 STABILITY, (pk-pk noise)/(pk RF volt) 0.001  
 RF PHASE stable to ± \_\_\_\_\_ deg  
 RF POWER input, max 40 kW  
 RF PROTECT circuit, speed \_\_\_\_\_ μsec  
 Type Ignitron crowbar  
 FREQUENCY MODULATION, rate \_\_\_\_\_ /sec  
 MODULATOR, type \_\_\_\_\_  
 BEAM PULSE, width \_\_\_\_\_

**VACUUM SYSTEM**

PUMPS, No., Type, Size 2 Turbomolecular  
pumps, Refrigerator cryopump  
 OPERATING PRESSURE 15 μTorr,  
 PUMPDOWN TIME 0.5 hrs

**ION SOURCES/INJECTION SYSTEM**

Internal Penning

**EXTRACTION SYSTEM**

Electrost. deflector + mag. channel

**CONTROL SYSTEM**

Manual control

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CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p	24	24
	d <sup>+</sup>	14	14
	<sup>3</sup> He <sup>++</sup>	36	36
	<sup>4</sup> He <sup>++</sup>	28	28
CURRENT		(μA)	(μA)
	Internal		500
			450
			300
	External		100
			100
		60	
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	%	μA of MeV
Res, ΔE/E	%	μA of MeV
Emittance	(mm-mrad) { $\frac{6}{9}$ axial } 10 μA of 6 MeV d <sup>+</sup> radial	

OPERATING PROGRAMS, time dist

Basic Nuclear Physics	%
Solid State Physics	%
Bio-Medical Applications	%
Isotope Production	%
Development	%
Production of monoenergetic neutrons	100 %

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

The Van de Graaff generator and the energy variable cyclotron are used to produce "monoenergetic" neutrons with continuously variable energy between about 10 keV and 31.5 MeV. Both accelerators can be operated in a nanosecond pulsed beam mode, as needed for time-of-flight spectroscopy. The building comprises a low backscatter experimental hall and a set-up for a fast neutron scattering experiment with five flight paths in fixed positions and a cyclotron moving on a swivel arm.