Charge Exchange Yield Tables

The following tables have been reproduced from:

Marion and Young, *Nuclear Reaction Analysis Graphs and Tables* (North-Holland Publishing Co., 1968) pp. 36-45

The tables are scaled horizontally in both velocity and MeV/amu, the vertical scale is percent yield.

The charge state yields are based on the injection energy of the negative ion, essentially the terminal energy of the accelerator.

When the 4.5 MV maximum falls on a table, a line has been drawn to denote that limit.

When the beam is derived from injecting a molecular ion, the mass ratio for the molecule has been noted and figured into the maximum limit.

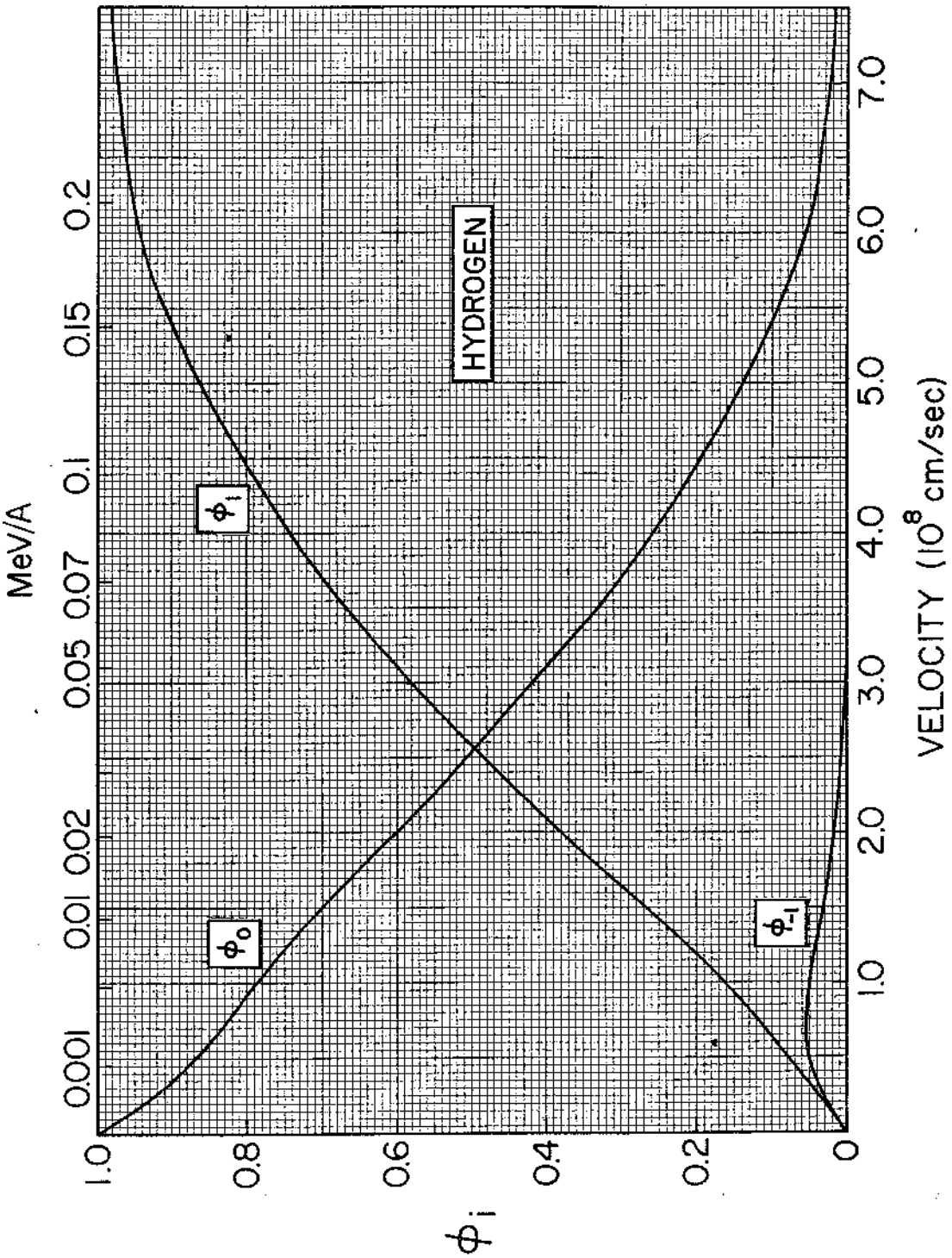
To use:

