K1200 OPERATING EXPERIENCE

D. Poe, P. Miller, and M. Garbek

Table I shows operating time statistics for the K1200 cyclotron for the year 1997, and Table II shows the various beams which were run, along with the hours for each. It also gives the percentage of total beam time for each beam. There were 124 different beams of 78 different types occurring in 5,695.75 hours of operation and 4,517.25 hours of research. This implies that there was one beam change for every 45.9 hours of operation and every 36.4 hours of research.

There were 4517.25 hours of research in 1997 versus 5,127 hours in 1996. The category of operation, or (research + development + overhead) was 5,965.75 hours. This represents the amount of time that the cyclotron was running. The efficiency is defined in Table I as the time that the cyclotron ran divided by the amount of time that we tried to run it and is 88.0%, versus 89.6% in 1996.

Table I
K1200 Time Distribution in 1997

	Hours	Percentage
Operation		
Research	4517.25	68.42
Developmeent	194.25	2.94
Overhead	984.25	14.91
(R+D+O)	5695.75	86.27
Maintenance	126.50	1.92
Breakdown	779.75	11.81
TOTAL	6602.00	100.00
Off	2117.00	
Startup	40.00	

EFFICIENCY=E=(R+D+O)/(TOTAL-MAINTENANCE)

E=5695.75/(6602.00-126.50)=0.880=88.0%

Since 1997 was not a leap year, it had 8,760 hours in it. Therefore, research was carried on 51.6% of the total time and operation 65.0%

Beams run for the first time in 1997 are listed in Table III. Notable among them were 70 MeV/u $^{46}Ti^{12+}$, 70 MeV/u $^{76}Ge^{19+}$, ^{197}Au at 50, 55, 59, and 60 MeV/u, and 29 MeV/u $^{208}Pb^{36+}$. Solid beams are generally produced in the ECR by either the sputter technique or by the use of an oven. In the sputter technique, a piece of the appropriate metal is placed near the plasma inside the ECR and biased negatively with respect to the ECR bias. This

draws ions from the plasma to the sample, which sputters material into the plasma. The ovens are miniature devices attached to the ECR ports, allowing for the heating of the desired sample to 1400^{o}C.

Table II
Beams Run in K1200 Cyclotron in 1997

Ion	E/A [MeV/u]	Hours	%Time	Ion	E/A [MeV/u]	Hours	%Time
$^{2}H1^{+}$	140	19.50	0.4%	$^{36}Ar^{12+}$	80	10.25	0.2%
$^{2}H1^{+}$	200	10.75	0.2%	$^{36}Ar^{12+}$	100	437.00	9.2%
$^{4}He^{1+}$	40	8.00	0.2%	$^{36}Ar^{15+}$	150	15.25	0.3%
$^{4}He^{1+}$	60	4.00	0.1%	$^{36}Ar^{18+}$	155	4.50	0.1%
$^{4}He^{1+}$	70	8.00	0.2%	$^{40}Ar^{10+}$	70	27.75	0.6%
$^{4}He^{2+}$	140	89.00	1.9%	$^{40}Ar^{12+}$	80	48.50	1.0%
$^{4}He^{2+}$	155	6.50	0.1%	$^{40}Ar^{12+}$	90	176.50	3.7%
$^{7}Li^{1+}$	19	123.75	2.6%	$^{40}Ar^{12+}$	100	24.25	0.5%
$^{7}Li^{2+}$	50	195.00	4.1%	$^{40}Ar^{14+}$	125	15.25	0.3%
$^{9}Be^{2+}$	35	49.50	1.0%	$^{40}Ar^{15+}$	135	27.50	0.6%
$^{12}C^{4+}$	75	7.75	0.2%	$^{40}Ca^{12+}$	80	63.75	1.3%
$^{12}C^{4+}$	100	126.75	2.7%	$^{40}Ca^{12+}$	100	4.50	0.1%
$^{12}C^{5+}$	100	137.25	2.9%	$^{40}Ca^{14+}$	125	16.50	0.3%
$^{12}C^{5+}$	125	117.25	2.5%	$^{46}Ti^{12+}$	70	106.00	2.2%
$^{12}C^{5+}$	150	15.75	0.3%	$^{48}Ca^{10+}$	35	41.50	0.9%
$^{13}C^{3+}$	40	107.00	2.2%	$^{48}Ca^{12+}$	70	71.25	1.5%
$^{13}C^{4+}$	80	245.75	5.2%	$^{48}Ca^{13+}$	80	100.00	2.1%
$^{13}C^{4+}$	100	169.75	3.6%	$^{55}M^{n12+}$	50	42.25	0.9%
$^{14}N^{2+}$	19	8.50	0.2%	$^{55}M^{n16+}$	90	83.00	1.7%
$^{16}O^{4+}$	40	8.25	0.2%	$^{58}Ni^{15+}$	70	101.75	2.1%
$^{16}O^{4+}$	50	3.00	0.1%	$^{64}Zn^{16+}$	70	15.75	0.3%
$^{16}O^{4+}$	60	2.00	0.0%	$^{76}Ge^{19+}$	70	109.75	2.3%
$^{16}O^{4+}$	70	19.75	0.4%	$^{82}Se^{21+}$	70	40.50	0.9%
$^{16}O^{8+}$	140	6.50	0.1%	$^{84}Kr^{18+}$	35	69.25	1.5%
$^{16}O^{8+}$	155	37.25	0.8%	$^{84}Kr^{21+}$	60	42.50	0.9%
$^{16}O^{8+}$	200	1.00	0.0%	$^{86}Kr^{19+}$	40	82.50	1.7%
$^{17}O^{6+}$	84	11.25	0.2%	$^{86}Kr^{20+}$	60	27.25	0.6%
$^{17}O^{6+}$	100	16.00	0.3%	$^{86}Kr^{21+}$	55	32.50	0.7%
$^{18}O^{5+}$	60	114.25	2.4%	$^{124}Sn^{25+}$	40	17.50	0.4%
$^{18}O^{6+}$	80	626.75	13.2%	$^{129}Xe^{27+}$	35	12.25	0.3%
$^{18}O^{6+}$	100	18.75	0.4%	$^{132}Xe^{23+}$	29	2.00	0.0%
$^{20}Ne^{6+}$	80	113.50	2.4%	$^{136}Xe^{29+}$	40	20.75	0.4%
$^{20}Ne^{6+}$	100	15.50	0.3%	$^{197}Au^{29+}$	20	47.50	1.0%
$^{20}Ne^{7+}$	80	4.00	0.1%	$^{197}Au^{35+}$	30	27.00	0.6%
$^{22}Ne^{7+}$	80	159.50	3.3%	$^{197}Au^{41+}$	45	23.75	0.5%
$^{22}Ne^{9+}$	120	2.25	0.0%	$^{197}Au^{42+}$	50	61.50	1.3%
$^{36}Ar^{9+}$	70	28.25	0.6%	$^{197}Au^{44+}$	55	49.75	1.0%
$^{36}Ar^{11+}$	80	4.75	0.1%	$^{197}Au^{44+}$	59	16.25	0.3%
$^{36}Ar^{12+}$	75	2.75	0.1%	$^{208}Pb^{36+}$	29	3.00	0.1%
						4763.50	100.0%