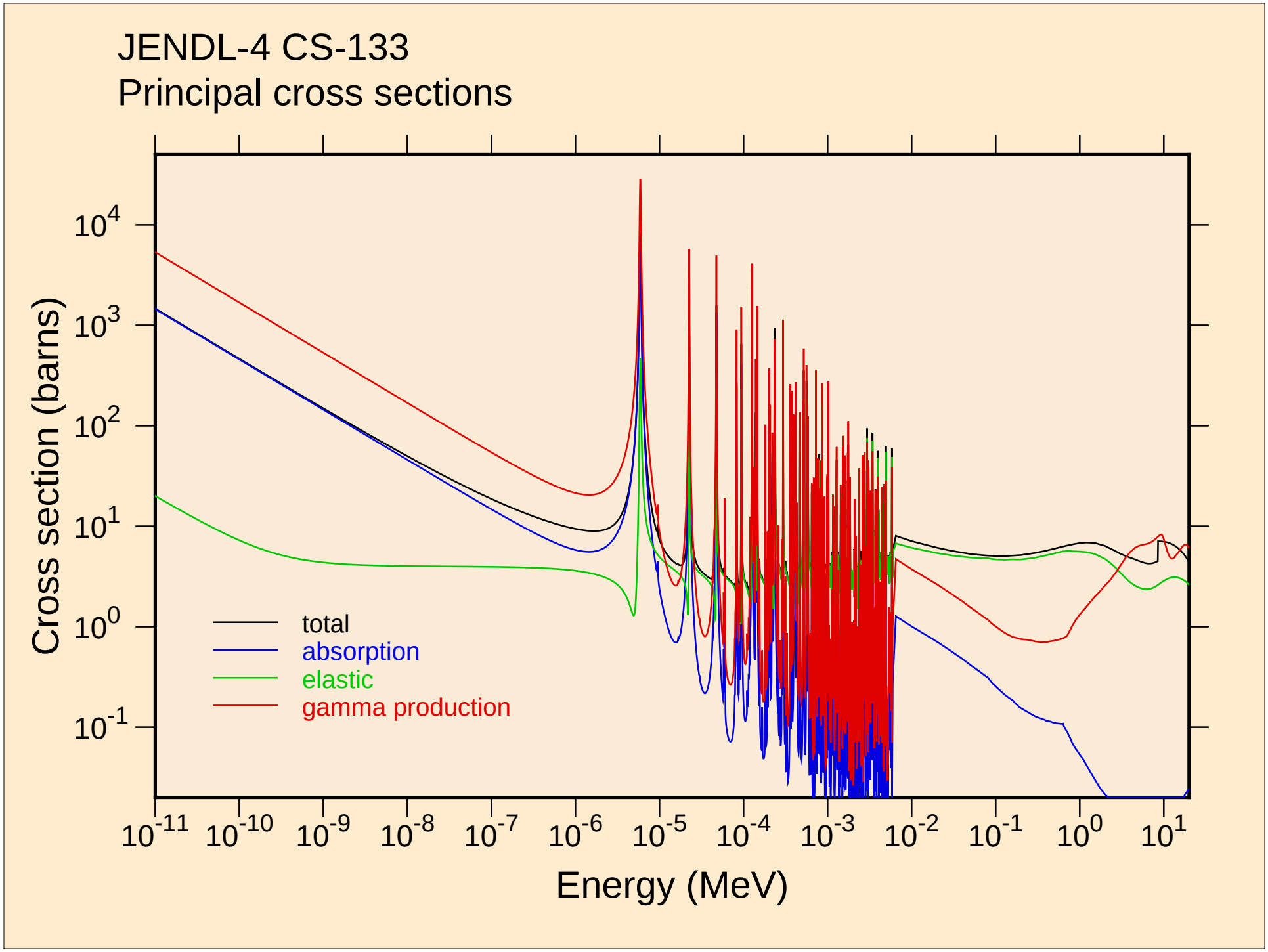
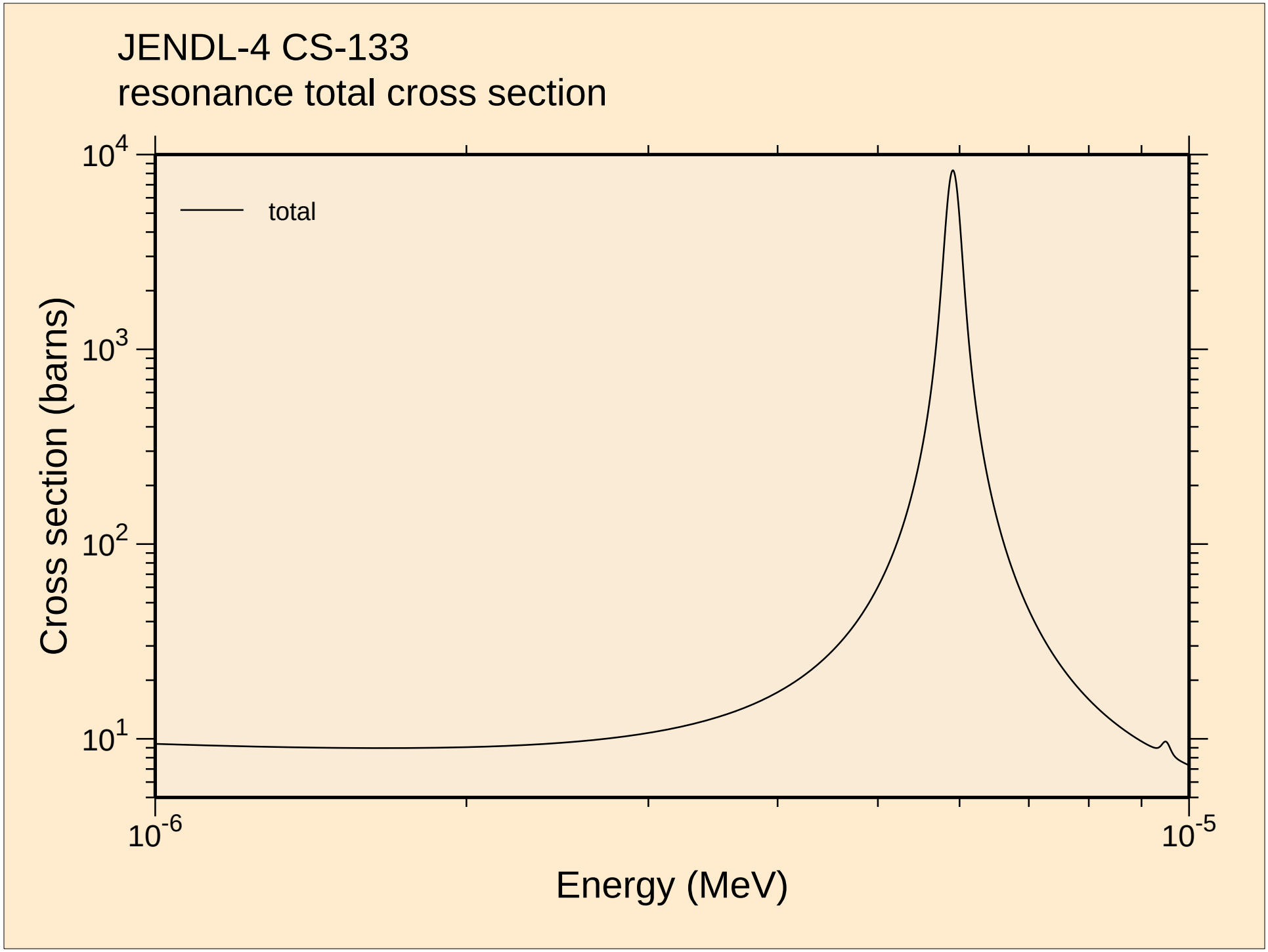
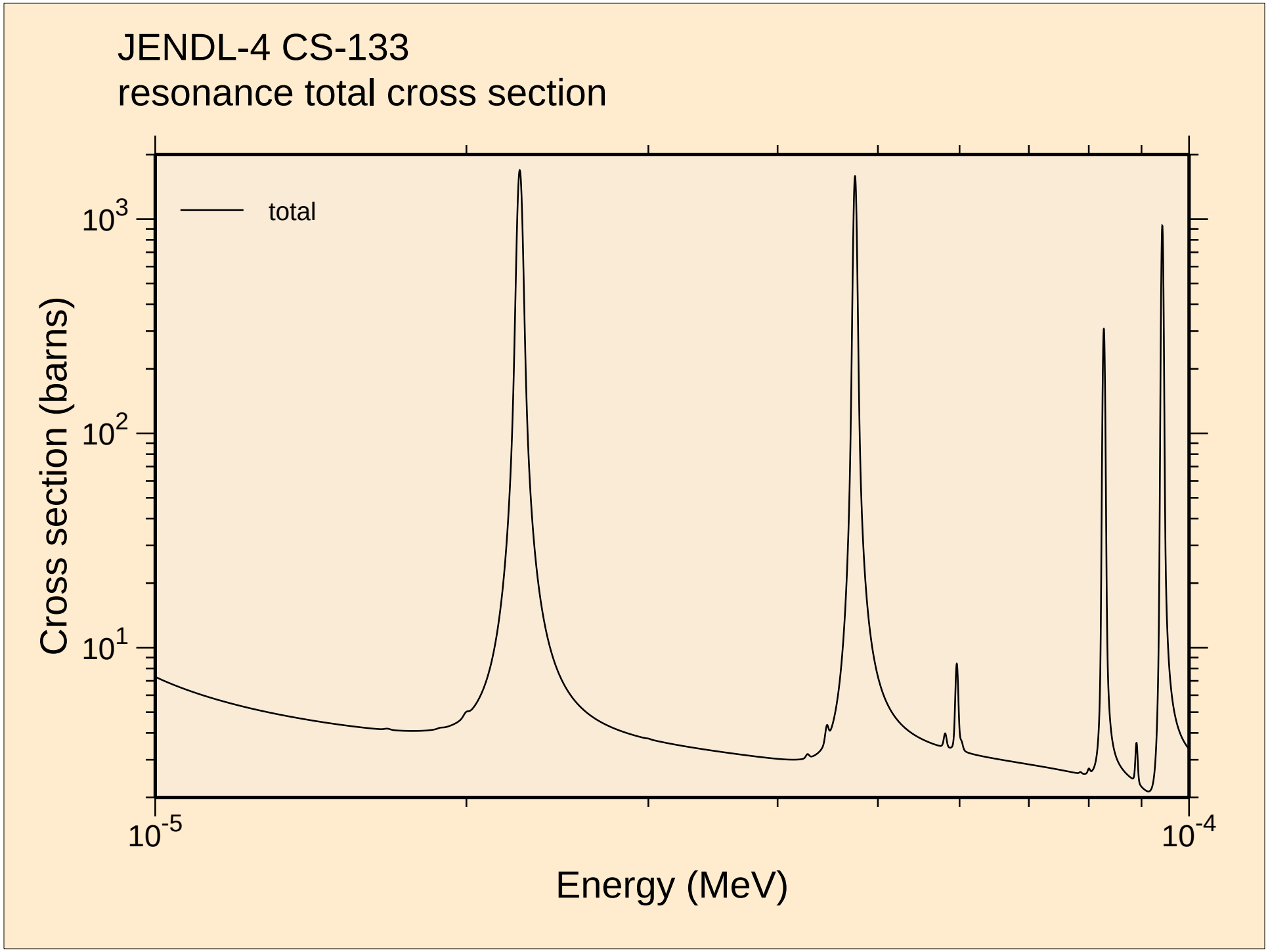
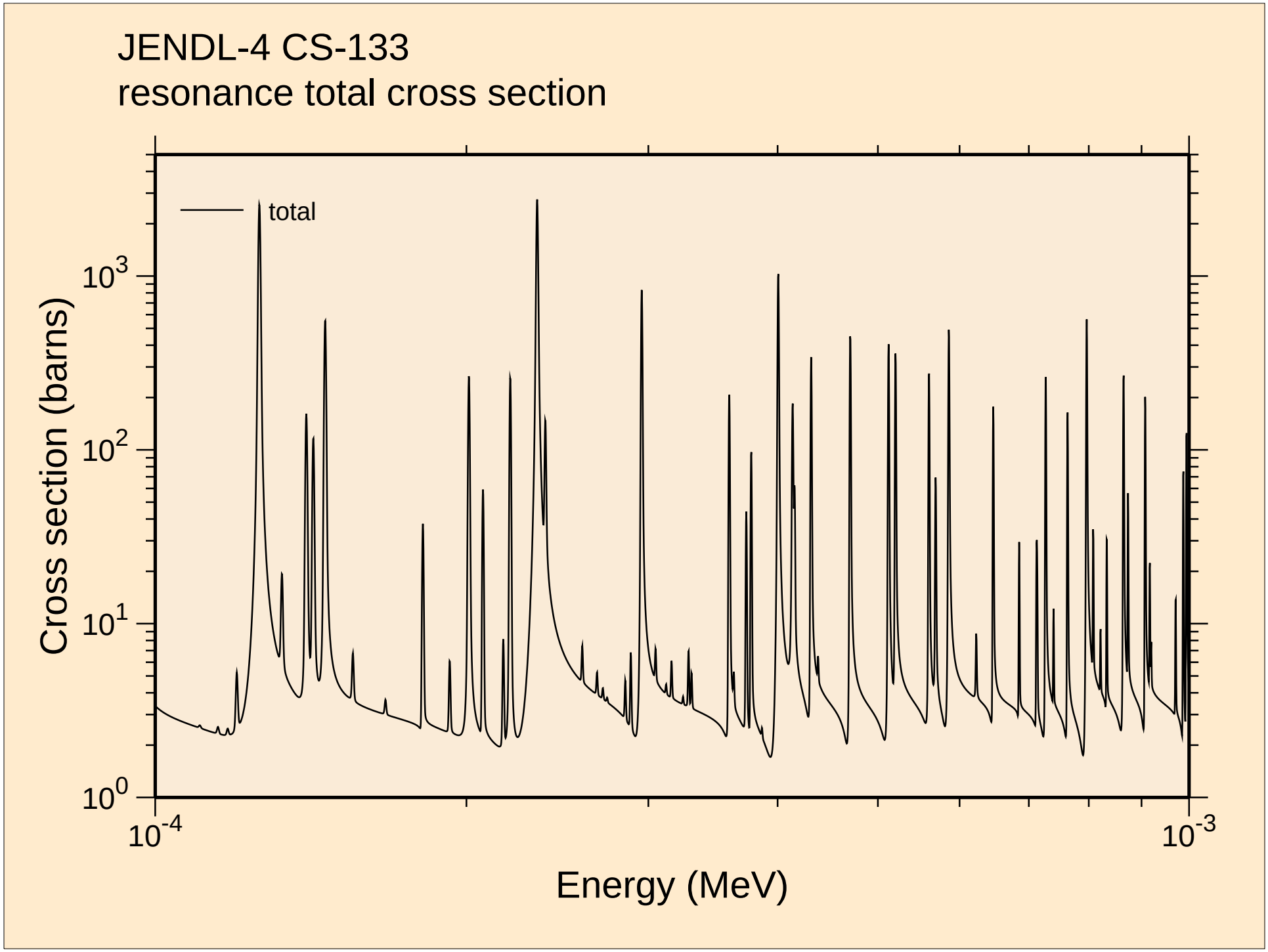
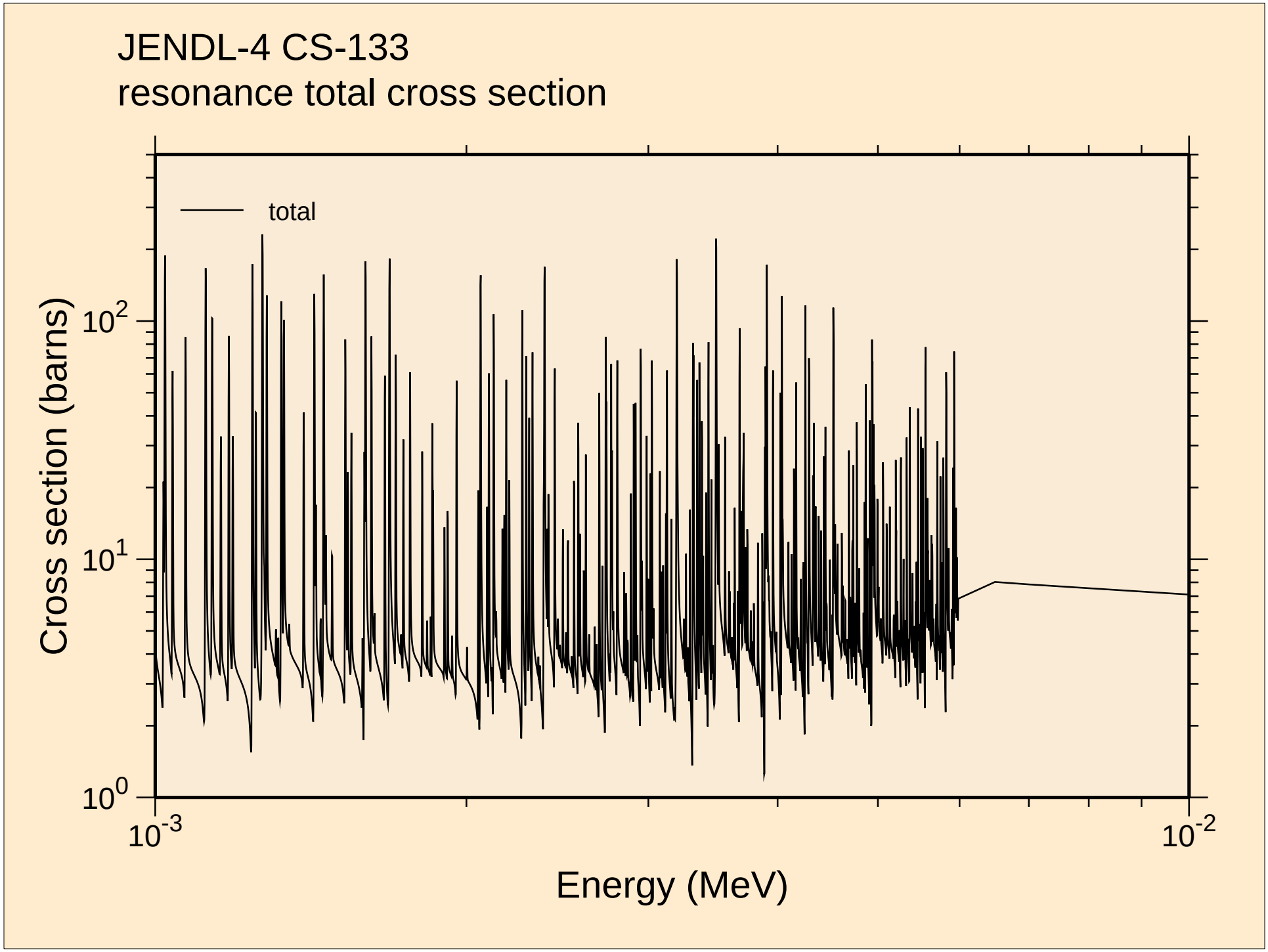
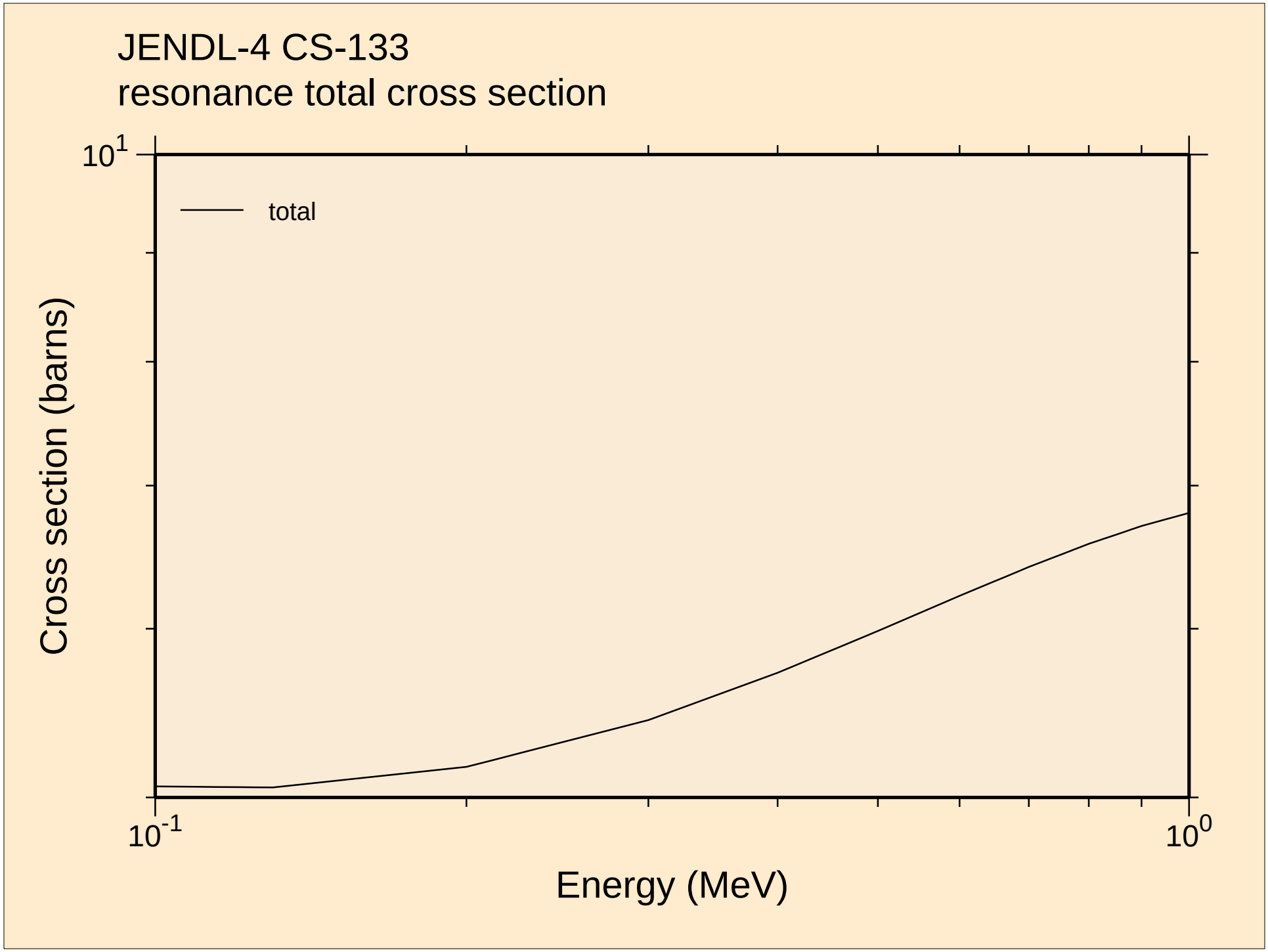

JENDL-4 CS-133
Principal cross sections
Cross section (barns)
Energy (MeV)
total
absorption
elastic
gamma production

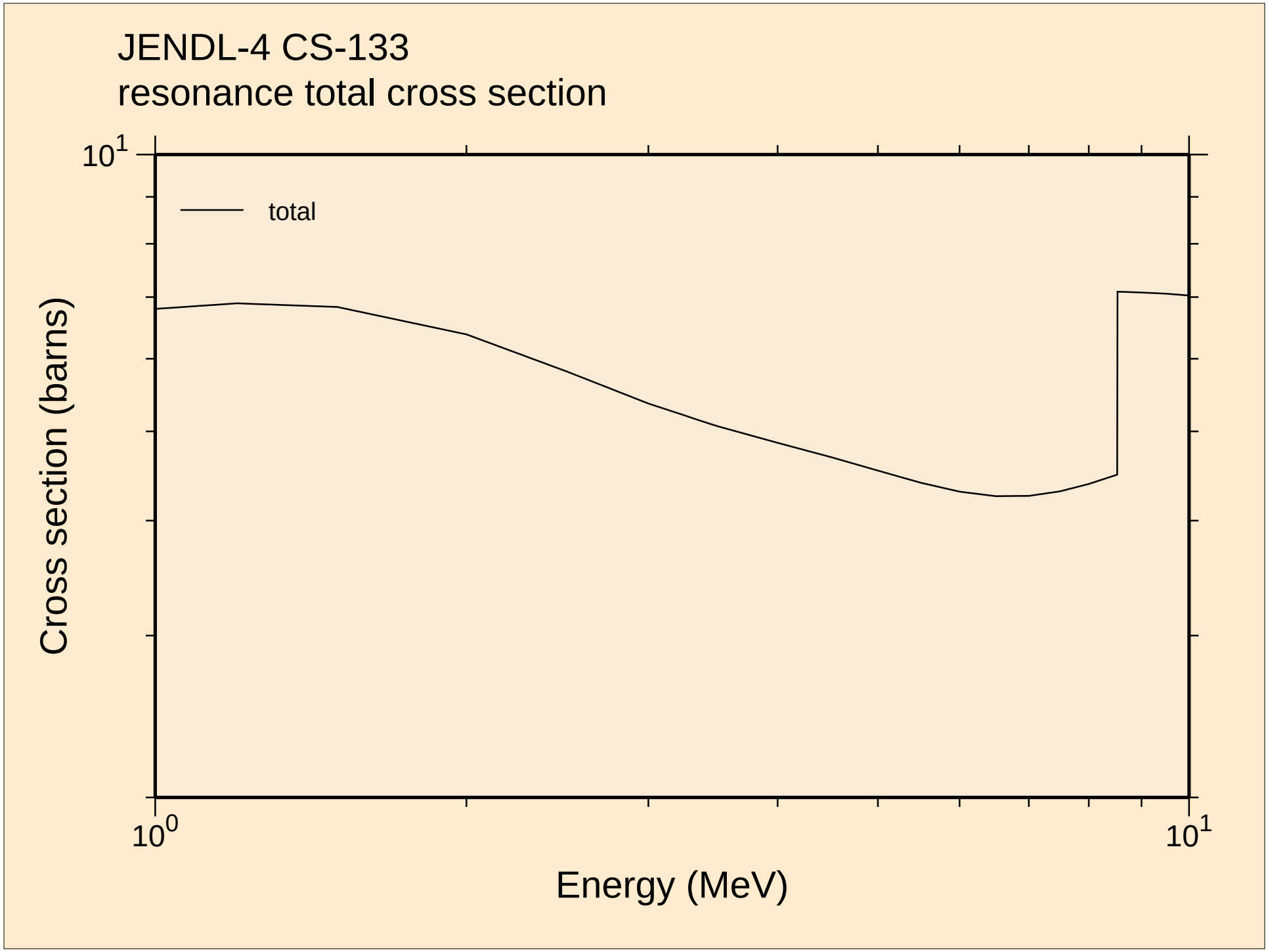

JENDL-4 CS-133
resonance total cross section
total
Cross section (barns)
10^4
10^3
10^2
10^1
10^{-6}
10^{-5}
Energy (MeV)

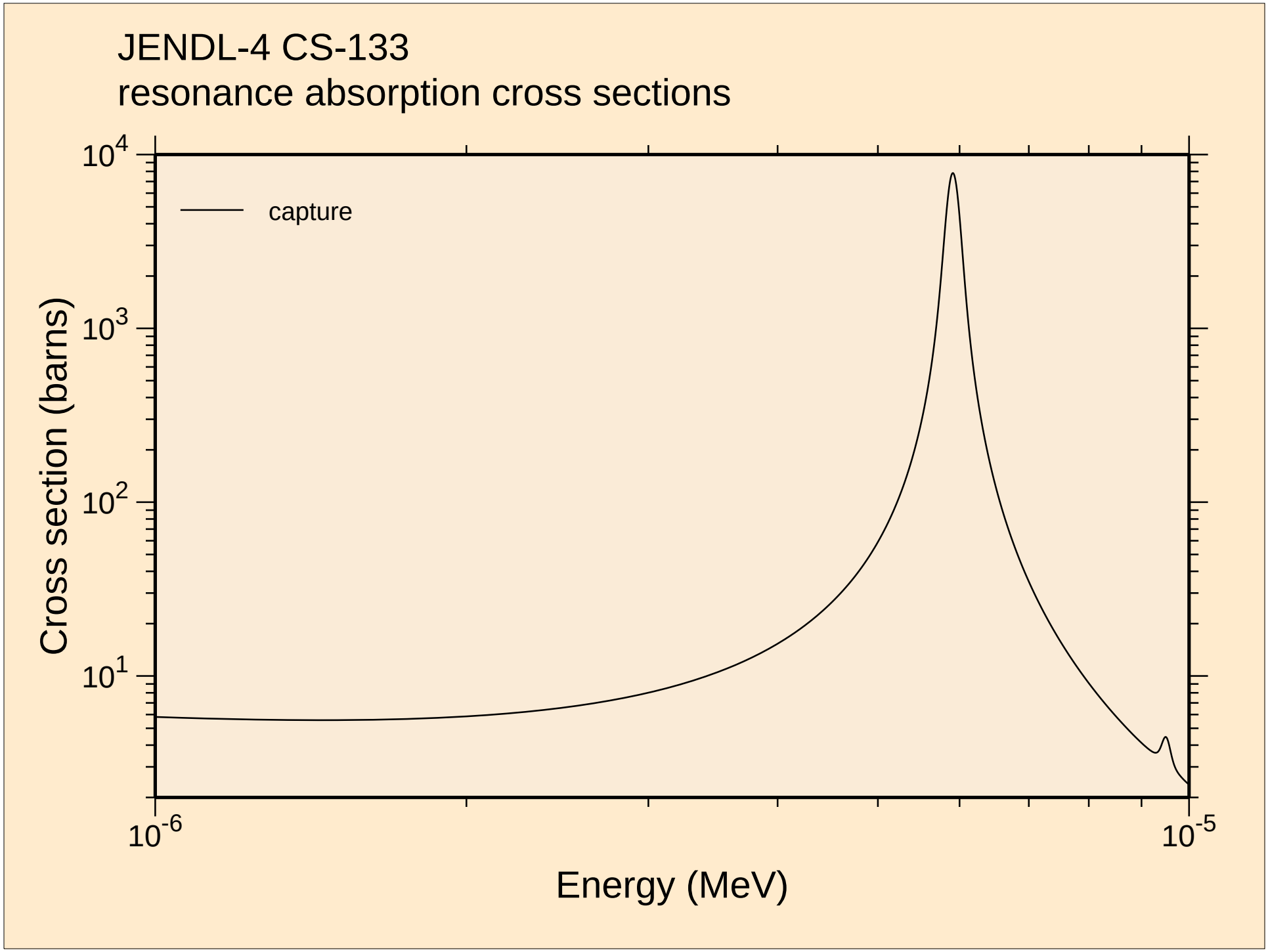

JENDL-4 CS-133
resonance total cross section
total
Cross section (barns)
10^3
10^2
10^1
10^{-5}
10^{-4}
Energy (MeV)

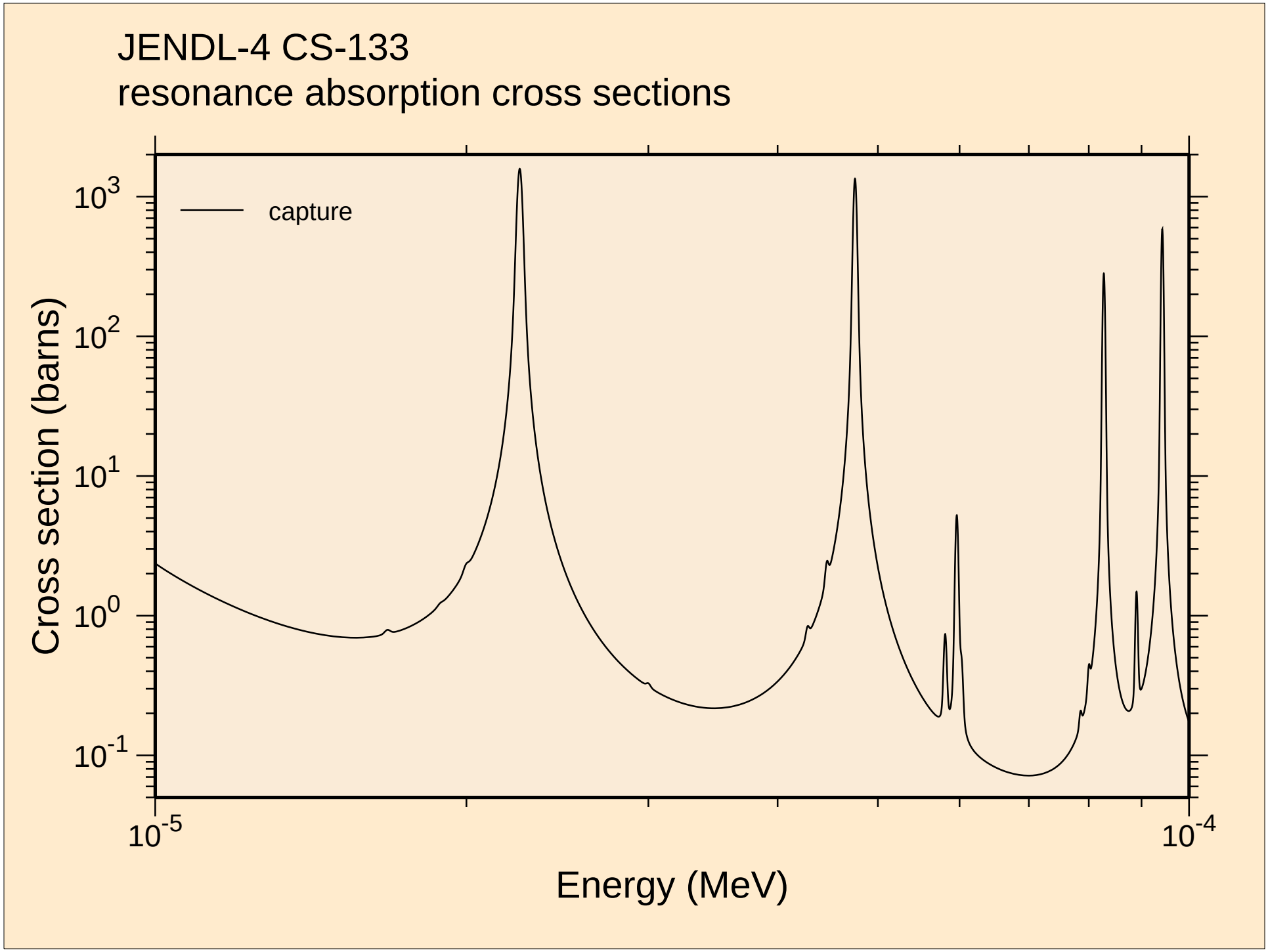

JENDL-4 CS-133
resonance total cross section
total
Cross section (barns)
10^3
10^2
10^1
10^0
10^{-4}
10^{-3}
Energy (MeV)

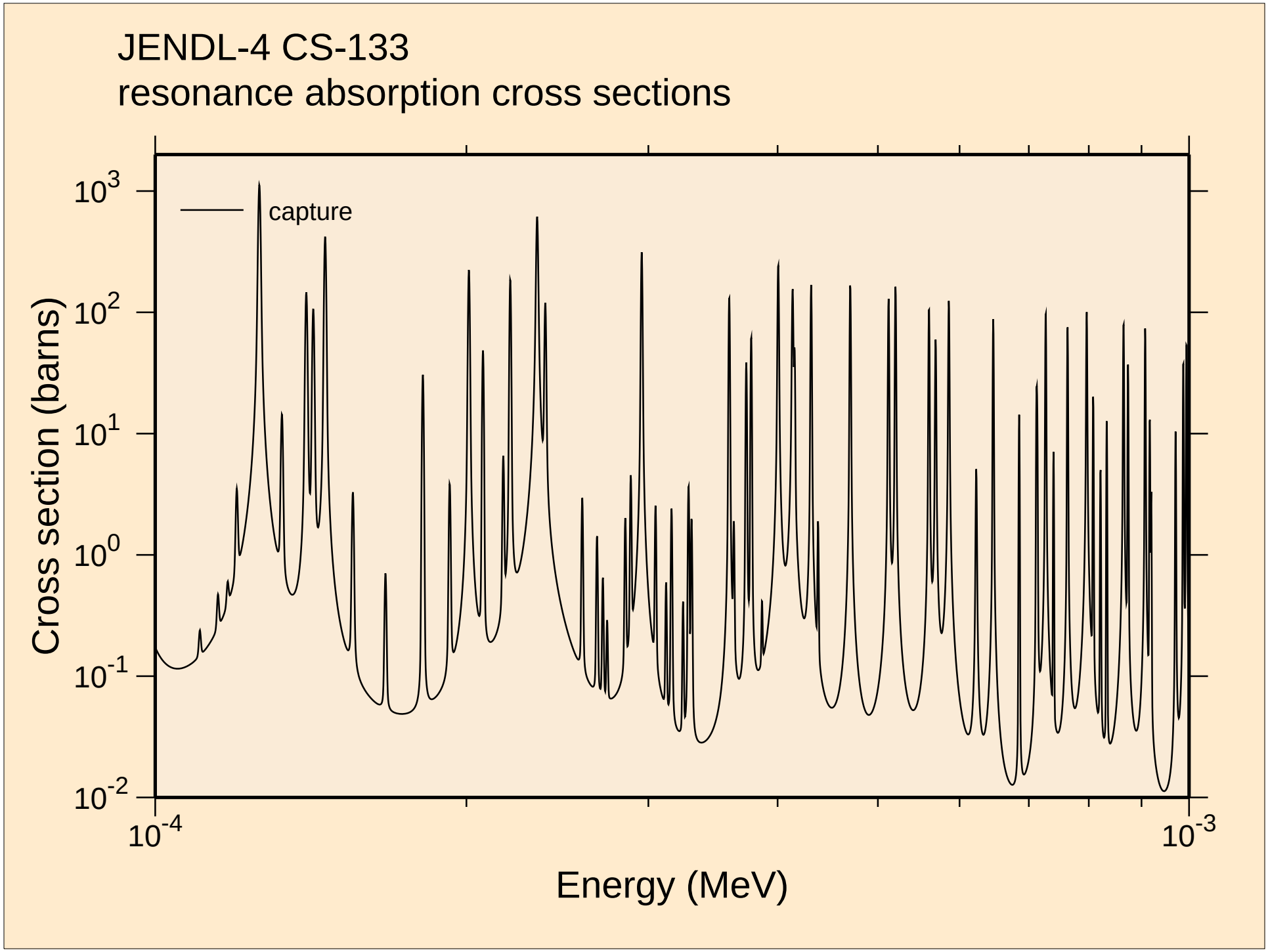

JENDL-4 CS-133
resonance total cross section
total
Cross section (barns)
10^2
10^1
10^0
10^{-3}
10^{-2}
Energy (MeV)

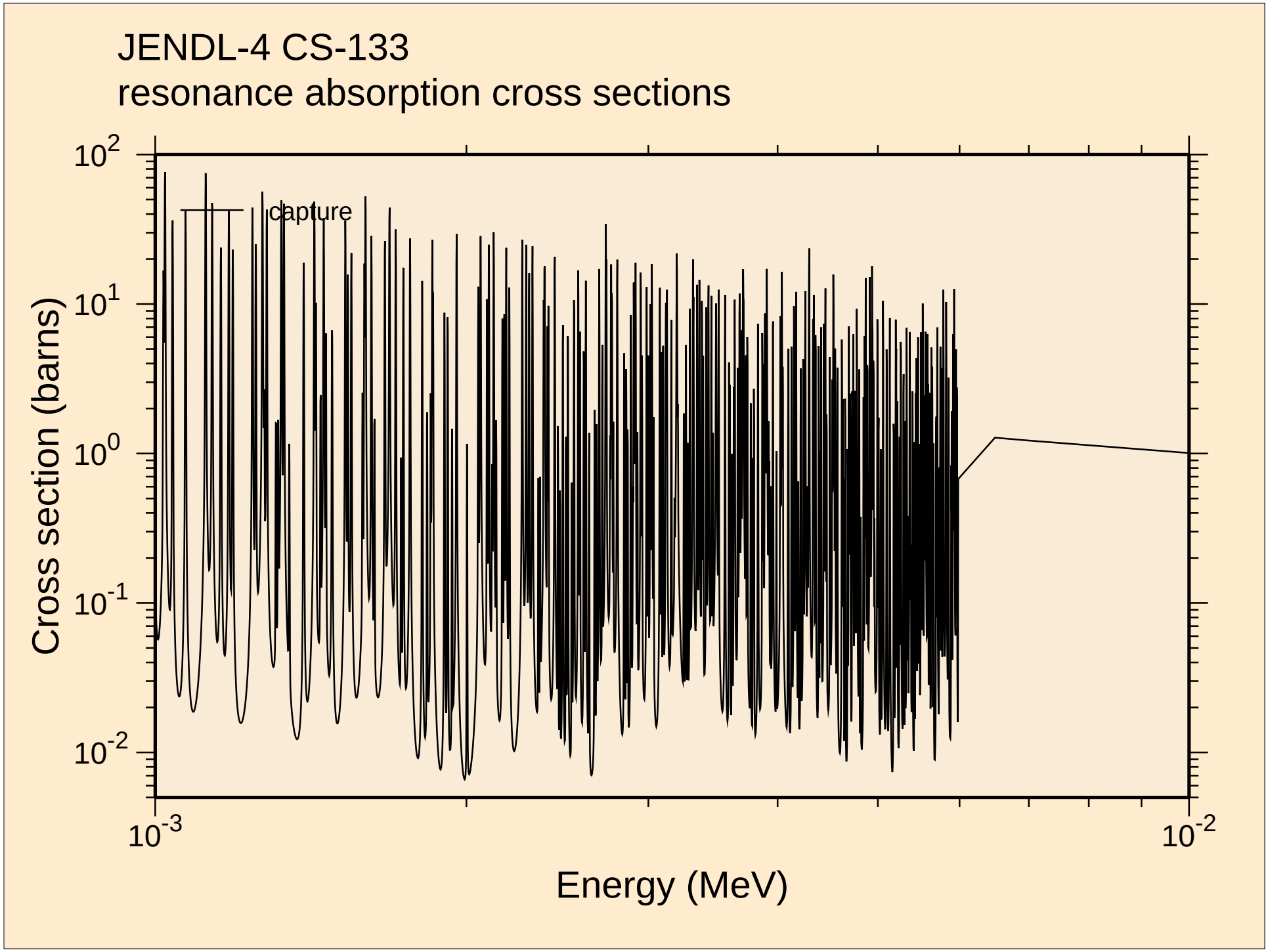

JENDL-4 CS-133
resonance total cross section
total
Cross section (barns)
Energy (MeV)
10^{1}
10^{-1}
10^{0}


JENDL-4 CS-133
resonance total cross section
total
Cross section (barns)
Energy (MeV)
10^1
10^0
10^1

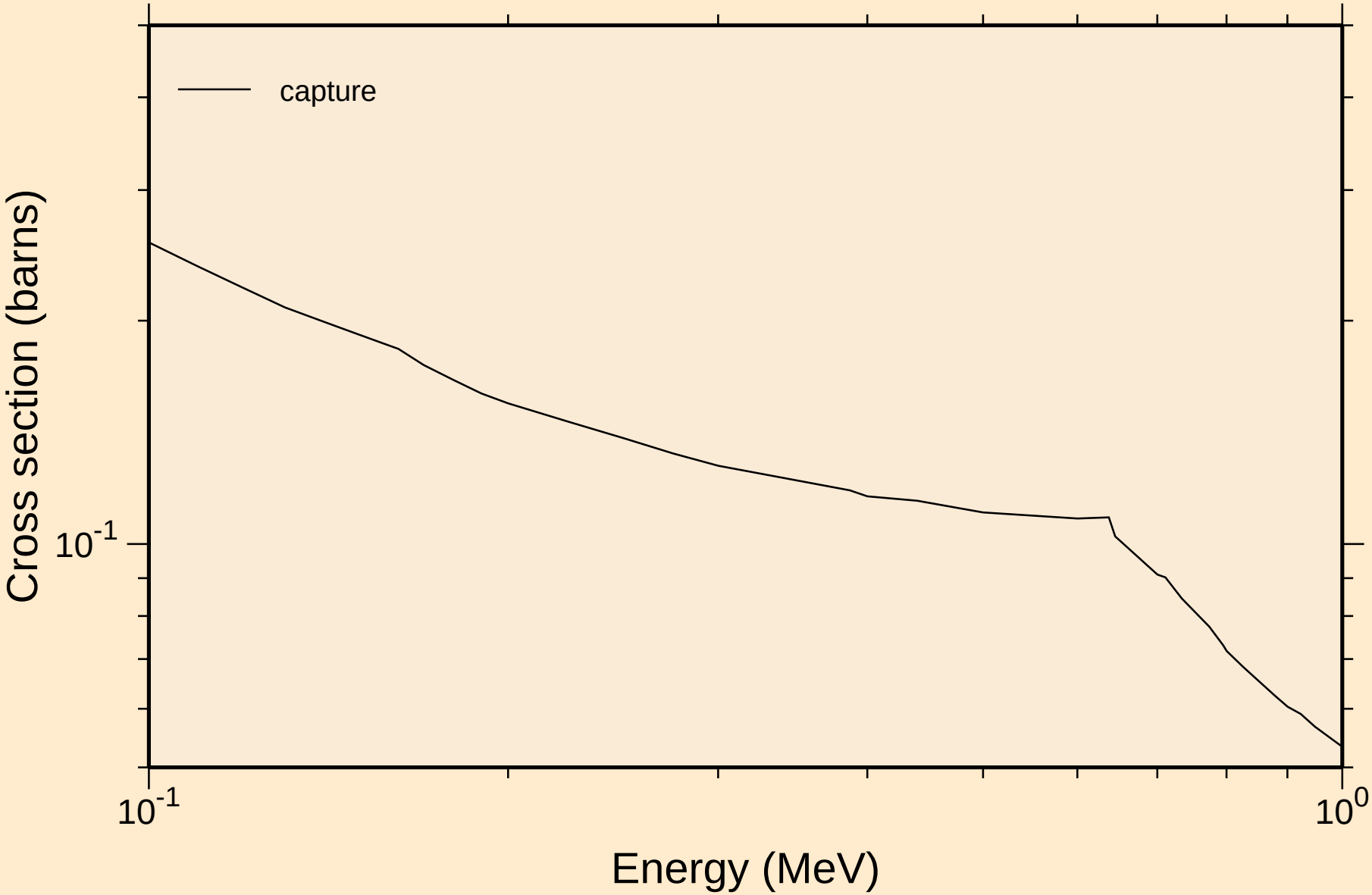

JENDL-4 CS-133
resonance absorption cross sections
capture
Cross section (barns)
10^4
10^3
10^2
10^1
10^{-6}
10^{-5}
Energy (MeV)

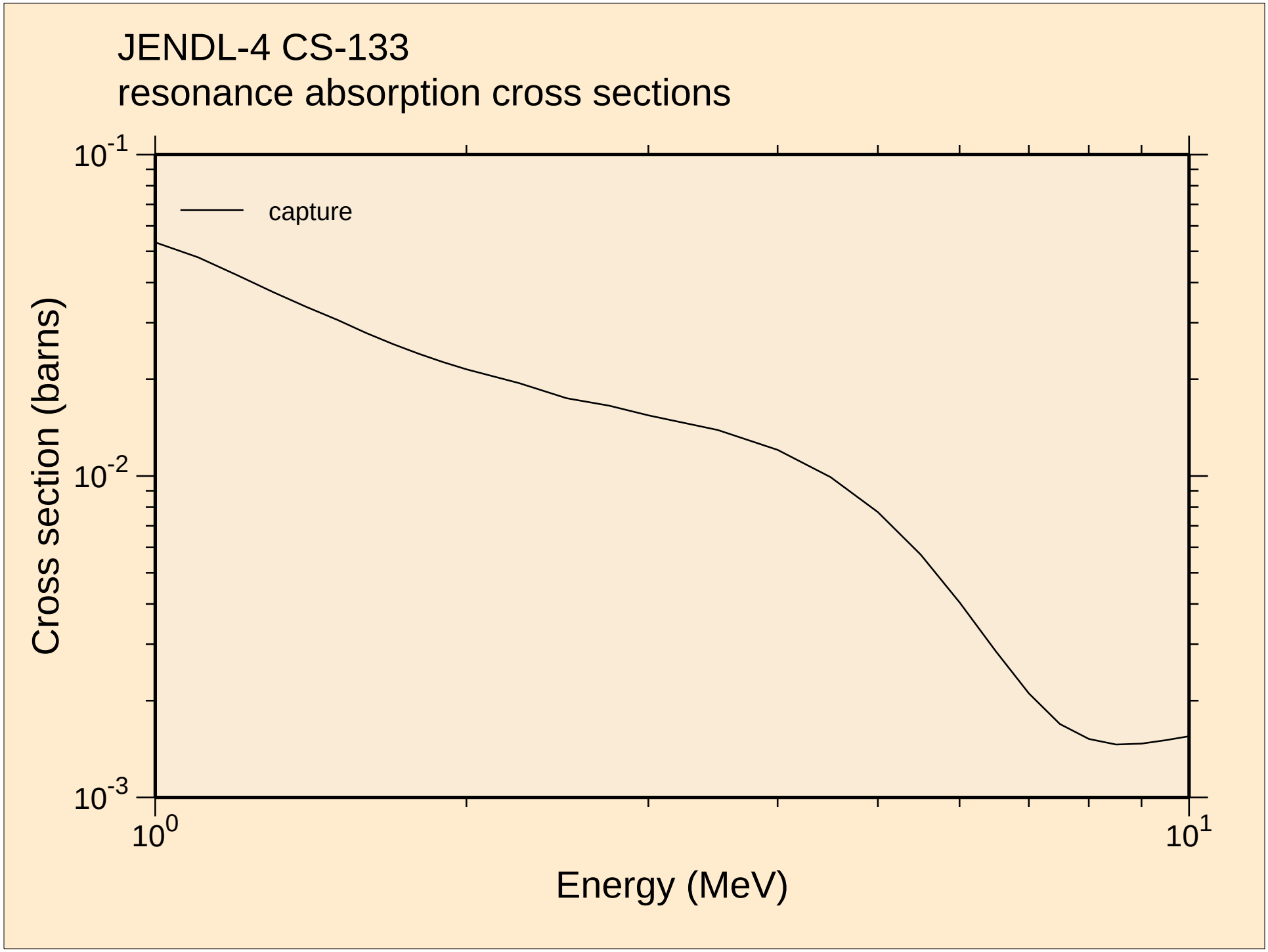

JENDL-4 CS-133
resonance absorption cross sections
capture
Cross section (barns)
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
10^{-5}
10^{-4}
Energy (MeV)