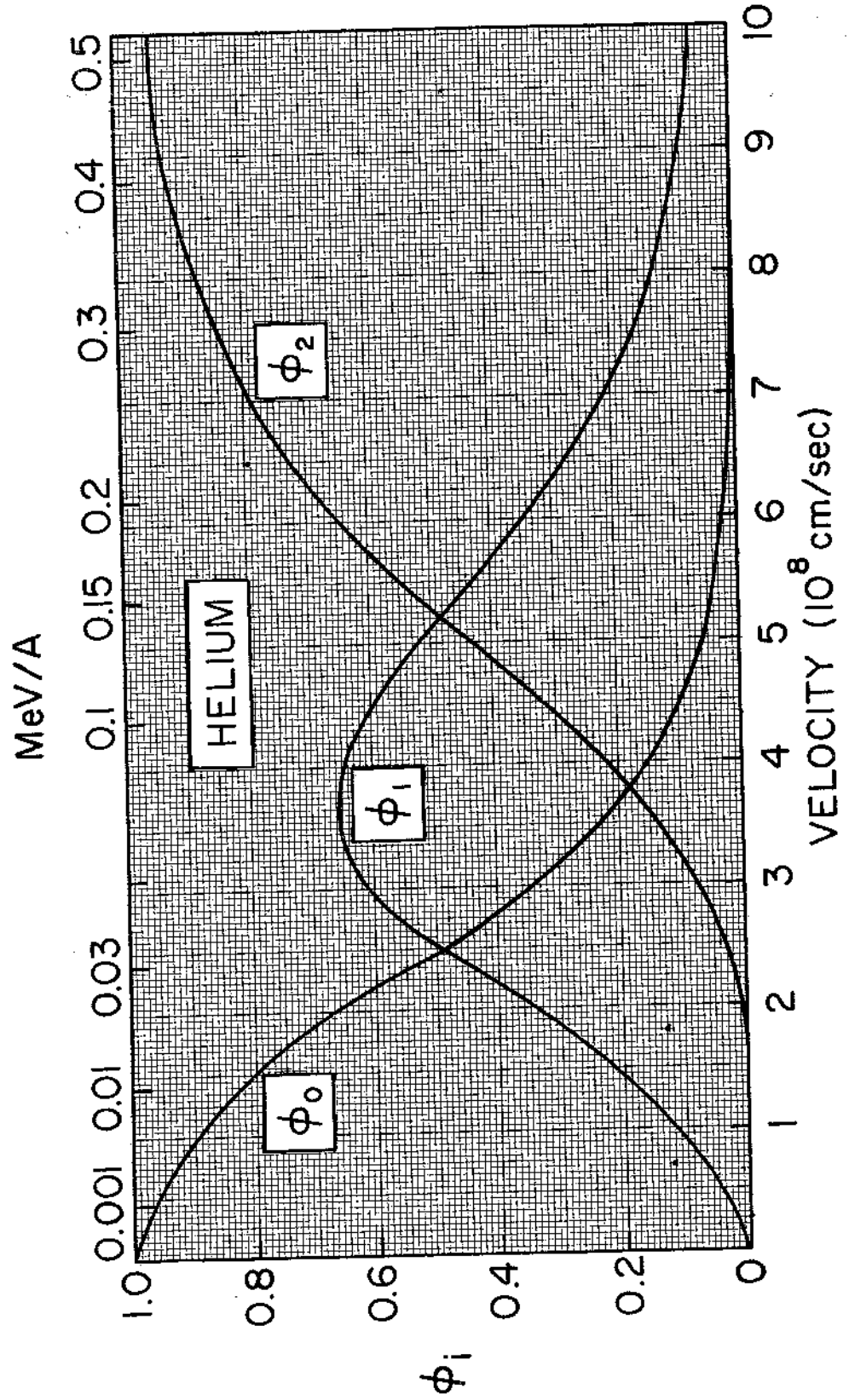
Use your desired beam energy to calculate terminal energies for different + charge states. Acceptable terminal energies are 0.225 to 4.5 MV.

