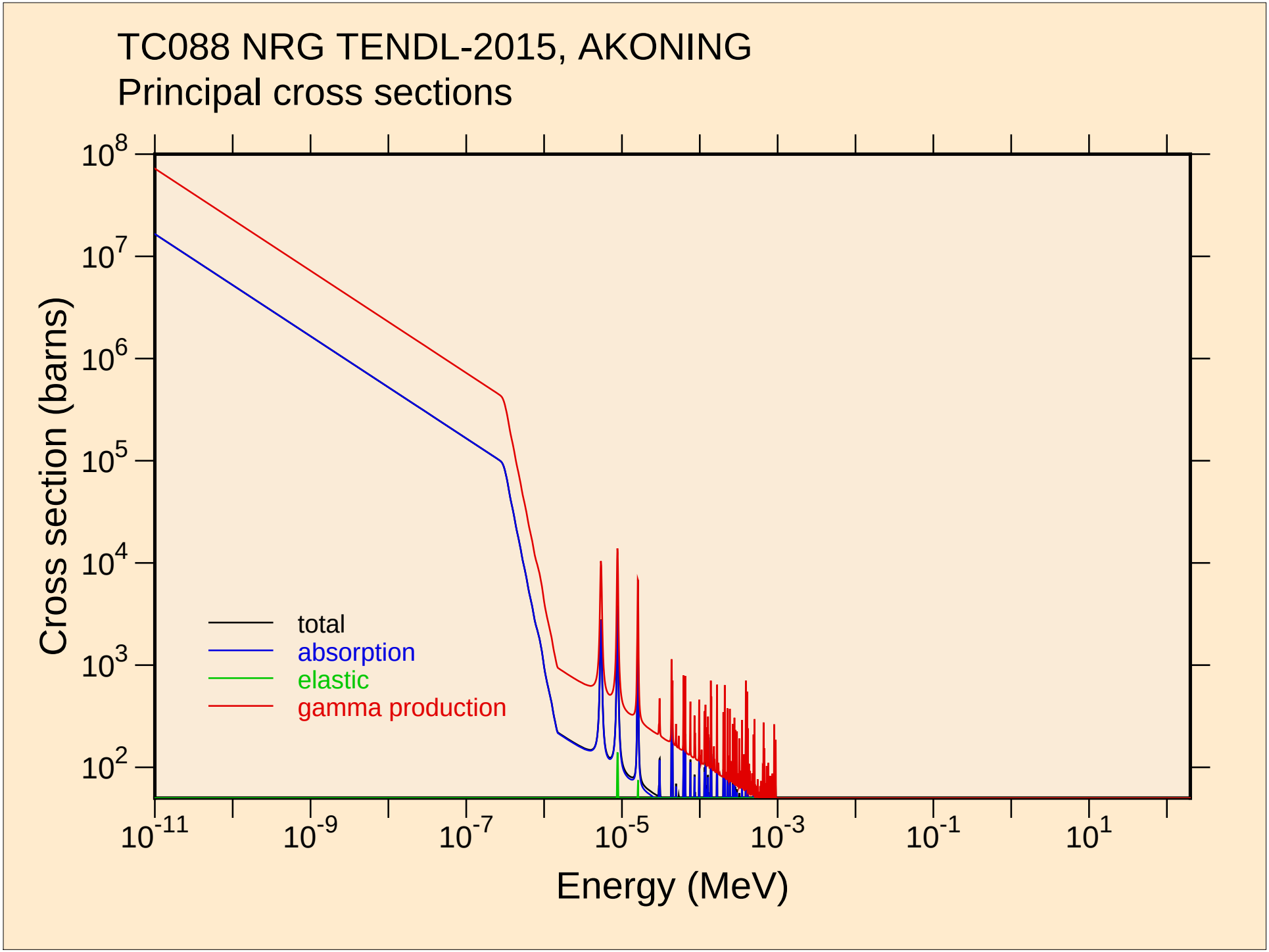
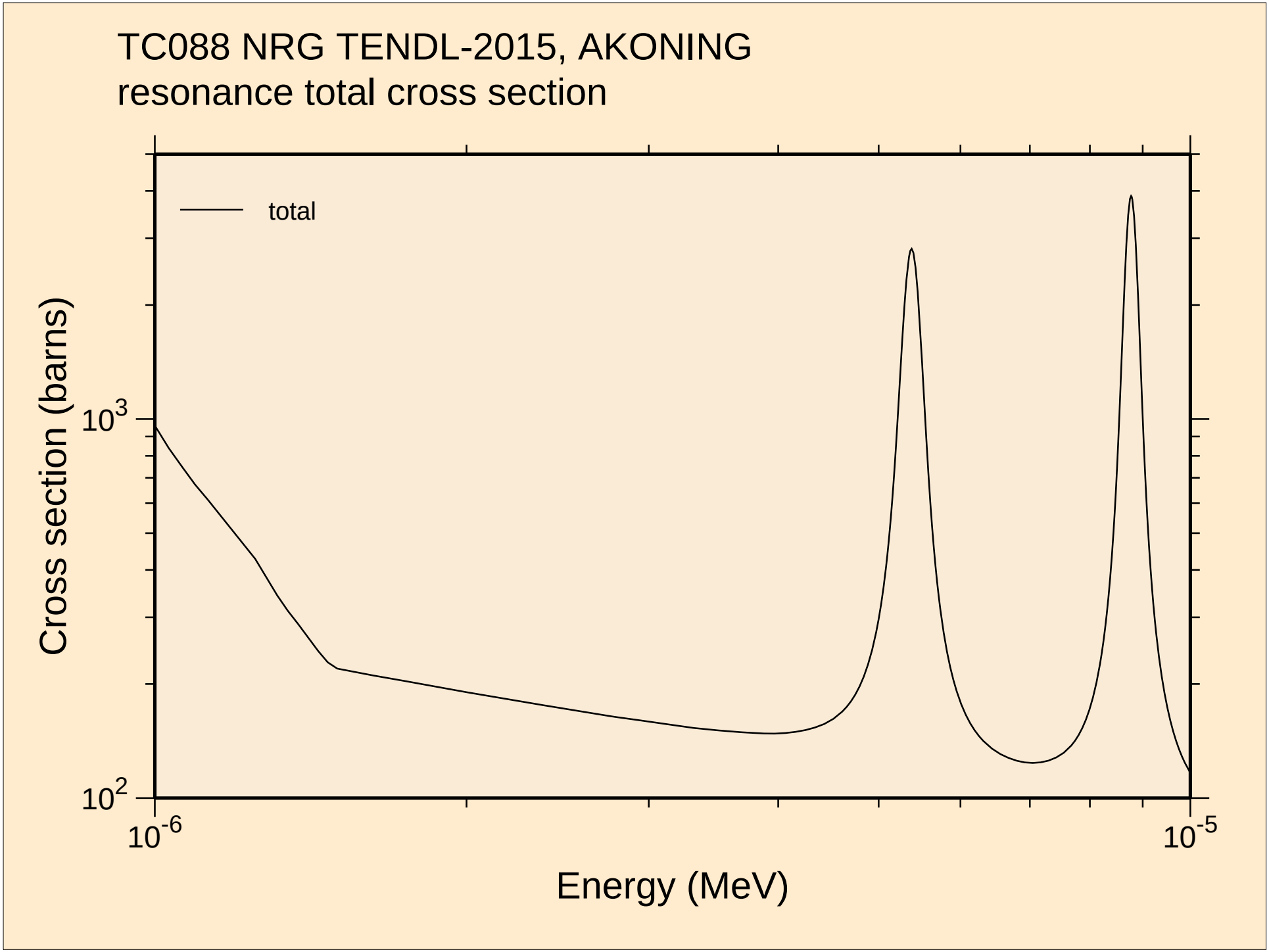
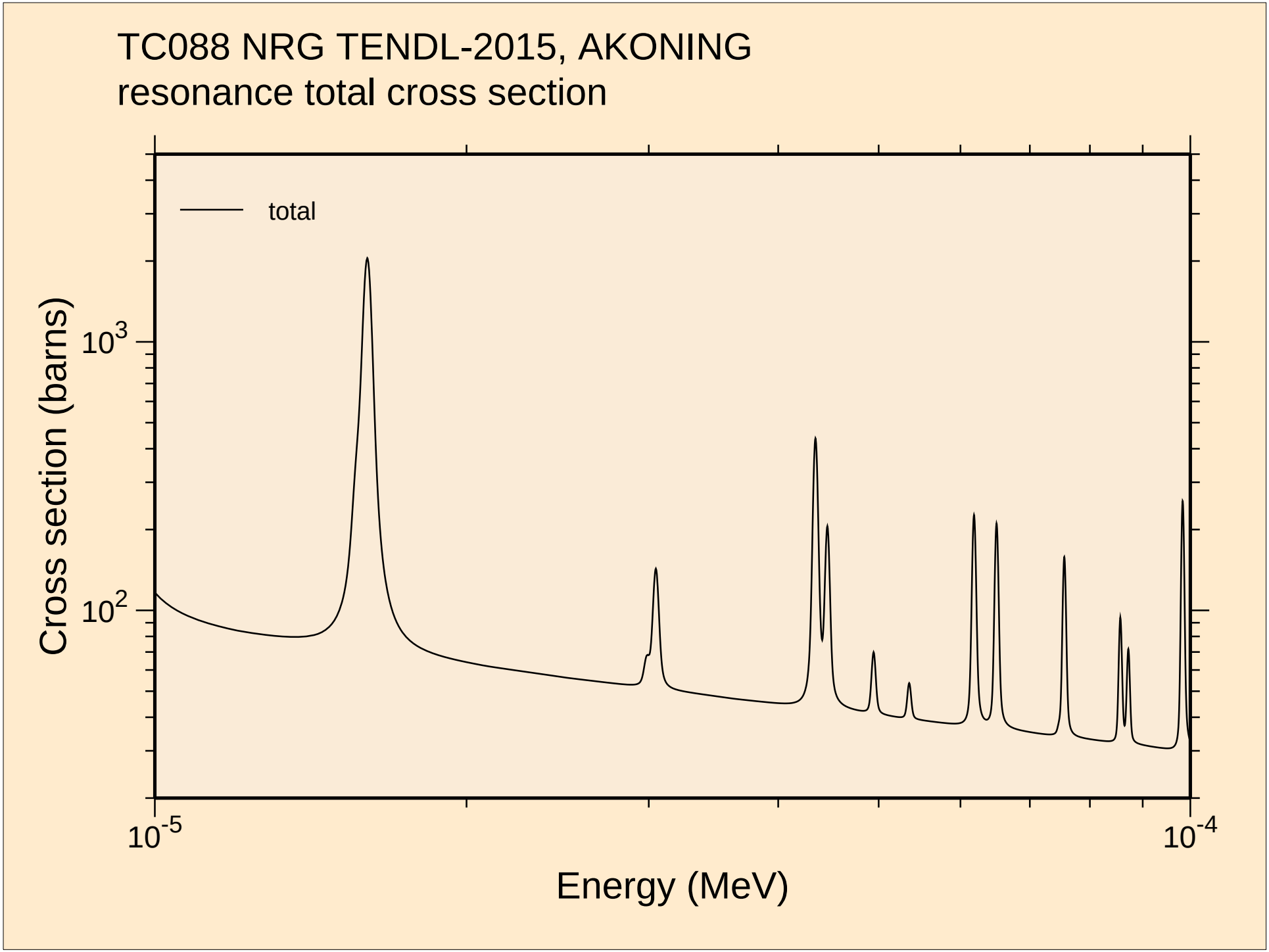
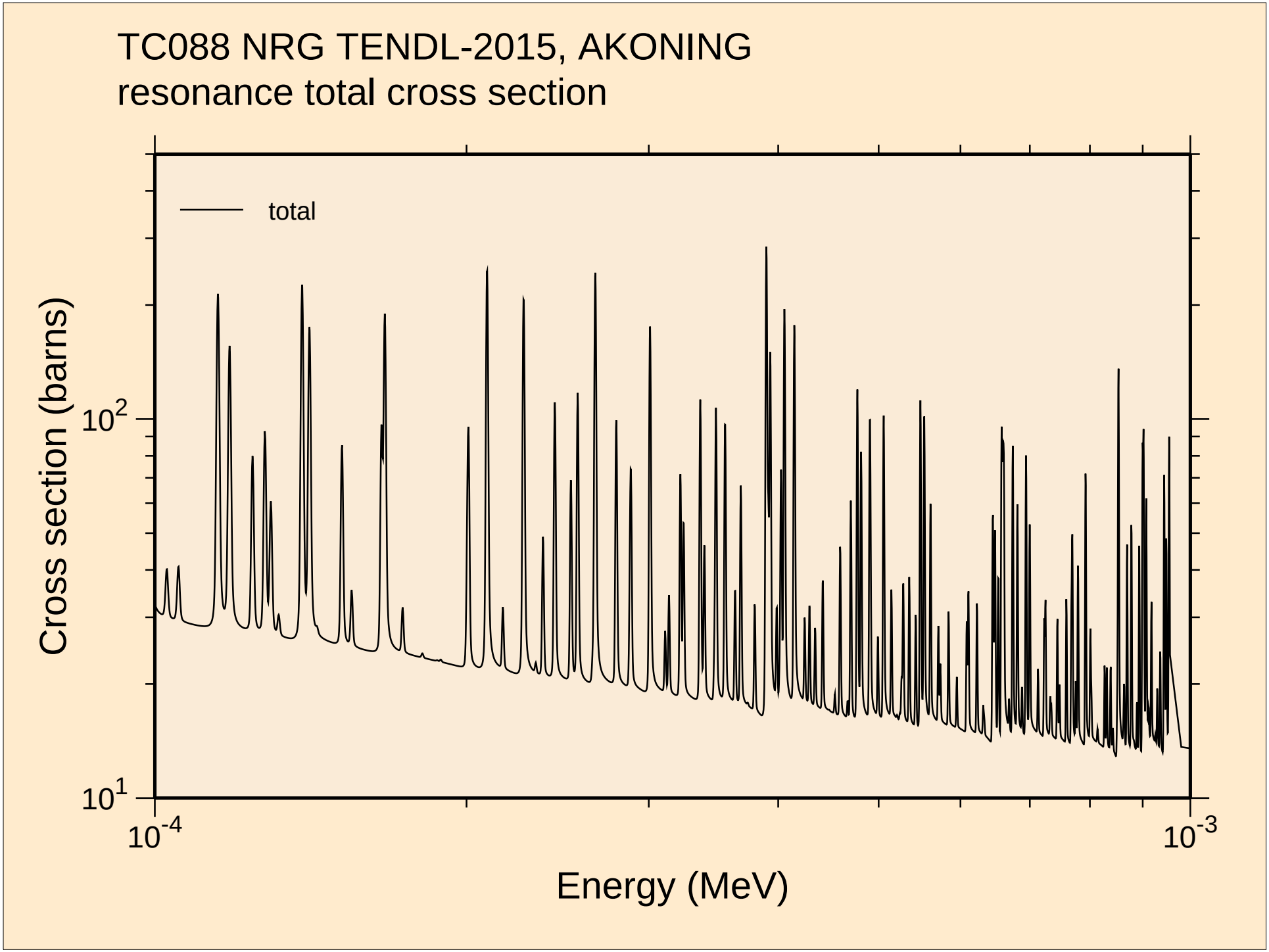
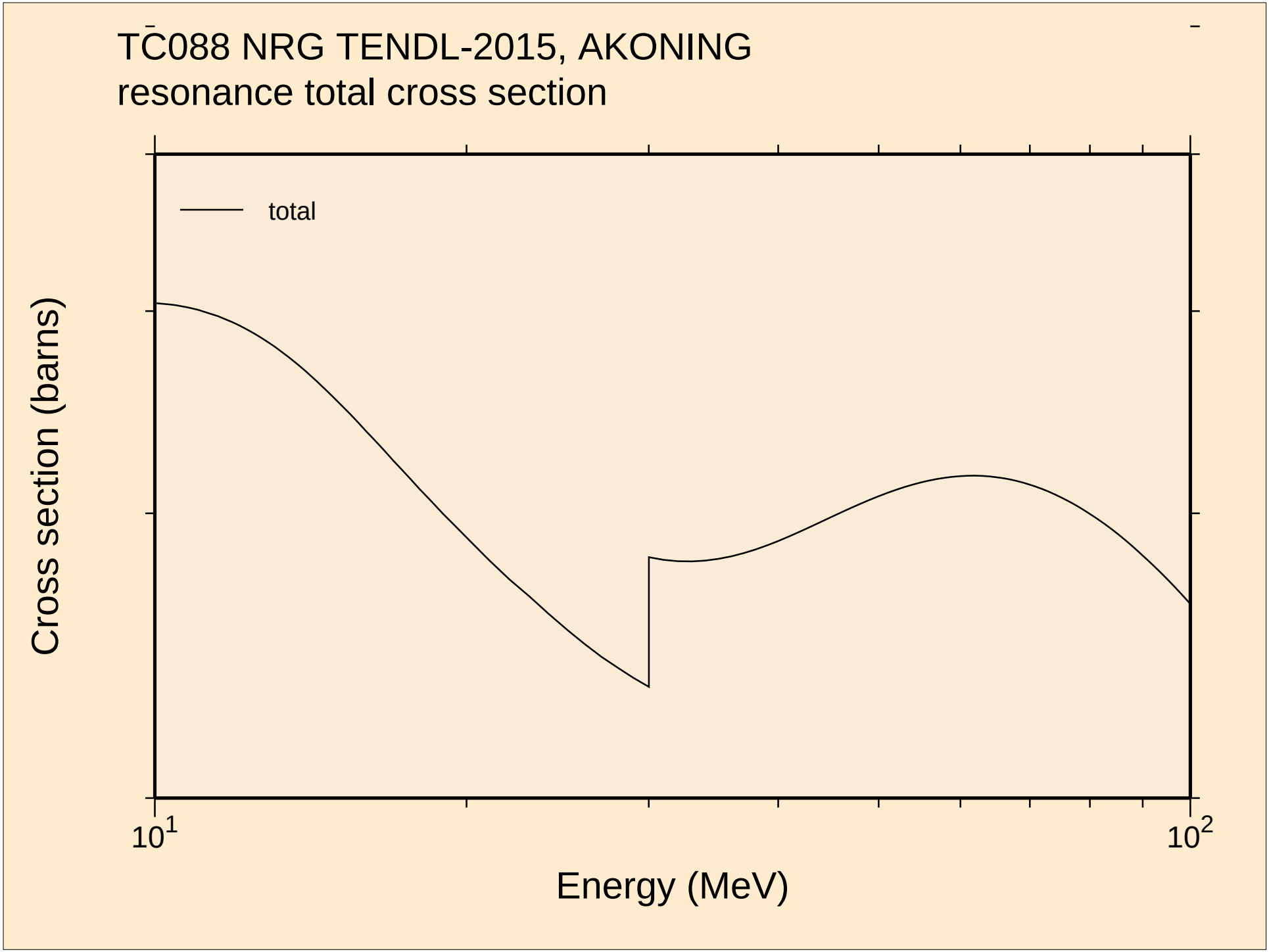
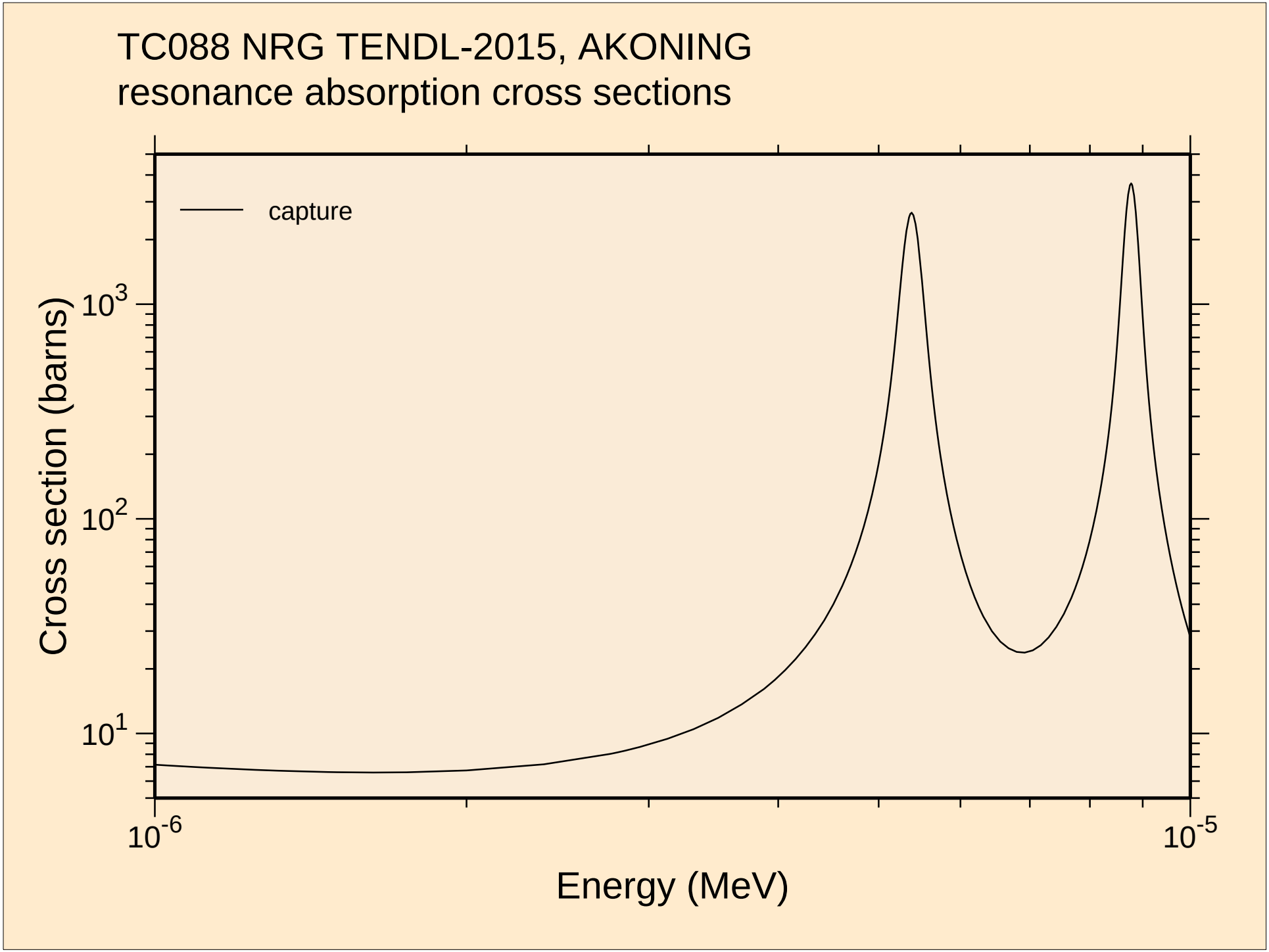

TC088 NRG TENDL-2015, AKONING
Principal cross sections
Cross section (barns)
10^8
10^7
10^6
10^5
10^4
10^3
10^2
total
absorption
elastic
gamma production
10^{-11}
10^{-9}
10^{-7}
10^{-5}
10^{-3}
10^{-1}
10^{1}
Energy (MeV)

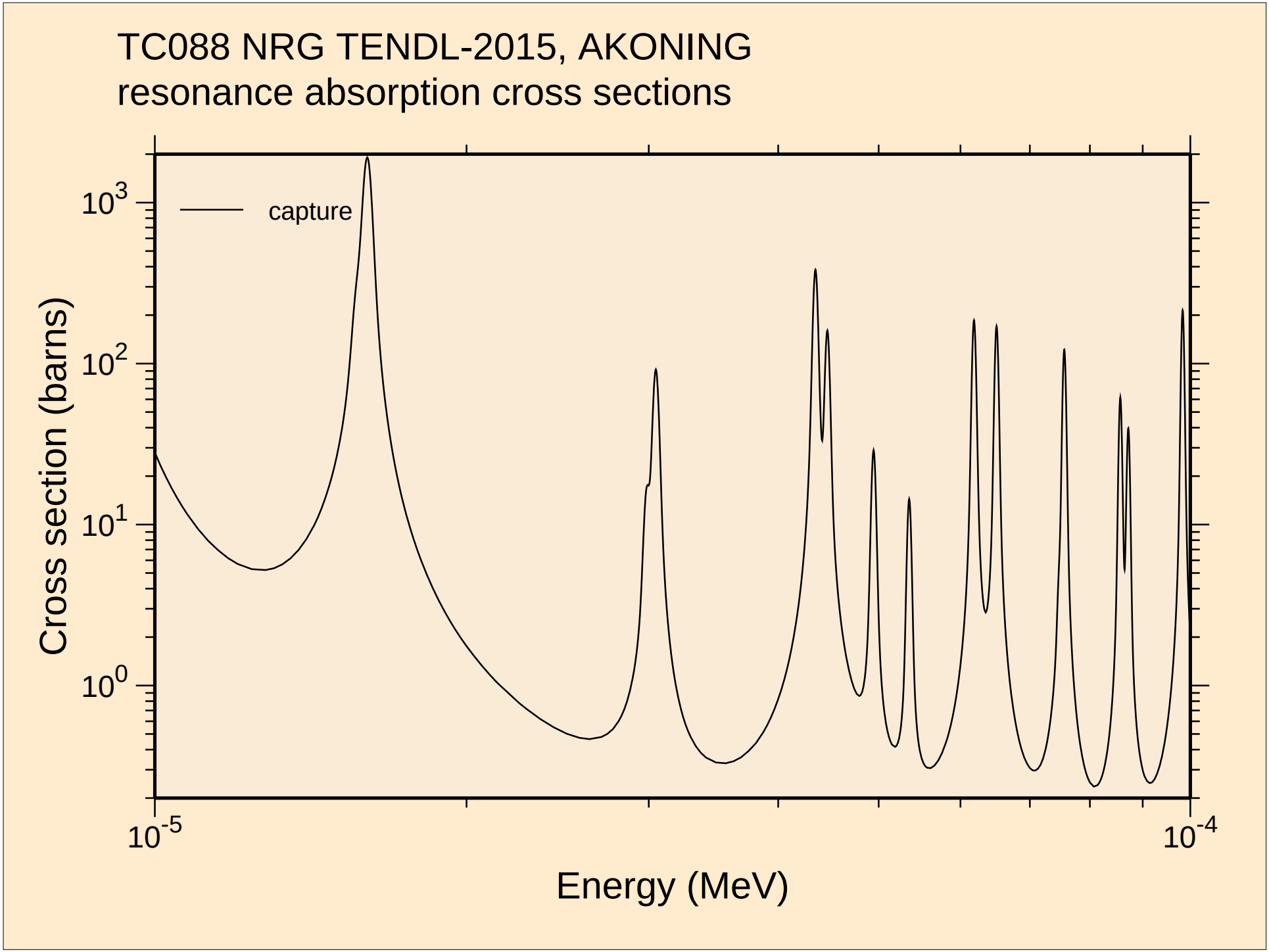

TC088 NRG TENDL-2015, AKONING
resonance total cross section
total
Cross section (barns)
10^3
10^2
10^-6
10^-5
Energy (MeV)

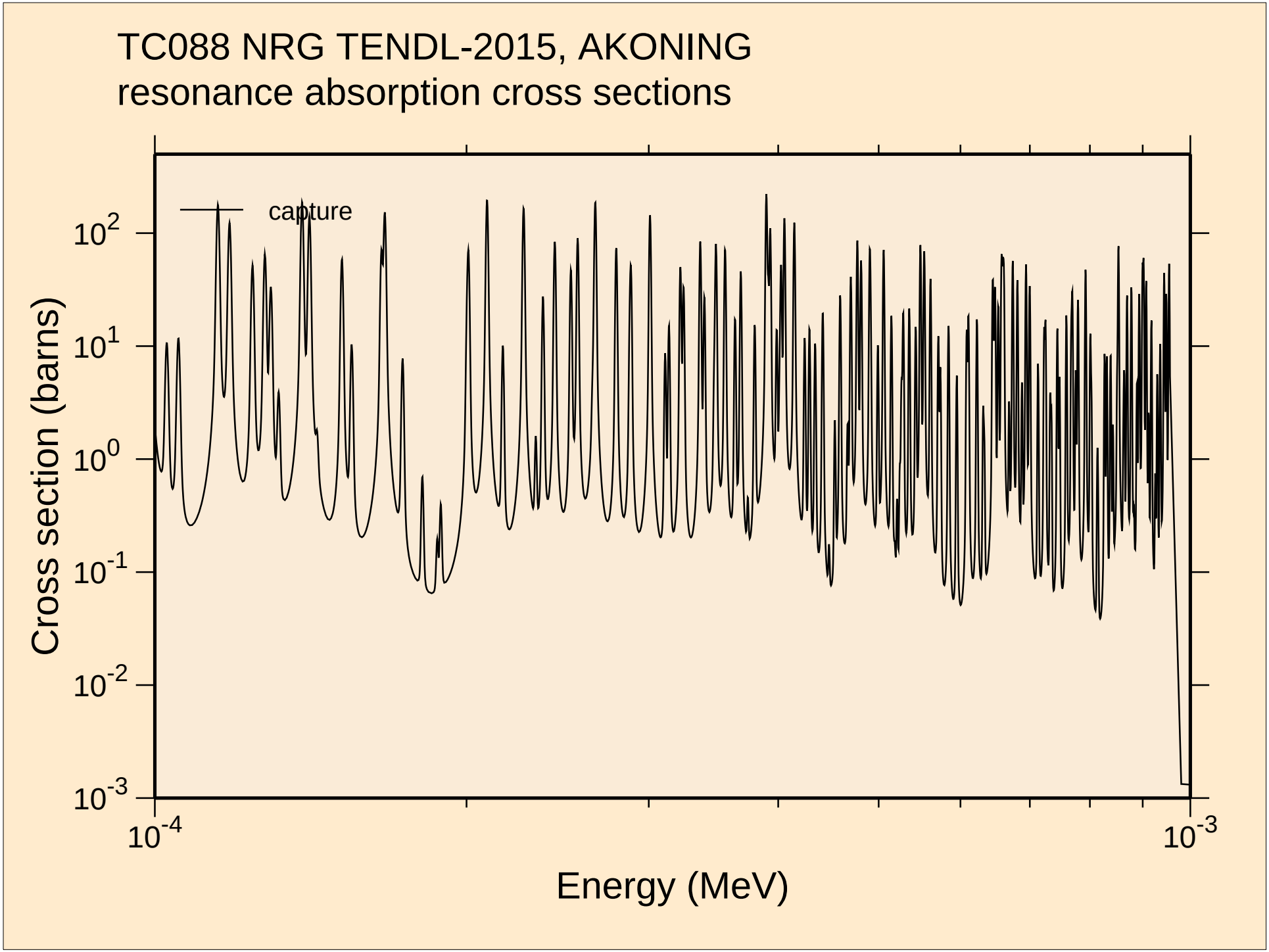

TC088 NRG TENDL-2015, AKONING
resonance total cross section
total
Cross section (barns)
10^3
10^2
10^-5
10^-4
Energy (MeV)

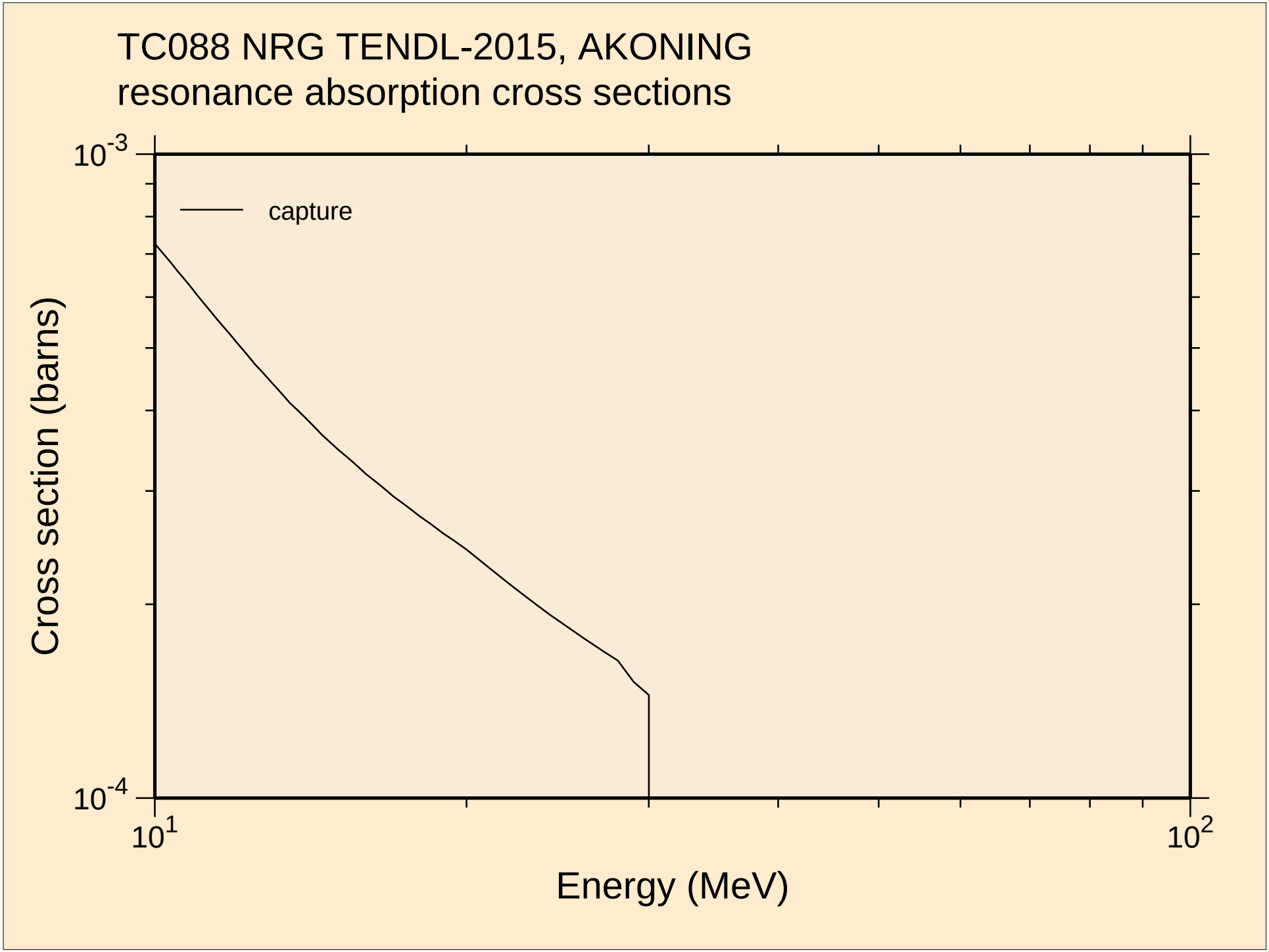

TC088 NRG TENDL-2015, AKONING
resonance total cross section
total
Cross section (barns)
10^2
10^1
10^-4
10^-3
Energy (MeV)

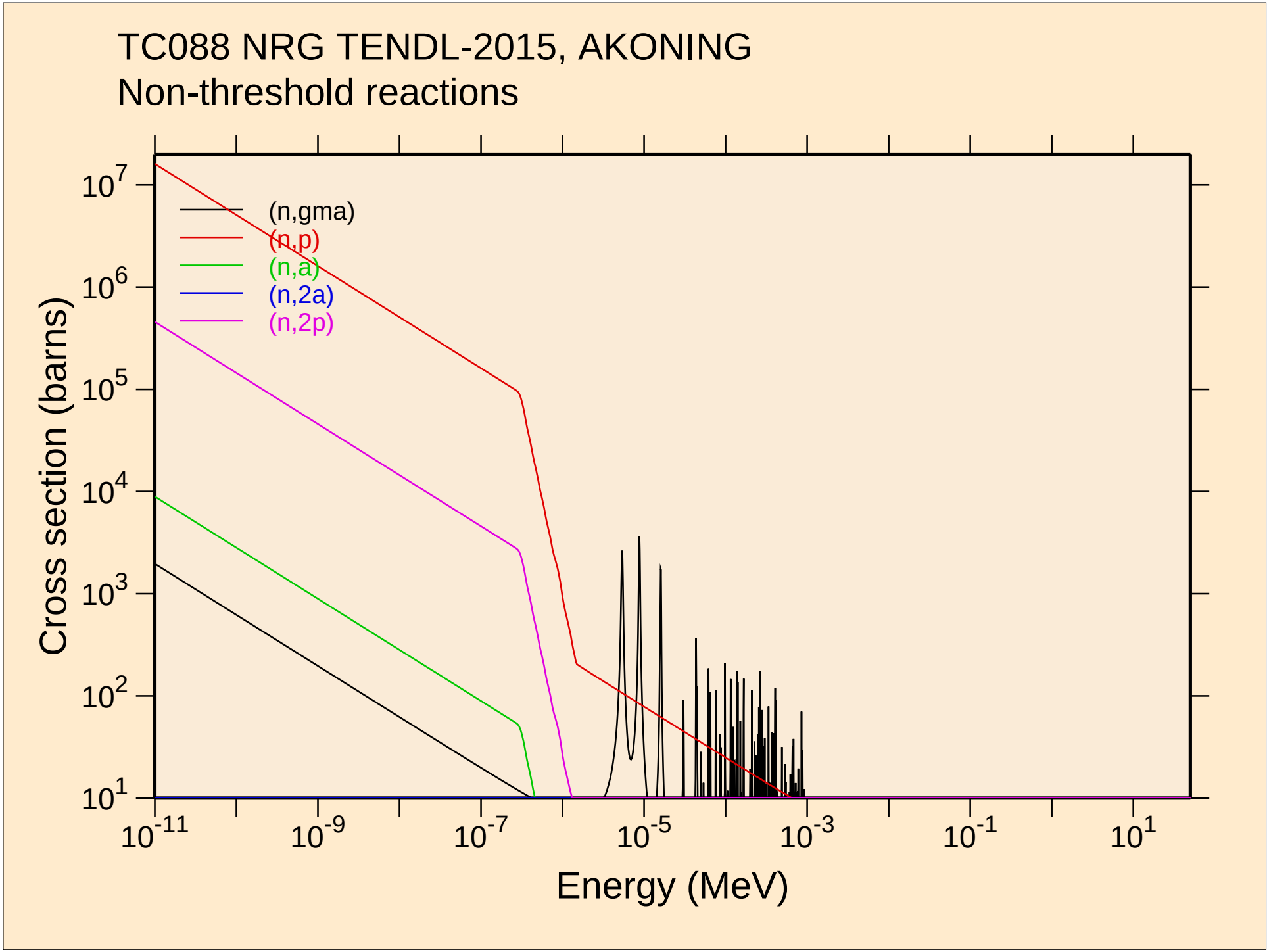

TC088 NRG TENDL-2015, AKONING
resonance total cross section
total
Cross section (barns)
10^1
10^2
Energy (MeV)

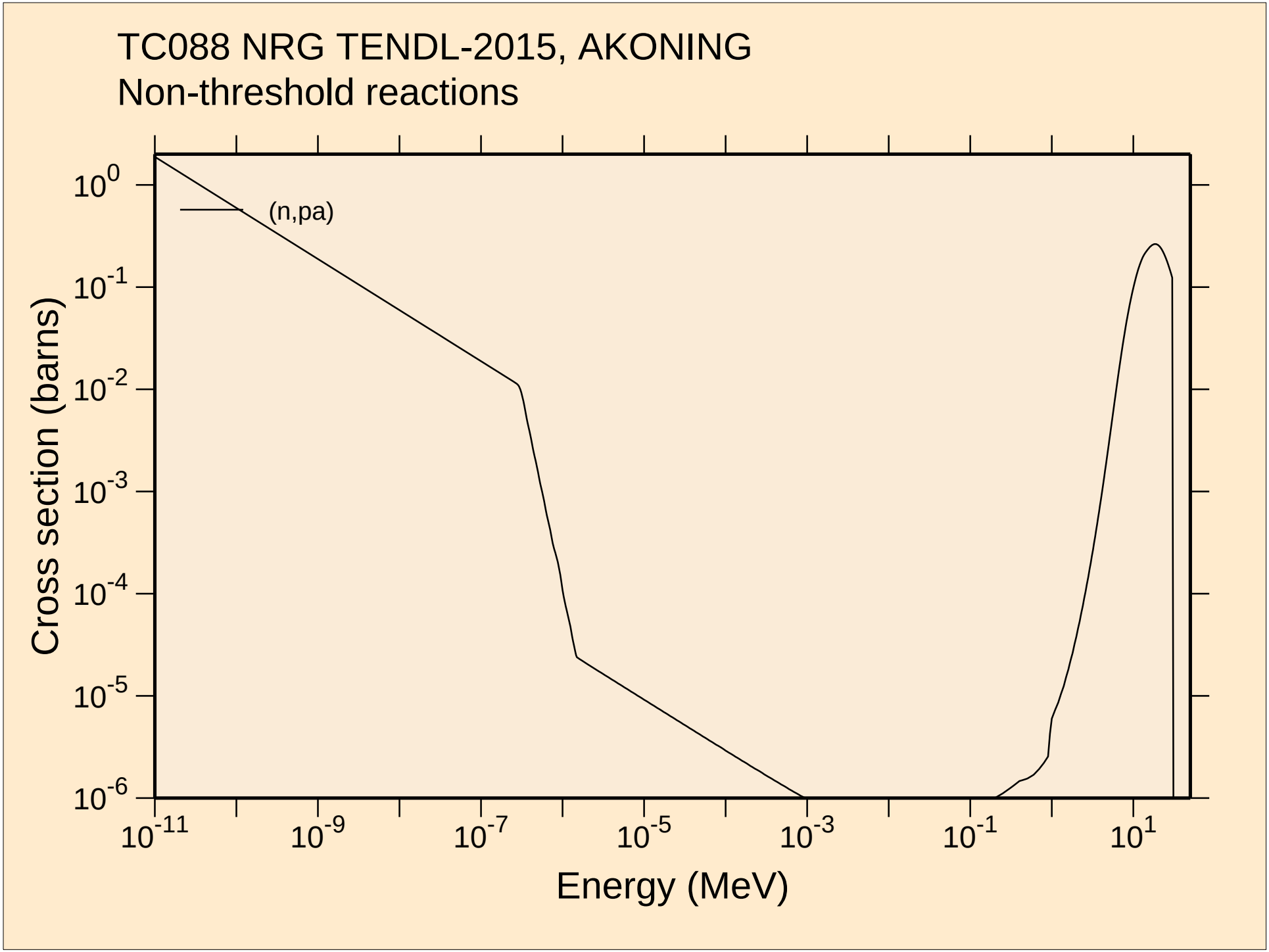

TC088 NRG TENDL-2015, AKONING
resonance absorption cross sections
capture
Cross section (barns)
10^3
10^2
10^1
10^-6
10^-5
Energy (MeV)

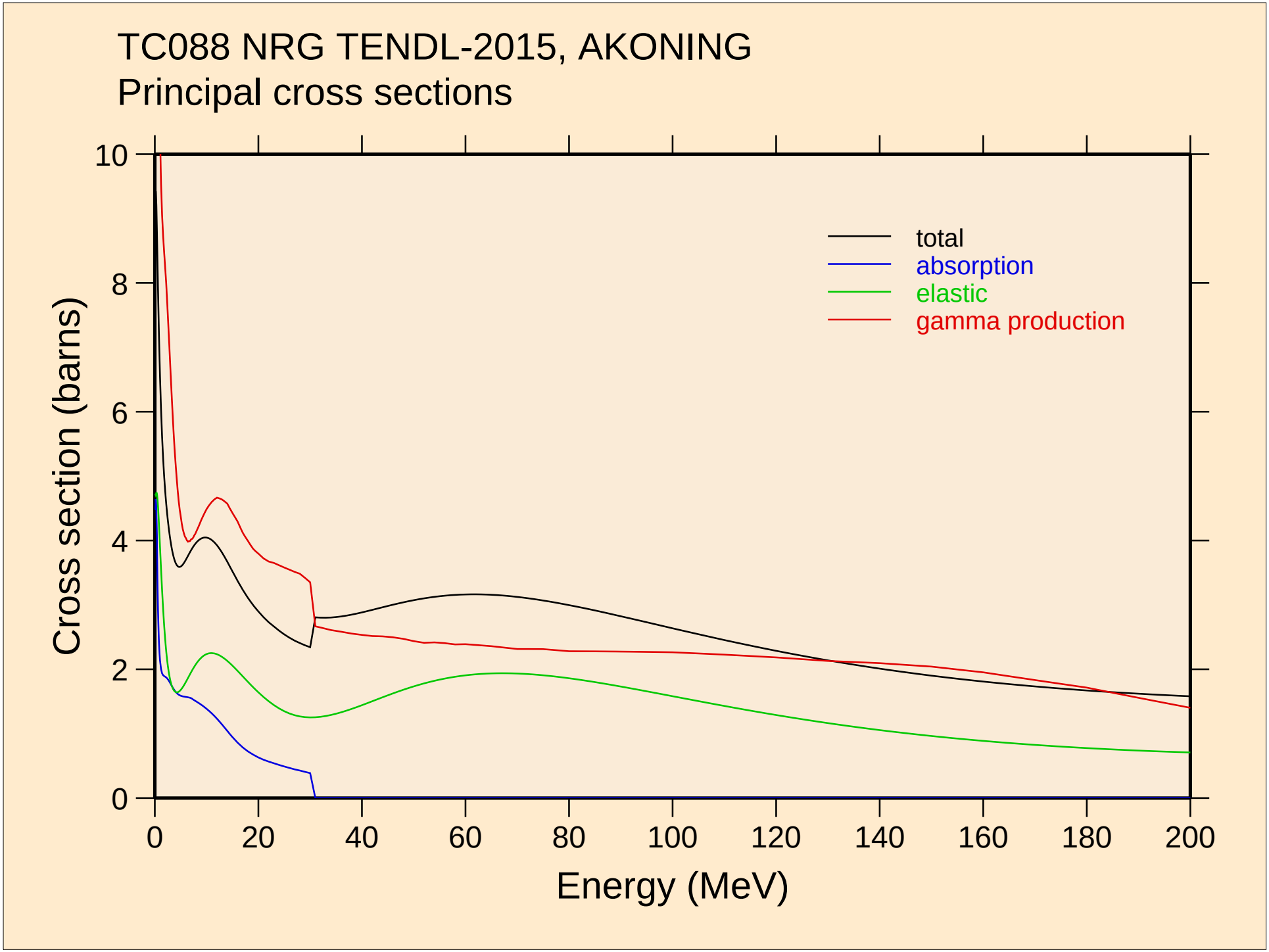

TC088 NRG TENDL-2015, AKONING
resonance absorption cross sections
capture
Cross section (barns)
10^3
10^2
10^1
10^0
10^-5
10^-4
Energy (MeV)

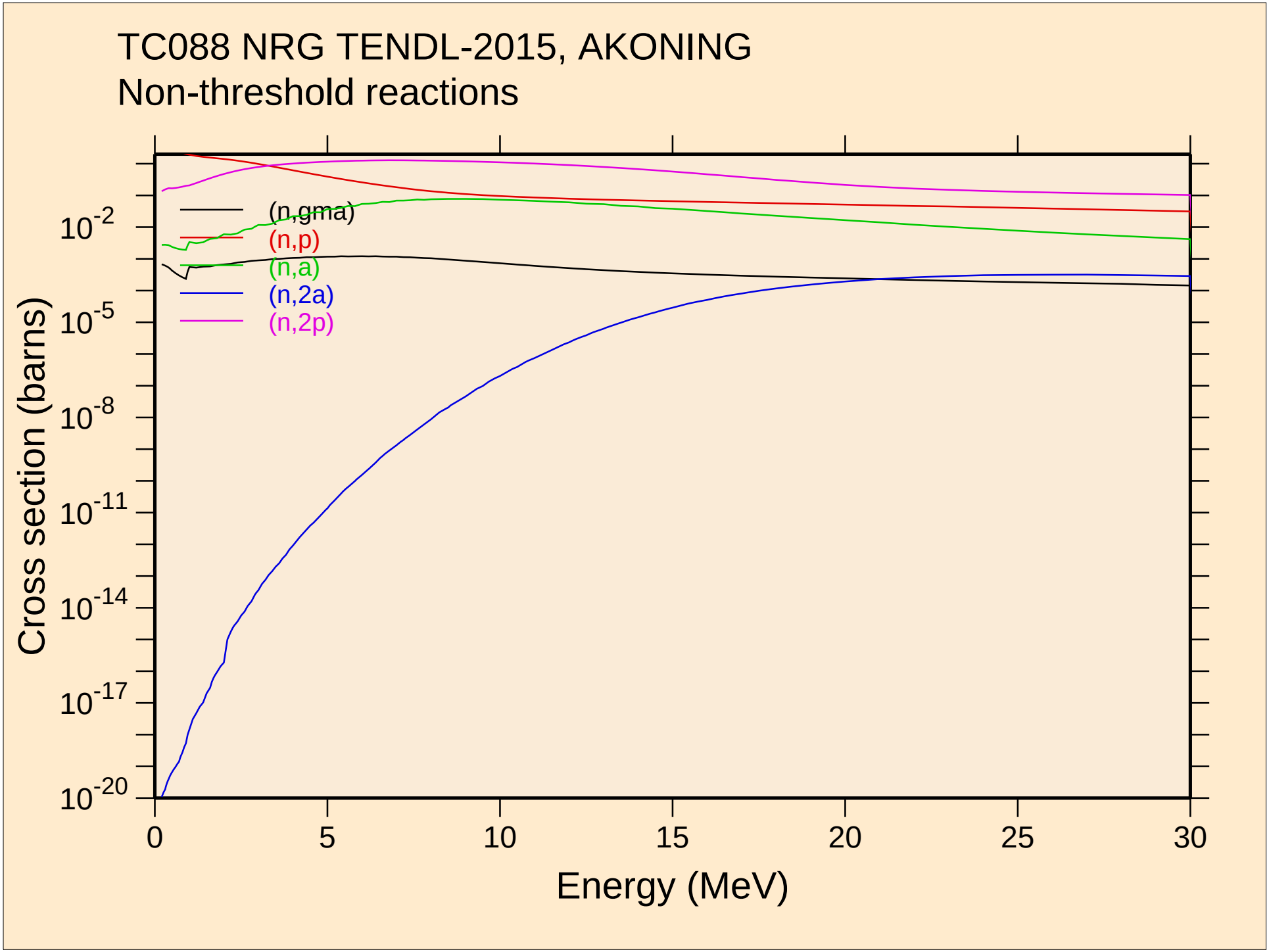

TC088 NRG TENDL-2015, AKONING
resonance absorption cross sections
capture
Cross section (barns)
10^2
10^1
10^0
10^-1
10^-2
10^-3
10^-4
10^-3
Energy (MeV)

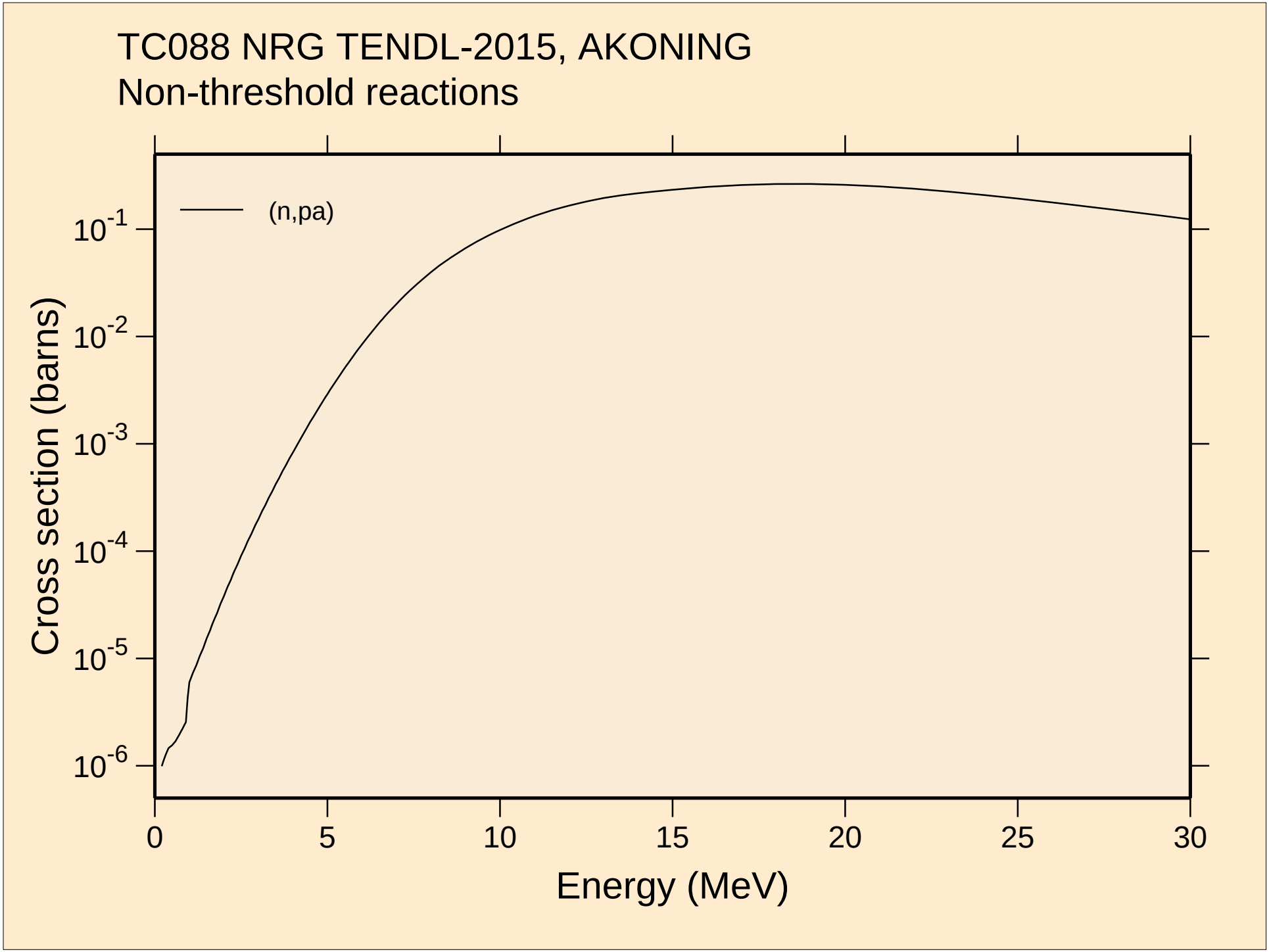

TC088 NRG TENDL-2015, AKONING
resonance absorption cross sections
capture
Cross section (barns)
10-3
10-4
101
102
Energy (MeV)