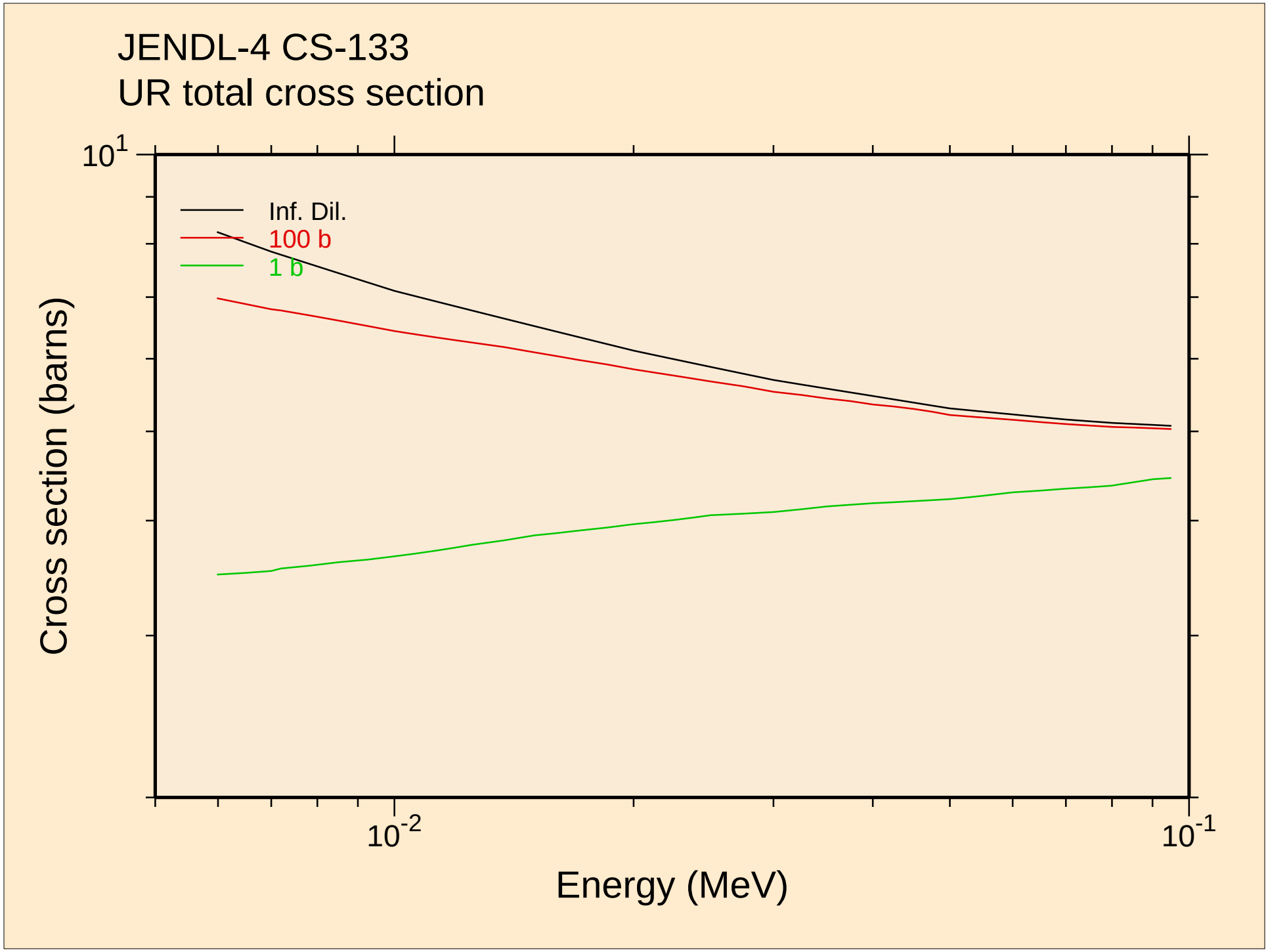

JENDL-4 CS-133
resonance absorption cross sections
capture
Cross section (barns)
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-4}
10^{-3}
Energy (MeV)

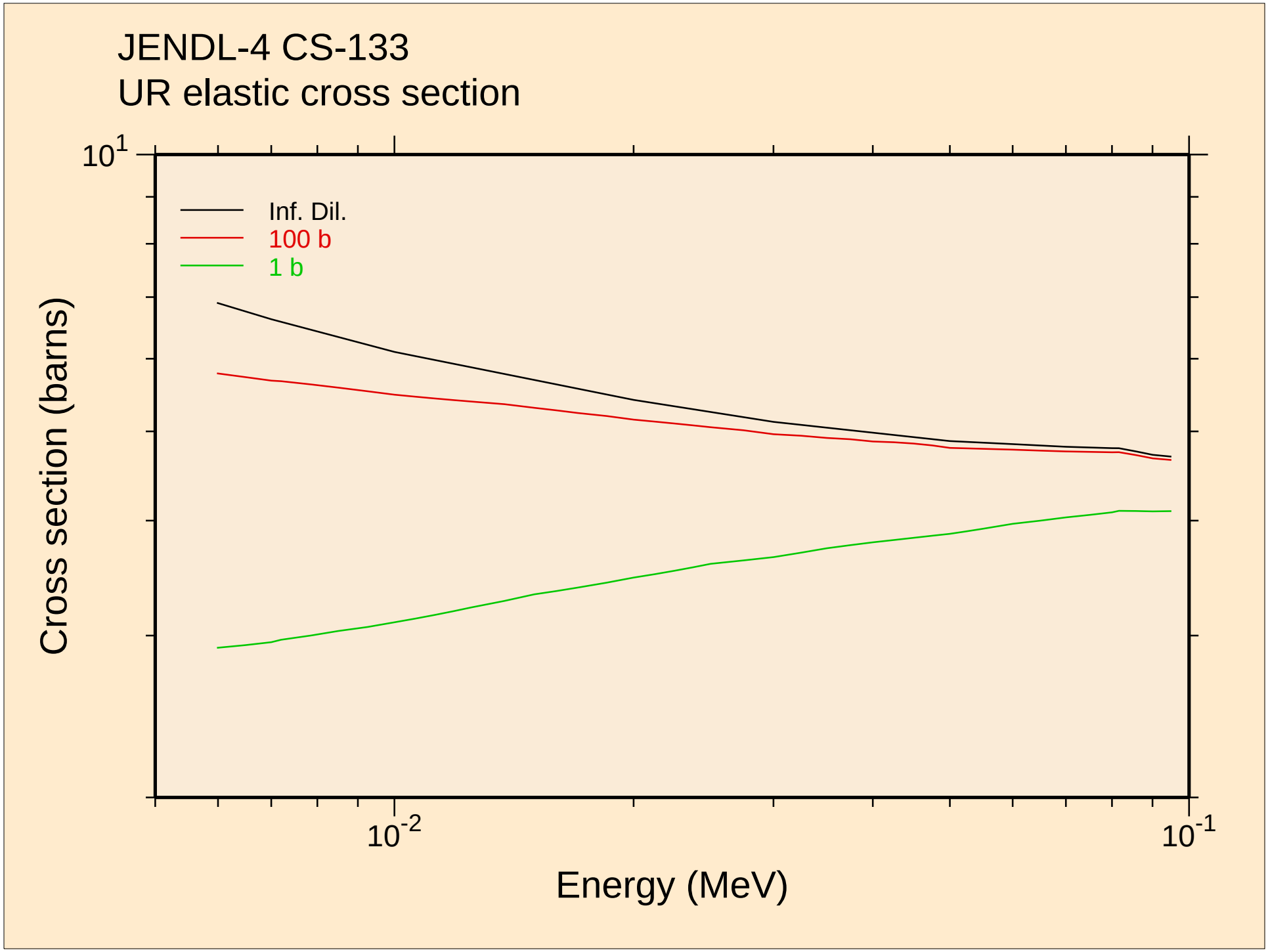

JENDL-4 CS-133
resonance absorption cross sections
capture
Cross section (barns)
Energy (MeV)
10^2
10^1
10^0
10^-1
10^-2
10^-3
10^-2

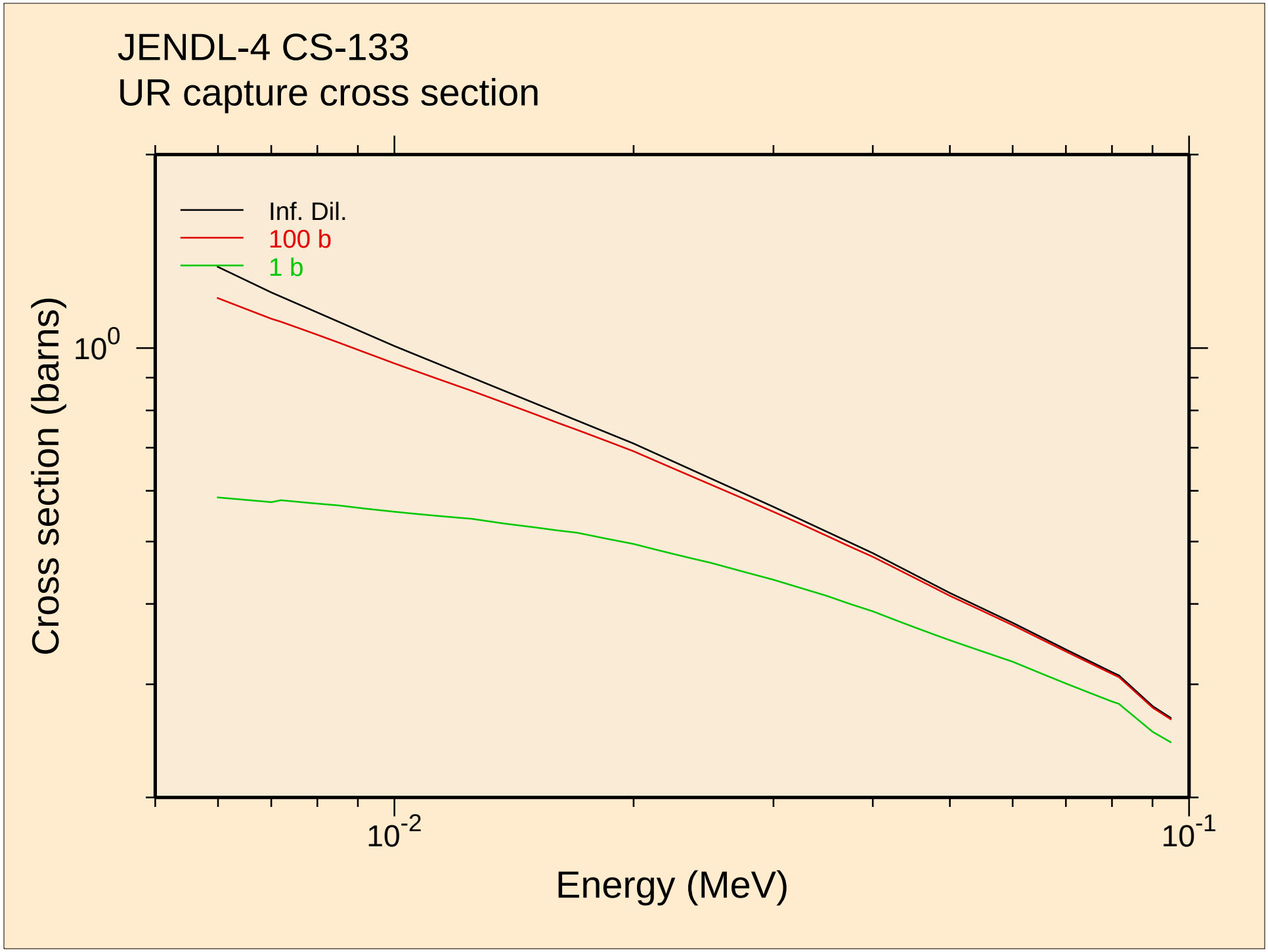
JENDL-4 CS-133
resonance absorption cross sections

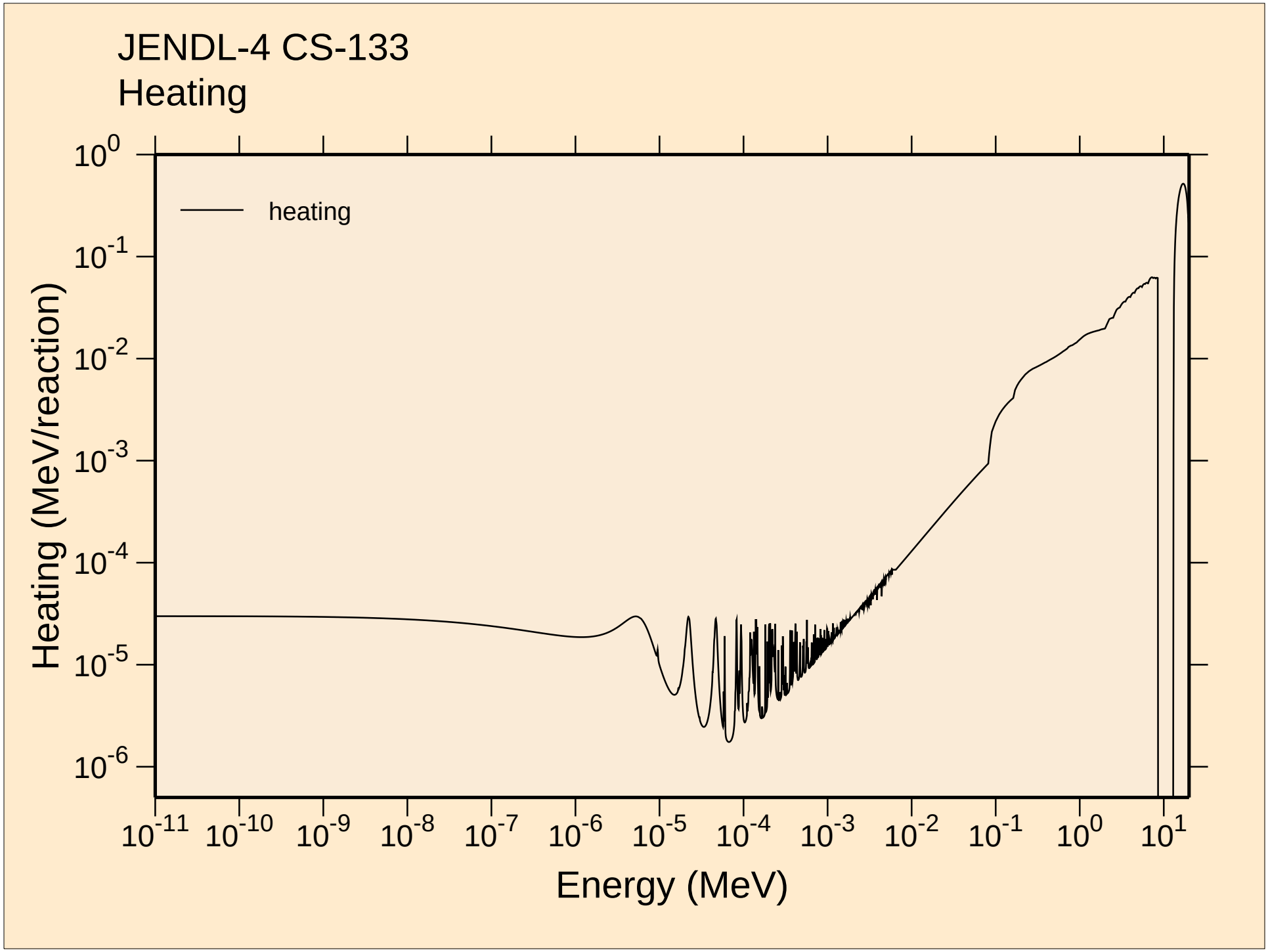


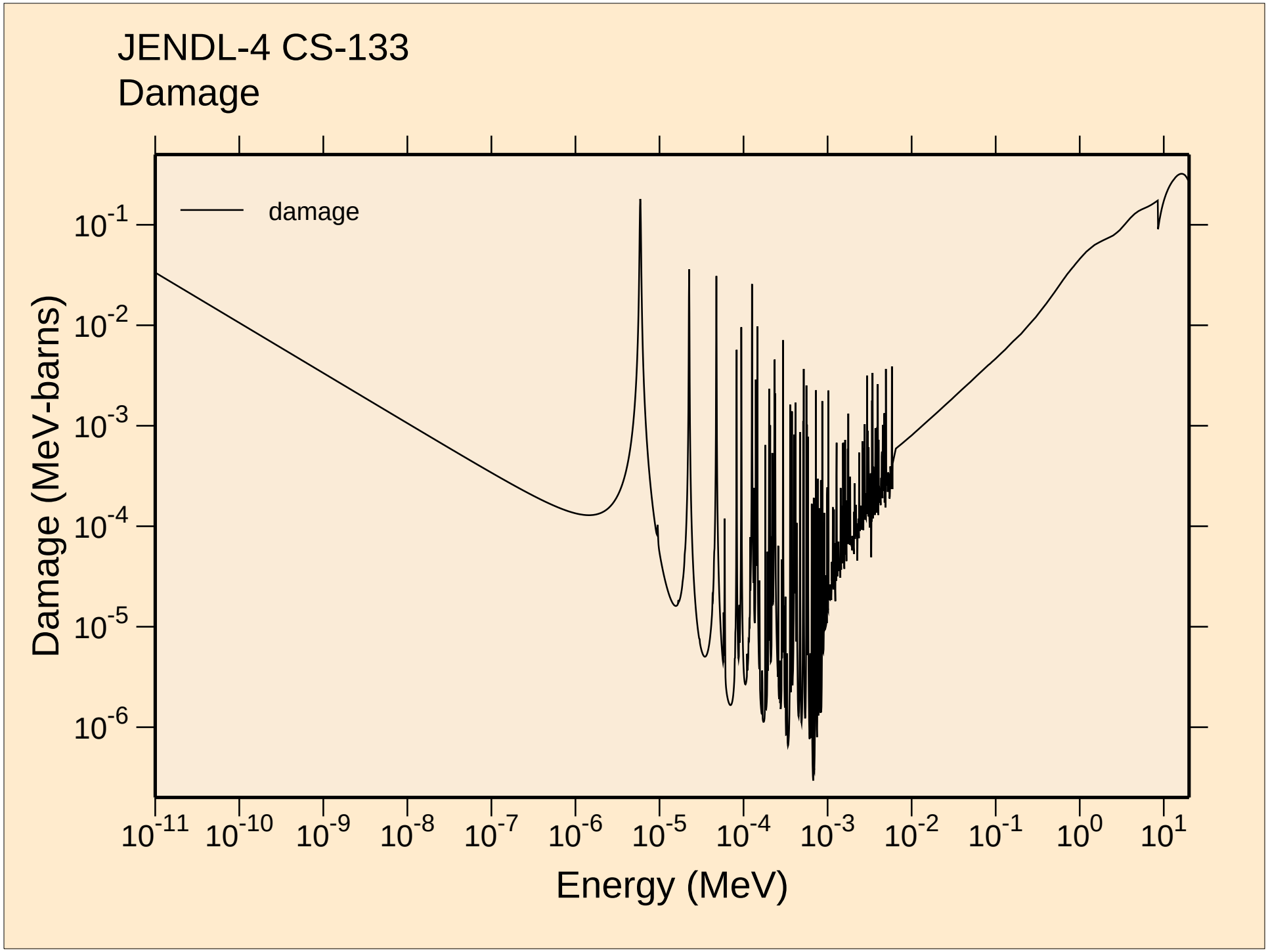

JENDL-4 CS-133
resonance absorption cross sections
capture
Cross section (barns)
10-1
10-2
10-3
100
101
Energy (MeV)

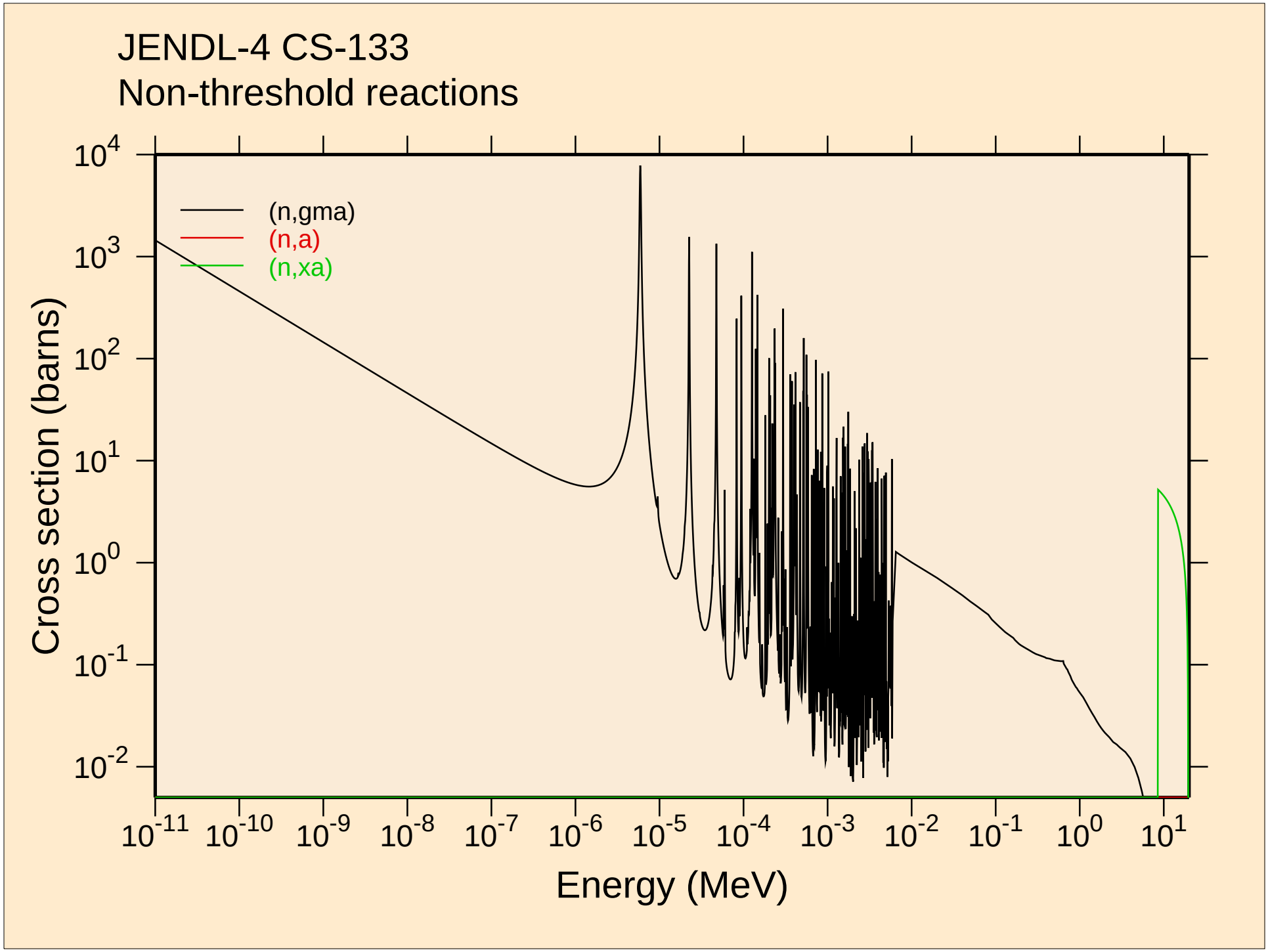

JENDL-4 CS-133
UR total cross section
Inf. Dil.
100 b
1 b
Cross section (barns)
Energy (MeV)
10^1
10^-2
10^-1

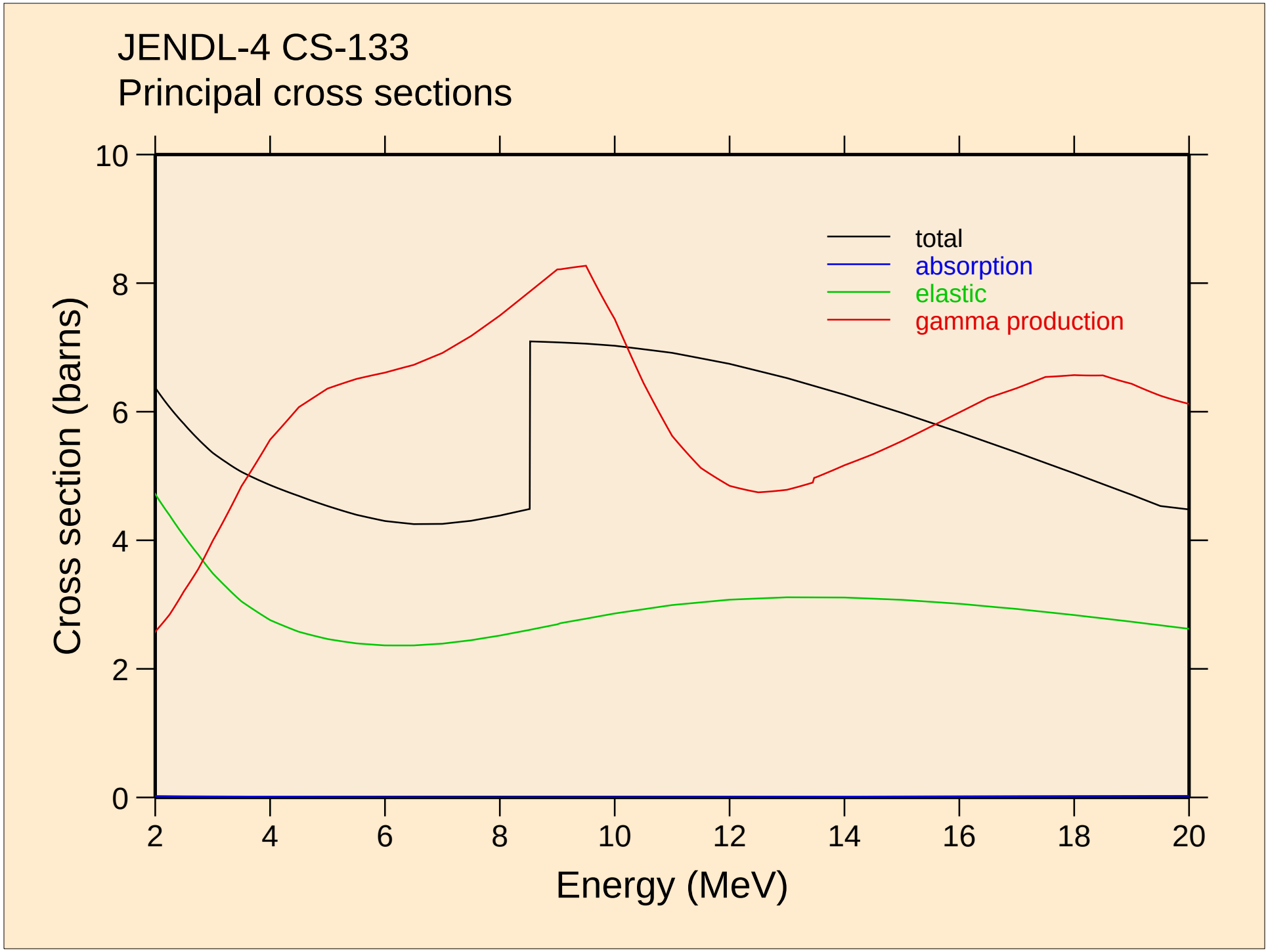

JENDL-4 CS-133
UR elastic cross section
Inf. Dil.
100 b
1 b
Cross section (barns)
Energy (MeV)
10^1
10^-2
10^-1

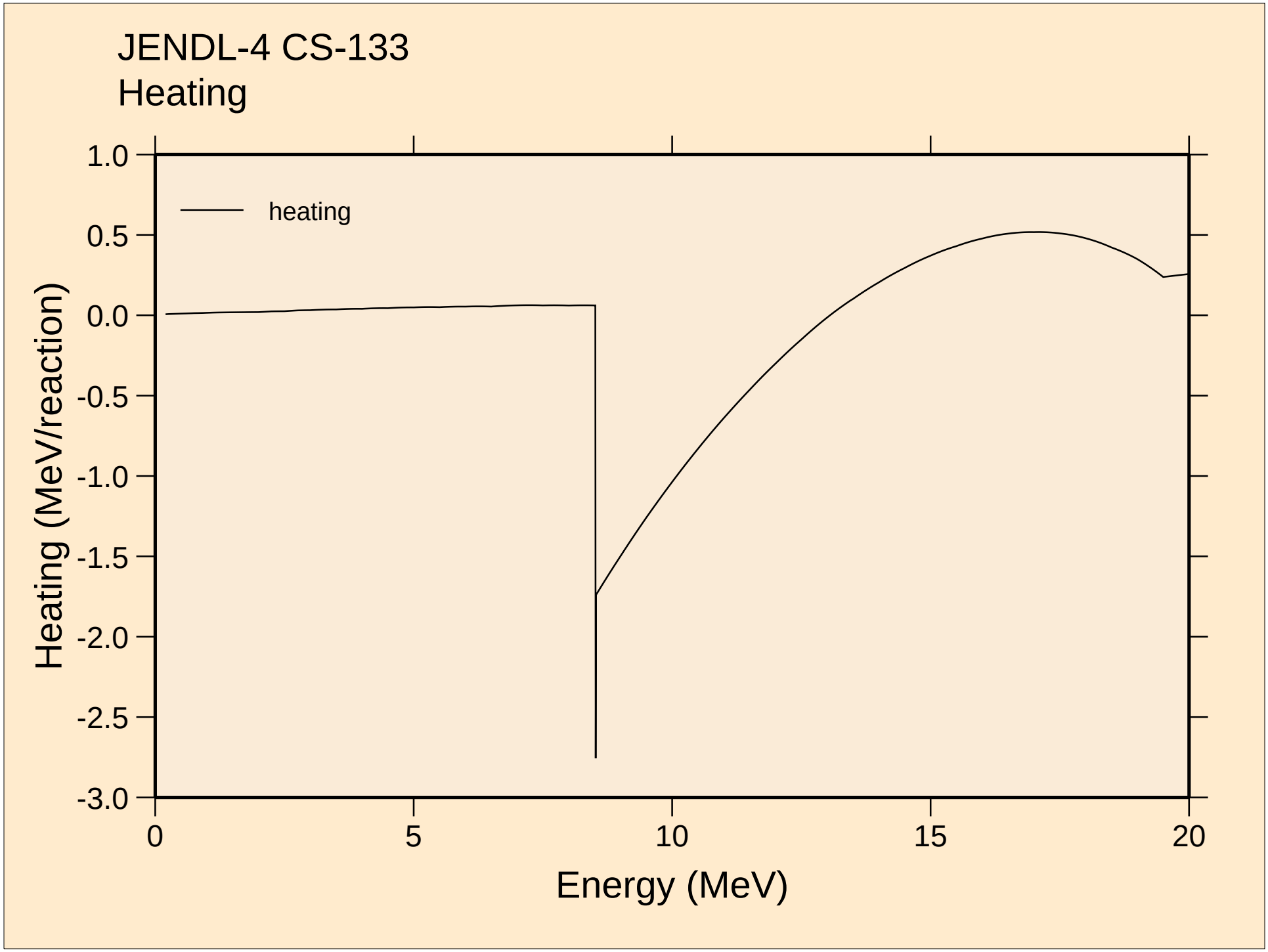

JENDL-4 CS-133
UR capture cross section
Inf. Dil.
100 b
1 b
Cross section (barns)
10^0
10^{-2}
10^{-1}
Energy (MeV)

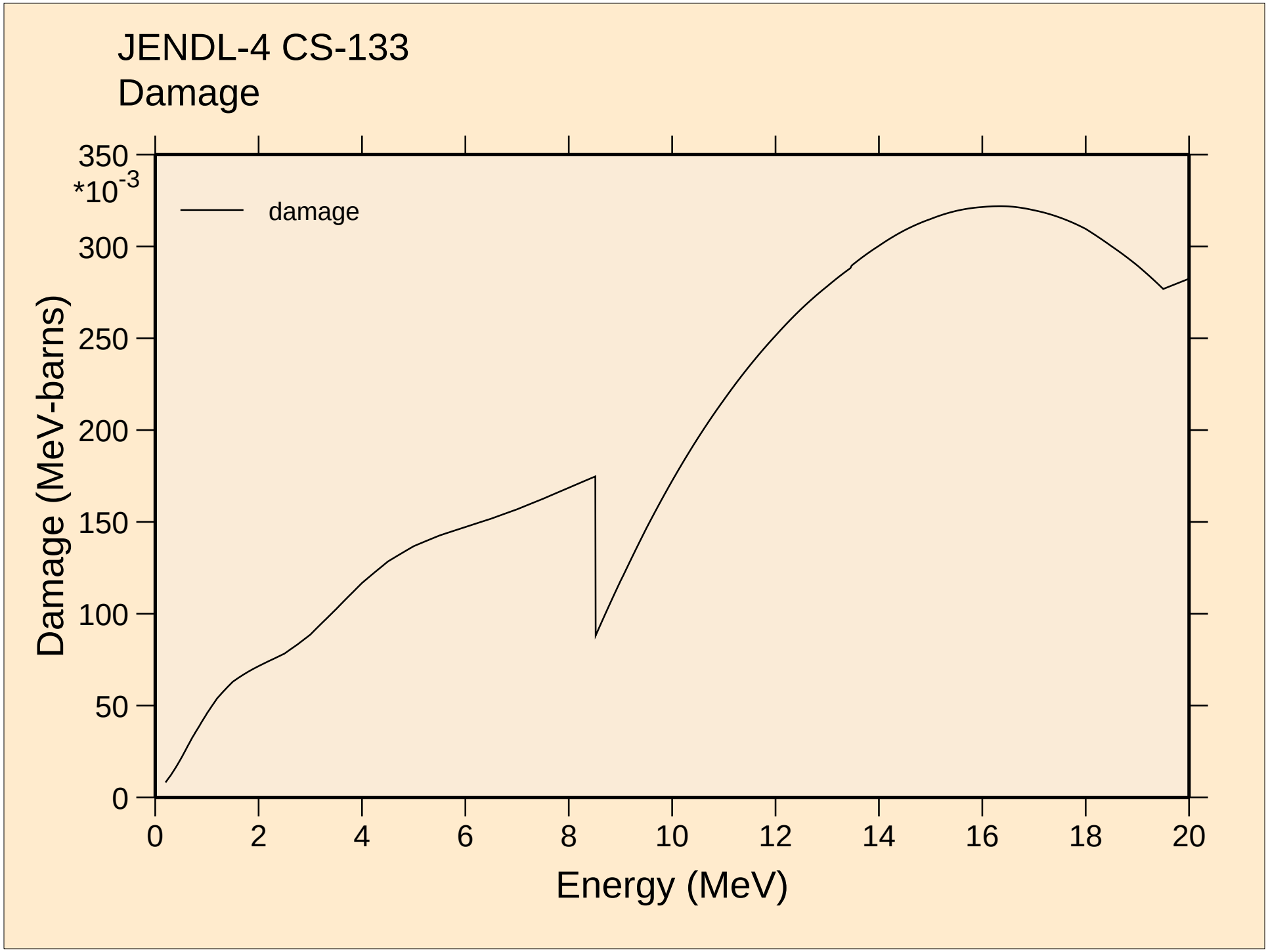

JENDL-4 CS-133
Heating
heating
Heating (MeV/reaction)
Energy (MeV)
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
10^-11
10^-10
10^-9
10^-8
10^-7
10^-6
10^-5
10^-4
10^-3
10^-2
10^-1
10^0
10^1

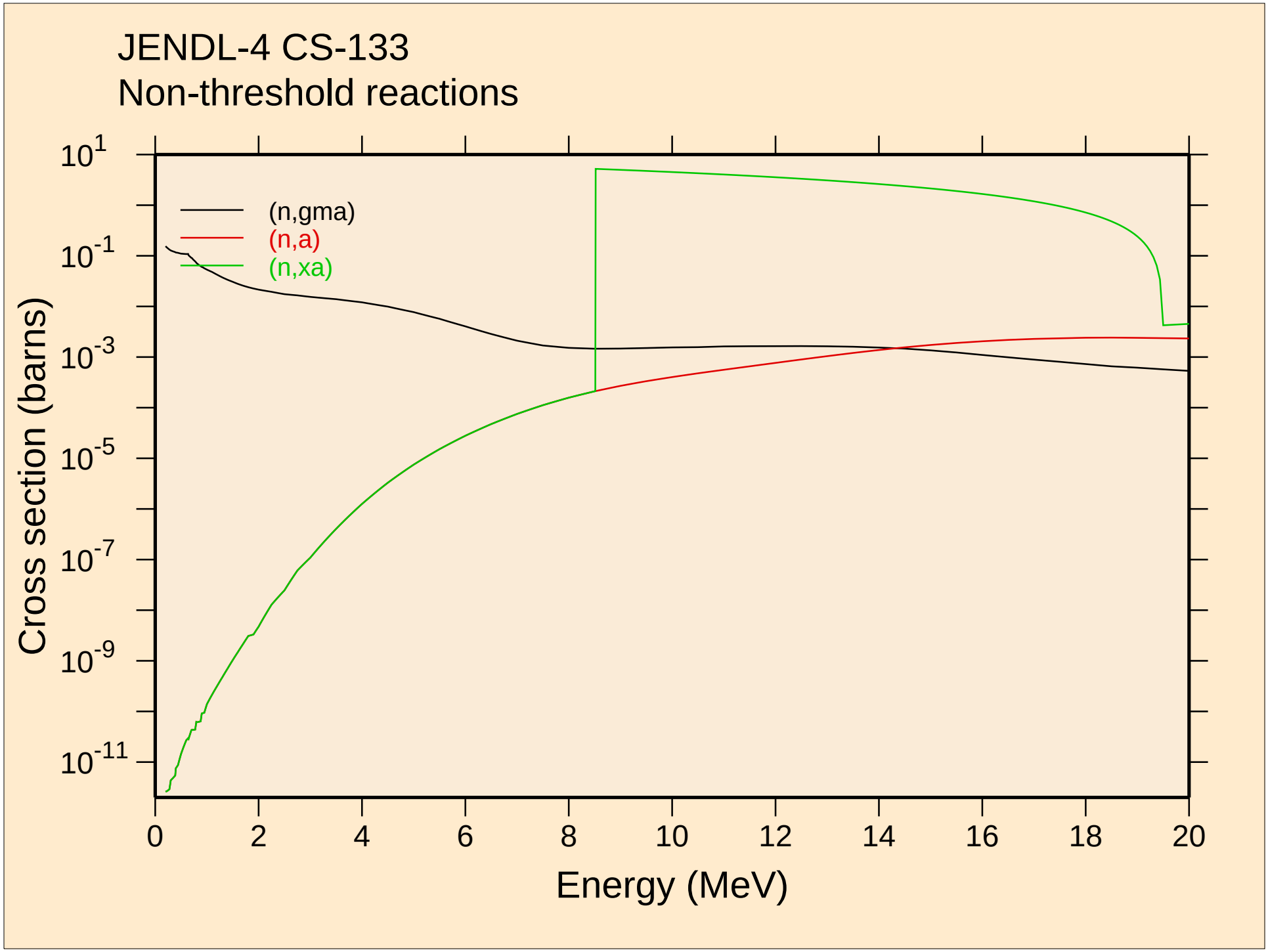

JENDL-4 CS-133
Damage
damage
Damage (MeV-barns)
Energy (MeV)
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
10^-11
10^-10
10^-9
10^-8
10^-7
10^-6
10^-5
10^-4
10^-3
10^-2
10^-1
10^0
10^1

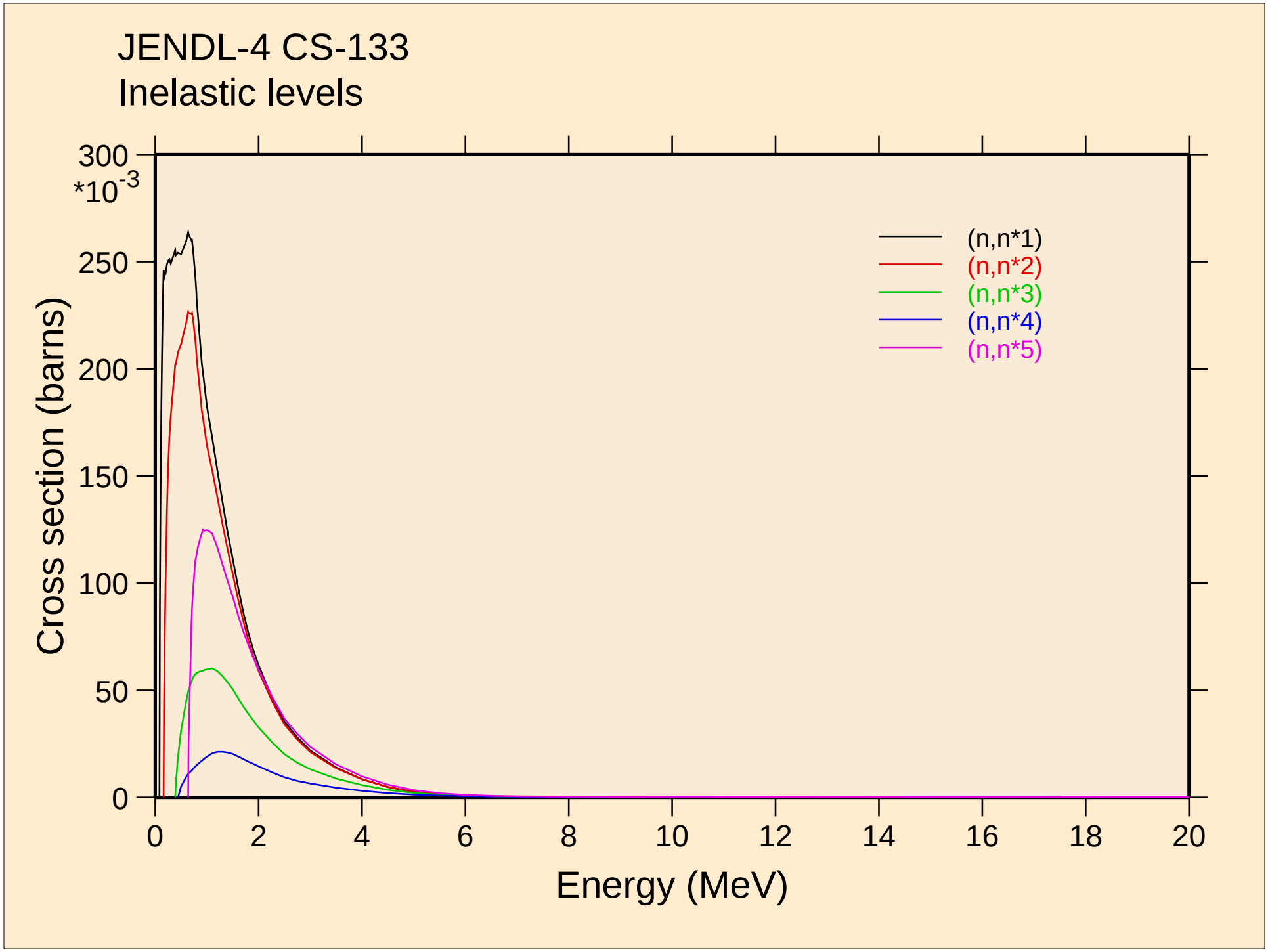

JENDL-4 CS-133
Non-threshold reactions
(n,gma)
(n,a)
(n,xa)
Cross section (barns)
Energy (MeV)
10^4
10^3
10^2
10^1
10^0
10^-1
10^-2
10^-11
10^-10
10^-9
10^-8
10^-7
10^-6
10^-5
10^-4
10^-3
10^-2
10^-1
10^0
10^1

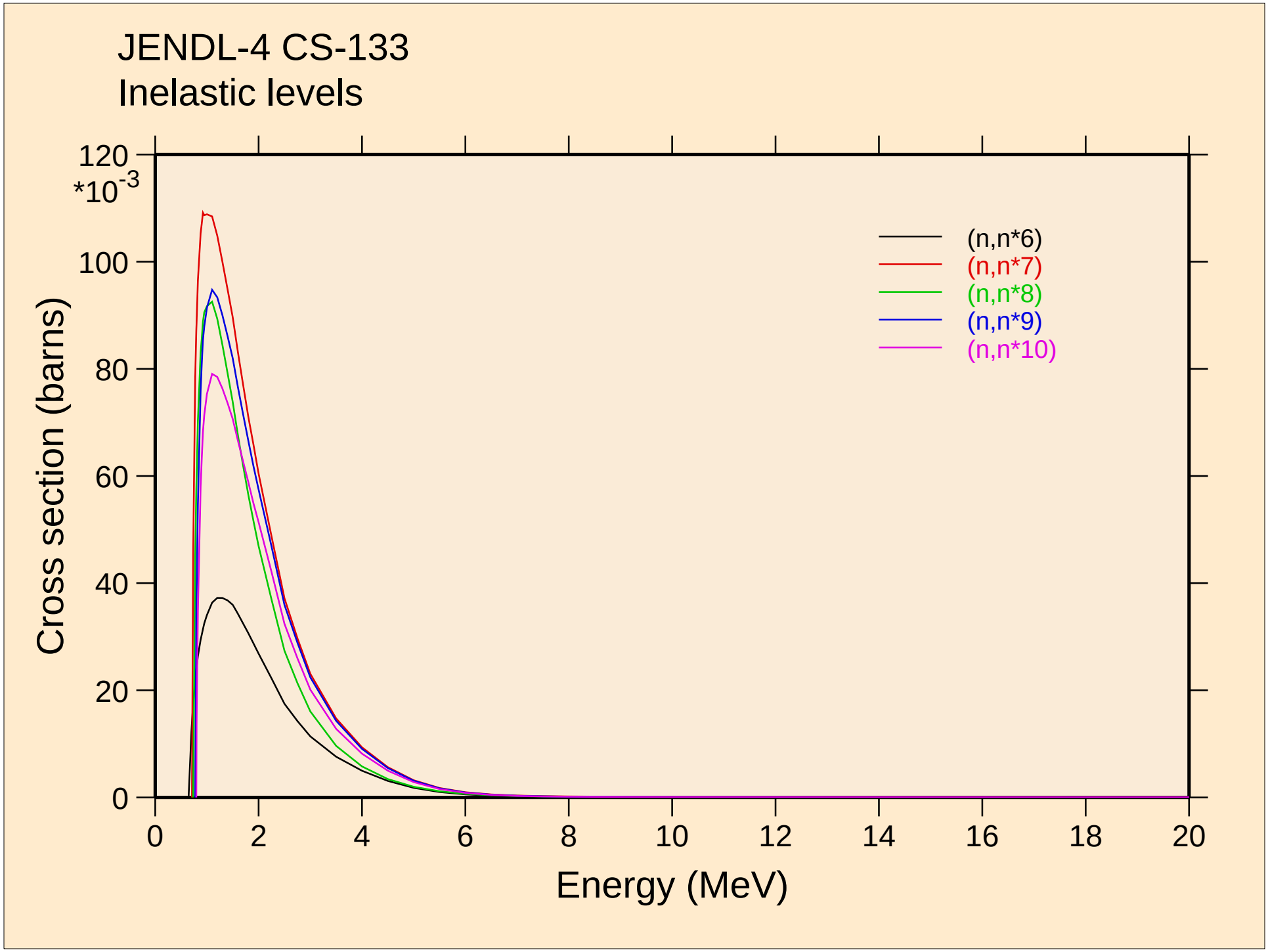

JENDL-4 CS-133
Principal cross sections
total
absorption
elastic
gamma production
Cross section (barns)
Energy (MeV)
0
2
4
6
8
10
2
4
6
8
10
12
14
16
18
20

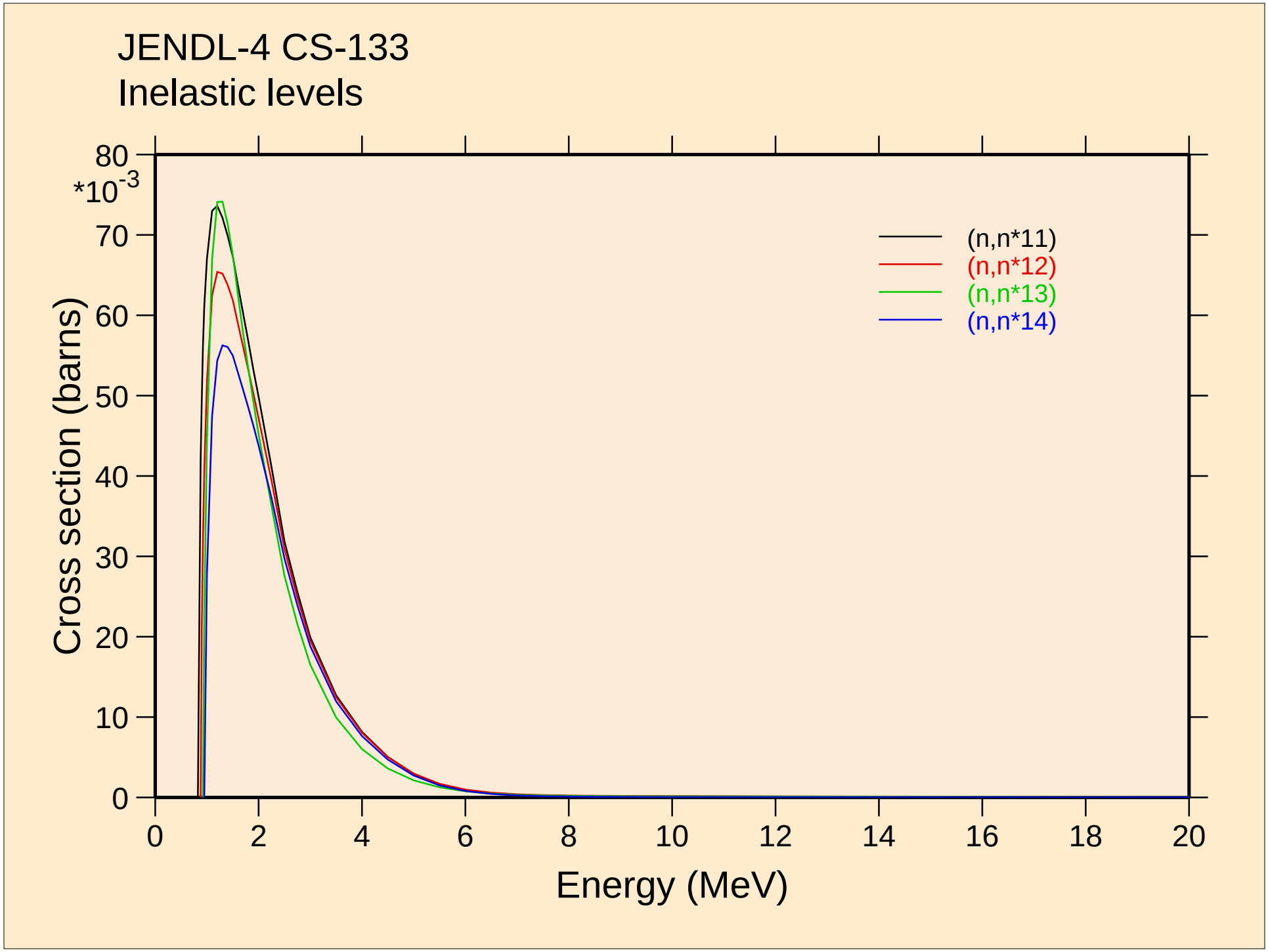

JENDL-4 CS-133
Heating
heating
Heating (MeV/reaction)
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
0
5
10
15
20
Energy (MeV)