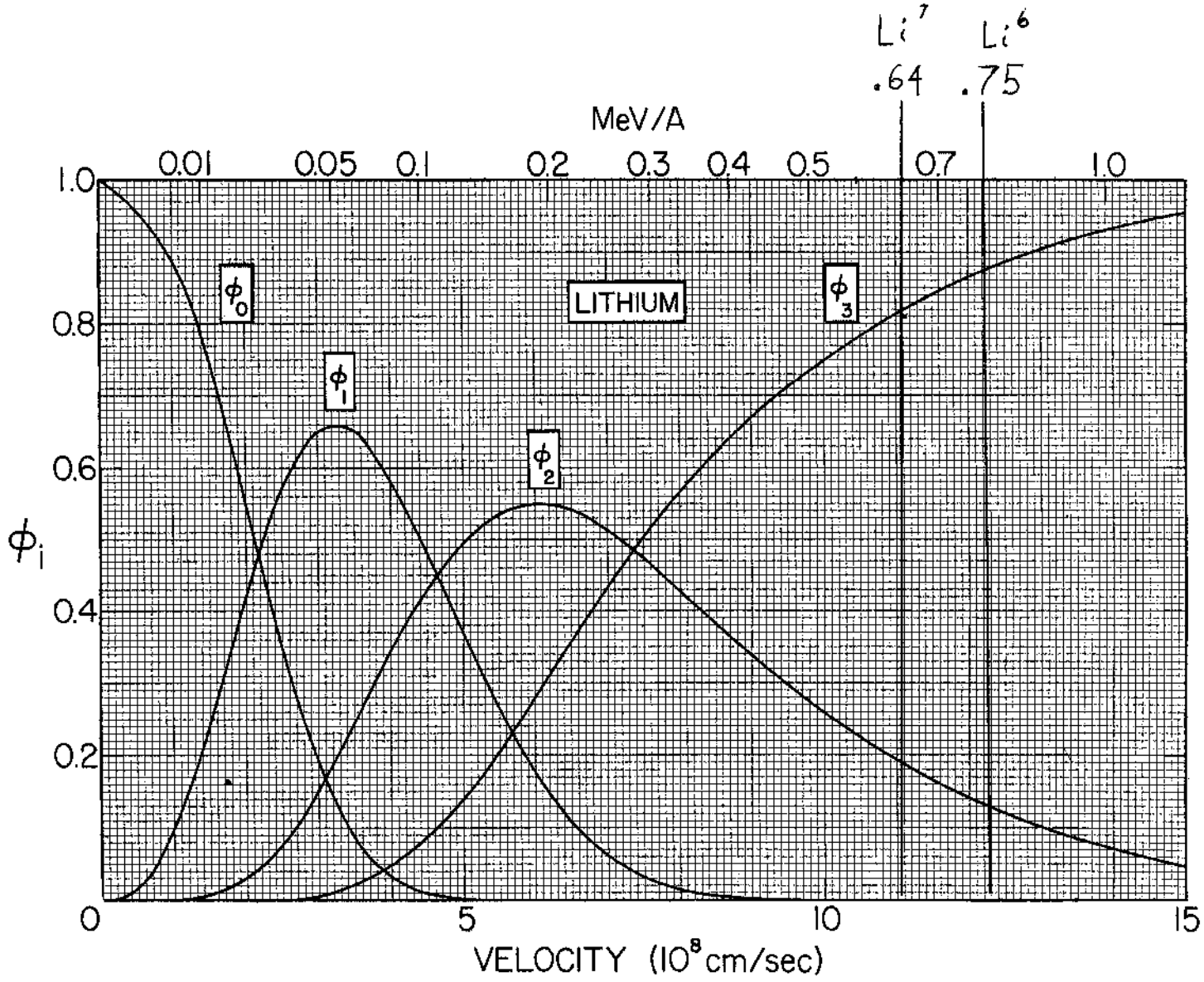
When injecting a molecule: mass ratio MR= $AMU_{beam}/AMU_{molecule}$

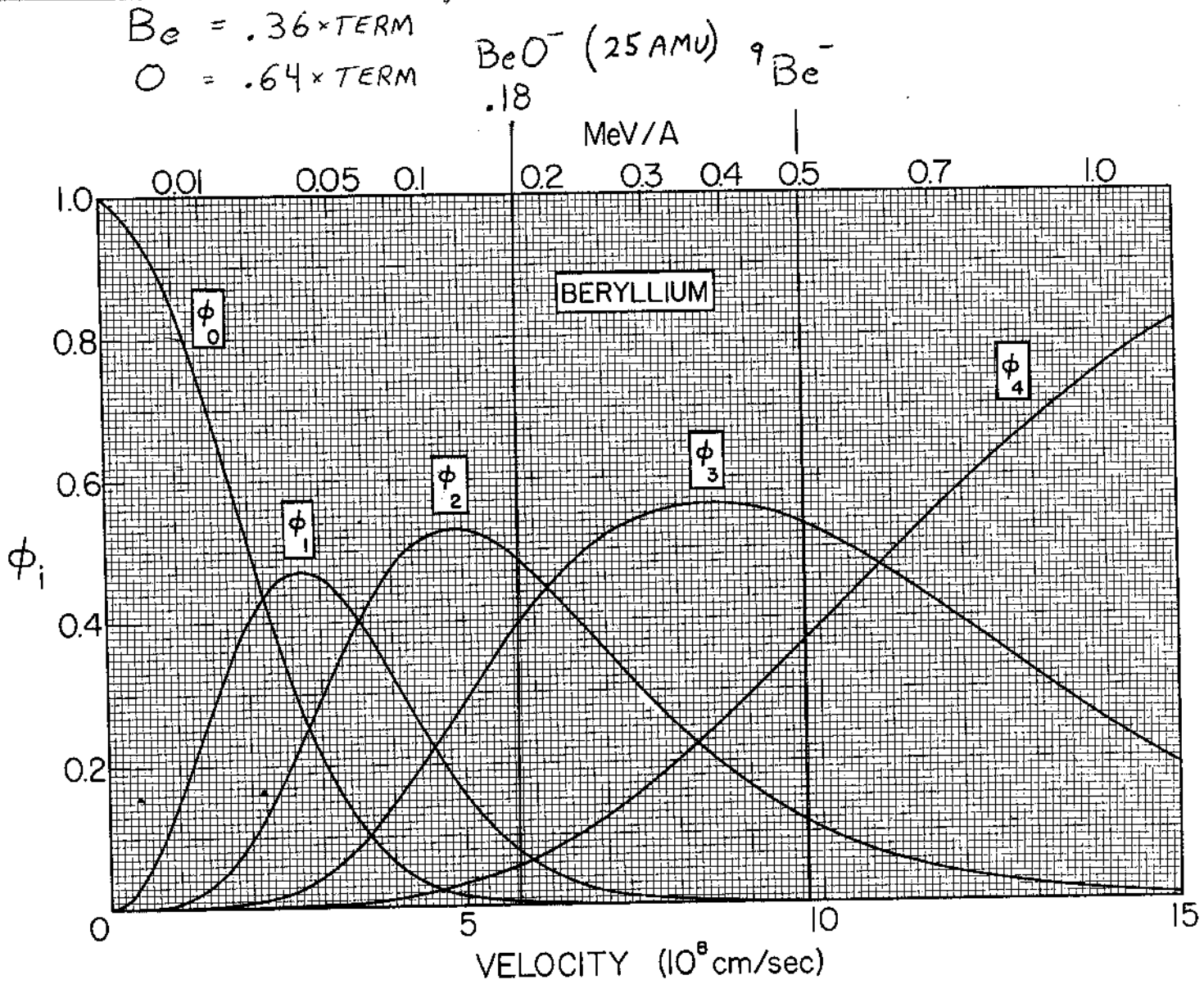
T = (E - source energy*MR)/(charge state + MR)