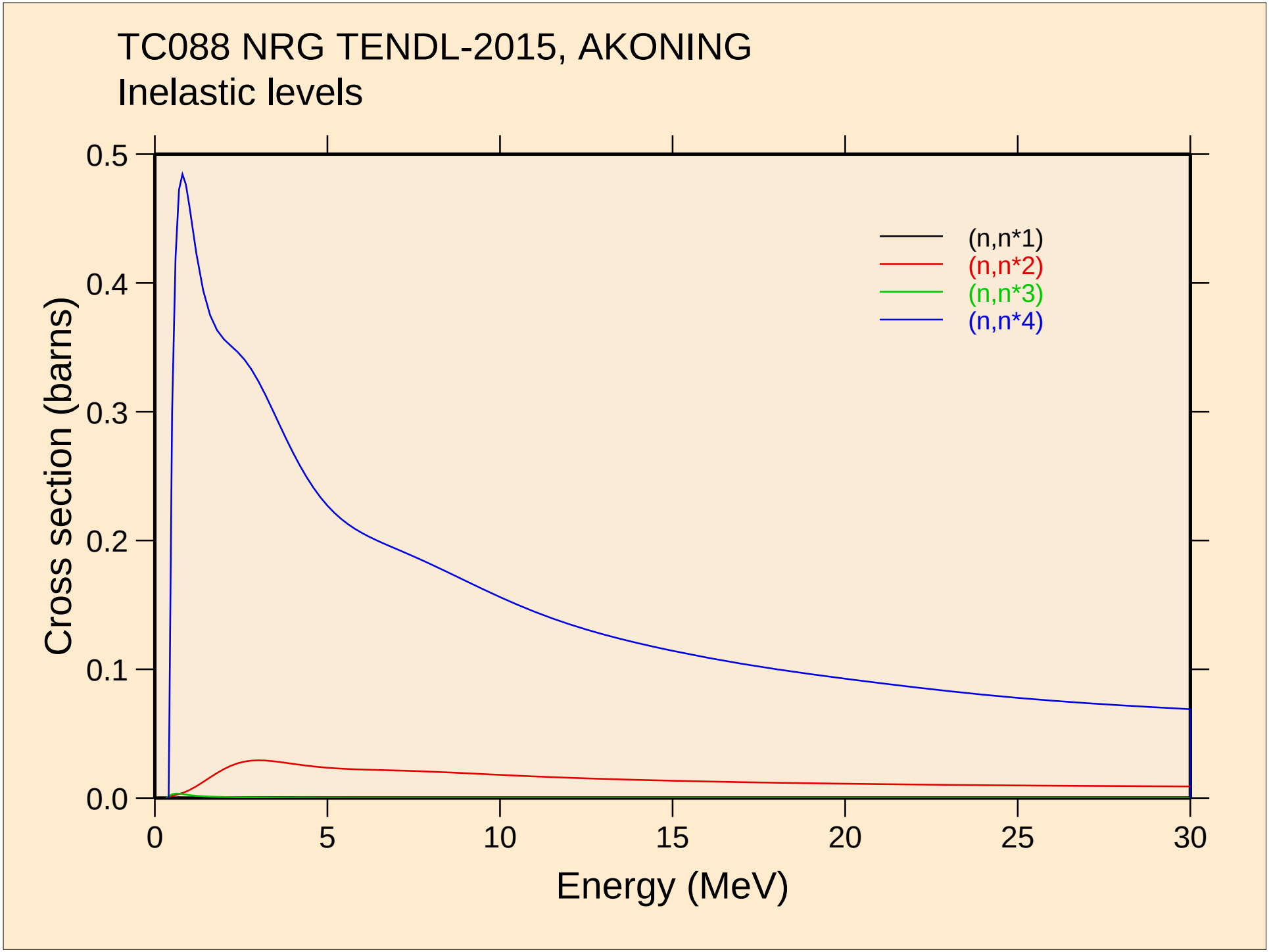

TC088 NRG TENDL-2015, AKONING
Non-threshold reactions
(n,gma)
(n,p)
(n,a)
(n,2a)
(n,2p)
Cross section (barns)
Energy (MeV)
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^-11
10^-9
10^-7
10^-5
10^-3
10^-1
10^1

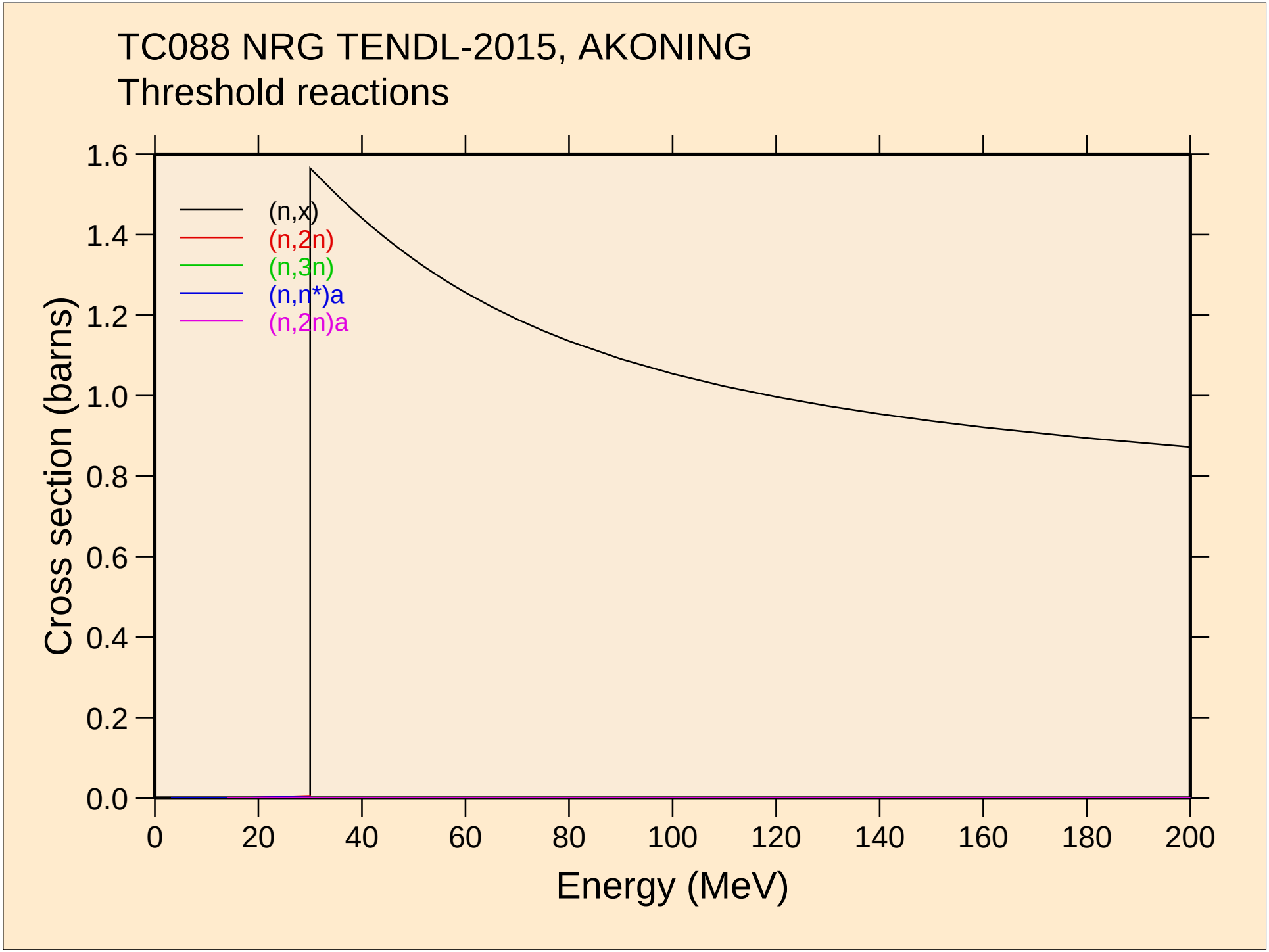

TC088 NRG TENDL-2015, AKONING
Non-threshold reactions
(n,pa)
Cross section (barns)
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-11}
10^{-9}
10^{-7}
10^{-5}
10^{-3}
10^{-1}
10^{1}
Energy (MeV)

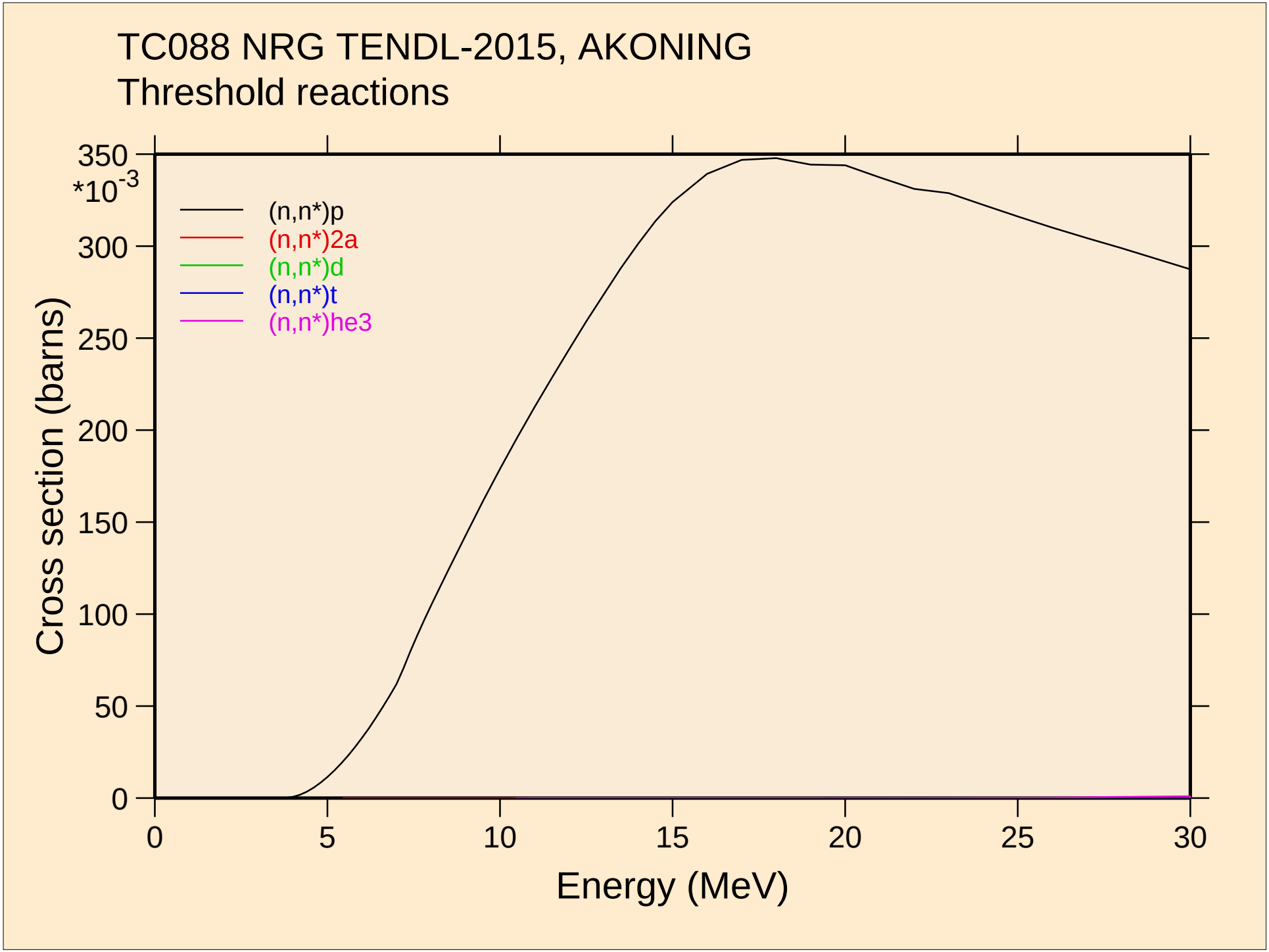

TC088 NRG TENDL-2015, AKONING
Principal cross sections
Cross section (barns)
Energy (MeV)
0
2
4
6
8
10
0
20
40
60
80
100
120
140
160
180
200
total
absorption
elastic
gamma production

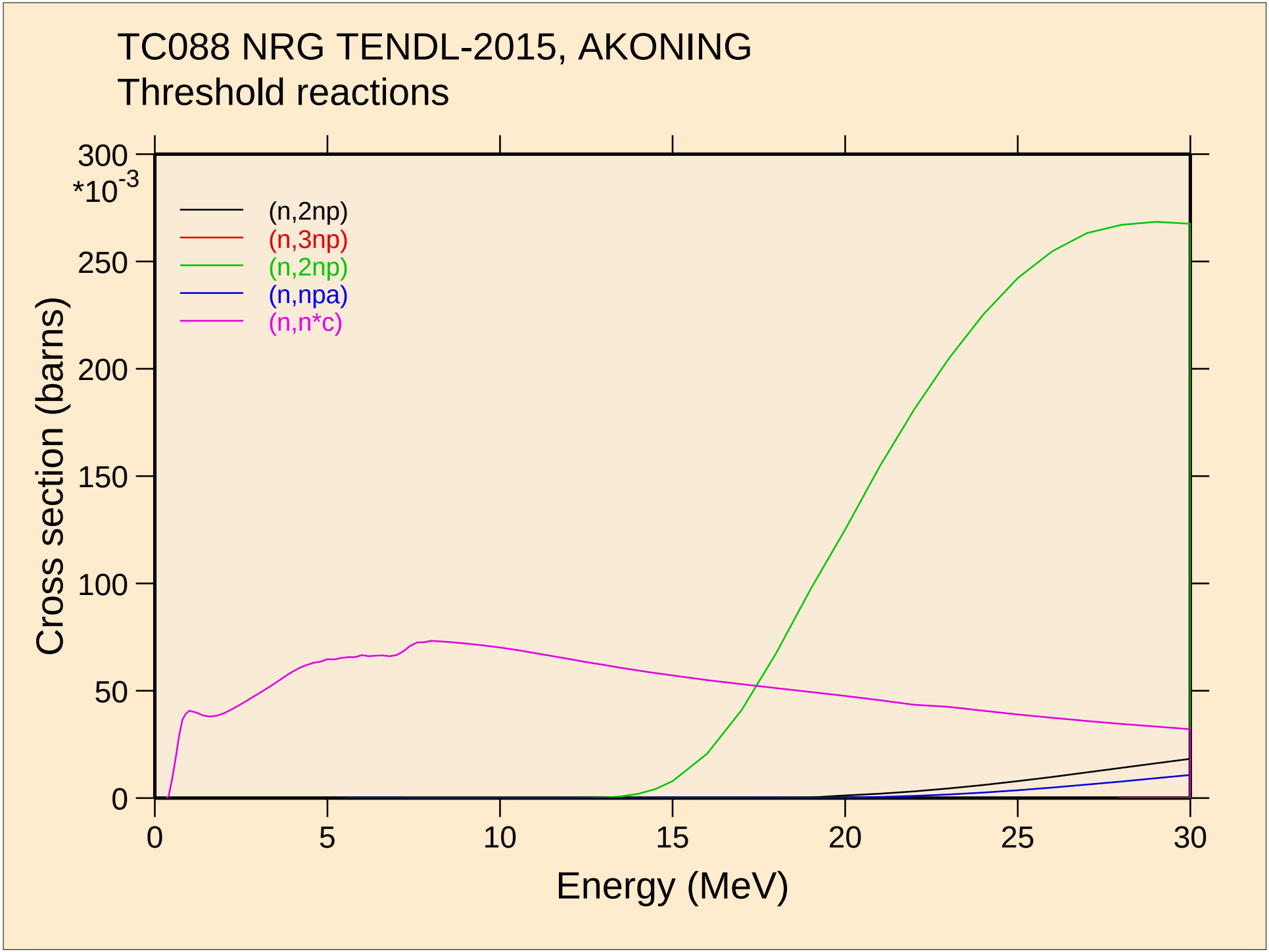

TC088 NRG TENDL-2015, AKONING
Non-threshold reactions
(n,gma)
(n,p)
(n,a)
(n,2a)
(n,2p)
Cross section (barns)
10-2
10-5
10-8
10-11
10-14
10-17
10-20
0
5
10
15
20
25
30
Energy (MeV)

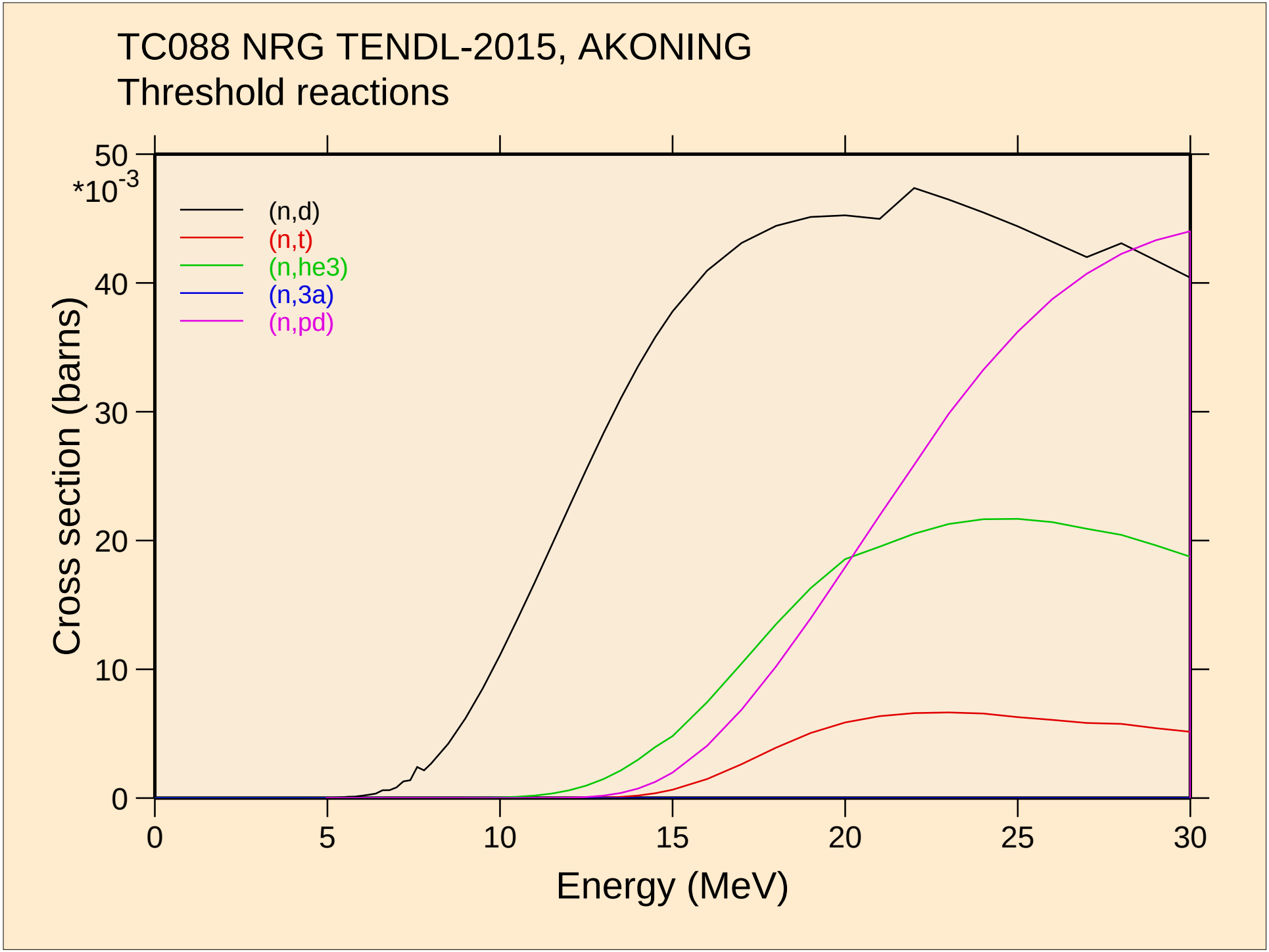

TC088 NRG TENDL-2015, AKONING
Non-threshold reactions
(n,pa)
Cross section (barns)
10-1
10-2
10-3
10-4
10-5
10-6
0
5
10
15
20
25
30
Energy (MeV)

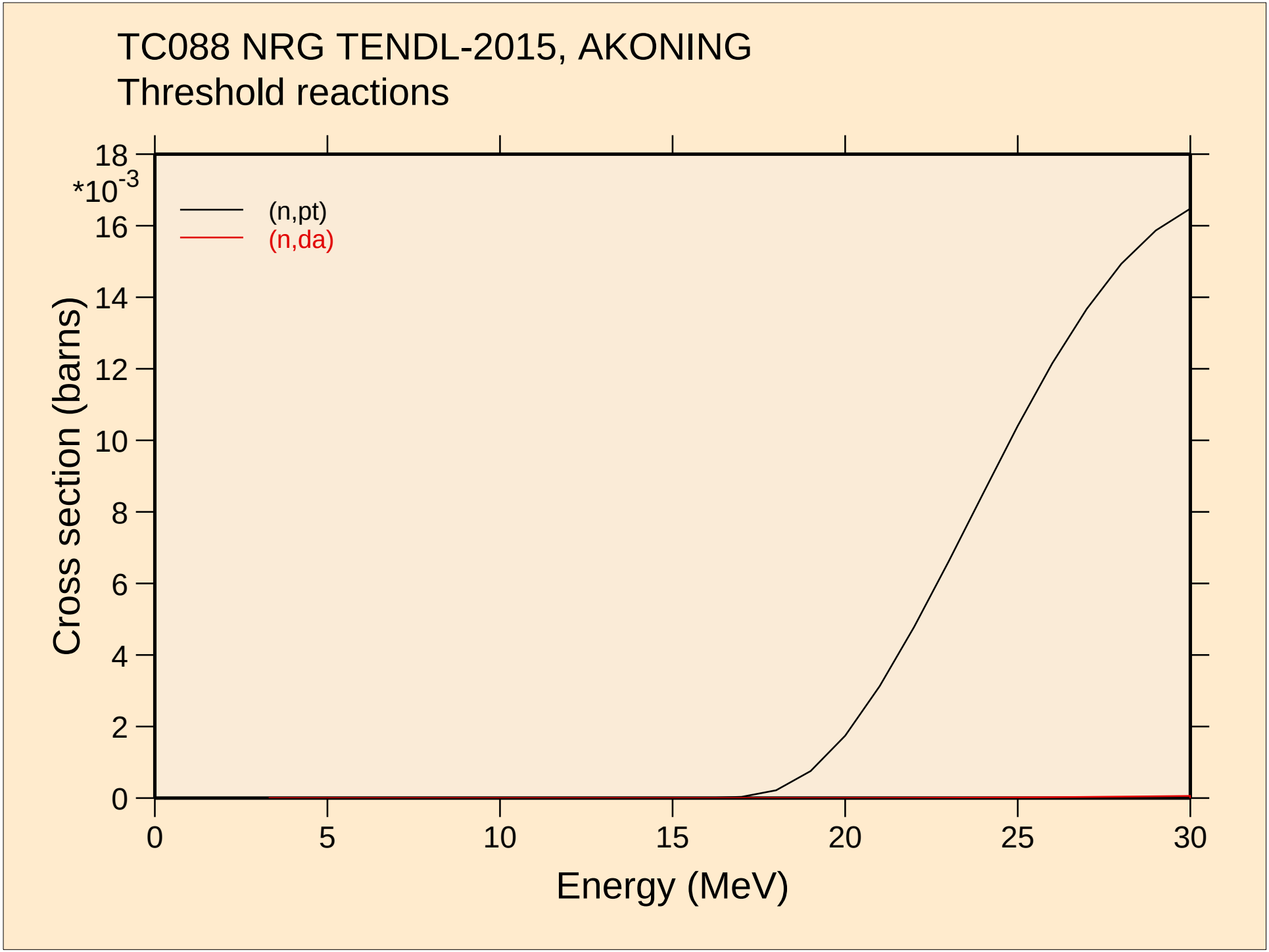

TC088 NRG TENDL-2015, AKONING
Inelastic levels
Cross section (barns)
0.0
0.1
0.2
0.3
0.4
0.5
0
5
10
15
20
25
30
Energy (MeV)
(n,n*1)
(n,n*2)
(n,n*3)
(n,n*4)

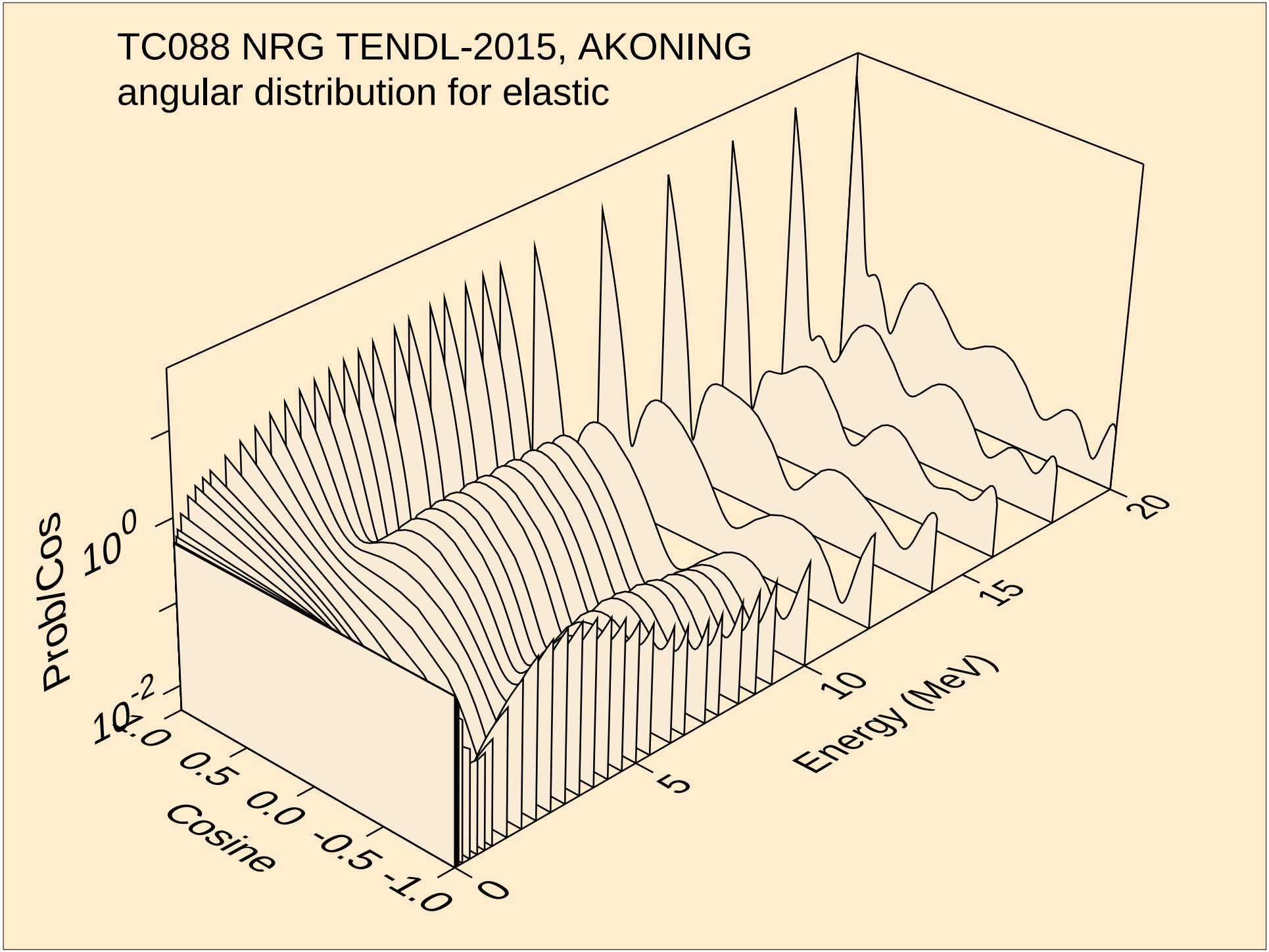

TC088 NRG TENDL-2015, AKONING
Threshold reactions
(n,x)
(n,2n)
(n,3n)
(n,n*)a
(n,2n)a
Cross section (barns)
Energy (MeV)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0
20
40
60
80
100
120
140
160
180
200

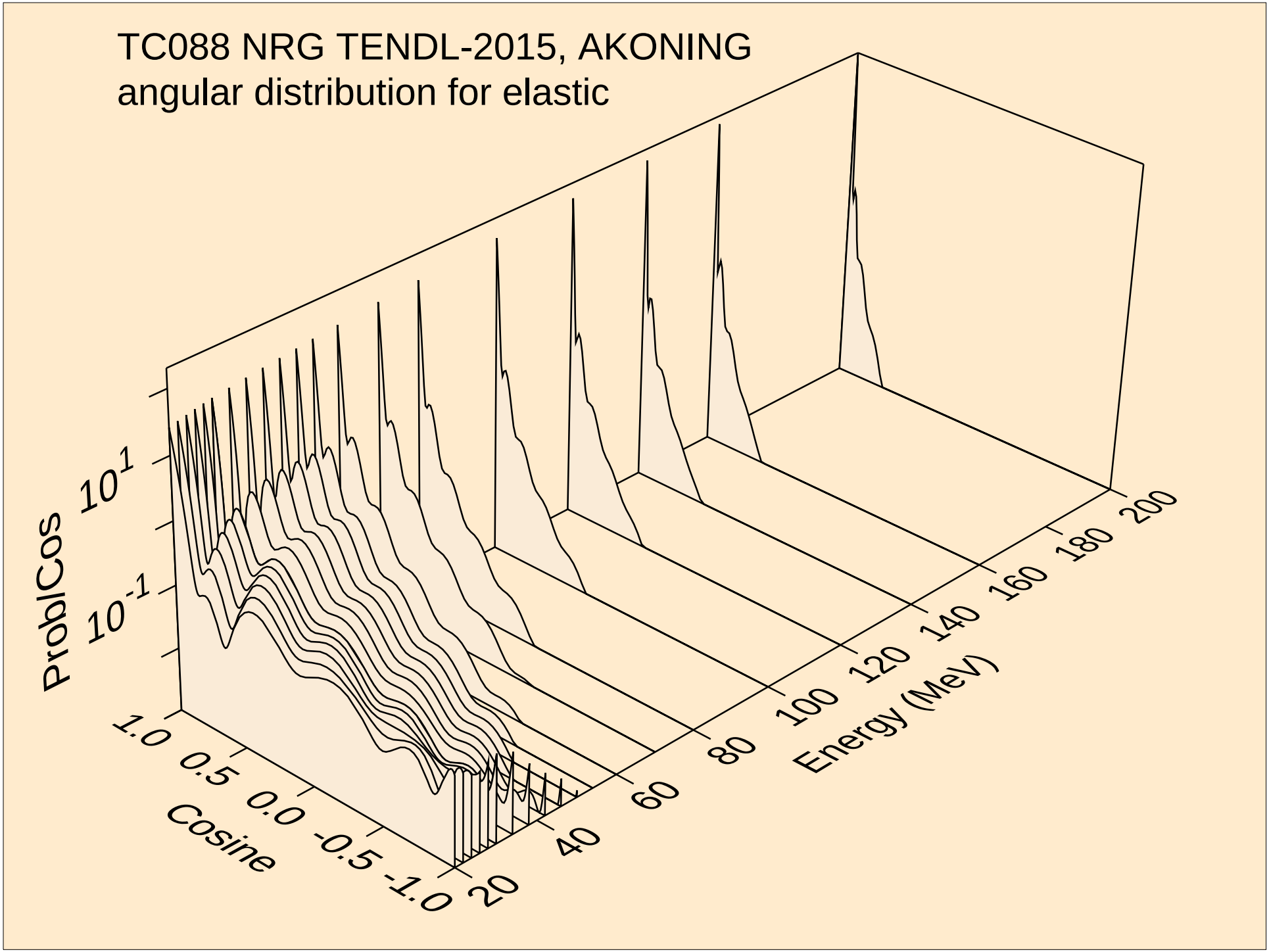

TC088 NRG TENDL-2015, AKONING
Threshold reactions
350
*10-3
300
250
200
150
100
50
0
Cross section (barns)
(n,n*)p
(n,n*)2a
(n,n*)d
(n,n*)t
(n,n*)he3
0
5
10
15
20
25
30
Energy (MeV)

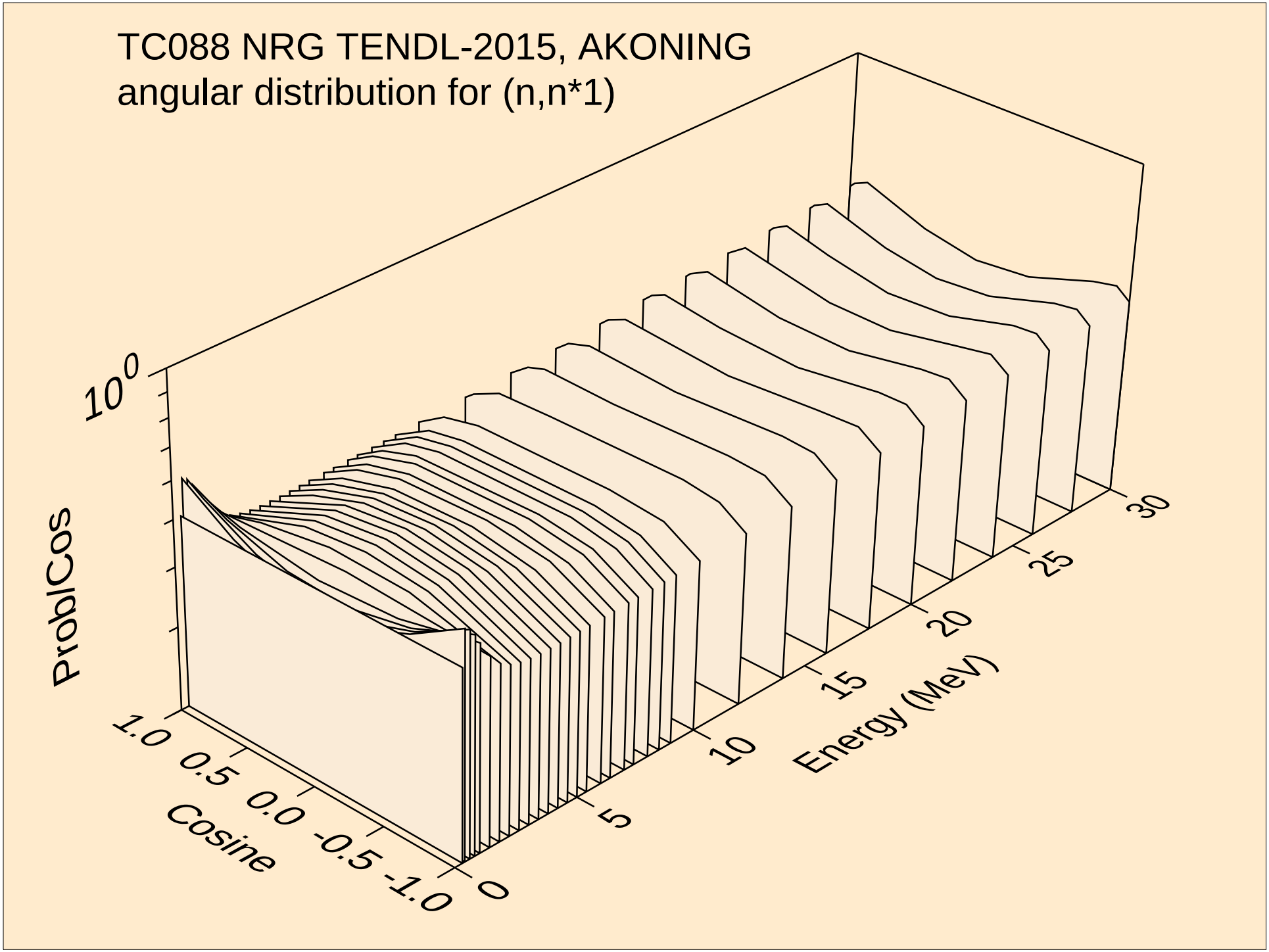

TC088 NRG TENDL-2015, AKONING
Threshold reactions
300
*10-3
250
200
150
100
50
0
Cross section (barns)
(n,2np)
(n,3np)
(n,2np)
(n,npa)
(n,n*c)
0
5
10
15
20
25
30
Energy (MeV)

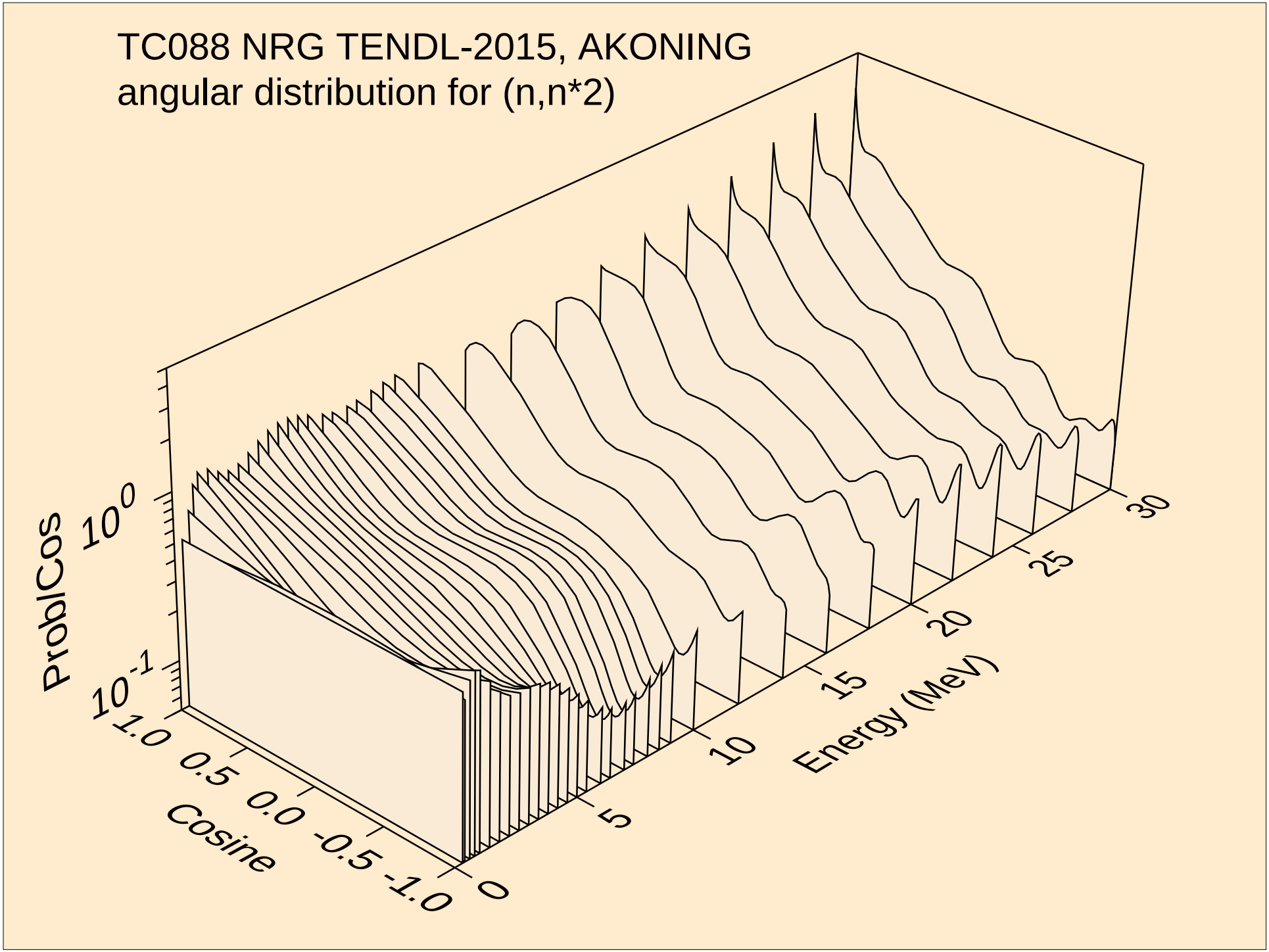

TC088 NRG TENDL-2015, AKONING
Threshold reactions
*10-3
Cross section (barns)
Energy (MeV)
(n,d)
(n,t)
(n,he3)
(n,3a)
(n,pd)
0
10
20
30
40
50
0
5
10
15
20
25
30

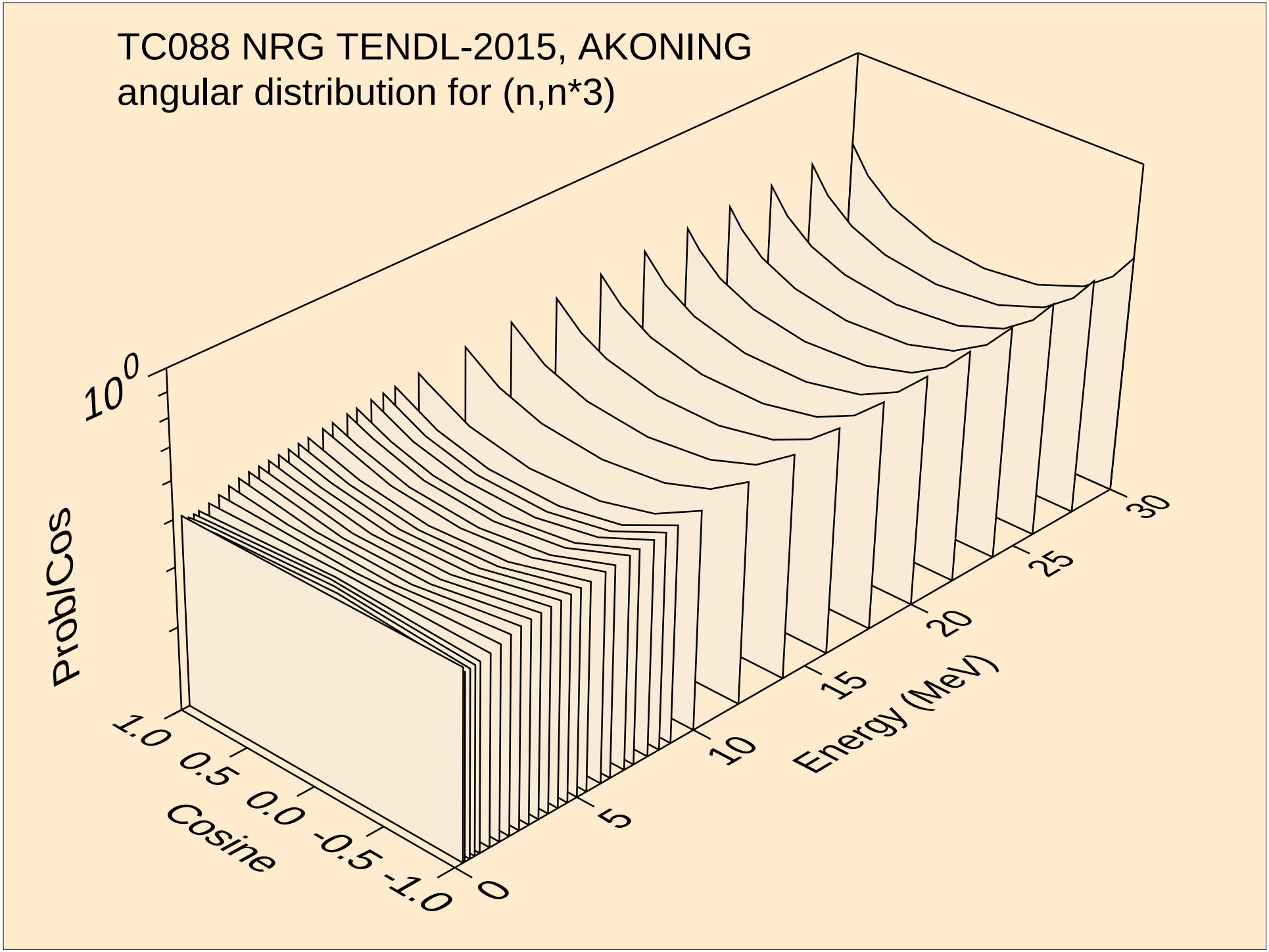

TC088 NRG TENDL-2015, AKONING
Threshold reactions
*10-3
18
16
14
12
10
8
6
4
2
0
(n,pt)
(n,da)
Cross section (barns)
0
5
10
15
20
25
30
Energy (MeV)

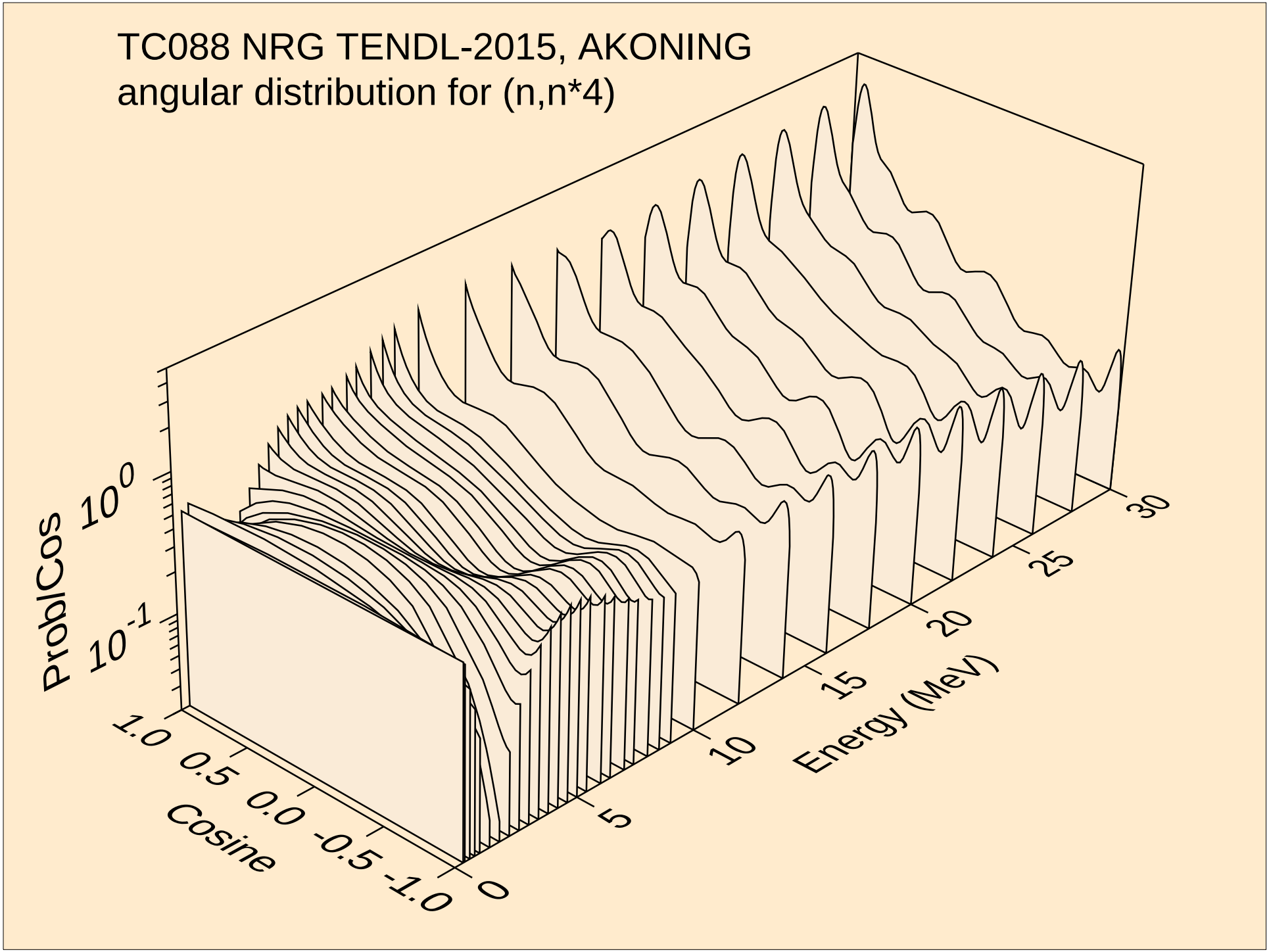

TC088 NRG TENDL-2015, AKONING
angular distribution for elastic
ProbICos
10^0
10^-2
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
5
10
15
20
Energy (MeV)

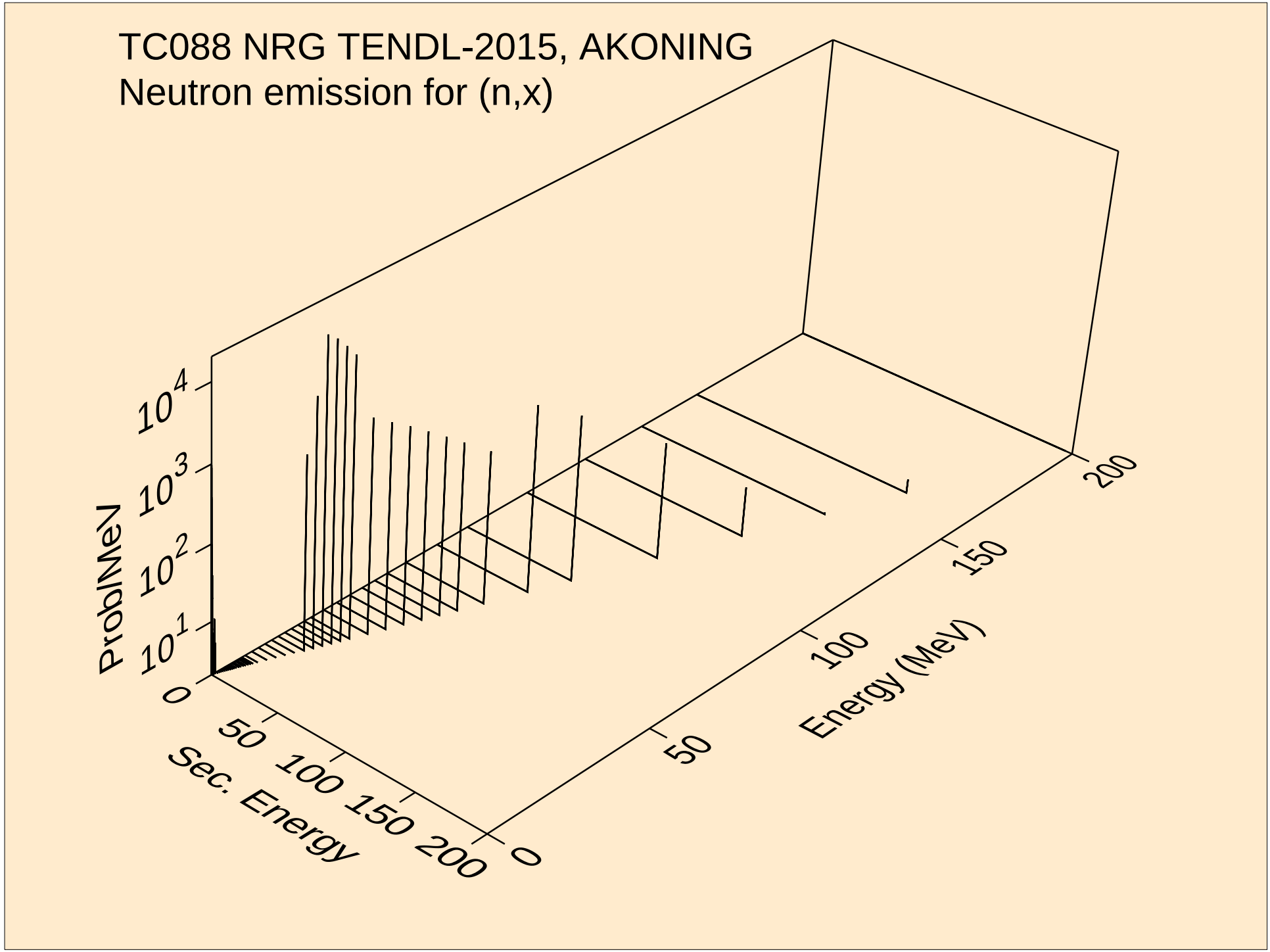

TC088 NRG TENDL-2015, AKONING
angular distribution for elastic
ProbCos
10^{1}
10^{-1}
1.0
0.5
0.0
-0.5
-1.0
Cosine
20
40
60
80
100
120
140
160
180
200
Energy (MeV)