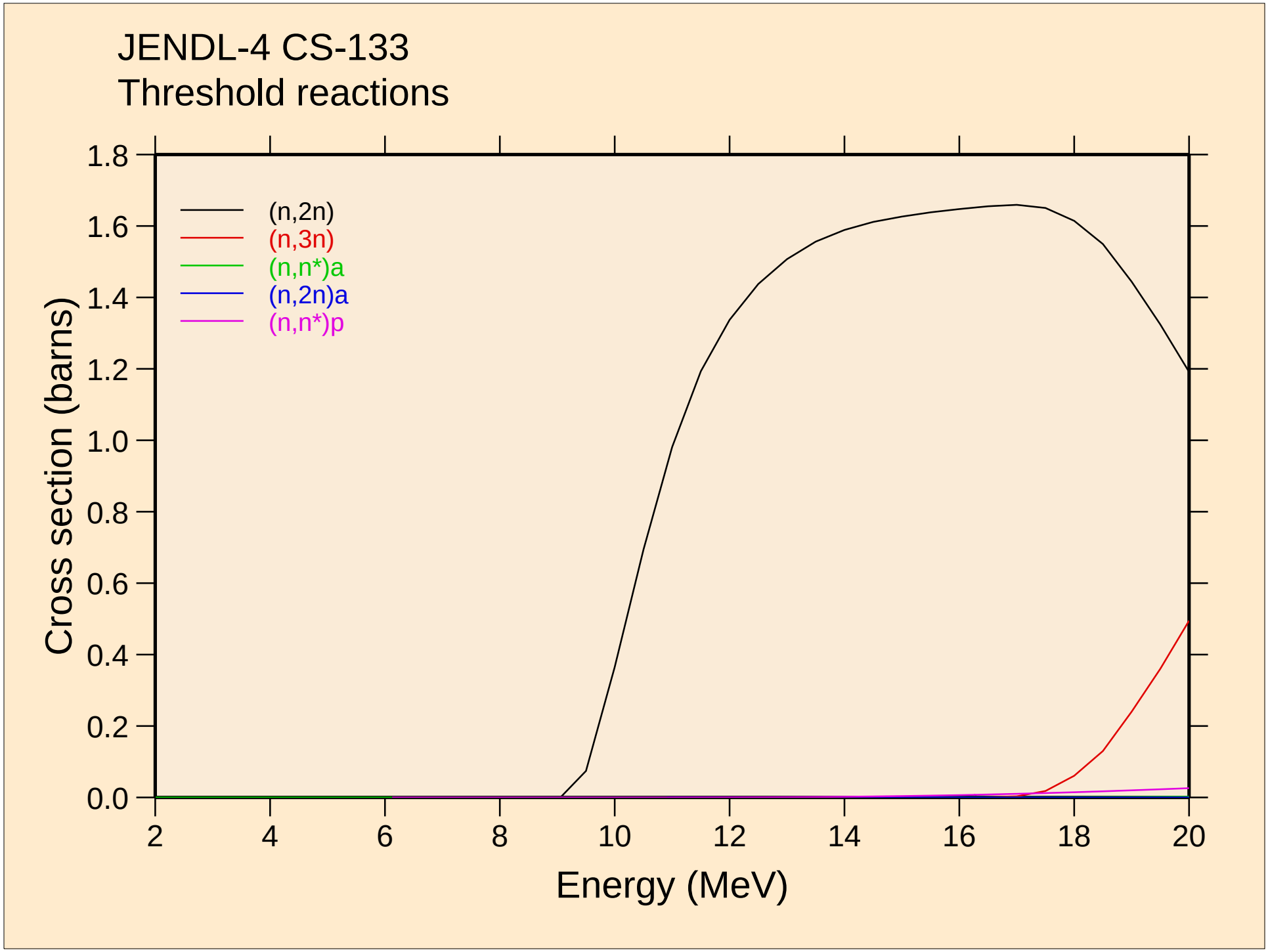

JENDL-4 CS-133
Damage
damage
*10-3
350
300
250
200
150
100
50
0
Damage (MeV-barns)
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

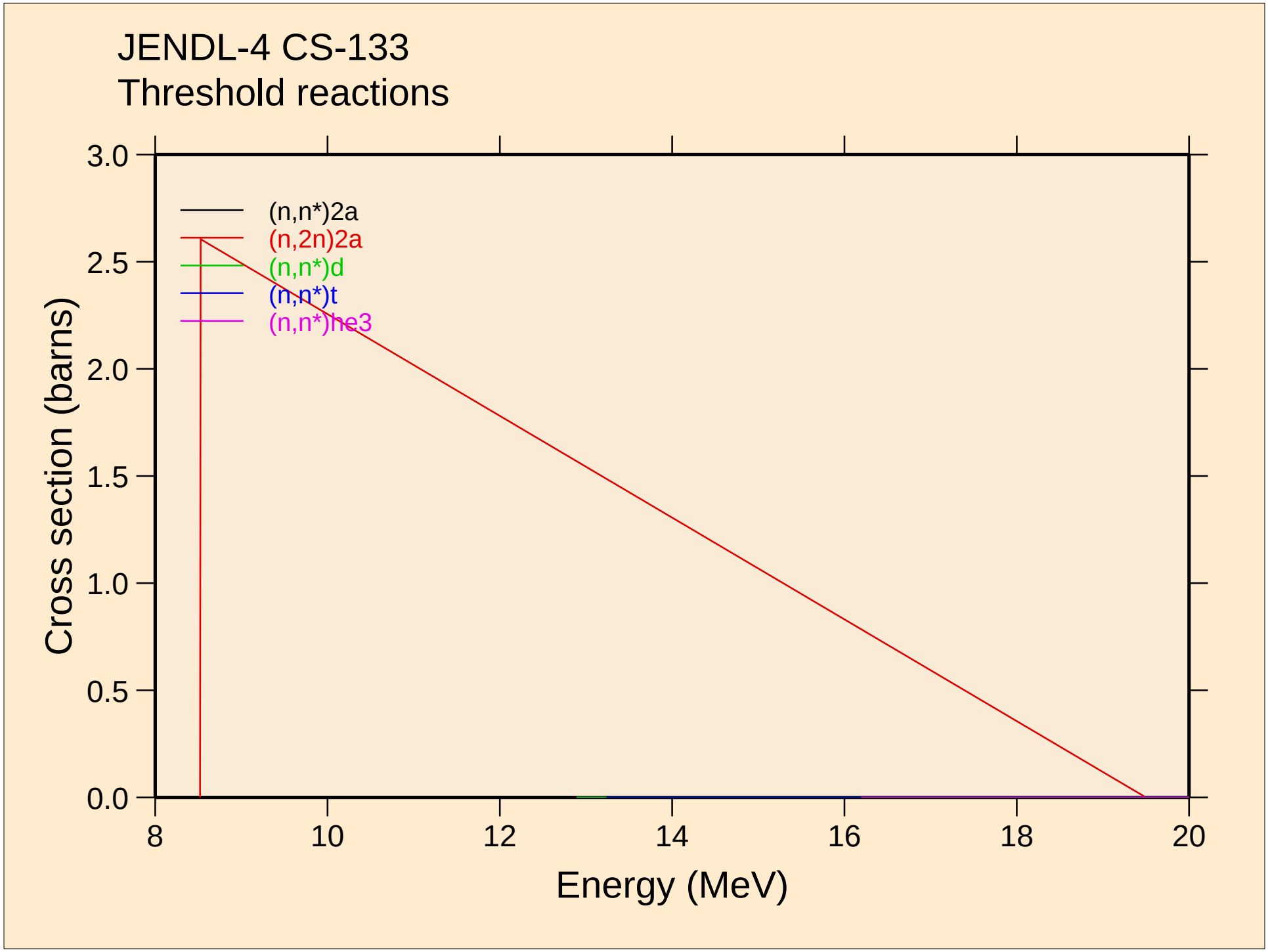

JENDL-4 CS-133
Non-threshold reactions
(n,gma)
(n,a)
(n,xa)
Cross section (barns)
Energy (MeV)
10^1
10^-1
10^-3
10^-5
10^-7
10^-9
10^-11
0
2
4
6
8
10
12
14
16
18
20

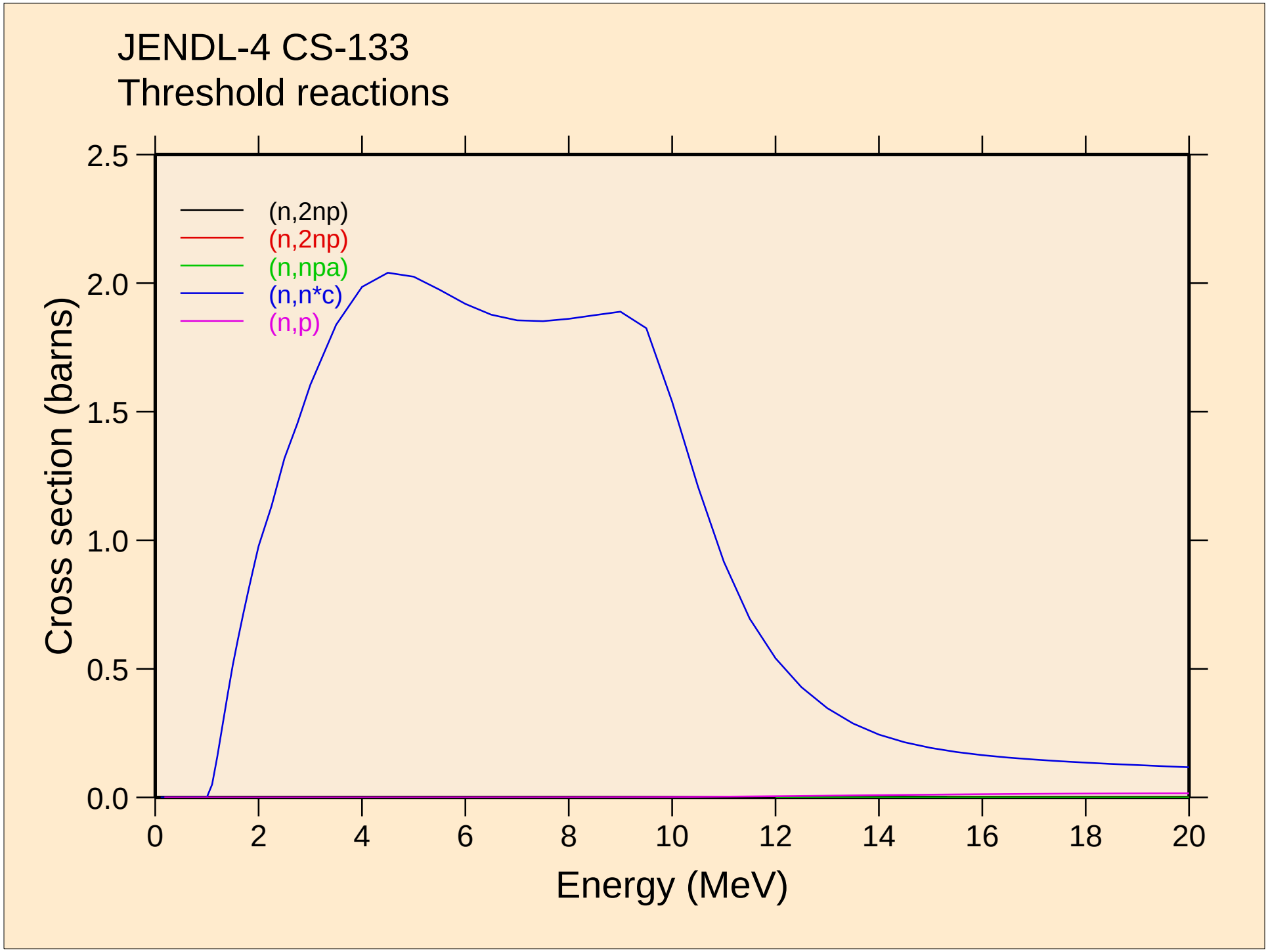

JENDL-4 CS-133
Inelastic levels
300
*10-3
250
200
150
100
50
0
Cross section (barns)
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)
(n,n*1)
(n,n*2)
(n,n*3)
(n,n*4)
(n,n*5)

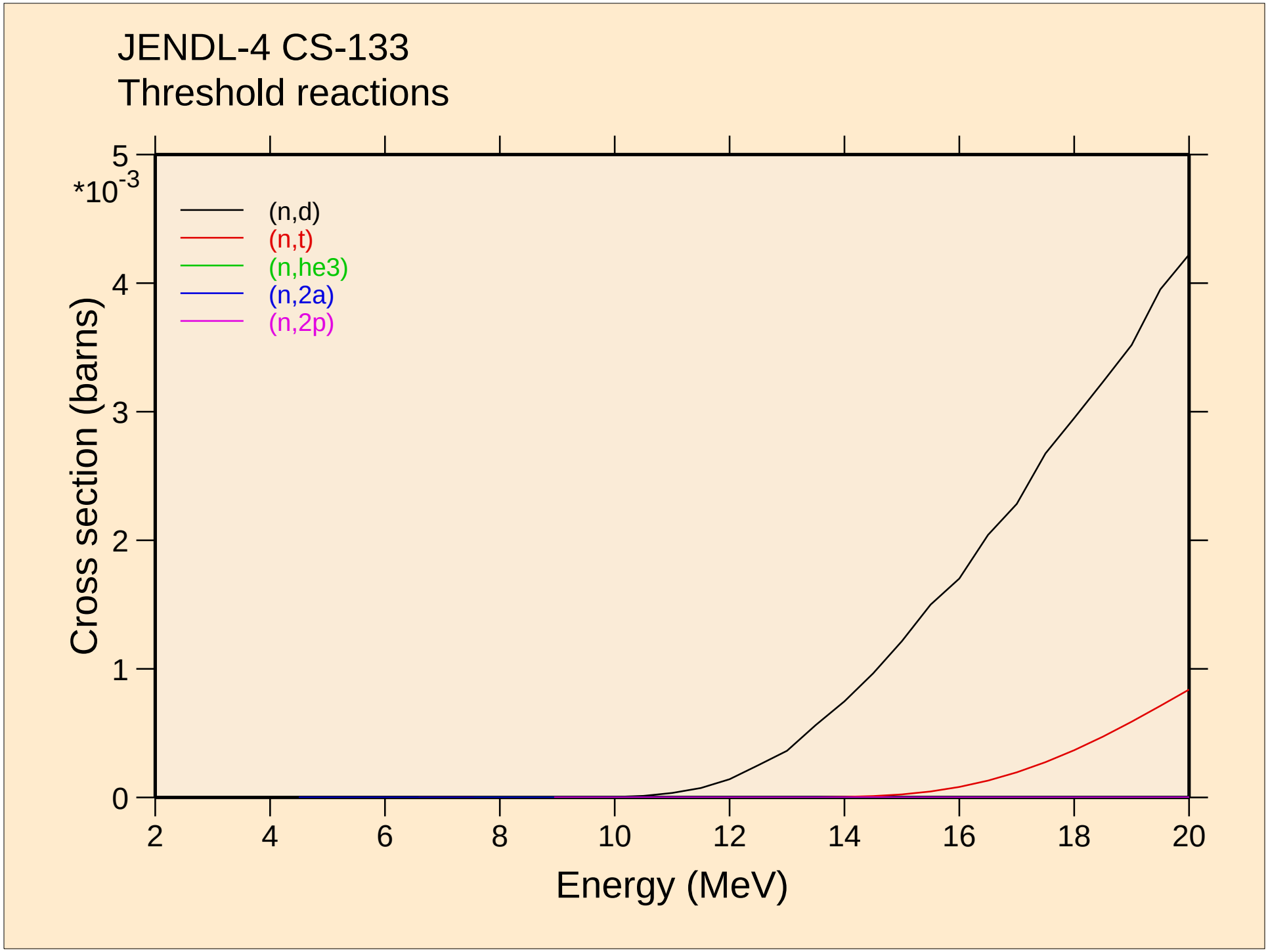

JENDL-4 CS-133
Inelastic levels
120
*10-3
100
80
60
40
20
0
Cross section (barns)
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)
(n,n*6)
(n,n*7)
(n,n*8)
(n,n*9)
(n,n*10)

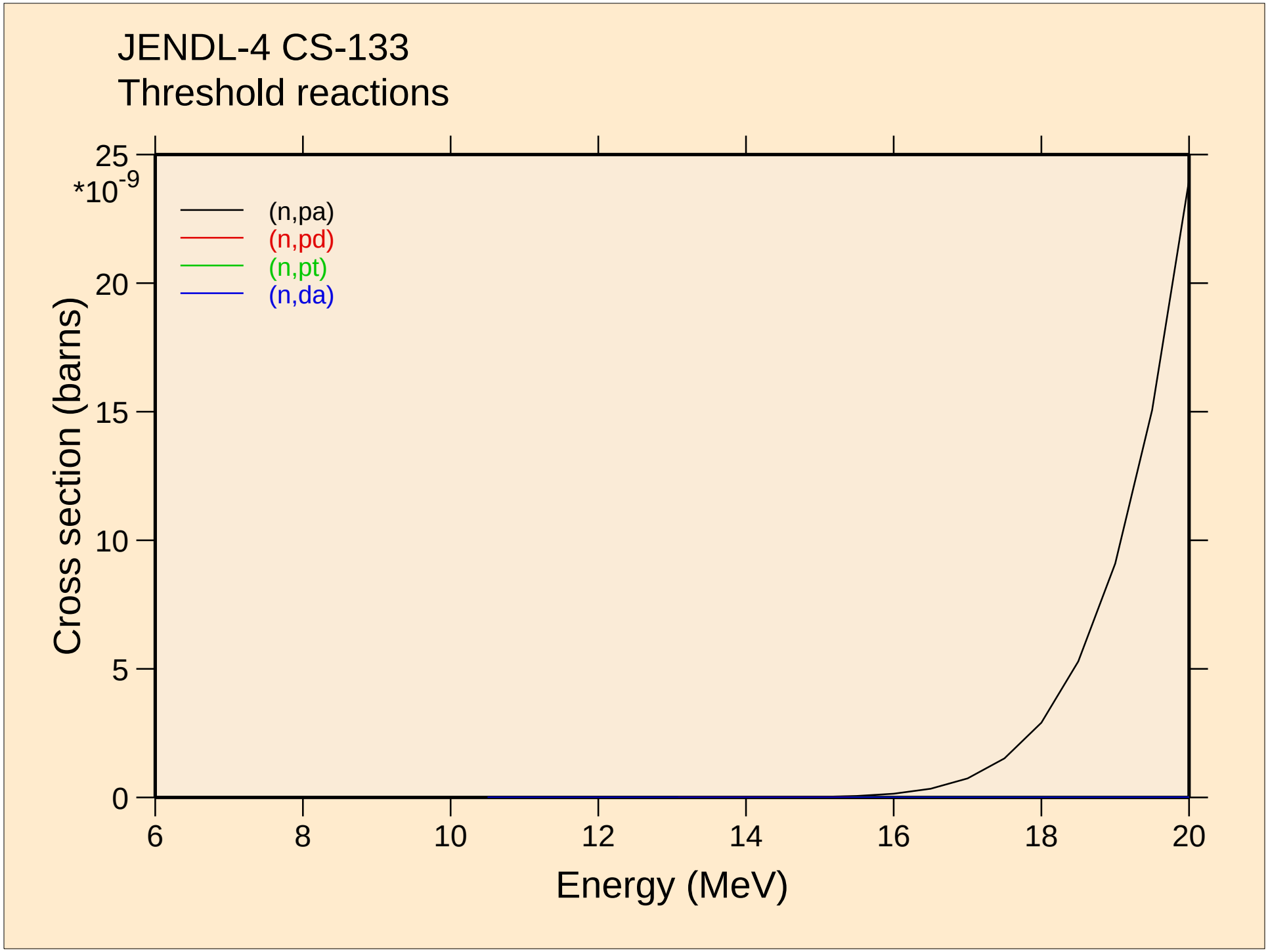

JENDL-4 CS-133
Inelastic levels
*10-3
80
70
60
50
40
30
20
10
0
Cross section (barns)
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)
(n,n*11)
(n,n*12)
(n,n*13)
(n,n*14)

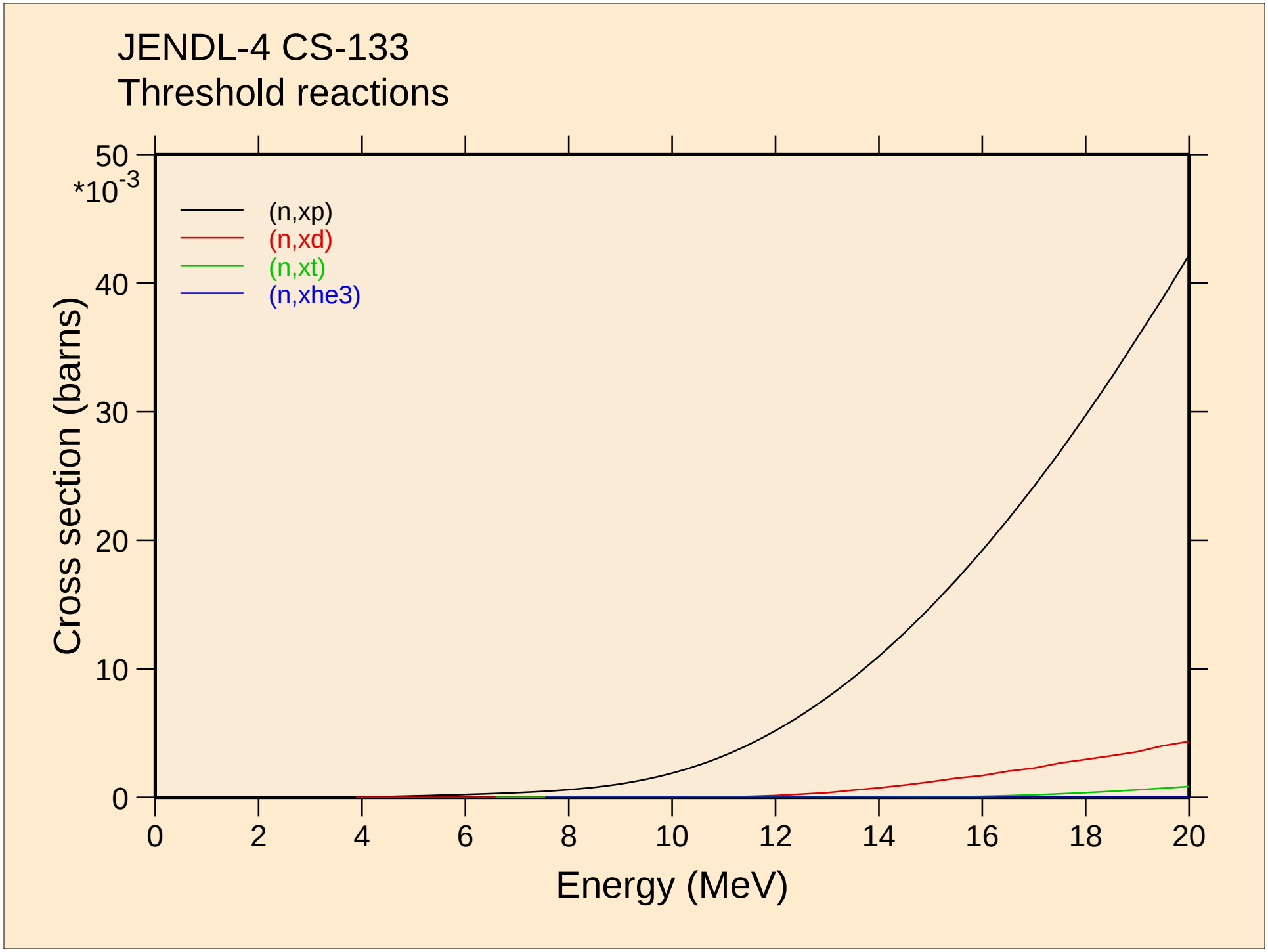

JENDL-4 CS-133
Threshold reactions
(n,2n)
(n,3n)
(n,n*)a
(n,2n)a
(n,n*)p
Cross section (barns)
Energy (MeV)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2
4
6
8
10
12
14
16
18
20

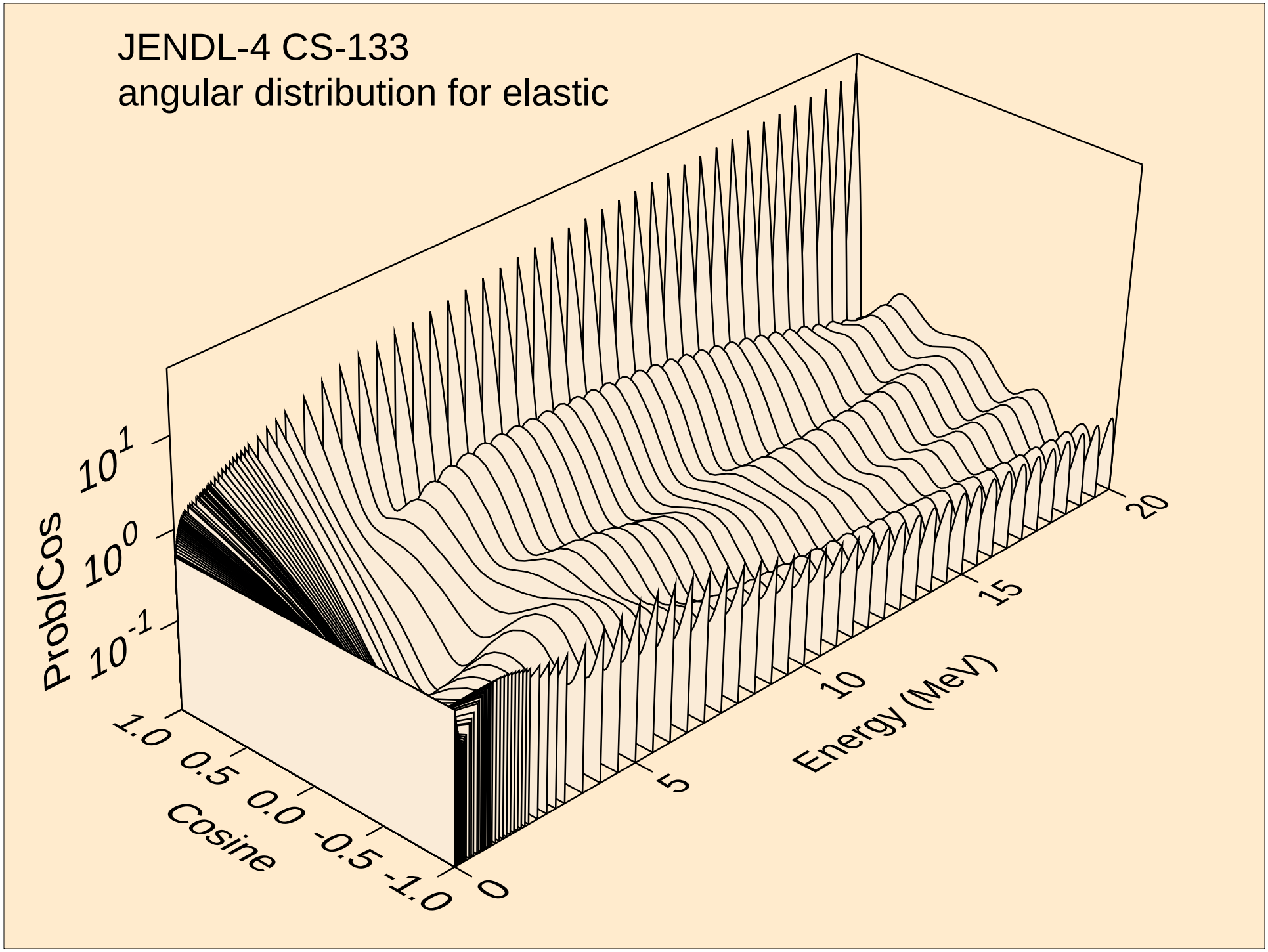

JENDL-4 CS-133
Threshold reactions
(n,n*)2a
(n,2n)2a
(n,n*)d
(n,n*)t
(n,n*)he3
Cross section (barns)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
8
10
12
14
16
18
20
Energy (MeV)

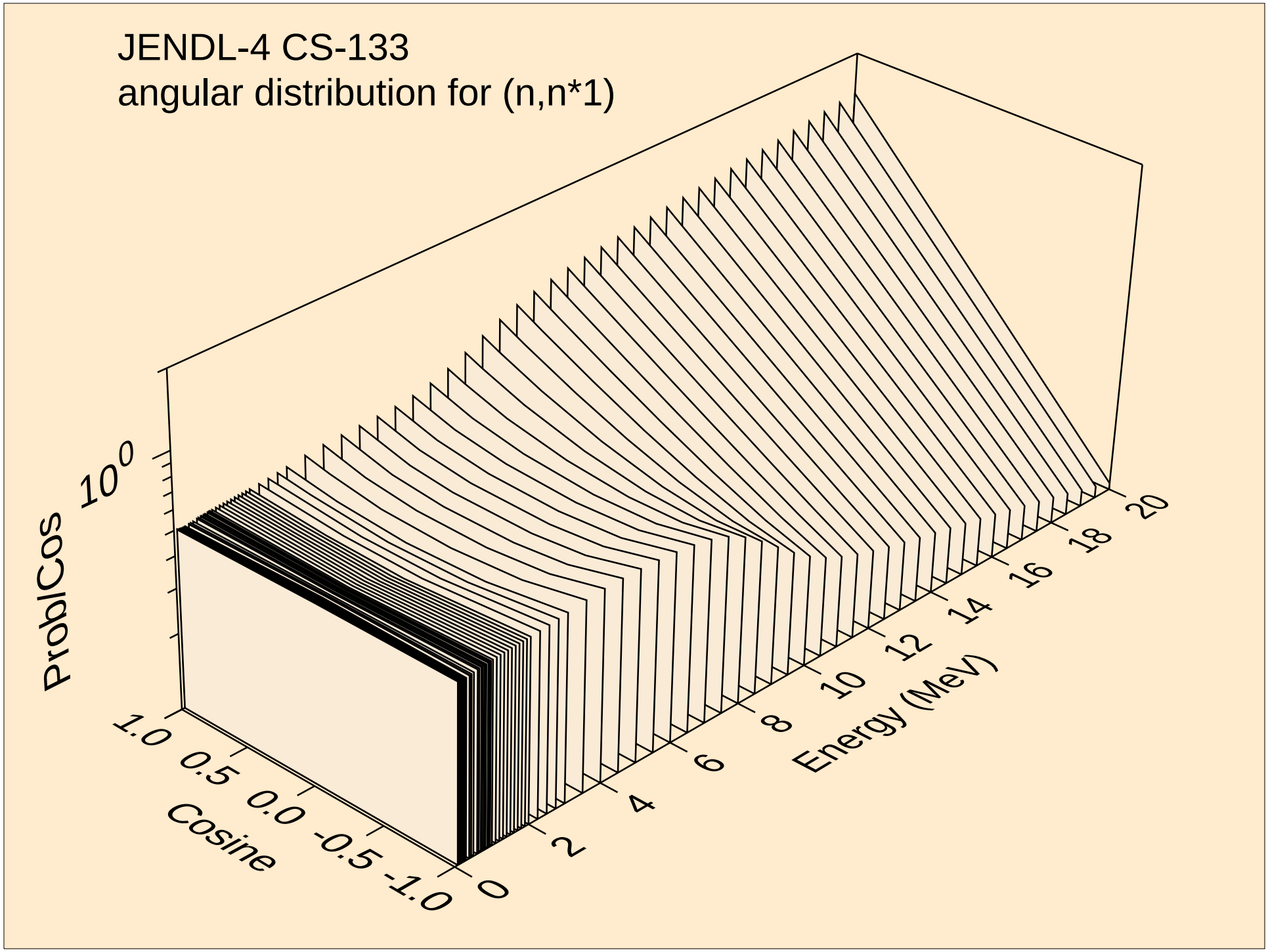

JENDL-4 CS-133
Threshold reactions
(n,2np)
(n,2np)
(n,npa)
(n,n*c)
(n,p)
Cross section (barns)
Energy (MeV)
0.0
0.5
1.0
1.5
2.0
2.5
0
2
4
6
8
10
12
14
16
18
20

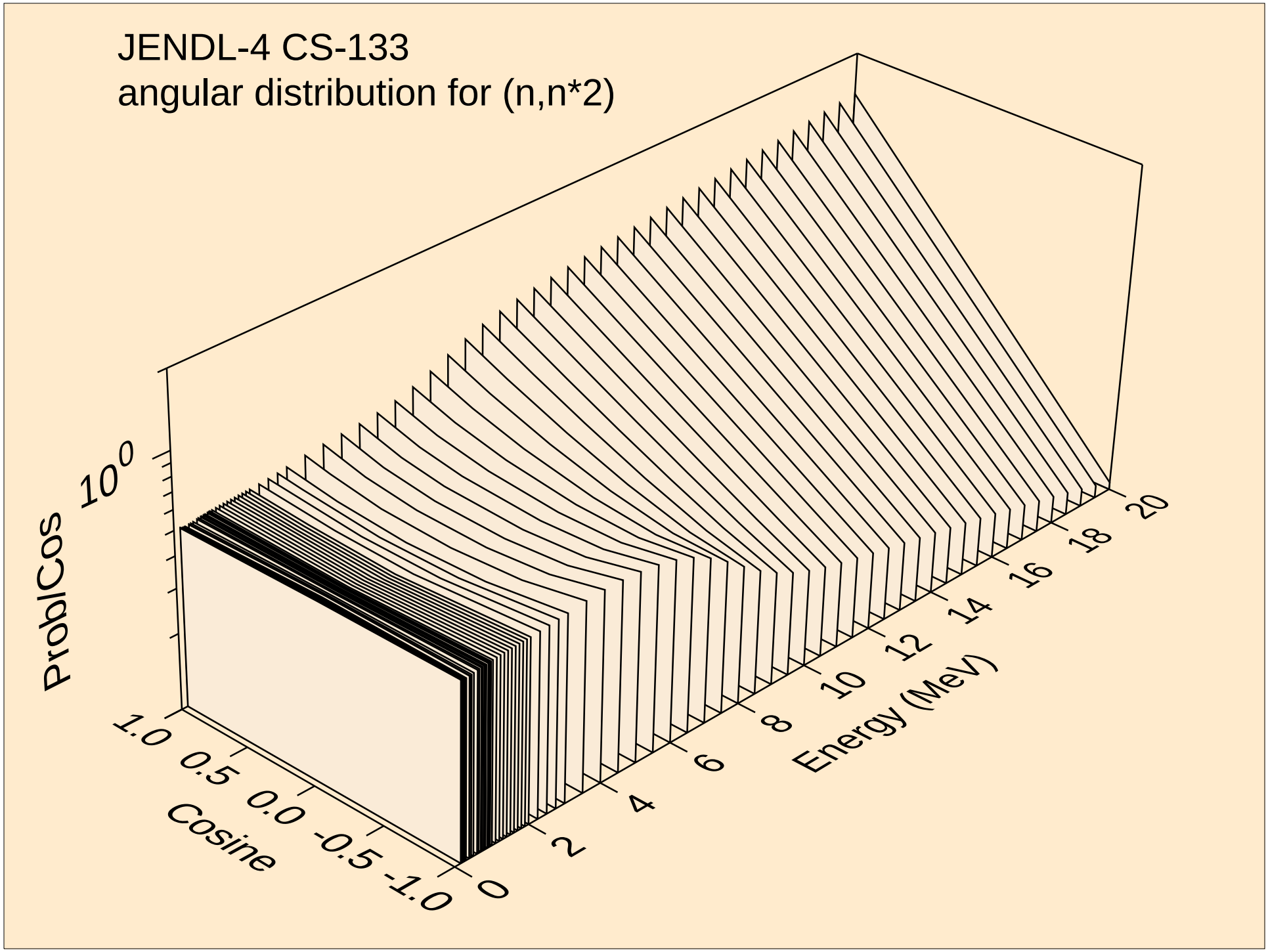

JENDL-4 CS-133
Threshold reactions
*10-3
(n,d)
(n,t)
(n,he3)
(n,2a)
(n,2p)
Cross section (barns)
Energy (MeV)
0
1
2
3
4
5
2
4
6
8
10
12
14
16
18
20

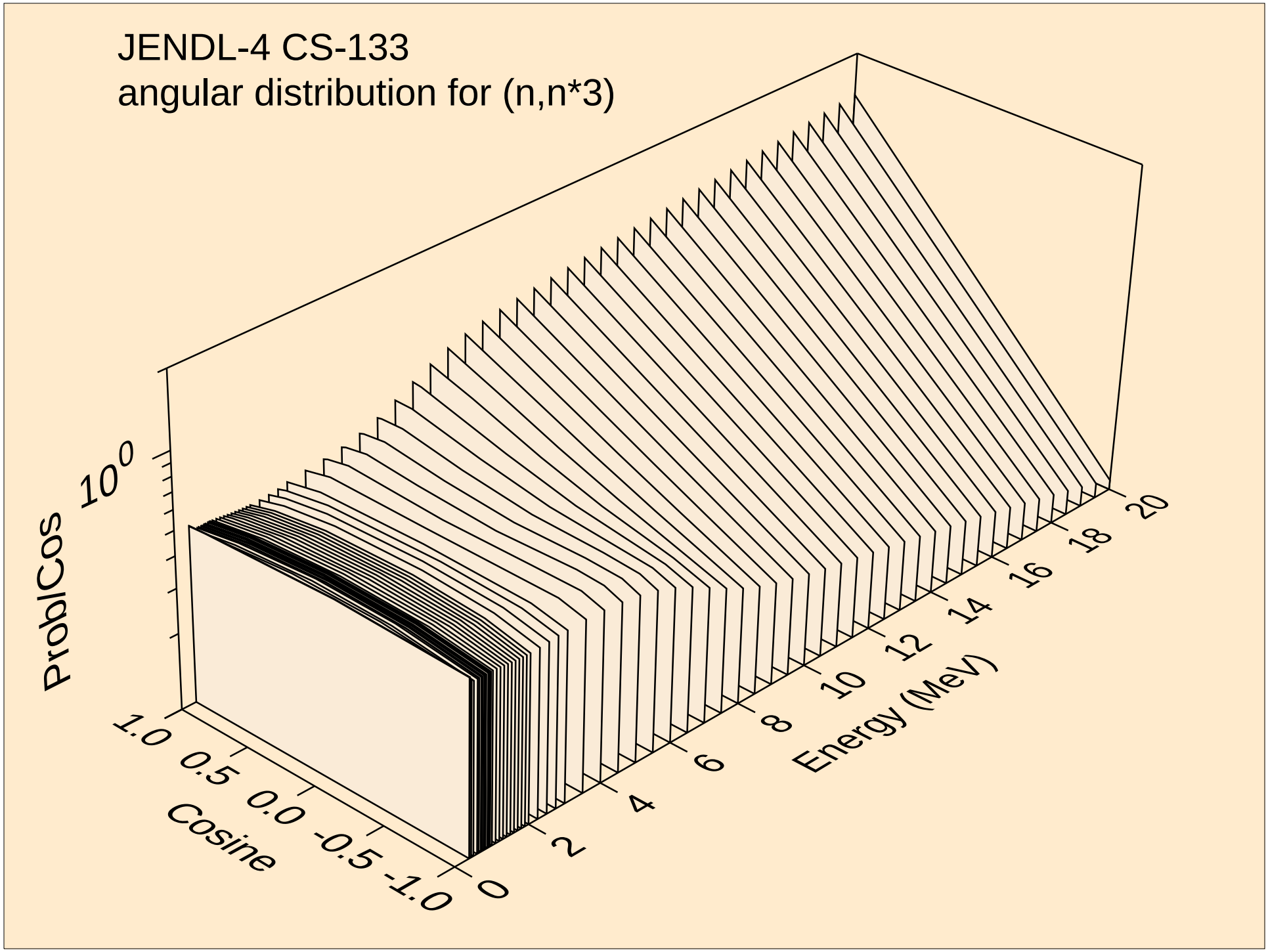

JENDL-4 CS-133
Threshold reactions
*10^-9
(n,pa)
(n,pd)
(n,pt)
(n,da)
Cross section (barns)
Energy (MeV)
0
5
10
15
20
25
6
8
10
12
14
16
18
20

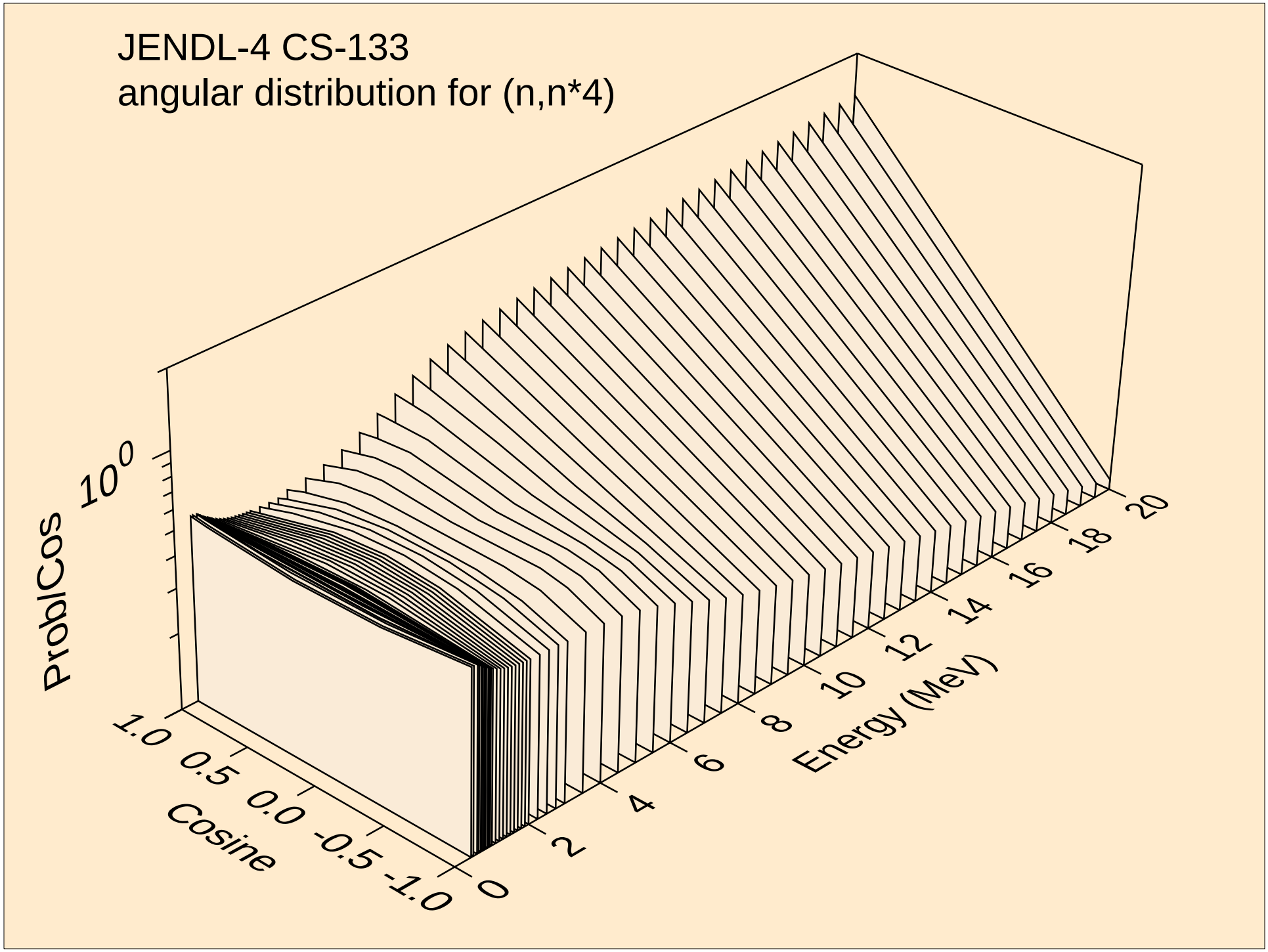

JENDL-4 CS-133
Threshold reactions
*10-3
50
40
30
20
10
0
Cross section (barns)
(n,xp)
(n,xd)
(n,xt)
(n,xhe3)
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

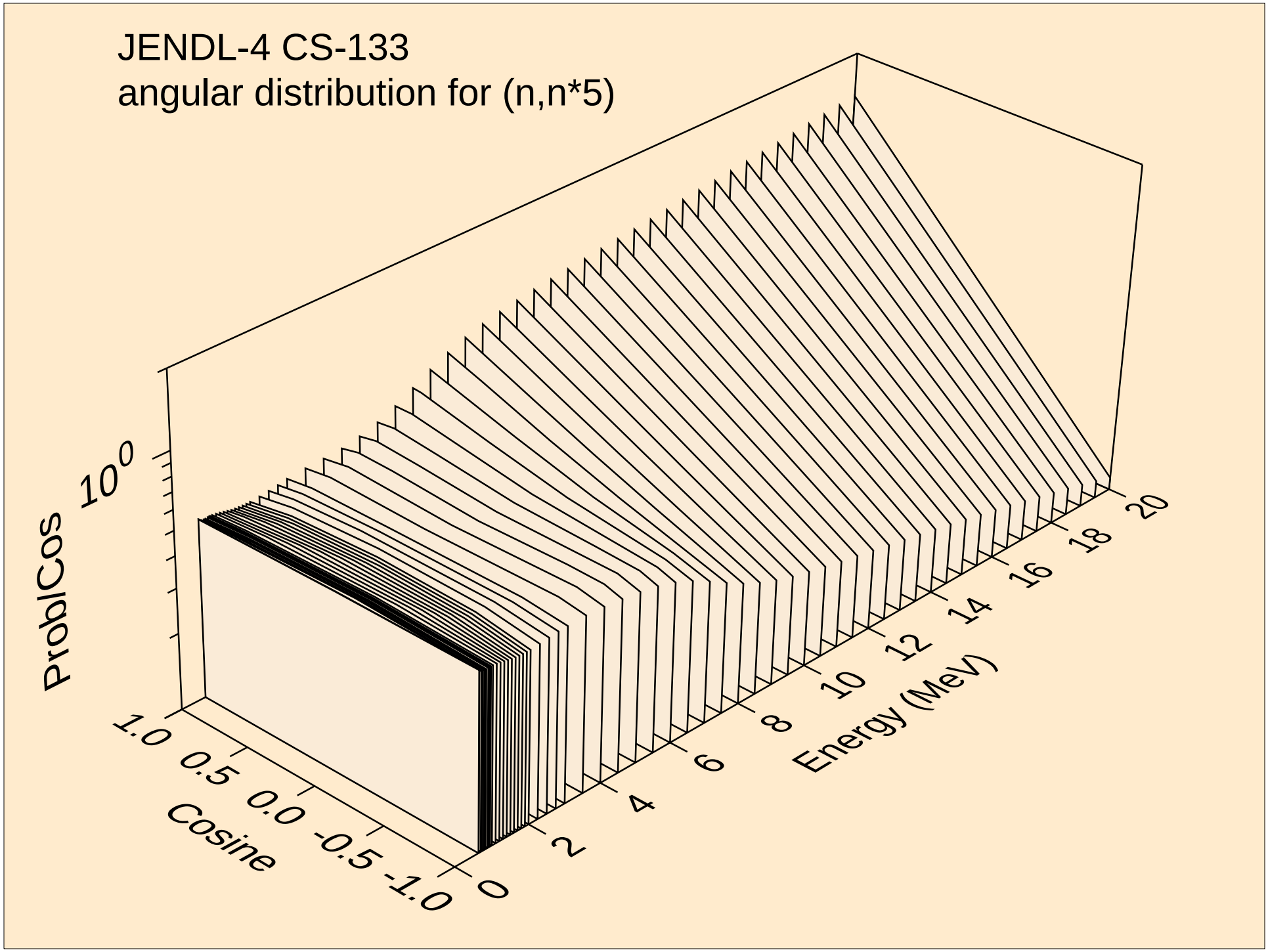

JENDL-4 CS-133
angular distribution for elastic
ProblCos
10^{1}
10^{0}
10^{-1}
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
5
10
15
20
Energy (MeV)