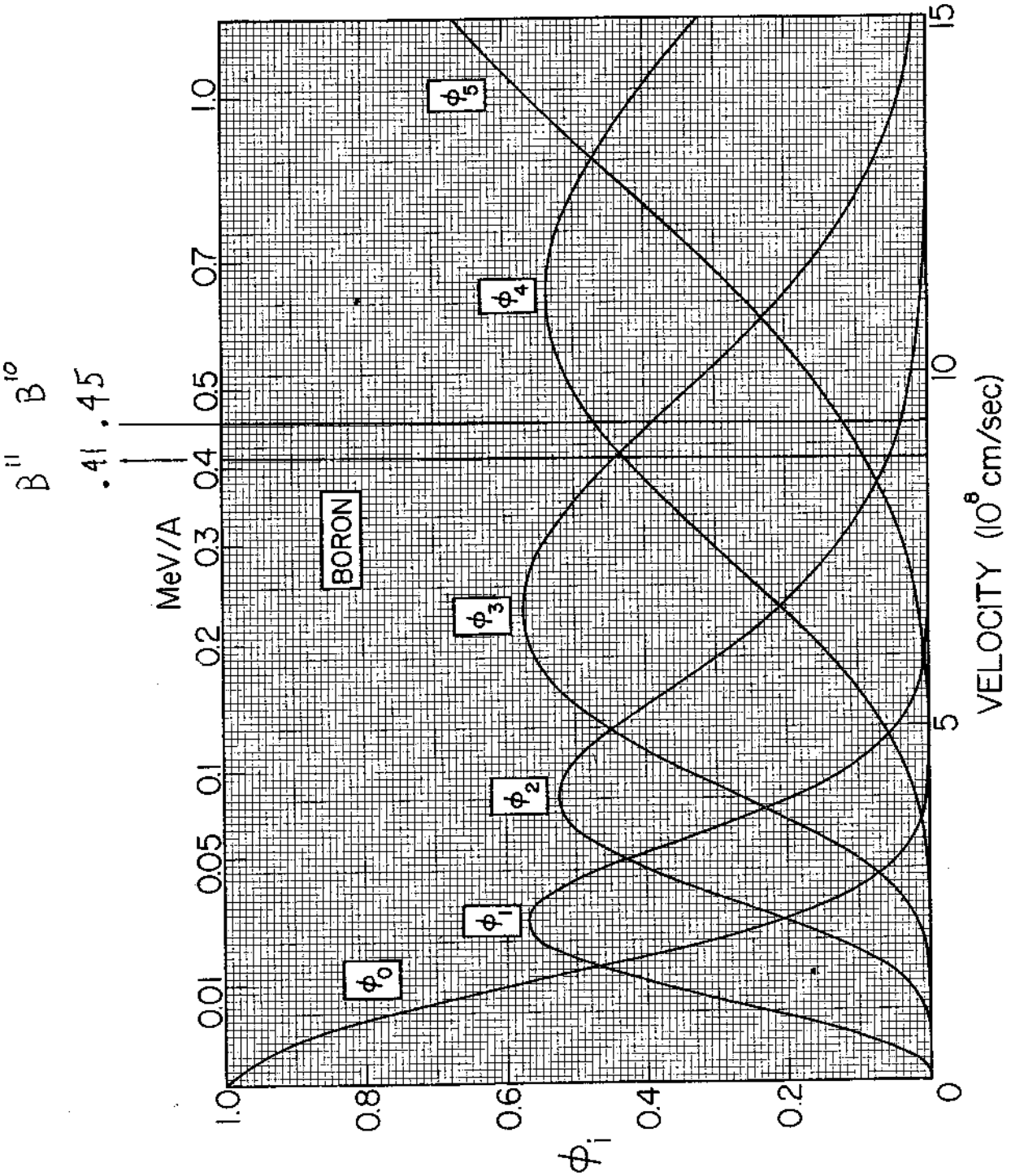
Divide the given terminal energy for a charge state by the AMU of the injected particle and see what the relative yield of that charge state is on the table.