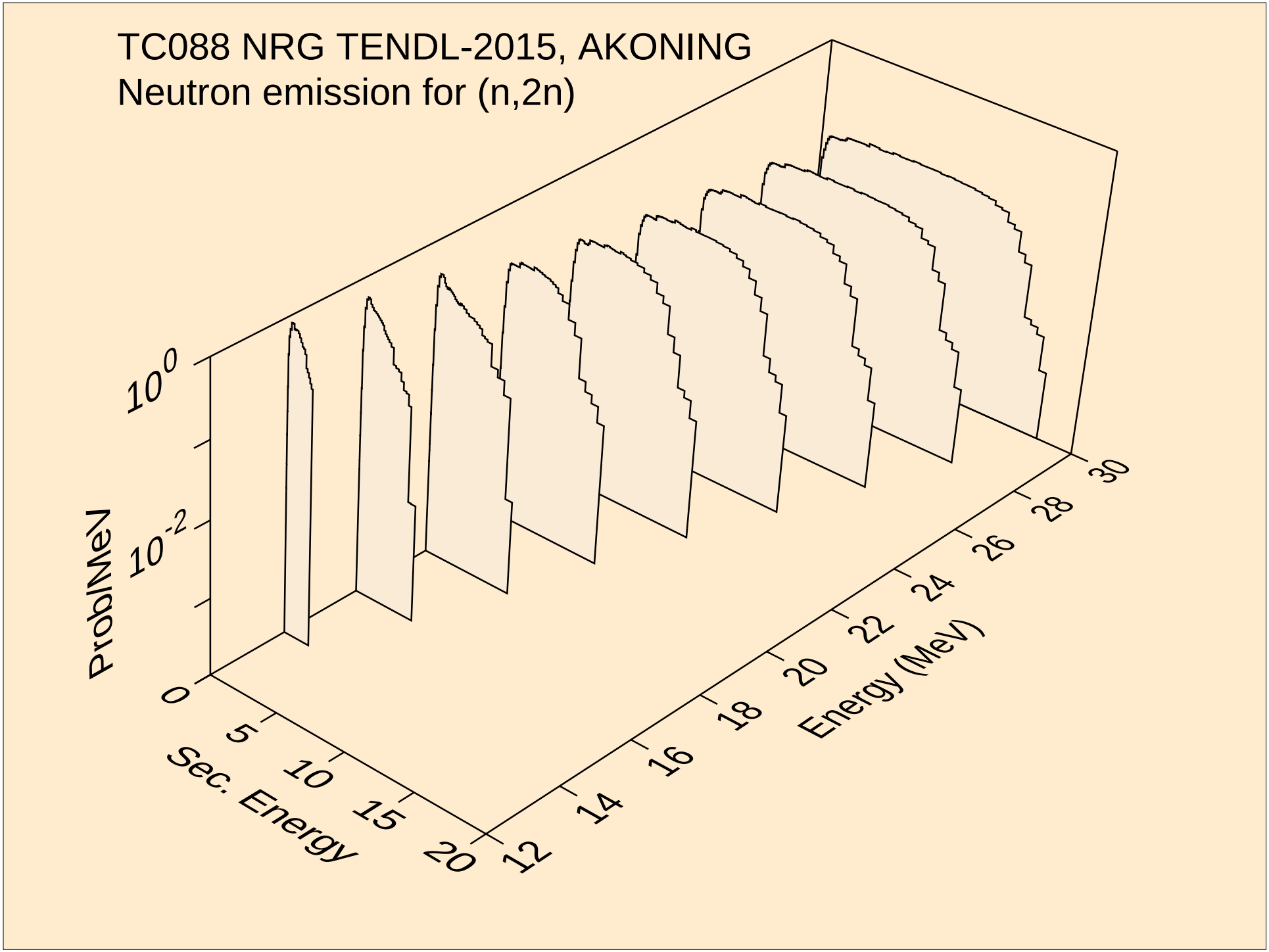

TC088 NRG TENDL-2015, AKONING
angular distribution for (n,n*1)
ProbICos
10^0
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
5
10
15
20
25
30
Energy (MeV)

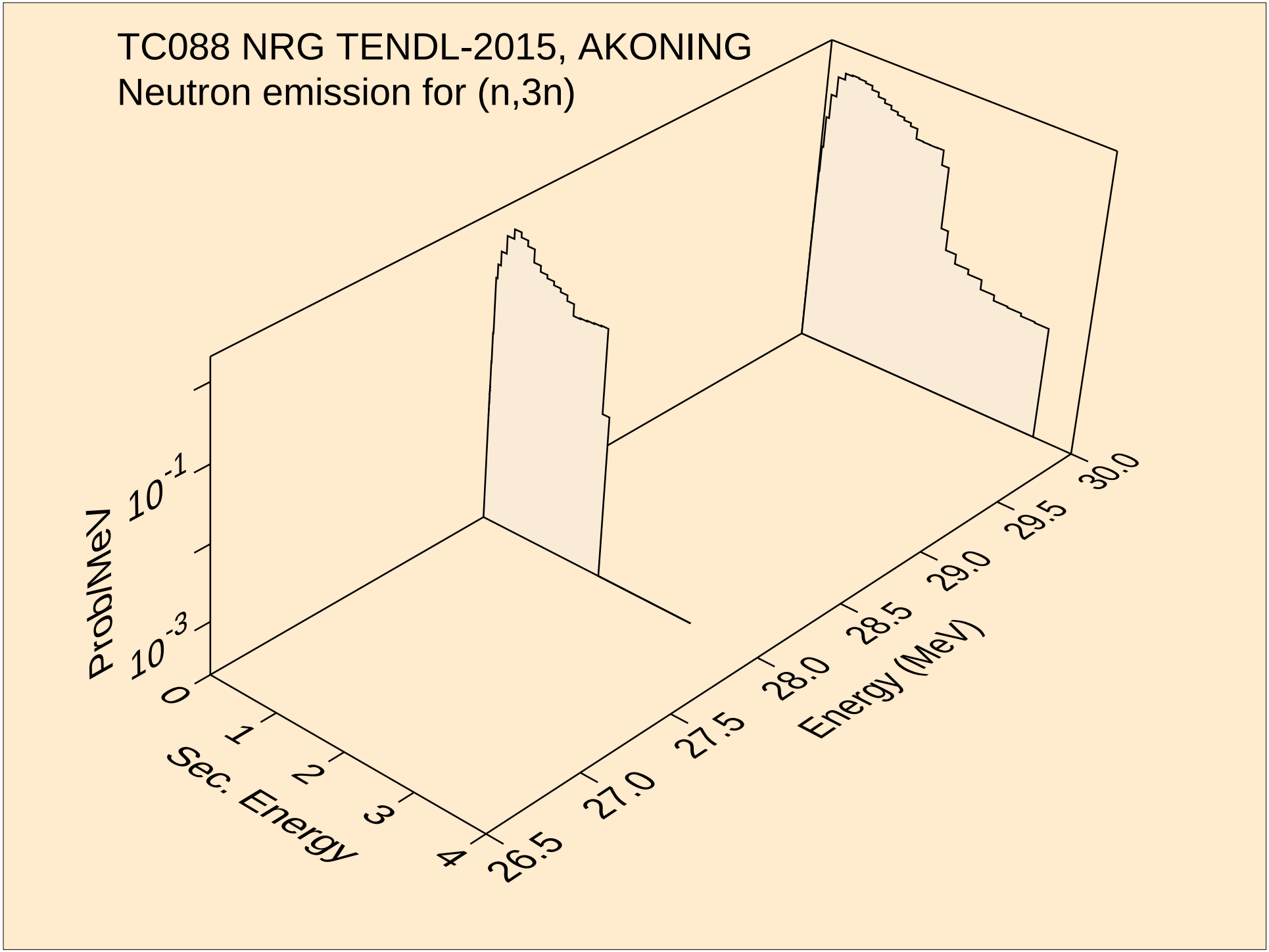

TC088 NRG TENDL-2015, AKONING
angular distribution for (n,n*2)
ProbCos
10^{0}
10^{-1}
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
5
10
15
20
25
30
Energy (MeV)

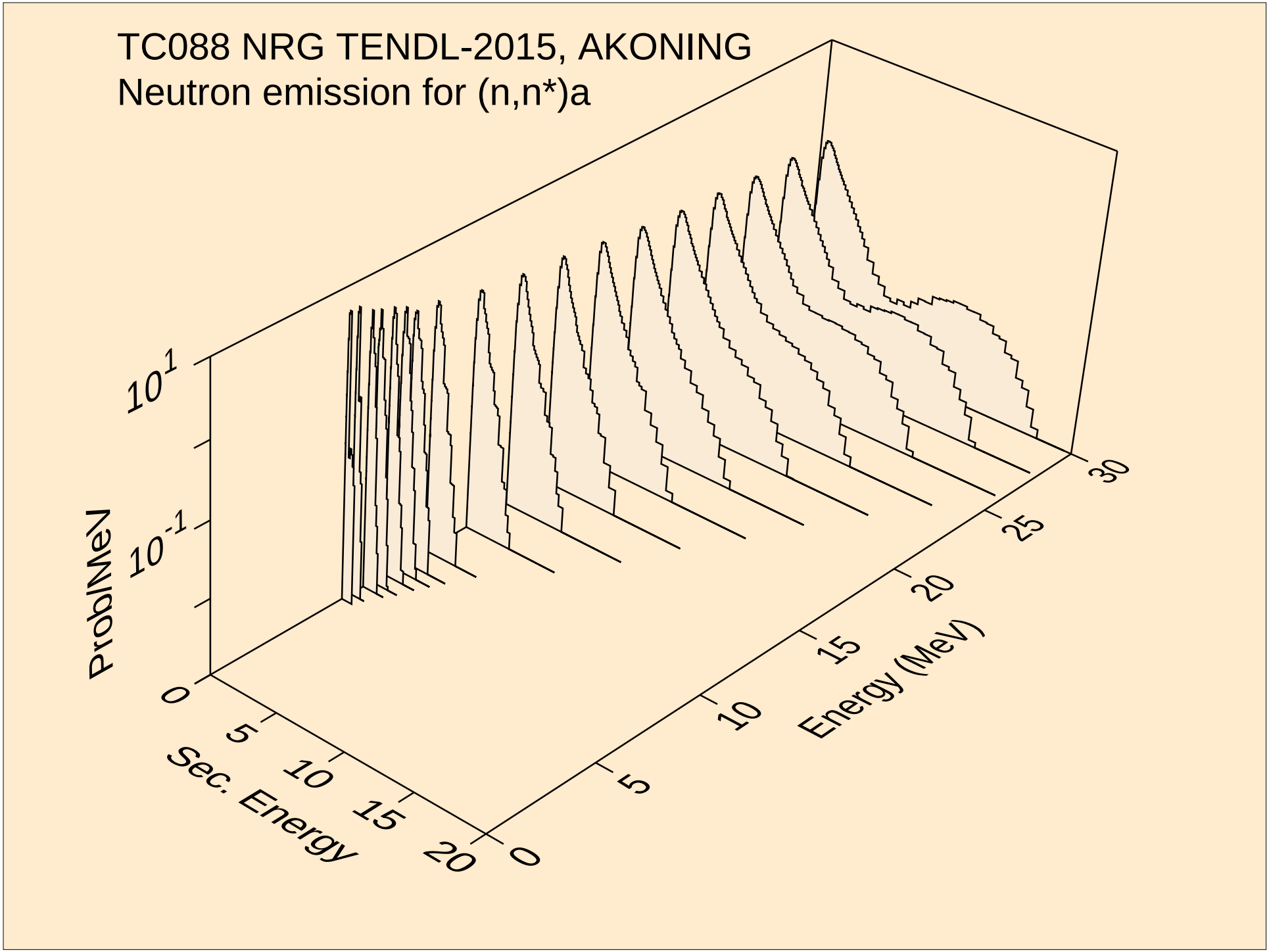

TC088 NRG TENDL-2015, AKONING
angular distribution for (n,n*3)
10^0
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
5
10
15
20
25
30
Energy (MeV)

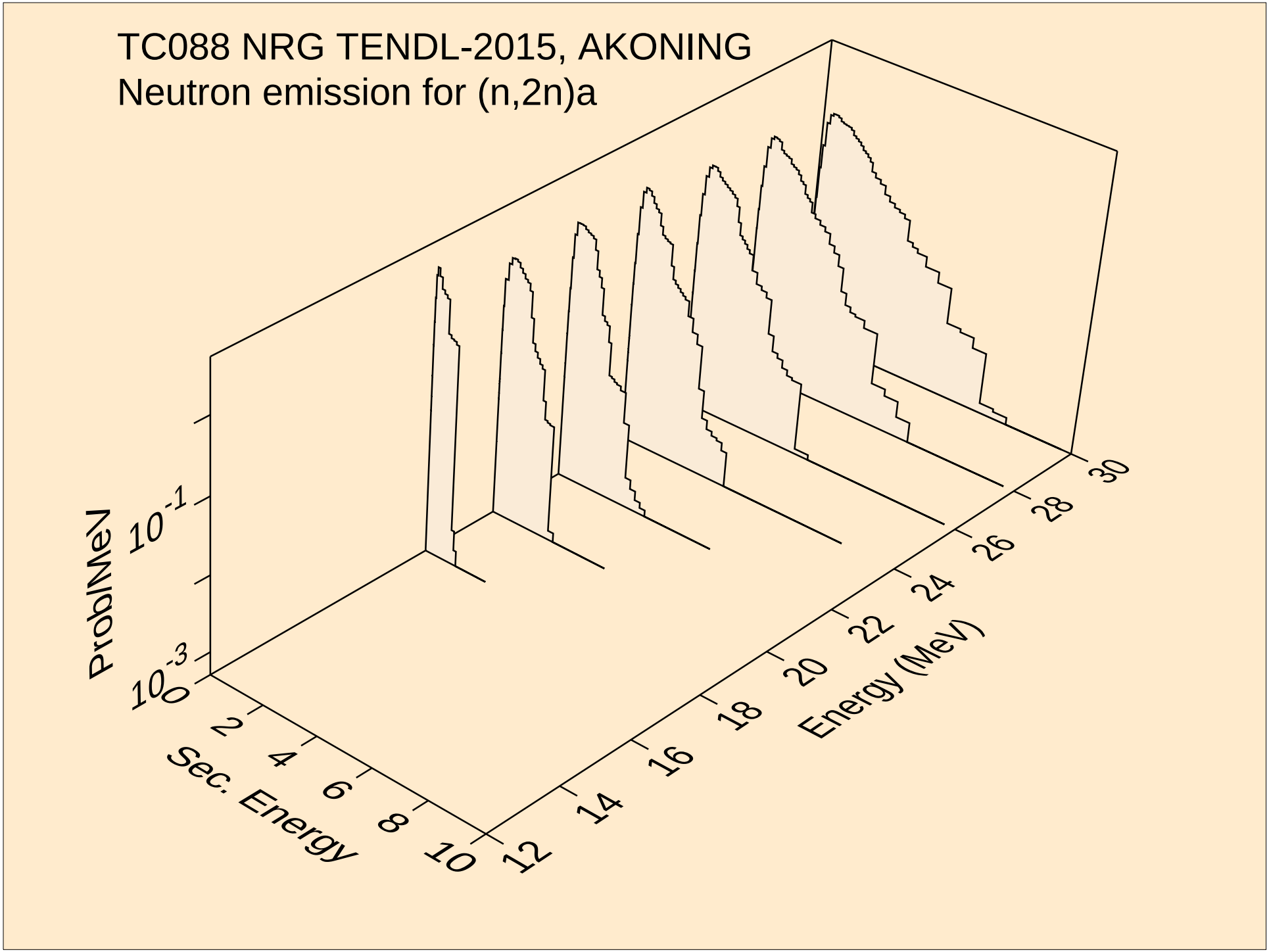

TC088 NRG TENDL-2015, AKONING
angular distribution for (n,n*4)
ProbCos
10^{0}
10^{-1}
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
5
10
15
20
25
30
Energy (MeV)

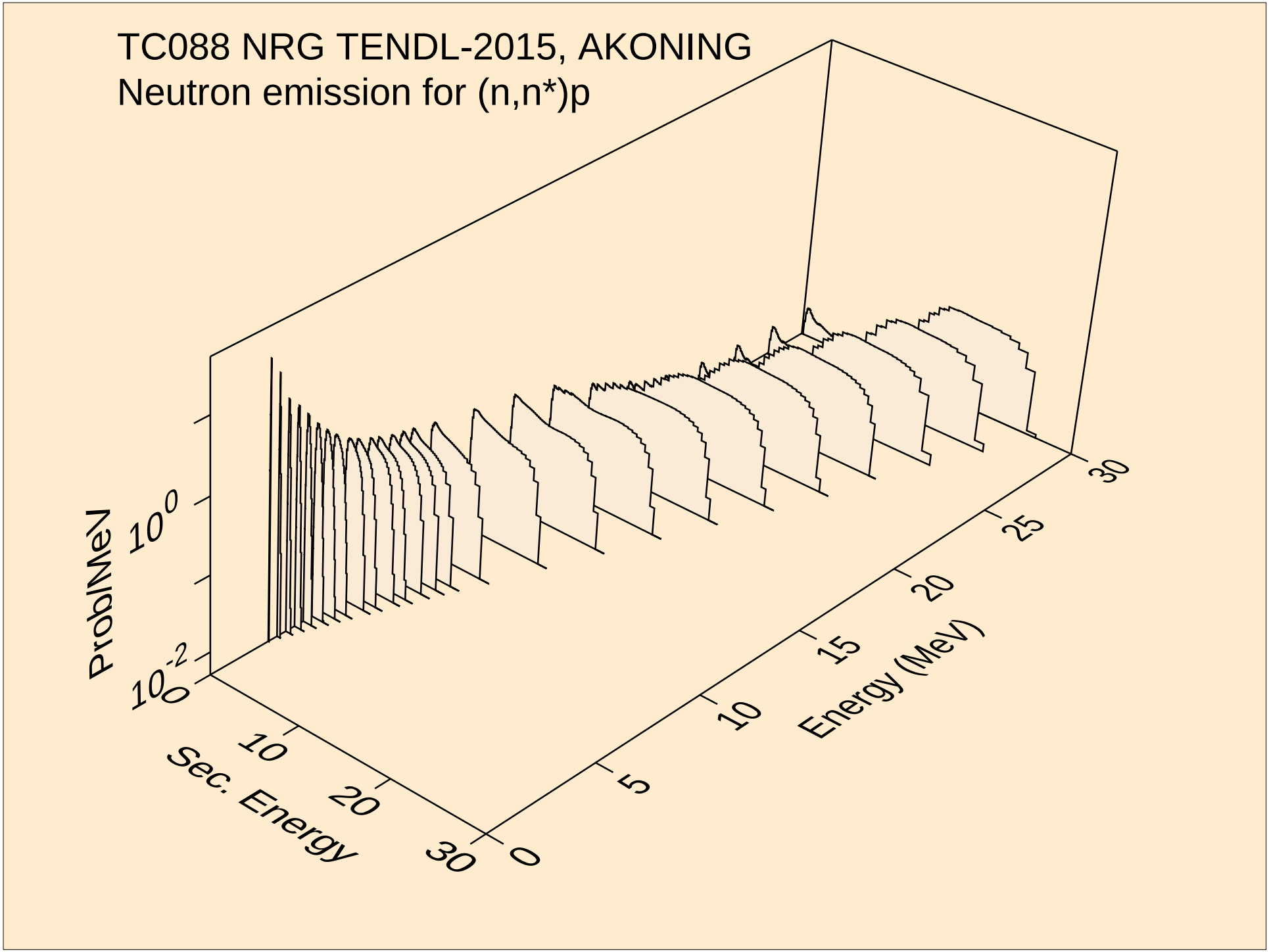

TC088 NRG TENDL-2015, AKONING
Neutron emission for (n,x)
Prob/MeV
10^4
10^3
10^2
10^1
0
50
100
150
200
Sec. Energy
0
50
100
150
200
Energy (MeV)

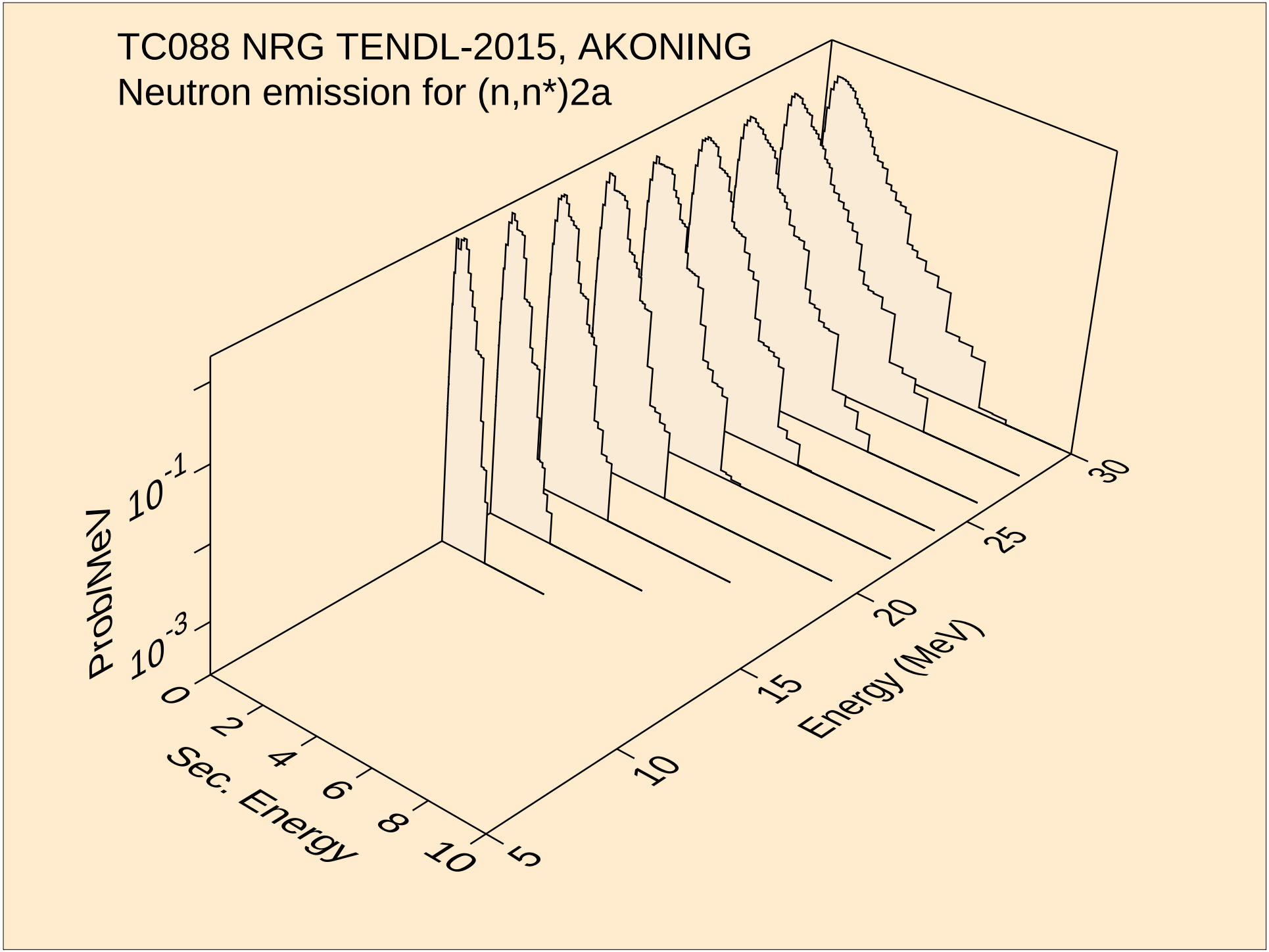

TC088 NRG TENDL-2015, AKONING
Neutron emission for (n,2n)
Prob/MeV
10^{0}
10^{-2}
0
5
10
15
20
Sec. Energy
12
14
16
18
20
22
24
26
28
30
Energy (MeV)

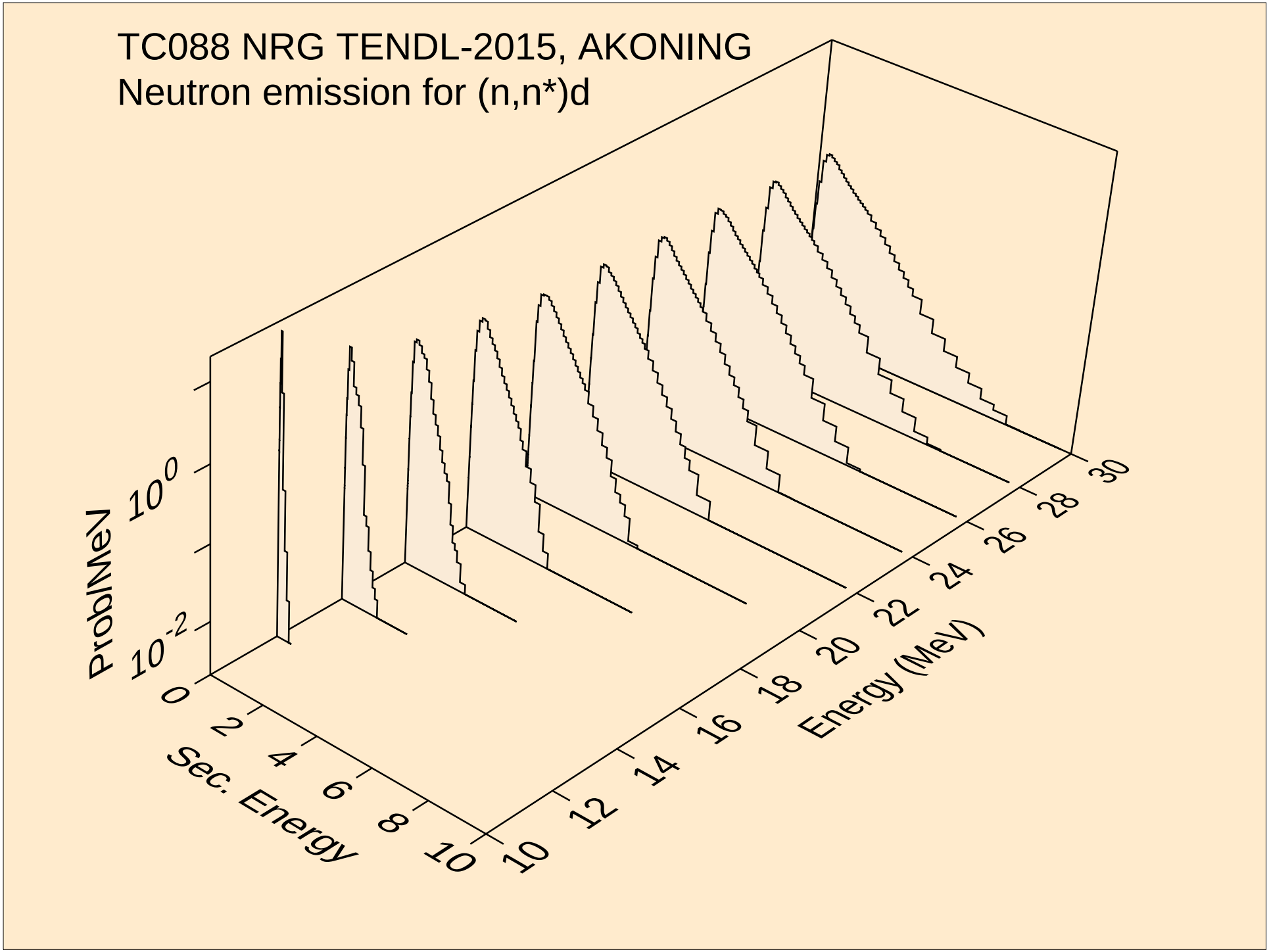

TC088 NRG TENDL-2015, AKONING
Neutron emission for (n,3n)
Prob/MeV
10-1
10-3
0
1
2
3
4
Sec. Energy
26.5
27.0
27.5
28.0
28.5
29.0
29.5
30.0
Energy (MeV)

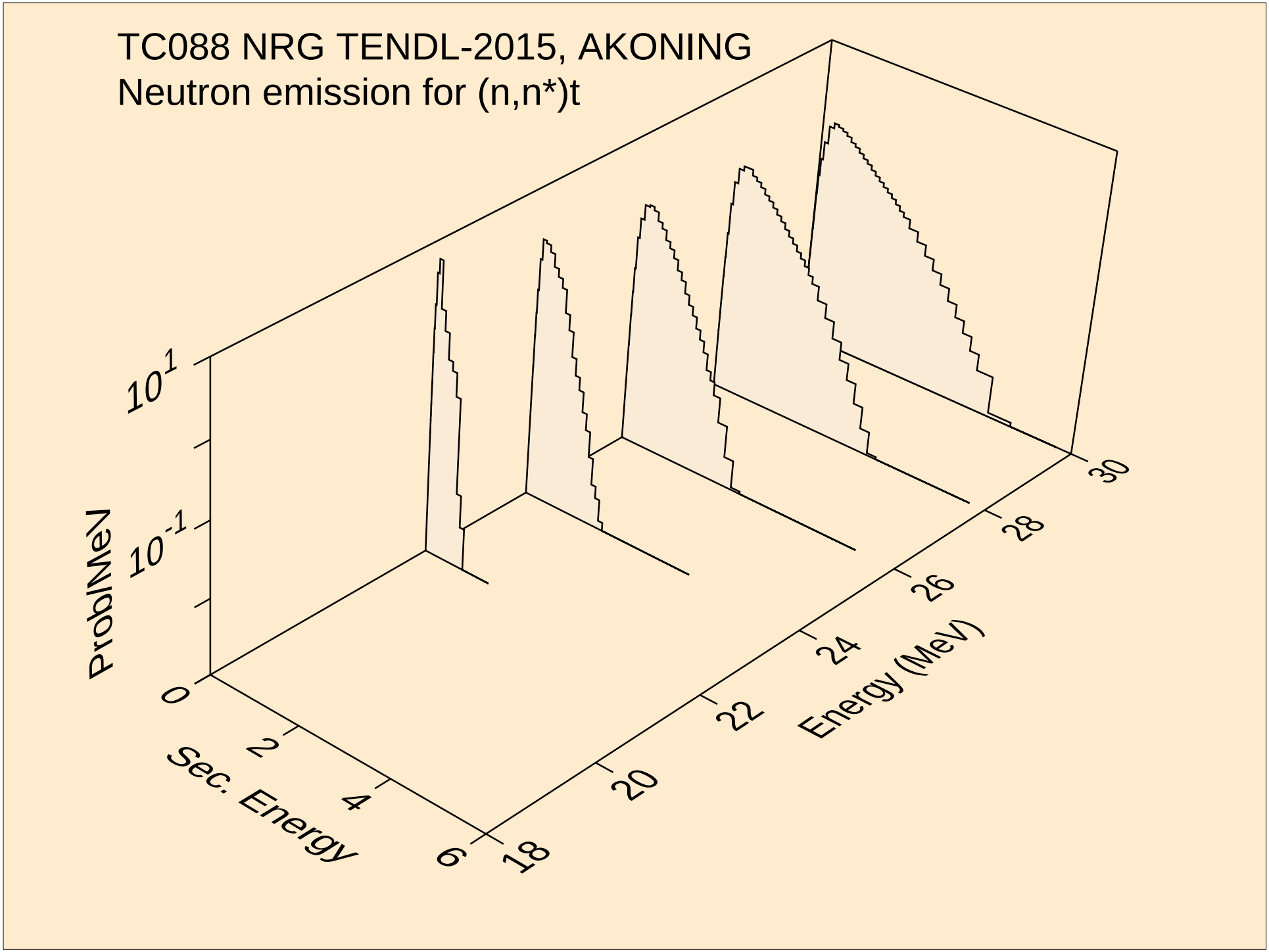

TC088 NRG TENDL-2015, AKONING
Neutron emission for (n,n*)a
Prob/MeV
10^1
10^-1
0
Sec. Energy
5
10
15
20
0
5
10
15
20
25
30
Energy (MeV)

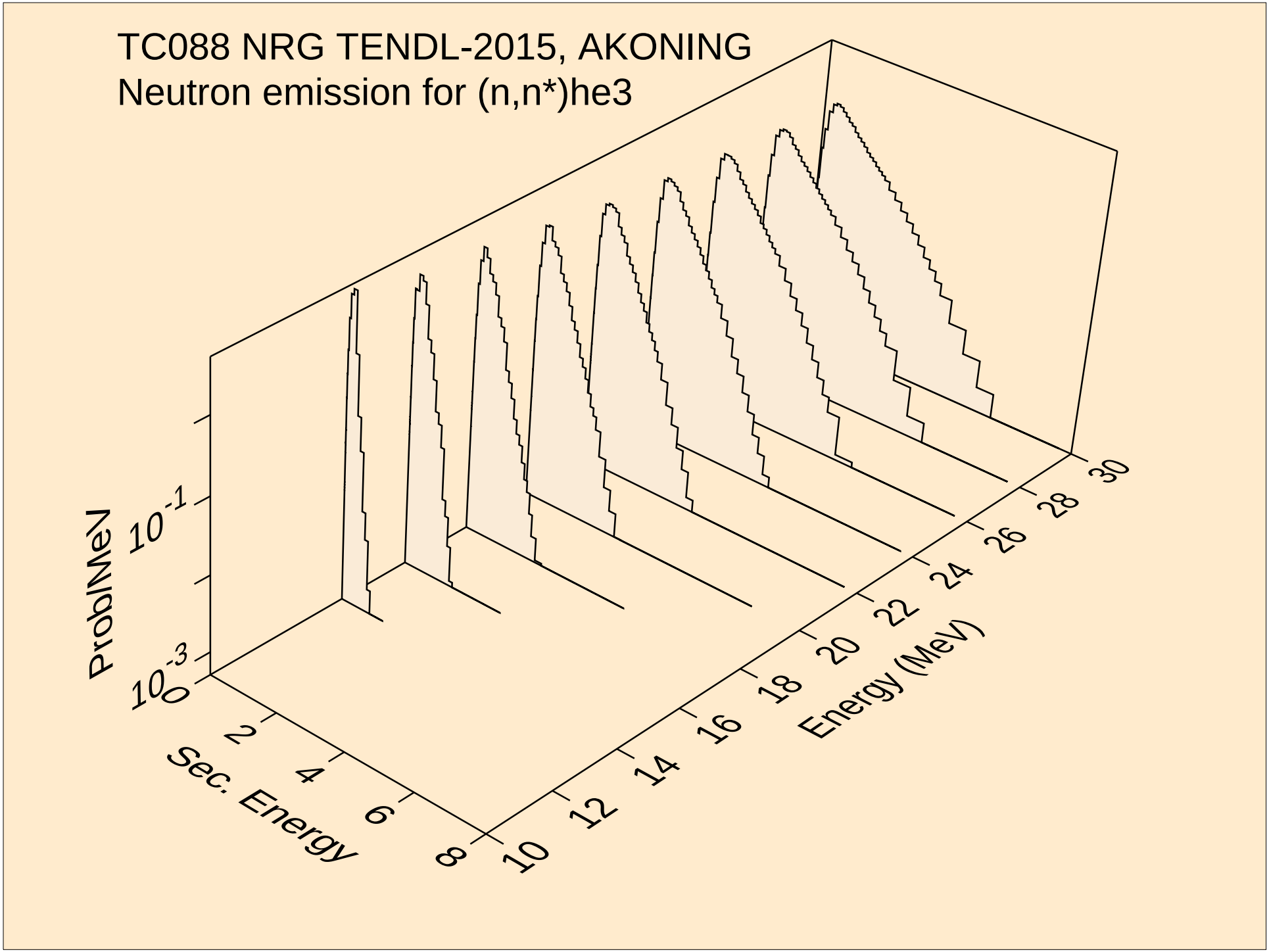

TC088 NRG TENDL-2015, AKONING
Neutron emission for (n,2n)a
Prob/MeV
10-1
10-3
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
Sec. Energy
Energy (MeV)

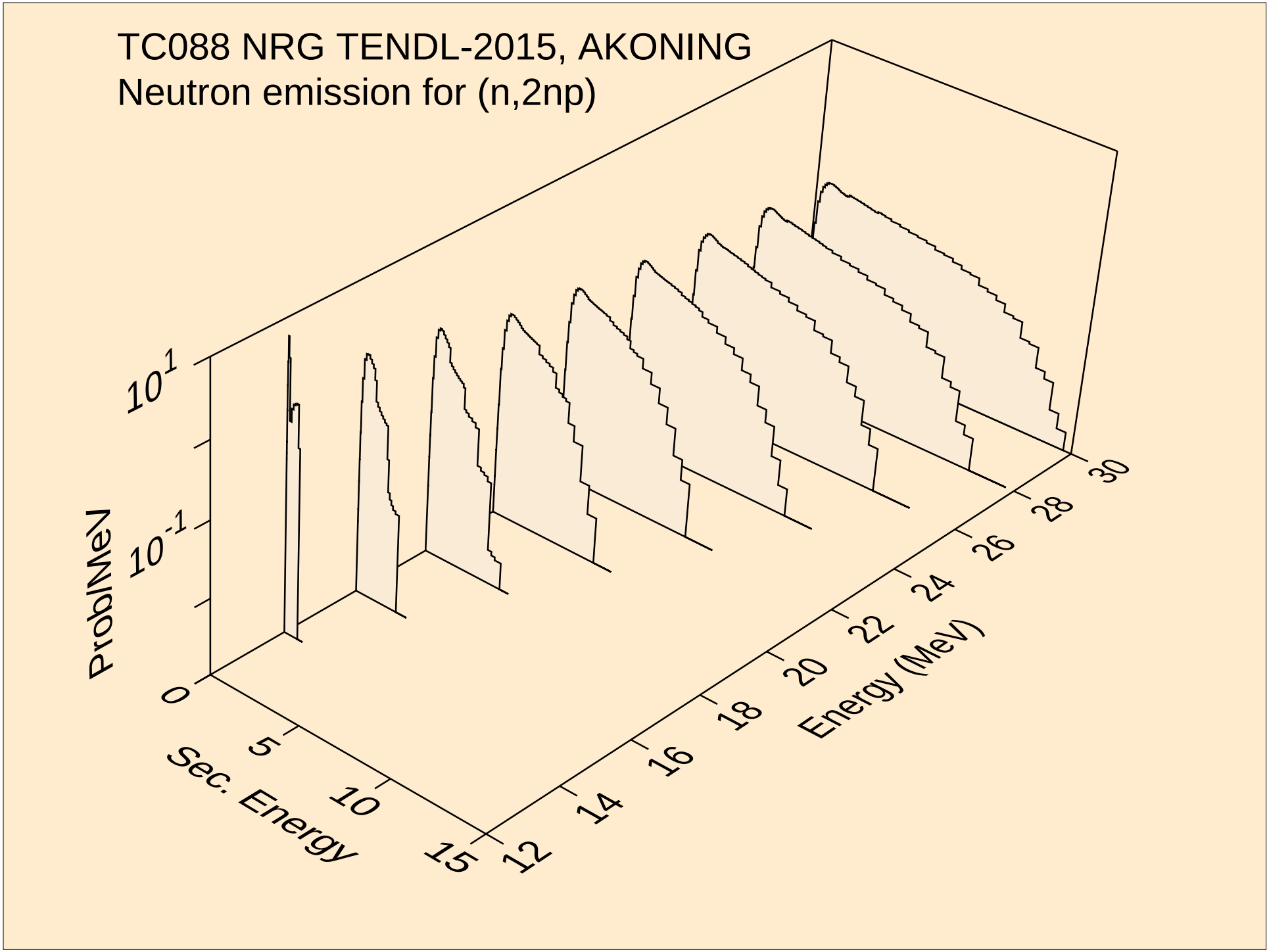

TC088 NRG TENDL-2015, AKONING
Neutron emission for (n,n*)p
Prob/MeV
10^0
10^-2
0
10
20
30
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)

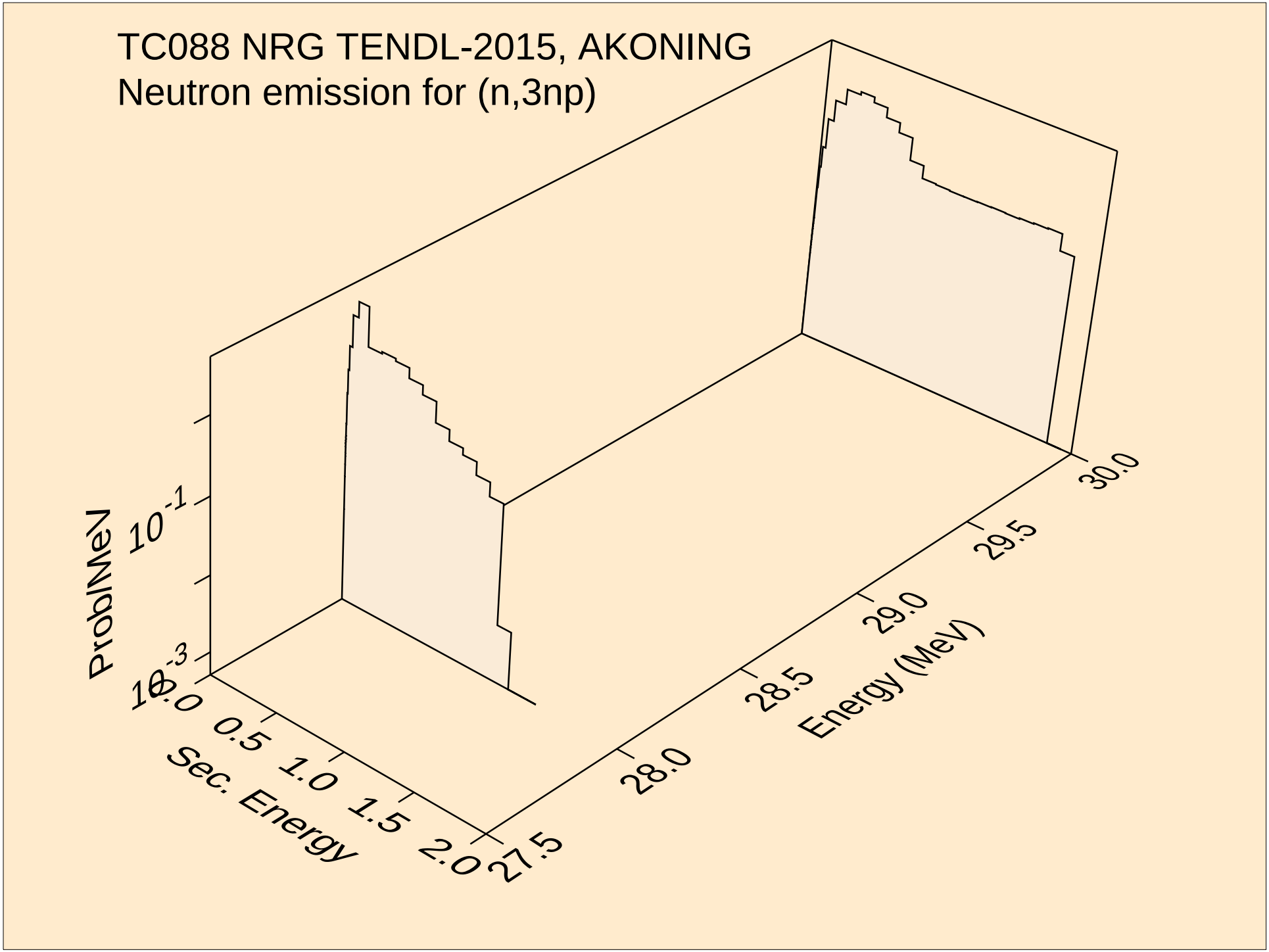

TC088 NRG TENDL-2015, AKONING
Neutron emission for (n,n*)2a
Prob/MeV
10-1
10-3
0
2
4
6
8
10
Sec. Energy
5
10
15
20
25
30
Energy (MeV)

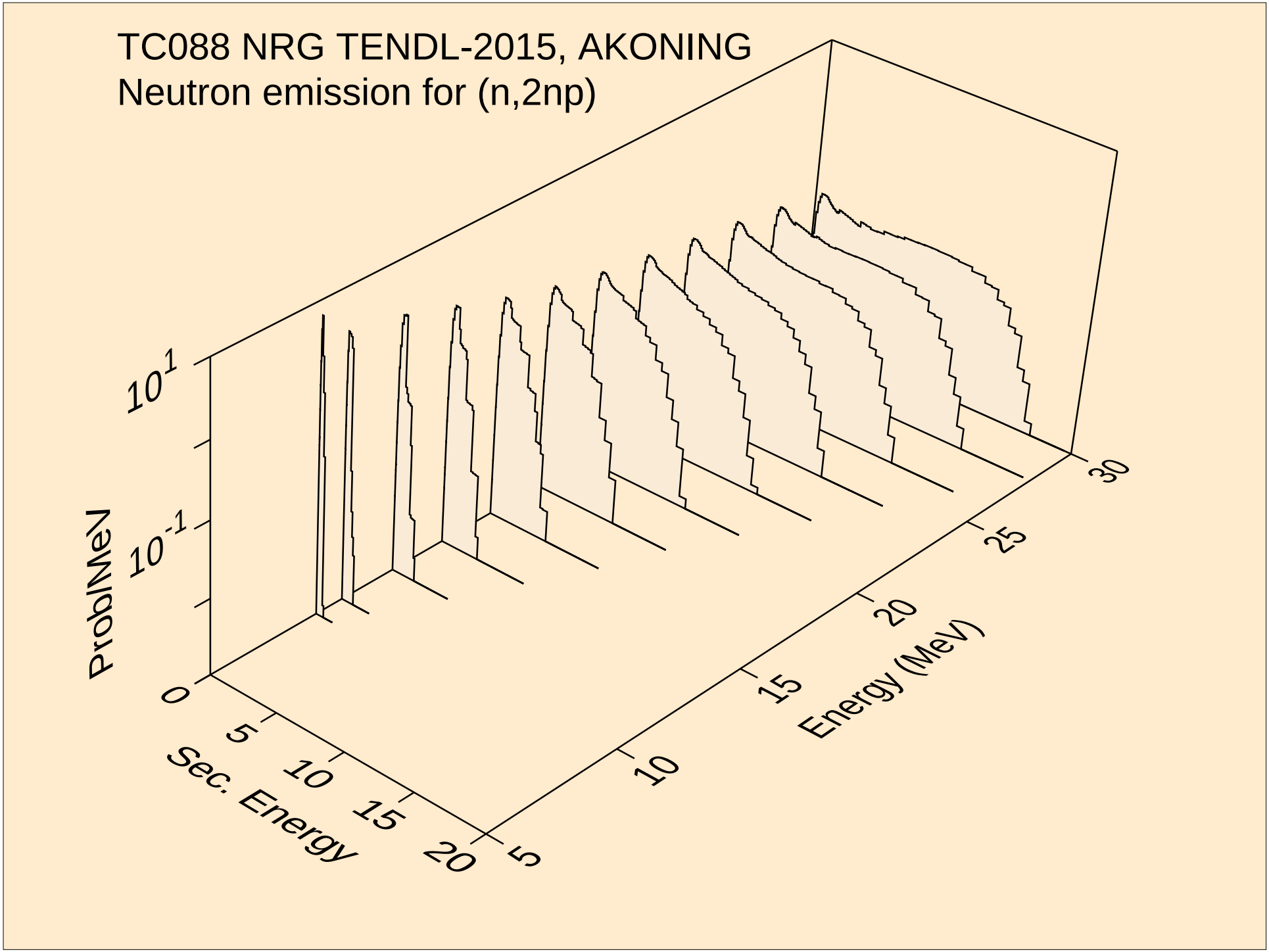

TC088 NRG TENDL-2015, AKONING
Neutron emission for (n,n*)d
Prob/MeV
10^{0}
10^{-2}
0
2
4
6
8
10
Sec. Energy
10
12
14
16
18
20
22
24
26
28
30
Energy (MeV)

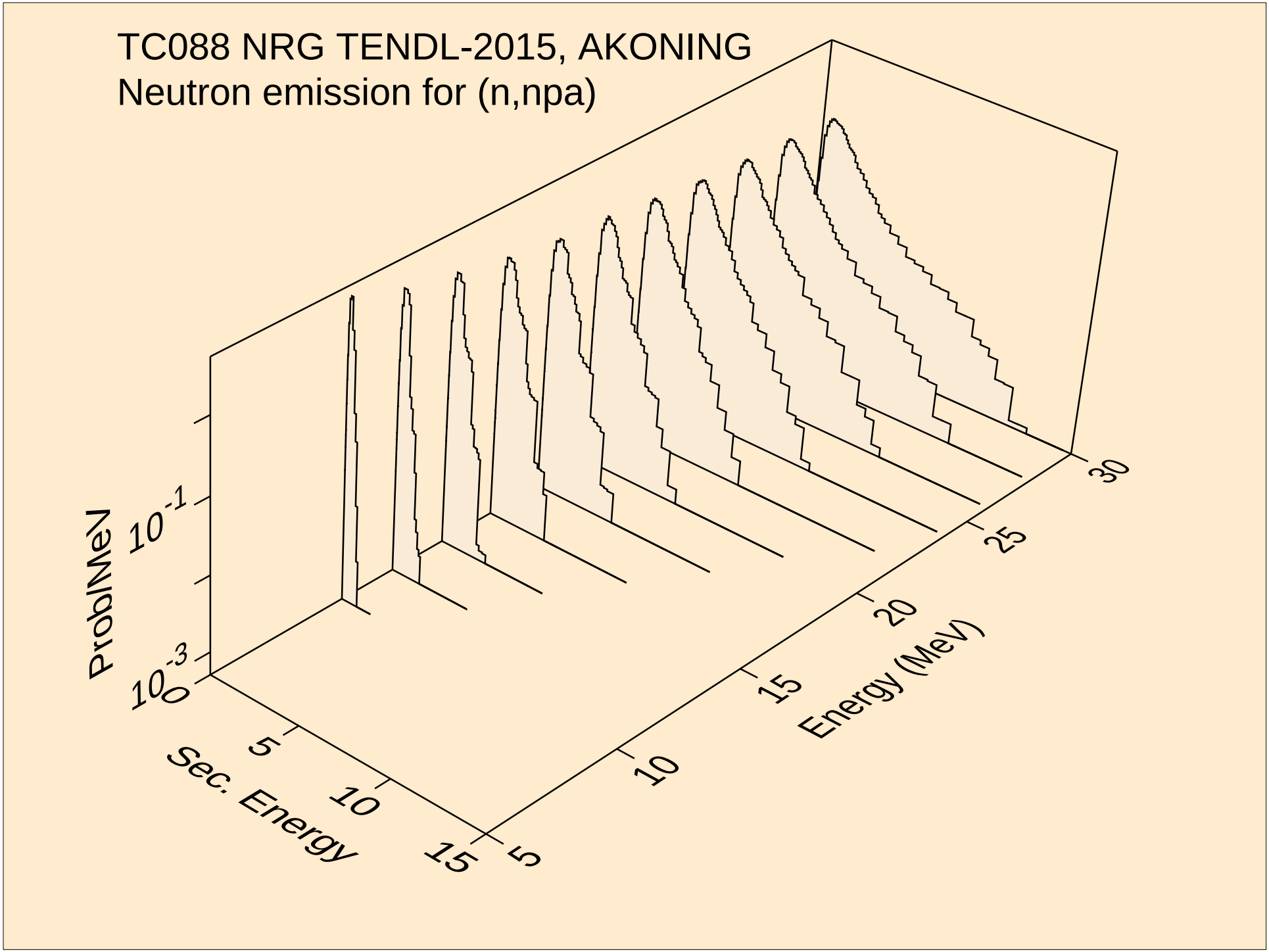

TC088 NRG TENDL-2015, AKONING
Neutron emission for (n,n*)t
Prob/MeV
10^1
10^-1
0
Sec. Energy
2
4
6
18
20
22
24
26
28
30
Energy (MeV)