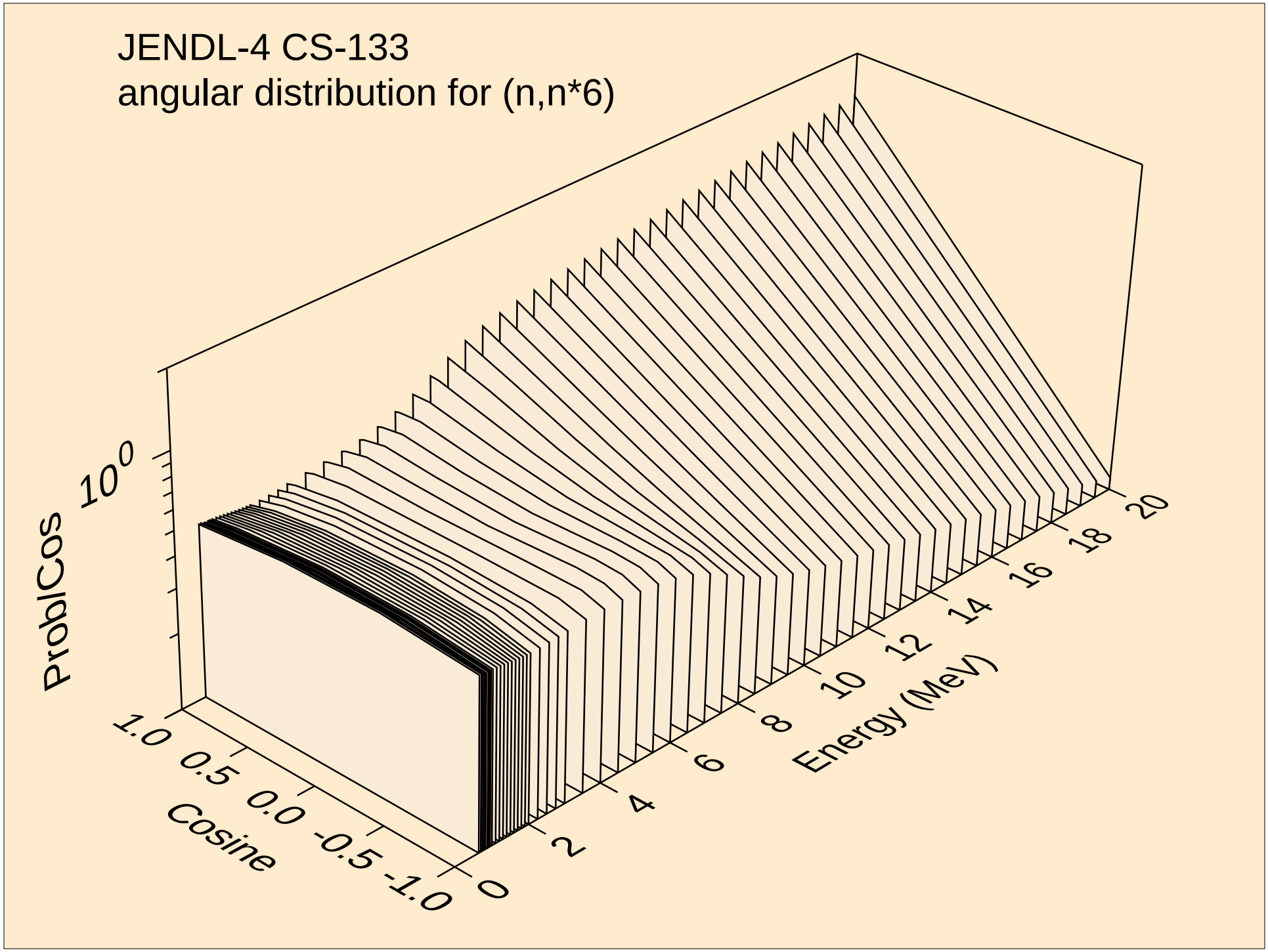

JENDL-4 CS-133
angular distribution for (n,n*1)
ProblCos
10^0
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

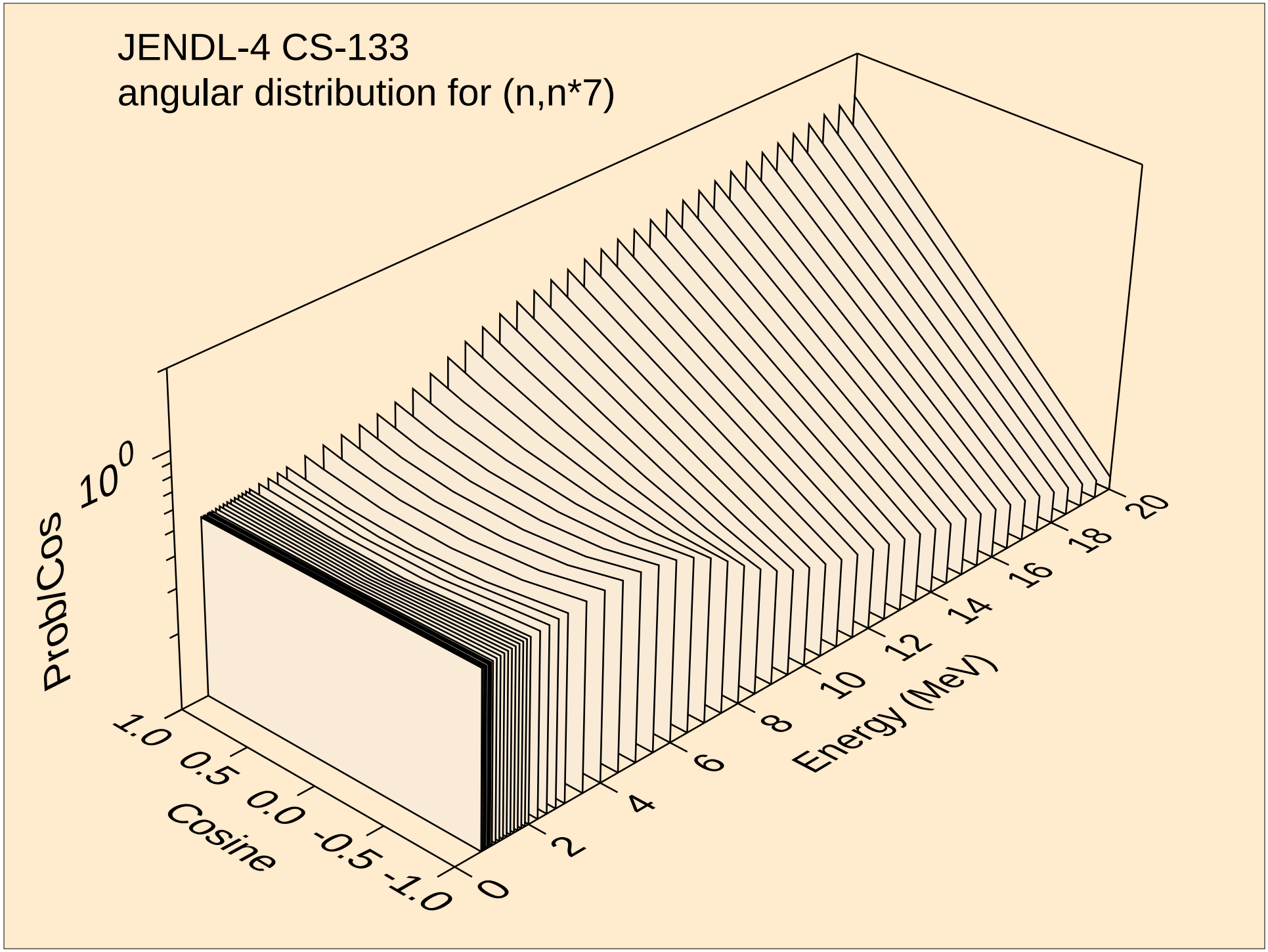

JENDL-4 CS-133
angular distribution for (n,n*2)
ProbCos
10^0
Cosine
1.0
0.5
0.0
-0.5
-1.0
Energy (MeV)
0
2
4
6
8
10
12
14
16
18
20

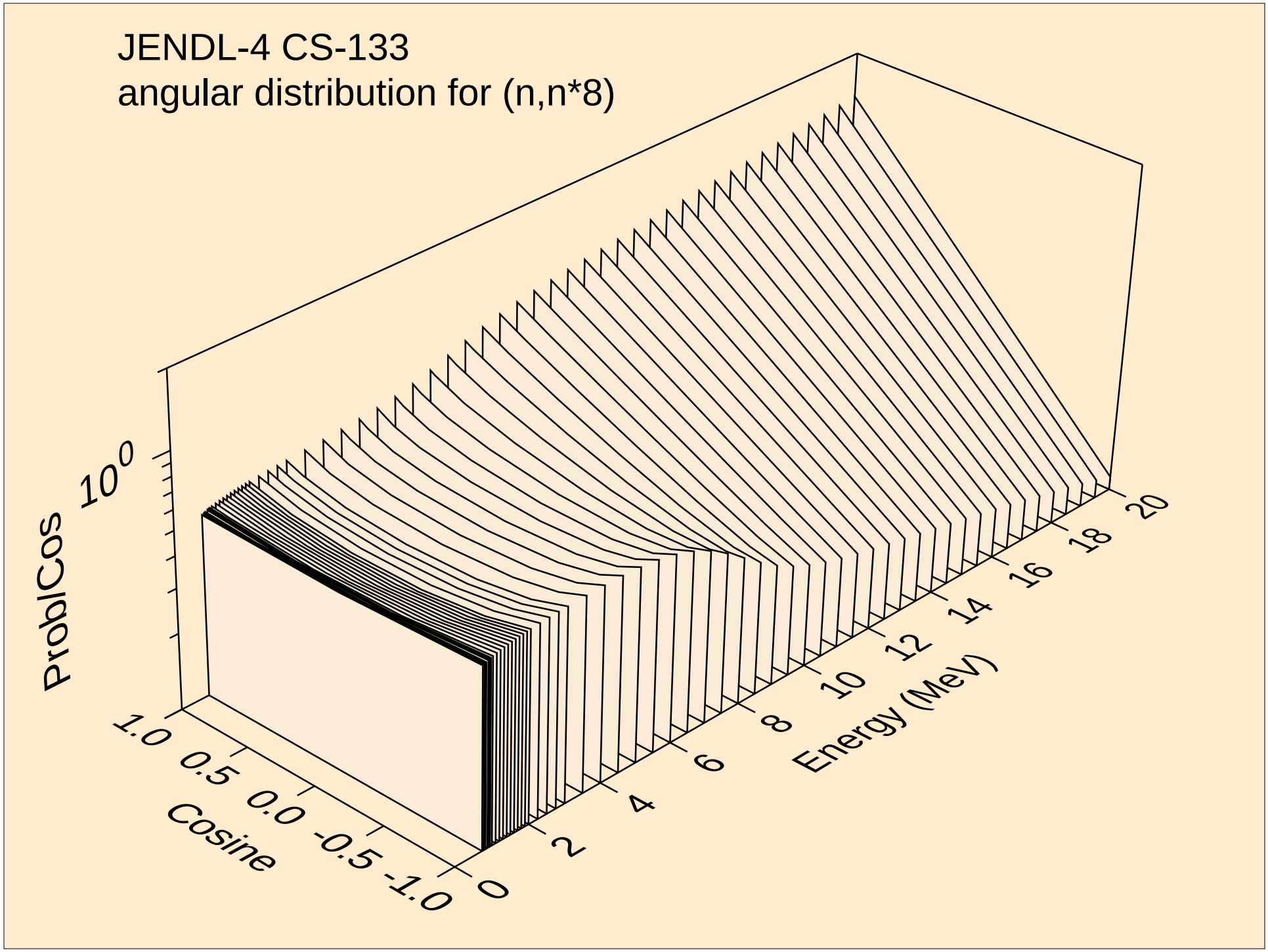

JENDL-4 CS-133
angular distribution for (n,n*3)
ProblCos
10^0
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

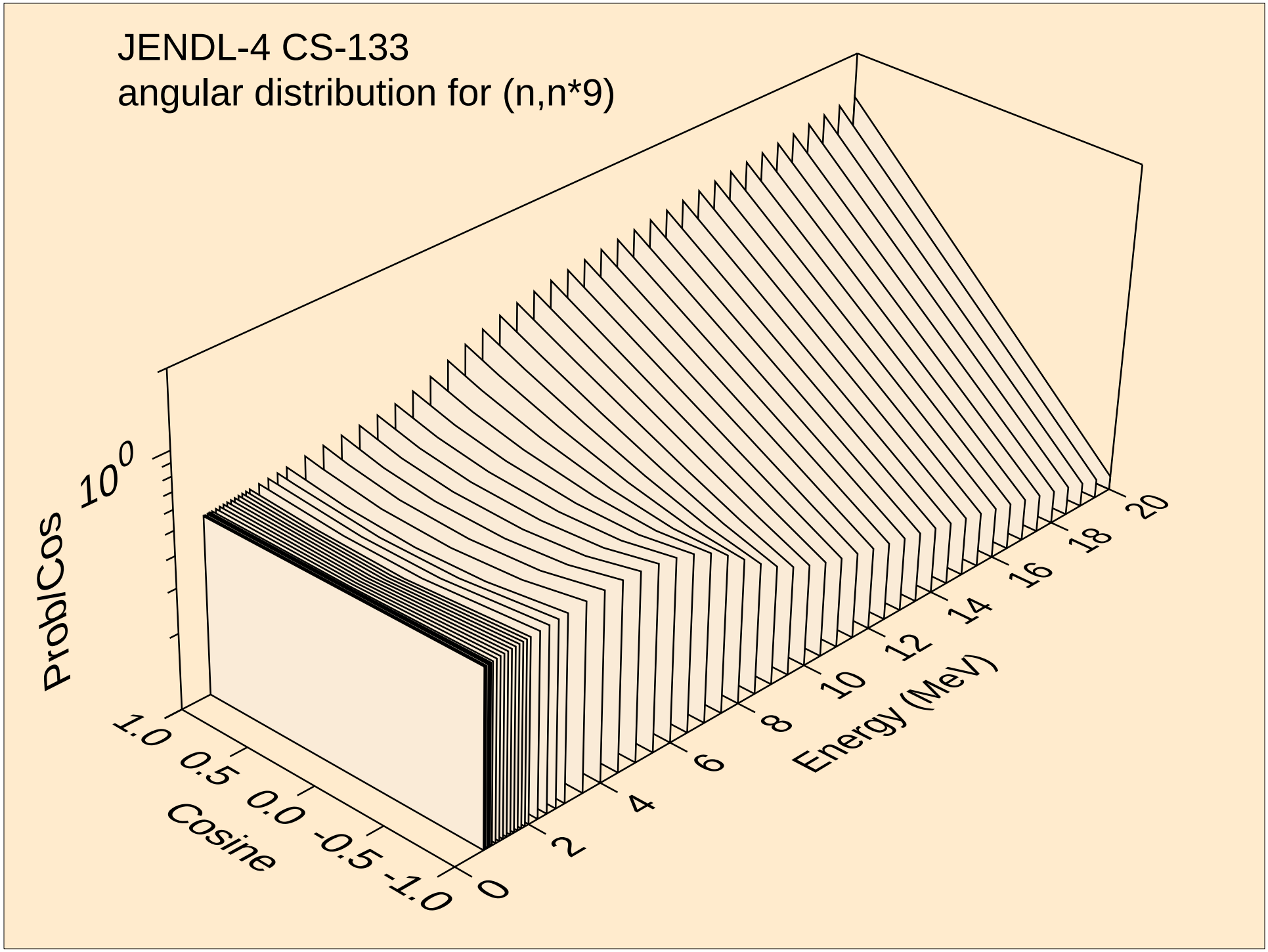

JENDL-4 CS-133
angular distribution for (n,n*4)
ProblCos
10^0
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

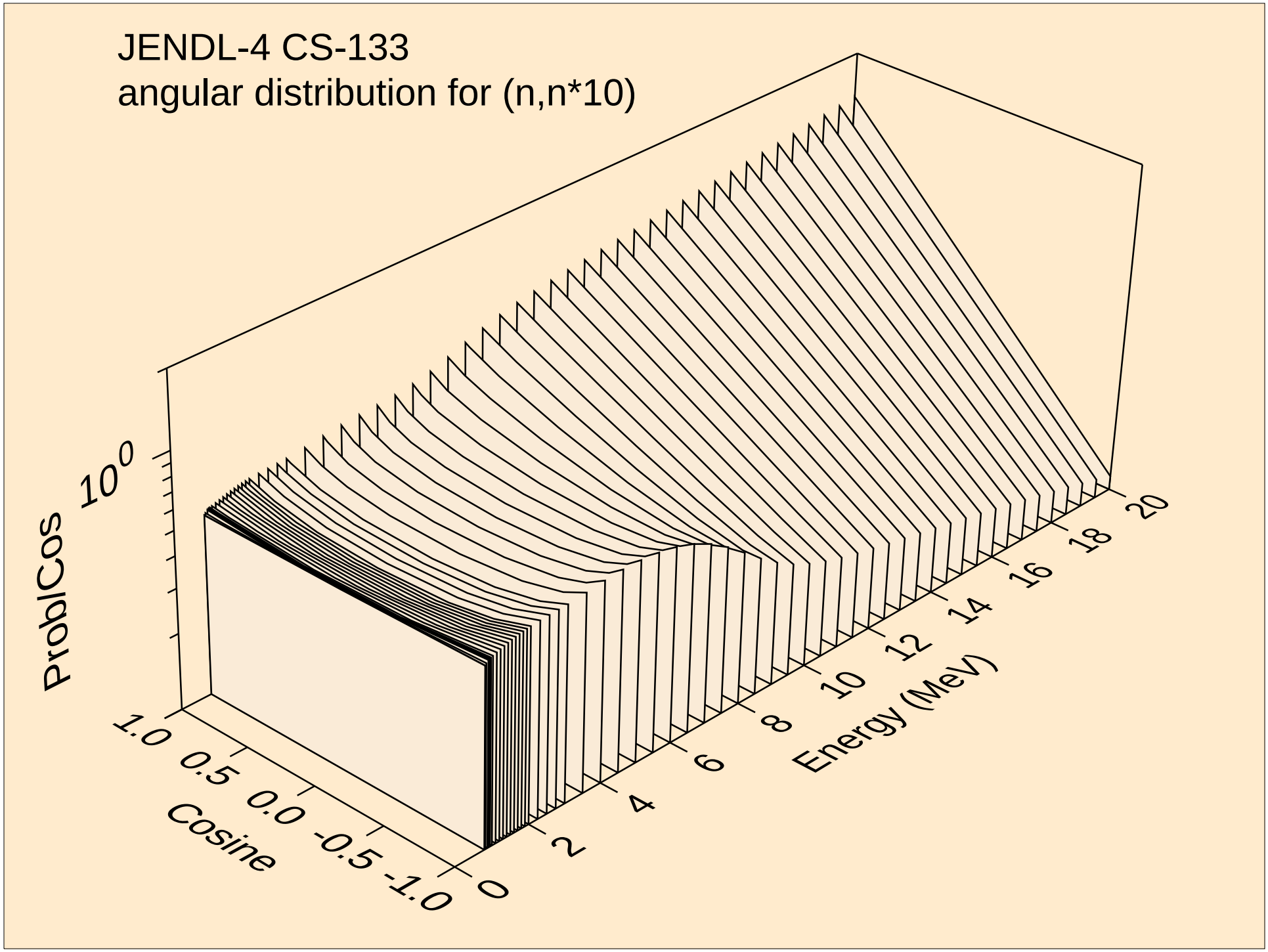

JENDL-4 CS-133
angular distribution for (n,n*5)
ProbCos
10^0
Cosine
1.0
0.5
0.0
-0.5
-1.0
Energy (MeV)
0
2
4
6
8
10
12
14
16
18
20

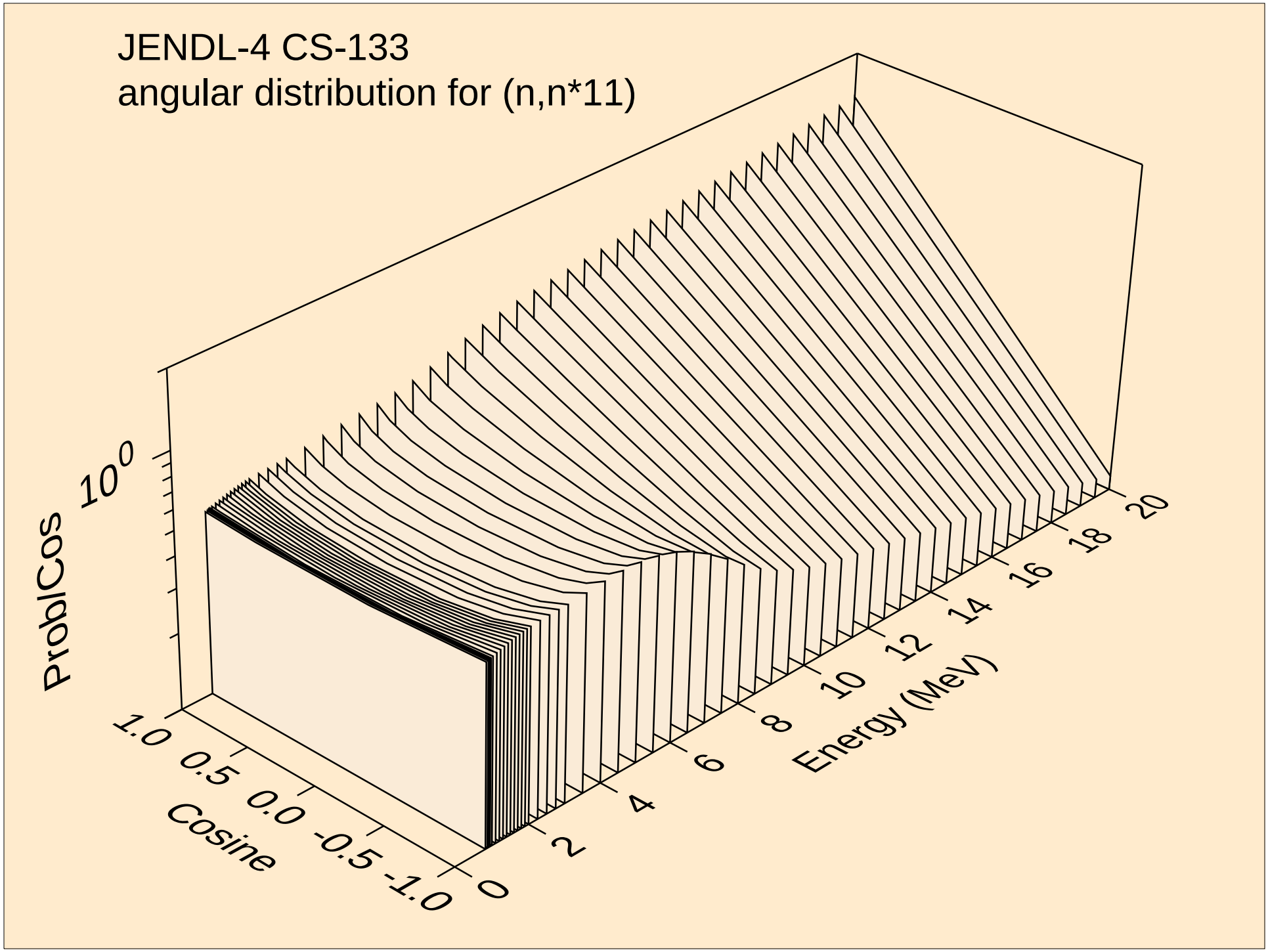

JENDL-4 CS-133
angular distribution for (n,n*6)
ProbCos
10^0
Cosine
1.0
0.5
0.0
-0.5
-1.0
Energy (MeV)
0
2
4
6
8
10
12
14
16
18
20

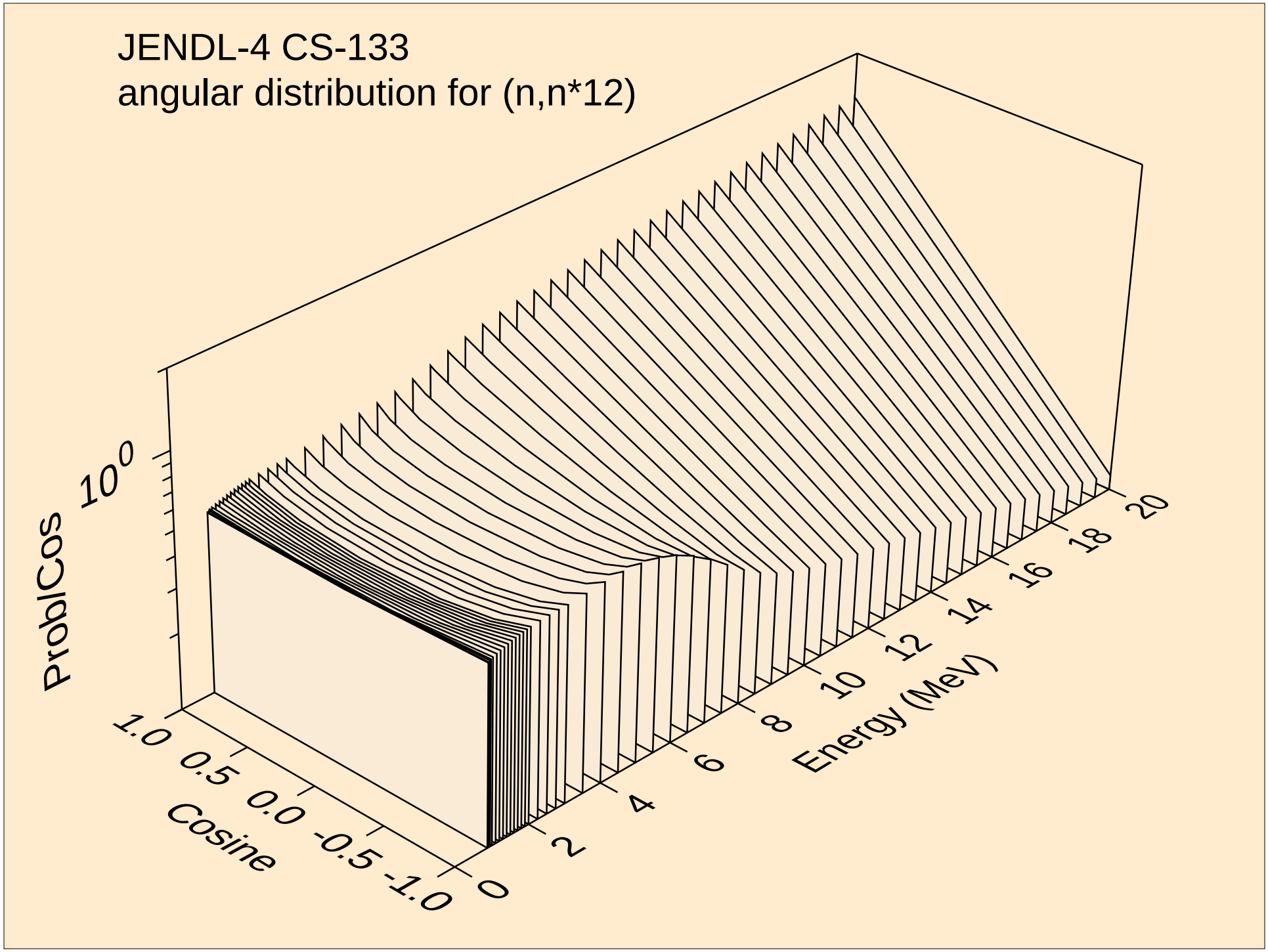

JENDL-4 CS-133
angular distribution for (n,n*7)
ProbCos
10^0
Cosine
1.0
0.5
0.0
-0.5
-1.0
Energy (MeV)
0
2
4
6
8
10
12
14
16
18
20

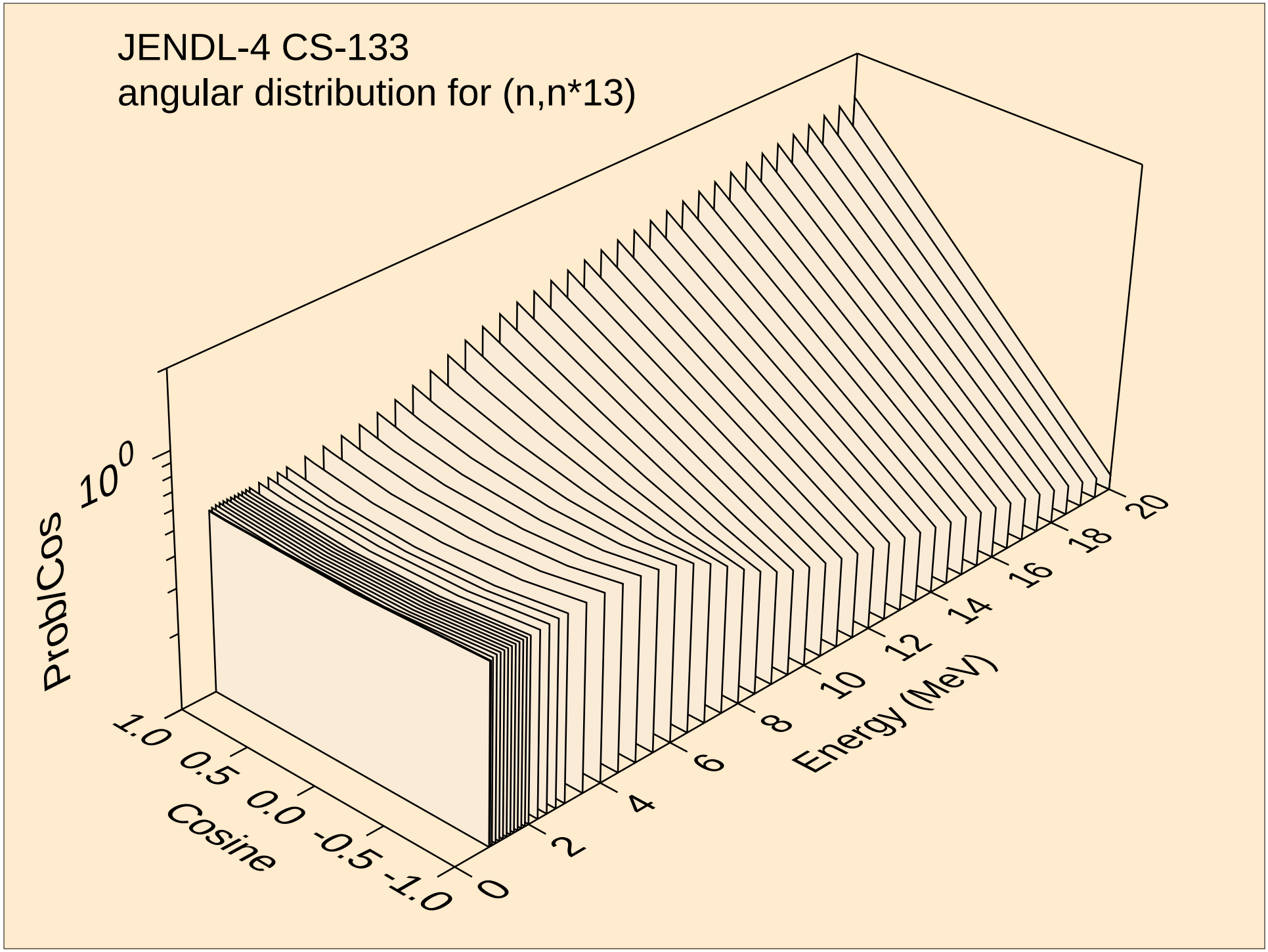

JENDL-4 CS-133
angular distribution for (n,n*8)
ProblCos
10^0
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

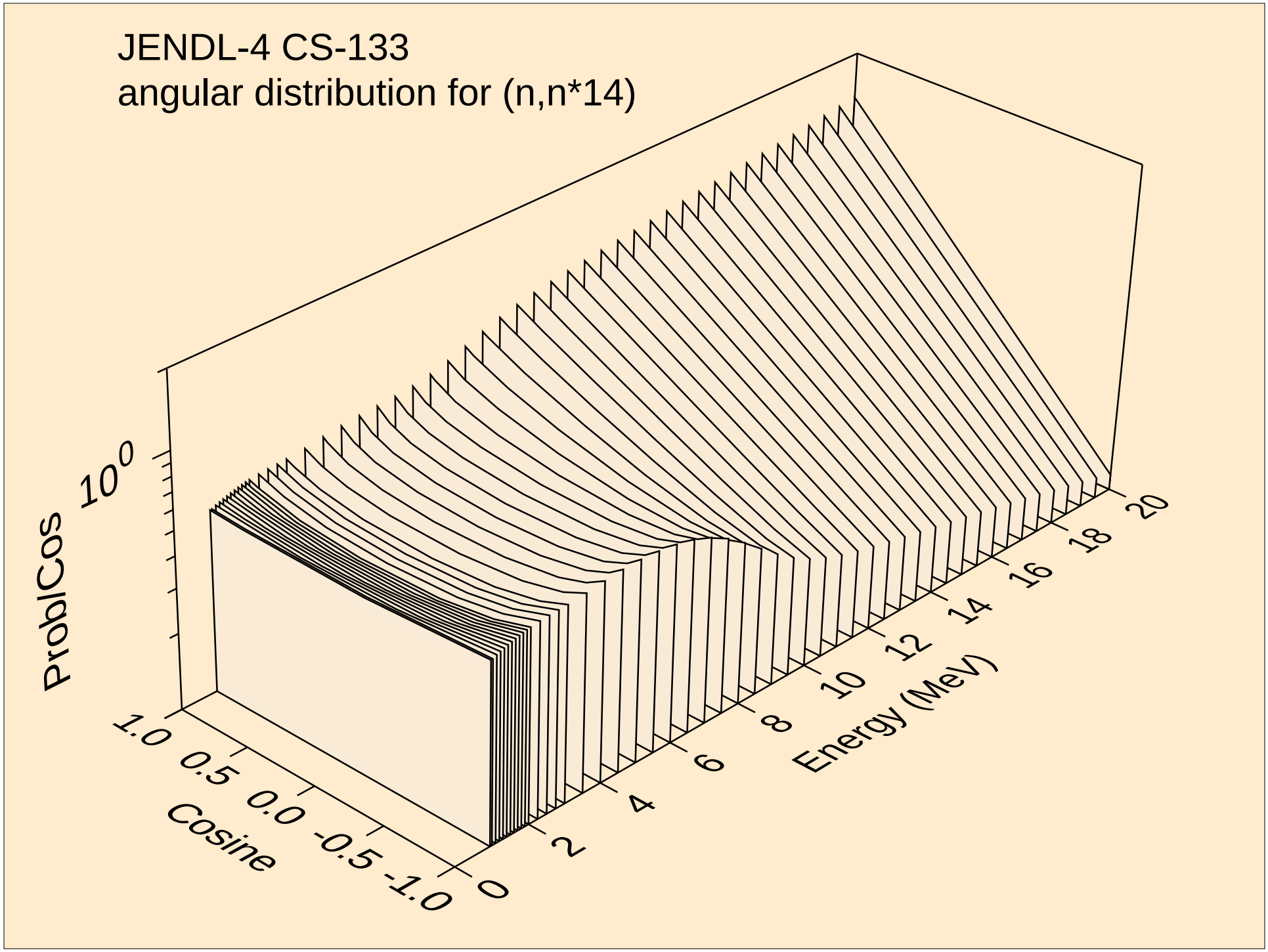

JENDL-4 CS-133
angular distribution for (n,n*9)
ProbCos
10^0
Cosine
1.0
0.5
0.0
-0.5
-1.0
Energy (MeV)
0
2
4
6
8
10
12
14
16
18
20

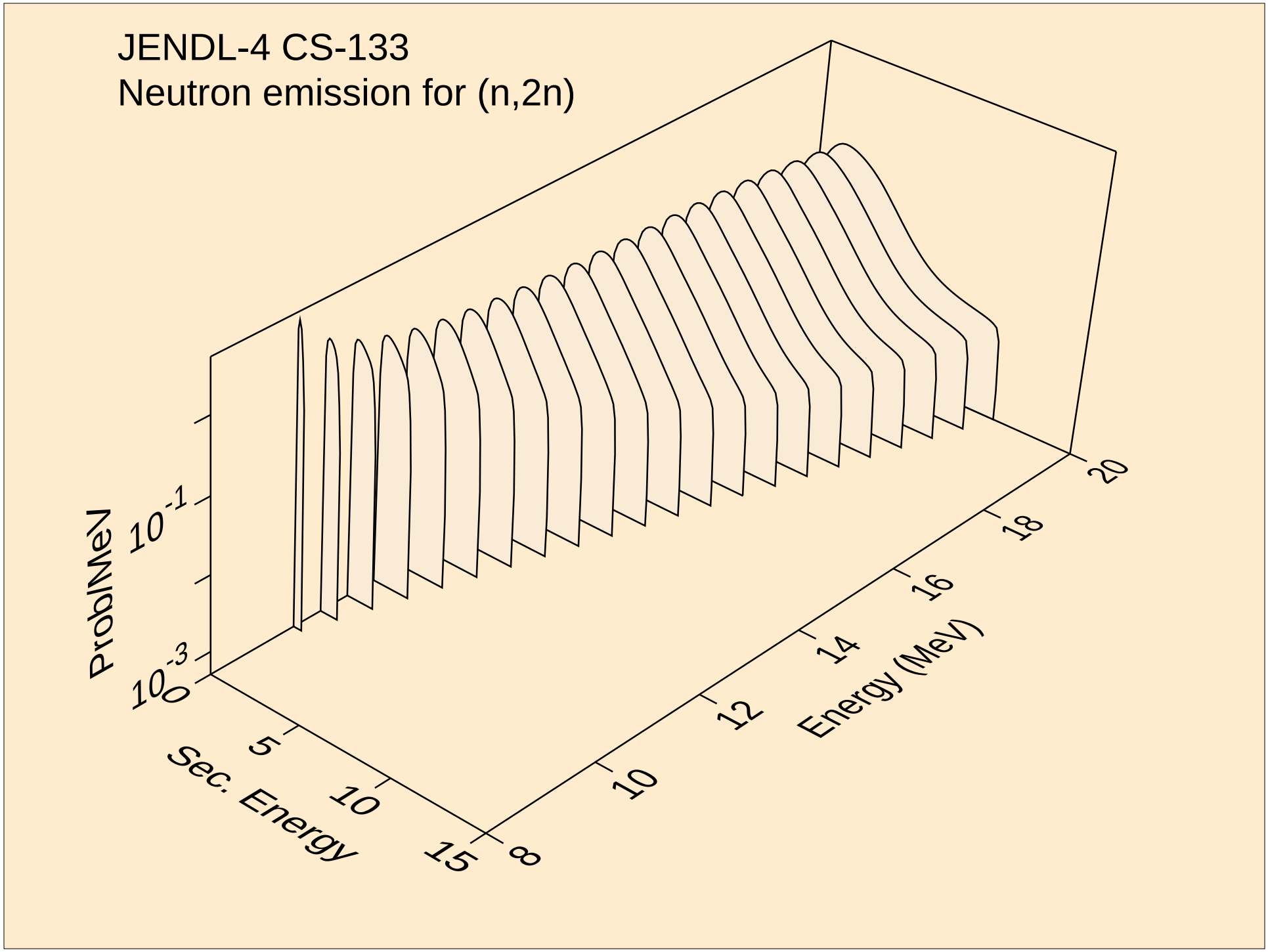

JENDL-4 CS-133
angular distribution for (n,n*10)
ProblCos
10^0
Cosine
1.0
0.5
0.0
-0.5
-1.0
Energy (MeV)
0
2
4
6
8
10
12
14
16
18
20

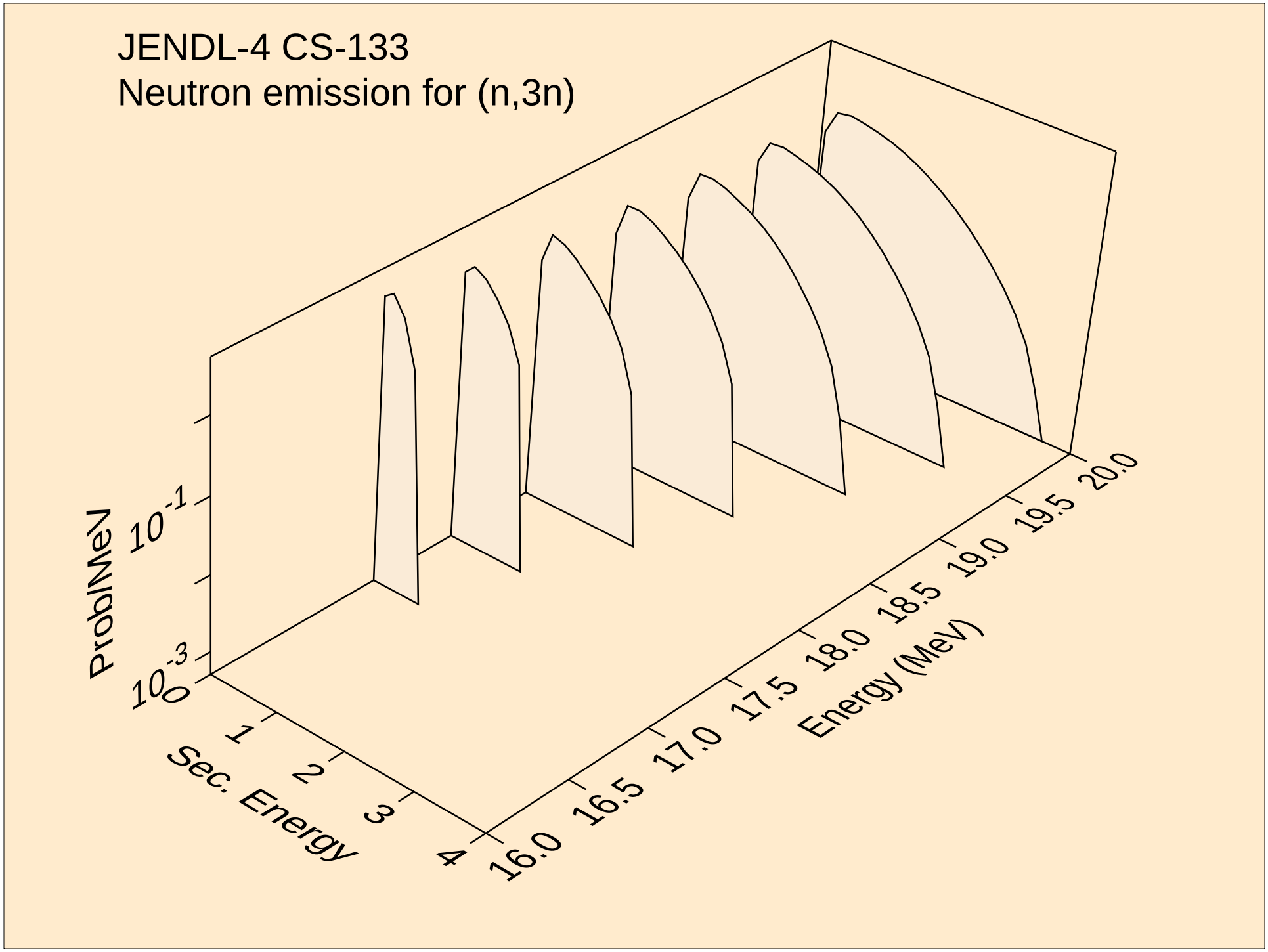

JENDL-4 CS-133
angular distribution for (n,n*11)
ProblCos
10^0
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

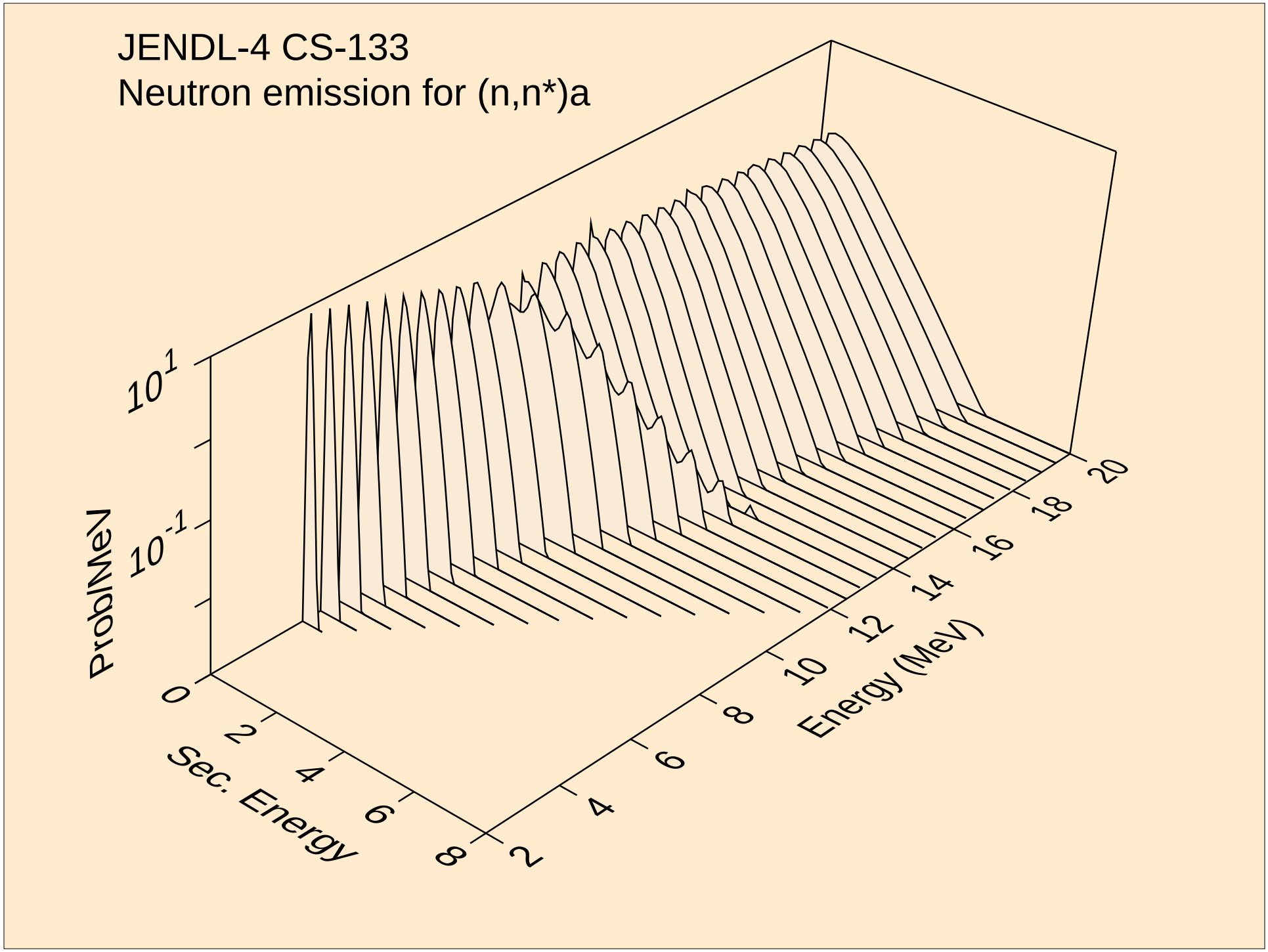

JENDL-4 CS-133
angular distribution for (n,n*12)
ProblCos
10^0
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

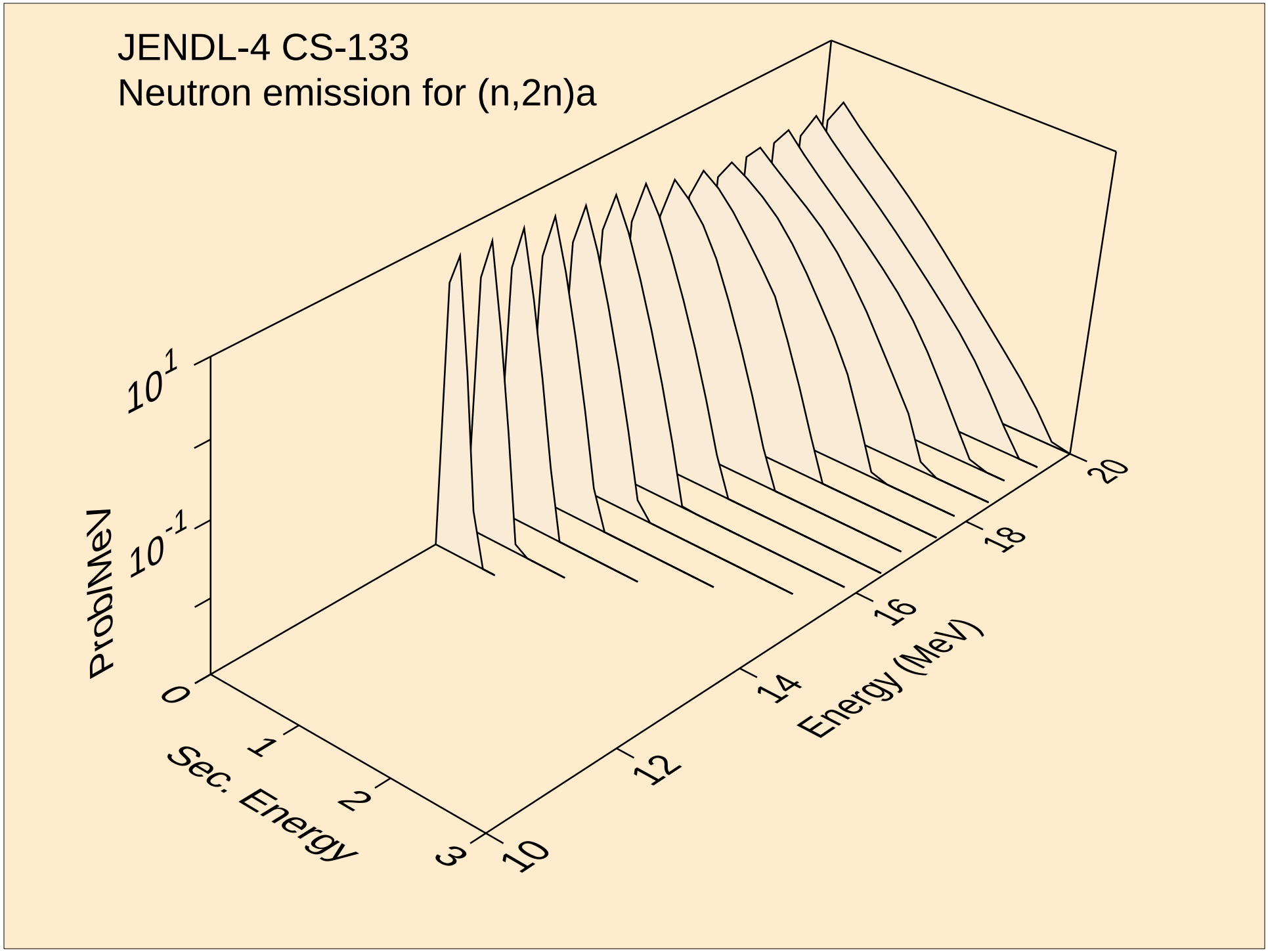

JENDL-4 CS-133
angular distribution for (n,n*13)
ProbCos
10^0
Cosine
1.0
0.5
0.0
-0.5
-1.0
Energy (MeV)
0
2
4
6
8
10
12
14
16
18
20