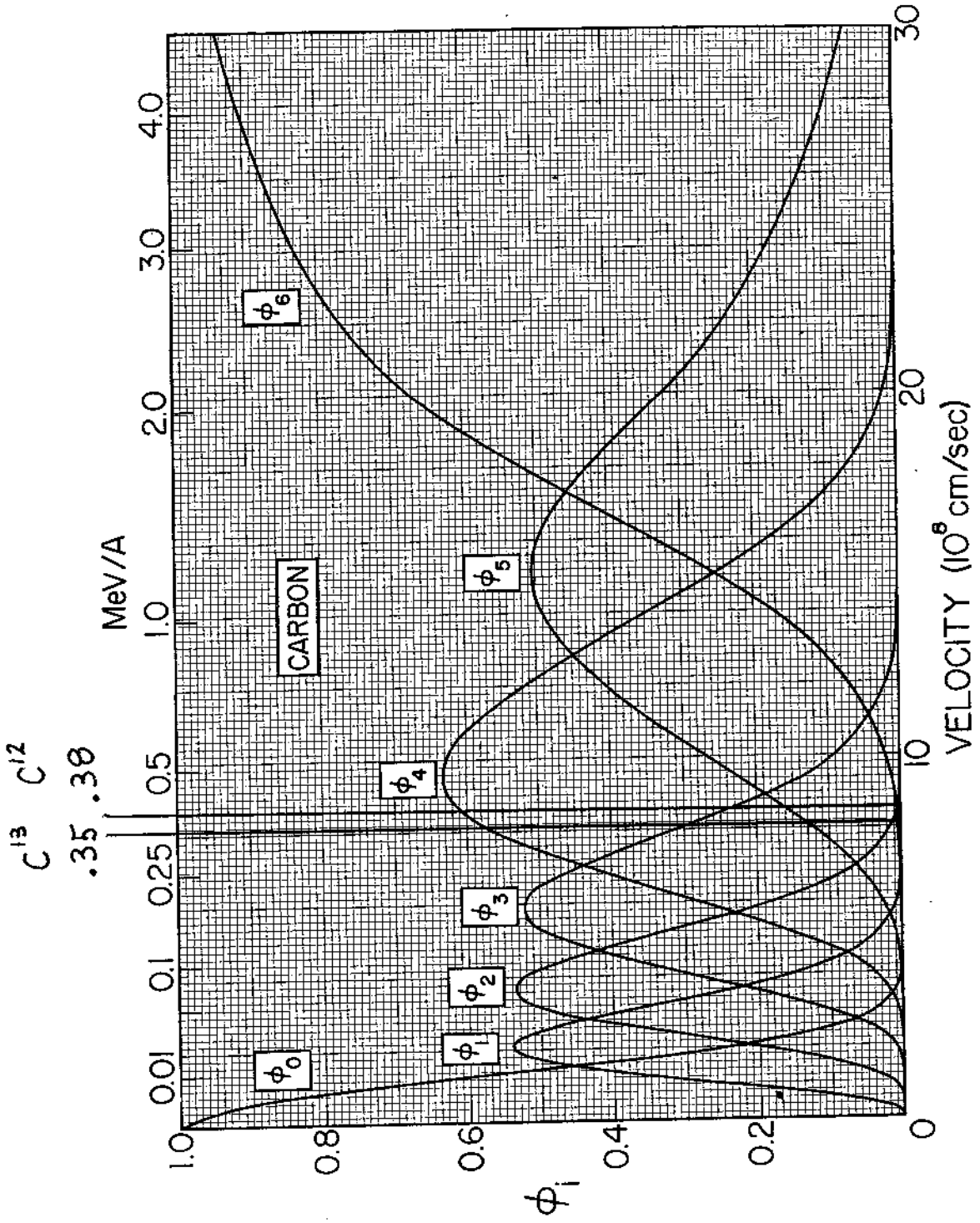

HYDROGEN
ϕ_1
ϕ_0
ϕ_{-1}
MeV/A
0.001
0.01
0.02
0.05
0.07
0.1
0.15
0.2
ϕ_i
1.0
0.8
0.6
0.4
0.2
0
VELOCITY (10^8 cm/sec)
1.0
2.0
3.0
4.0
5.0
6.0
7.0