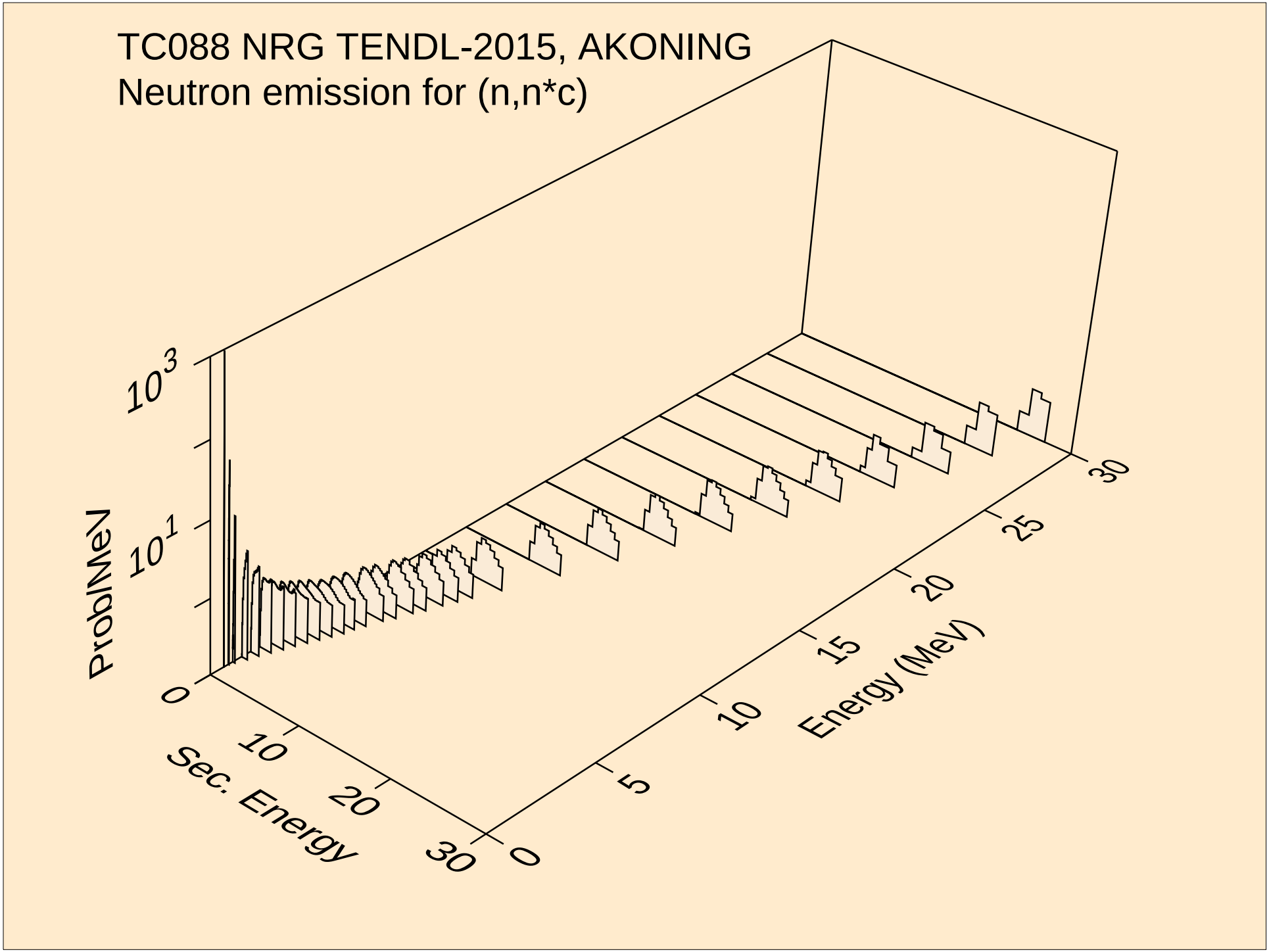

TC088 NRG TENDL-2015, AKONING
Neutron emission for (n,n*)he3
Prob/MeV
10-1
10-3
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
Sec. Energy
Energy (MeV)

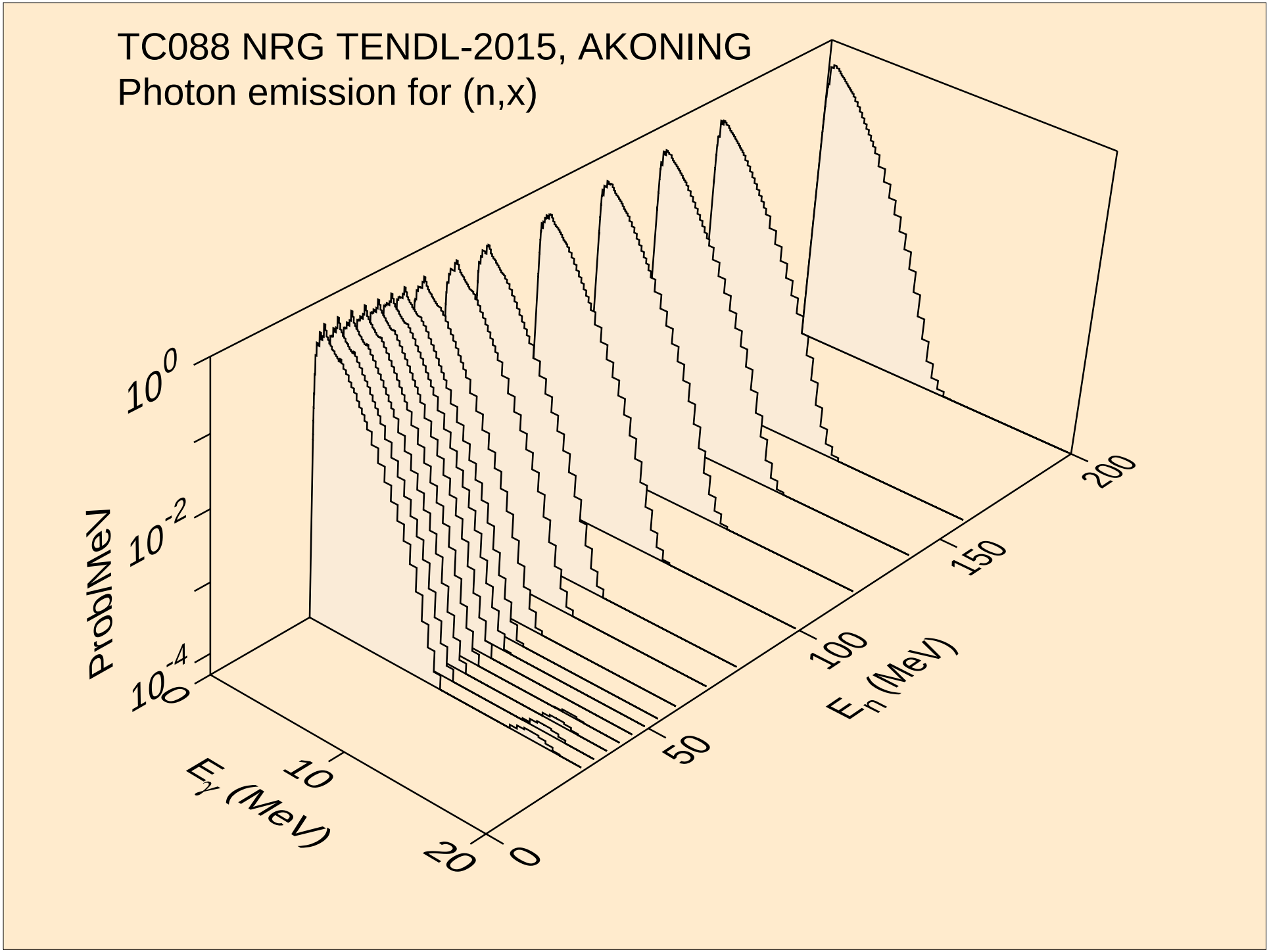

TC088 NRG TENDL-2015, AKONING
Neutron emission for (n,2np)
Prob/MeV
10^1
10^-1
0
Sec. Energy
5
10
15
Energy (MeV)
12
14
16
18
20
22
24
26
28
30

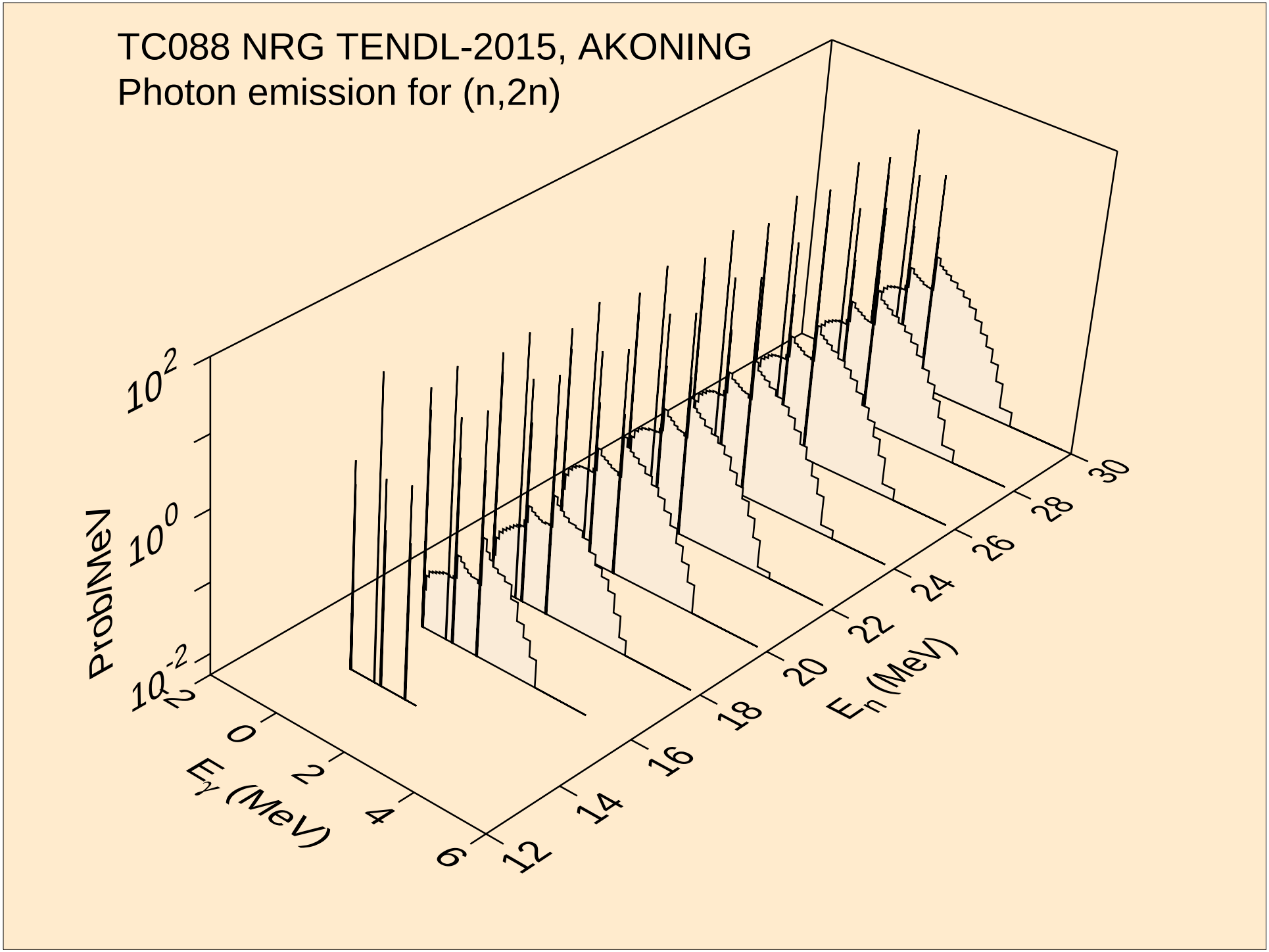

TC088 NRG TENDL-2015, AKONING
Neutron emission for (n,3np)
Prob/MeV
10-1
10-3
0.0
0.5
1.0
1.5
2.0
Sec. Energy
27.5
28.0
28.5
29.0
29.5
30.0
Energy (MeV)

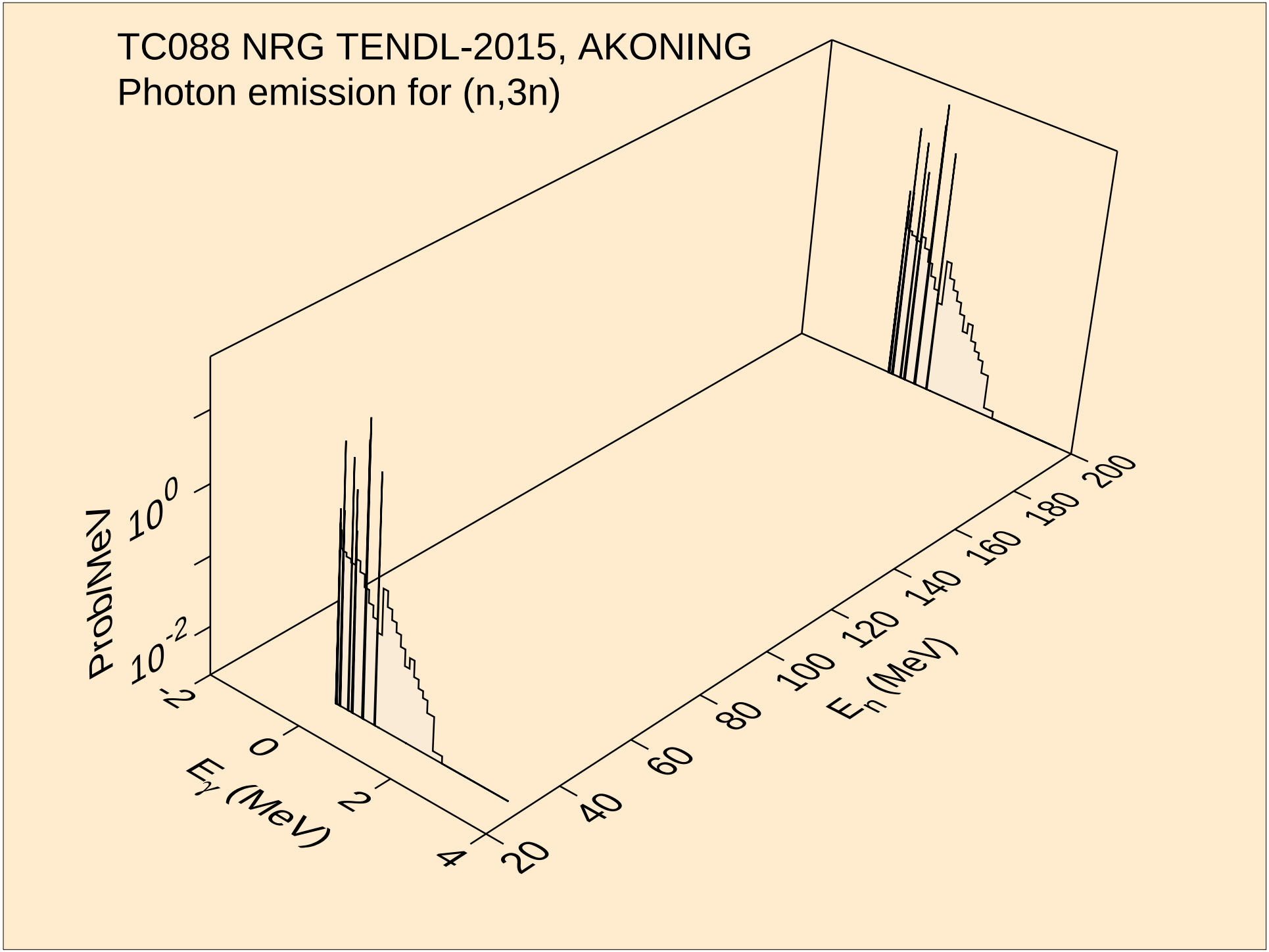

TC088 NRG TENDL-2015, AKONING
Neutron emission for (n,2np)
Prob/MeV
10^{1}
10^{-1}
0
5
10
15
20
Sec. Energy
5
10
15
20
25
30
Energy (MeV)

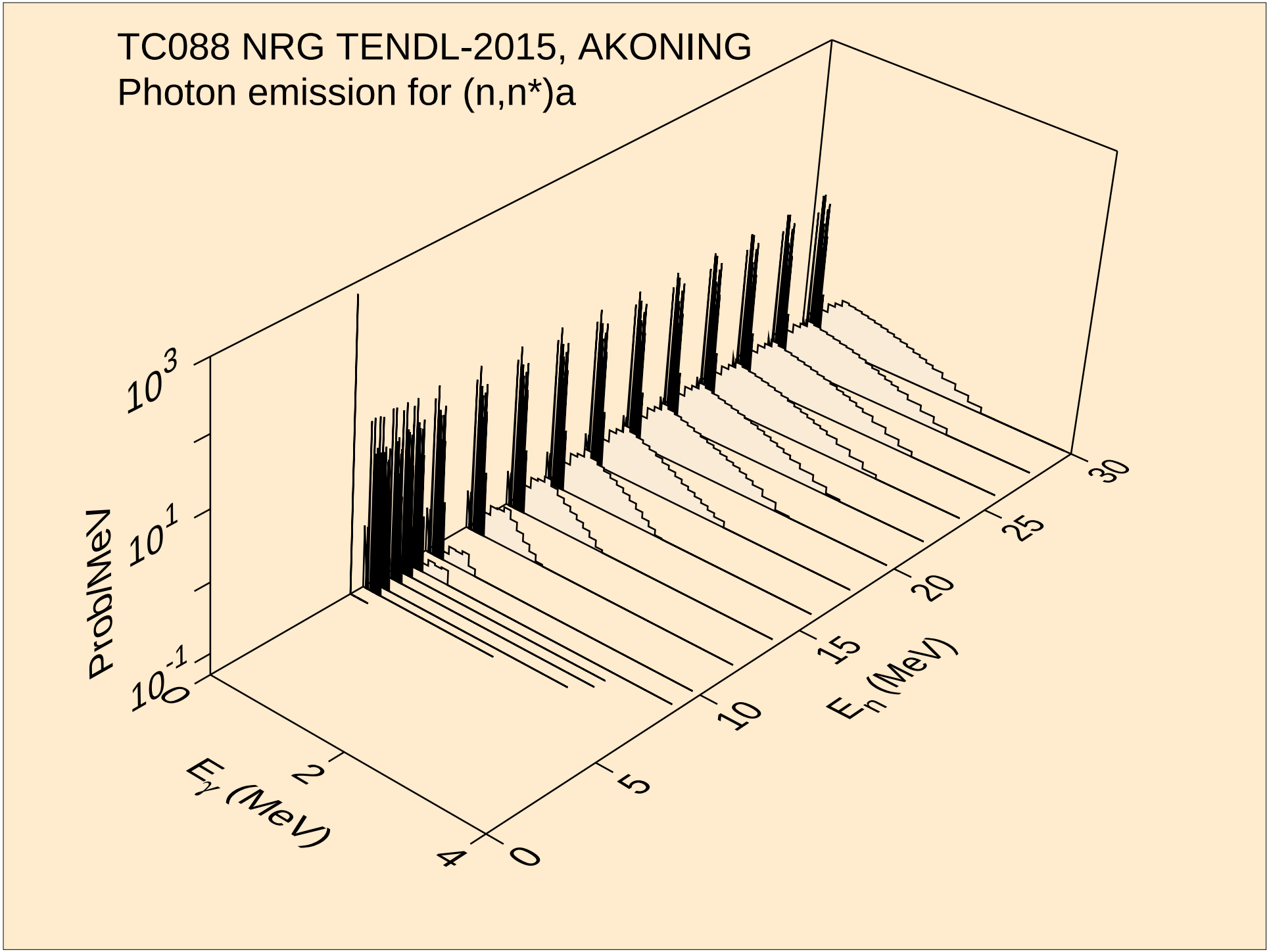

TC088 NRG TENDL-2015, AKONING
Neutron emission for (n,npa)
Prob/MeV
10-1
10-3
0
5
10
15
Sec. Energy
5
10
15
20
25
30
Energy (MeV)

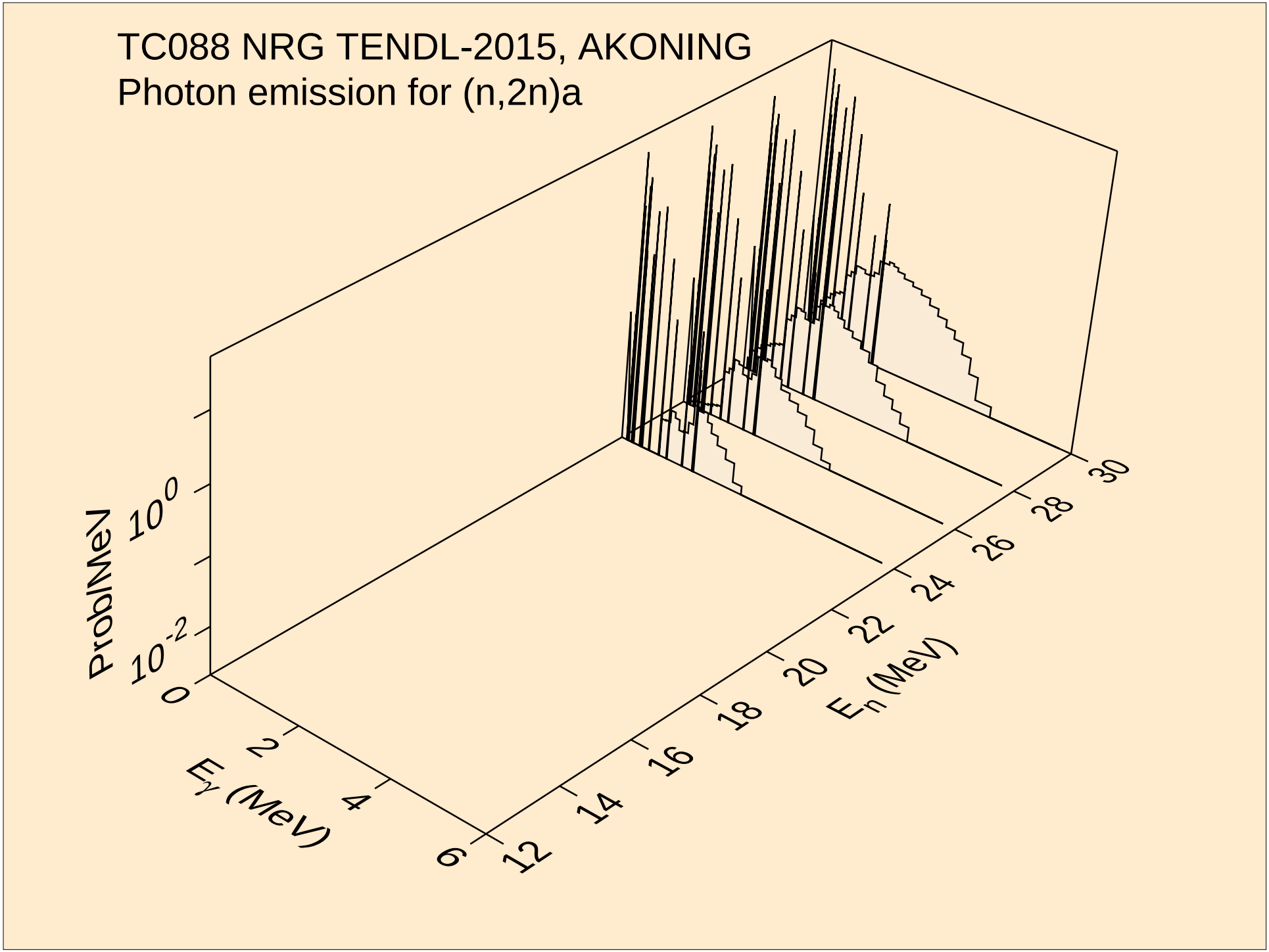

TC088 NRG TENDL-2015, AKONING
Neutron emission for (n,n*c)
Prob/MeV
10^3
10^1
0
10
20
30
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)

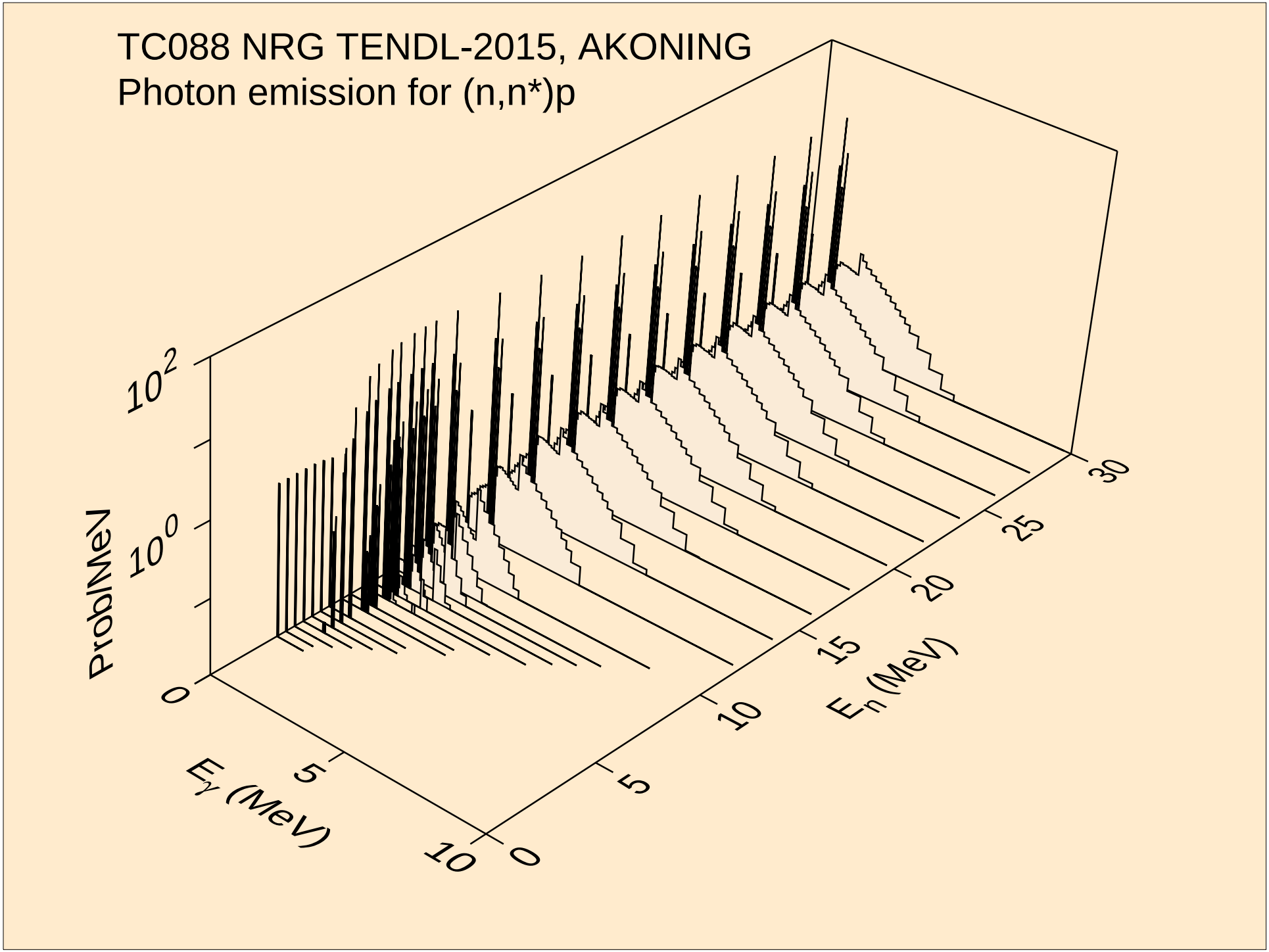

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,x)
Prob/MeV
10^{0}
10^{-2}
10^{-4}
E_γ (MeV)
0
10
20
E_n (MeV)
50
100
150
200

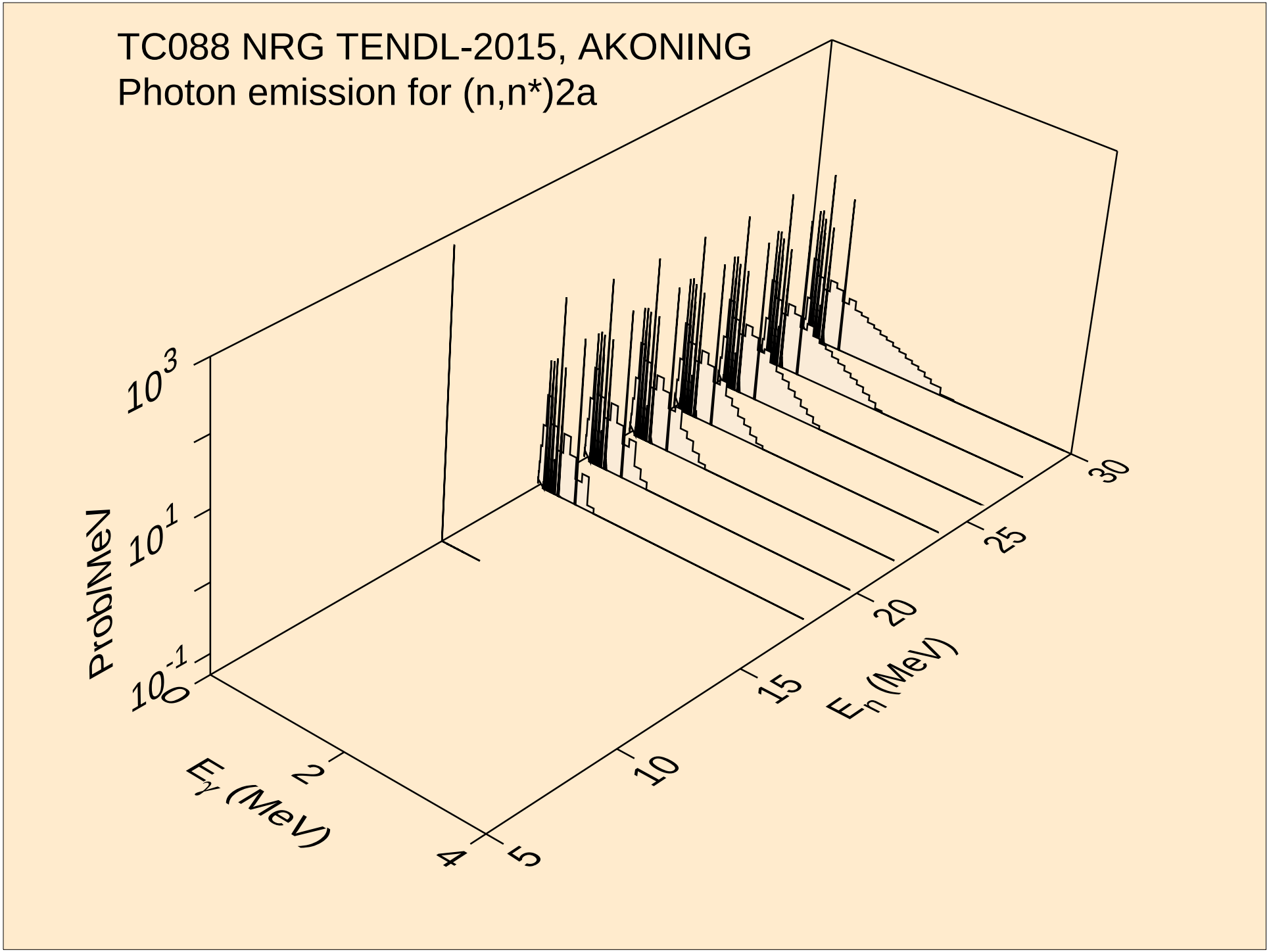

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,2n)
Prob/MeV
10^{2}
10^{0}
10^{-2}
E_γ (MeV)
0
2
4
6
E_n (MeV)
12
14
16
18
20
22
24
26
28
30

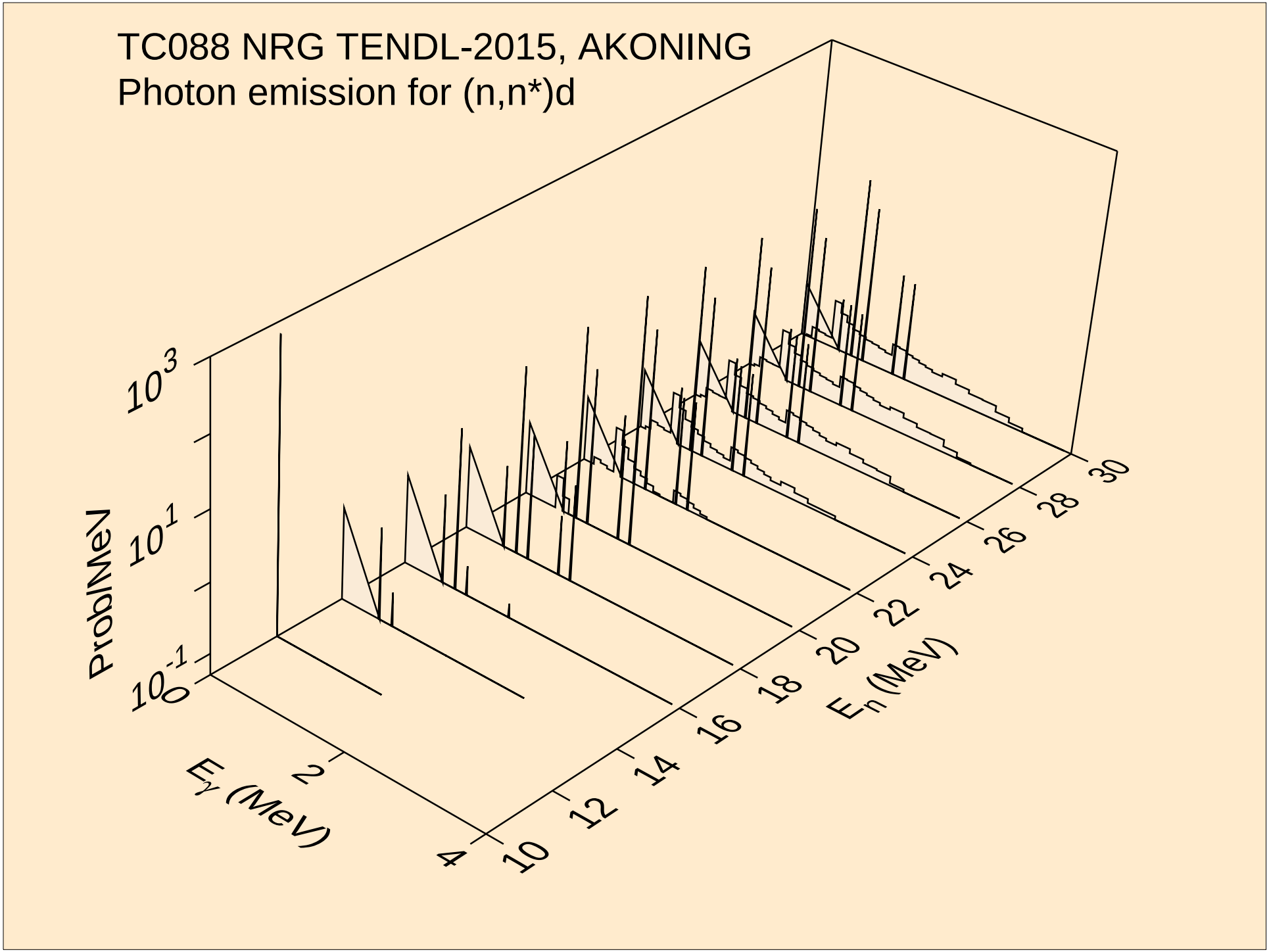

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,3n)
Prob/MeV
10^{0}
10^{-2}
-2
0
2
4
E_γ (MeV)
20
40
60
80
100
120
140
160
180
200
E_n (MeV)

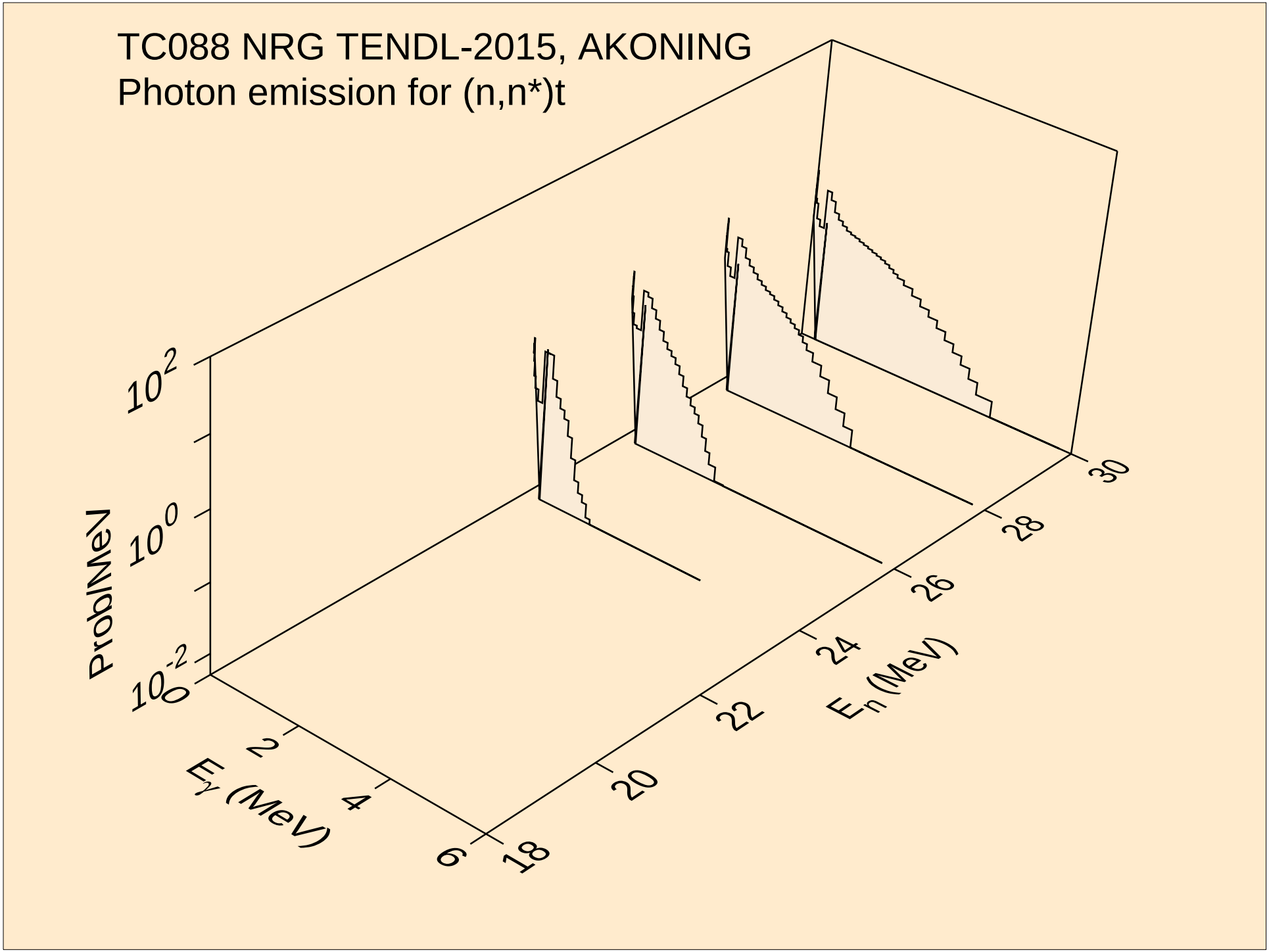

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,n*)a
Prob/MeV
10^{3}
10^{1}
10^{-1}
0
2
4
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

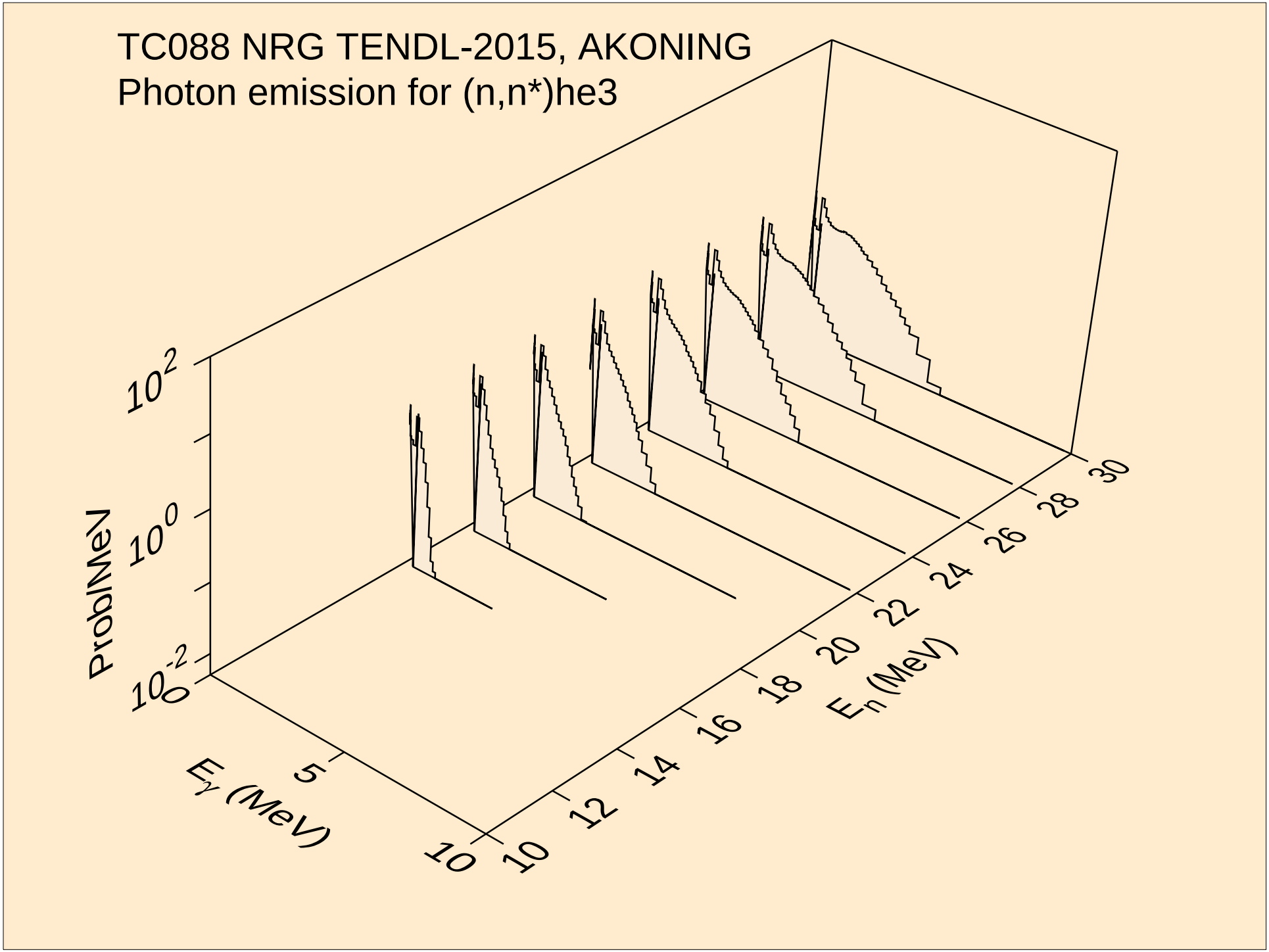

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,2n)a
Prob/MeV
10^0
10^-2
0
2
4
6
E_γ (MeV)
12
14
16
18
20
22
24
26
28
30
E_n (MeV)

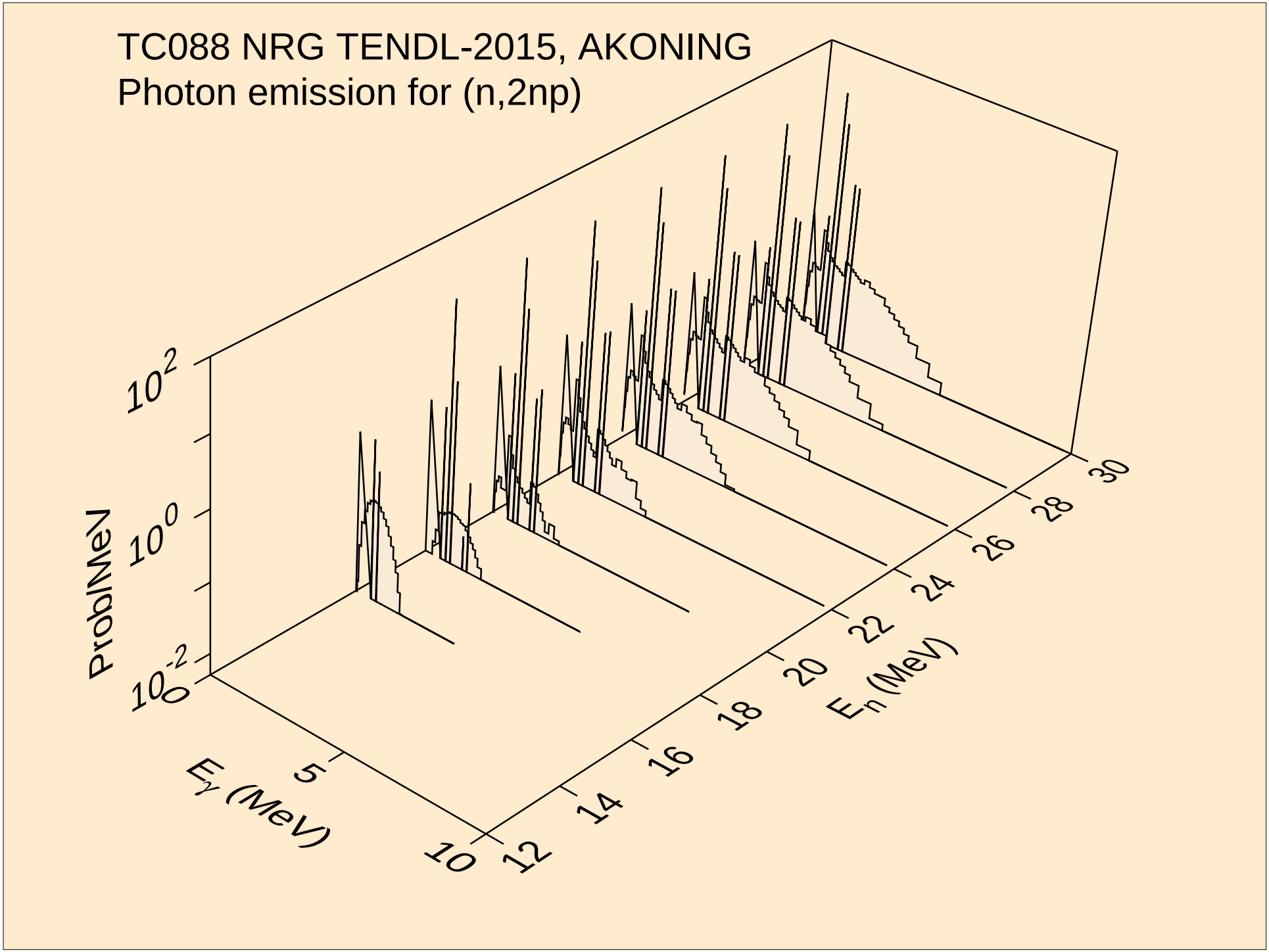

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,n*)p
Prob/MeV
10^2
10^0
0
5
10
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

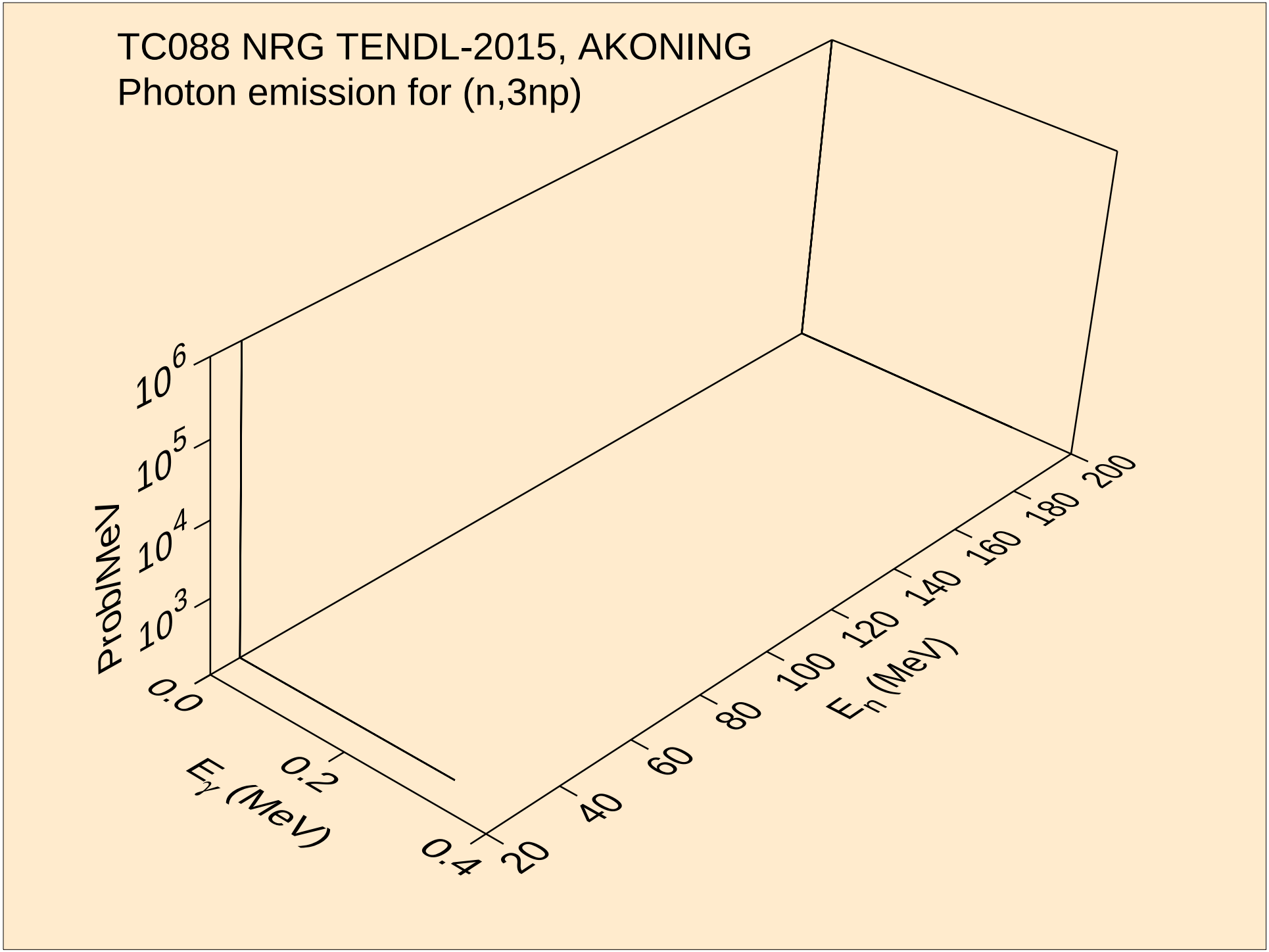

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,n*)2a
Prob/MeV
10^{3}
10^{1}
10^{-1}
0
2
4
E_γ (MeV)
5
10
15
20
25
30
E_n (MeV)