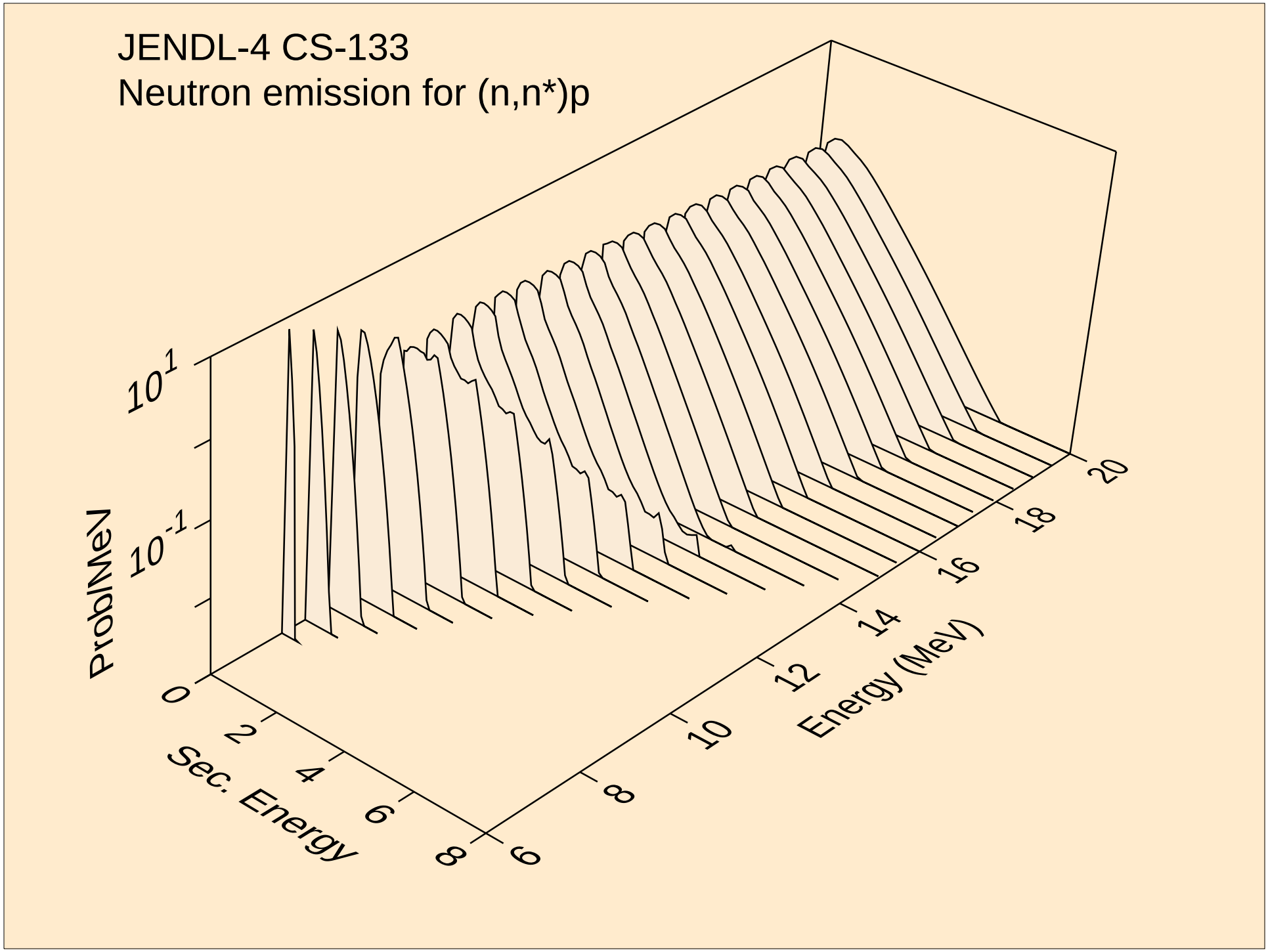

JENDL-4 CS-133
angular distribution for (n,n*14)
ProblCos
10^0
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

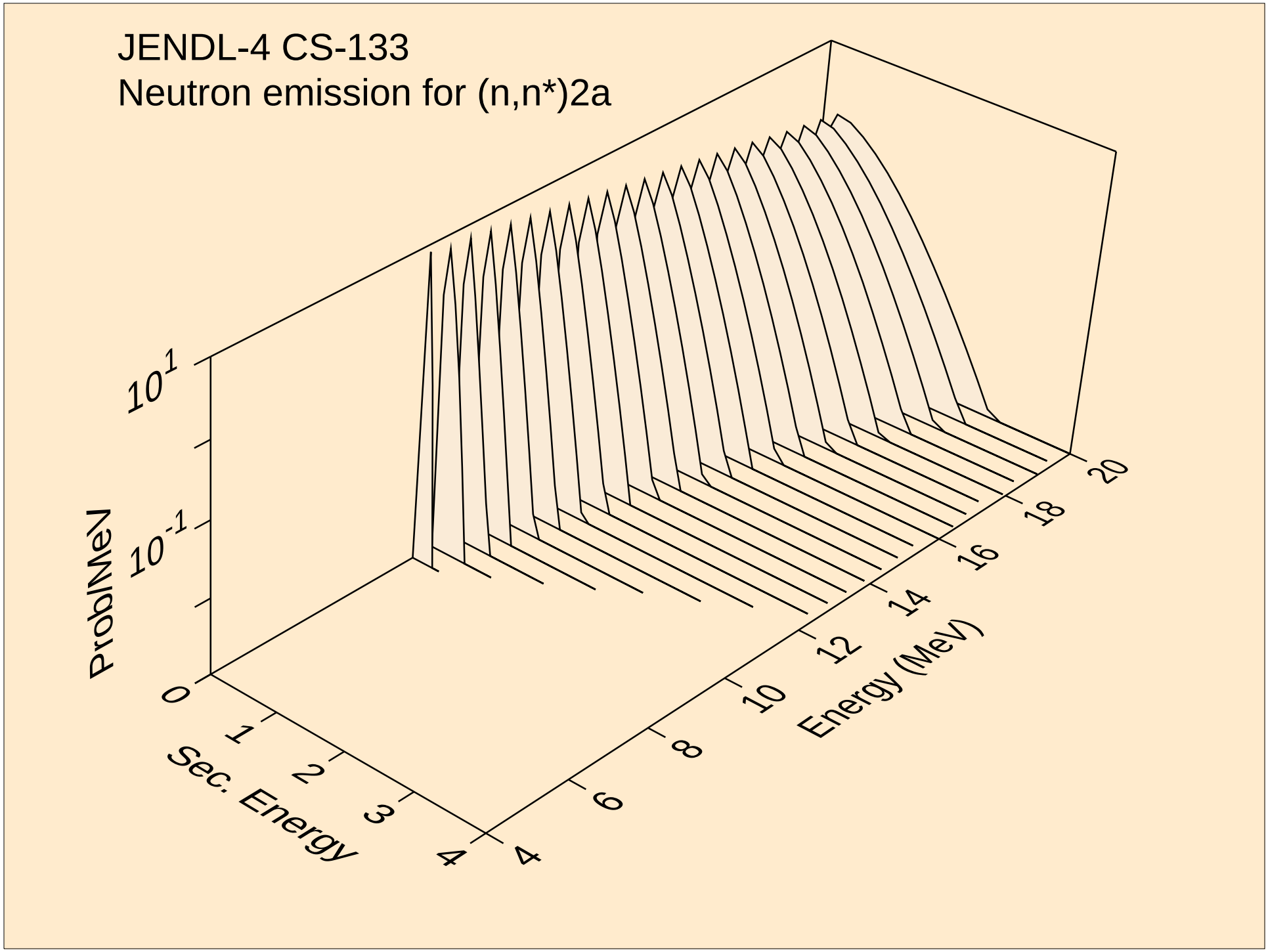

JENDL-4 CS-133
Neutron emission for (n,2n)
Prob/MeV
10^{-1}
10^{-3}
0
5
10
15
Sec. Energy
8
10
12
14
16
18
20
Energy (MeV)


JENDL-4 CS-133
Neutron emission for (n,3n)
Prob/MeV
10^{-1}
10^{-3}
0
1
2
3
4
Sec. Energy
16.0
16.5
17.0
17.5
18.0
18.5
19.0
19.5
20.0
Energy (MeV)

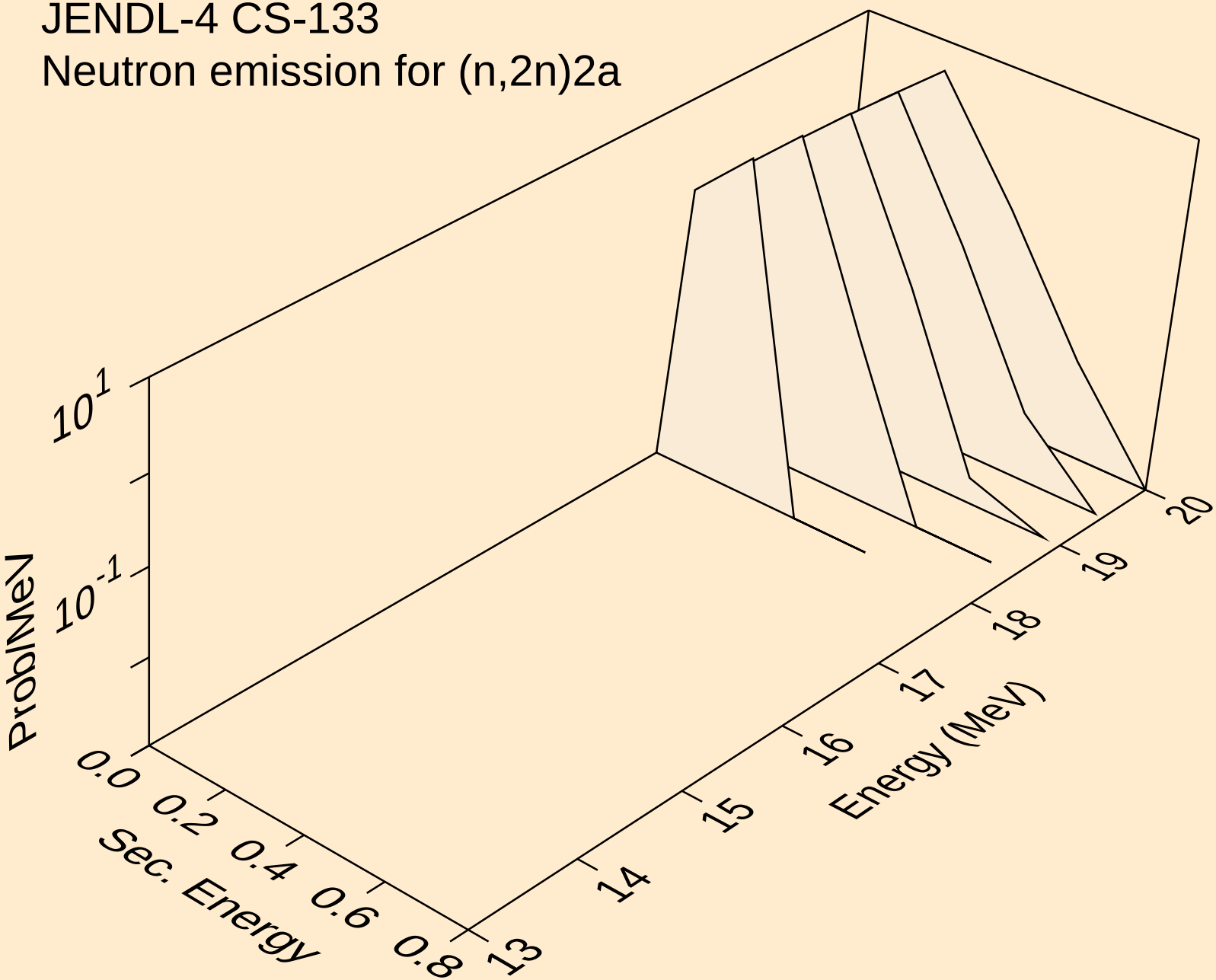

JENDL-4 CS-133
Neutron emission for (n,n*)a
Prob/MeV
10^{1}
10^{-1}
0
Sec. Energy
2
4
6
8
Energy (MeV)
2
4
6
8
10
12
14
16
18
20

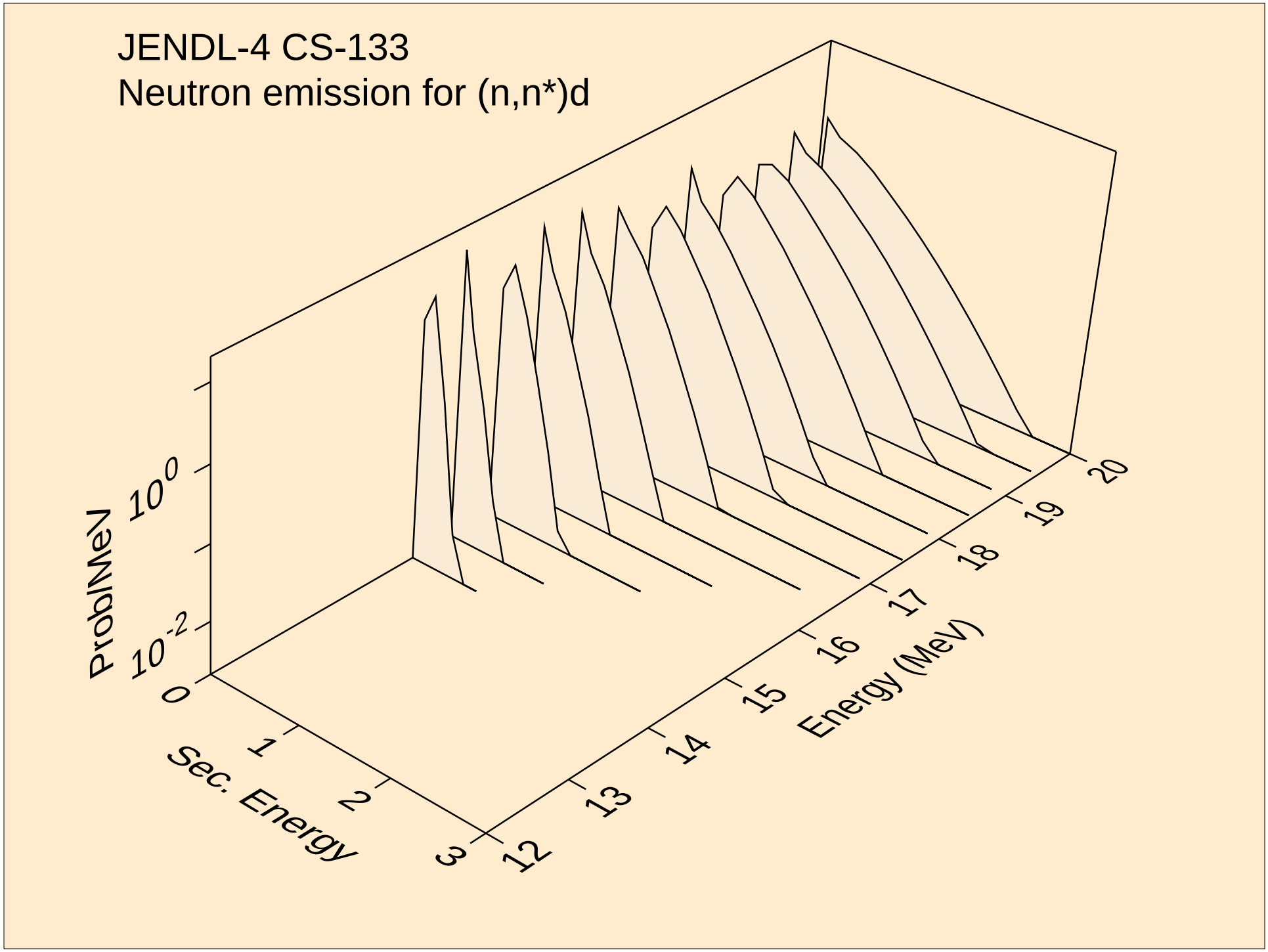

JENDL-4 CS-133
Neutron emission for (n,2n)a
Prob/MeV
10^{1}
10^{-1}
0
Sec. Energy
1
2
3
Energy (MeV)
10
12
14
16
18
20

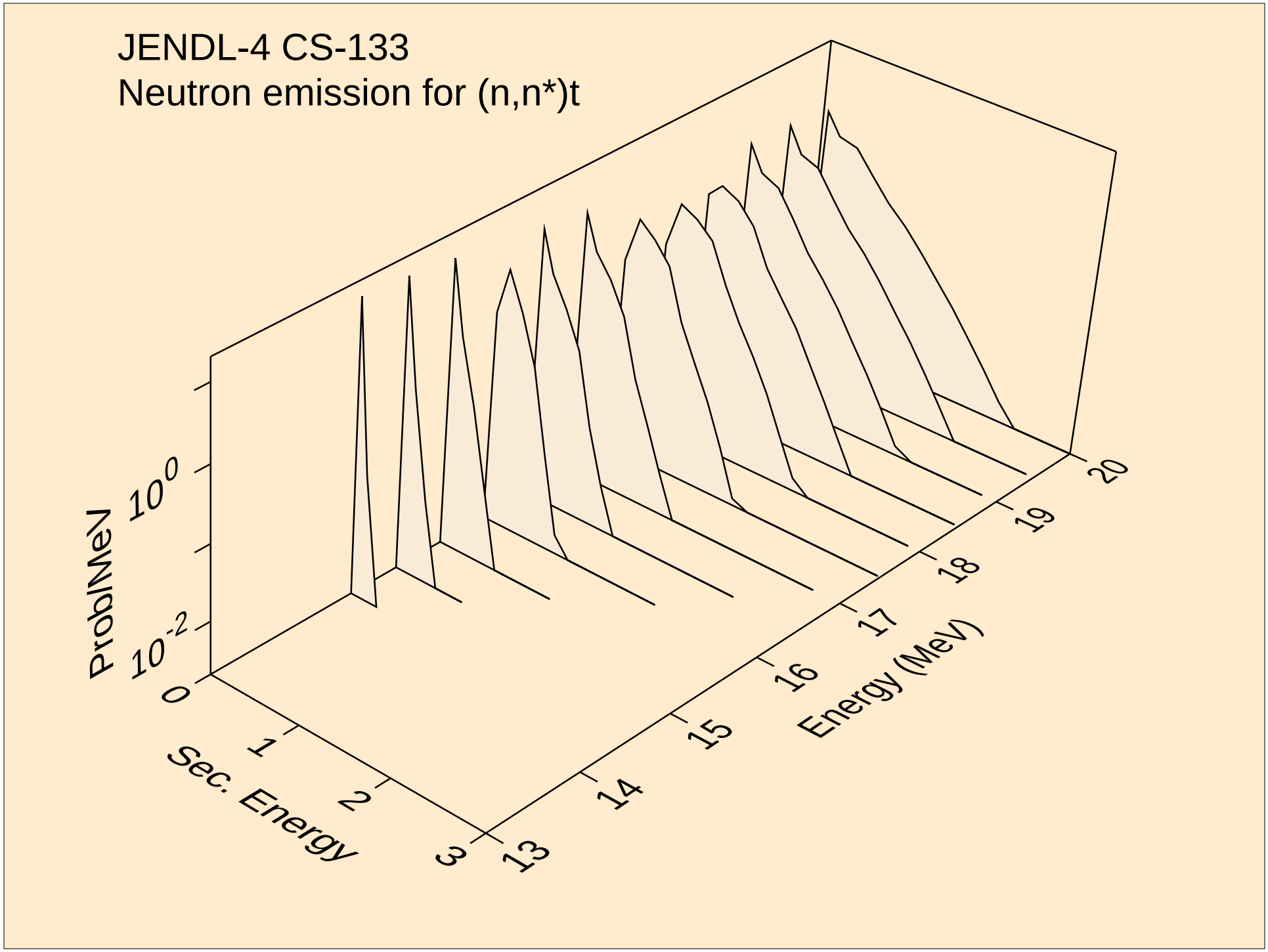

JENDL-4 CS-133
Neutron emission for (n,n*)p
Prob/MeV
10^{1}
10^{-1}
0
Sec. Energy
2
4
6
8
Energy (MeV)
6
8
10
12
14
16
18
20

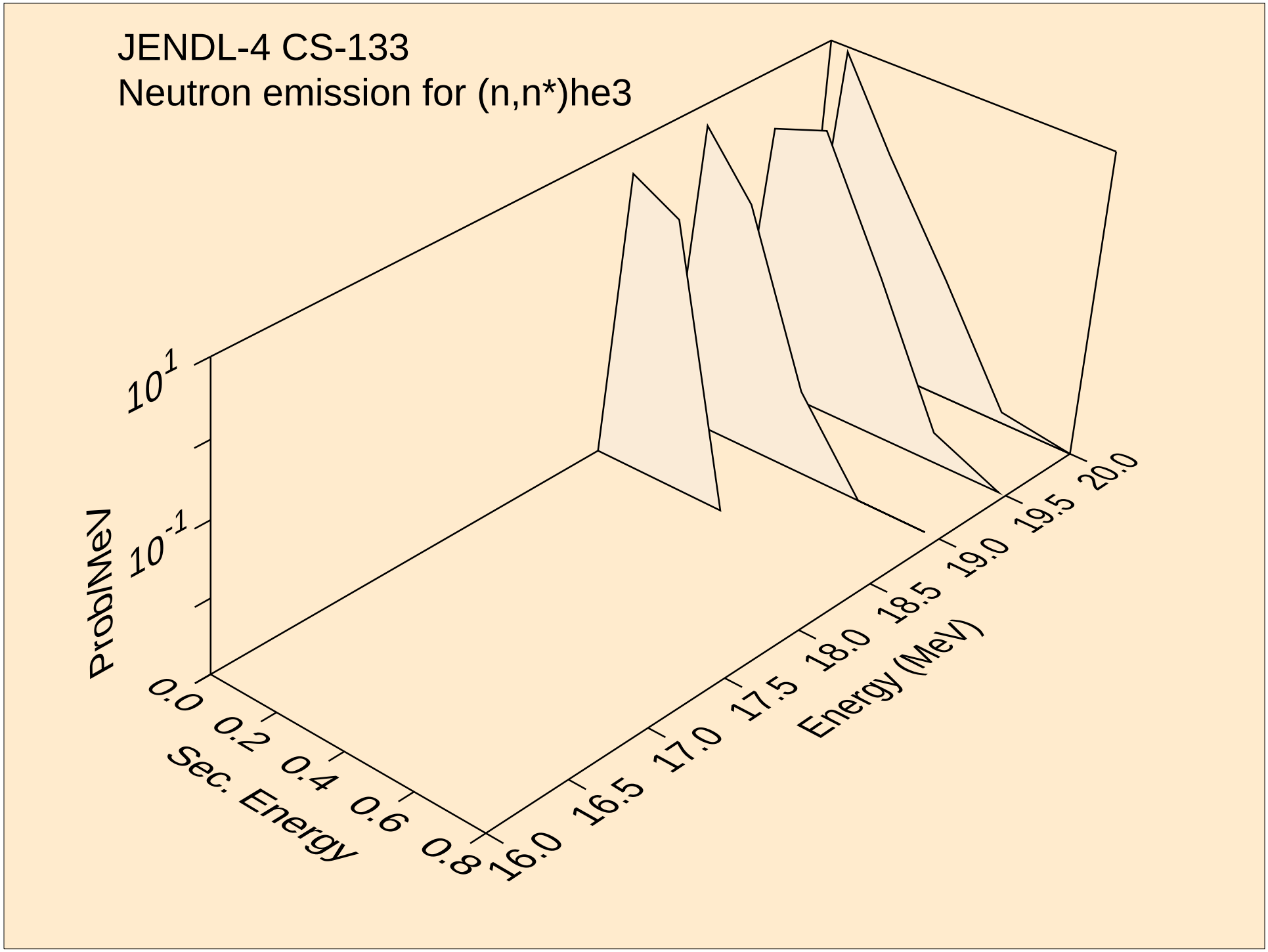

JENDL-4 CS-133
Neutron emission for (n,n*)2a
Prob/MeV
10^1
10^-1
0
Sec. Energy
1
2
3
4
Energy (MeV)
4
6
8
10
12
14
16
18
20

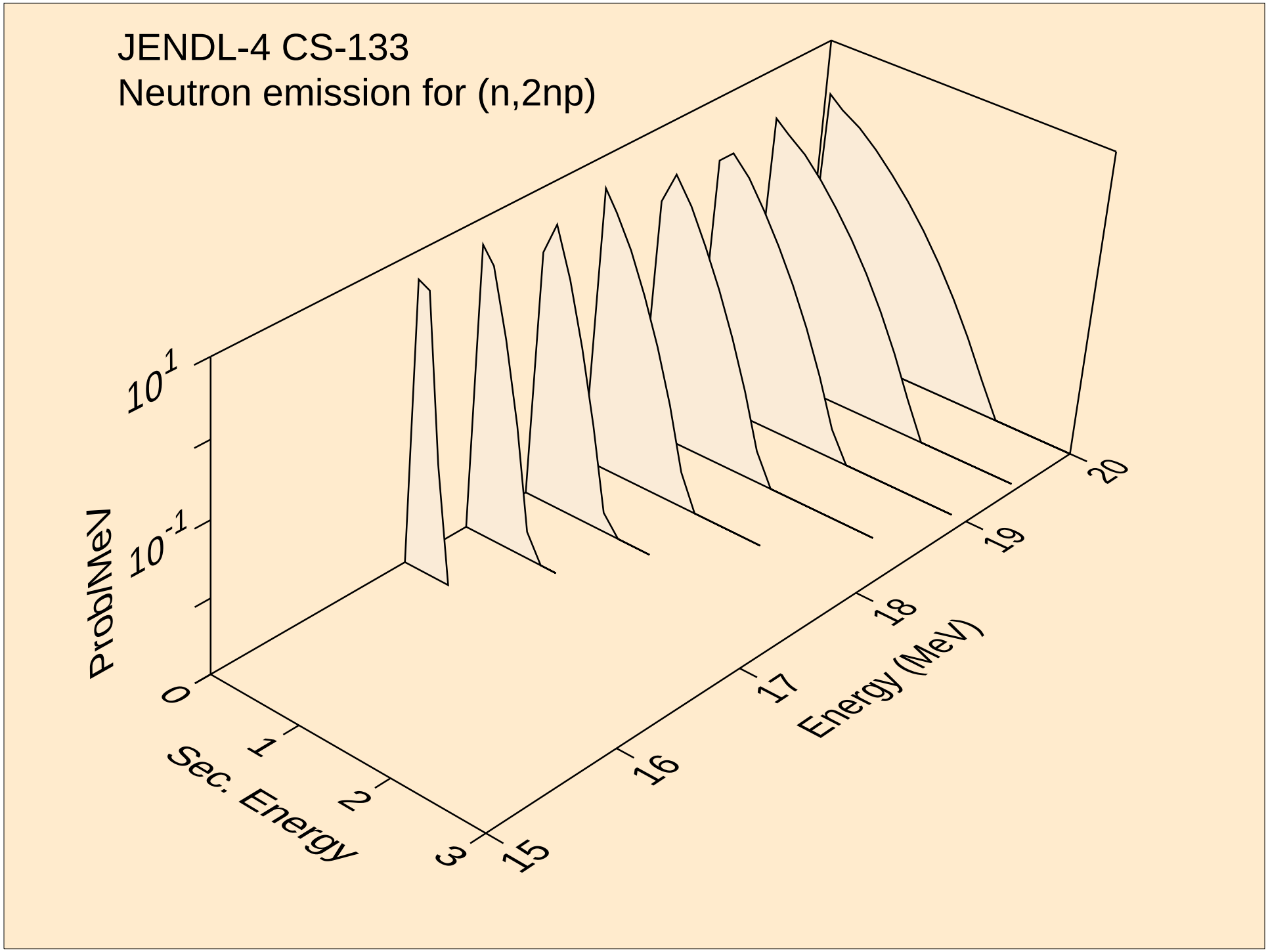
JENDL-4 CS-133
Neutron emission for (n,2n)2a

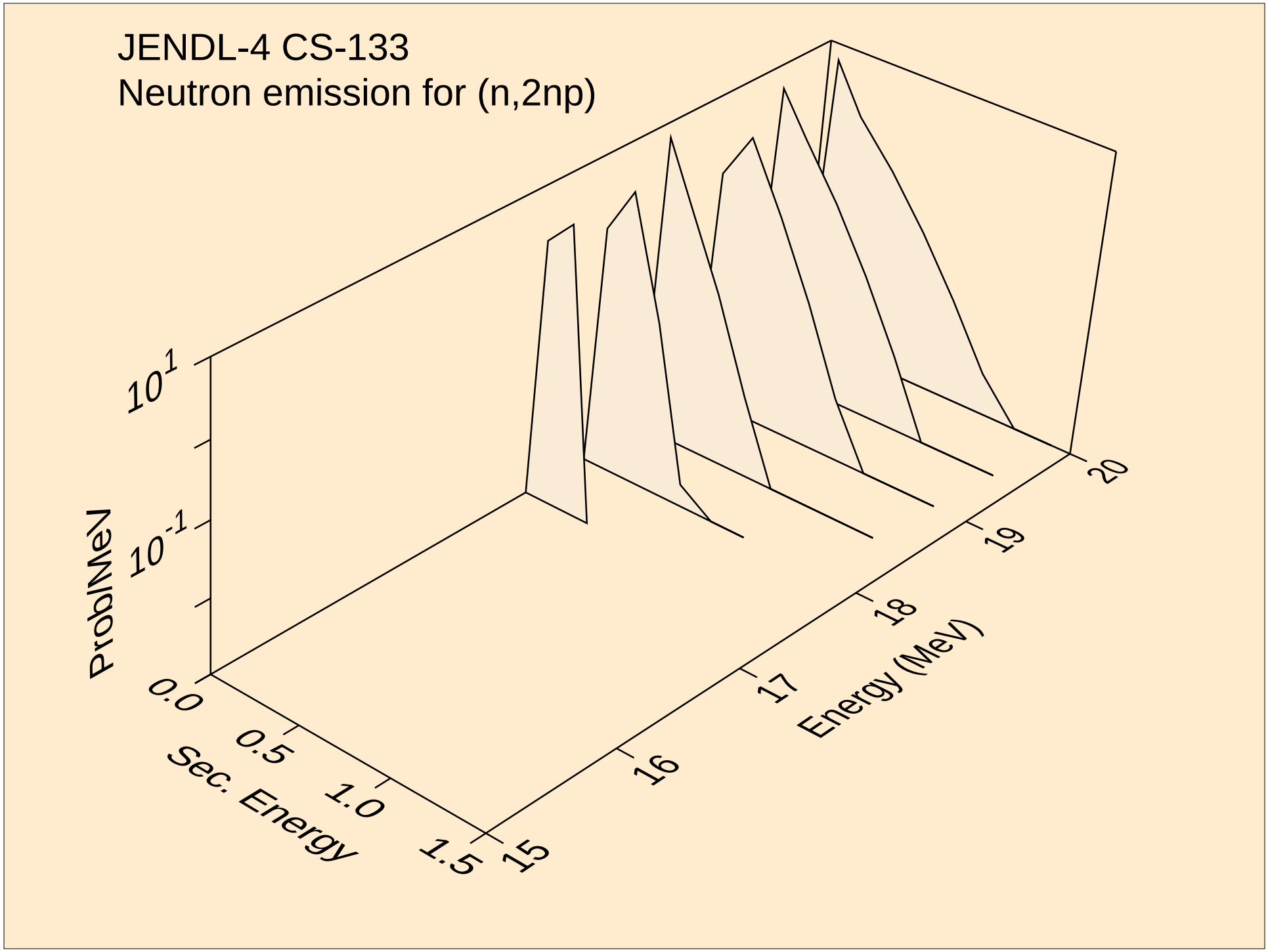


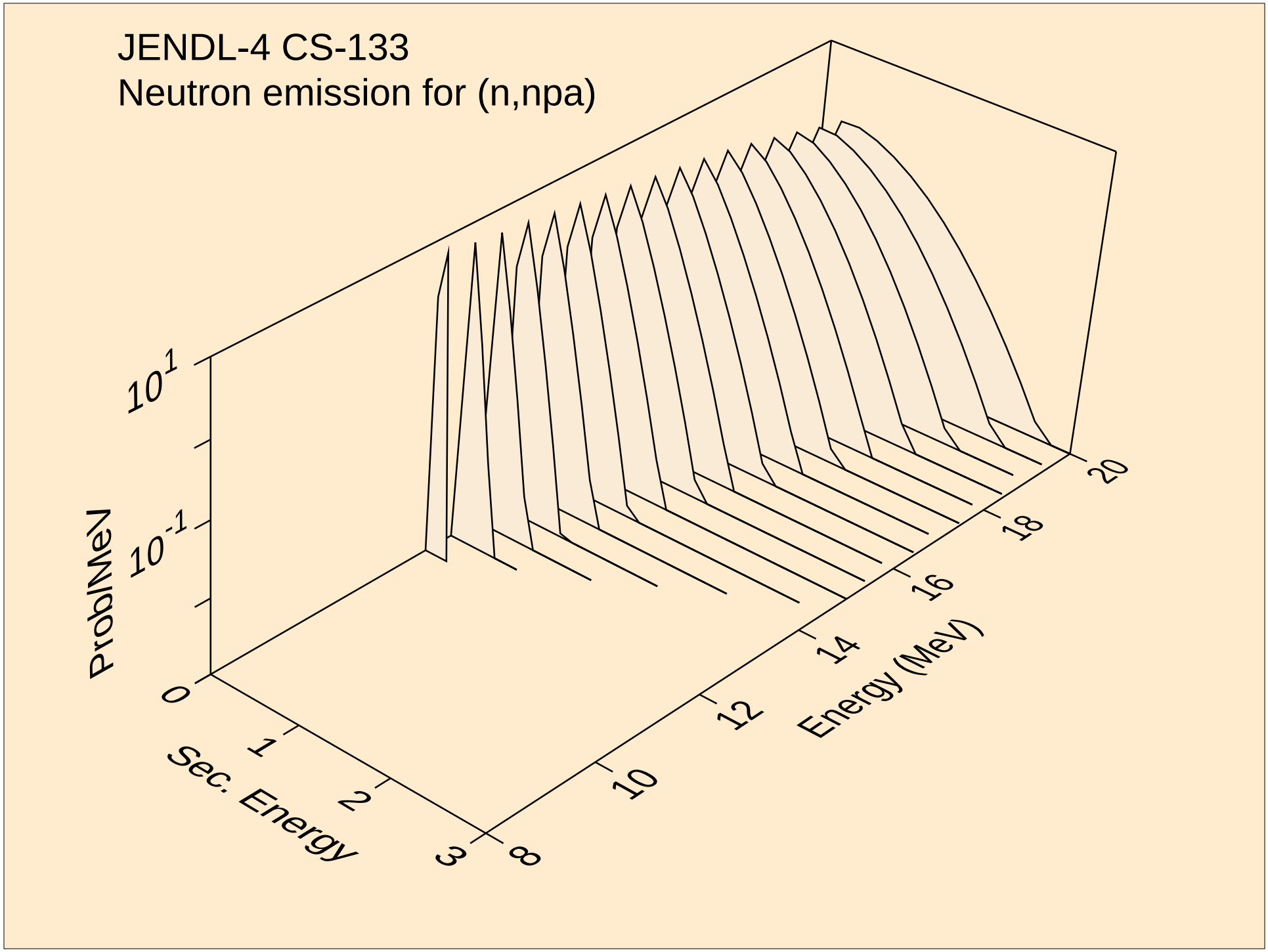

JENDL-4 CS-133
Neutron emission for (n,n*)d
Prob/MeV
10^0
10^{-2}
0
Sec. Energy
1
2
3
Energy (MeV)
12
13
14
15
16
17
18
19
20

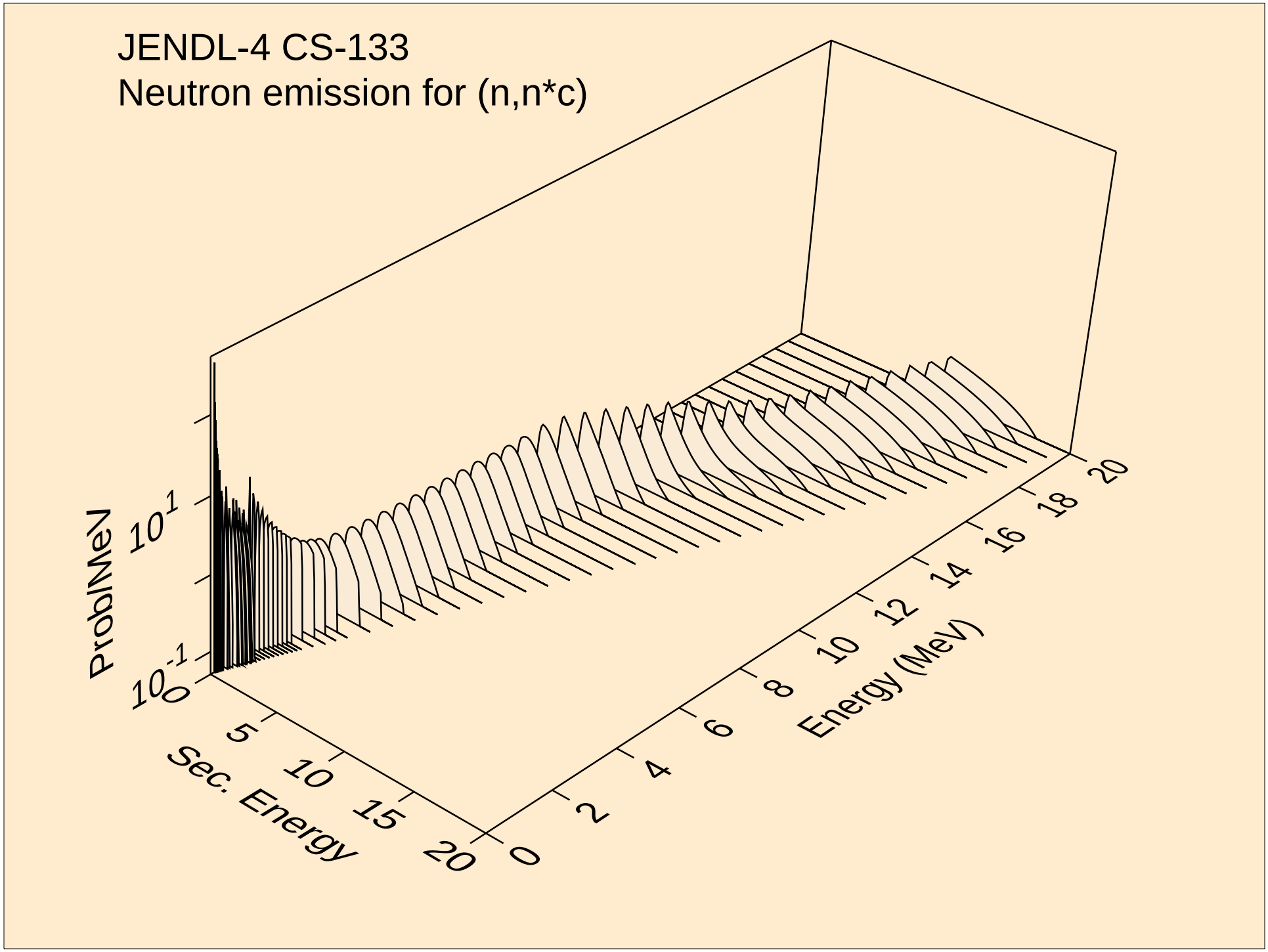

JENDL-4 CS-133
Neutron emission for (n,n*)t
Prob/MeV
10^0
10^{-2}
0
1
2
3
Sec. Energy
13
14
15
16
17
18
19
20
Energy (MeV)

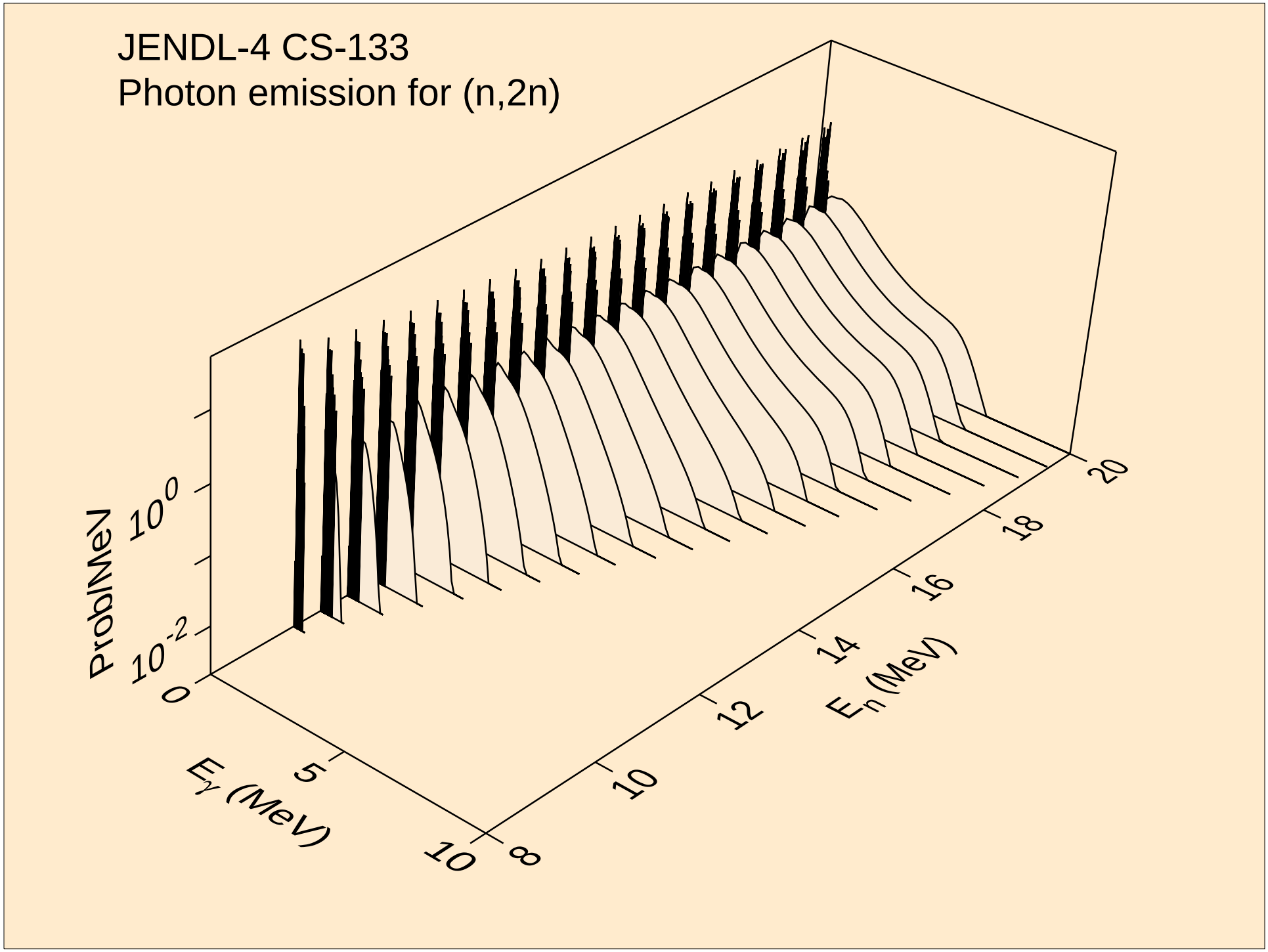

JENDL-4 CS-133
Neutron emission for (n,n*)he3
Prob/MeV
10^1
10^-1
0.0
0.2
0.4
0.6
0.8
Sec. Energy
16.0
16.5
17.0
17.5
18.0
18.5
19.0
19.5
20.0
Energy (MeV)

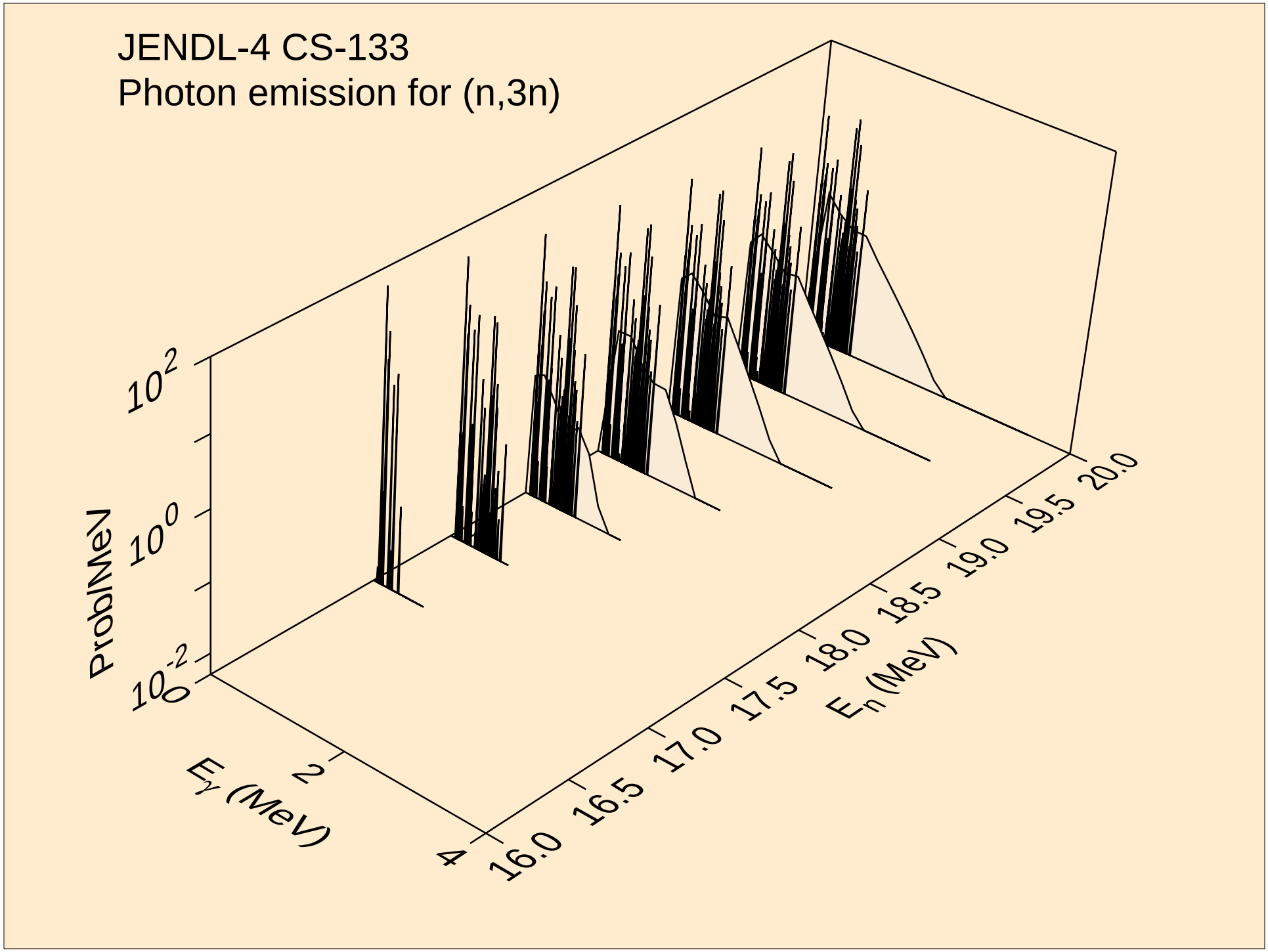

JENDL-4 CS-133
Neutron emission for (n,2np)
Prob/MeV
10^{1}
10^{-1}
0
Sec. Energy
1
2
3
Energy (MeV)
15
16
17
18
19
20