MeV/A
0.001
0.01
0.03
0.1
0.15
0.2
0.3
0.4
0.5
HELIUM
ϕ_0
ϕ_1
ϕ_2
1.0
0.8
0.6
0.4
0.2
0
ϕ_i
1
2
3
4
5
6
7
8
9
10
VELOCITY (10^8 cm/sec)


Li⁷
.64
Li⁶
.75
MeV/A
0.01
0.05
0.1
0.2
0.3
0.4
0.5
0.7
1.0
LITHIUM
ϕ_0
ϕ_1
ϕ_2
ϕ_3
ϕ_i
1.0
0.8
0.6
0.4
0.2
0
5
10
15
VELOCITY (10^8 cm/sec)


Be = .36 × TERM
O = .64 × TERM
BeO⁻ (25 AMU)
⁹Be⁻
.18
MeV/A
0.01
0.05
0.1
0.2
0.3
0.4
0.5
0.7
1.0
BERYLLIUM
φ0
φ1
φ2
φ3
φ4
φi
1.0
0.8
0.6
0.4
0.2
0
5
10
15
VELOCITY (10⁸ cm/sec)

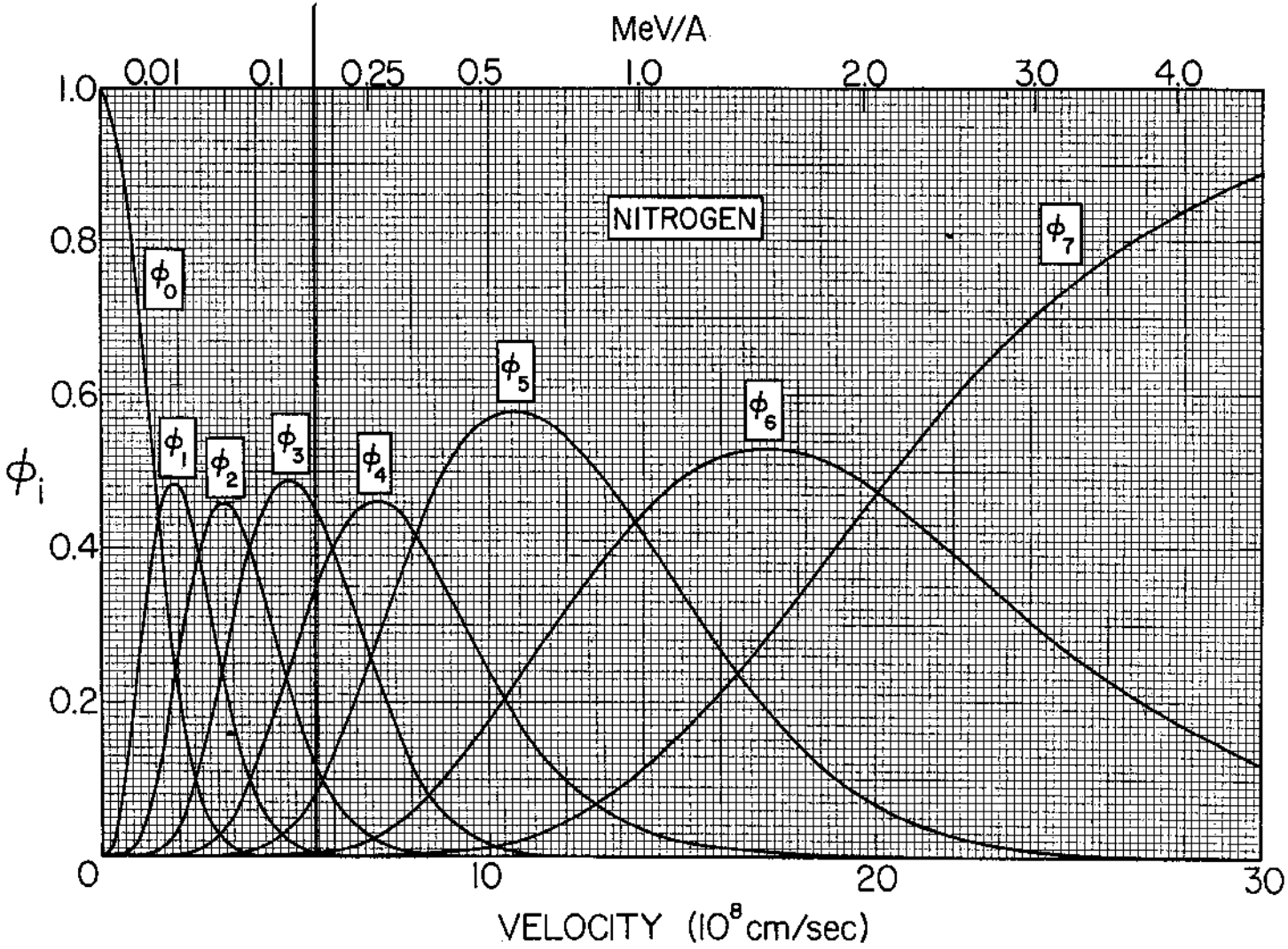

B11 B10
.41 .45
MeV/A
0.01
0.05
0.1
0.2
0.3
0.4
0.5
0.7
1.0
BORON
ϕ_0
ϕ_1
ϕ_2
ϕ_3
ϕ_4
ϕ_5
1.0
0.8
0.6
0.4
0.2
0
ϕ_i
0
5
10
15
VELOCITY (10^8 cm/sec)