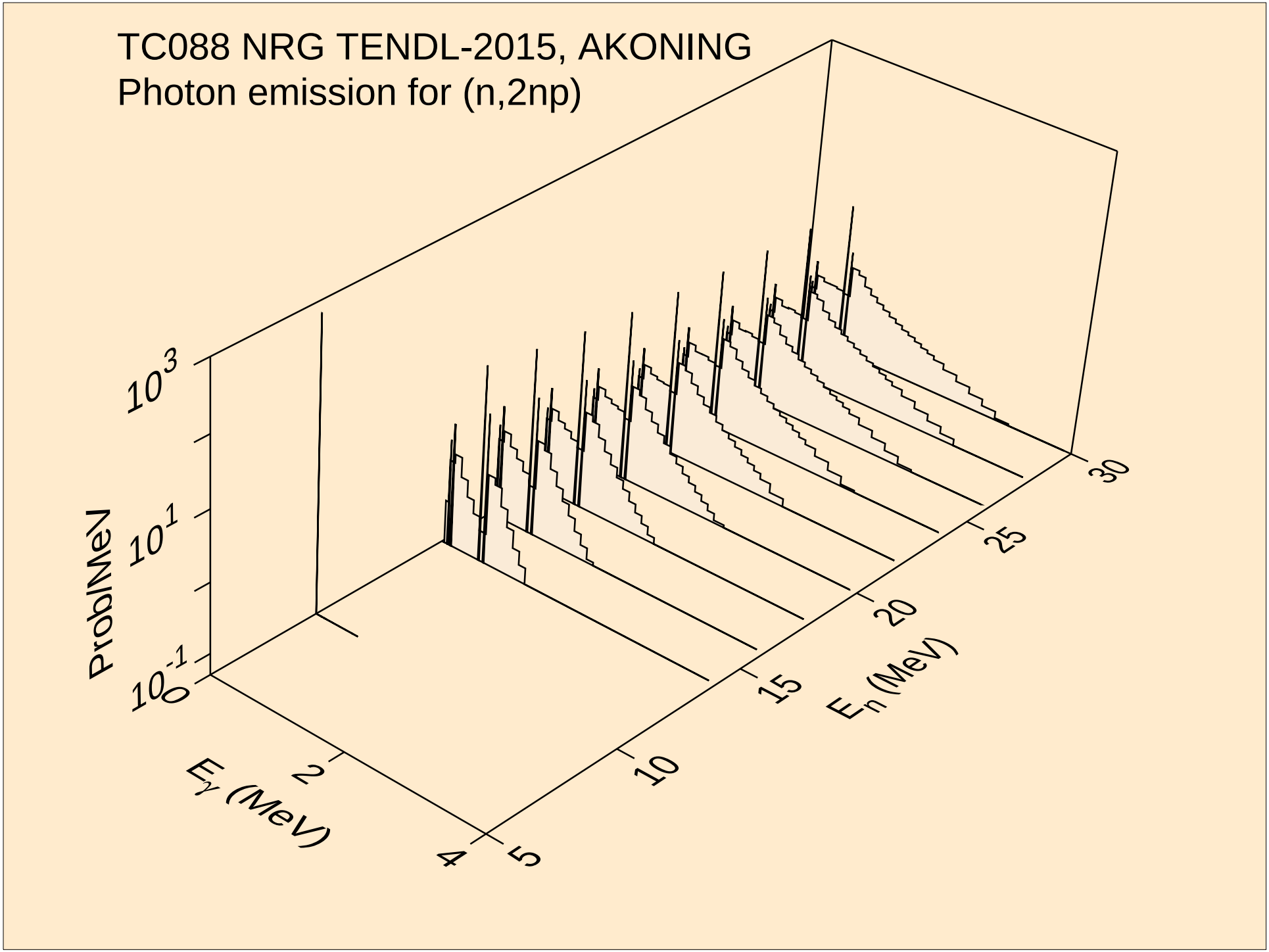

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,n*)d
Prob/MeV
10^{3}
10^{1}
10^{-1}
0
2
4
E_γ (MeV)
10
12
14
16
18
20
22
24
26
28
30
E_n (MeV)

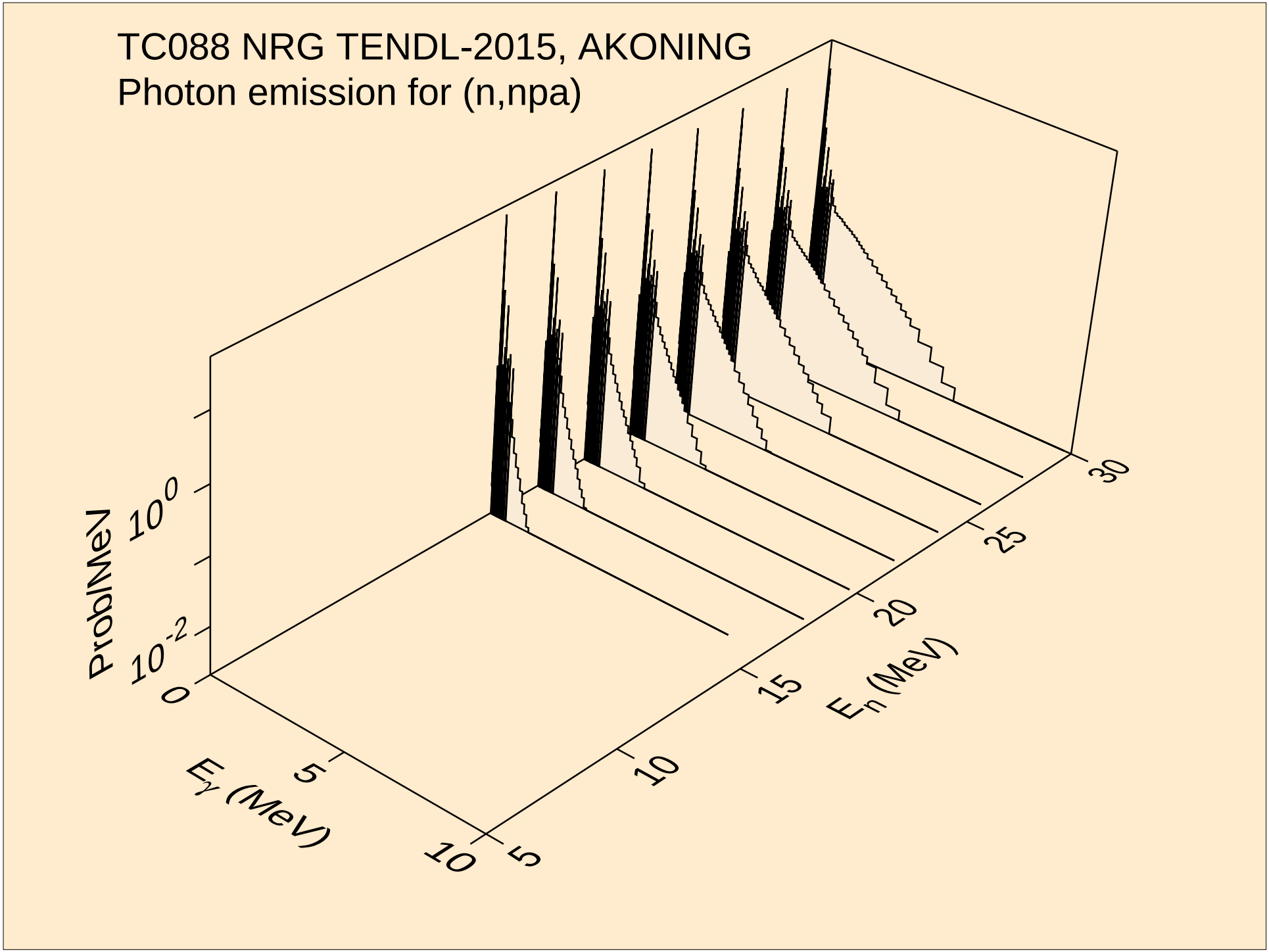

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,n*)t
Prob/MeV
10^{2}
10^{0}
10^{-2}
0
2
4
6
E_γ (MeV)
18
20
22
24
26
28
30
E_n (MeV)

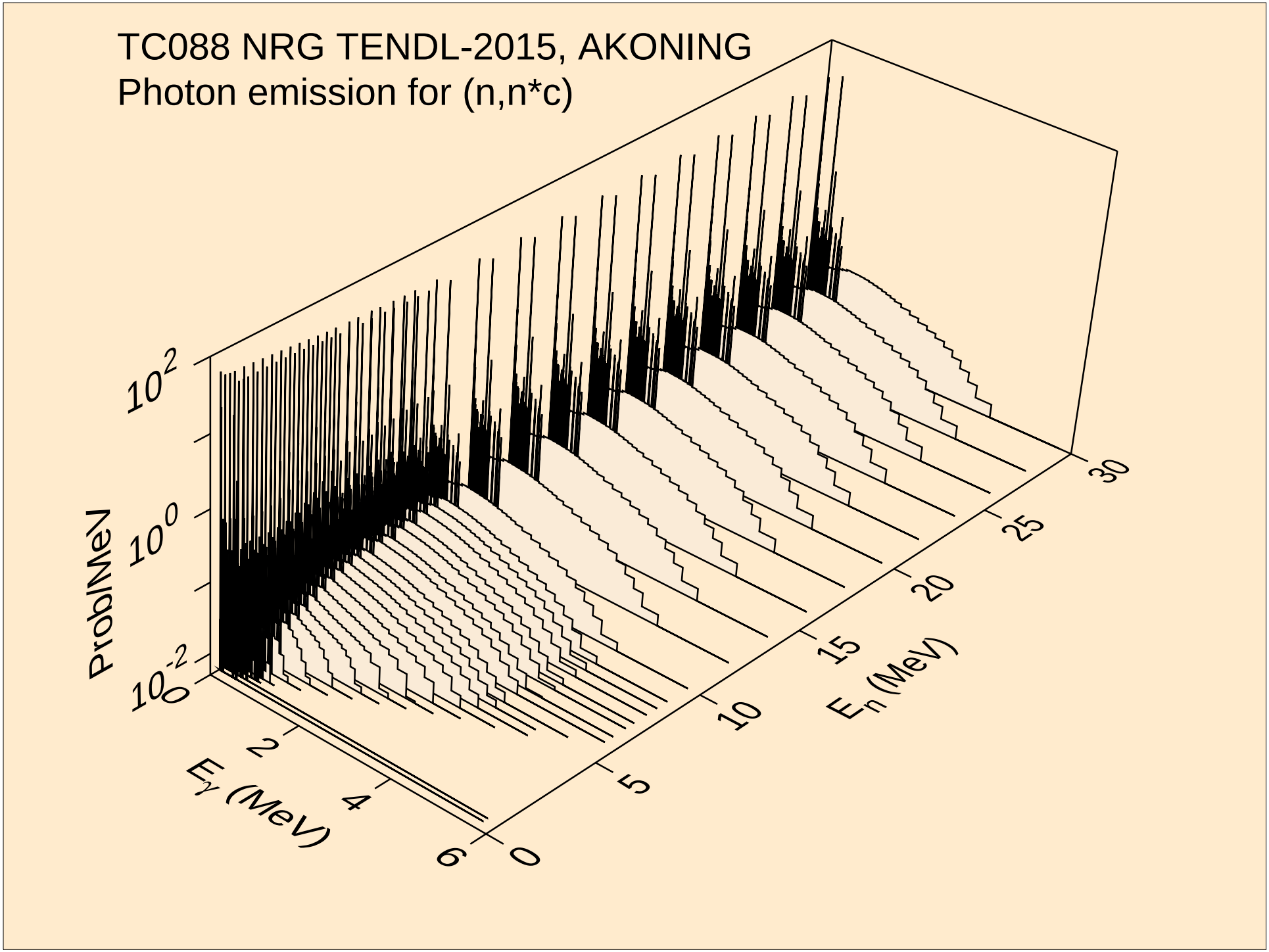

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,n*)he3
Prob/MeV
10^{2}
10^{0}
10^{-2}
0
5
10
E_γ (MeV)
10
12
14
16
18
20
22
24
26
28
30
E_n (MeV)

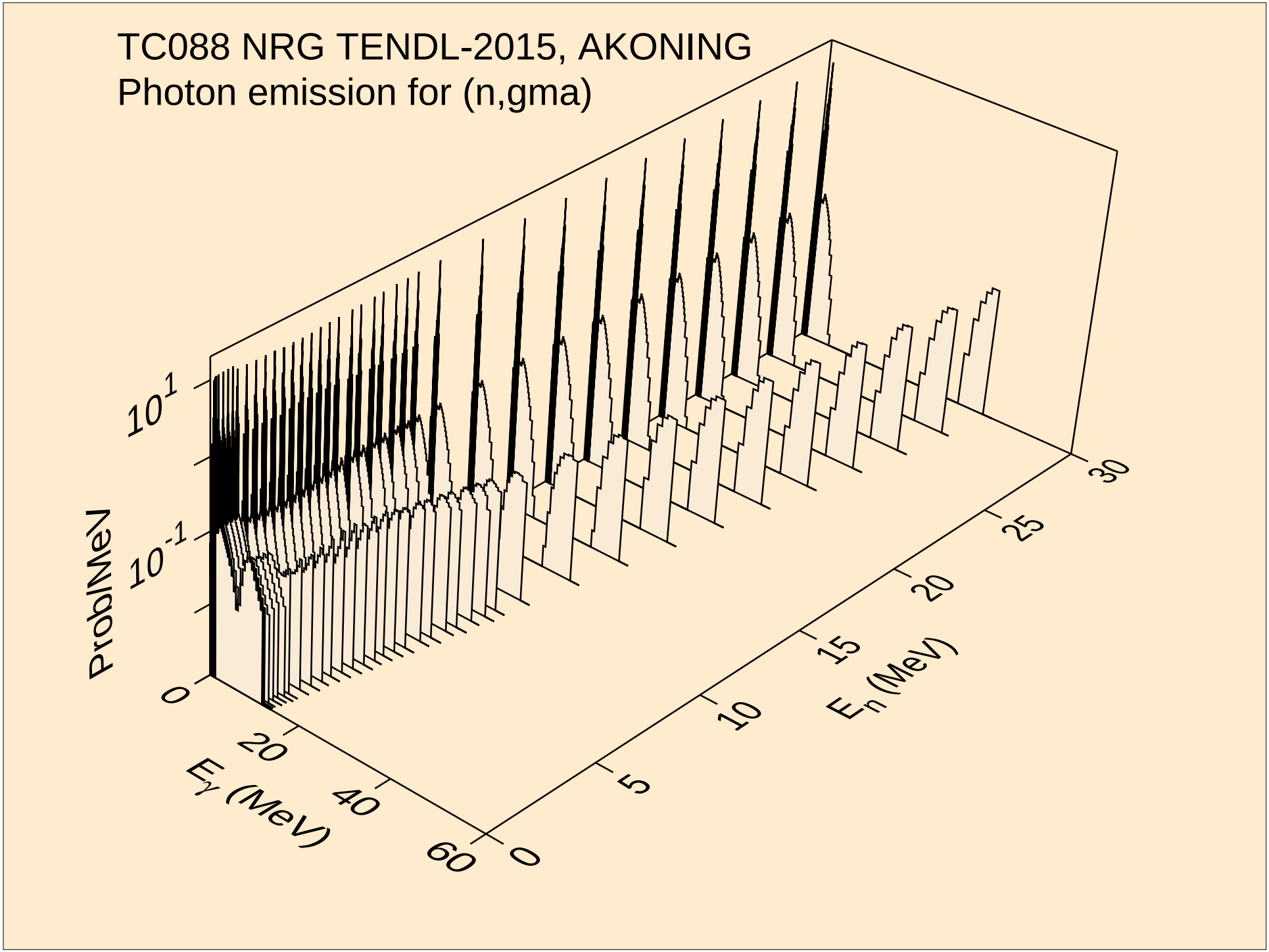

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,2np)
Prob/MeV
10^{2}
10^{0}
10^{-2}
0
5
10
E_γ (MeV)
12
14
16
18
20
22
24
26
28
30
E_n (MeV)

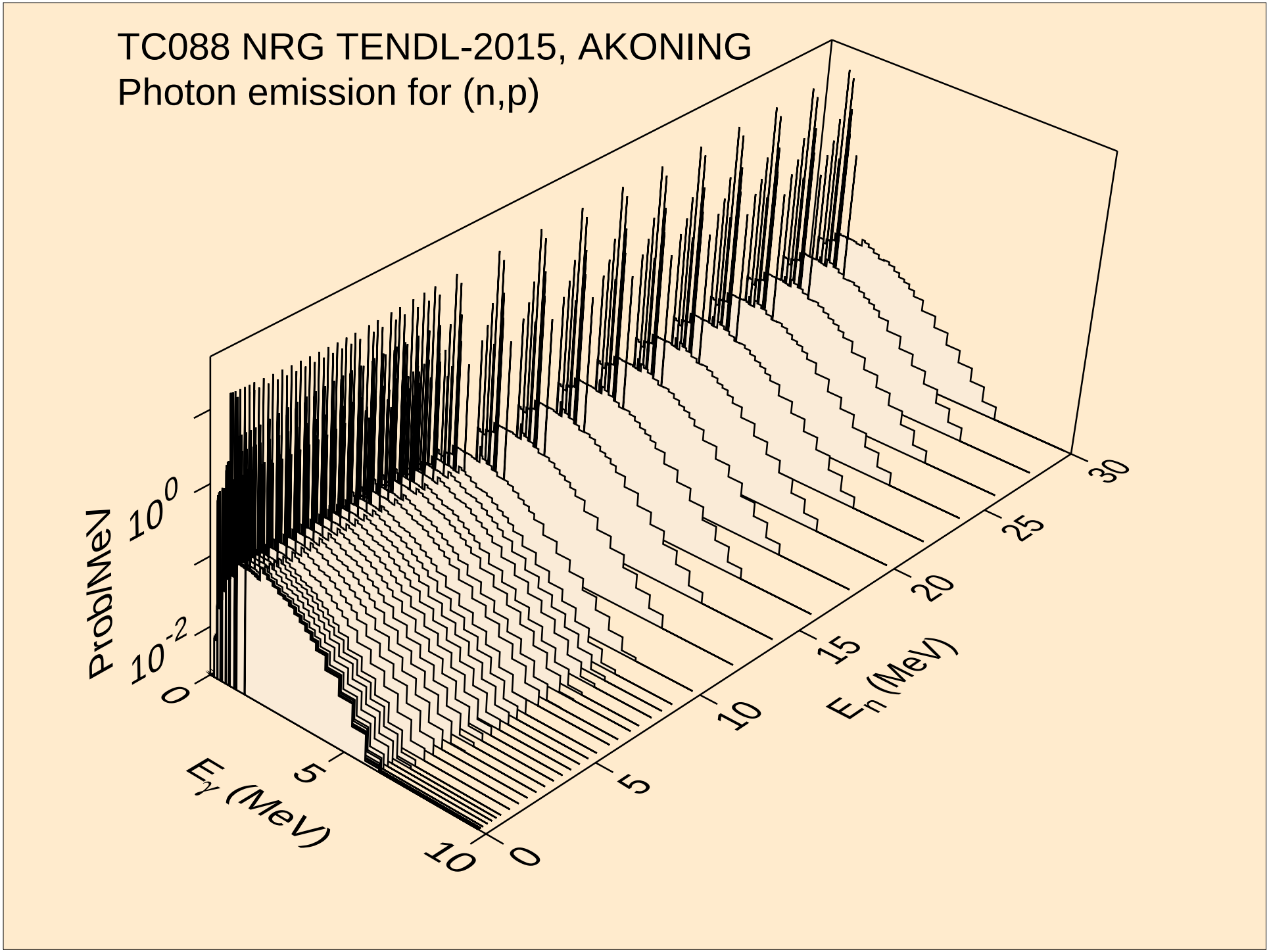

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,3np)
Prob/MeV
10^6
10^5
10^4
10^3
0.0
0.2
0.4
E_γ (MeV)
20
40
60
80
100
120
140
160
180
200
E_n (MeV)

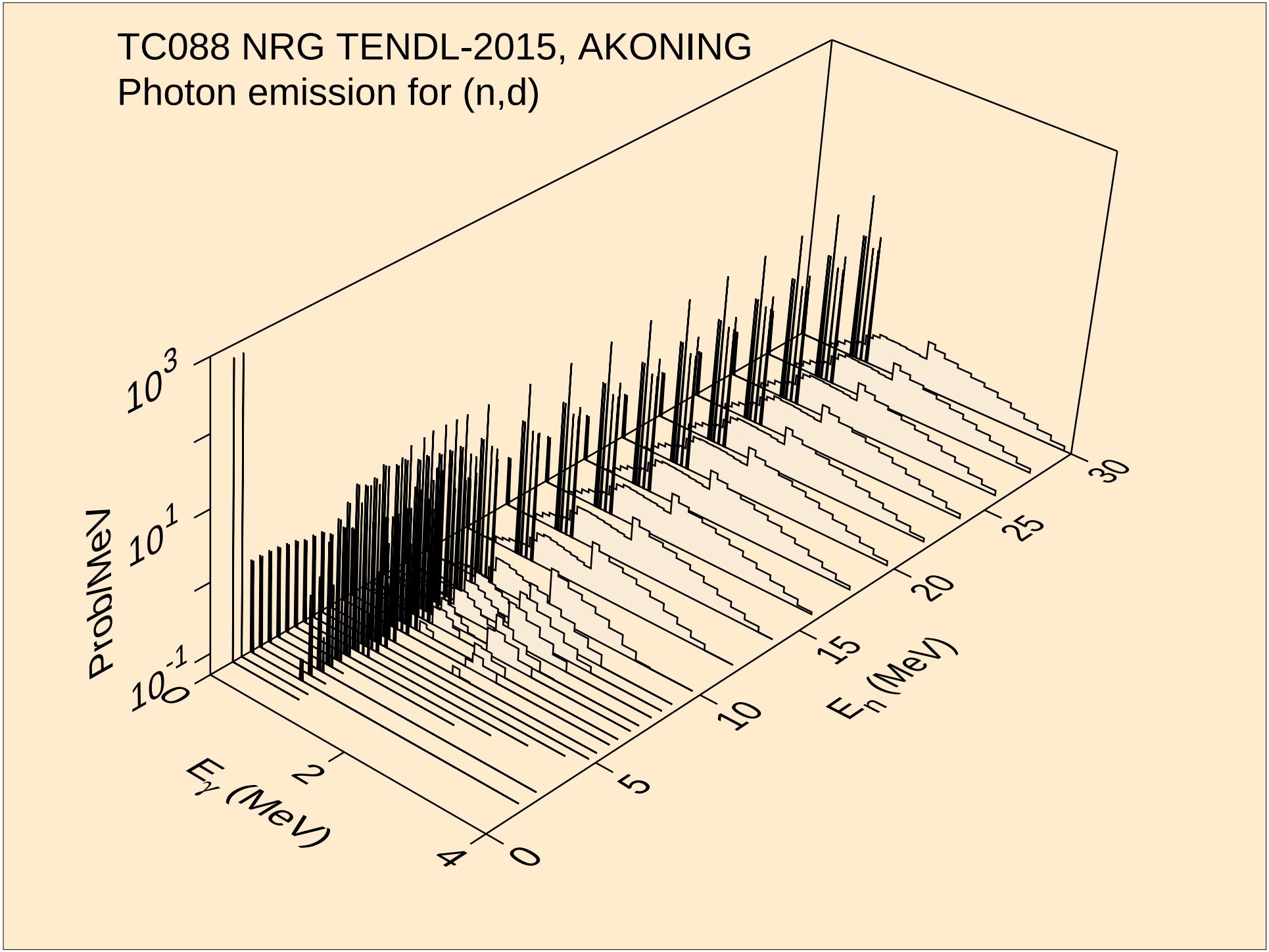

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,2np)
Prob/MeV
10^{3}
10^{1}
10^{-1}
0
2
4
E_γ (MeV)
5
10
15
20
25
30
E_n (MeV)

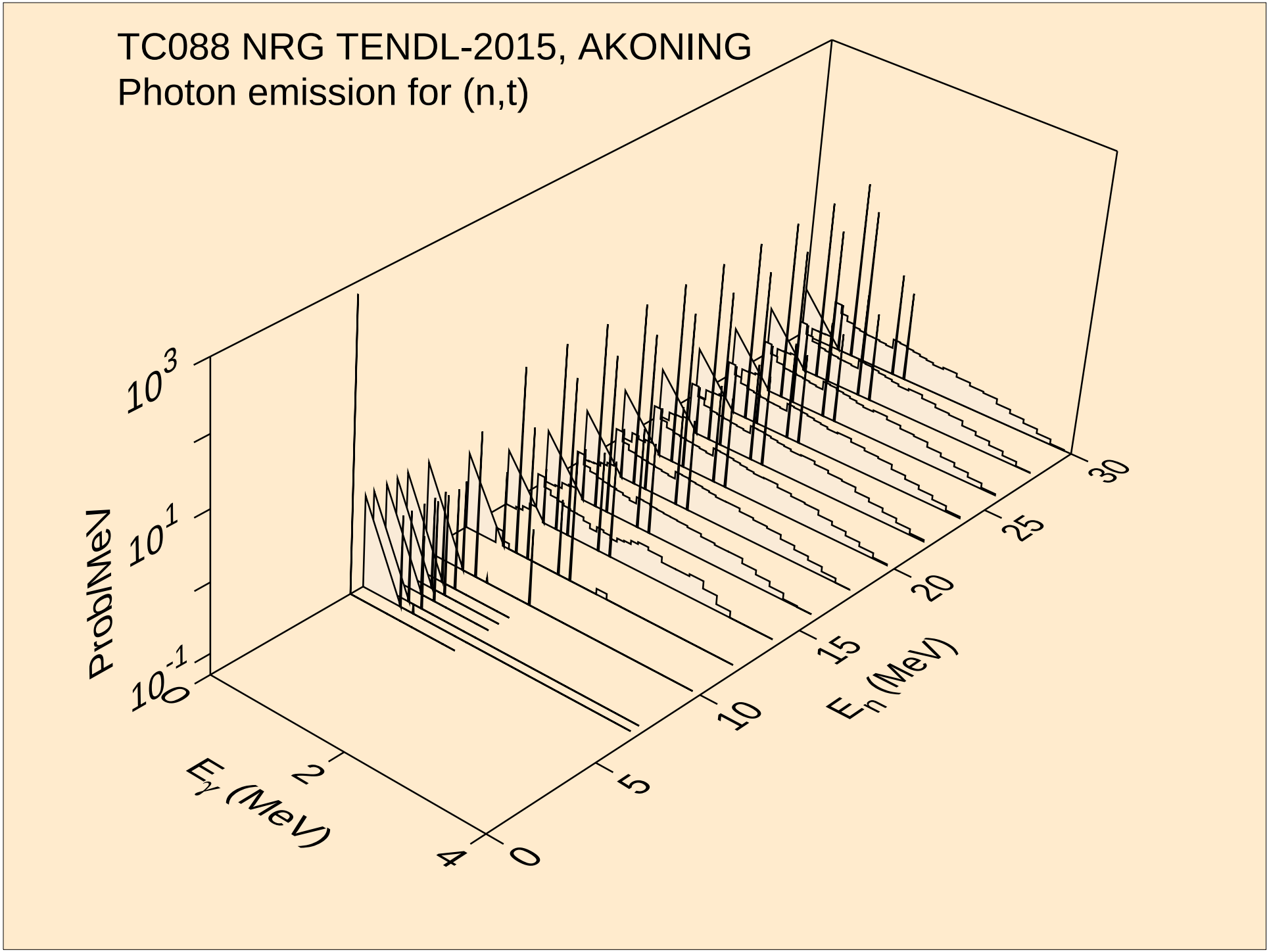

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,npa)
Prob/MeV
10^0
10^-2
0
5
10
E_γ (MeV)
5
10
15
20
25
30
E_n (MeV)

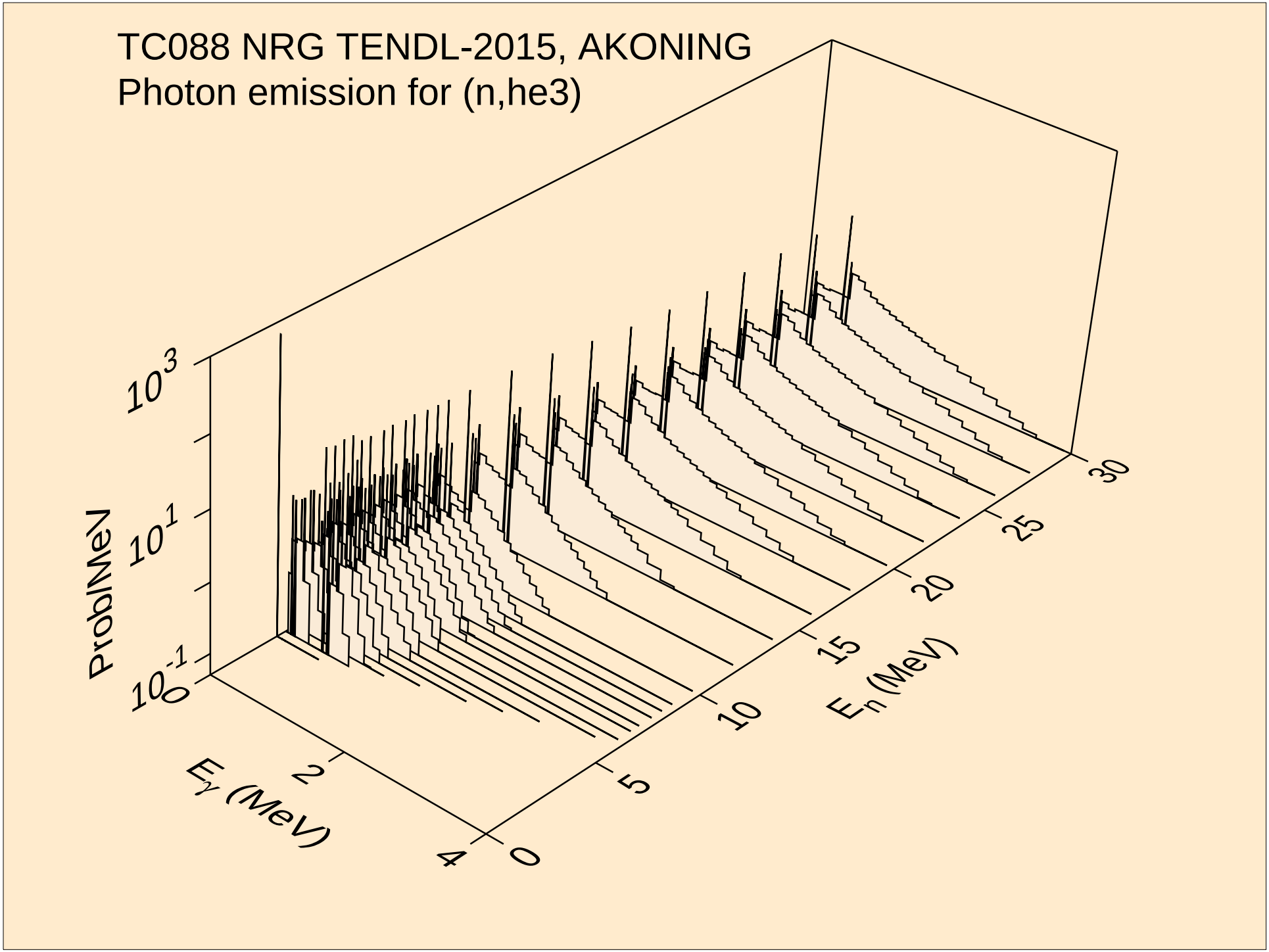

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,n*c)
Prob/MeV
10^{2}
10^{0}
10^{-2}
E_γ (MeV)
0
2
4
6
E_n (MeV)
0
5
10
15
20
25
30

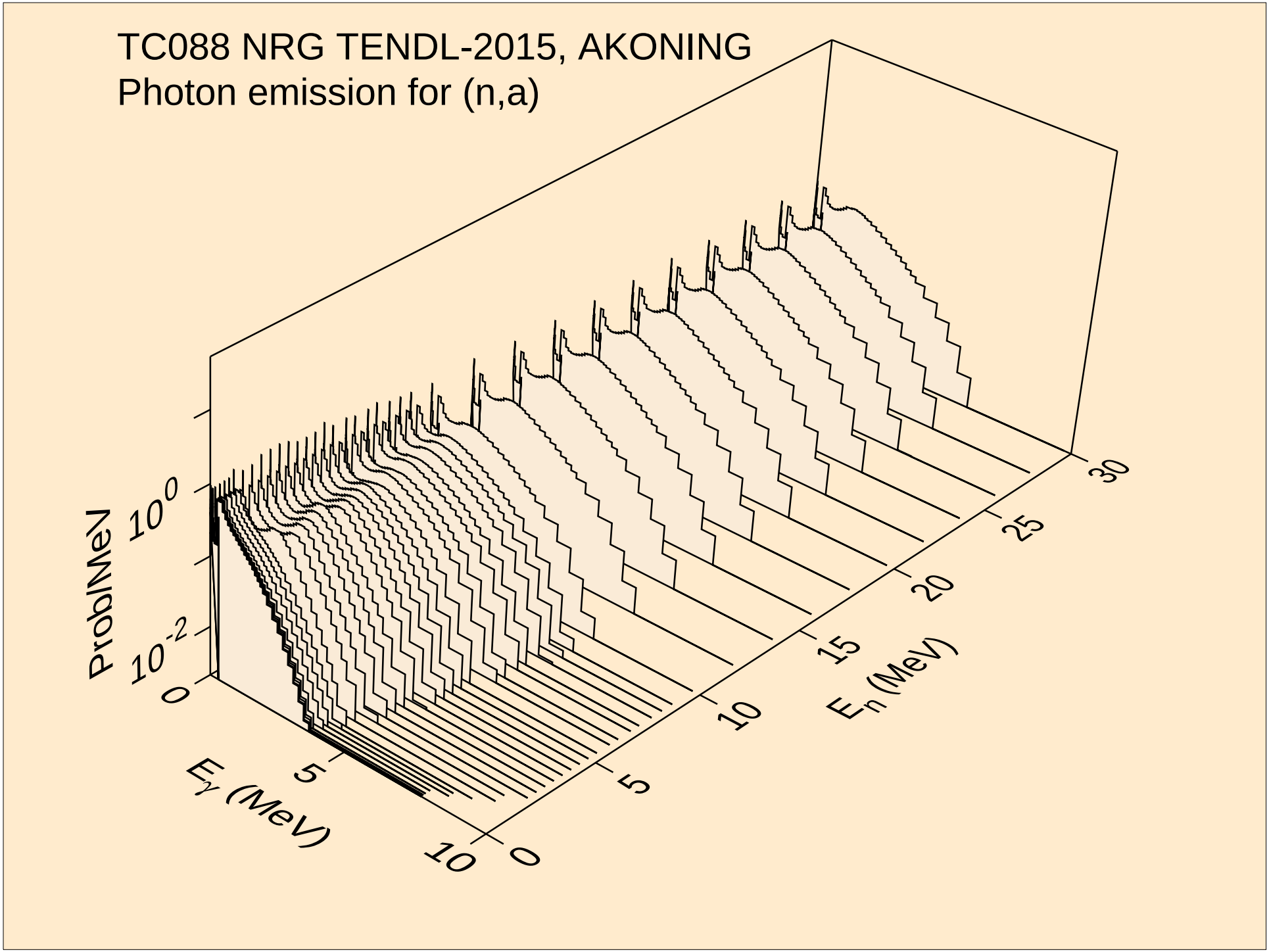

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,gma)
Prob/MeV
10^{1}
10^{-1}
0
20
40
60
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

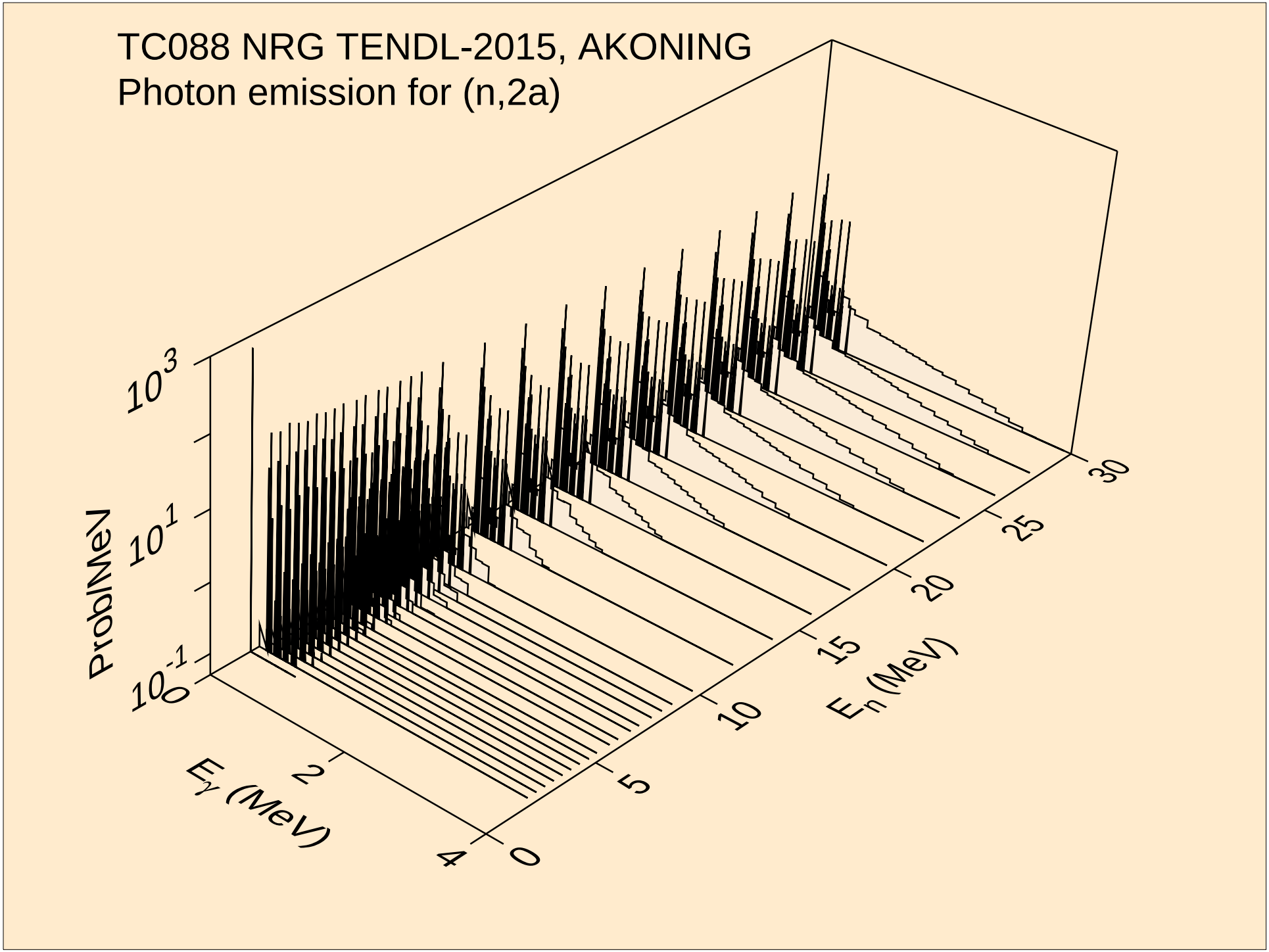

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,p)
Prob/MeV
10^0
10^-2
0
5
10
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

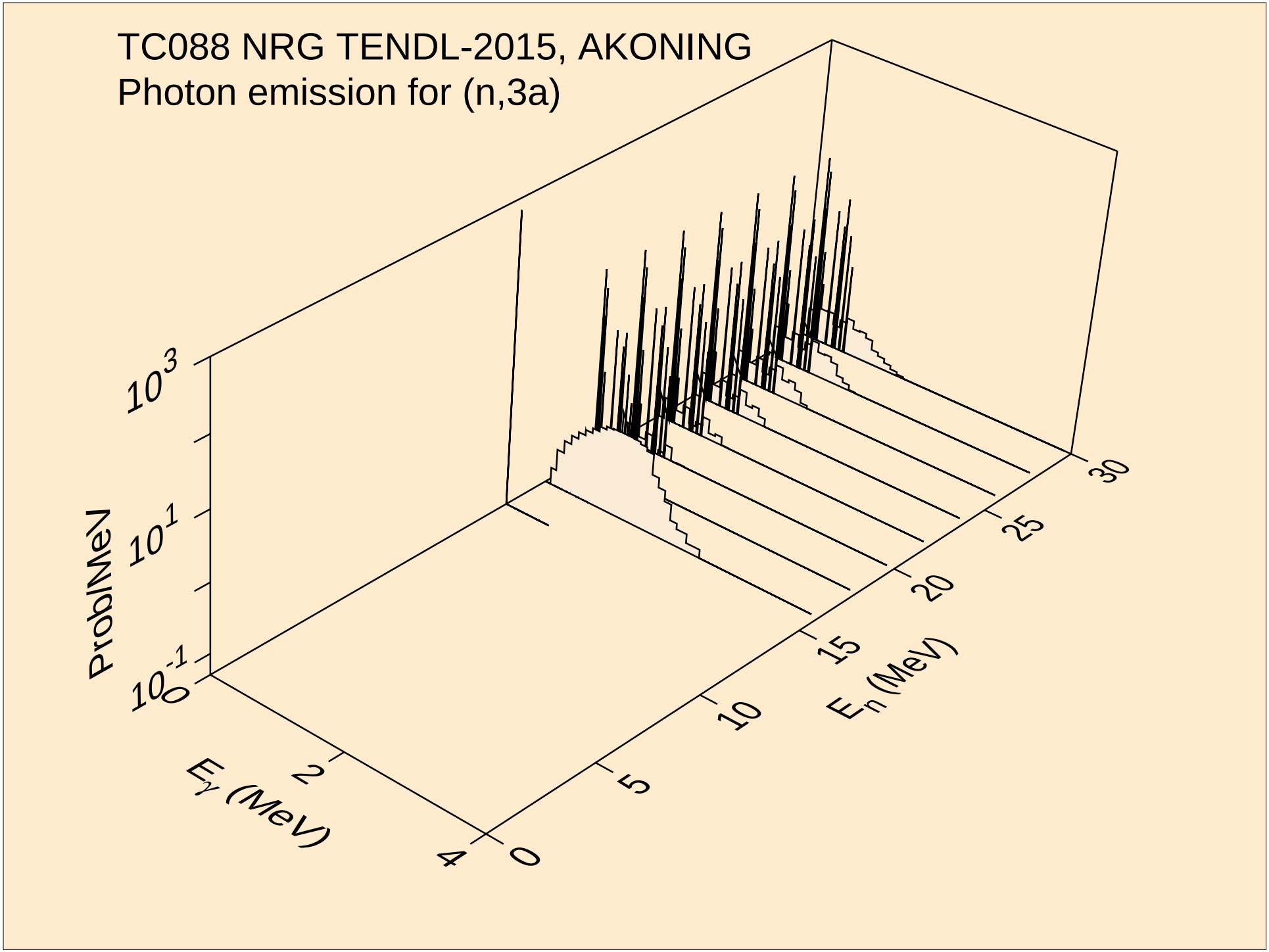

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,d)
Prob/MeV
10^{3}
10^{1}
10^{-1}
0
2
4
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

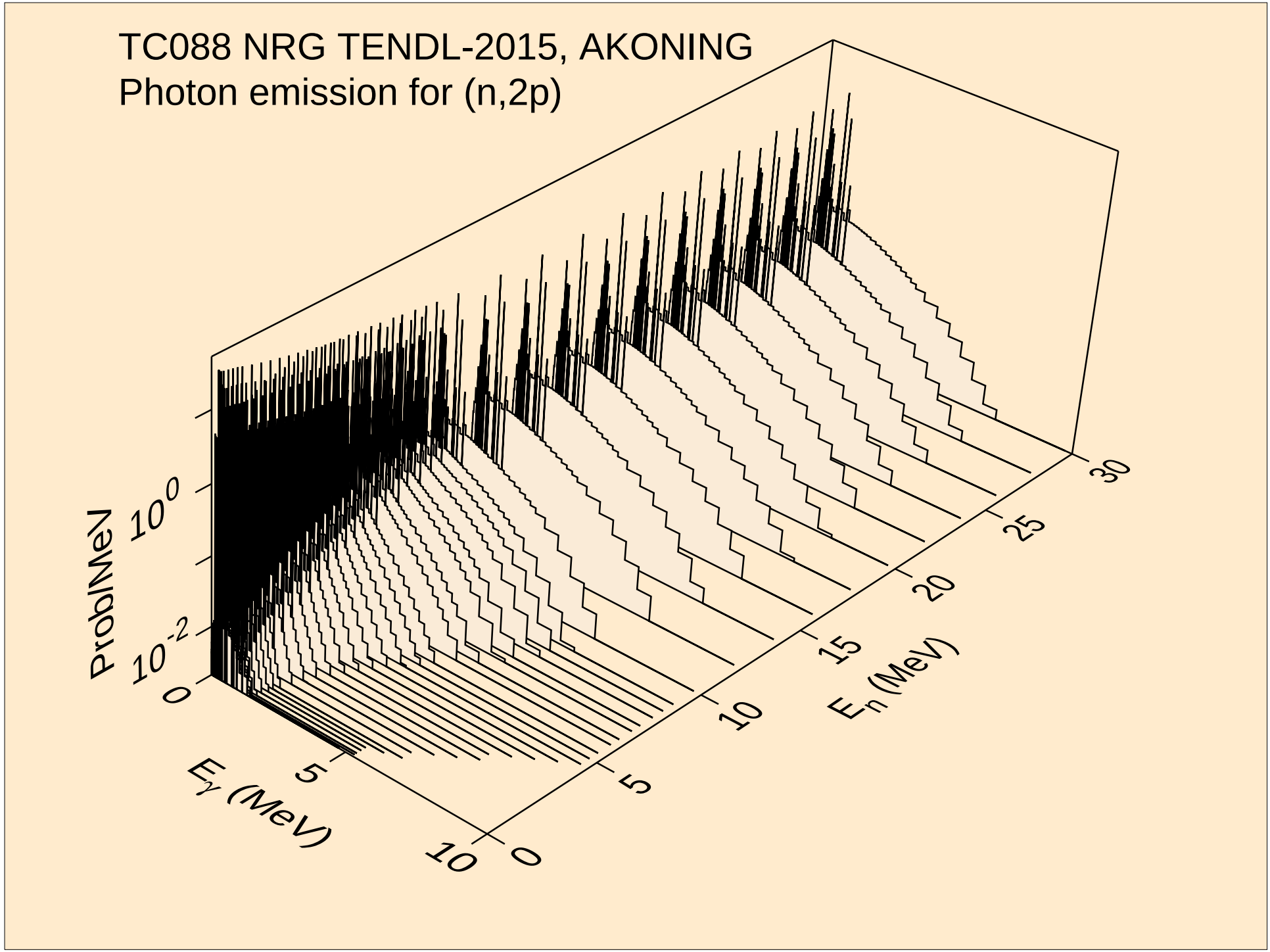

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,t)
Prob/MeV
10^{3}
10^{1}
10^{-1}
E_γ (MeV)
0
2
4
E_n (MeV)
0
5
10
15
20
25
30

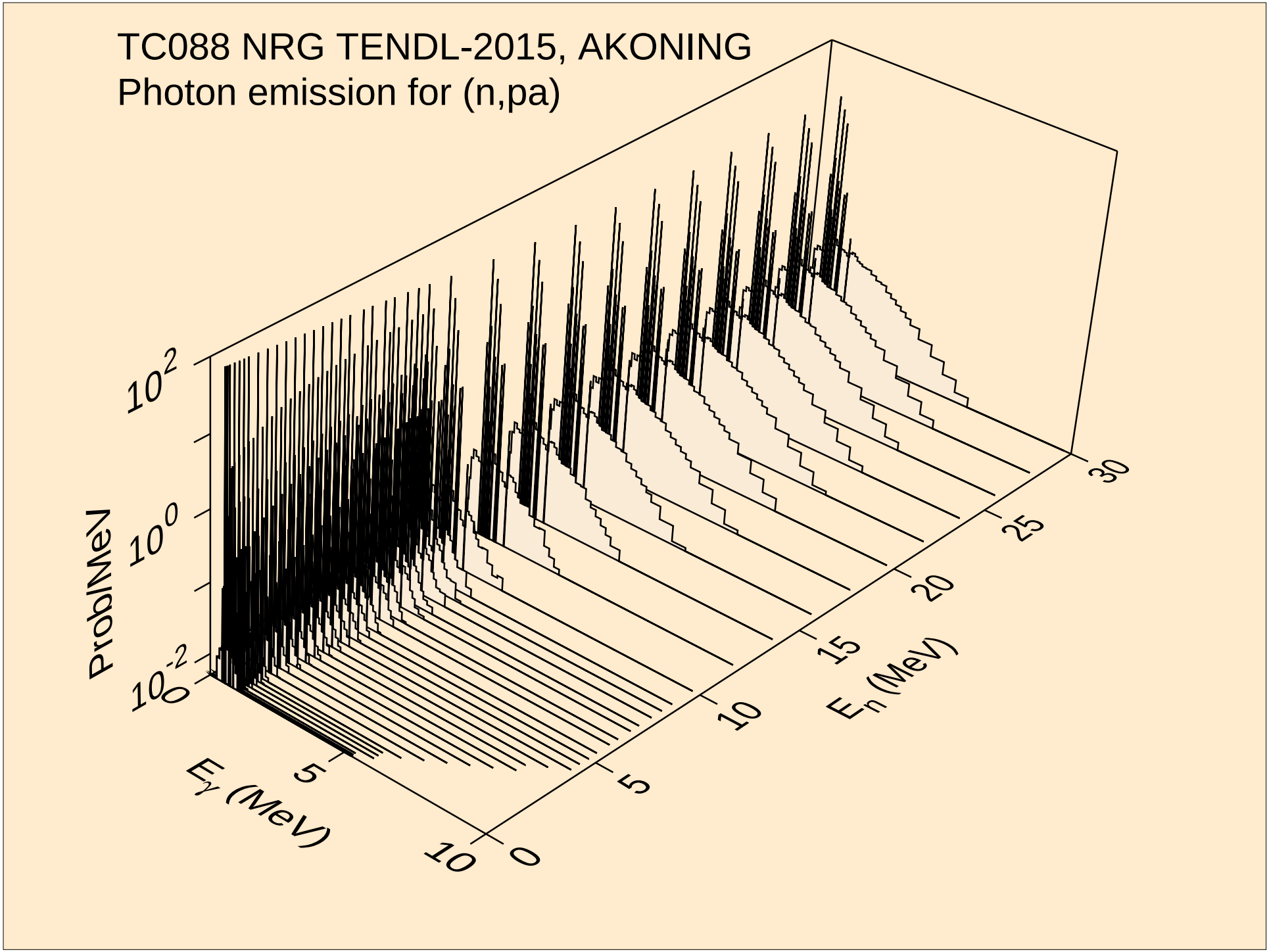

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,he3)
Prob/MeV
10^{3}
10^{1}
10^{-1}
E_γ (MeV)
0
2
4
E_n (MeV)
0
5
10
15
20
25
30

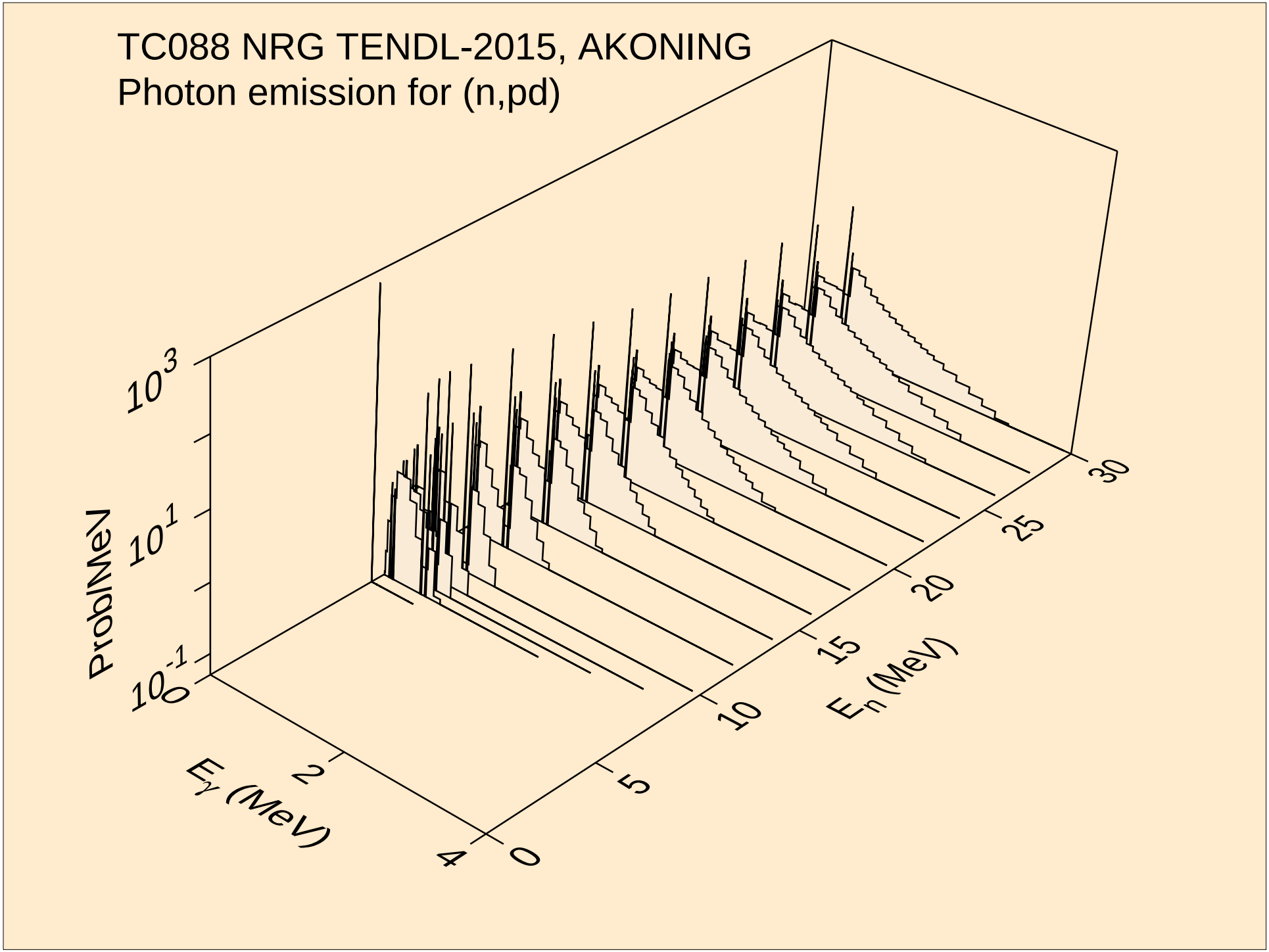

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,a)
Prob/MeV
10^0
10^-2
0
E_γ (MeV)
5
10
0
5
10
15
20
25
30
E_n (MeV)

