ION BEAM ANALYSIS TABLE OF THE ELEMENTS

Table of Selected Nuclear Reactions

Z		A	Reaction
1	H	1	(19F,γ)
1	H	2	(3He,p)
1	H	3	(p,n)
2	He	3	(3He,pp')
2	He	4	(11B,n)
3	Li	7	(p,α)
4	Be	9	(p,α)
5	B	11	(p,α)
6	C	12	(3He,p)
7	N	14	(α,p)
9	F	19	(p,γ)
10	Ne	20	(p,γ)
11	Na	23	(p,γ)
13	Al	27	(p,γ)
15	P	31	(p,γ)

U.S. DOE User Facility 975

ION BEAM MATERIALS RESEARCH LAB
Sandia National Laboratories

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1 H 1 E 4 3 2 N 5 4 1																	2 He 3 N 3 3 3 E 4 3 2
1 H 2 E 4 3 2 N 6 4 3																	2 He 4 R 3 3 2 E 4 3 2 N 2 3 2
1 H 3 E 4 3 2 N 5 4 3												5 B 10.8 R E 3 3 2 E 4 2 1 N 4 3 3	6 C 12 R E 4 3 2 E 4 2 1 N 3 4 2	7 N 14 R E 4 3 2 E 4 2 1 N 4 3 2	8 O 16 R E 4 3 2 E 4 2 1	9 F 19 R 2 3 2 N 6 4 3	10 Ne 20 R 2 3 2 N 3 3 2
3 Li 7 R 3 3 2 E 4 3 2 N 5 4 3	4 Be 9 R 3 3 2 E 4 3 2 N 4 3 2											13 Al 27 N 5 3 1 R 3 3 2 P 4 3 3 K 1.487	14 Si 28 R 3 3 2 P 4 3 3 K 1.740	15 P 31 N 4 3 2 R 3 3 2 P 4 4 4 K 2.015	16 S 32 R 3 3 2 P 4 4 4 K 2.308	17 Cl 35.5 R 3 3 2 P 4 4 4 K 2.622	18 Ar 40 R 3 3 2 P 4 4 4 K 2.957
11 Na 23 N 6 3 2 R 3 3 2	12 Mg 24 R 3 3 2 P 3 3 3 K 1.254																
19 K 39 H 5 2 R 4 3 2 P 4 4 4 K 3.313	20 Ca 40 H 6 2 R 4 3 2 P 5 4 4 K 3.691	21 Sc 45 H 6 2 R 4 3 2 P 5 4 4 K 4.090	22 Ti 48 H 6 2 R 4 3 2 P 5 4 4 K 4.510	23 V 51 H 6 2 R 4 3 2 P 6 4 4 K 4.952	24 Cr 52 H 6 2 R 4 3 2 P 6 4 4 K 5.414	25 Mn 55 H 6 2 R 4 3 2 P 6 4 4 K 5.898	26 Fe 56 H 6 2 R 4 3 2 P 6 4 4 K 6.403	27 Co 59 H 6 2 R 4 3 2 P 6 4 4 K 6.930	28 Ni 59 H 6 2 R 4 3 2 P 6 4 4 K 7.477	29 Cu 63.5 H 6 2 R 4 3 2 P 6 4 4 K 8.047	30 Zn 65 H 7 2 R 4 3 2 P 6 4 4 K 8.638	31 Ga 70 H 7 2 R 4 3 2 P 6 4 4 K 9.251	32 Ge 72.6 H 7 2 R 4 3 2 P 6 4 4 K 9.885	33 As 75 H 7 2 R 4 3 2 P 6 4 4 K 10.543	34 Se 79 H 7 2 R 4 3 2 P 6 4 4 K 11.221	35 Br 80 H 7 2 R 4 3 2 P 6 4 4 K 11.923	36 Kr 84 H 7 2 R 4 3 2 P 6 4 4 K 12.648
37 Rb 85.5 H 7 2 R 4 3 2 P 6 4 4 K 13.394	38 Sr 87.6 H 7 2 R 4 3 2 P 6 4 4 K 14.164	39 Y 89 H 7 2 R 4 3 2 P 6 4 4 K 14.957	40 Zr 91 H 7 2 R 4 3 2 P 6 4 4 K 15.774	41 Nb 93 H 7 2 R 4 3 2 P 5 4 4 K 16.614	42 Mo 96 H 7 2 R 4 3 2 P 5 4 4 K 17.478	43 Tc 98 H 7 2 R 4 3 2 P 5 4 4 L 2.424	44 Ru 101 H 7 2 R 4 3 2 P 5 4 4 L 2.558	45 Rh 103 H 7 2 R 4 3 2 P 5 4 4 L 2.696	46 Pd 106 H 7 2 R 4 3 2 P 5 4 4 L 2.838	47 Ag 108 H 7 2 R 4 3 2 P 5 4 4 L 2.984	48 Cd 112 H 7 2 R 4 3 2 P 5 4 4 L 3.133	49 In 115 H 7 2 R 4 3 2 P 5 4 4 L 3.287	50 Sn 119 H 7 2 R 4 3 2 P 4 4 4 L 3.444	51 Sb 122 H 7 2 R 4 3 2 P 4 4 4 L 3.605	52 Te 128 H 7 2 R 4 3 2 P 4 4 4 L 3.769	53 I 127 H 7 2 R 4 3 2 P 4 4 4 L 3.937	54 Xe 112 H 7 2 R 4 3 2 P 4 4 4 L 4.111
55 Cs 133 H 8 2 R 5 3 2 P 4 4 4 L 4.286	56 Ba 137 H 8 2 R 5 3 2 P 4 4 4 L 4.467	57 La 139 H 8 2 R 5 3 2 P 4 4 4 ☆ L 4.651	72 Hf 178 H 8 2 R 5 3 2 P 6 4 4 L 7.898	73 Ta 181 H 8 2 R 5 4 1 P 6 4 4 L 8.145	74 W 184 H 8 2 R 5 3 2 P 6 4 4 L 8.396	75 Re 186 H 8 2 R 5 3 2 P 6 4 4 L 8.651	76 Os 190 H 8 2 R 5 3 2 P 6 4 4 L 8.910	77 Ir 192 H 8 2 R 5 3 2 P 6 4 4 L 9.173	78 Pt 195 H 8 2 R 5 3 2 P 6 4 4 L 9.441	79 Au 197 H 8 2 R 5 3 2 P 6 4 4 L 9.711	80 Hg 201 H 8 2 R 5 3 2 P 6 4 4 L 9.987	81 Tl 204 H 8 2 R 5 3 2 P 6 4 4 L 10.266	82 Pb 207 H 8 2 R 5 3 2 P 6 4 4 L 10.549	83 Bi 209 H 8 2 R 5 3 2 P 6 4 4 L 10.836	84 Po 209 H 8 2 R 5 3 2 P 6 4 4 L 11.128	85 At 210 H 8 2 R 5 3 2 P 6 4 4 L 11.424	86 Rn 222 H 8 2 R 5 3 2 P 6 4 4 L 11.724
87 Fr 223 H 8 2 R 5 3 2 P 6 4 4 L 12.029	88 Ra 226 H 8 2 R 5 3 2 P 6 4 4 L 12.338	89 Ac 227 H 8 2 R 5 3 2 ☆☆ P 6 4 4 L 12.650															