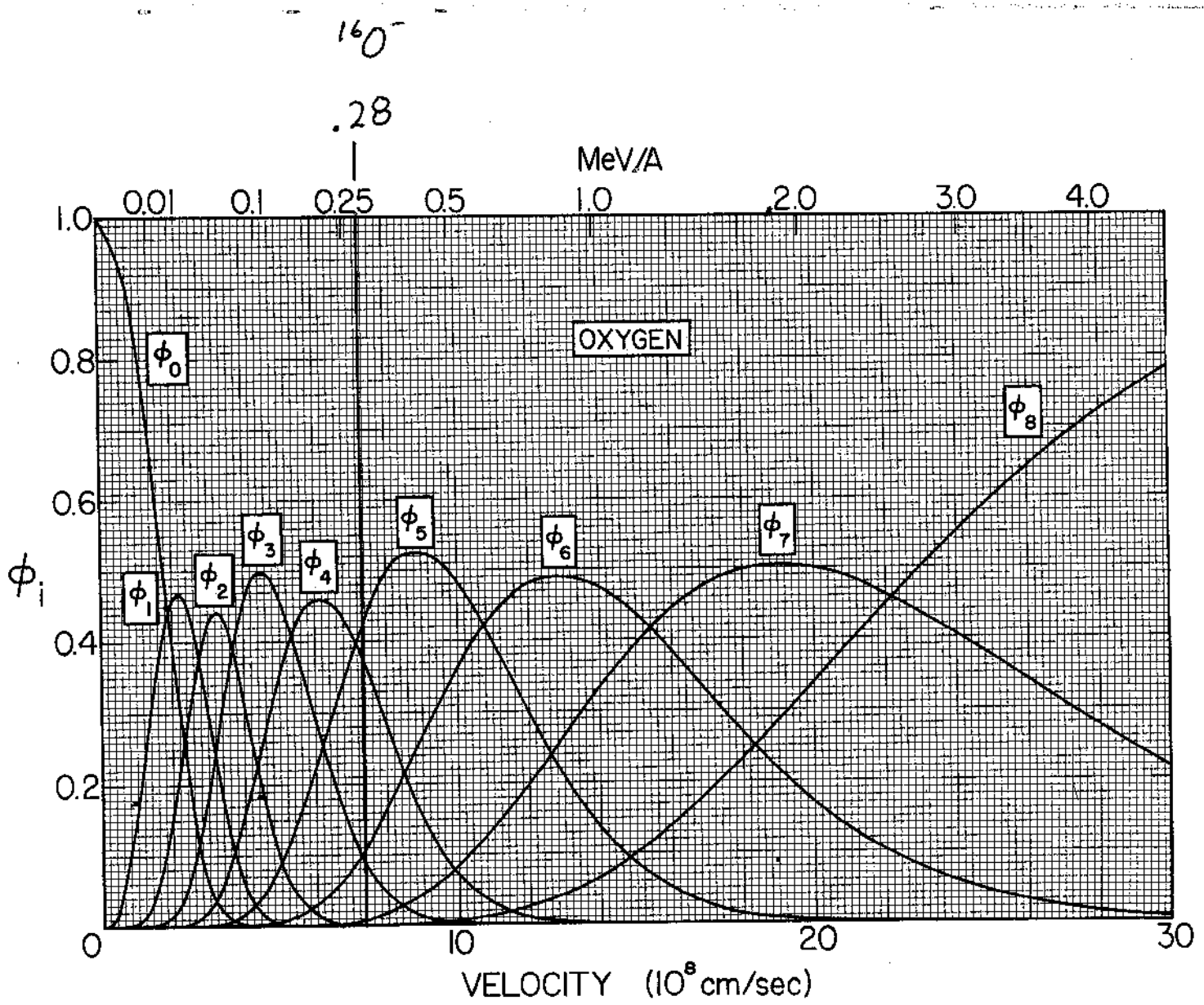

CARBON
C^{13} C^{12}
.35 .38
MeV/A
0.01
0.1
0.25
0.5
1.0
2.0
3.0
4.0
ϕ_0
ϕ_1
ϕ_2
ϕ_3
ϕ_4
ϕ_5
ϕ_6
1.0
0.8
0.6
0.4
0.2
0
ϕ_i
0
10
20
30
VELOCITY (10^8 cm/sec)