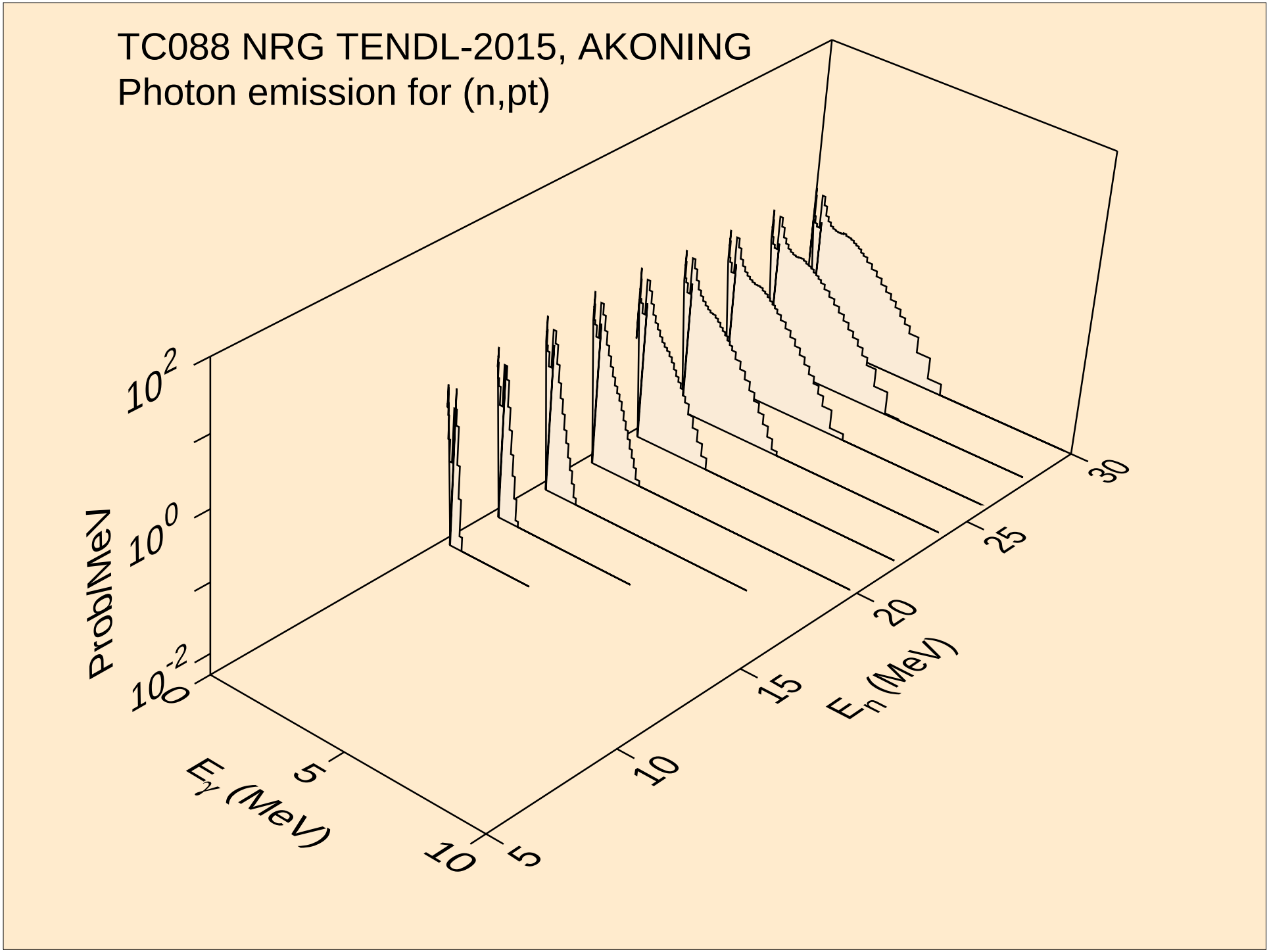

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,2a)
Prob/MeV
10^{3}
10^{1}
10^{-1}
0
2
4
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

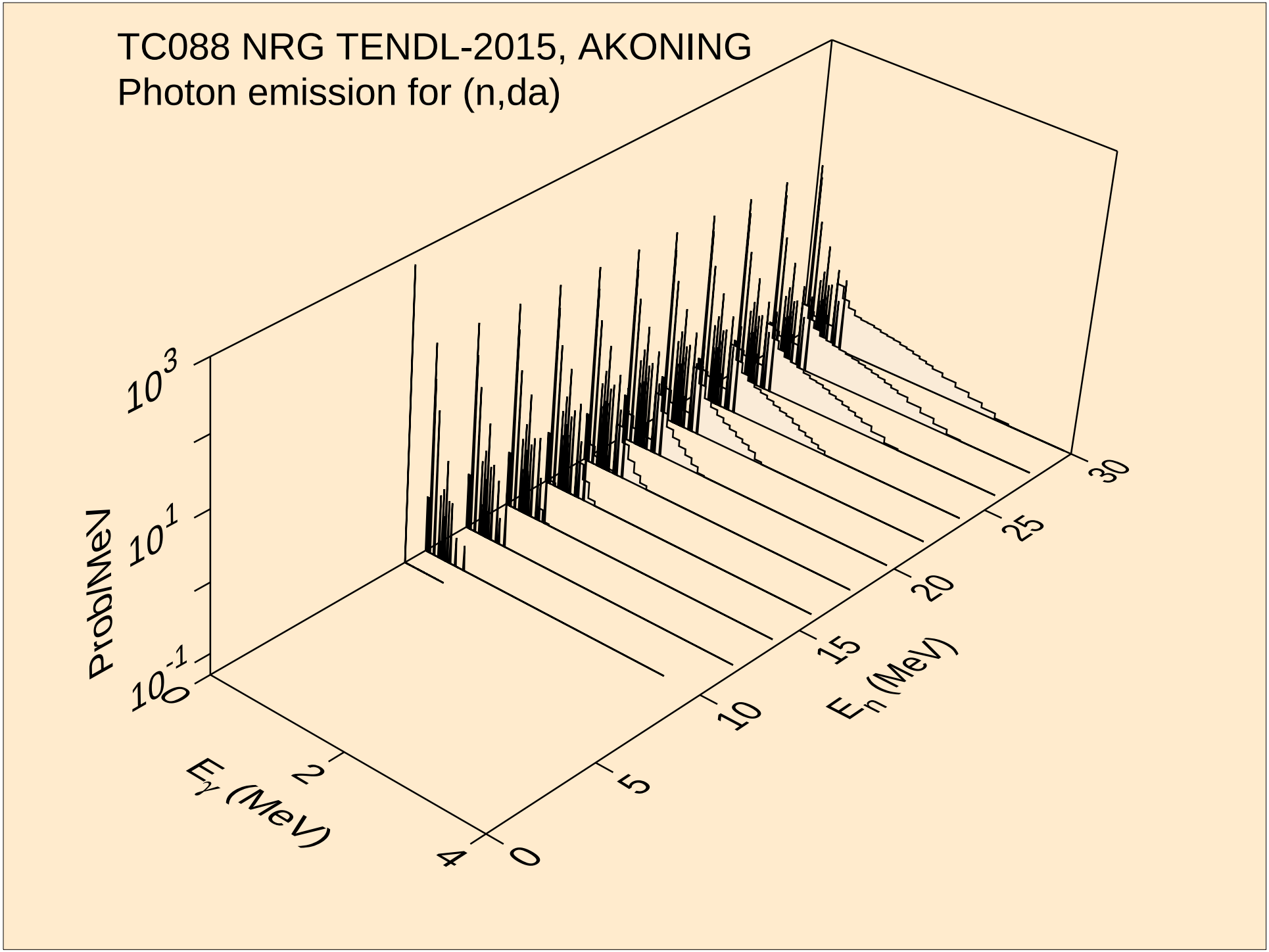

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,3a)
Prob/MeV
10^{3}
10^{1}
10^{-1}
0
2
4
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

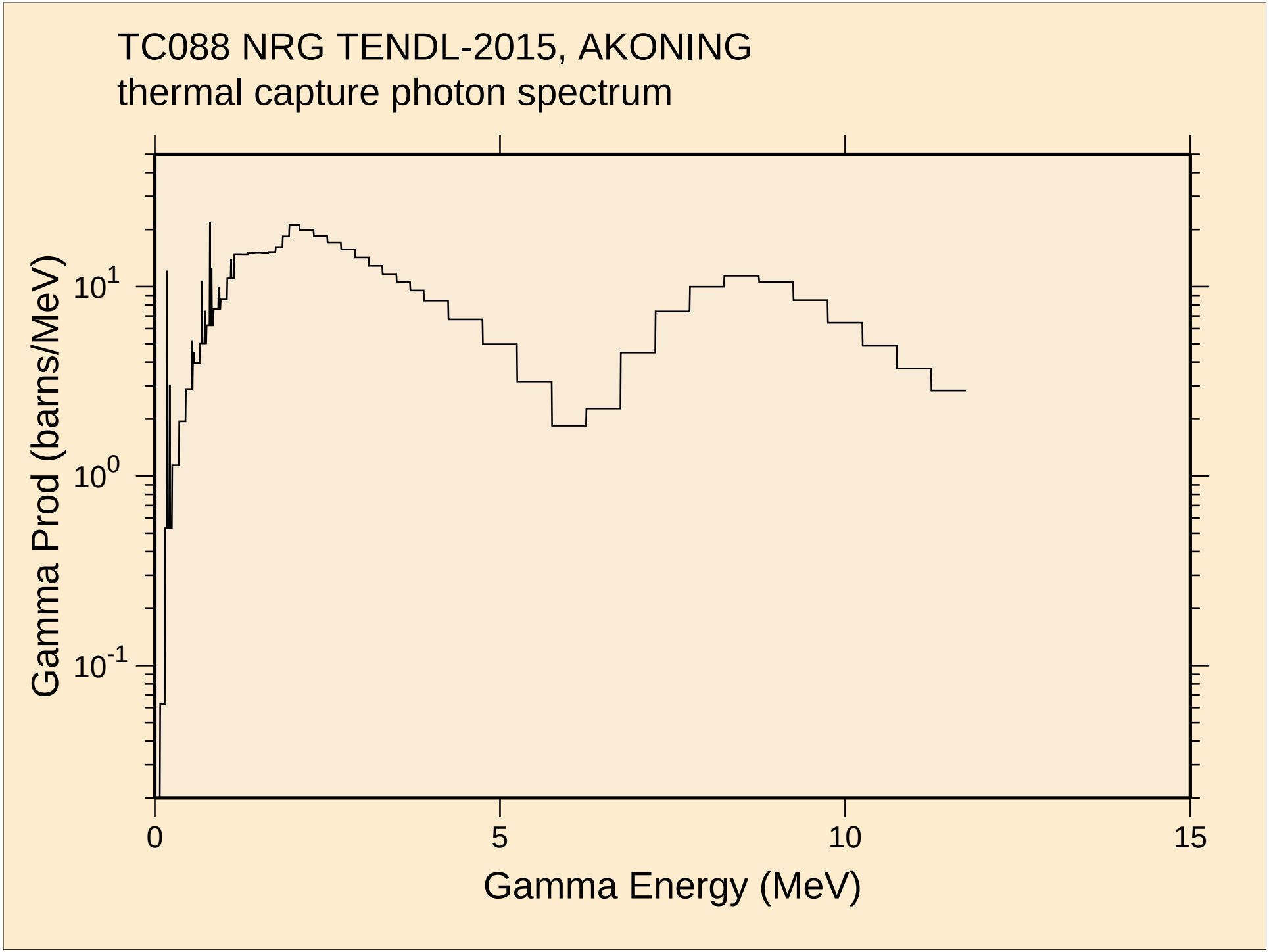

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,2p)
Prob/MeV
10^0
10^-2
0
5
10
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

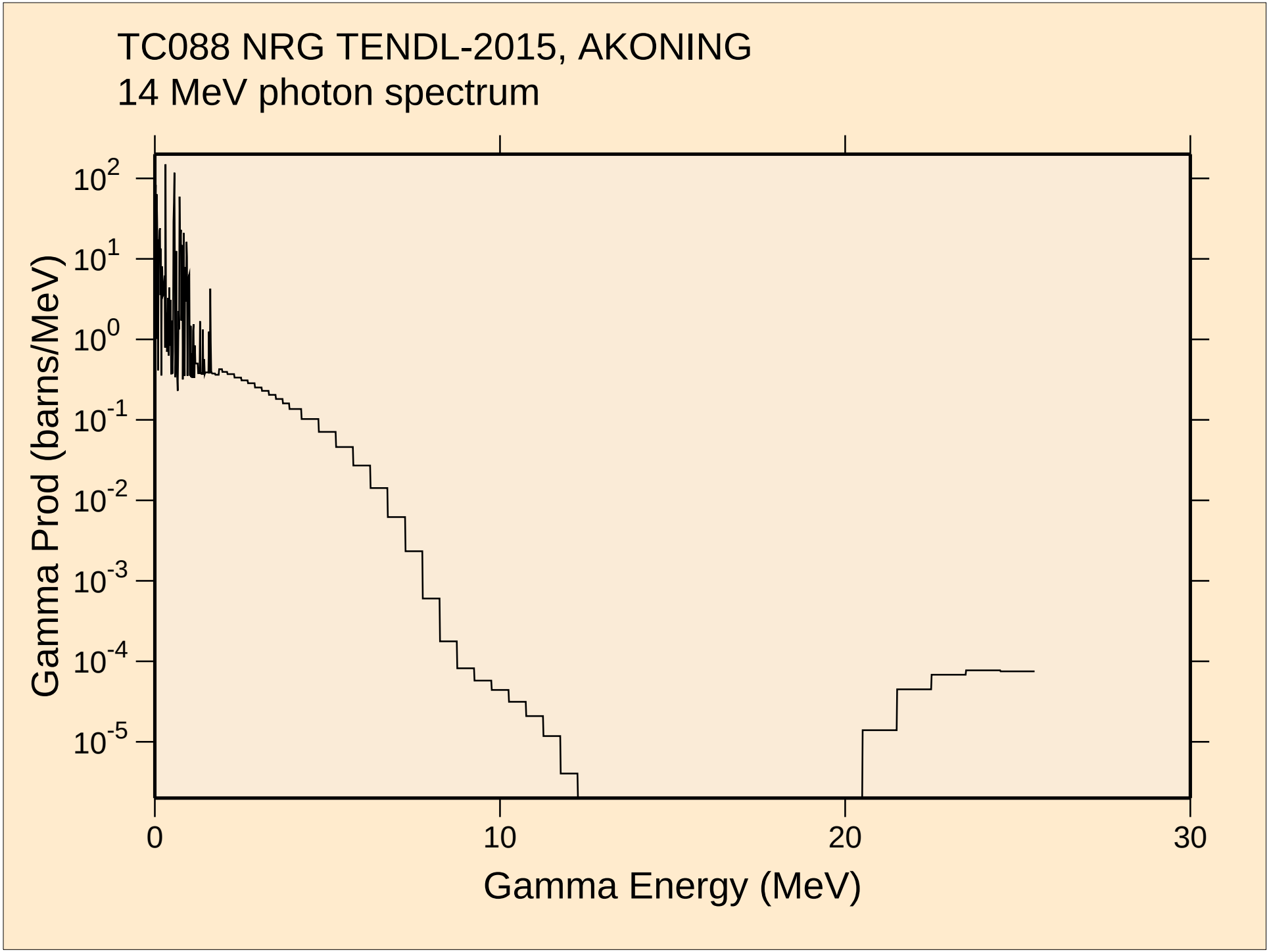

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,pa)
Prob/MeV
10^{2}
10^{0}
10^{-2}
0
5
10
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

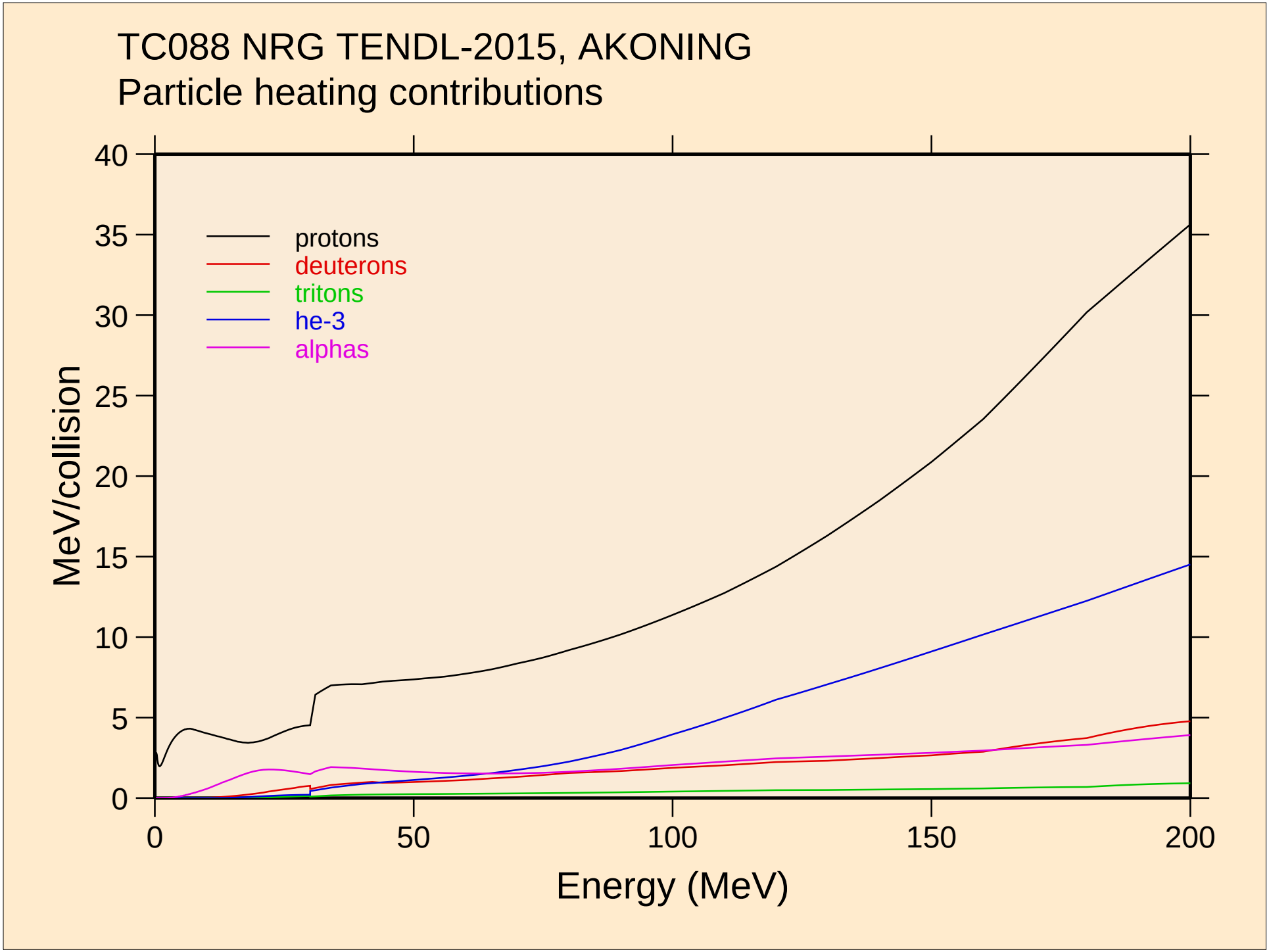

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,pd)
Prob/MeV
10^{3}
10^{1}
10^{-1}
E_γ (MeV)
0
2
4
E_n (MeV)
0
5
10
15
20
25
30

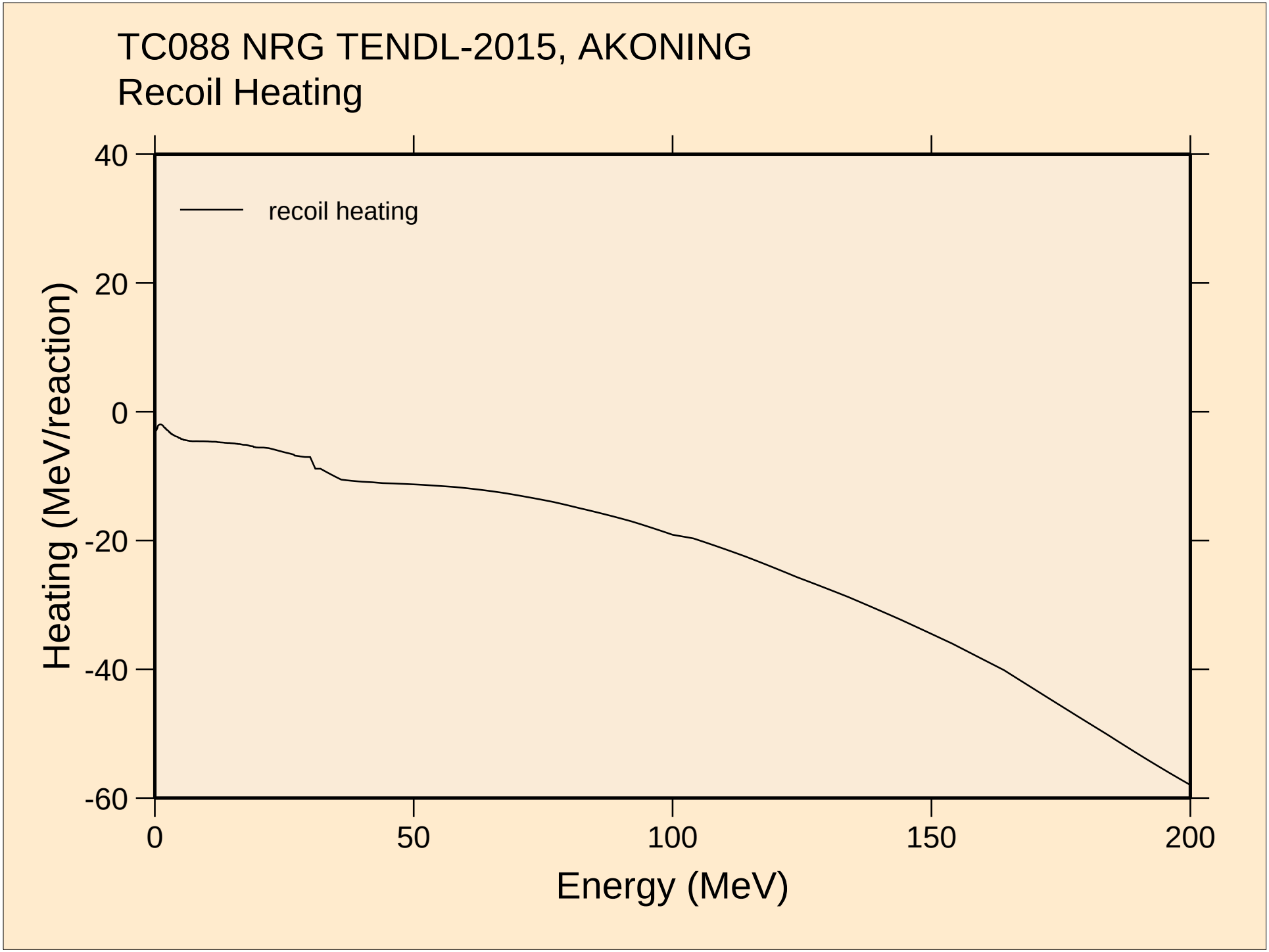

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,pt)
Prob/MeV
10^{2}
10^{0}
10^{-2}
0
5
10
E_γ (MeV)
5
10
15
20
25
30
E_n (MeV)

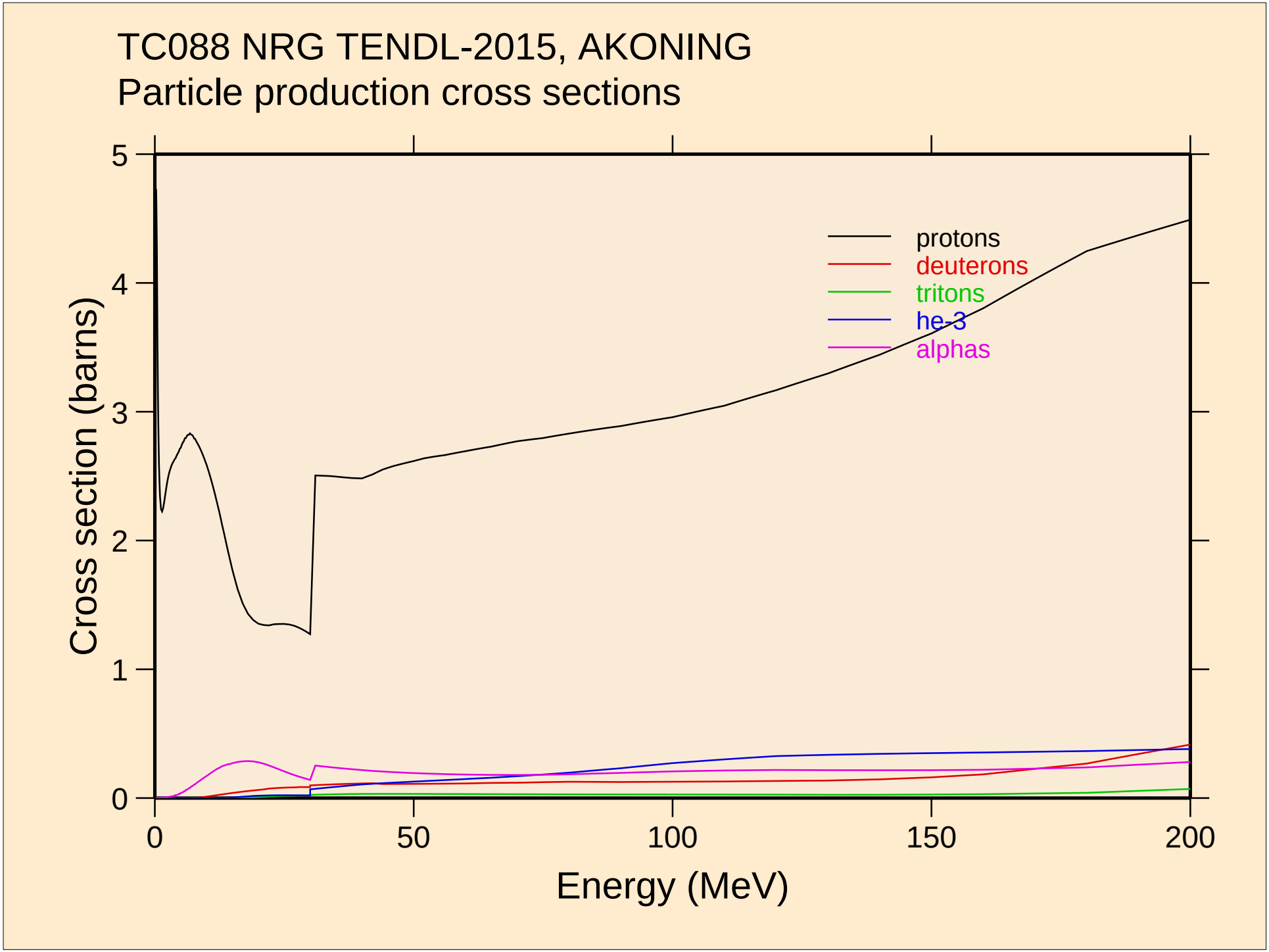

TC088 NRG TENDL-2015, AKONING
Photon emission for (n,da)
Prob/MeV
10^{3}
10^{1}
10^{-1}
0
2
4
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

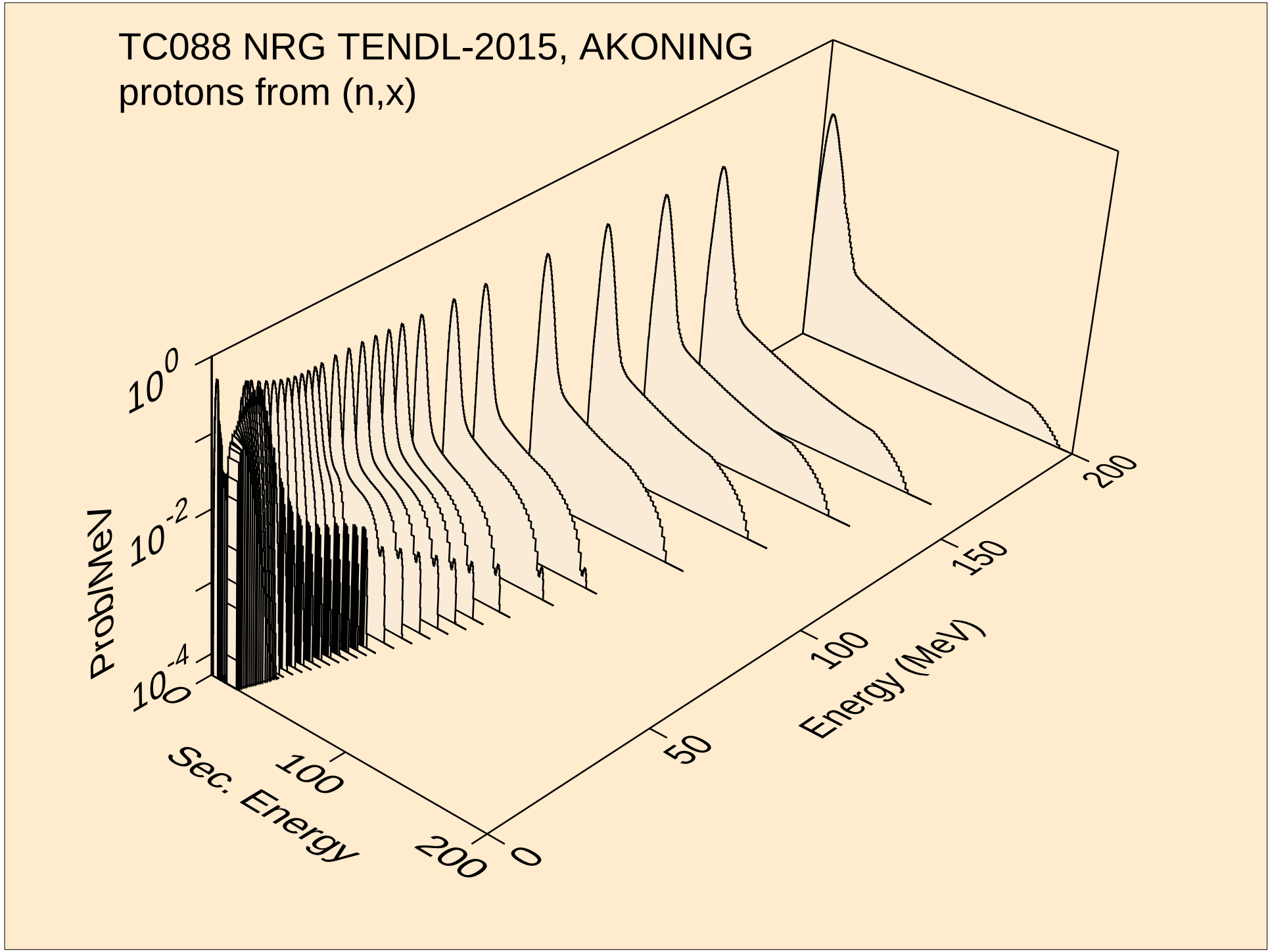

TC088 NRG TENDL-2015, AKONING
thermal capture photon spectrum
Gamma Prod (barns/MeV)
10^1
10^0
10^-1
0
5
10
15
Gamma Energy (MeV)

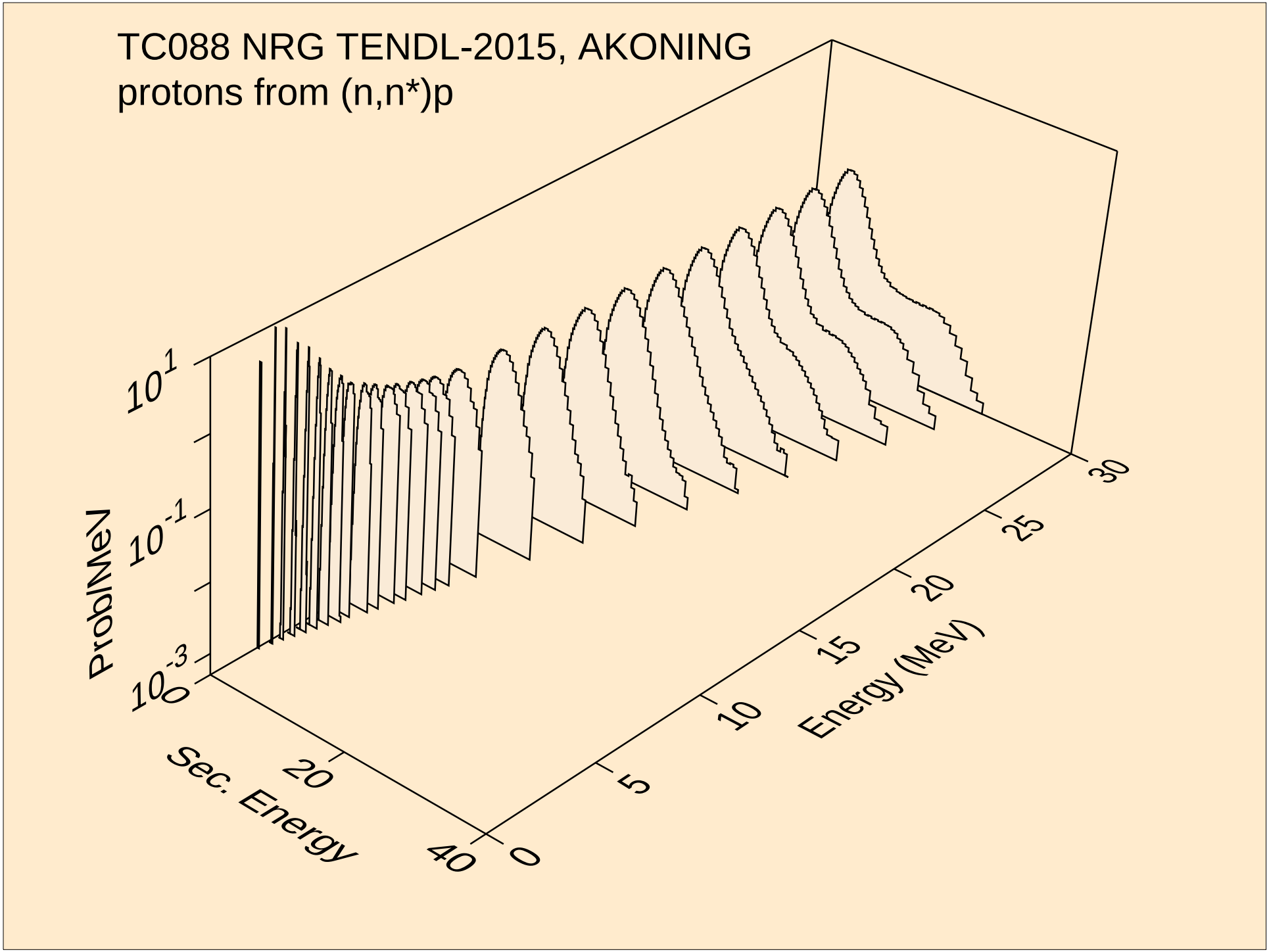

TC088 NRG TENDL-2015, AKONING
14 MeV photon spectrum
Gamma Prod (barns/MeV)
10^2
10^1
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
0
10
20
30
Gamma Energy (MeV)

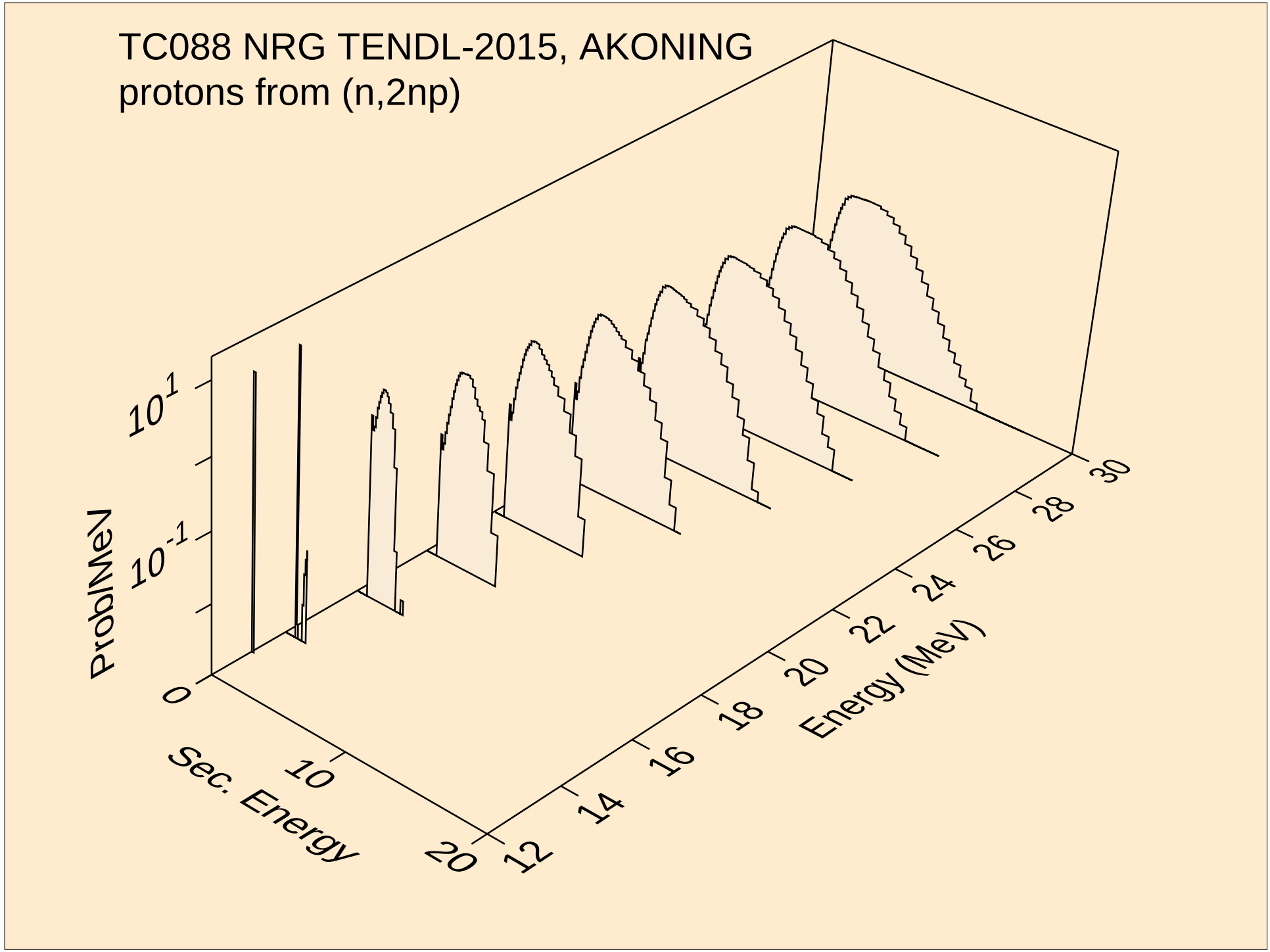

TC088 NRG TENDL-2015, AKONING
Particle heating contributions
protons
deuterons
tritons
he-3
alphas
MeV/collision
Energy (MeV)
0
5
10
15
20
25
30
35
40
0
50
100
150
200

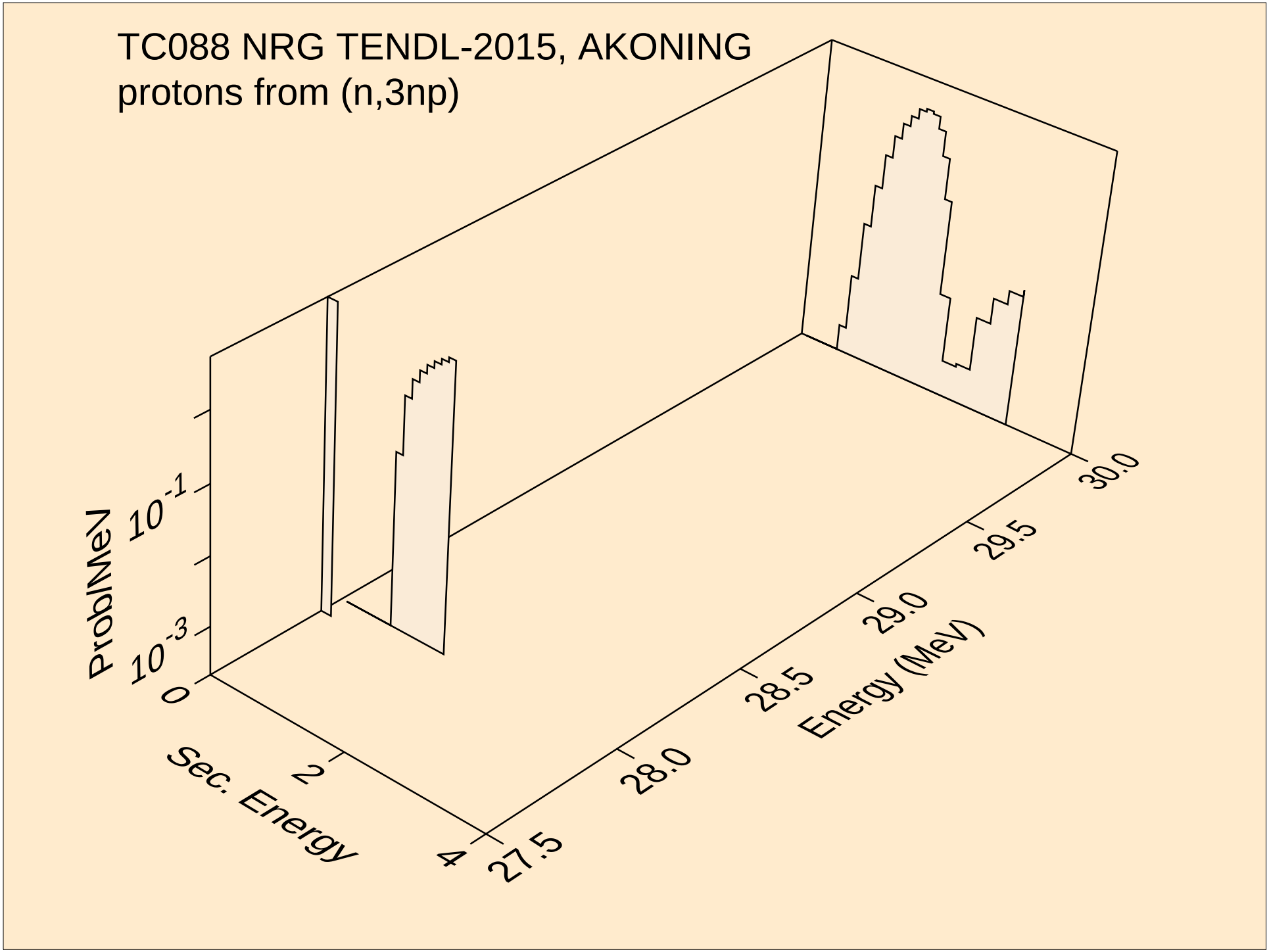

TC088 NRG TENDL-2015, AKONING
Recoil Heating
recoil heating
Heating (MeV/reaction)
40
20
0
-20
-40
-60
0
50
100
150
200
Energy (MeV)

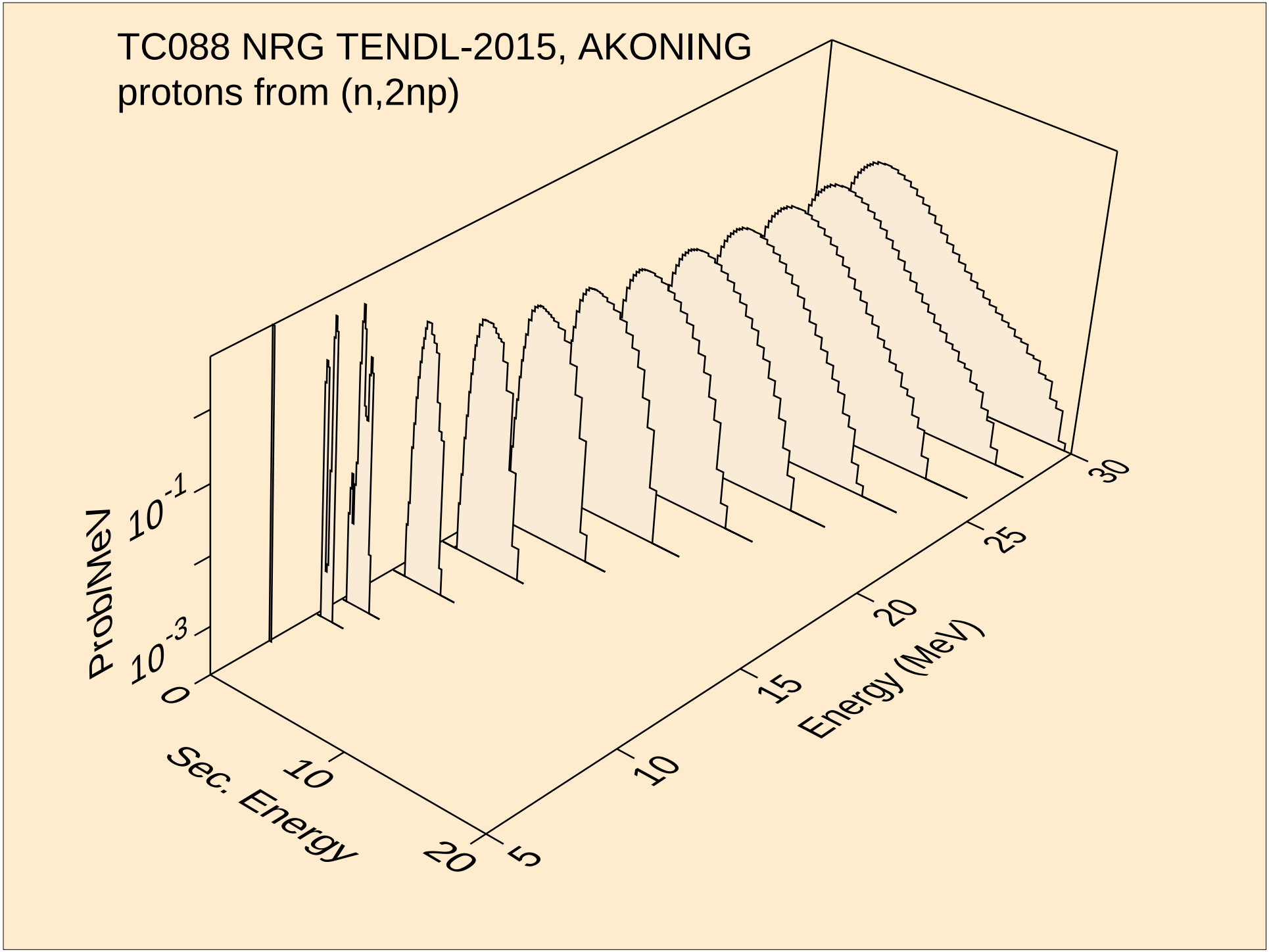

TC088 NRG TENDL-2015, AKONING
Particle production cross sections
Cross section (barns)
Energy (MeV)
0
1
2
3
4
5
0
50
100
150
200
protons
deuterons
tritons
he-3
alphas

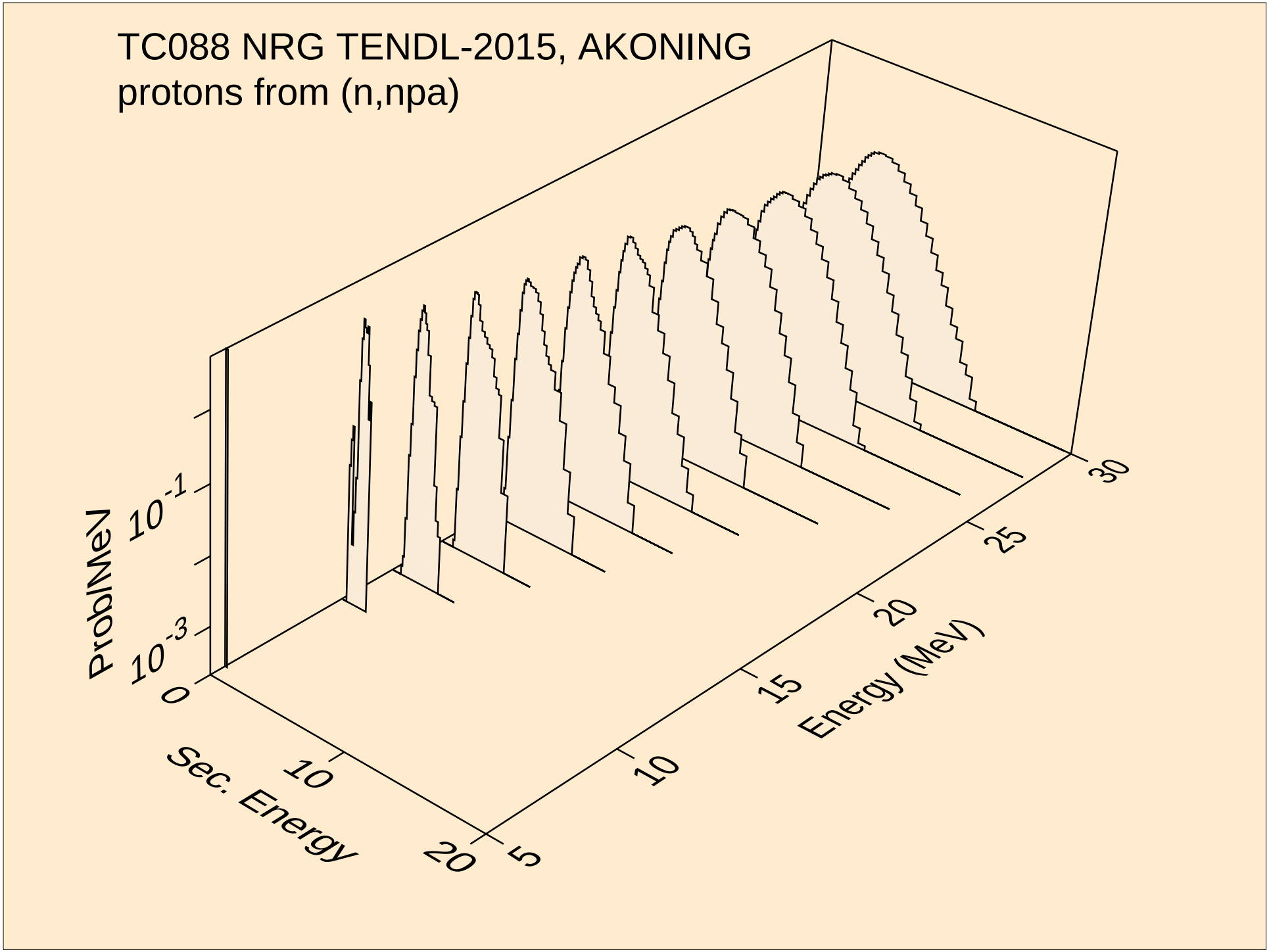

TC088 NRG TENDL-2015, AKONING
protons from (n,x)
Prob/MeV
10^0
10^-2
10^-4
0
100
200
Sec. Energy
0
50
100
150
200
Energy (MeV)