MASS RESOLUTION OF He RBS (specific / generic)

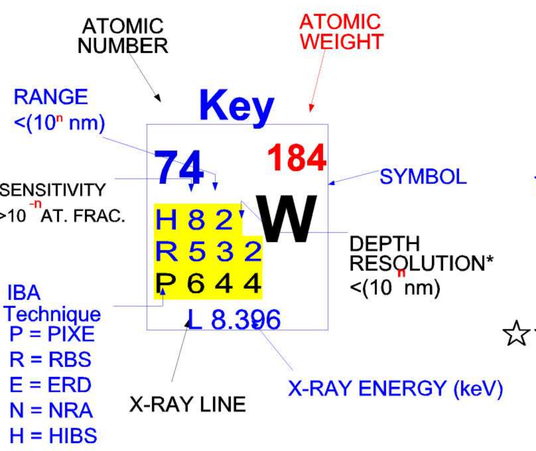
TOF- ERD has 10x better Resolution and worse Sensitivity than ERD.
X-IBA has 10x worse Resolution and Sensitivity than IBA.
Micro-IBA with 2 μm diameter beam spot has ~10x worse sensitivity than IBA.

P-RBS has ~2-10x worse mass and depth resolution and 10x more range than He RBS.
HIBS mass resolution is ~2x worse than RBS.

***DEPTH RESOLUTION COLOR SCALE**

1-10 nm	RED
10-100 nm	BLUE
100-1000 nm	GREEN
> 1000 nm	BLACK

*** Depth resolution in Si substrate. Resolution is better in higher Z substrate, worse in lower Z substrates.**



= PREVIOUS IBMRL EXPERIENCE

☆	58 Ce 140 H 8 2 R 5 3 2 P 5 4 4 L 4.840	59 Pr 141 H 8 2 R 5 3 2 P 5 4 4 L 5.034	60 Nd 144 H 8 2 R 5 3 2 P 5 4 4 L 5.230	61 Pm 145 H 8 2 R 5 3 2 P 5 4 4 L 5.431	62 Sm 150 H 8 2 R 5 3 2 P 5 4 4 L 5.636	63 Eu 152 H 8 2 R 5 3 2 P 5 4 4 L 5.846	64 Gd 157 H 8 2 R 5 3 2 P 6 4 4 L 6.059	65 Tb 159 H 8 2 R 5 3 2 P 6 4 4 L 6.275	66 Dy 163 H 8 2 R 5 3 2 P 6 4 4 L 6.495	67 Ho 165 H 8 2 R 5 3 2 P 6 4 4 L 6.720	68 Er 167 H 8 2 R 5 3 2 P 6 4 4 L 6.948	69 Tm 169 H 8 2 R 5 3 2 P 6 4 4 L 7.181	70 Yb 173 H 8 2 R 5 3 2 P 6 4 4 L 7.414	71 Lu 175 H 8 2 R 5 3 2 P 6 4 4 L 7.654
☆☆	90 Th 232 H 8 2 R 5 3 2 P 5 4 4 L 12.966	91 Pa 231 H 8 2 R 5 3 2 P 5 4 4 L 13.291	92 U 238 H 8 2 R 5 3 2 P 5 4 4 L 13.613	93 Np 237 H 8 2 R 5 3 2 P 5 4 4 L 13.945	94 Pu 244 H 8 2 R 5 3 2 P 5 4 4 L 14.279										

PIXE = Particle Induced X-ray Emission
RBS = Rutherford BackScattering
ERD = Elastic Recoil Detection
HIBS = Heavy Ion BackScattering

TOF = Time -of-Flight
X-IBA = eX-vacuo Ion Beam Analysis
R^E = Enhanced Rutherford Backscattering