CN^- (26 AMU)

C = .46 × TERM

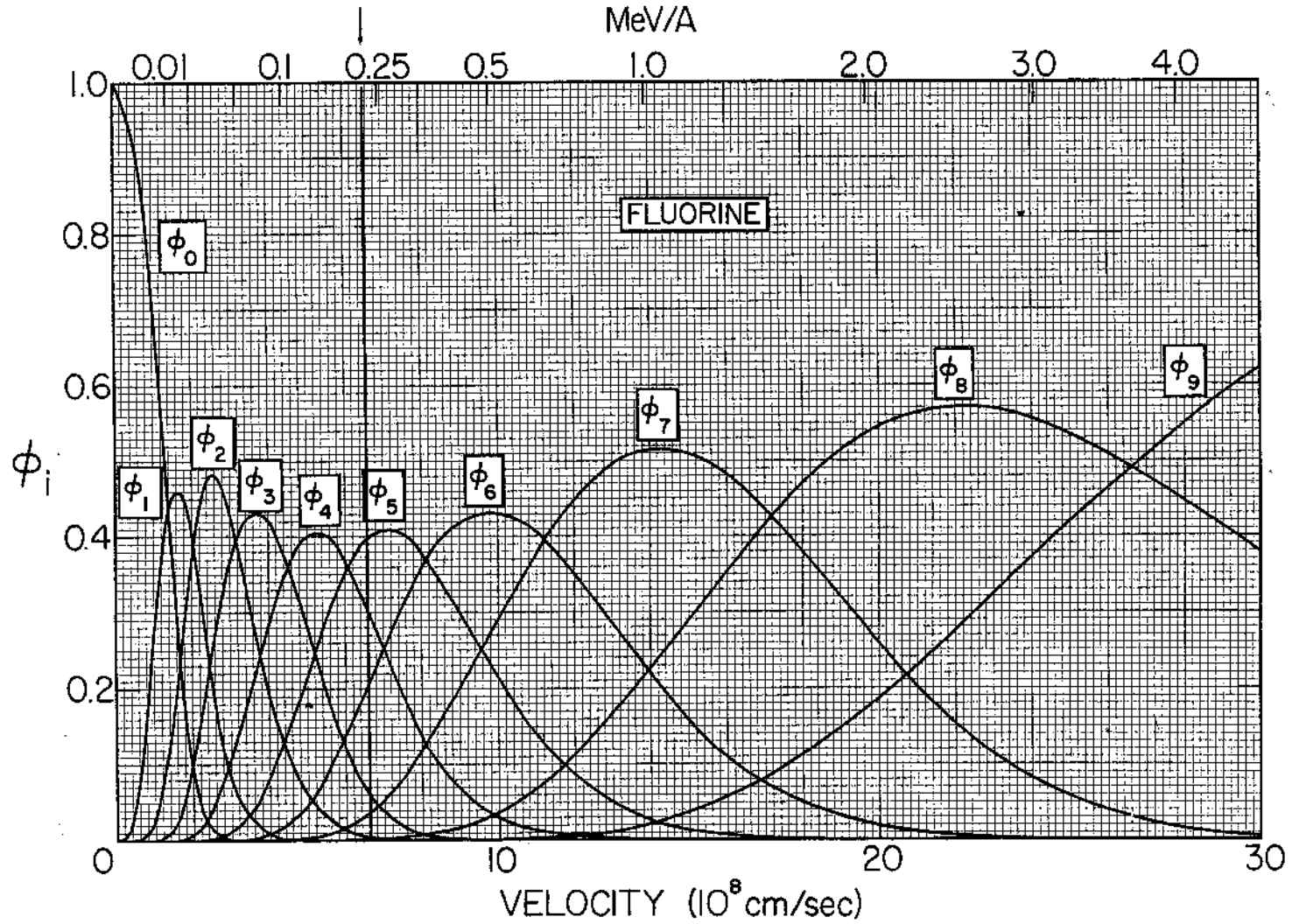
N = .54 × TERM




$^{16}O^-$
.28
MeV/A
0.01
0.1
0.25
0.5
1.0
2.0
3.0
4.0
1.0
0.8
0.6
0.4
0.2
0
ϕ_i
OXYGEN
ϕ_0
ϕ_1
ϕ_2
ϕ_3
ϕ_4
ϕ_5
ϕ_6
ϕ_7
ϕ_8
10
20
30
VELOCITY (10^8 cm/sec)

$^{19}F^-$

.237


MeV/A
0.01
0.1
0.25
0.5
1.0
2.0
3.0
4.0
1.0
0.8
0.6
0.4
0.2
0
ϕ_i
FLUORINE
ϕ_0
ϕ_1
ϕ_2
ϕ_3
ϕ_4
ϕ_5
ϕ_6
ϕ_7
ϕ_8
ϕ_9
10
20
30
VELOCITY (10^8 cm/sec)