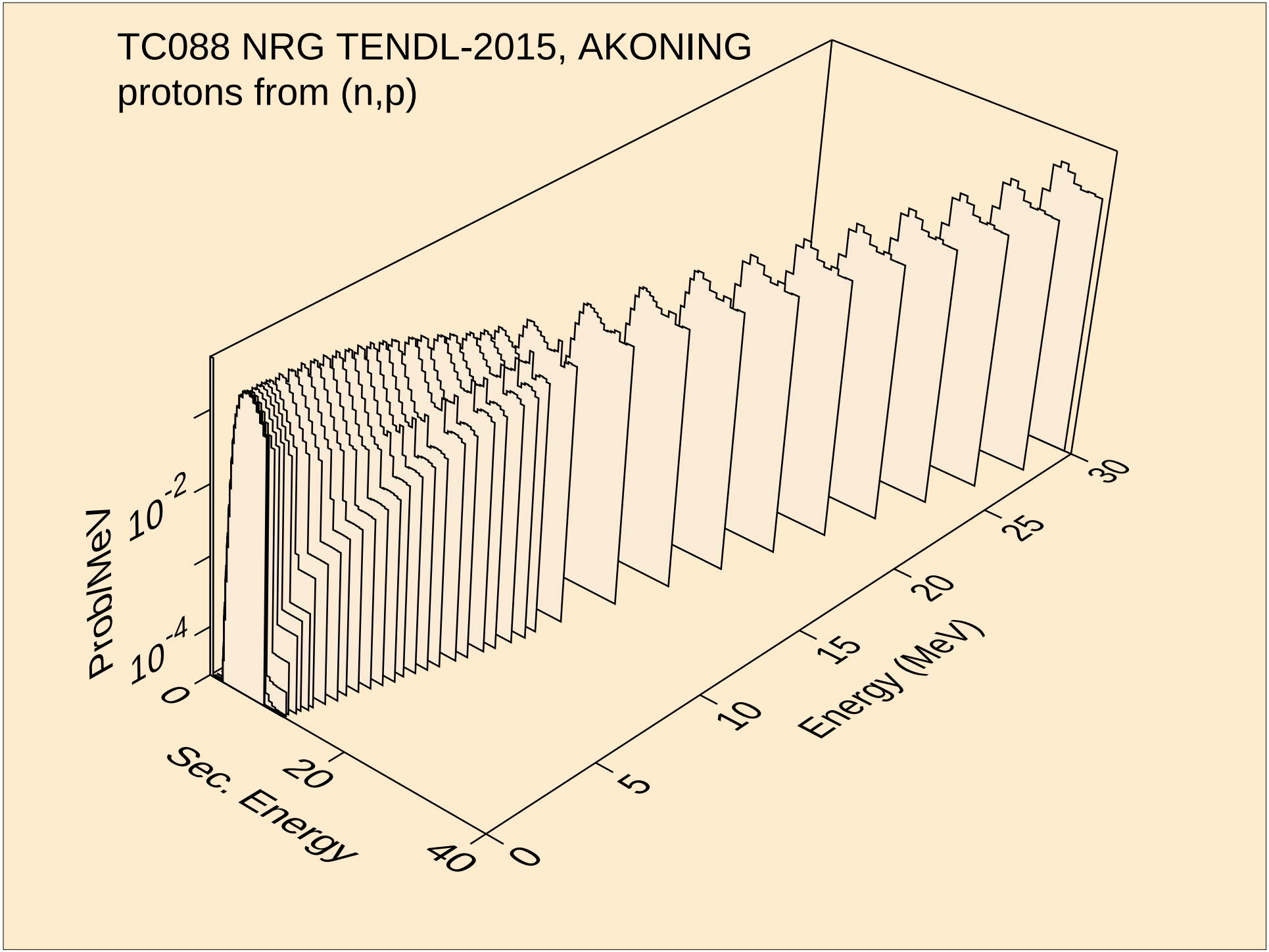

TC088 NRG TENDL-2015, AKONING
protons from (n,n*)p
Prob/MeV
10^1
10^-1
10^-3
0
20
40
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)

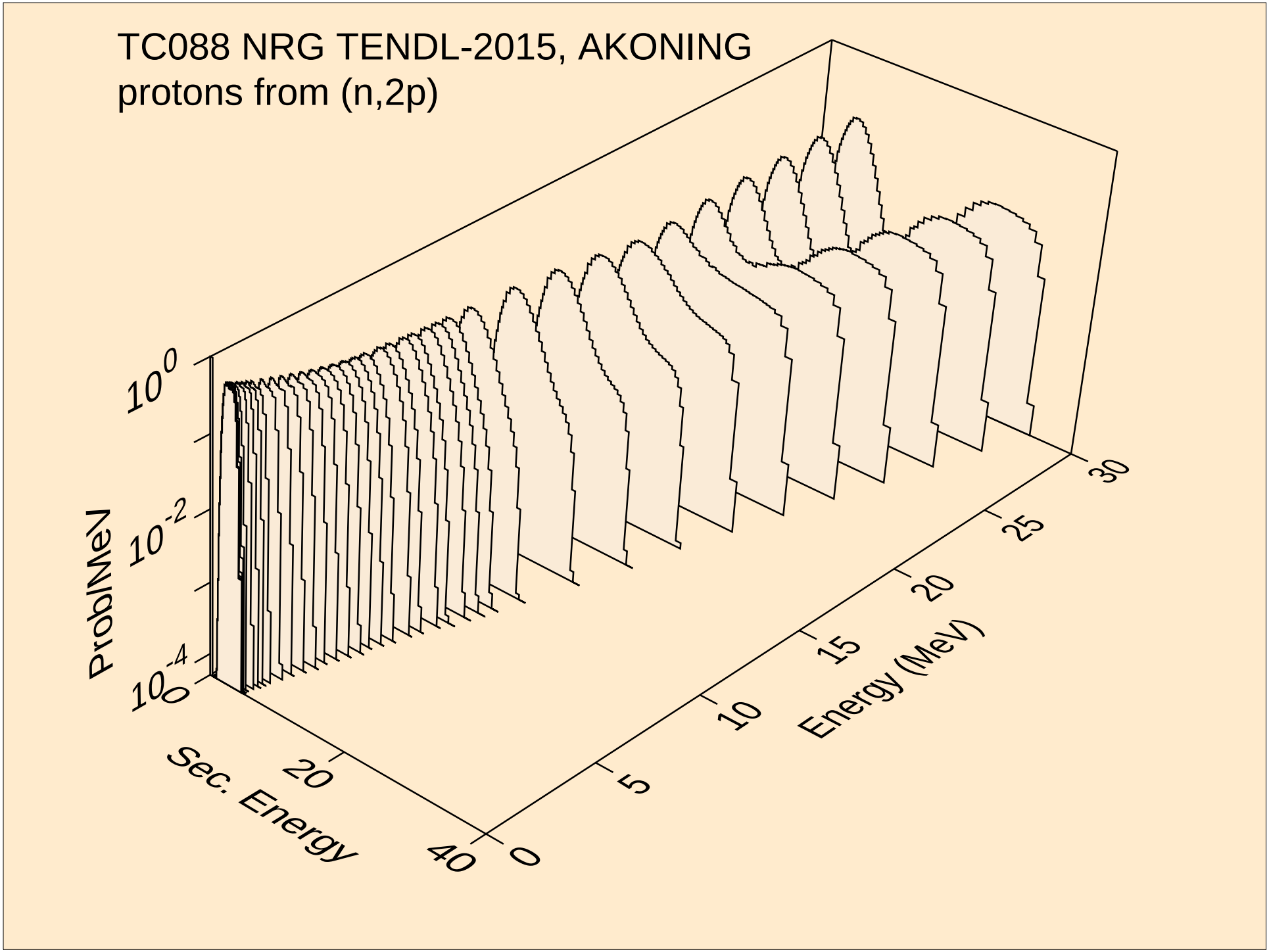

TC088 NRG TENDL-2015, AKONING
protons from (n,2np)
Prob/MeV
10^{1}
10^{-1}
0
Sec. Energy
10
20
12
14
16
18
20
22
24
26
28
30
Energy (MeV)

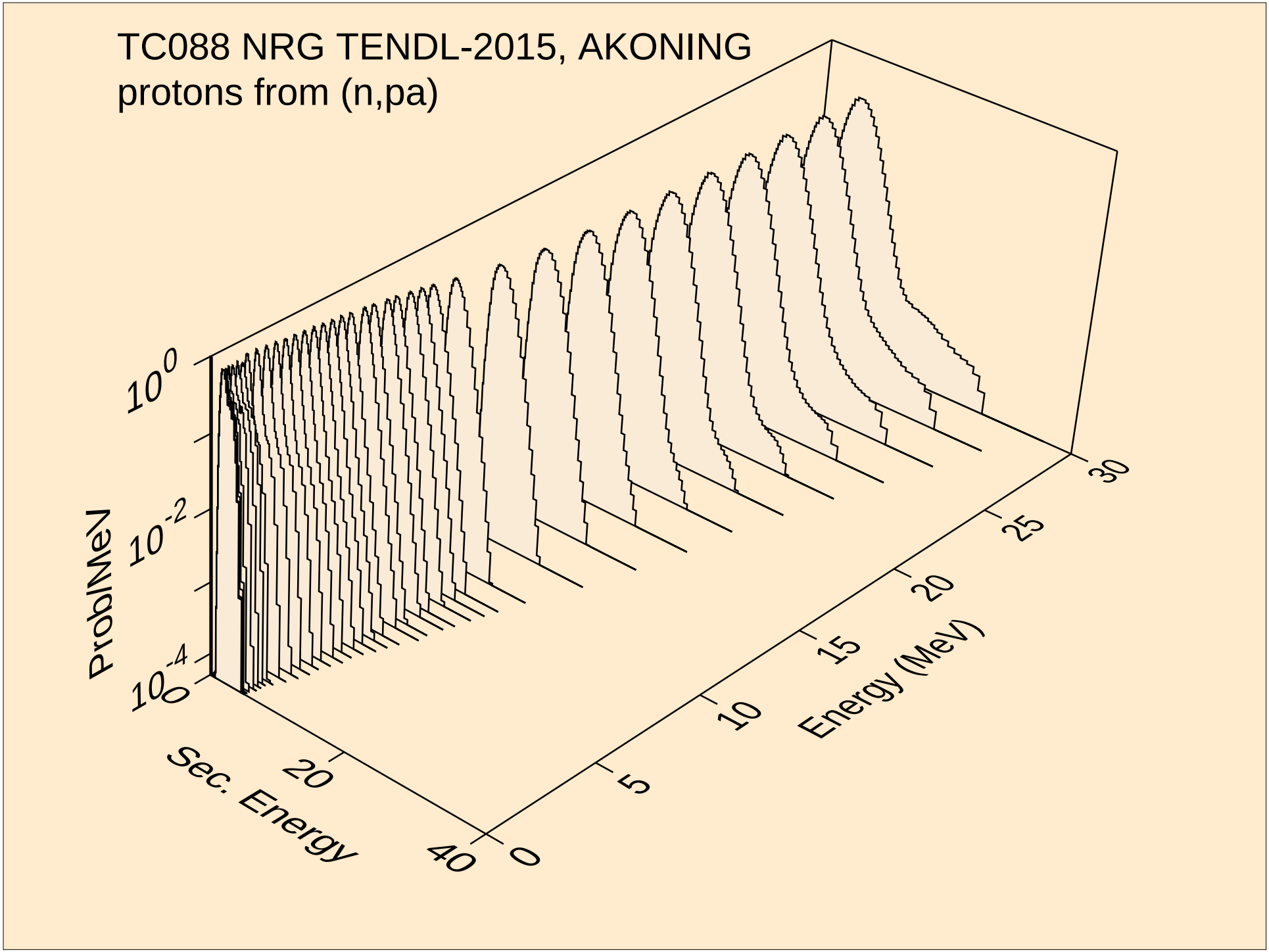

TC088 NRG TENDL-2015, AKONING
protons from (n,3np)
Prob/MeV
10-1
10-3
0
Sec. Energy
2
4
27.5
28.0
28.5
29.0
29.5
30.0
Energy (MeV)

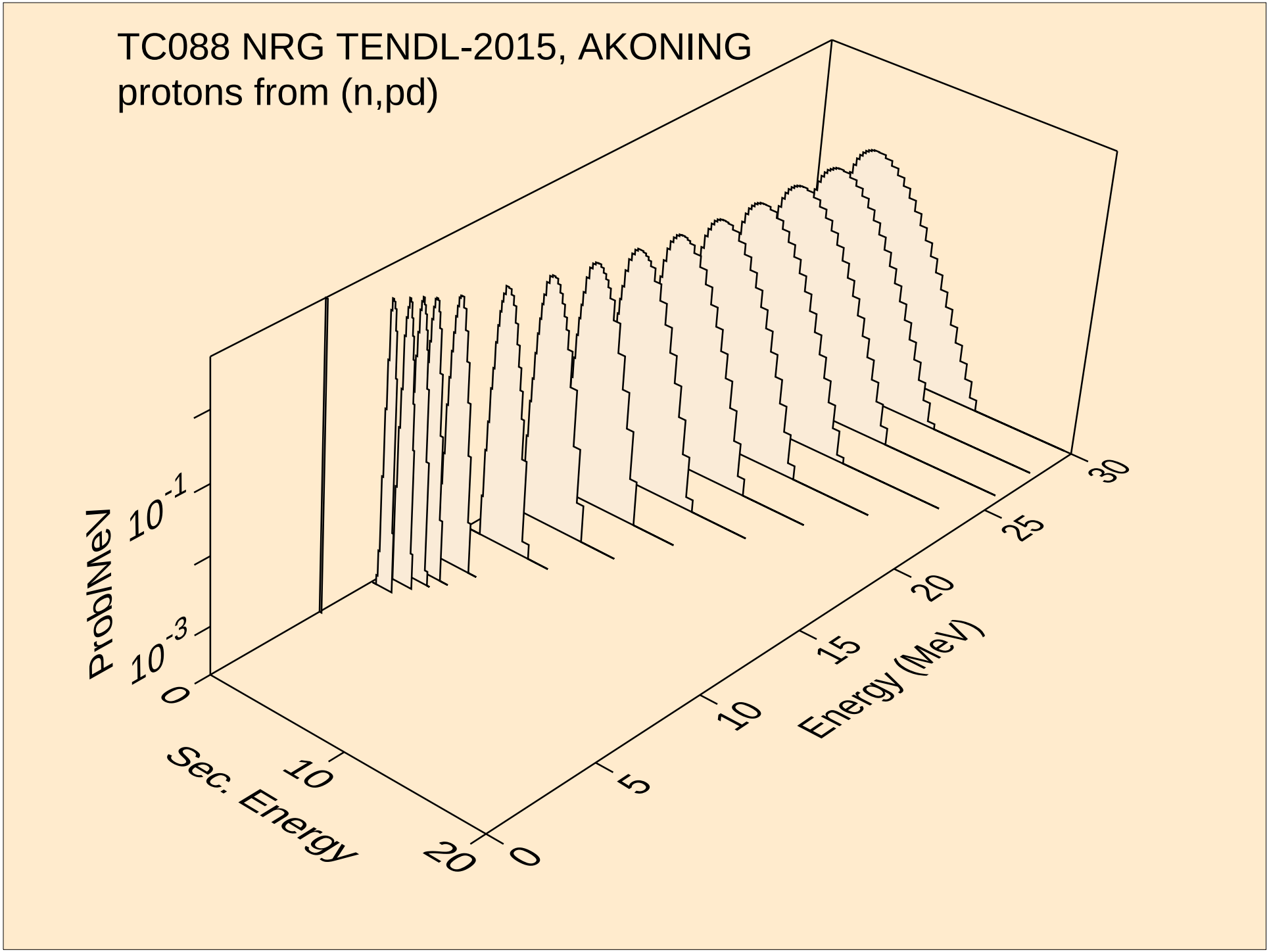

TC088 NRG TENDL-2015, AKONING
protons from (n,2np)
Prob/MeV
10-1
10-3
0
Sec. Energy
10
20
5
10
15
20
25
30
Energy (MeV)

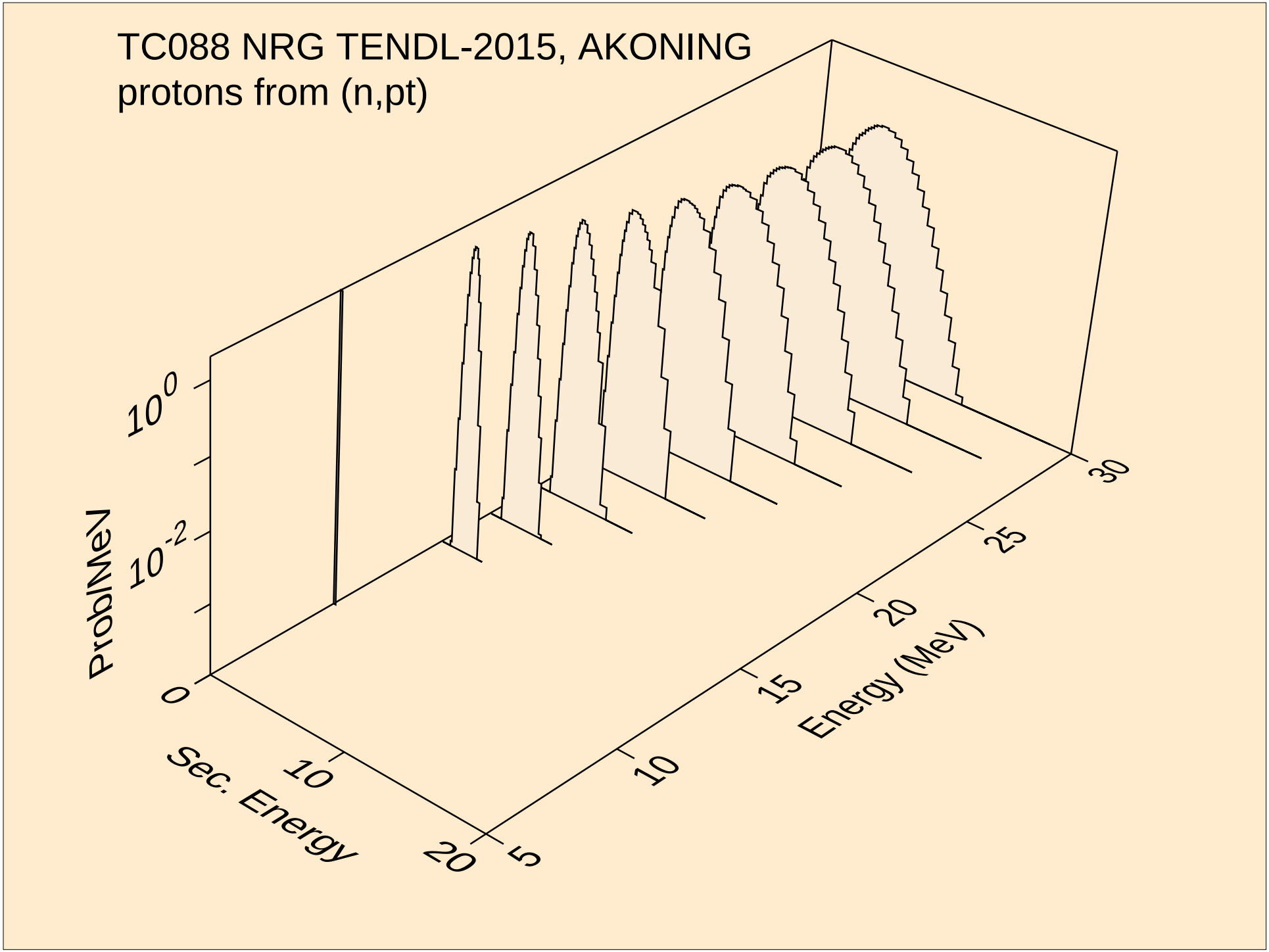

TC088 NRG TENDL-2015, AKONING
protons from (n,npa)
Prob/MeV
10-1
10-3
0
Sec. Energy
10
20
5
10
15
20
25
30
Energy (MeV)

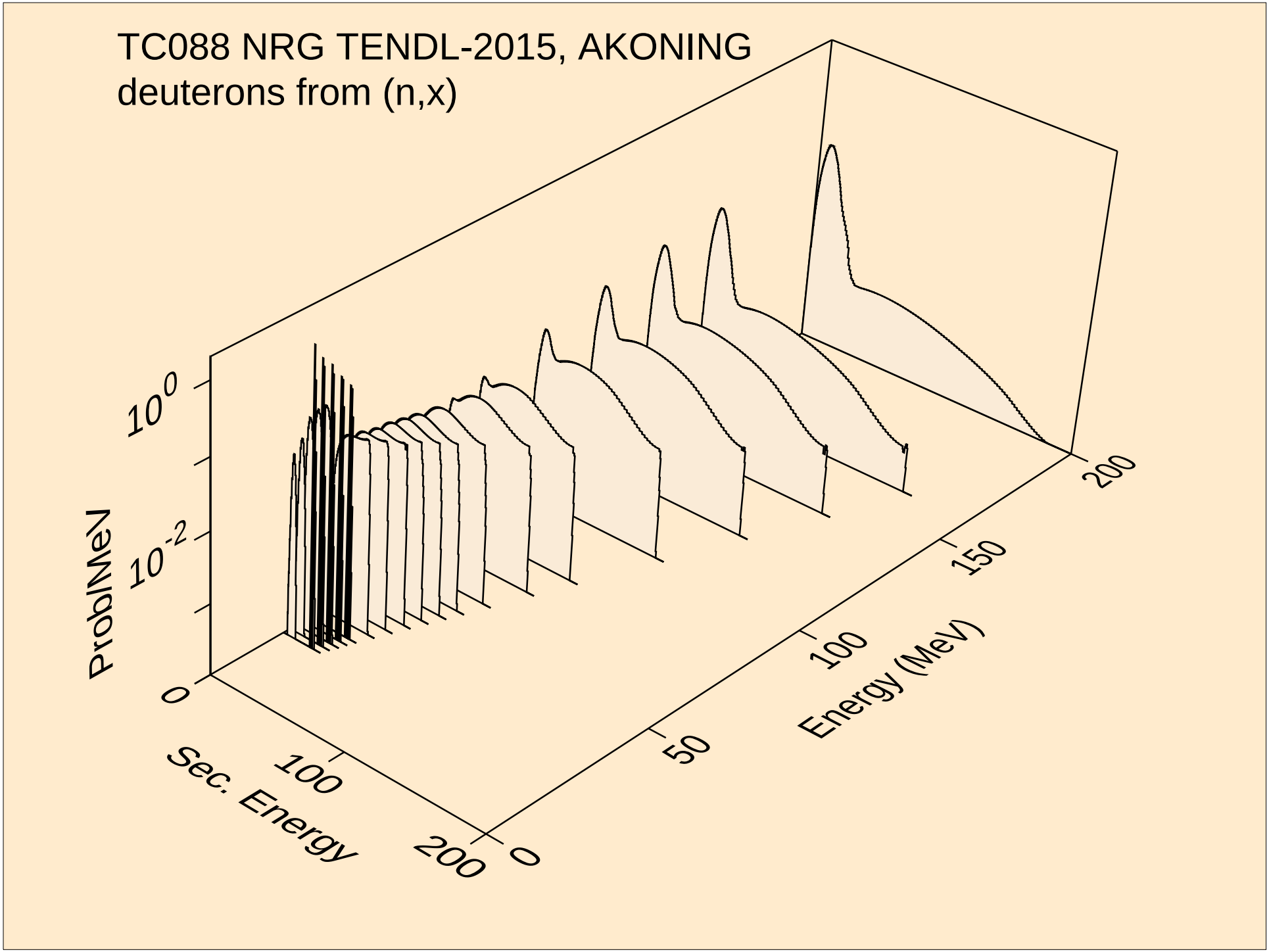

TC088 NRG TENDL-2015, AKONING
protons from (n,p)
Prob/MeV
10-2
10-4
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)

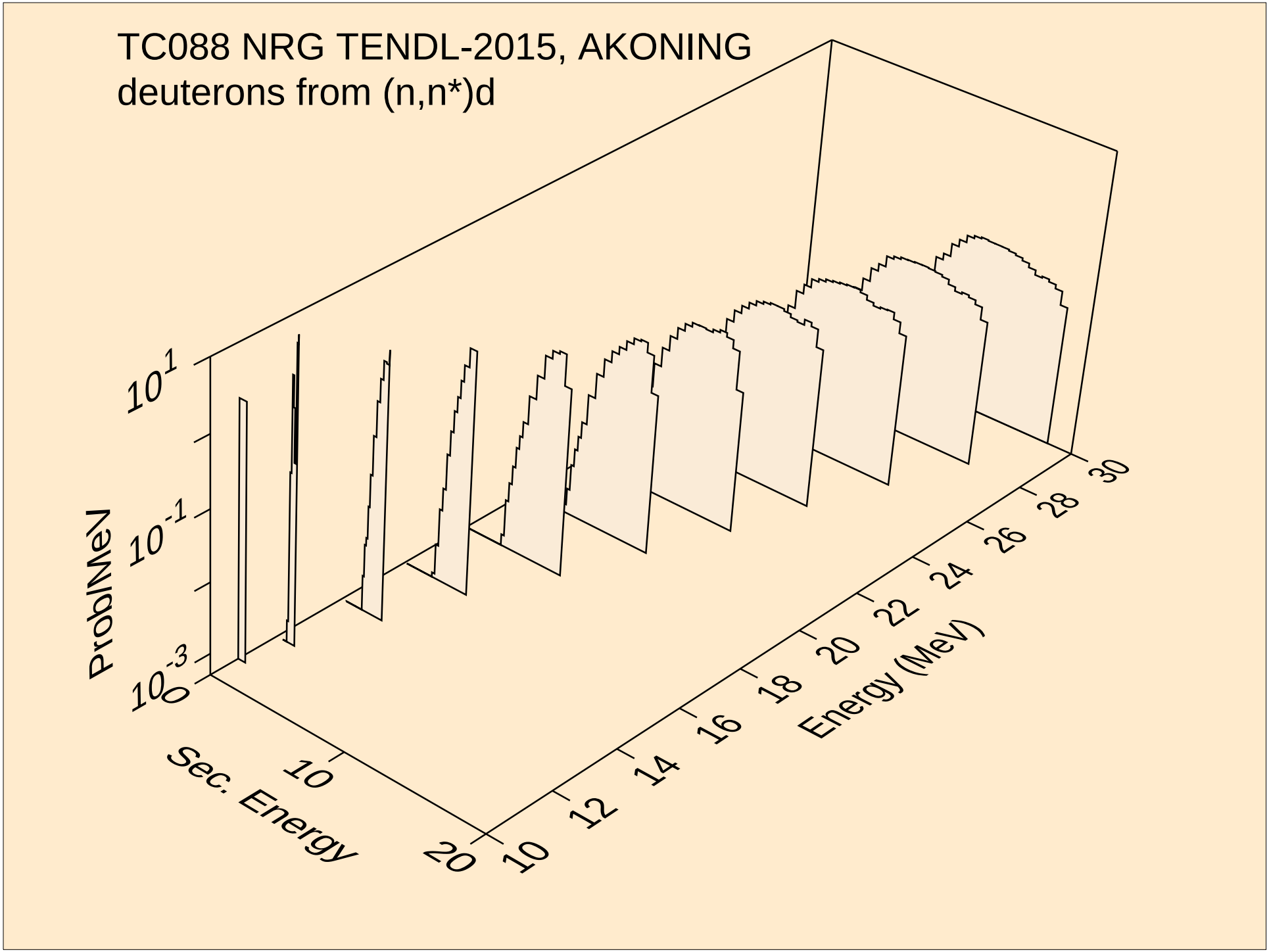

TC088 NRG TENDL-2015, AKONING
protons from (n,2p)
Prob/MeV
10^0
10^-2
10^-4
0
20
40
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)

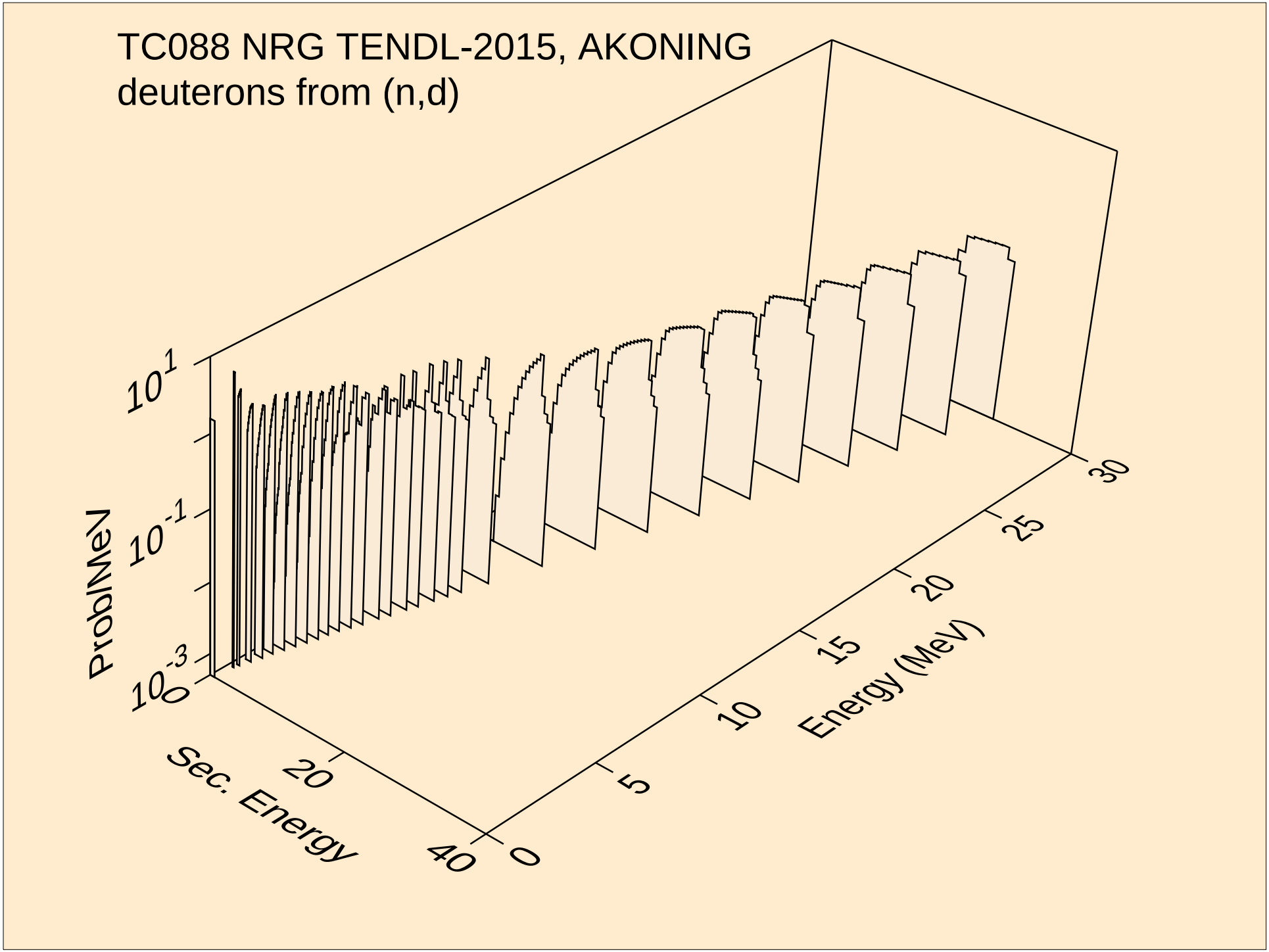

TC088 NRG TENDL-2015, AKONING
protons from (n,pa)
Prob/MeV
10^{0}
10^{-2}
10^{-4}
0
20
40
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)

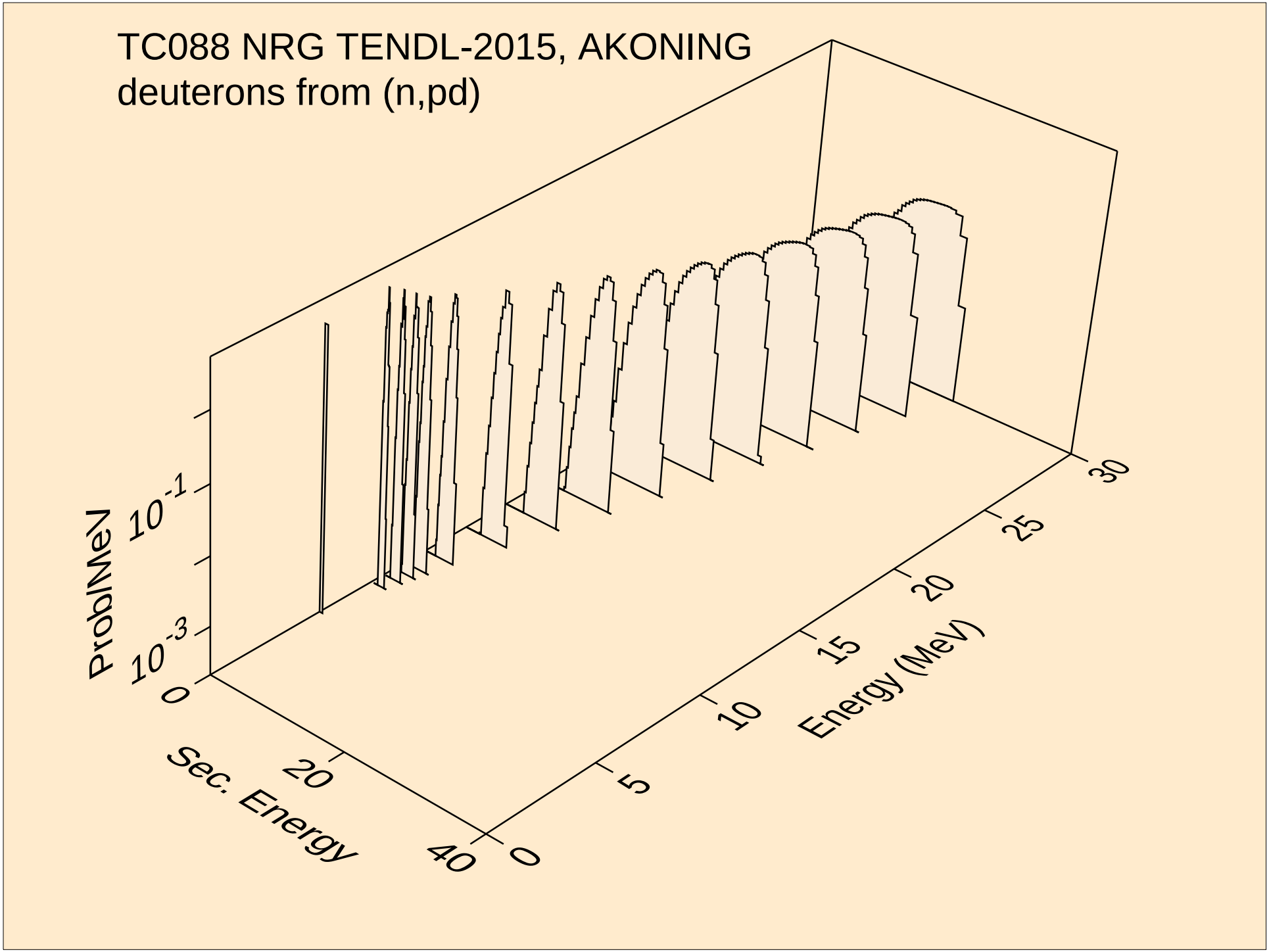

TC088 NRG TENDL-2015, AKONING
protons from (n,pd)
Prob/MeV
10-1
10-3
0
Sec. Energy
10
20
0
5
10
15
20
25
30
Energy (MeV)

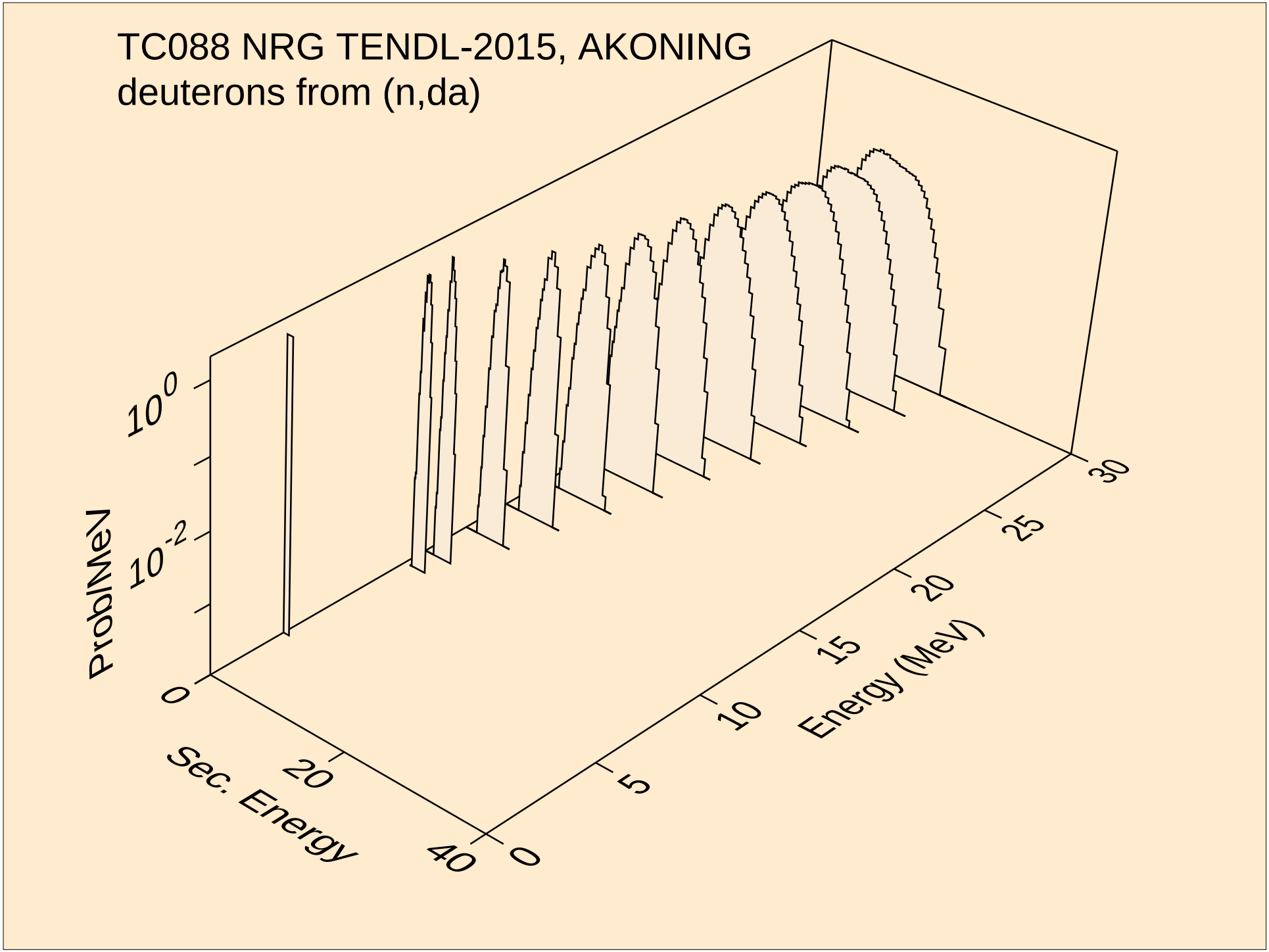

TC088 NRG TENDL-2015, AKONING
protons from (n,pt)
Prob/MeV
10^{0}
10^{-2}
0
Sec. Energy
10
20
5
10
15
20
25
30
Energy (MeV)

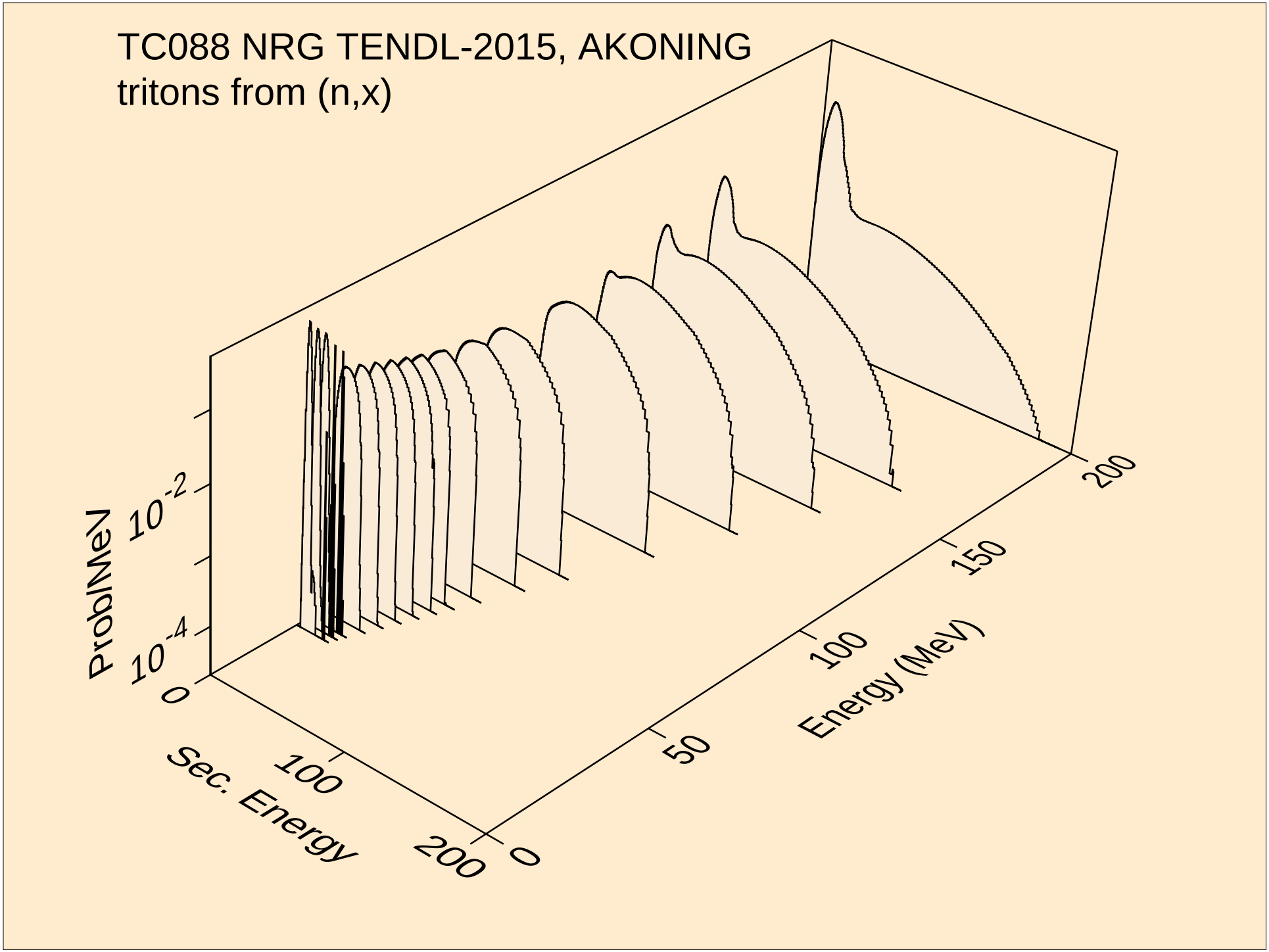

TC088 NRG TENDL-2015, AKONING
deuterons from (n,x)
Prob/MeV
10^0
10^-2
0
Sec. Energy
100
200
0
50
100
150
200
Energy (MeV)

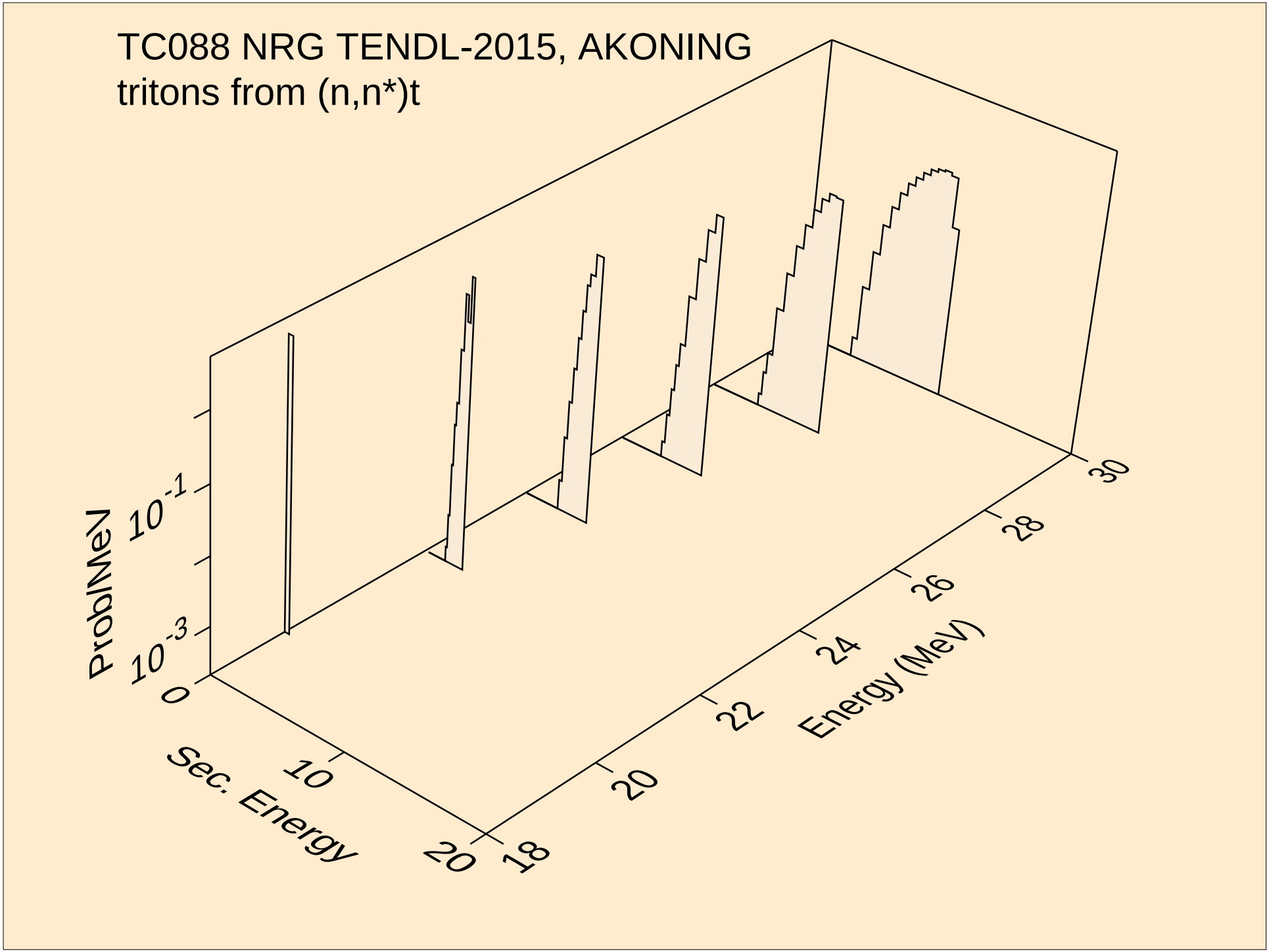

TC088 NRG TENDL-2015, AKONING
deuterons from (n,n*)d
Prob/MeV
10^1
10^-1
10^-3
0
Sec. Energy
10
20
Energy (MeV)
10
12
14
16
18
20
22
24
26
28
30

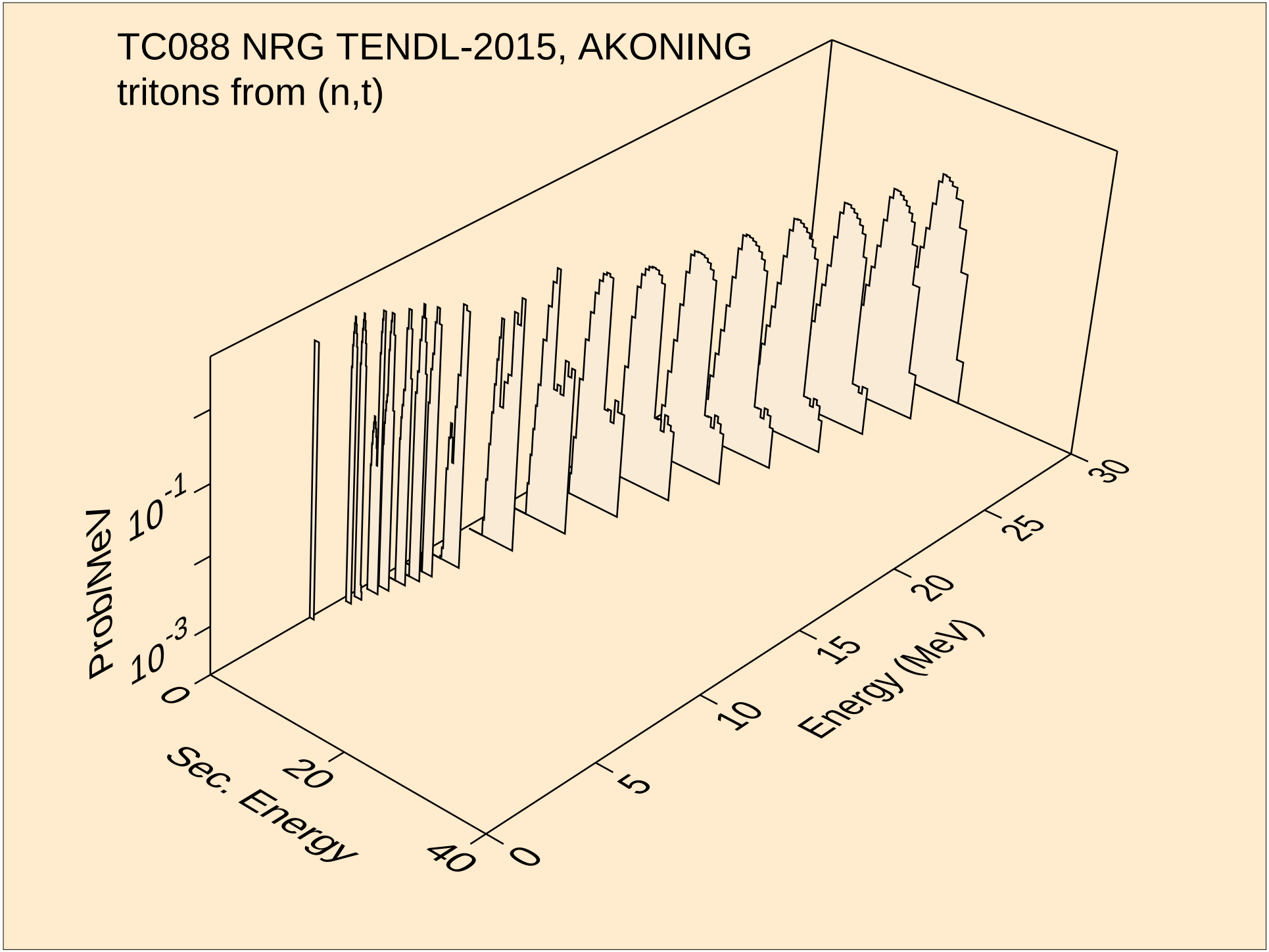

TC088 NRG TENDL-2015, AKONING
deuterons from (n,d)
Prob/MeV
10^{1}
10^{-1}
10^{-3}
0
20
40
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)

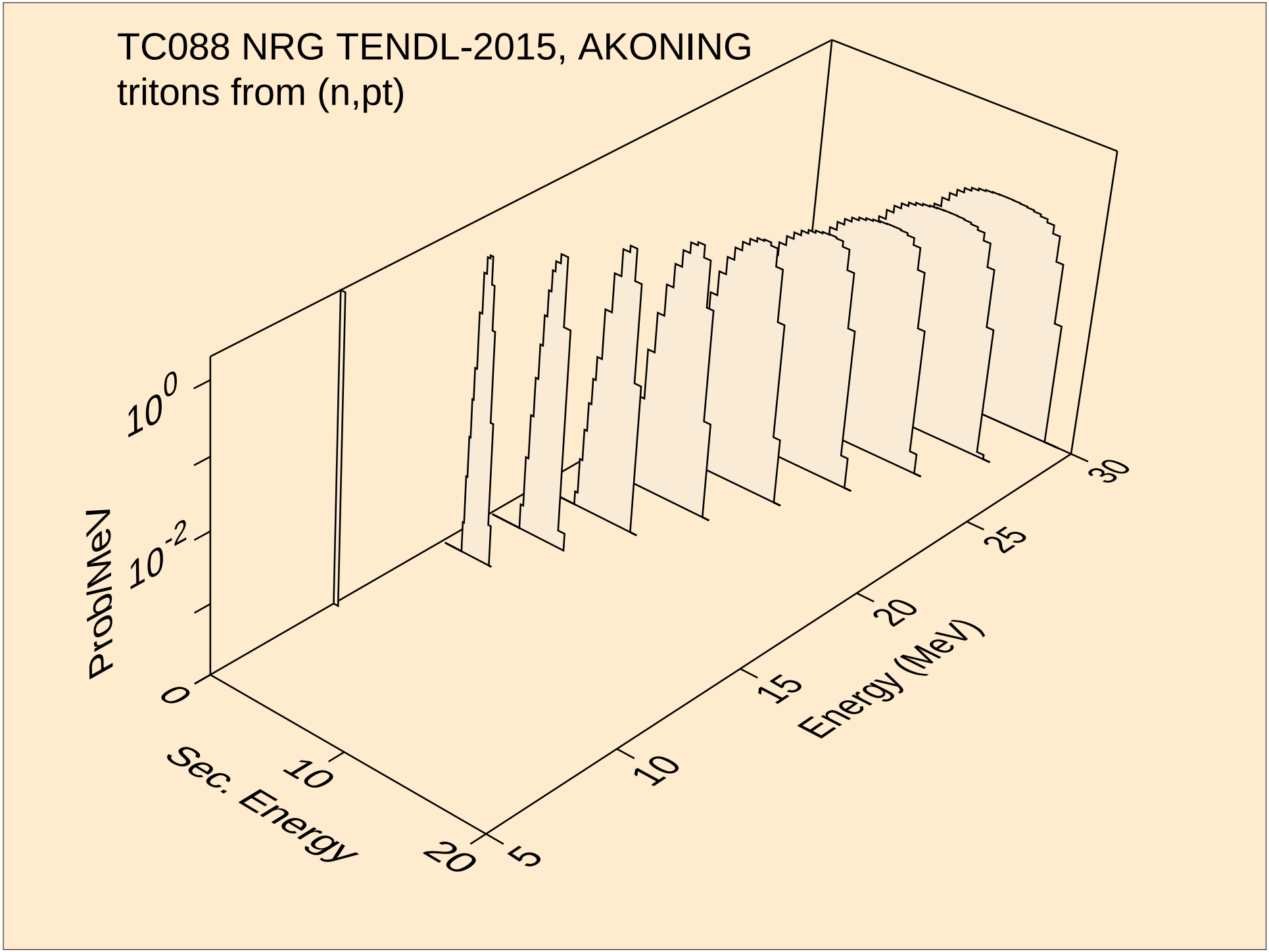

TC088 NRG TENDL-2015, AKONING
deuterons from (n,pd)
Prob/MeV
10-1
10-3
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)