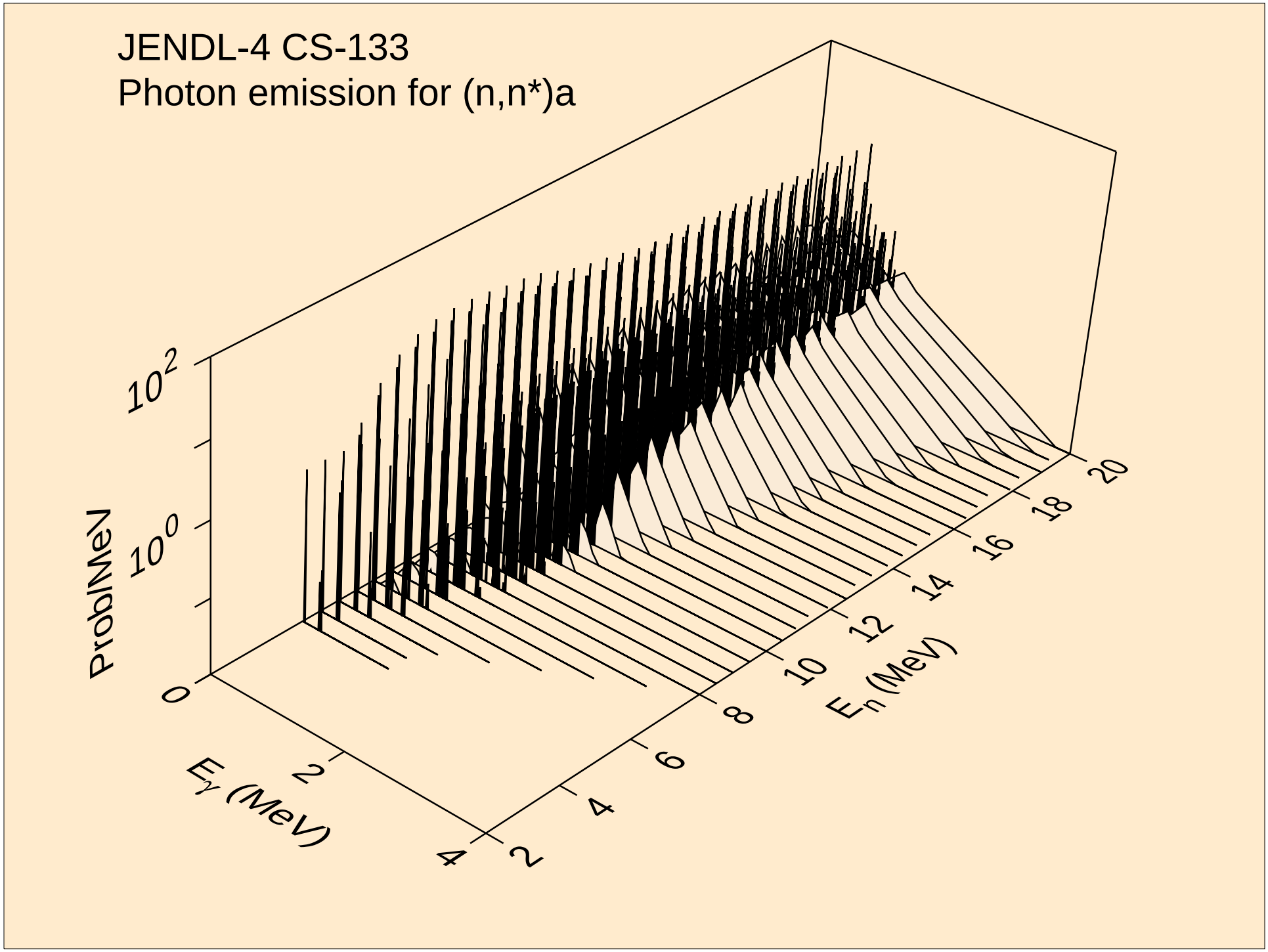

JENDL-4 CS-133
Neutron emission for (n,2np)
Prob/MeV
10^1
10^-1
0.0
0.5
1.0
1.5
Sec. Energy
15
16
17
18
19
20
Energy (MeV)


JENDL-4 CS-133
Neutron emission for (n,npa)
Prob/MeV
10^{1}
10^{-1}
0
Sec. Energy
1
2
3
8
10
12
14
16
18
20
Energy (MeV)

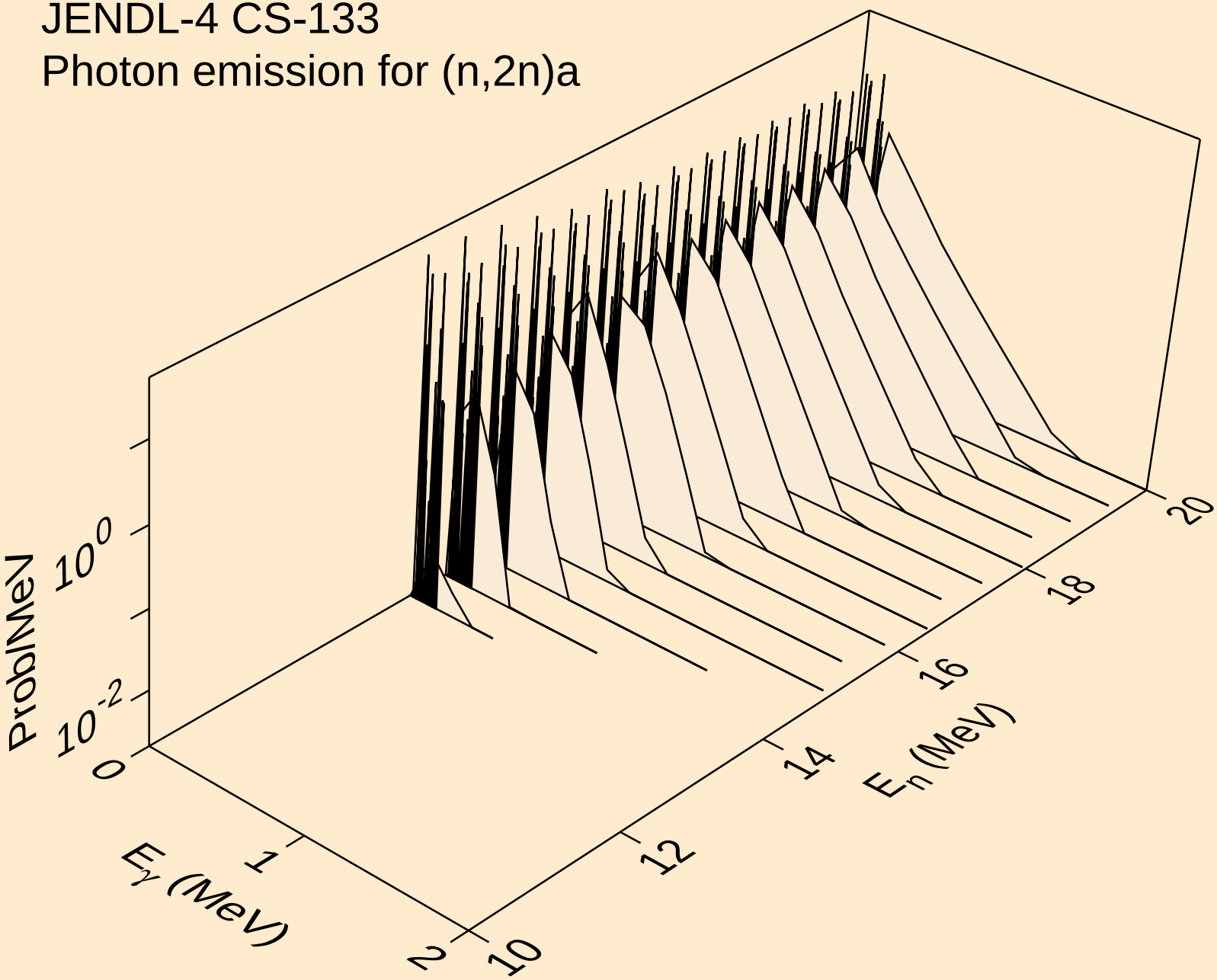

JENDL-4 CS-133
Neutron emission for (n,n*c)
Prob/MeV
10^{1}
10^{-1}
0
5
10
15
20
Sec. Energy
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)


JENDL-4 CS-133
Photon emission for (n,2n)
Prob/MeV
10^0
10^{-2}
0
5
10
E_γ (MeV)
8
10
12
14
16
18
20
E_n (MeV)

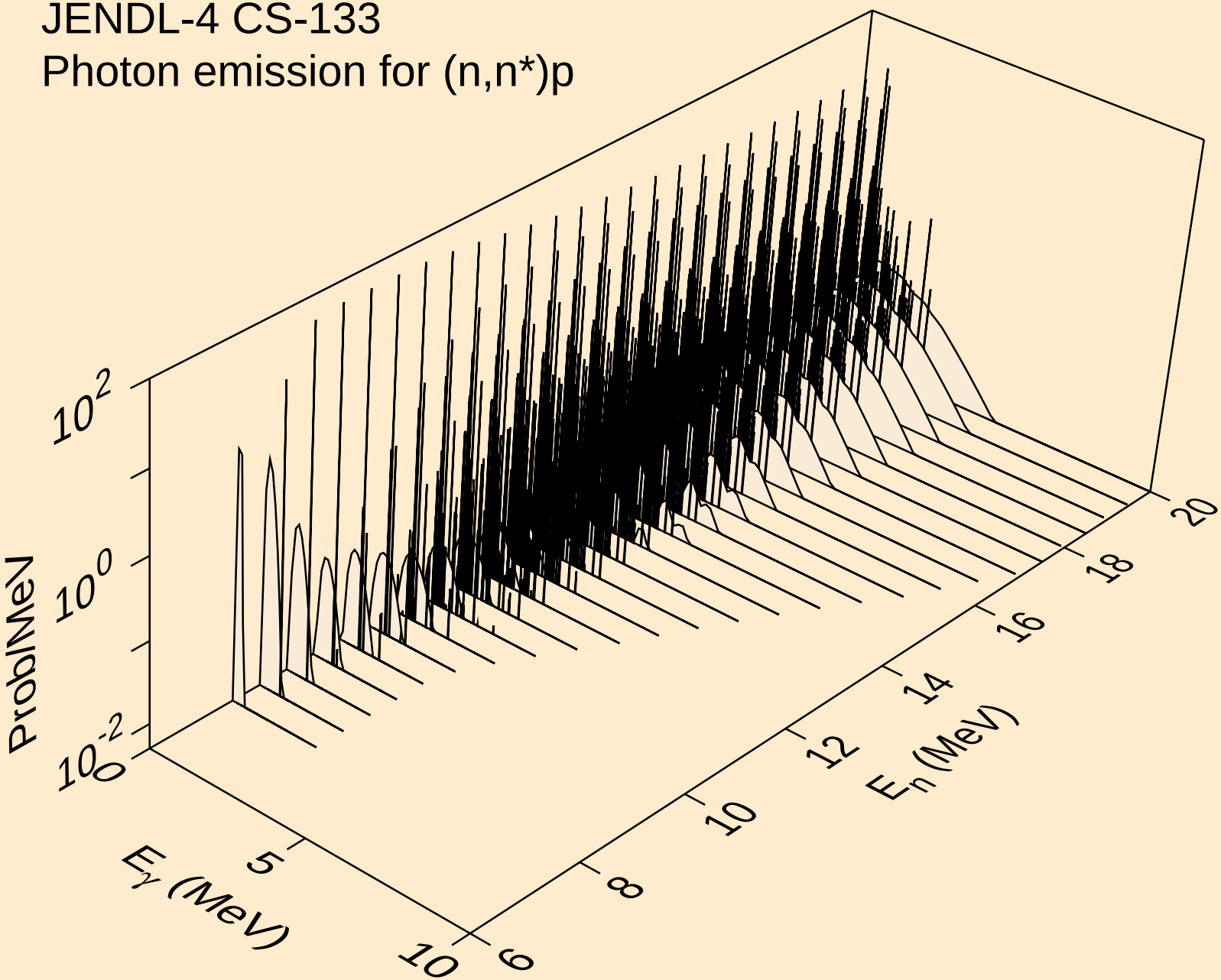

JENDL-4 CS-133
Photon emission for (n,3n)
Prob/MeV
10^{2}
10^{0}
10^{-2}
E_γ (MeV)
0
2
4
E_n (MeV)
16.0
16.5
17.0
17.5
18.0
18.5
19.0
19.5
20.0


JENDL-4 CS-133
Photon emission for (n,n*)a
Prob/MeV
10^2
10^0
0
2
4
E_γ (MeV)
2
4
6
8
10
12
14
16
18
20
E_n (MeV)

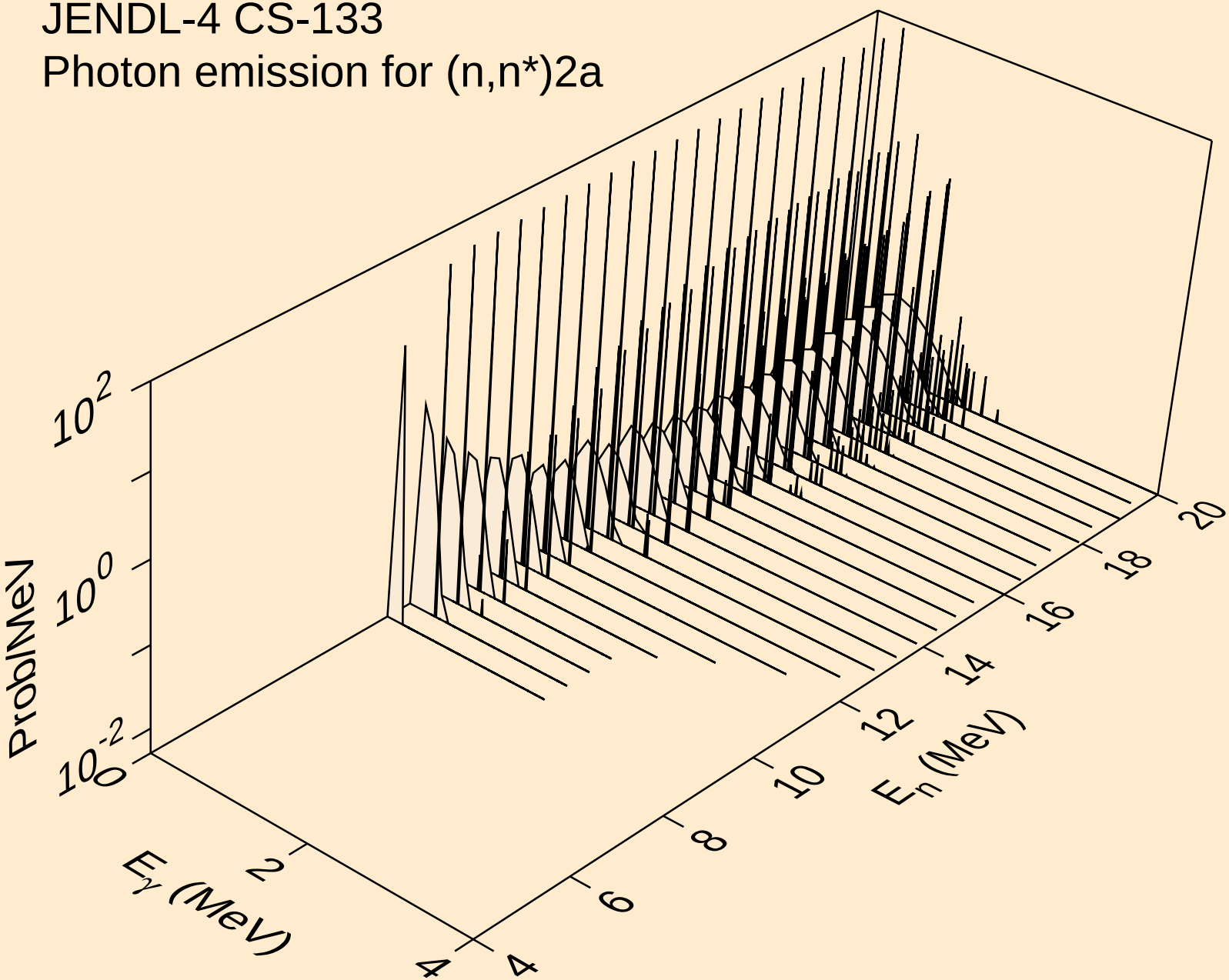
JENDL-4 CS-133
Photon emission for (n,2n)a



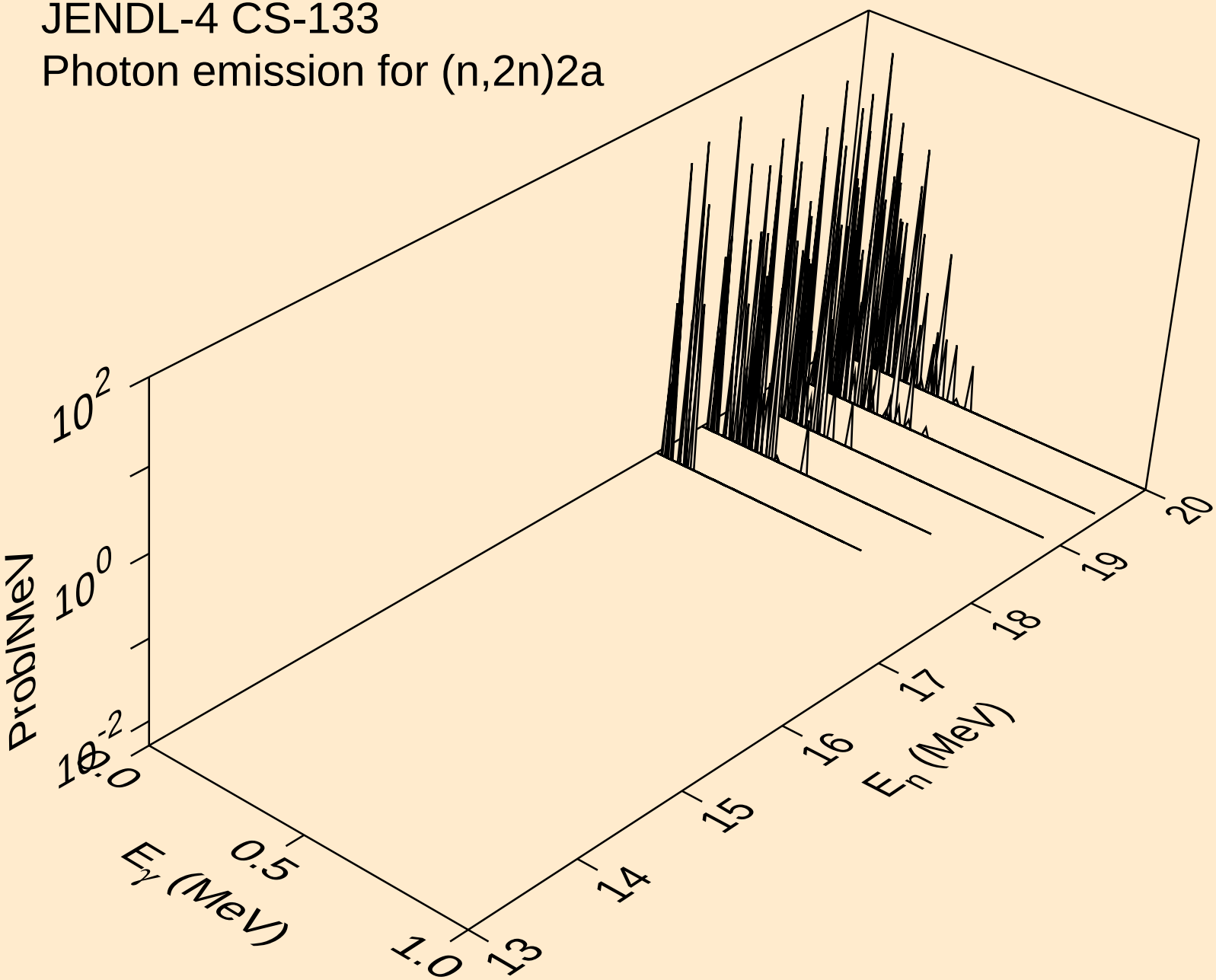
JENDL-4 CS-133
Photon emission for (n,n*)p



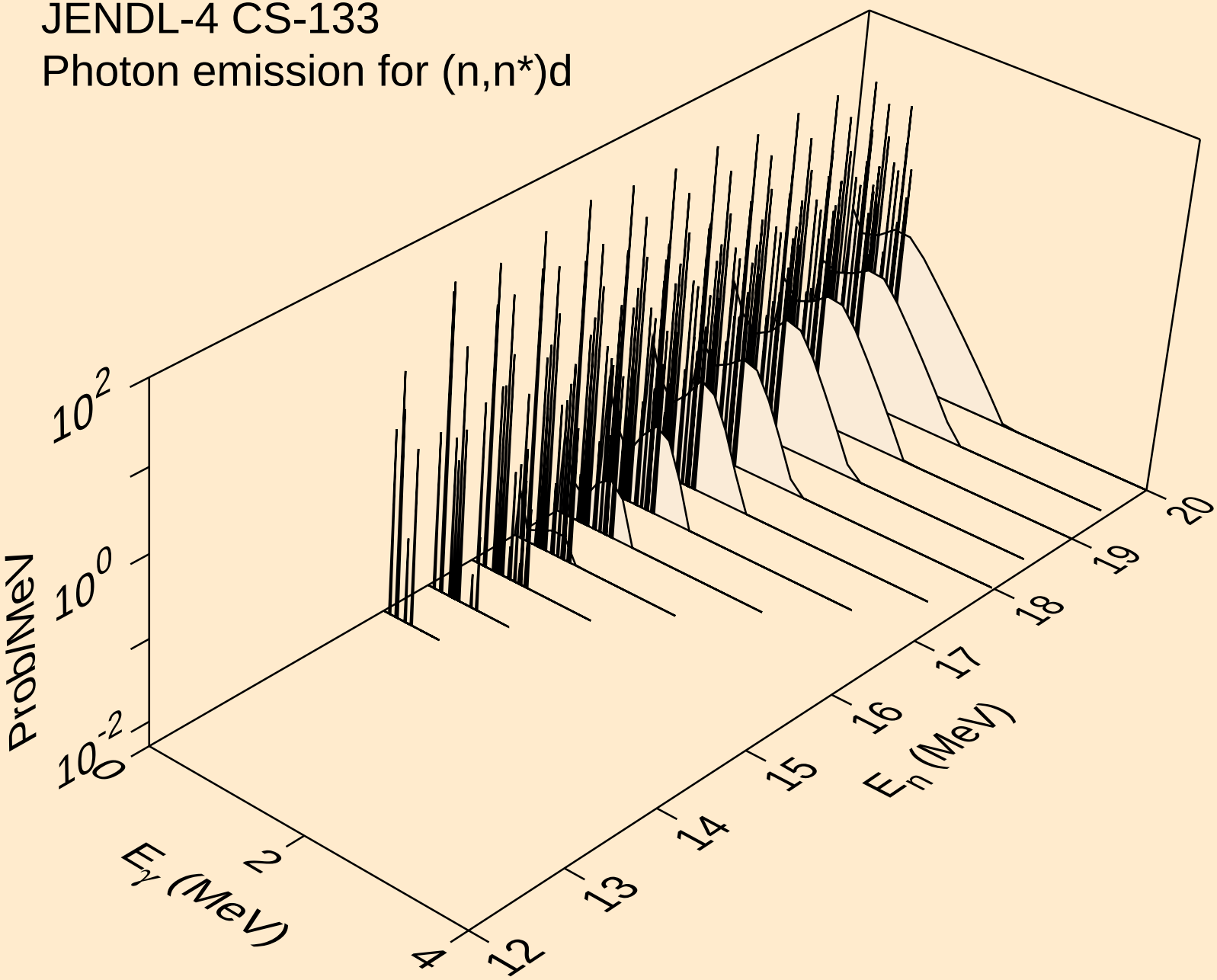
JENDL-4 CS-133
Photon emission for (n,n*)2a

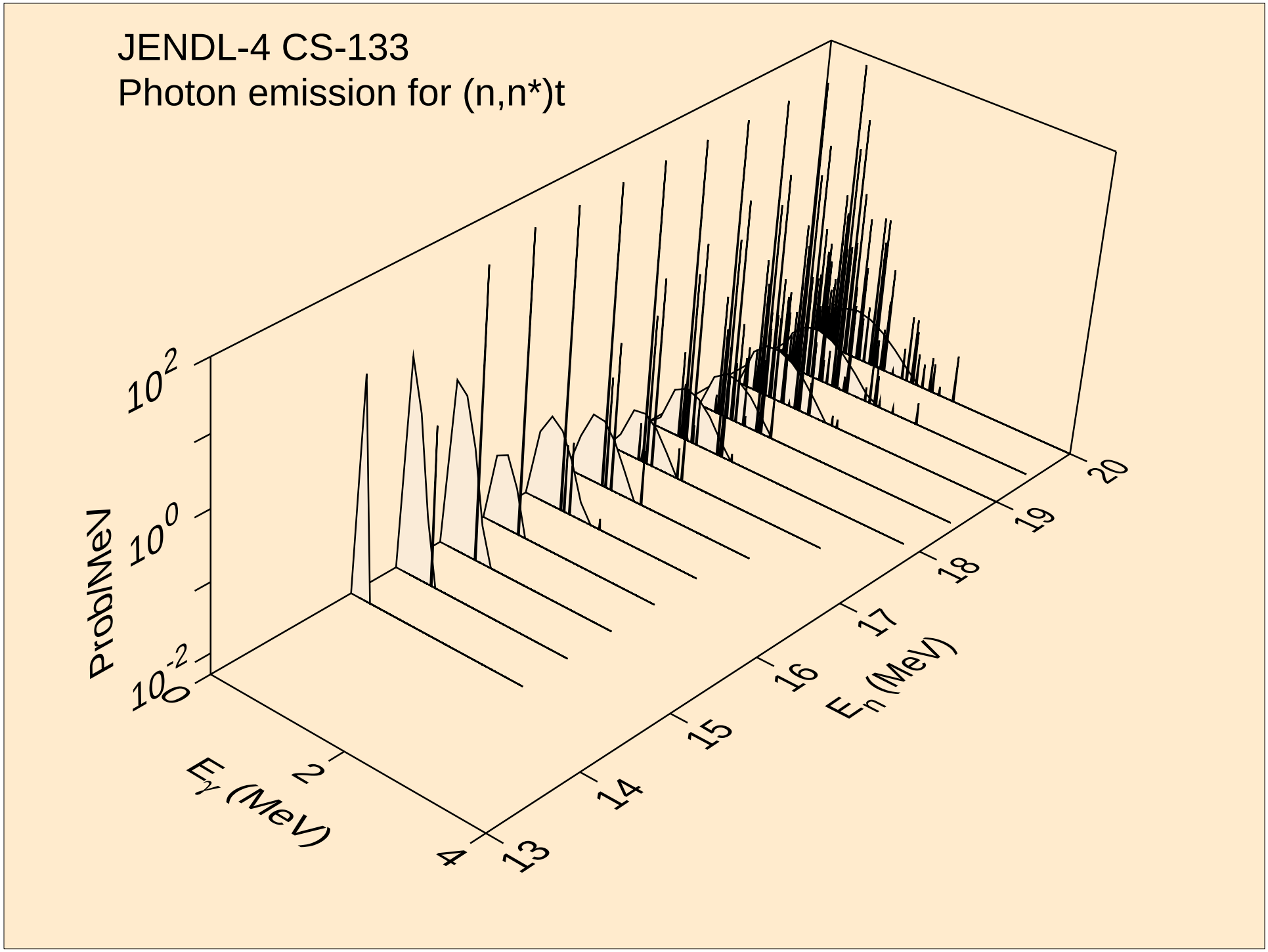


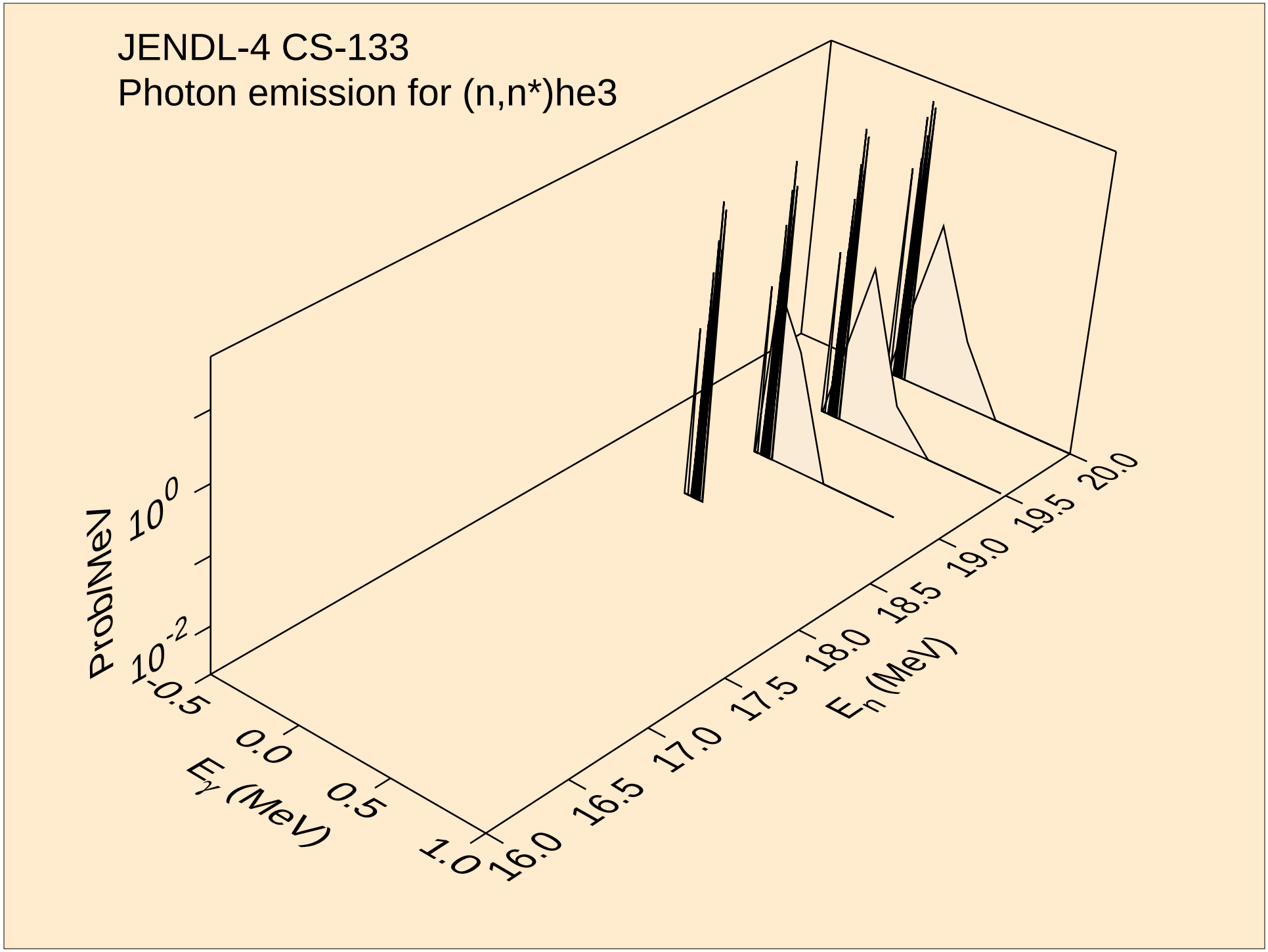
JENDL-4 CS-133
Photon emission for (n,2n)2a

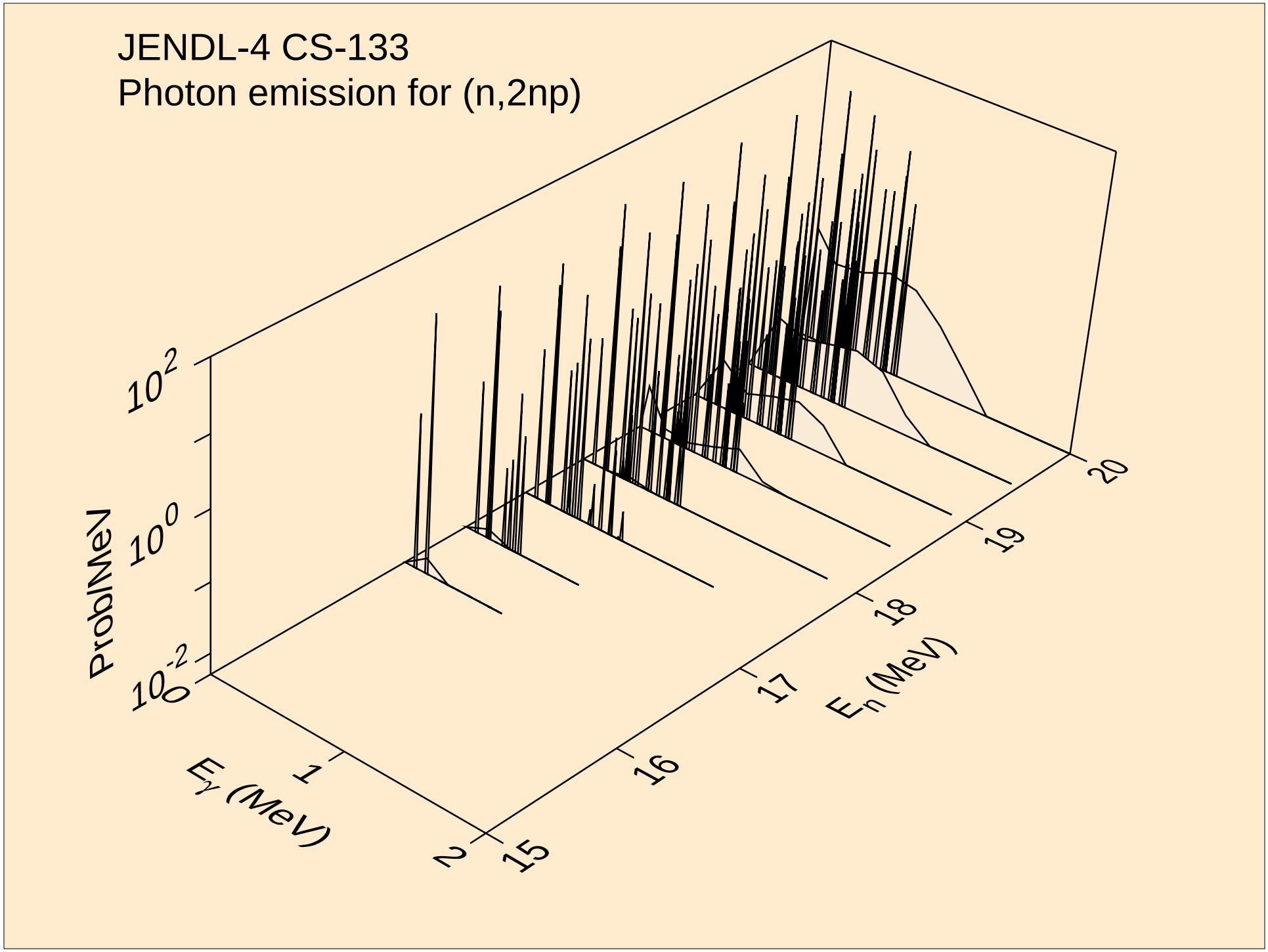


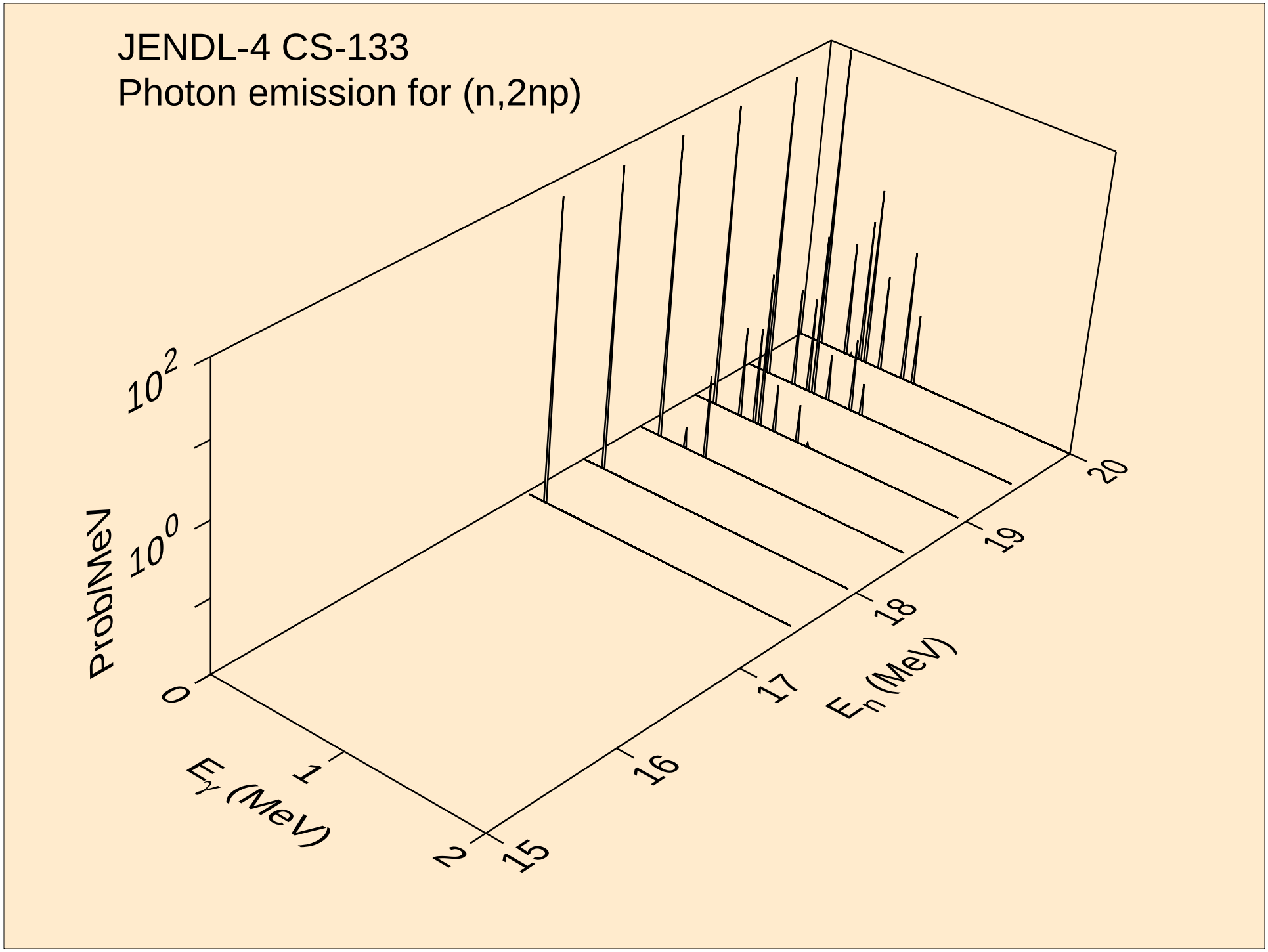
JENDL-4 CS-133
Photon emission for (n,n*)d



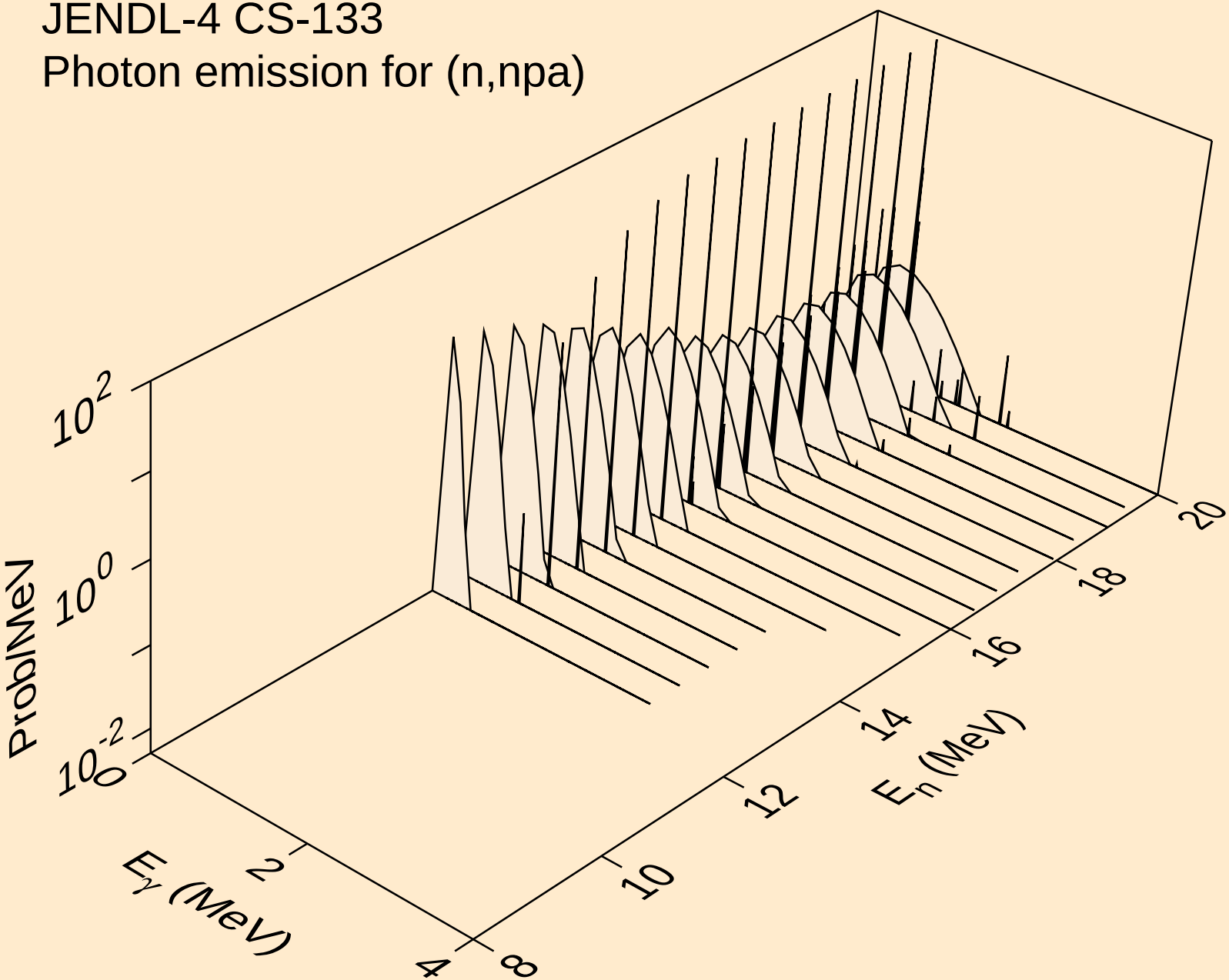

JENDL-4 CS-133
Photon emission for (n,n*)t
Prob/MeV
10^2
10^0
10^{-2}
0
2
4
E_γ (MeV)
13
14
15
16
17
18
19
20
E_n (MeV)

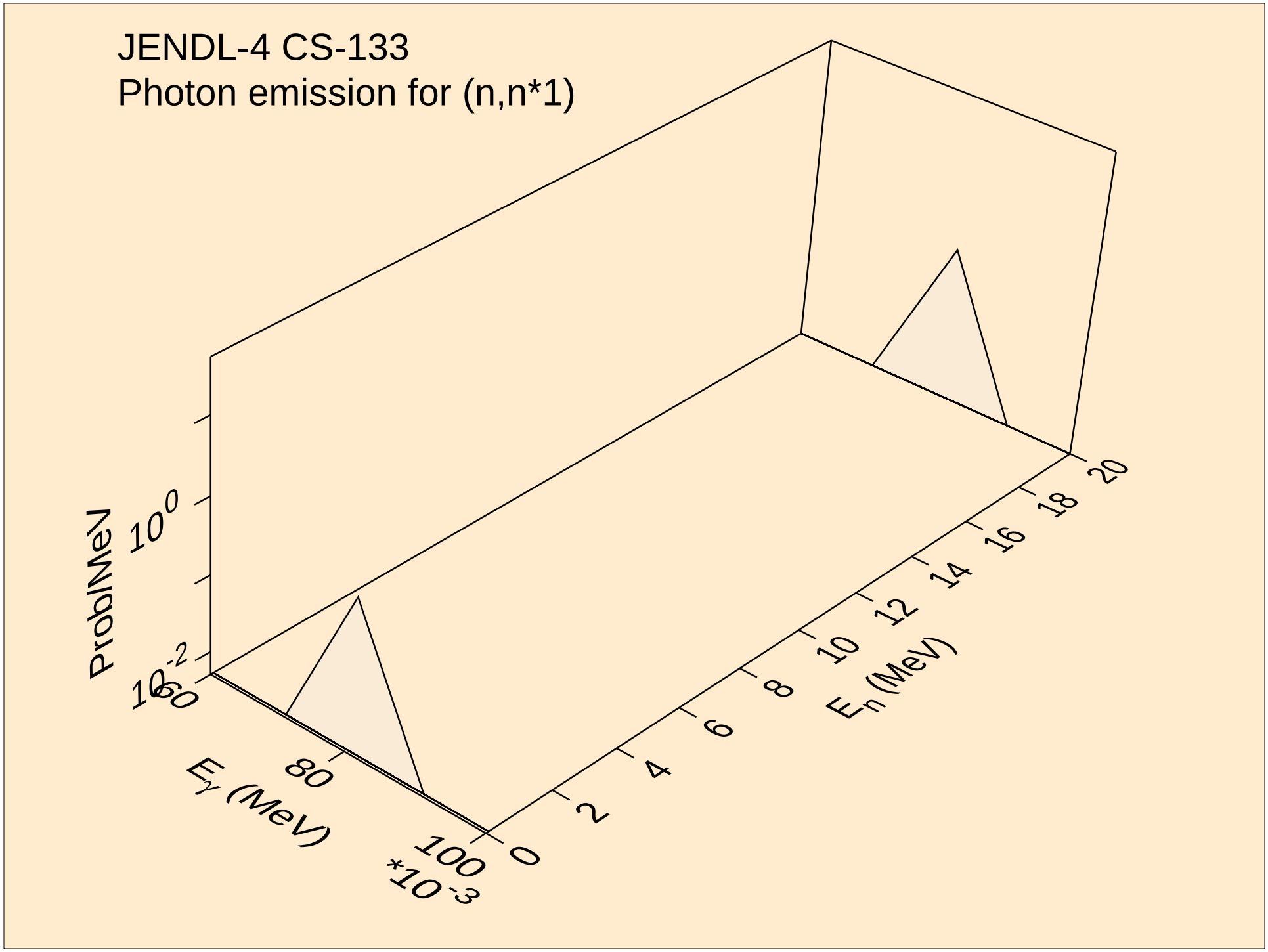

JENDL-4 CS-133
Photon emission for (n,n*)he3
Prob/MeV
10^{0}
10^{-2}
-0.5
0.0
0.5
1.0
E_γ (MeV)
16.0
16.5
17.0
17.5
18.0
18.5
19.0
19.5
20.0
E_n (MeV)


JENDL-4 CS-133
Photon emission for (n,2np)
Prob/MeV
10^2
10^0
10^{-2}
0
1
2
E_γ (MeV)
15
16
17
18
19
20
E_n (MeV)

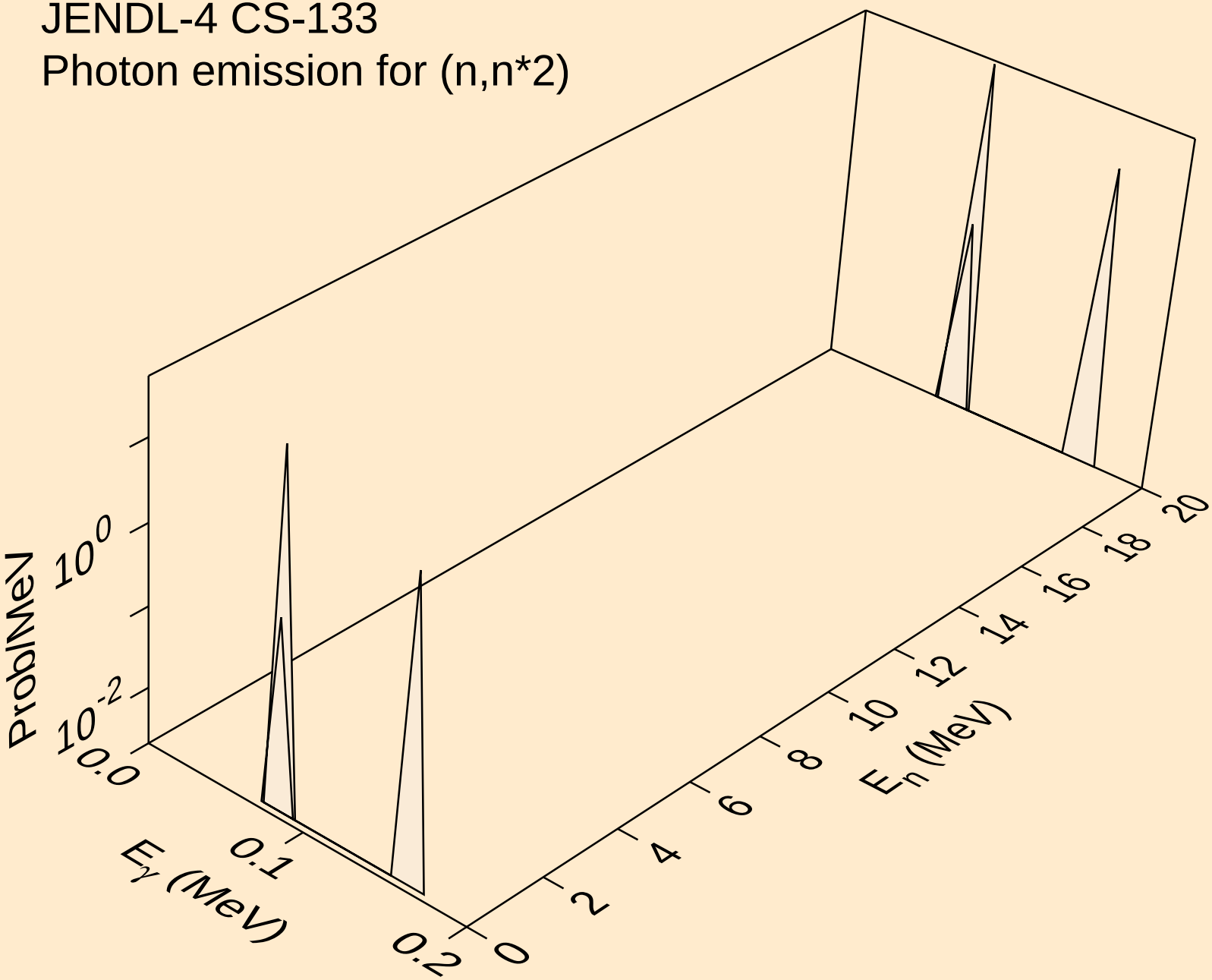

JENDL-4 CS-133
Photon emission for (n,2np)
Prob/MeV
10^2
10^0
0
E_γ (MeV)
1
2
E_n (MeV)
15
16
17
18
19
20

JENDL-4 CS-133
Photon emission for (n,npa)