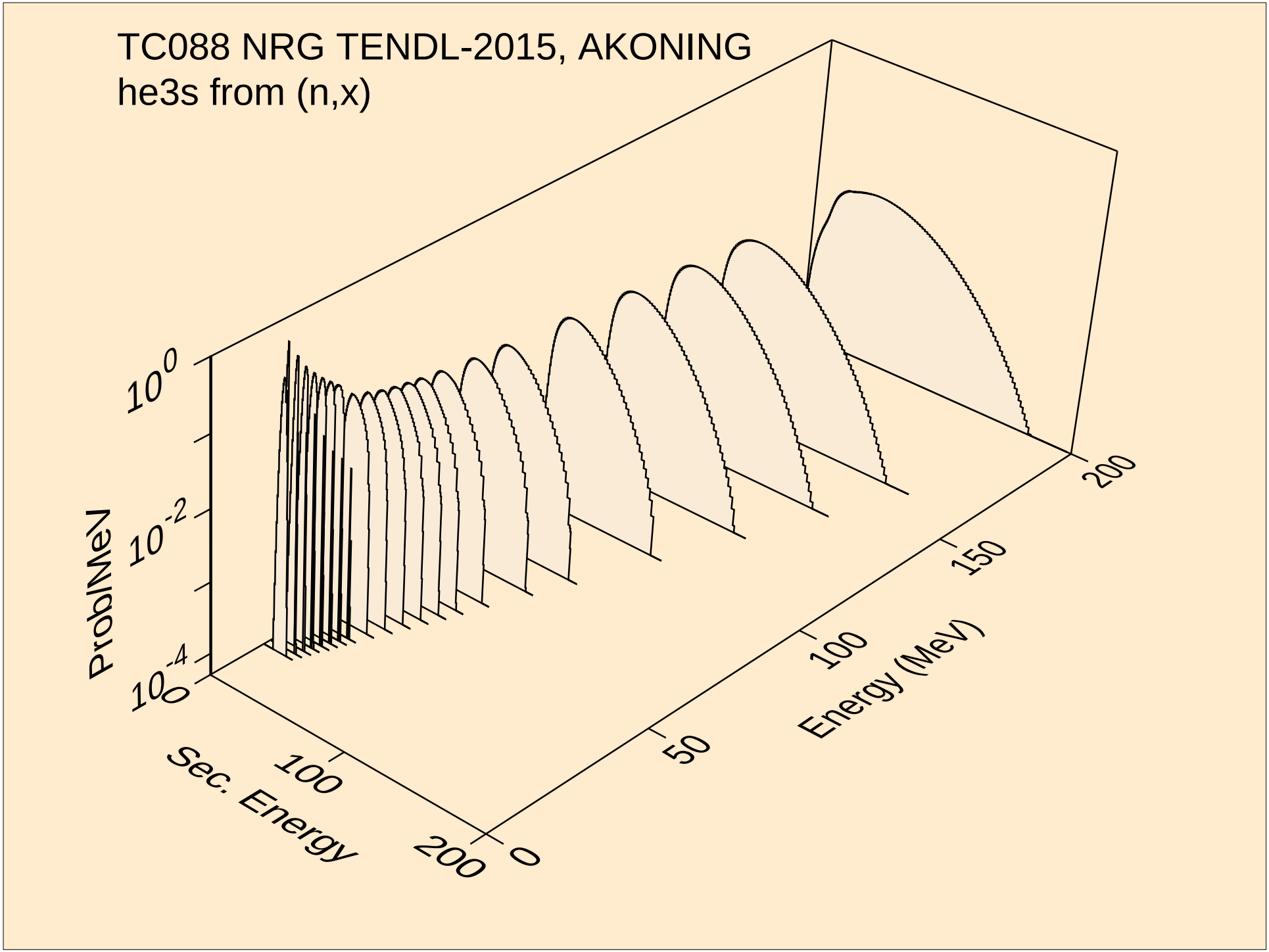

TC088 NRG TENDL-2015, AKONING
deuterons from (n,da)
Prob/MeV
10^0
10^-2
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)

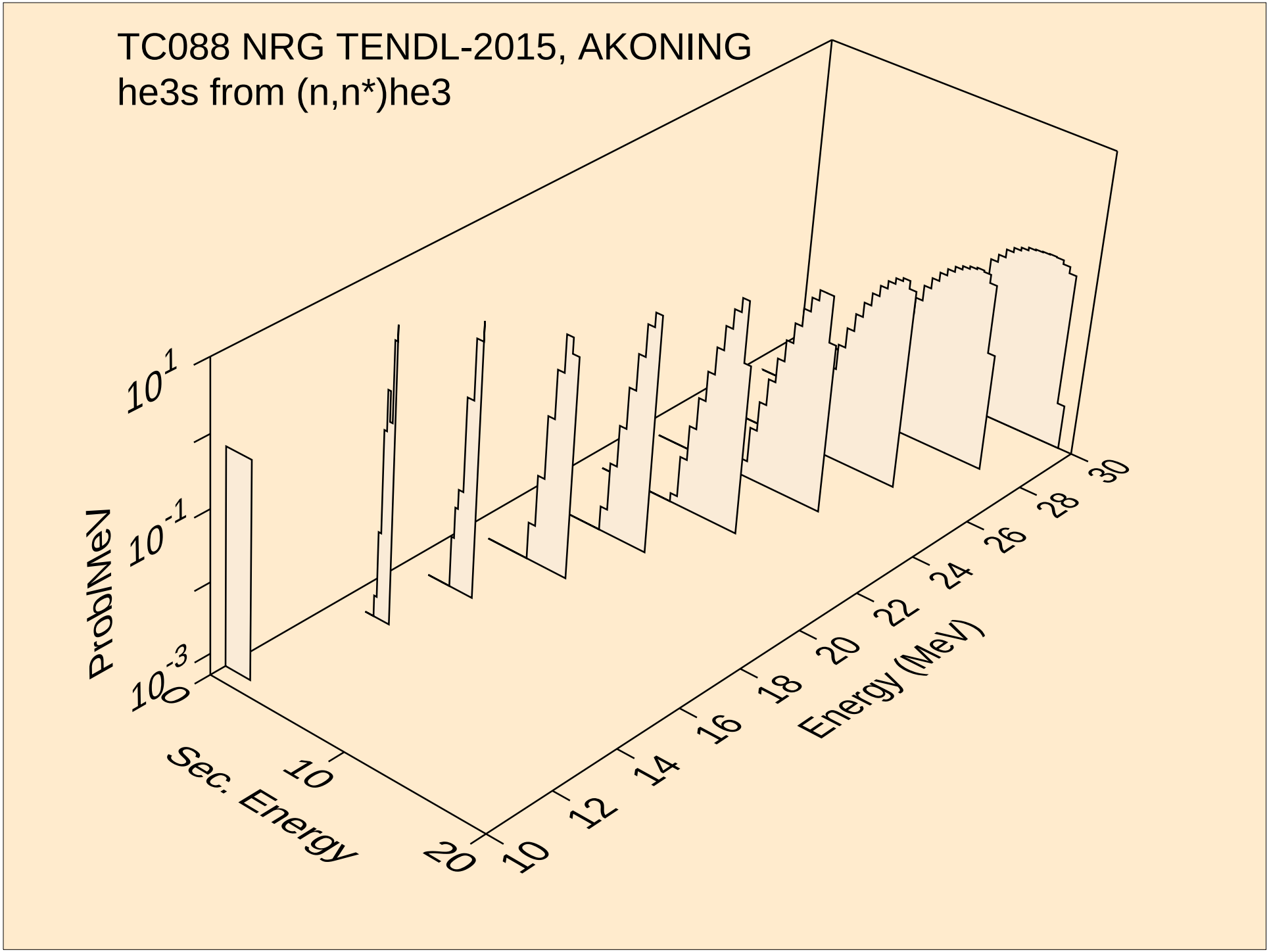

TC088 NRG TENDL-2015, AKONING
tritons from (n,x)
Prob/MeV
10-2
10-4
0
Sec. Energy
100
200
0
50
100
150
200
Energy (MeV)

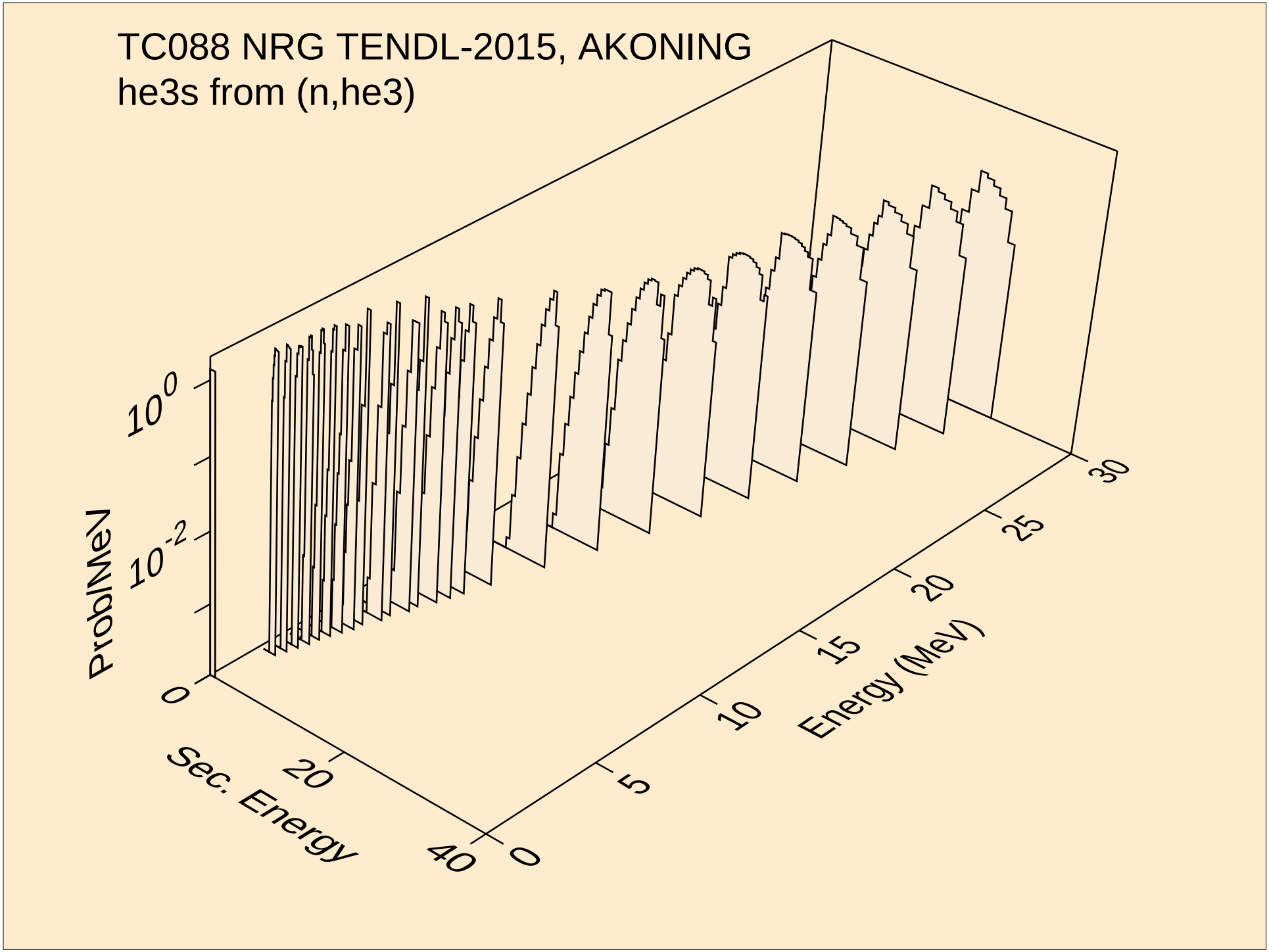

TC088 NRG TENDL-2015, AKONING
tritons from (n,n*)t
Prob/MeV
10^-1
10^-3
0
Sec. Energy
10
20
18
20
22
24
26
28
30
Energy (MeV)

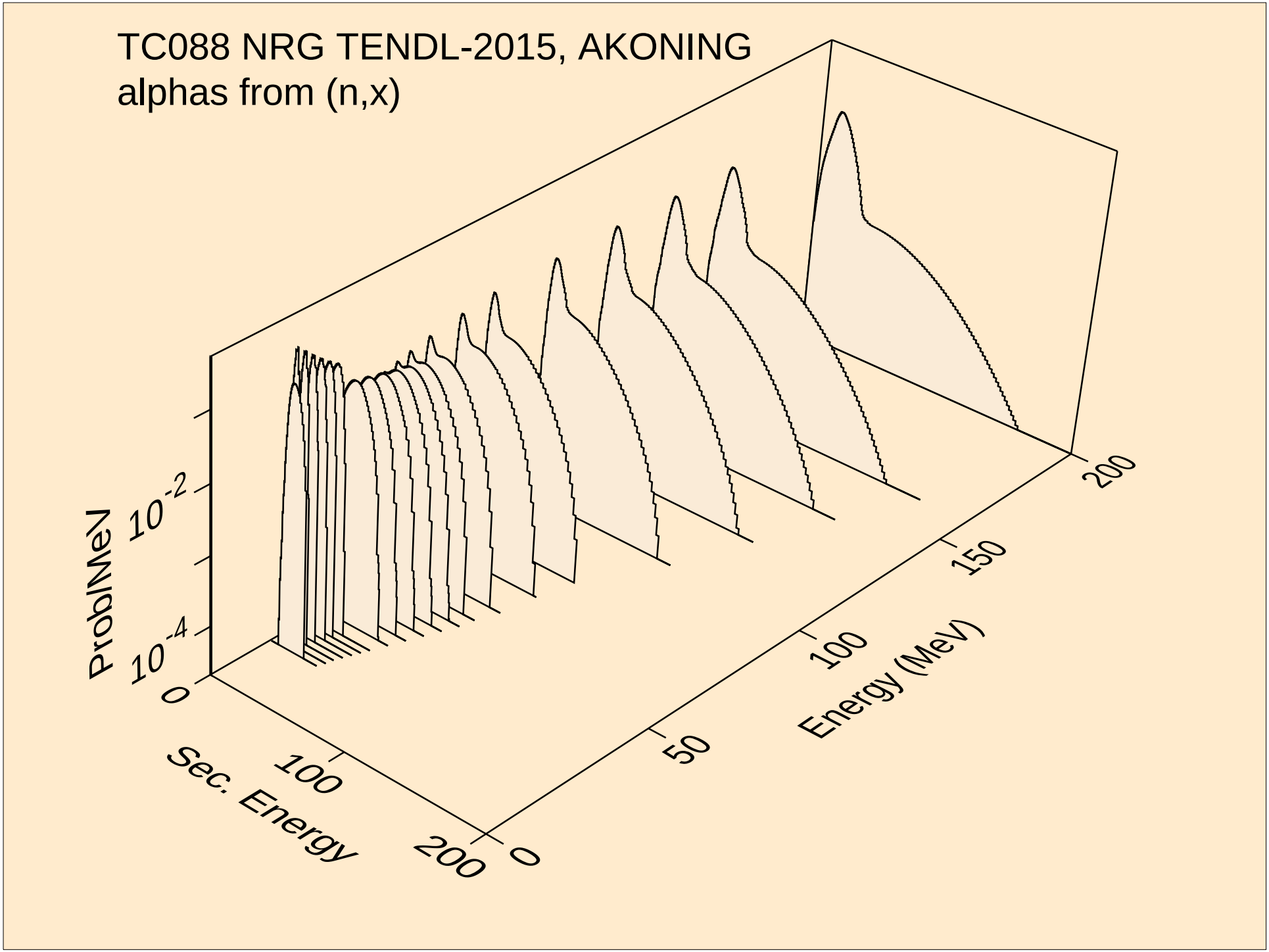

TC088 NRG TENDL-2015, AKONING
tritons from (n,t)
Prob/MeV
10-1
10-3
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)

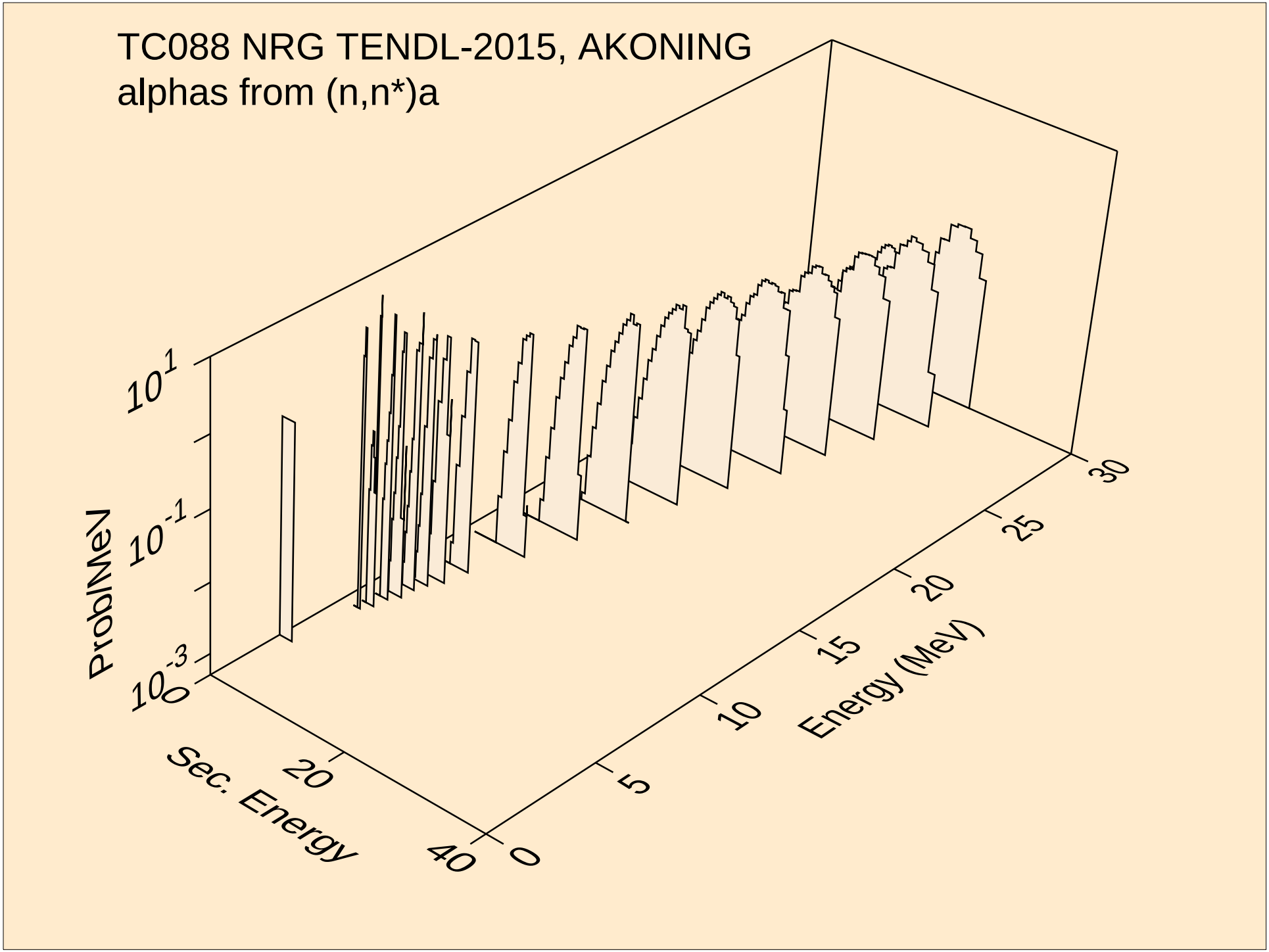

TC088 NRG TENDL-2015, AKONING
tritons from (n,pt)
Prob/MeV
10^0
10^-2
0
Sec. Energy
10
20
5
10
15
20
25
30
Energy (MeV)

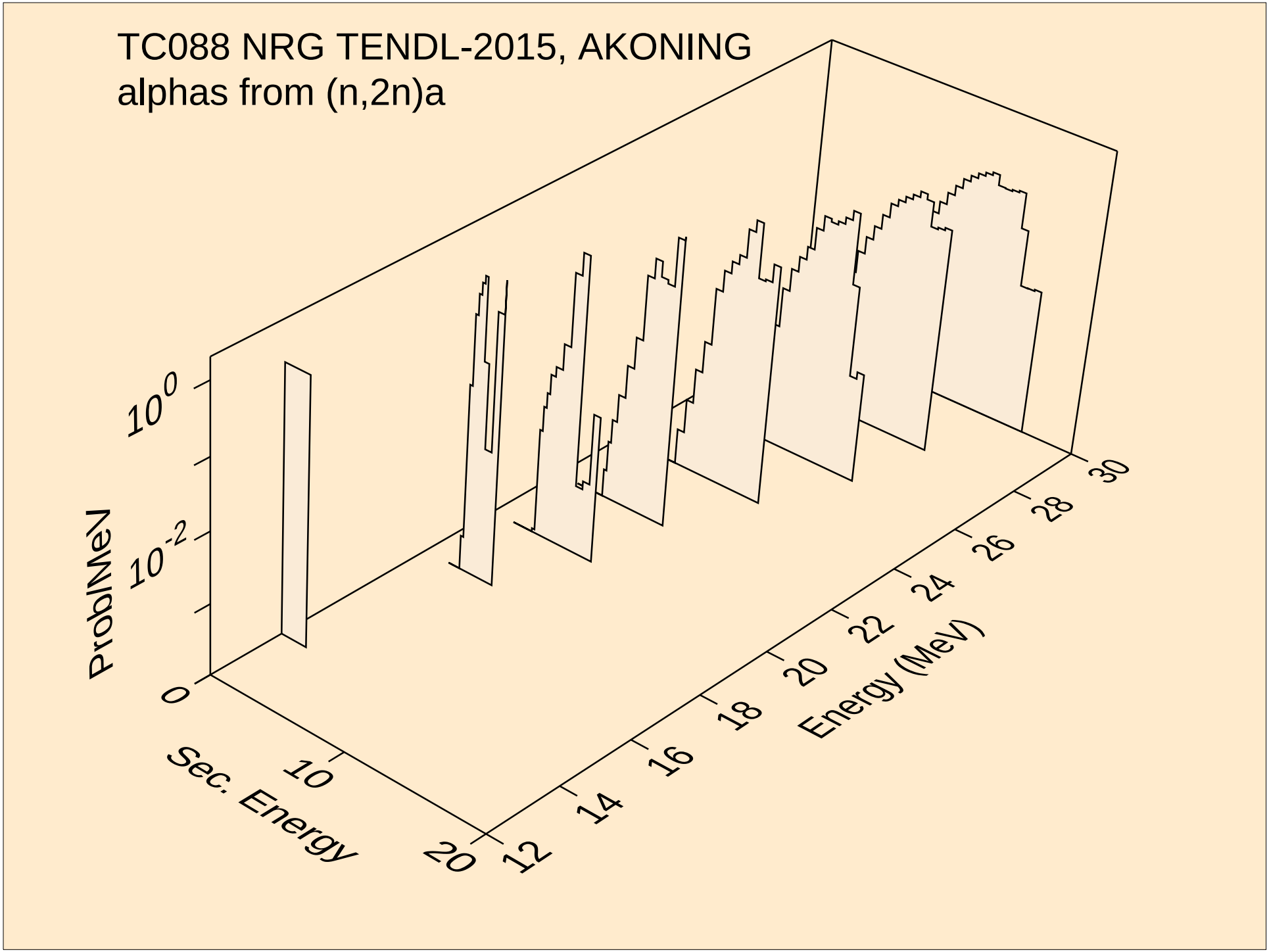

TC088 NRG TENDL-2015, AKONING
he3s from (n,x)
Prob/MeV
10^0
10^-2
10^-4
0
100
200
Sec. Energy
0
50
100
150
200
Energy (MeV)

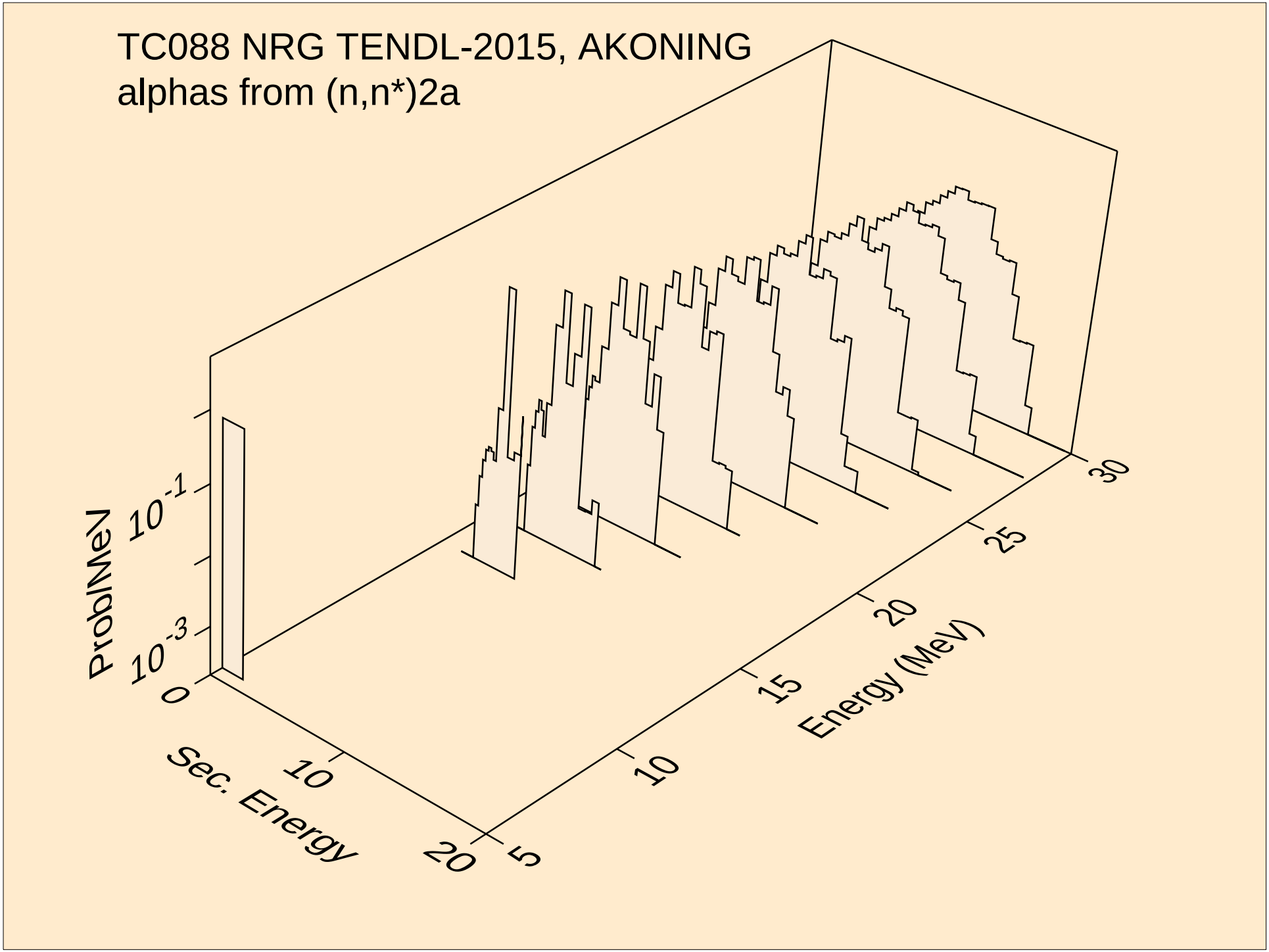

TC088 NRG TENDL-2015, AKONING
he3s from (n,n*)he3
Prob/MeV
10^1
10^-1
10^-3
0
Sec. Energy
10
20
Energy (MeV)
10
12
14
16
18
20
22
24
26
28
30

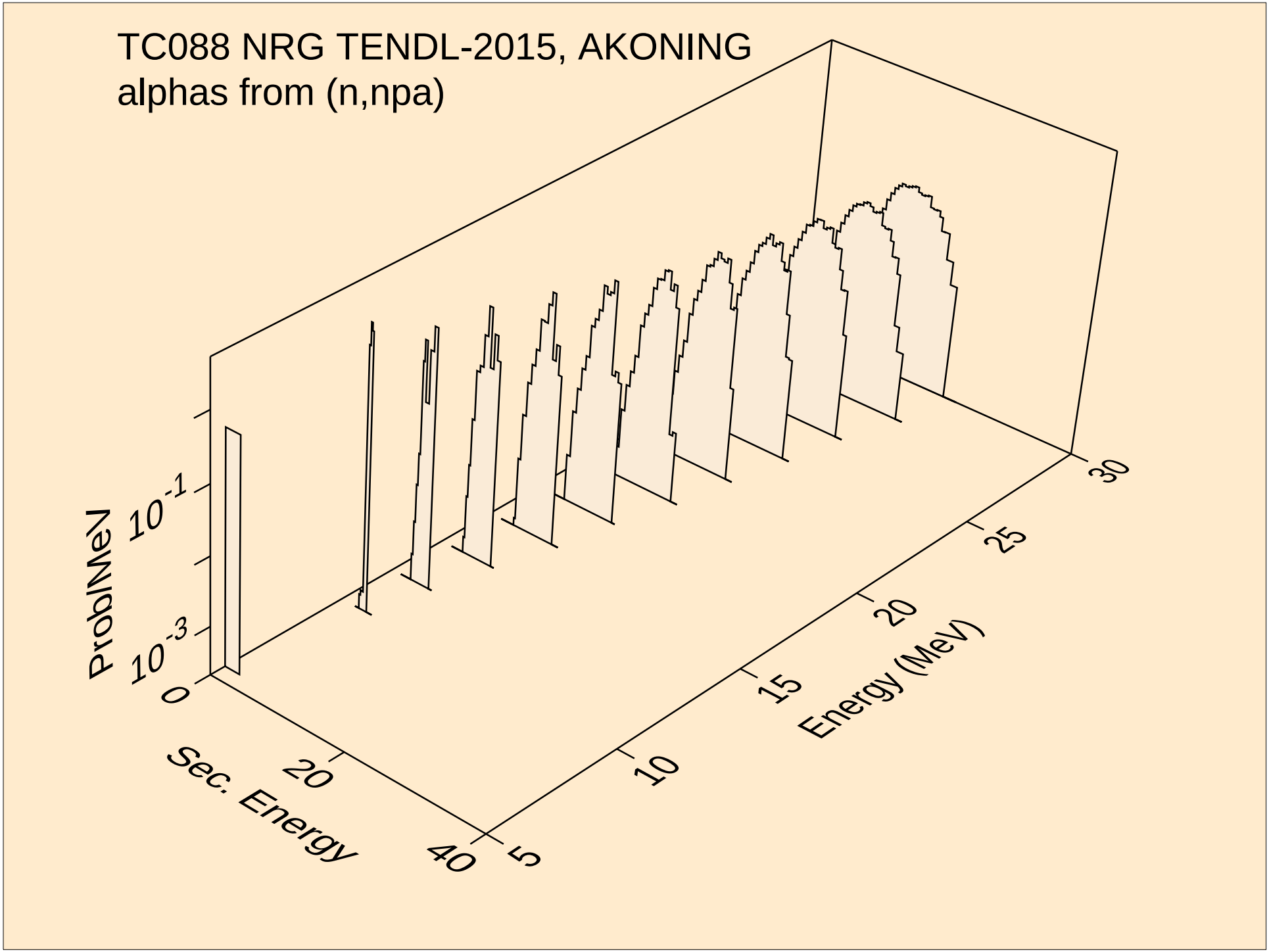

TC088 NRG TENDL-2015, AKONING
he3s from (n,he3)
Prob/MeV
10^0
10^-2
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)

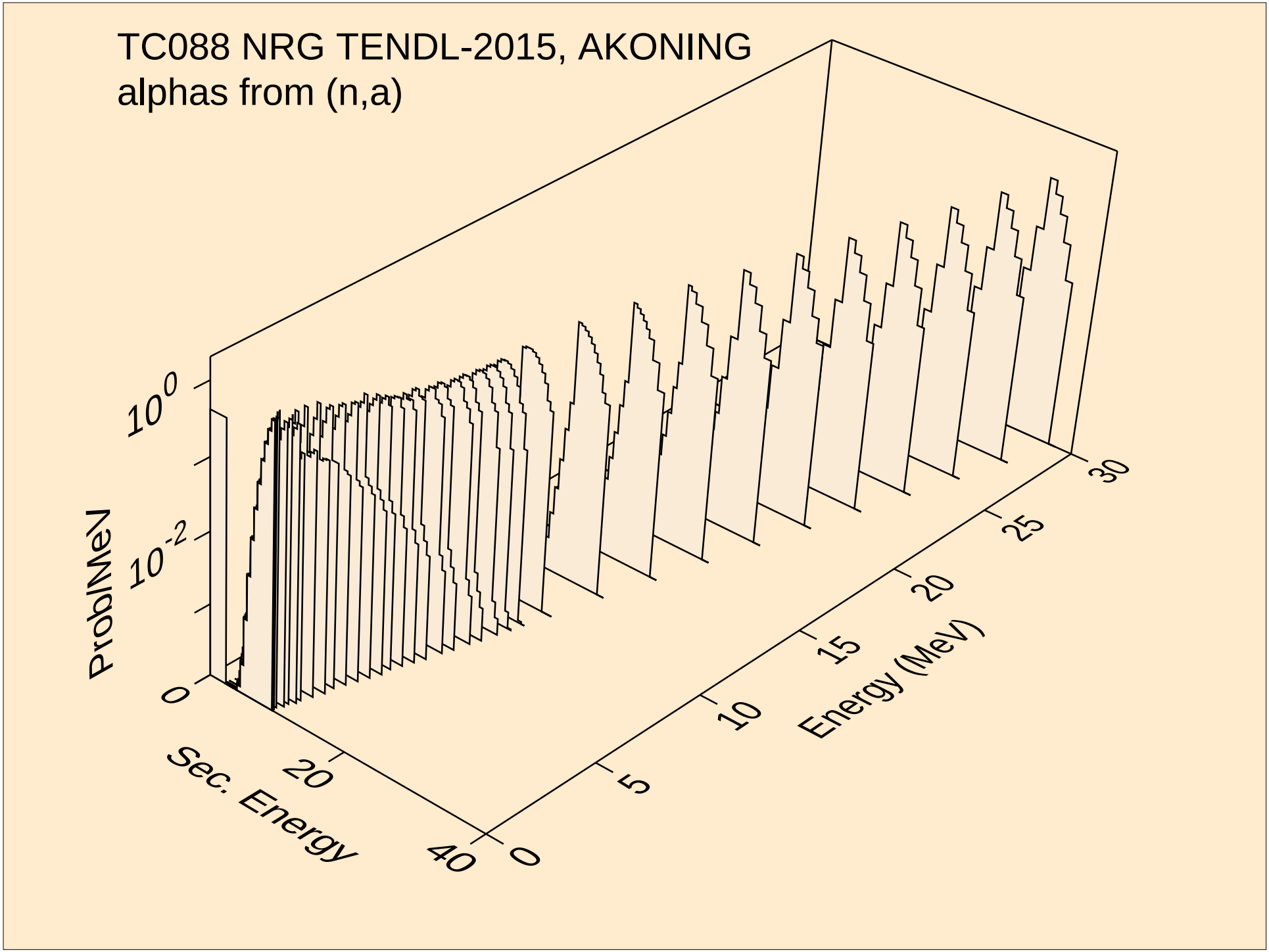

TC088 NRG TENDL-2015, AKONING
alphas from (n,x)
Prob/MeV
10-2
10-4
0
Sec. Energy
100
200
0
50
100
150
200
Energy (MeV)

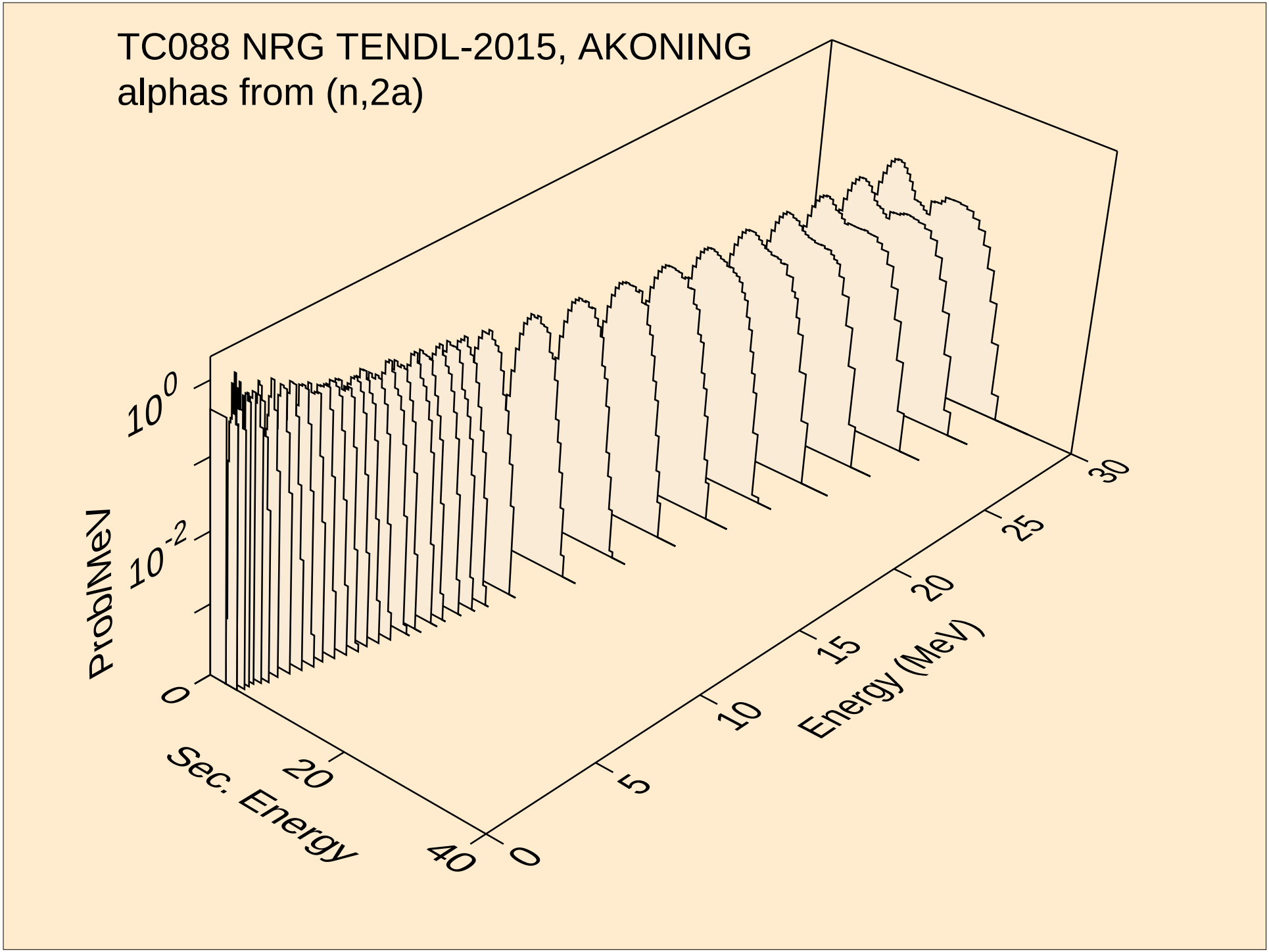

TC088 NRG TENDL-2015, AKONING
alphas from (n,n*)a
Prob/MeV
10^1
10^-1
10^-3
0
20
40
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)

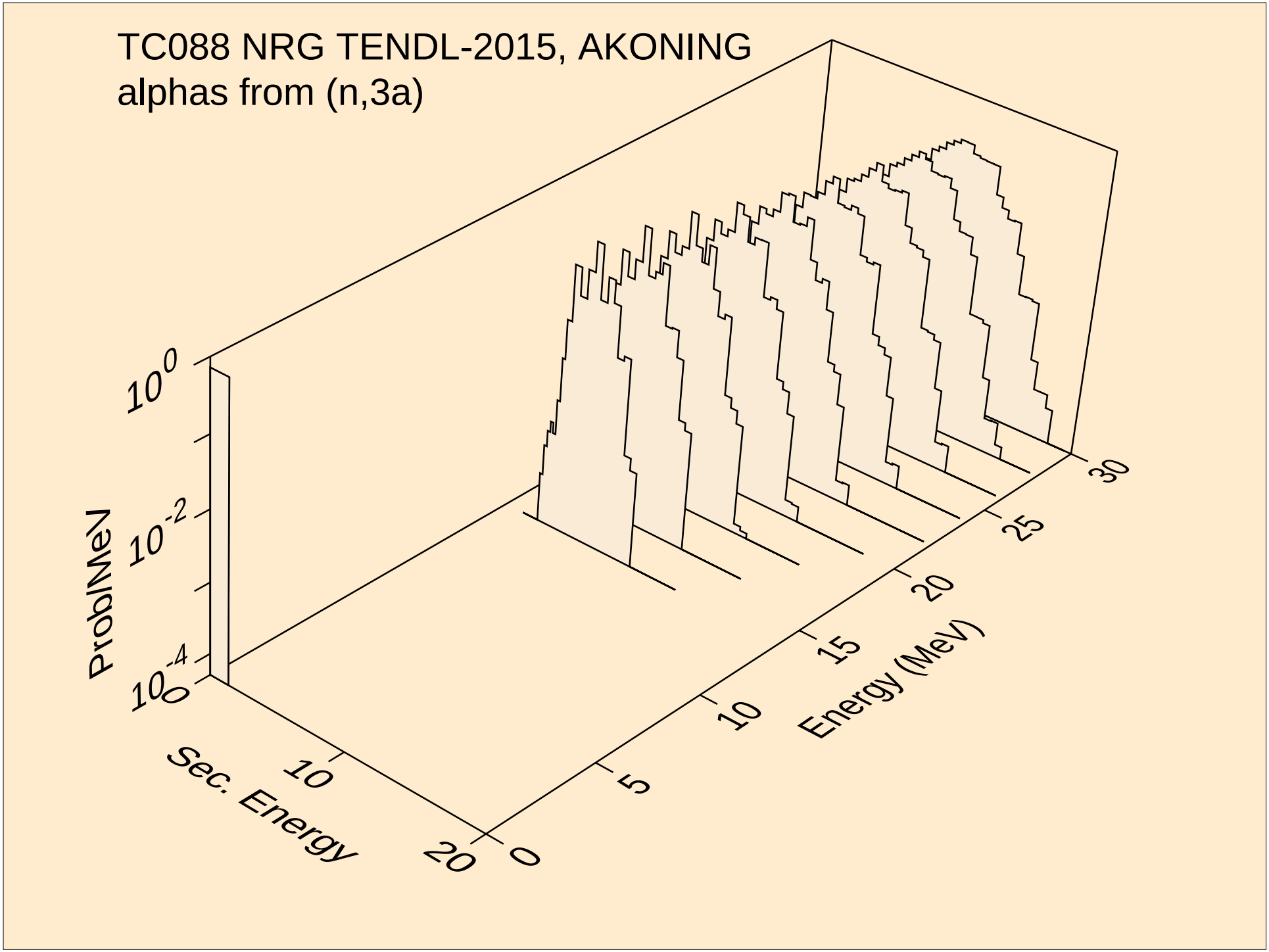

TC088 NRG TENDL-2015, AKONING
alphas from (n,2n)a
Prob/MeV
10^{0}
10^{-2}
0
Sec. Energy
10
20
Energy (MeV)
12
14
16
18
20
22
24
26
28
30

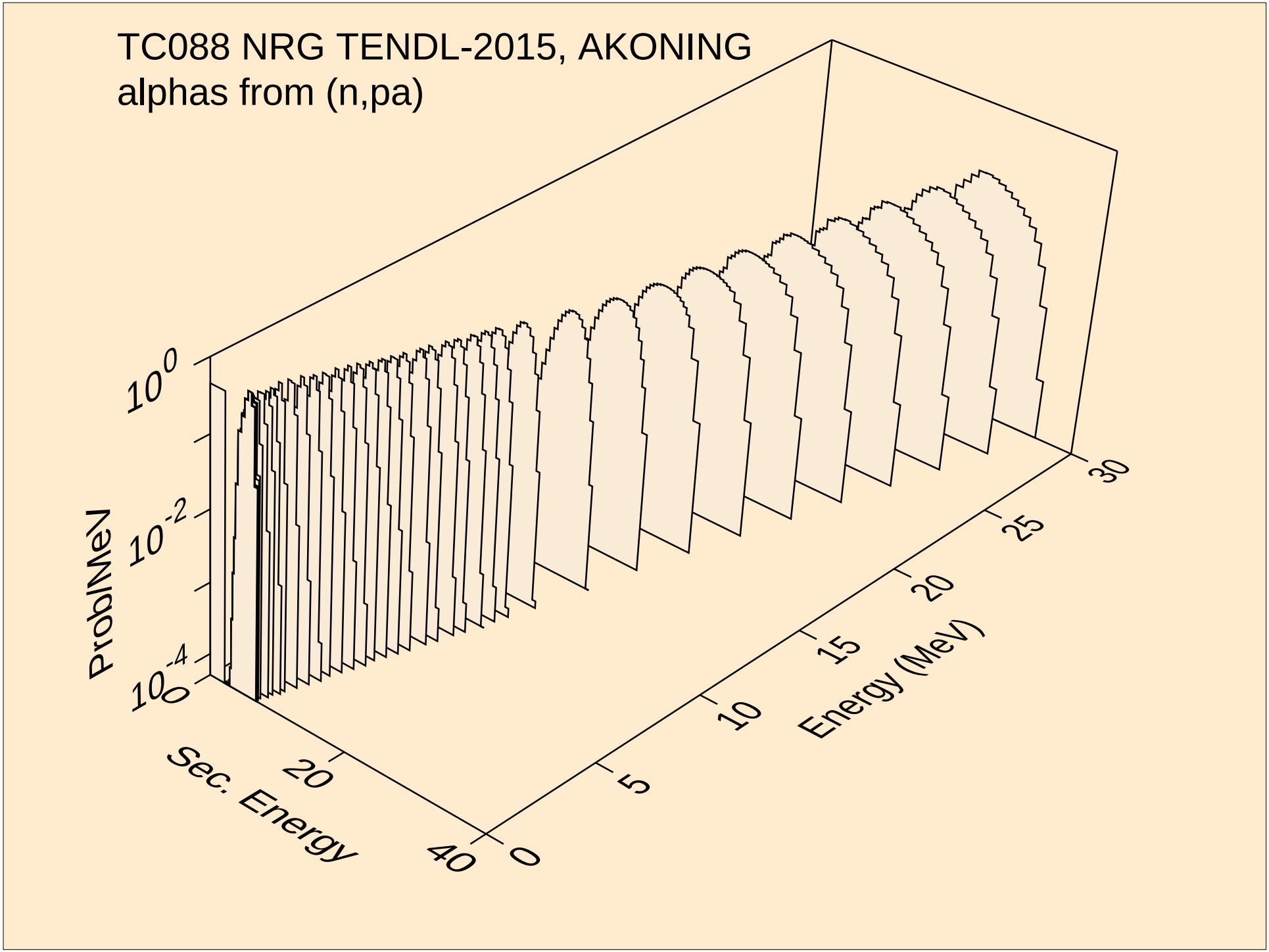

TC088 NRG TENDL-2015, AKONING
alphas from (n,n*)2a
Prob/MeV
10-1
10-3
0
Sec. Energy
10
20
5
10
15
20
25
30
Energy (MeV)

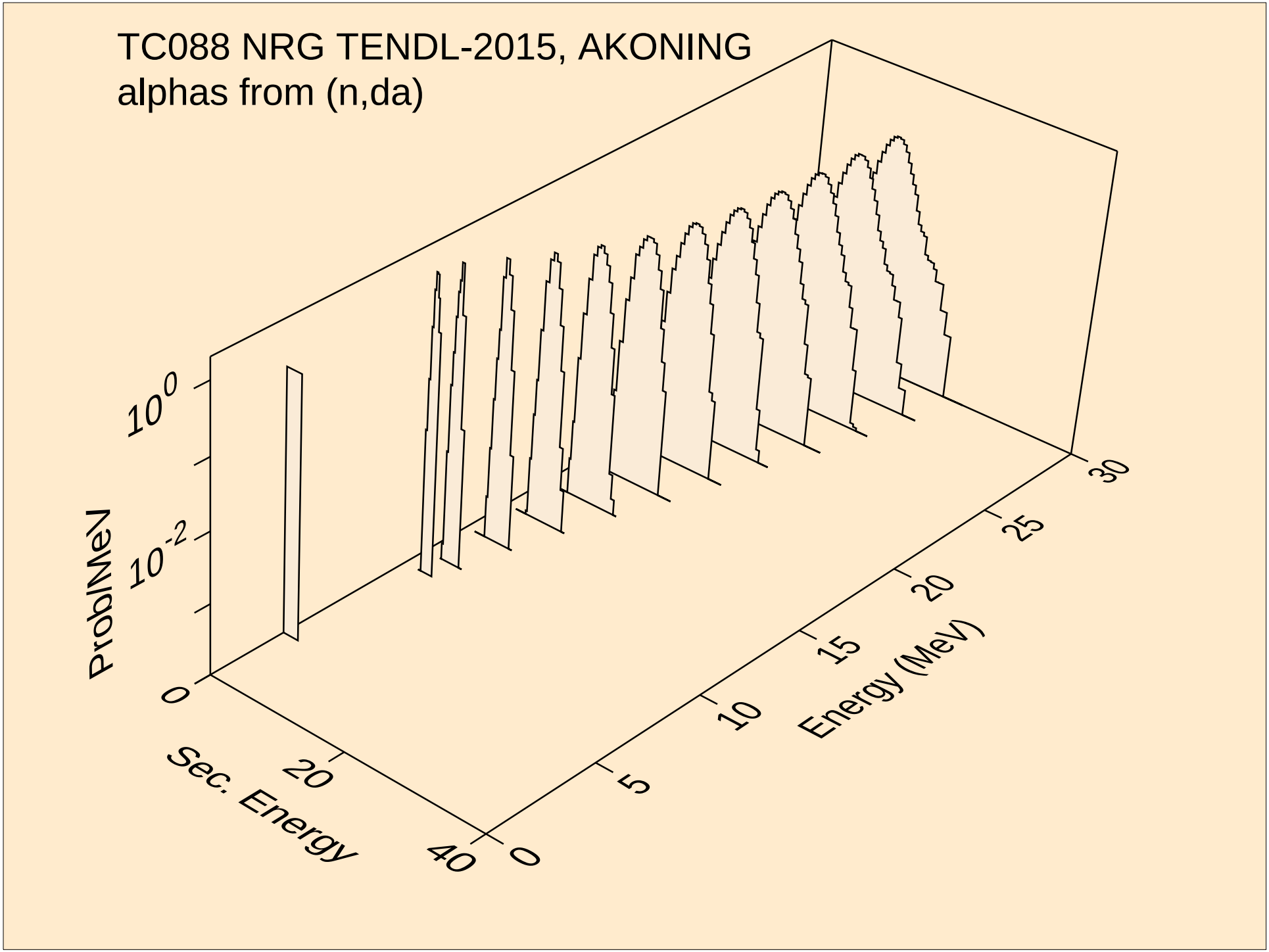

TC088 NRG TENDL-2015, AKONING
alphas from (n,npa)
Prob/MeV
10-1
10-3
0
Sec. Energy
20
40
5
10
15
Energy (MeV)
20
25
30


TC088 NRG TENDL-2015, AKONING
alphas from (n,a)
Prob/MeV
10^0
10^-2
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)


TC088 NRG TENDL-2015, AKONING
alphas from (n,2a)
Prob/MeV
10^0
10^-2
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)


TC088 NRG TENDL-2015, AKONING
alphas from (n,3a)
Prob/MeV
10^{0}
10^{-2}
10^{-4}
0
10
20
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)


TC088 NRG TENDL-2015, AKONING
alphas from (n,pa)
Prob/MeV
10^0
10^-2
10^-4
0
20
40
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)


TC088 NRG TENDL-2015, AKONING
alphas from (n,da)
Prob/MeV
10^0
10^-2
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)