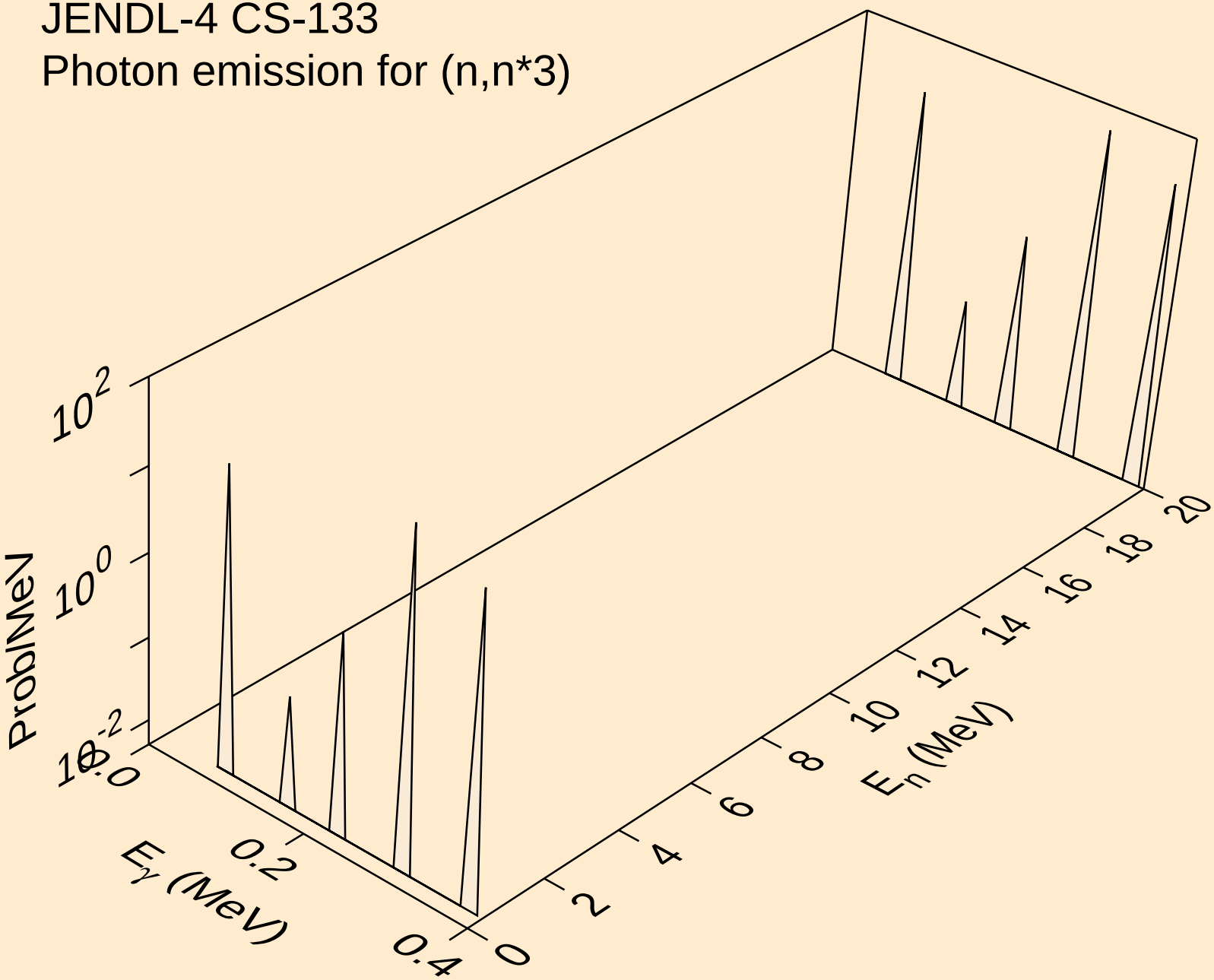



JENDL-4 CS-133
Photon emission for (n,n*1)
Prob/MeV
10^{0}
10^{-2}
60
80
100
E_γ (MeV)
*10^{-3}
0
2
4
6
8
10
12
14
16
18
20
E_n (MeV)

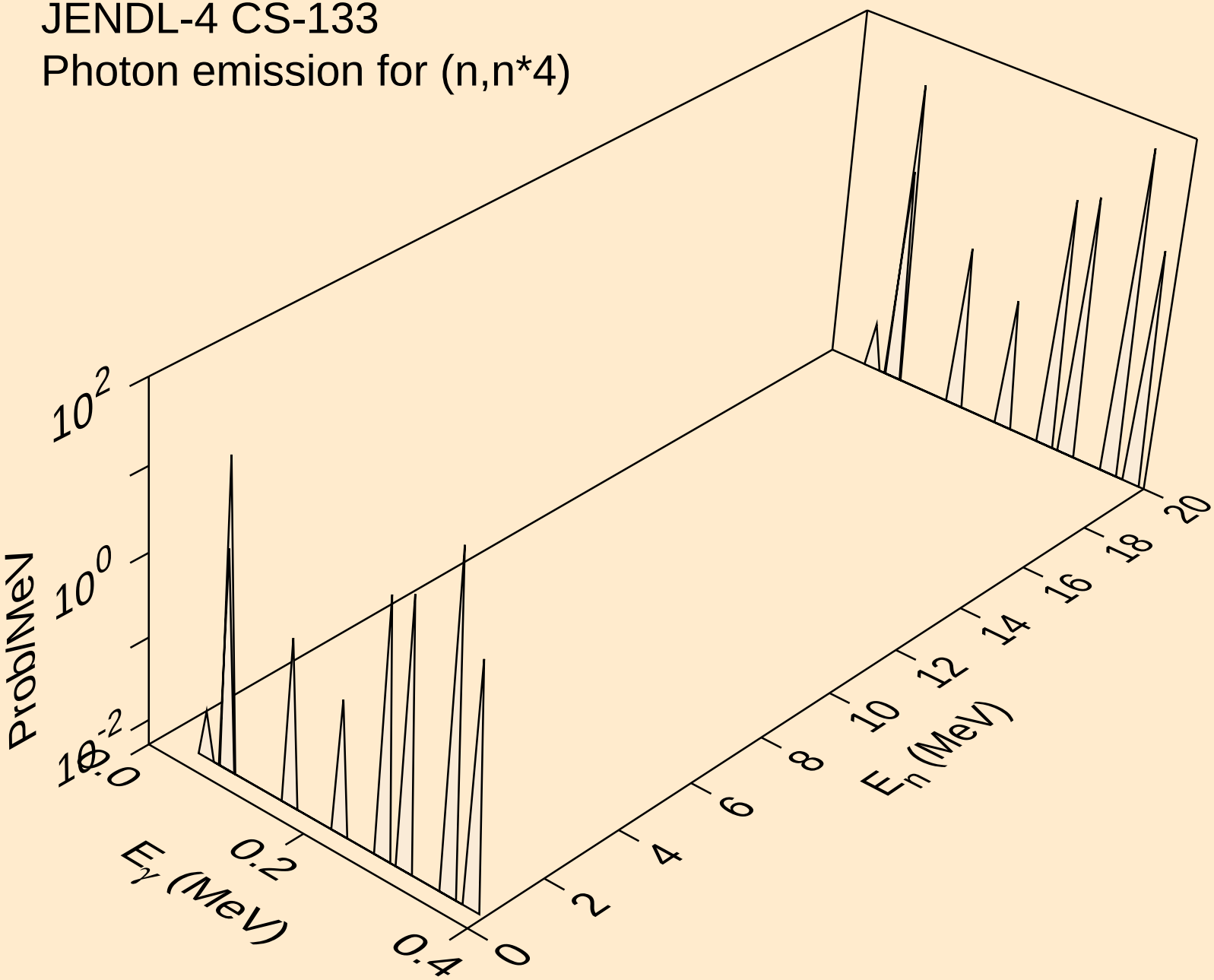
JENDL-4 CS-133
Photon emission for (n,n*2)



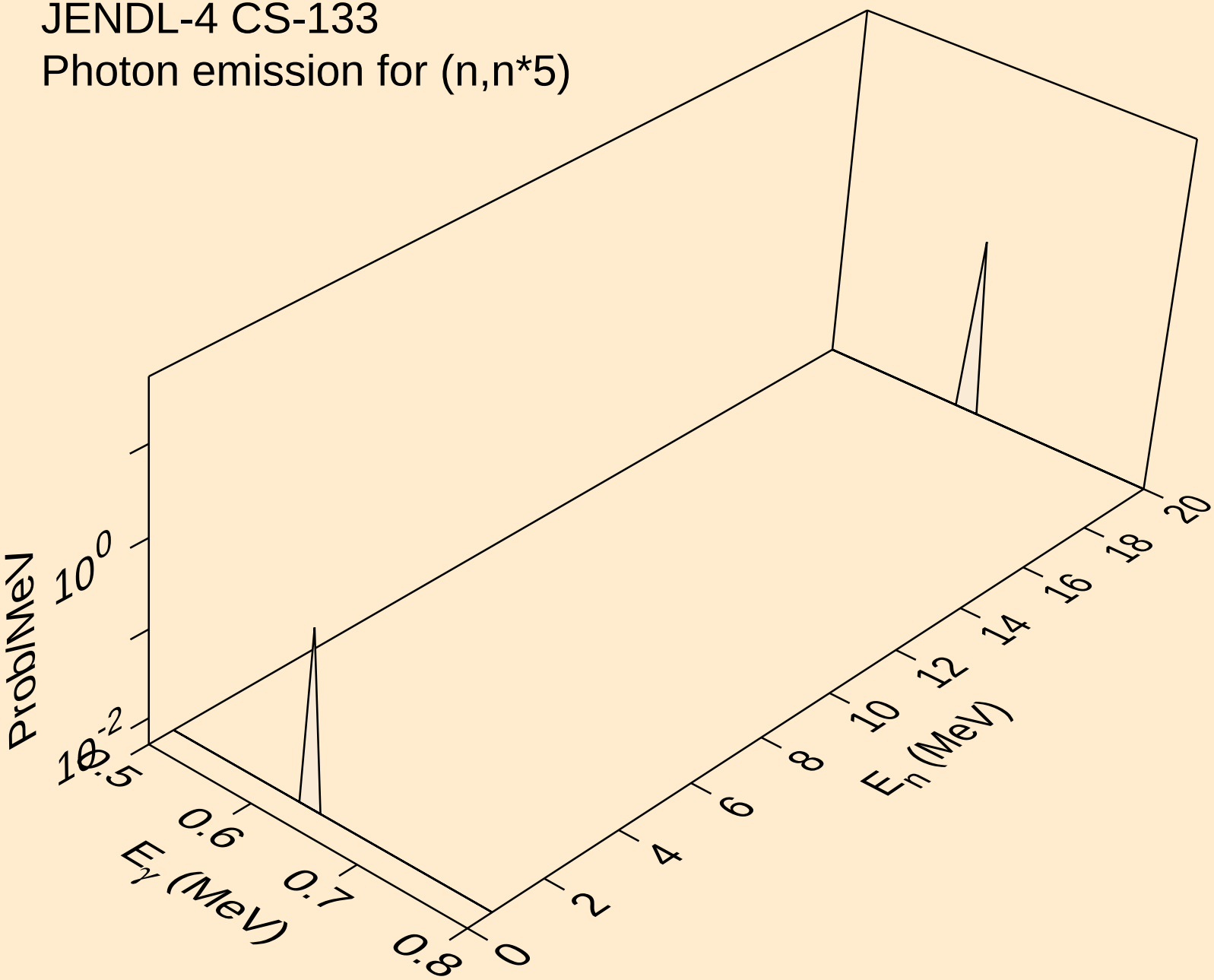
JENDL-4 CS-133
Photon emission for (n,n*3)

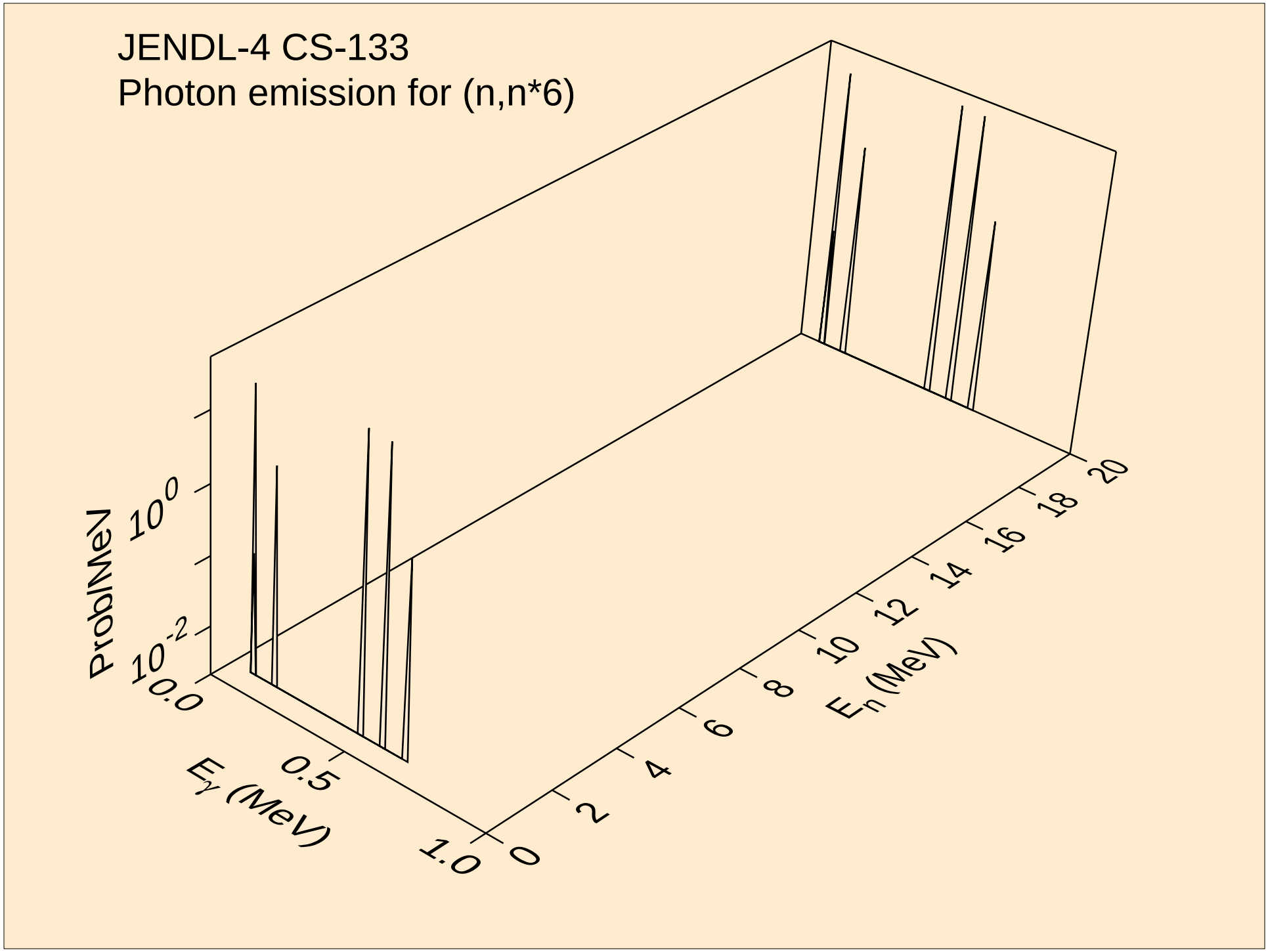


JENDL-4 CS-133
Photon emission for (n,n*4)

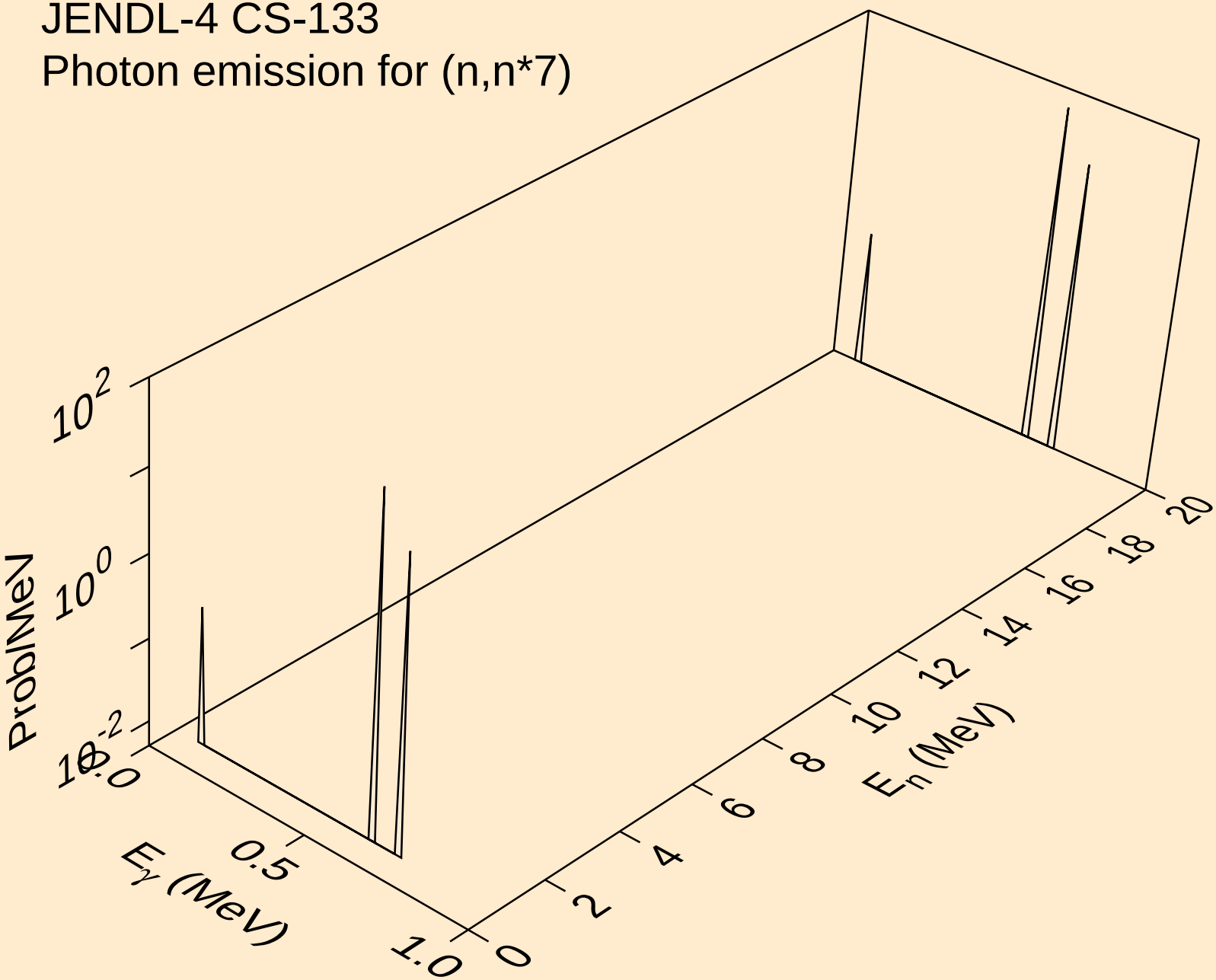


JENDL-4 CS-133
Photon emission for (n,n*5)

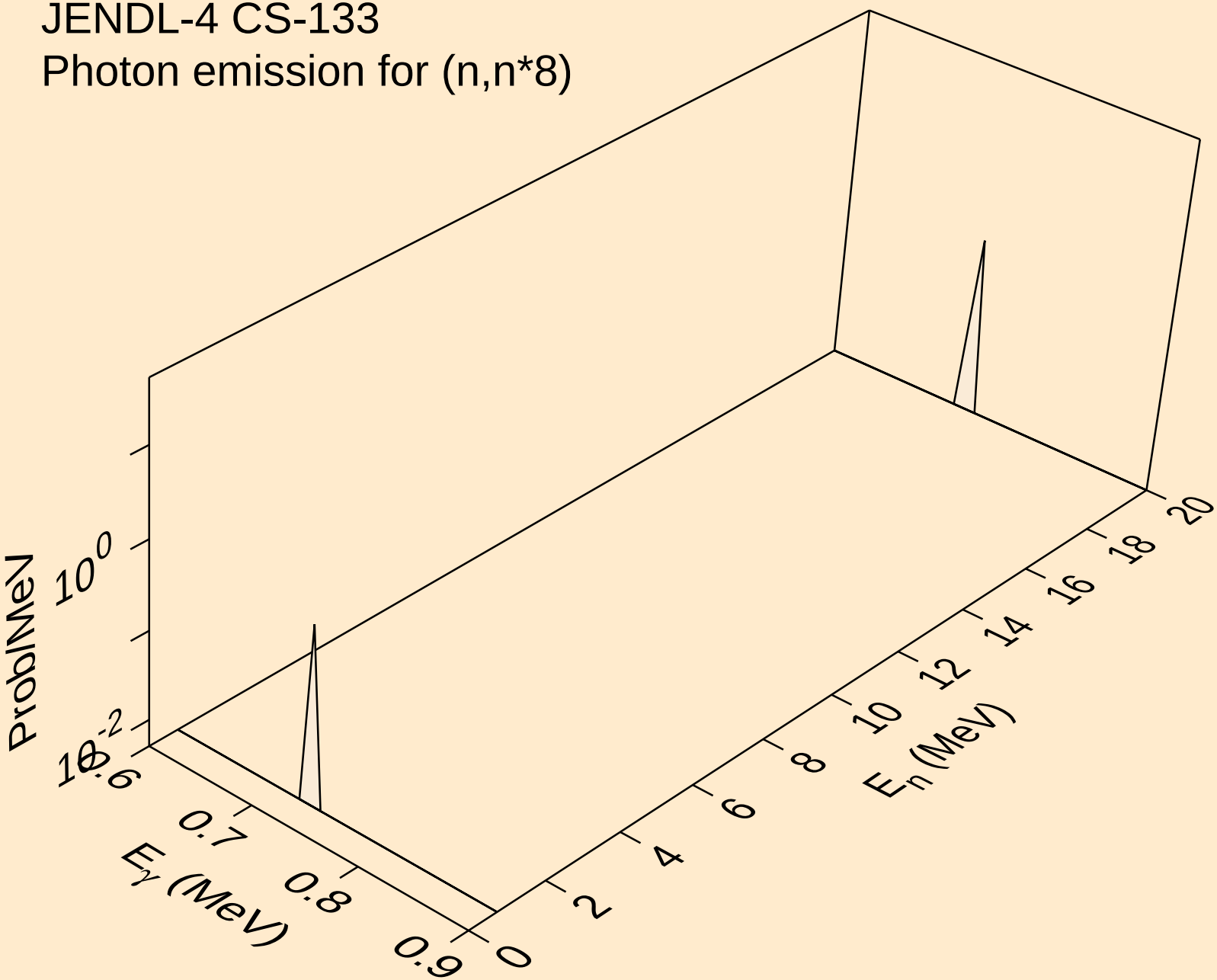


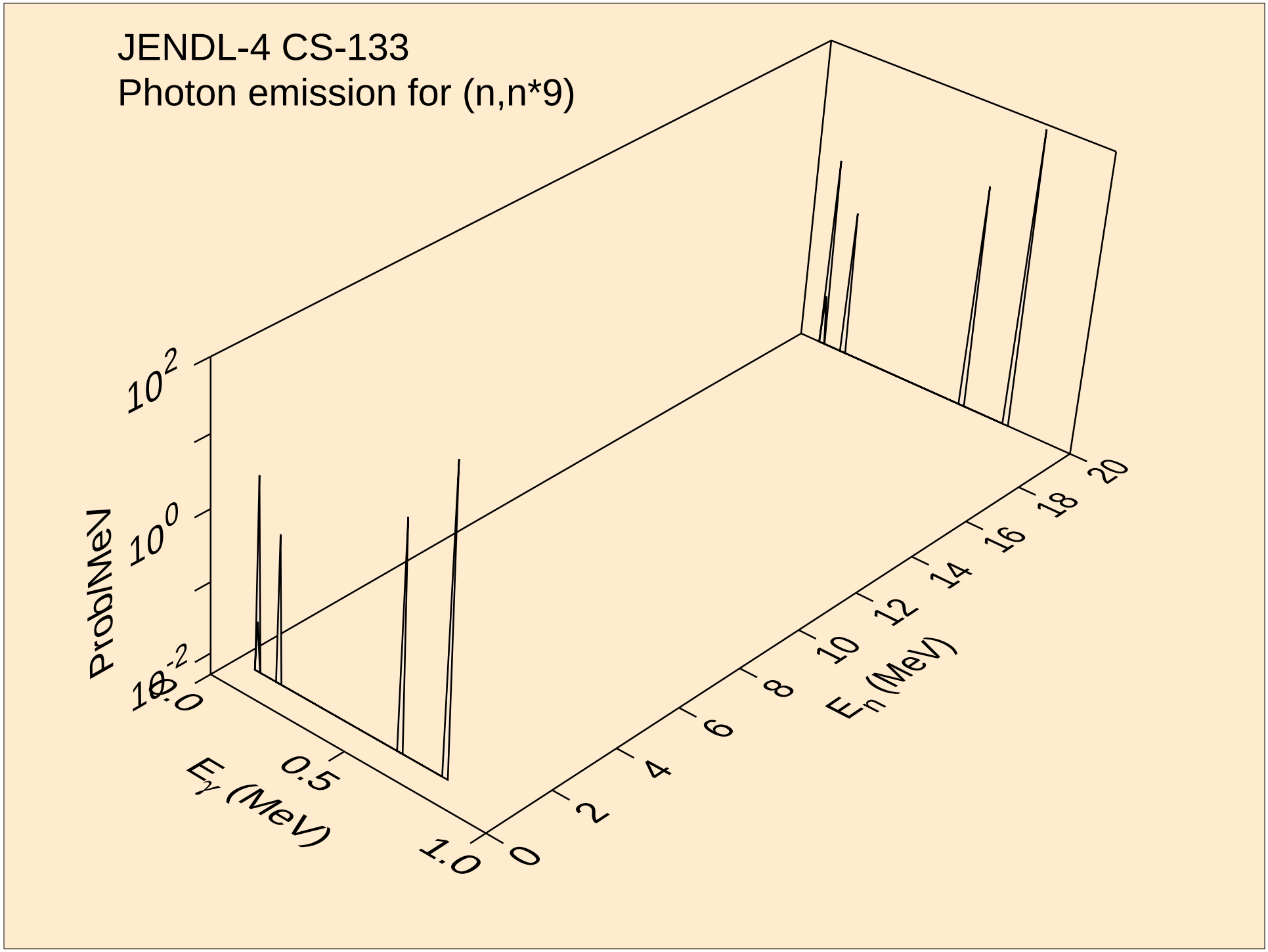

JENDL-4 CS-133
Photon emission for (n,n*6)
Prob/MeV
10^0
10^{-2}
0.0
0.5
1.0
E_γ (MeV)
0
2
4
6
8
10
12
14
16
18
20
E_n (MeV)

JENDL-4 CS-133
Photon emission for (n,n*7)

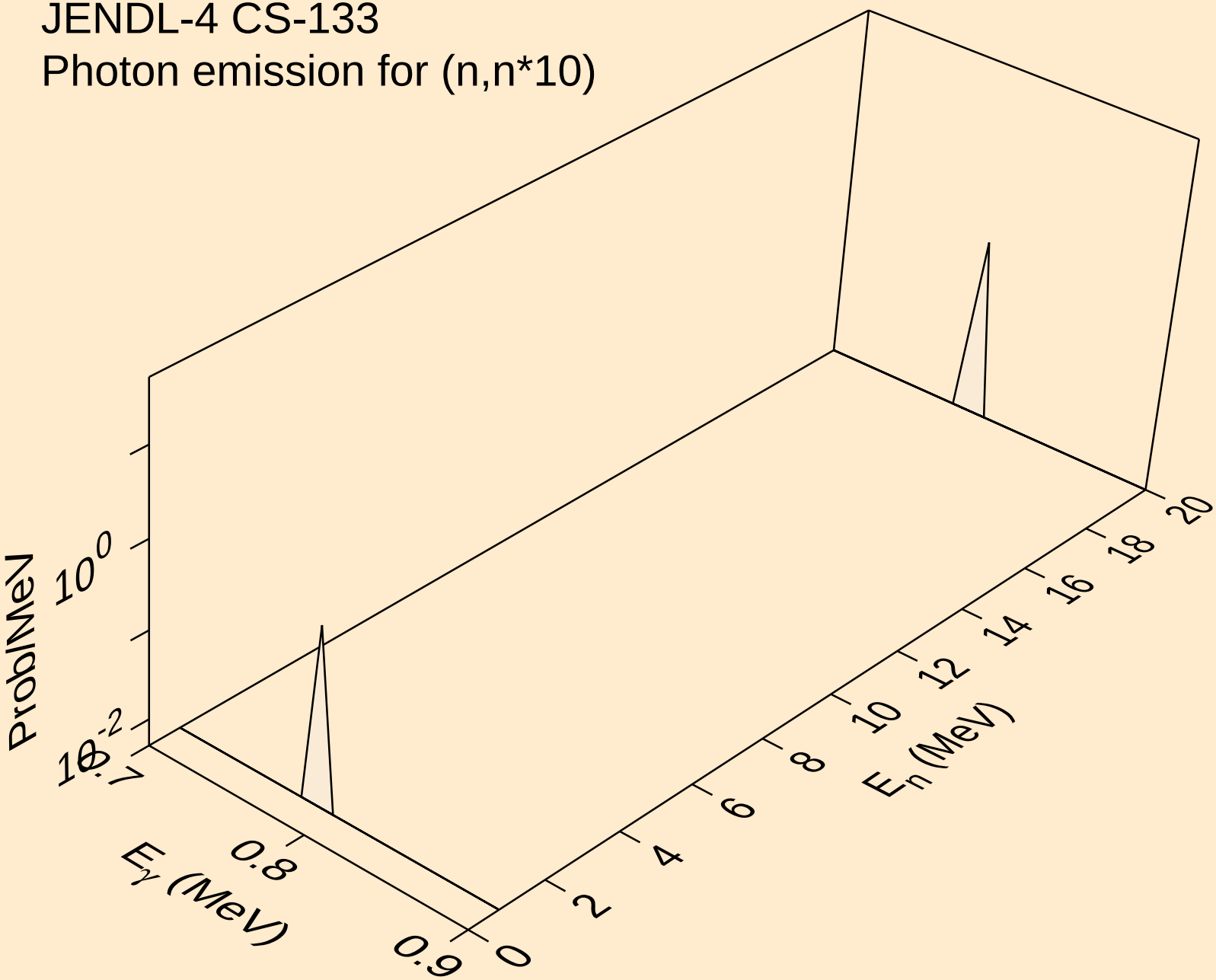


JENDL-4 CS-133
Photon emission for (n,n*8)

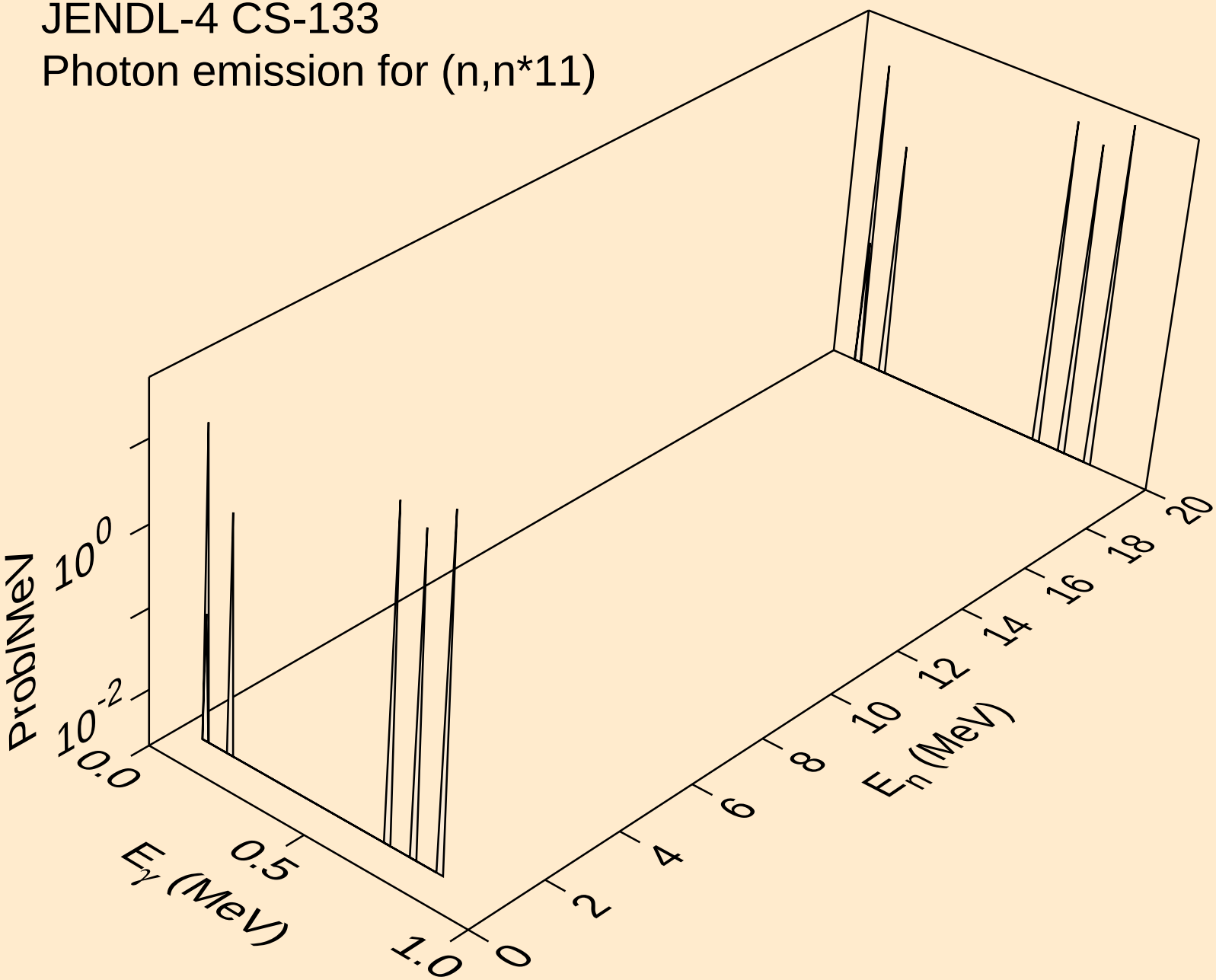



JENDL-4 CS-133
Photon emission for (n,n*9)
Prob/MeV
10^2
10^0
10^{-2}
0.0
0.5
1.0
E_γ (MeV)
0
2
4
6
8
10
12
14
16
18
20
E_n (MeV)

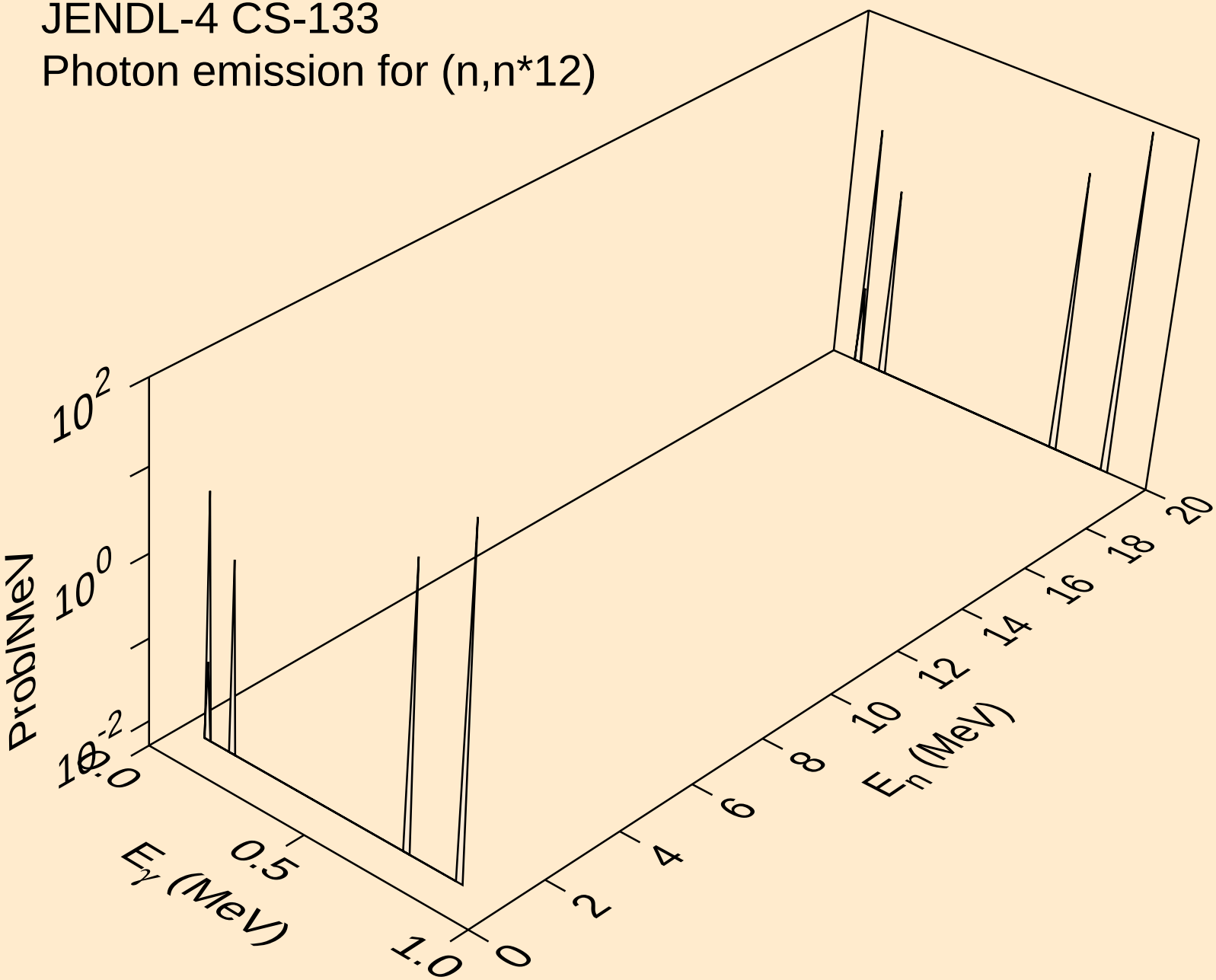
JENDL-4 CS-133
Photon emission for (n,n*10)



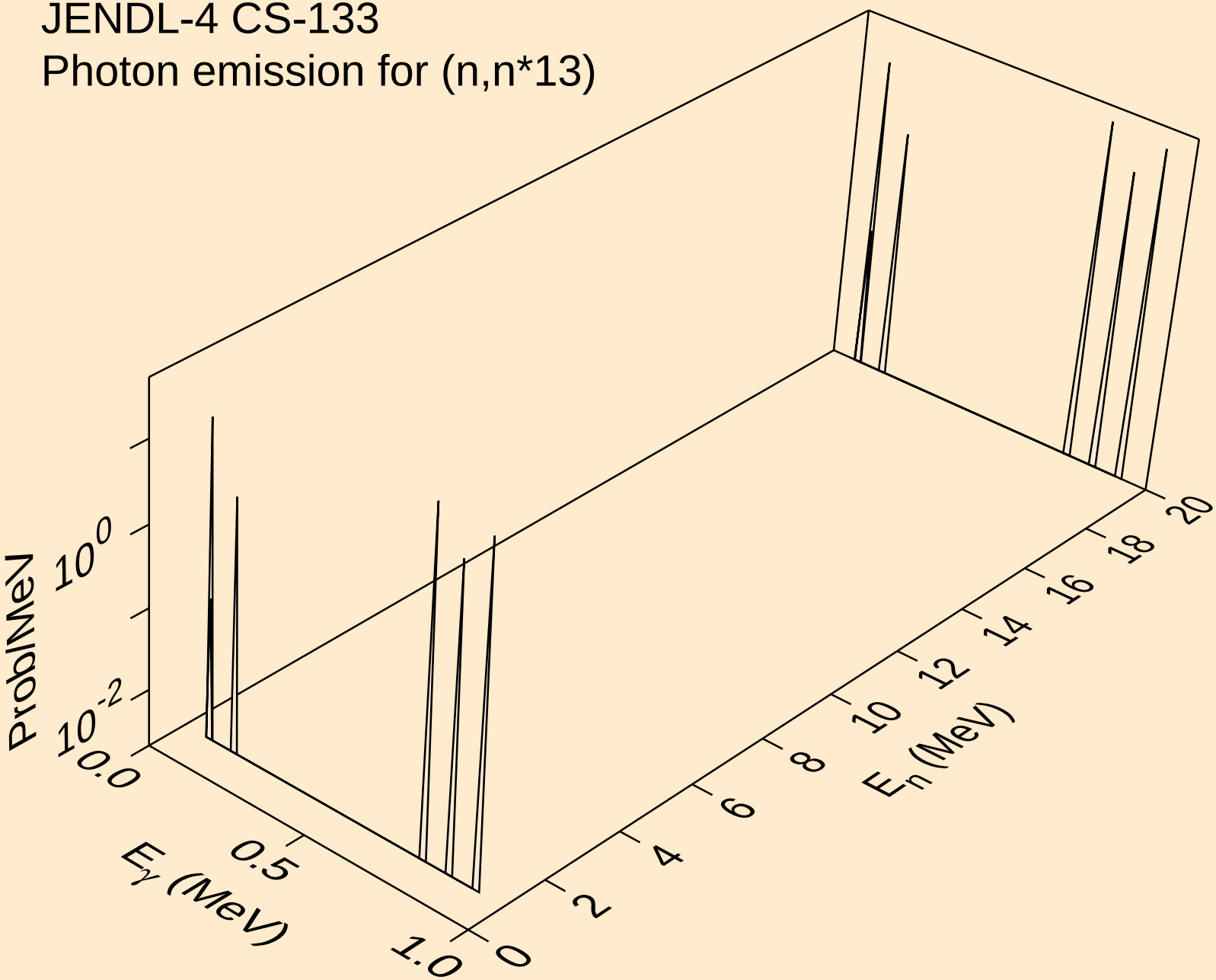
JENDL-4 CS-133
Photon emission for (n,n*11)



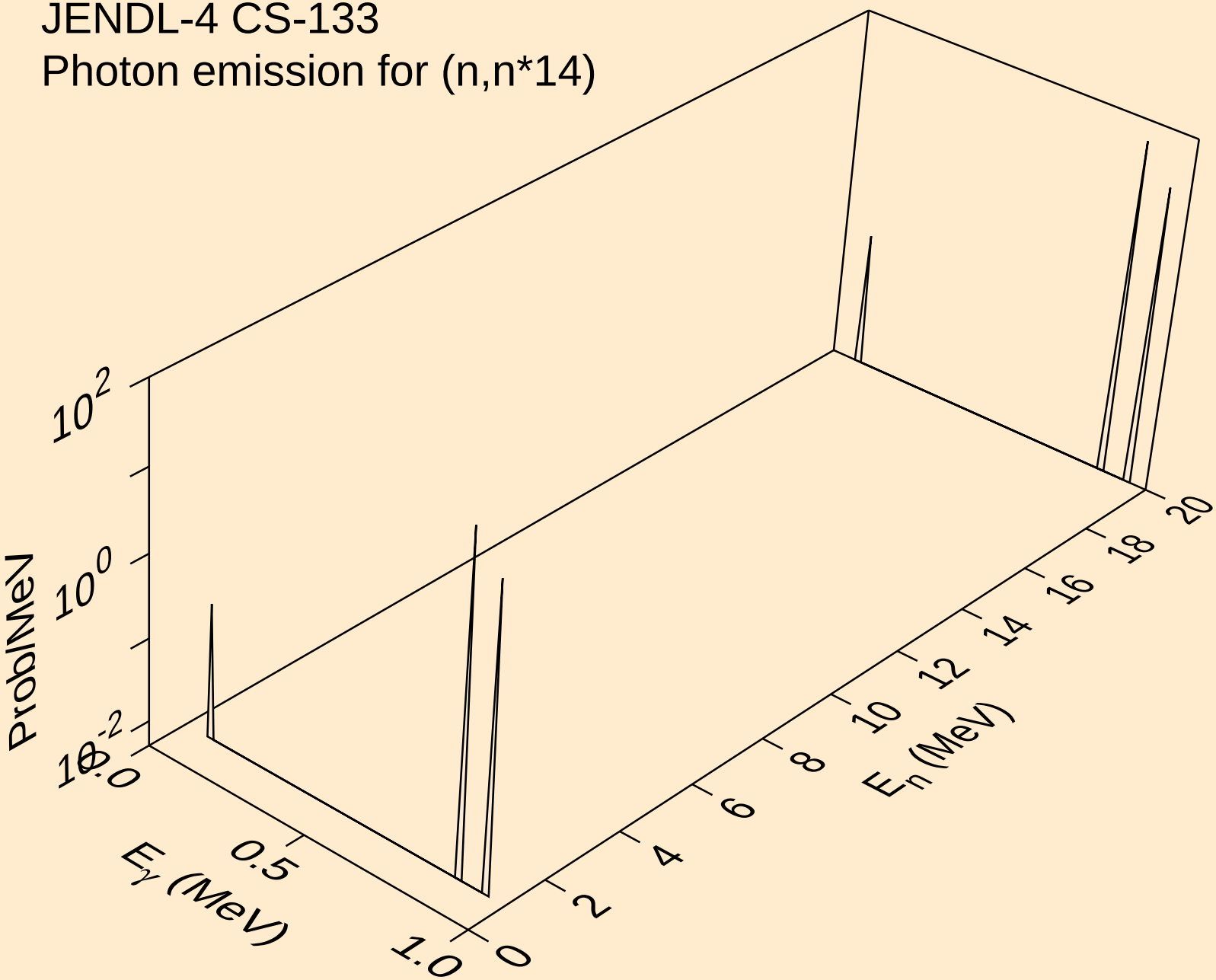
JENDL-4 CS-133
Photon emission for (n,n*12)



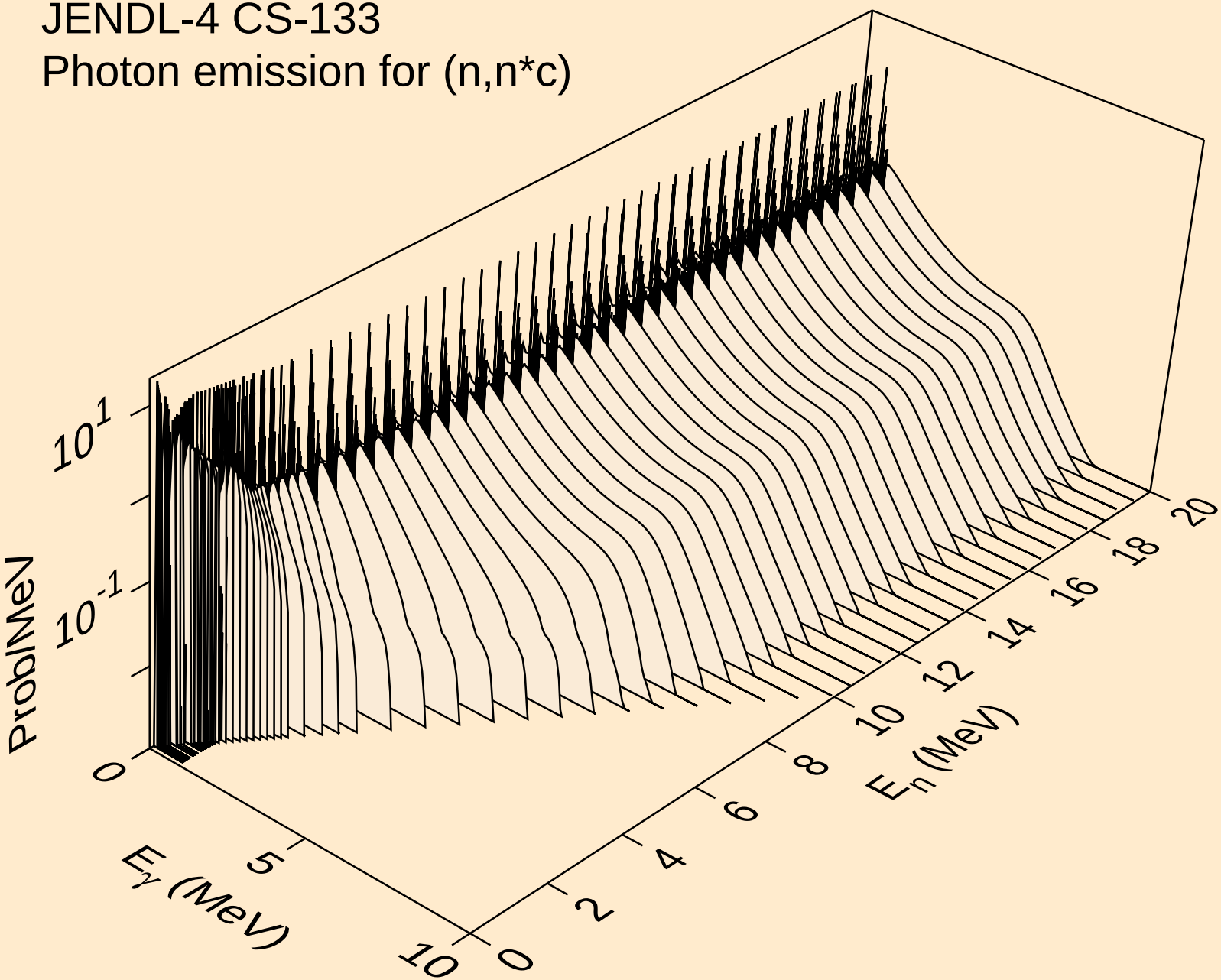
JENDL-4 CS-133
Photon emission for (n,n*13)



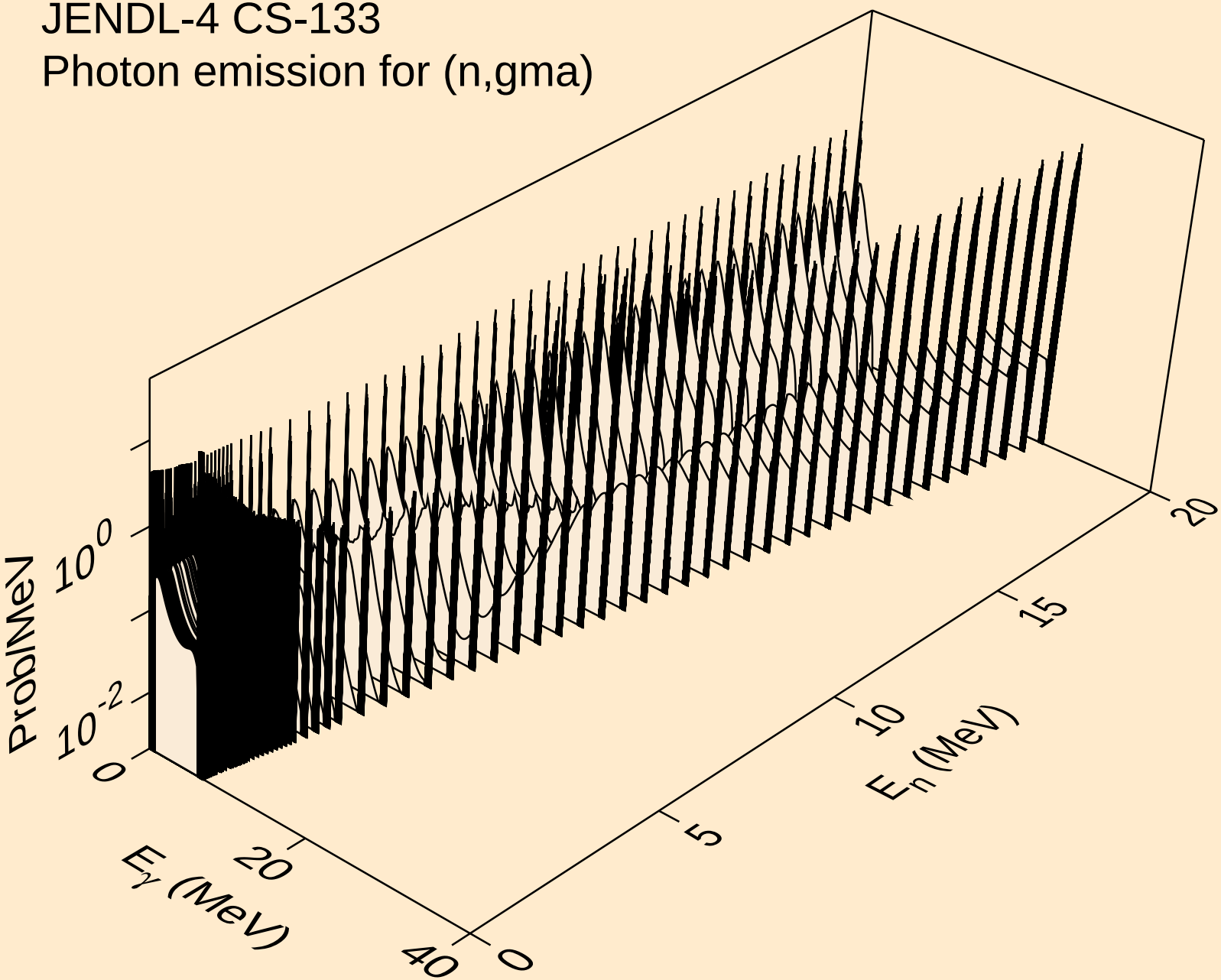
JENDL-4 CS-133
Photon emission for (n,n*14)

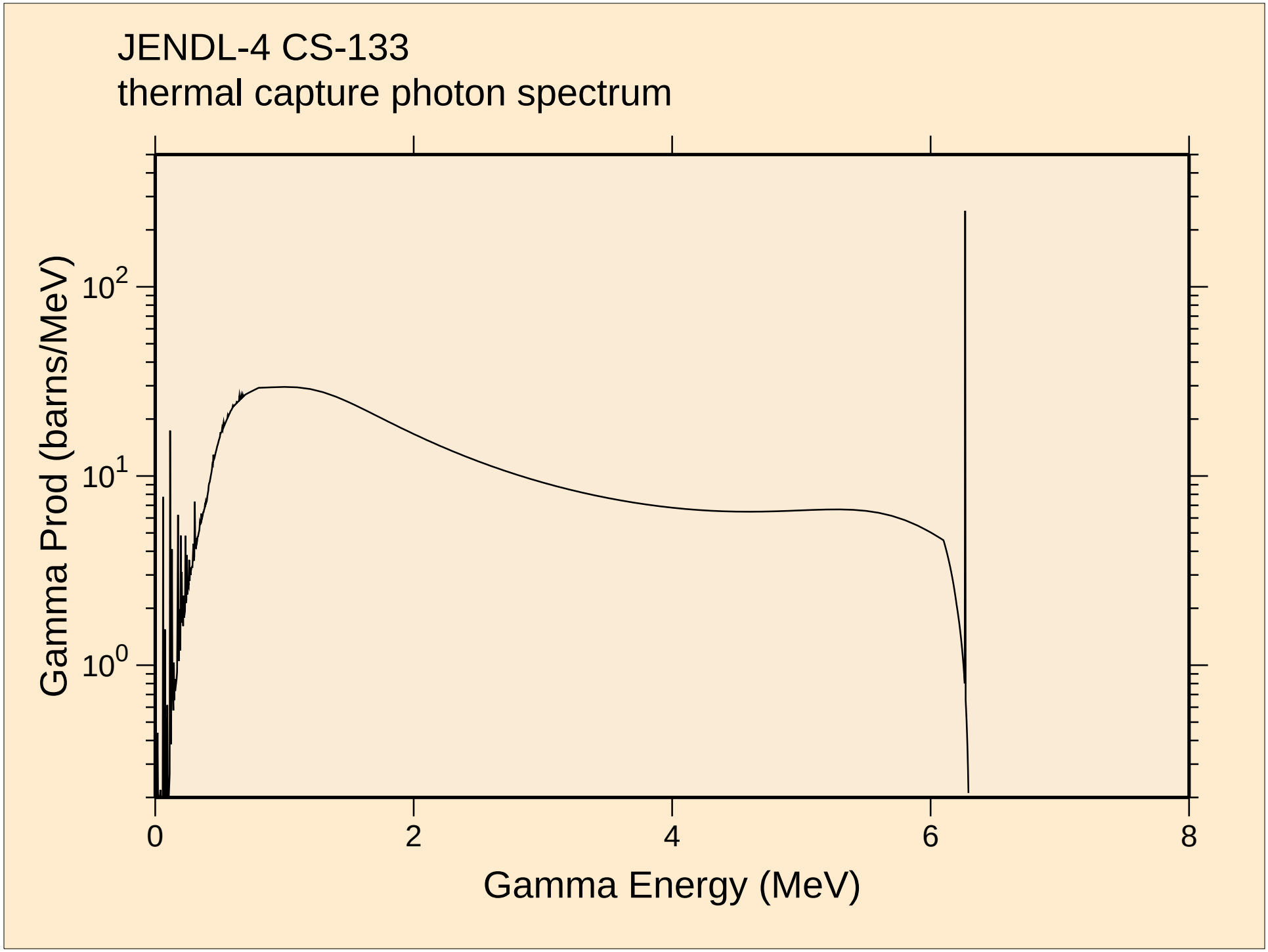


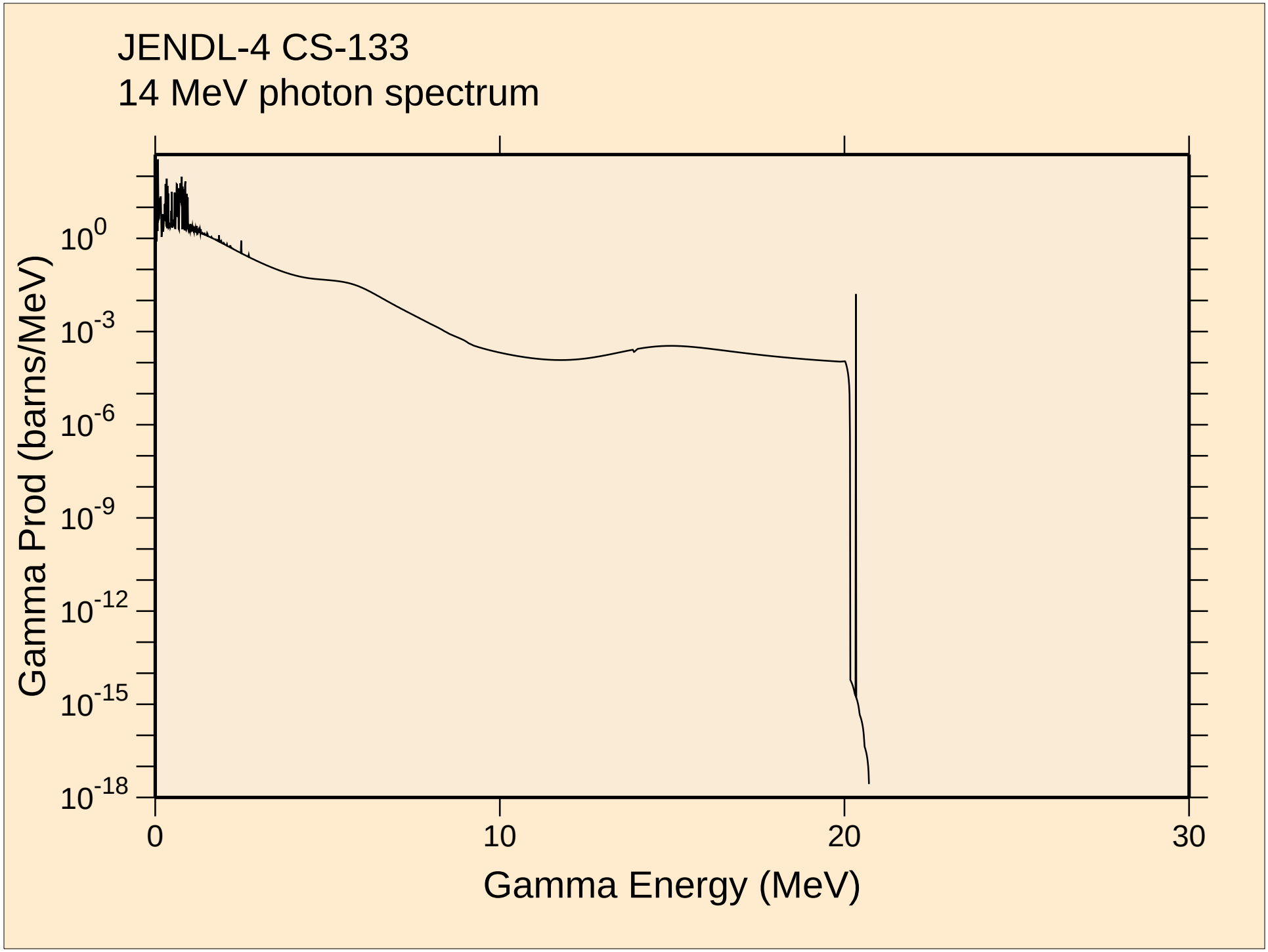
JENDL-4 CS-133
Photon emission for (n,n*c)

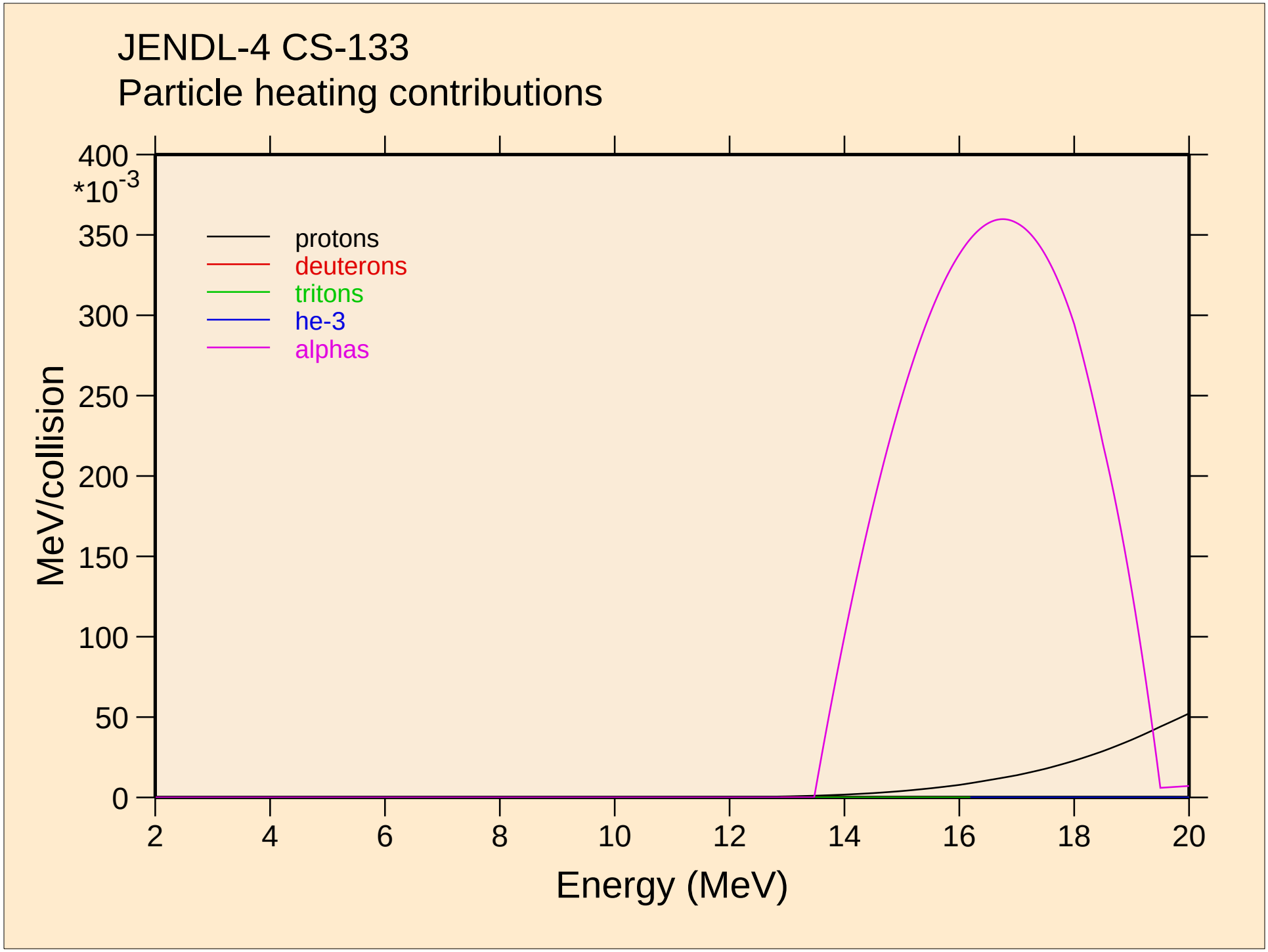


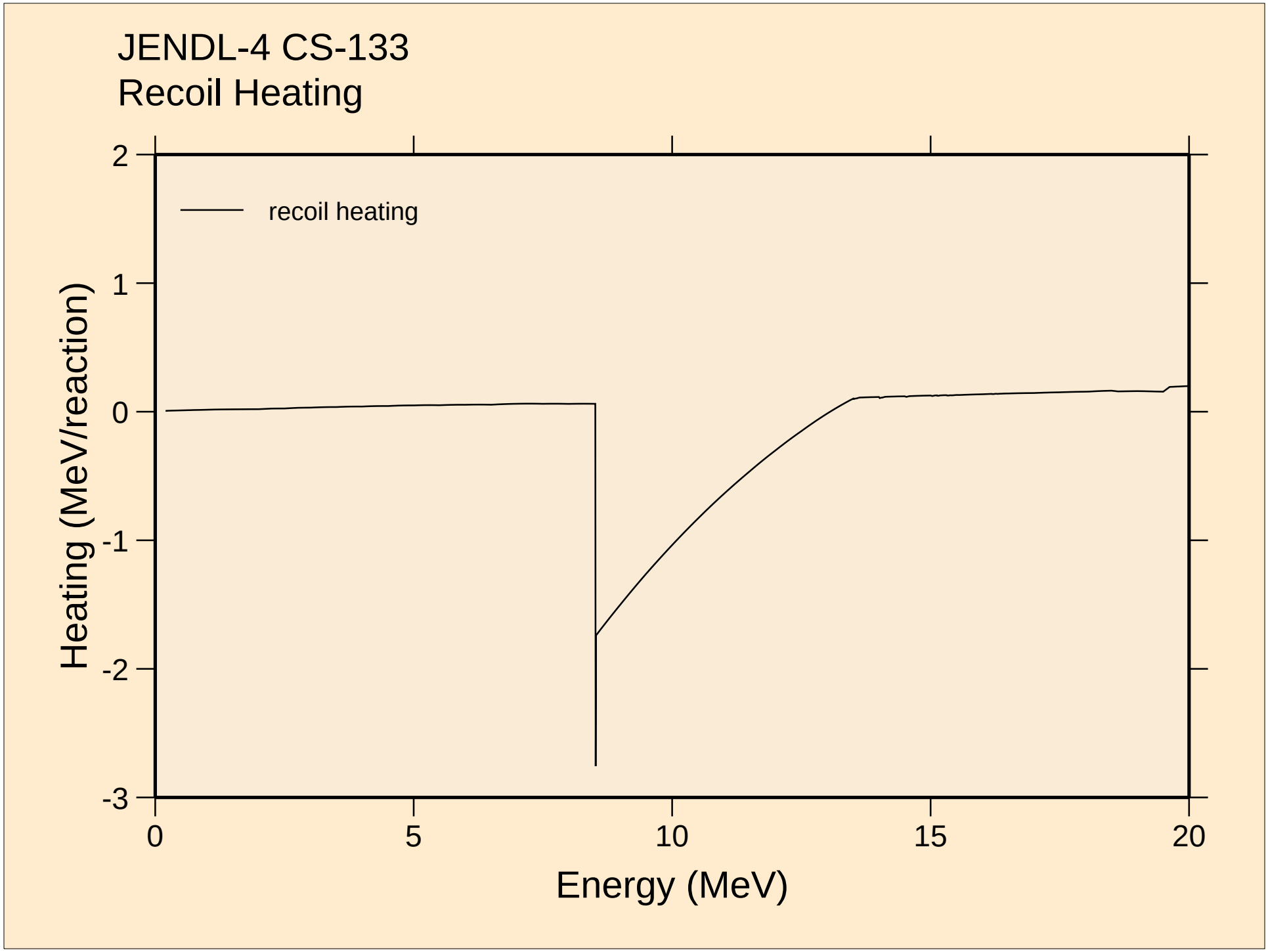
JENDL-4 CS-133
Photon emission for (n,gma)

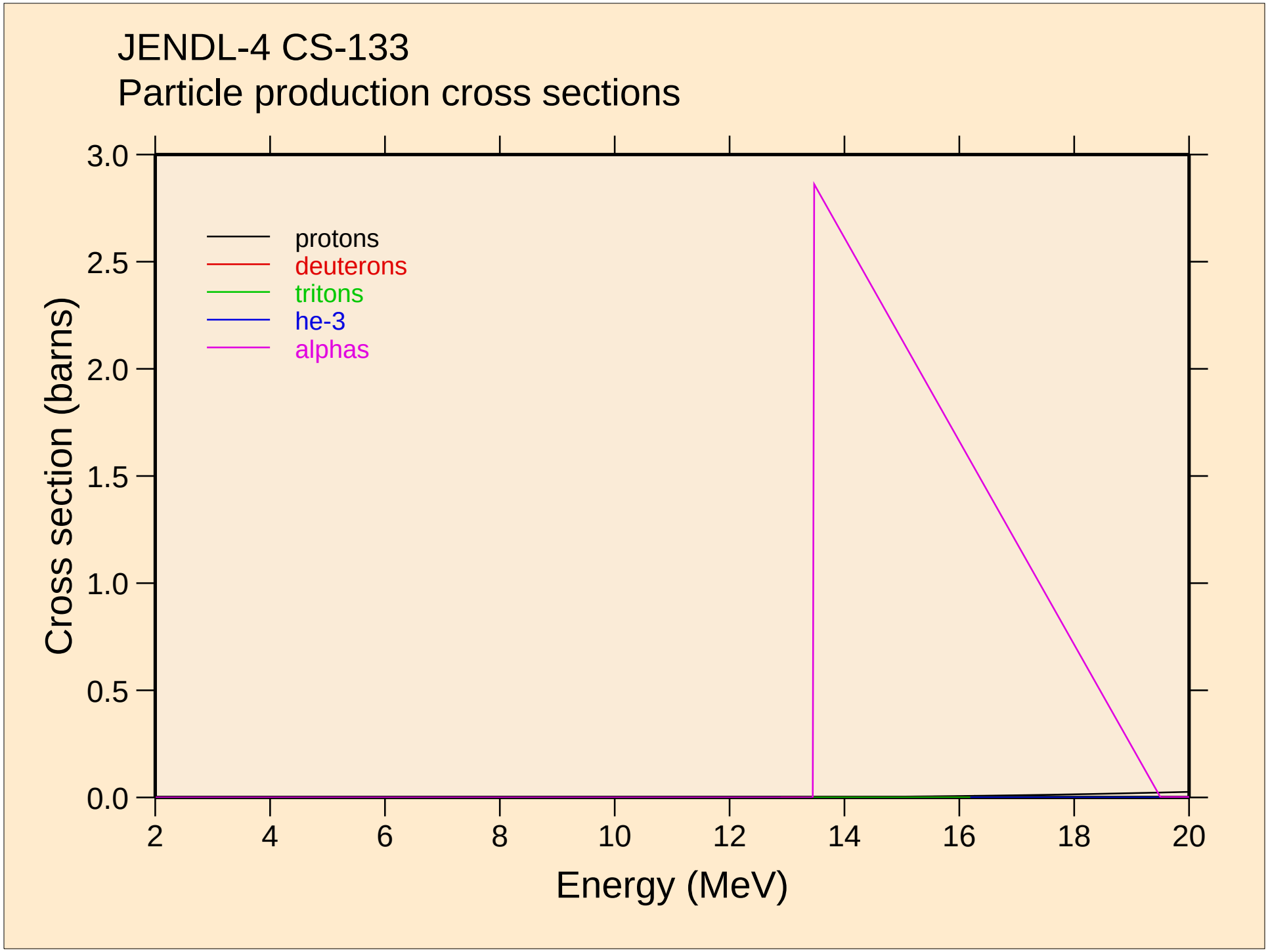


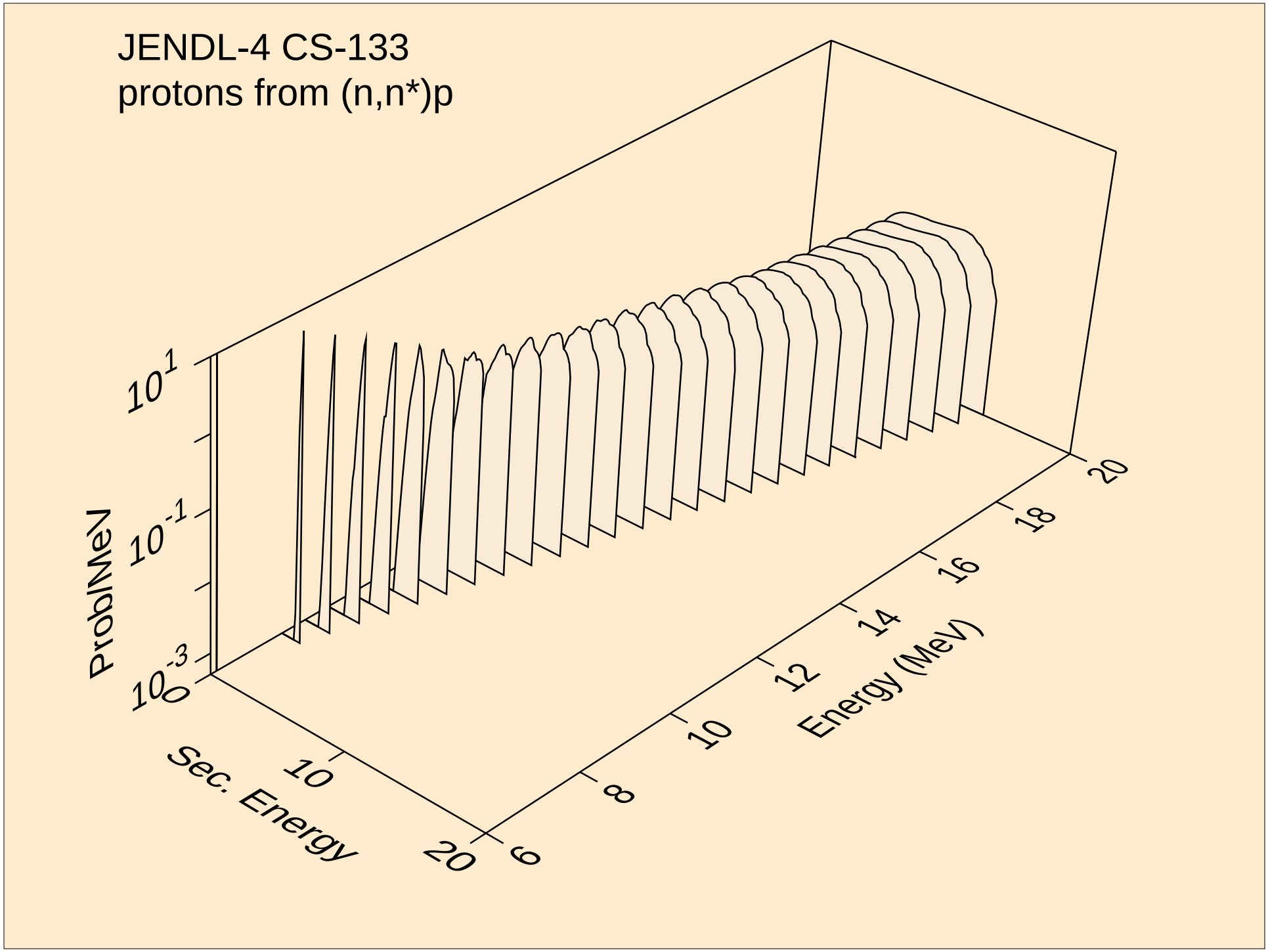

JENDL-4 CS-133
thermal capture photon spectrum
Gamma Prod (barns/MeV)
10^2
10^1
10^0
0
2
4
6
8
Gamma Energy (MeV)

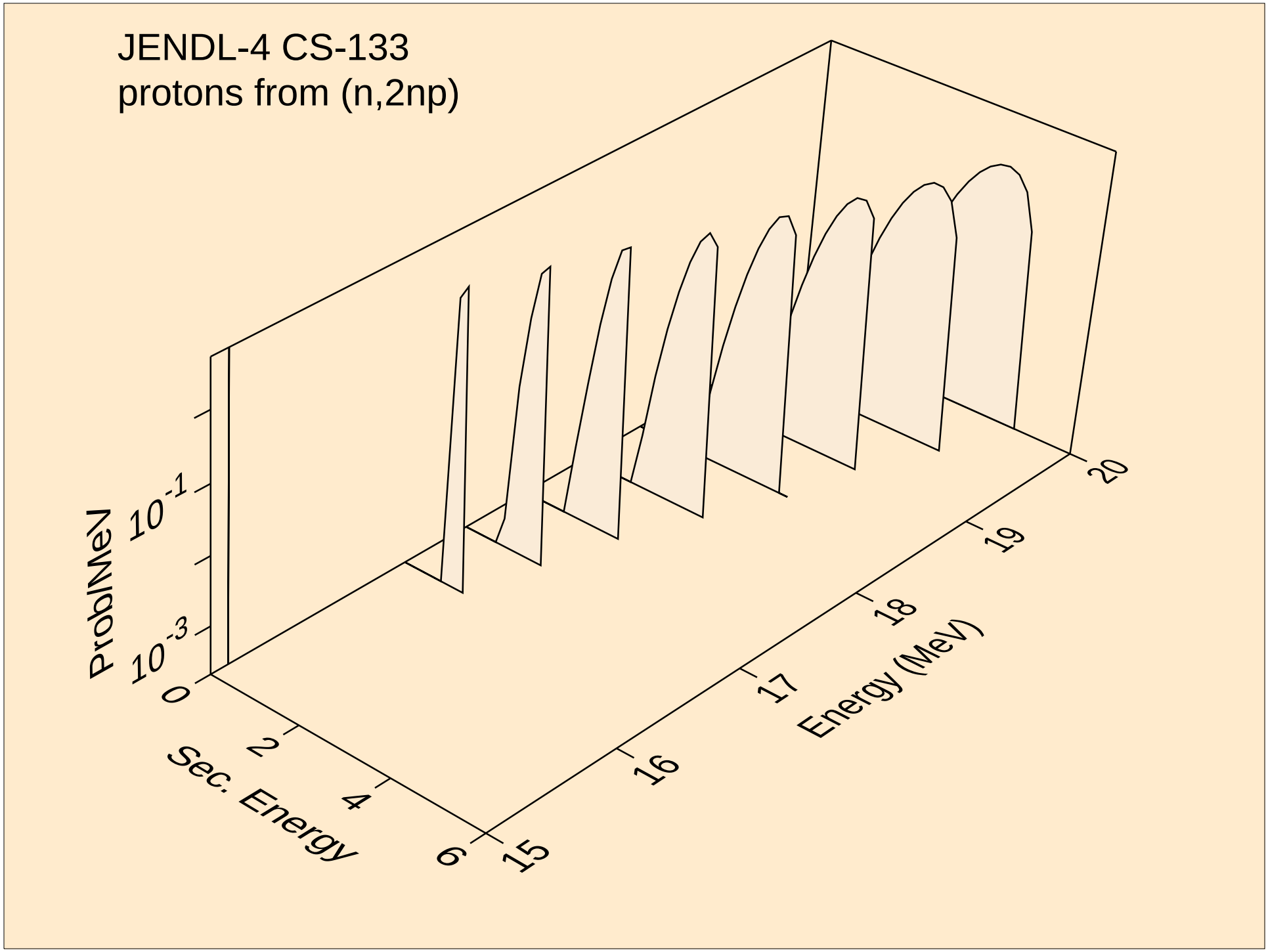

JENDL-4 CS-133
14 MeV photon spectrum
Gamma Prod (barns/MeV)
10^0
10^-3
10^-6
10^-9
10^-12
10^-15
10^-18
0
10
20
30
Gamma Energy (MeV)

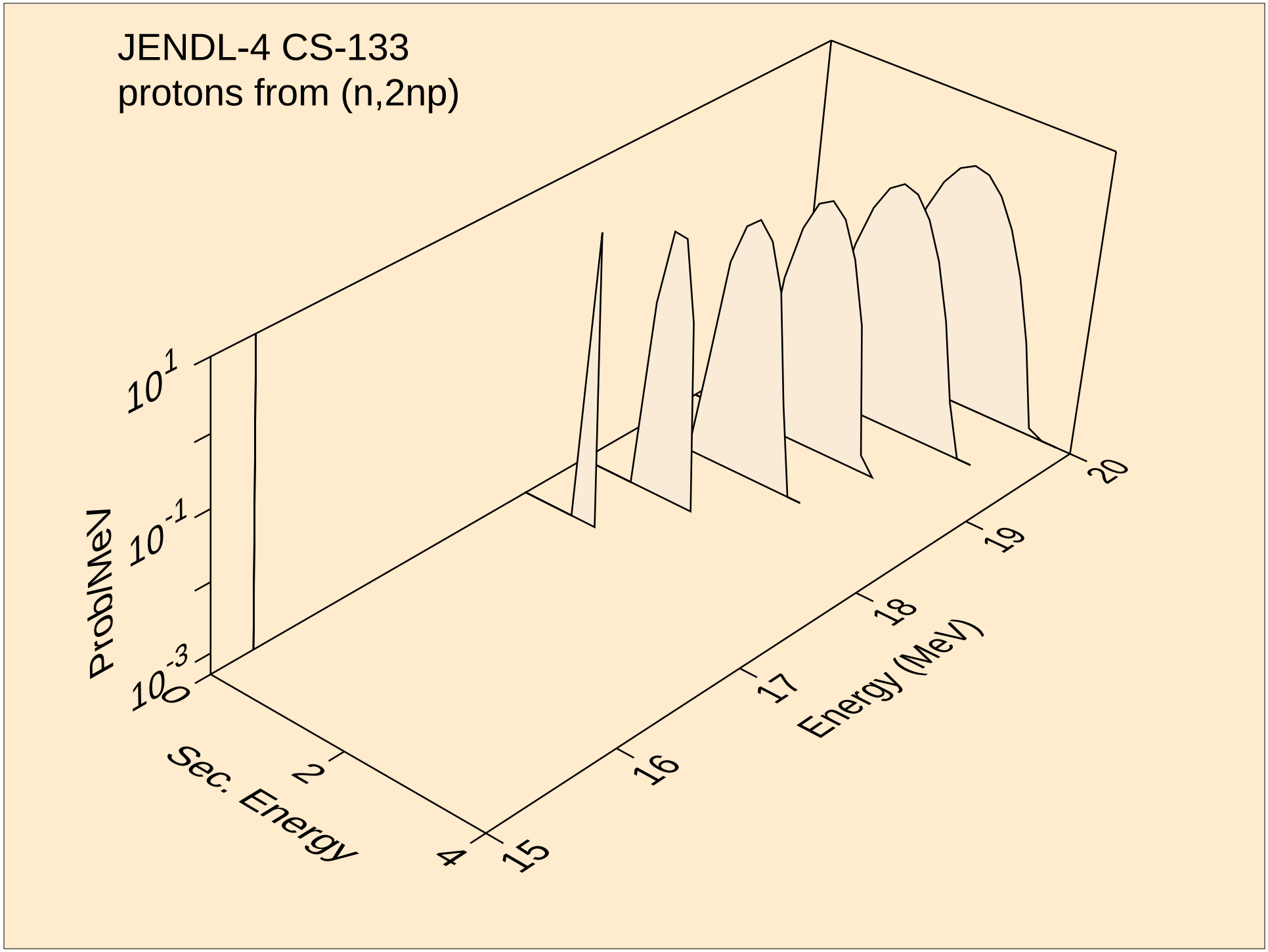

JENDL-4 CS-133
Particle heating contributions
400
*10-3
350
300
250
200
150
100
50
0
MeV/collision
protons
deuterons
tritons
he-3
alphas
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

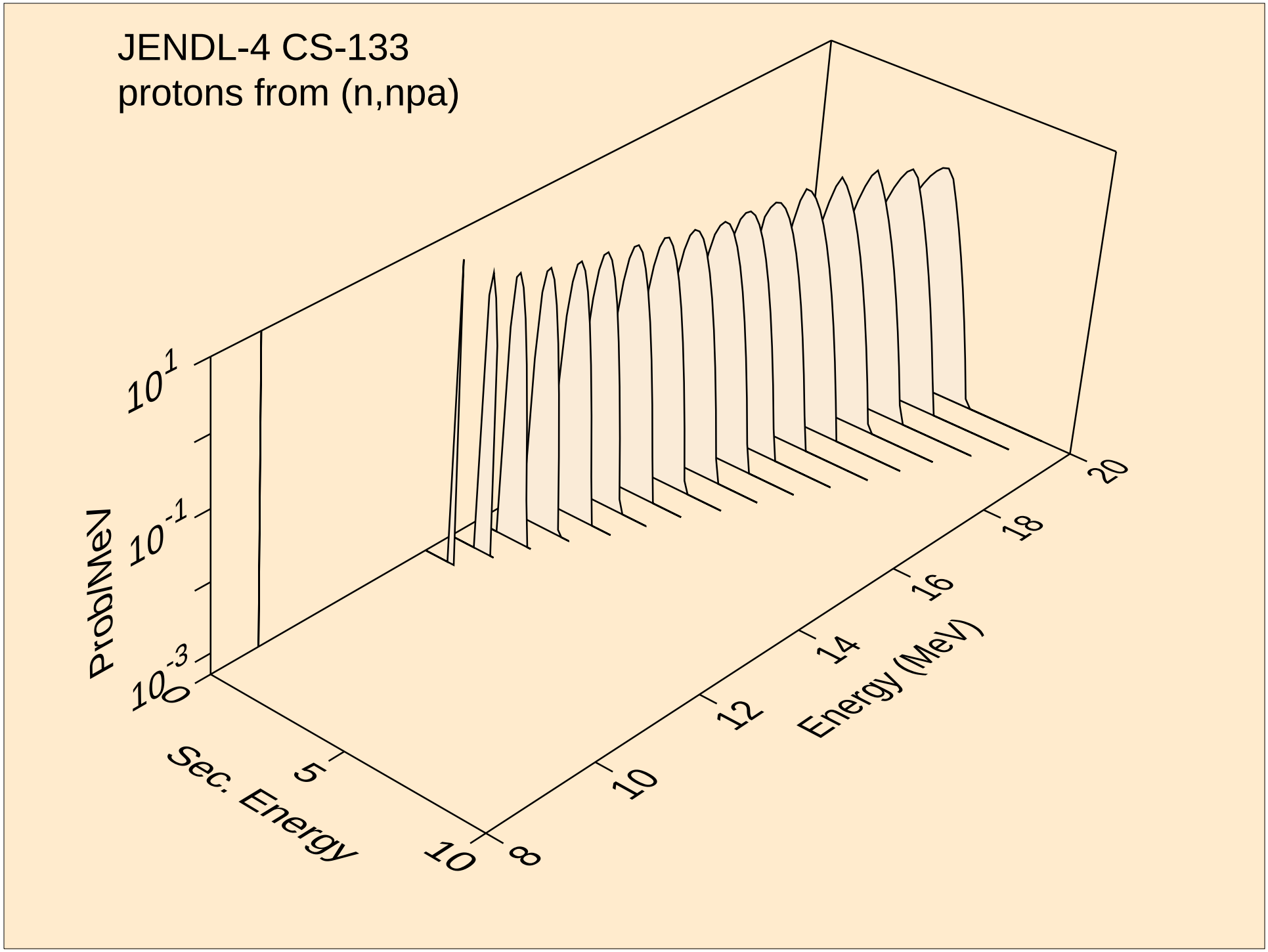

JENDL-4 CS-133
Recoil Heating
recoil heating
Heating (MeV/reaction)
2
1
0
-1
-2
-3
0
5
10
15
20
Energy (MeV)

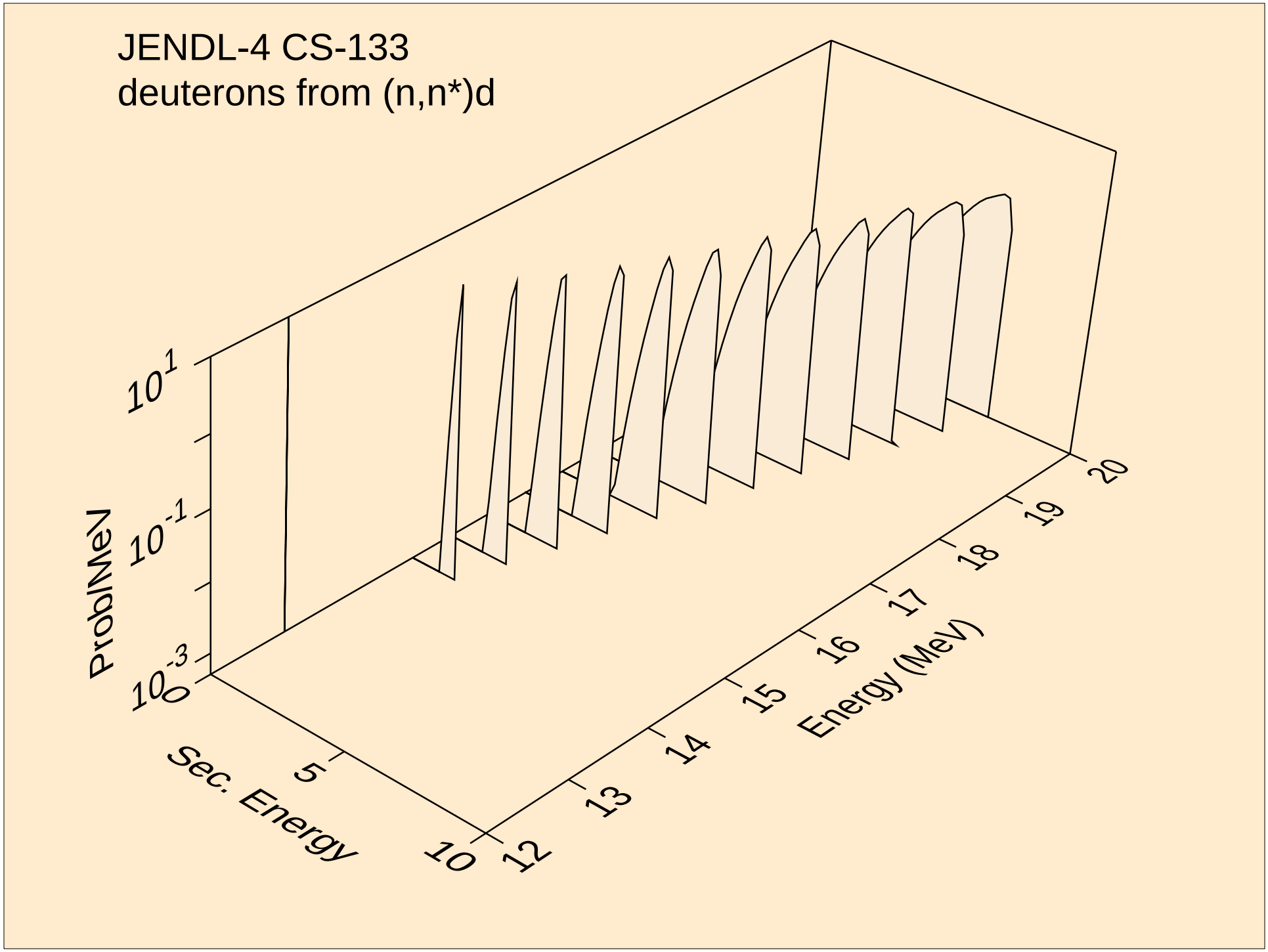

JENDL-4 CS-133
Particle production cross sections
protons
deuterons
tritons
he-3
alphas
Cross section (barns)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

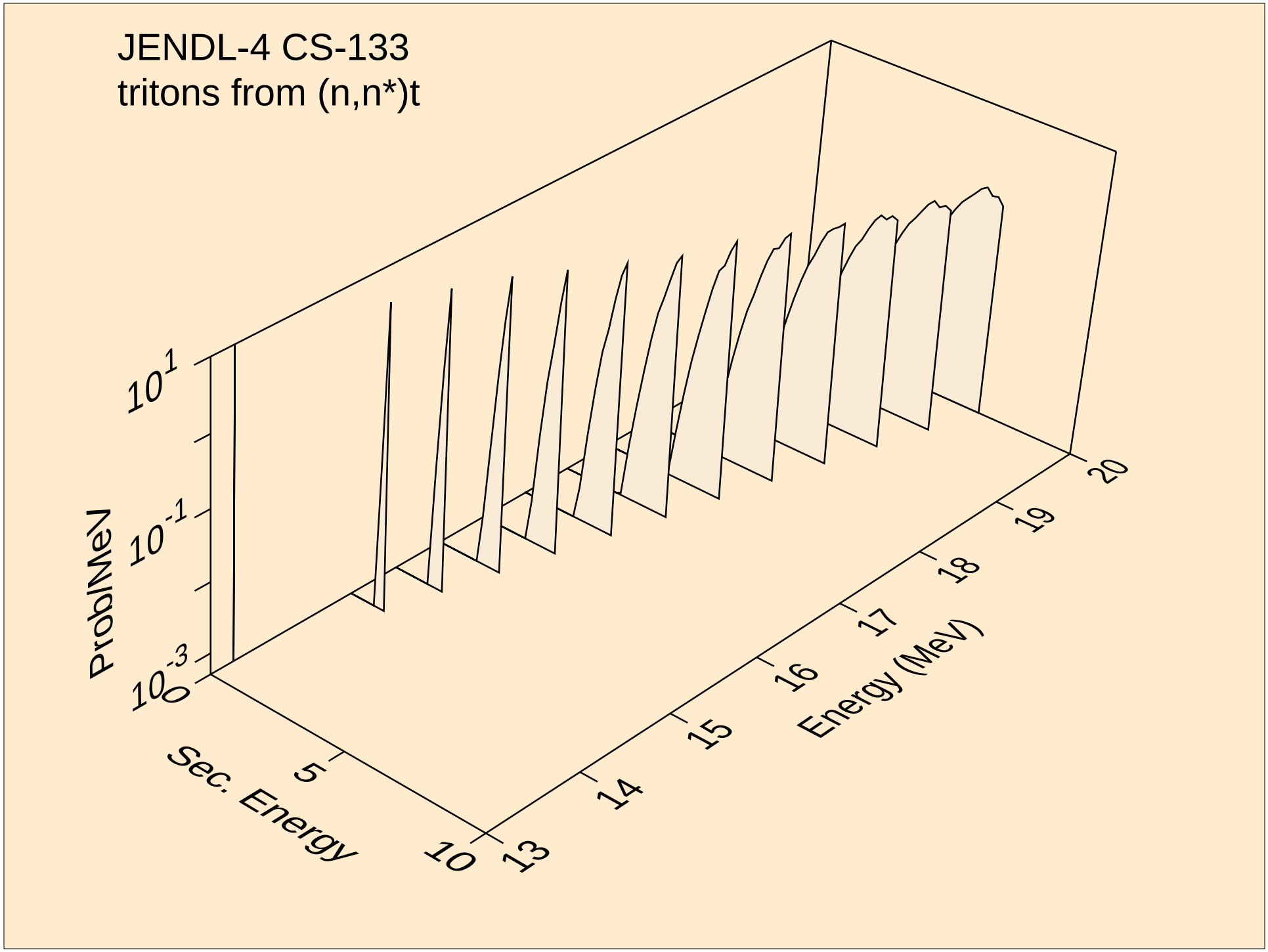

JENDL-4 CS-133
protons from (n,n*)p
Prob/MeV
10^1
10^-1
10^-3
Sec. Energy
0
10
20
Energy (MeV)
6
8
10
12
14
16
18
20

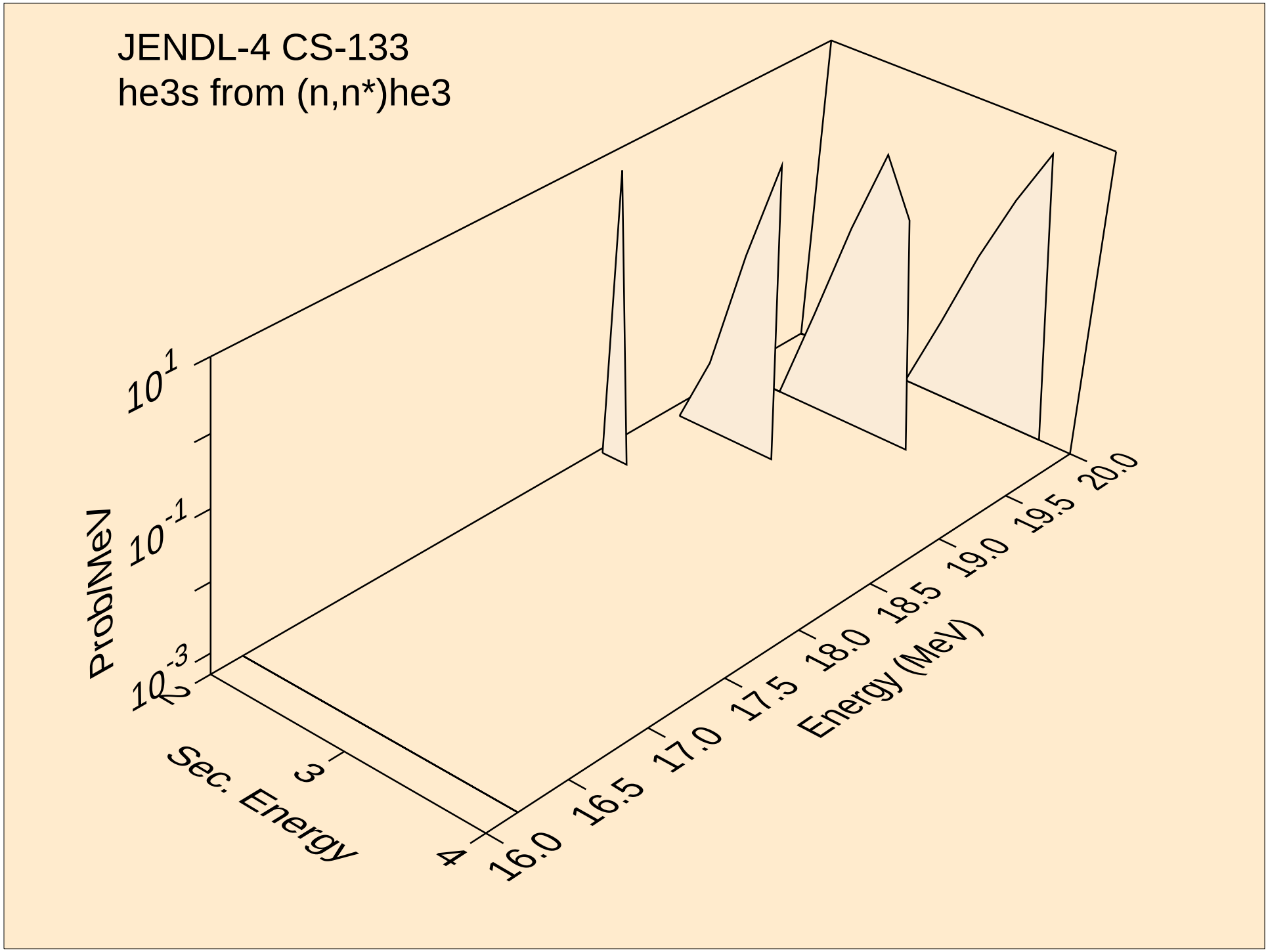

JENDL-4 CS-133
protons from (n,2np)
Prob/MeV
10^-1
10^-3
0
2
4
6
Sec. Energy
15
16
17
18
19
20
Energy (MeV)

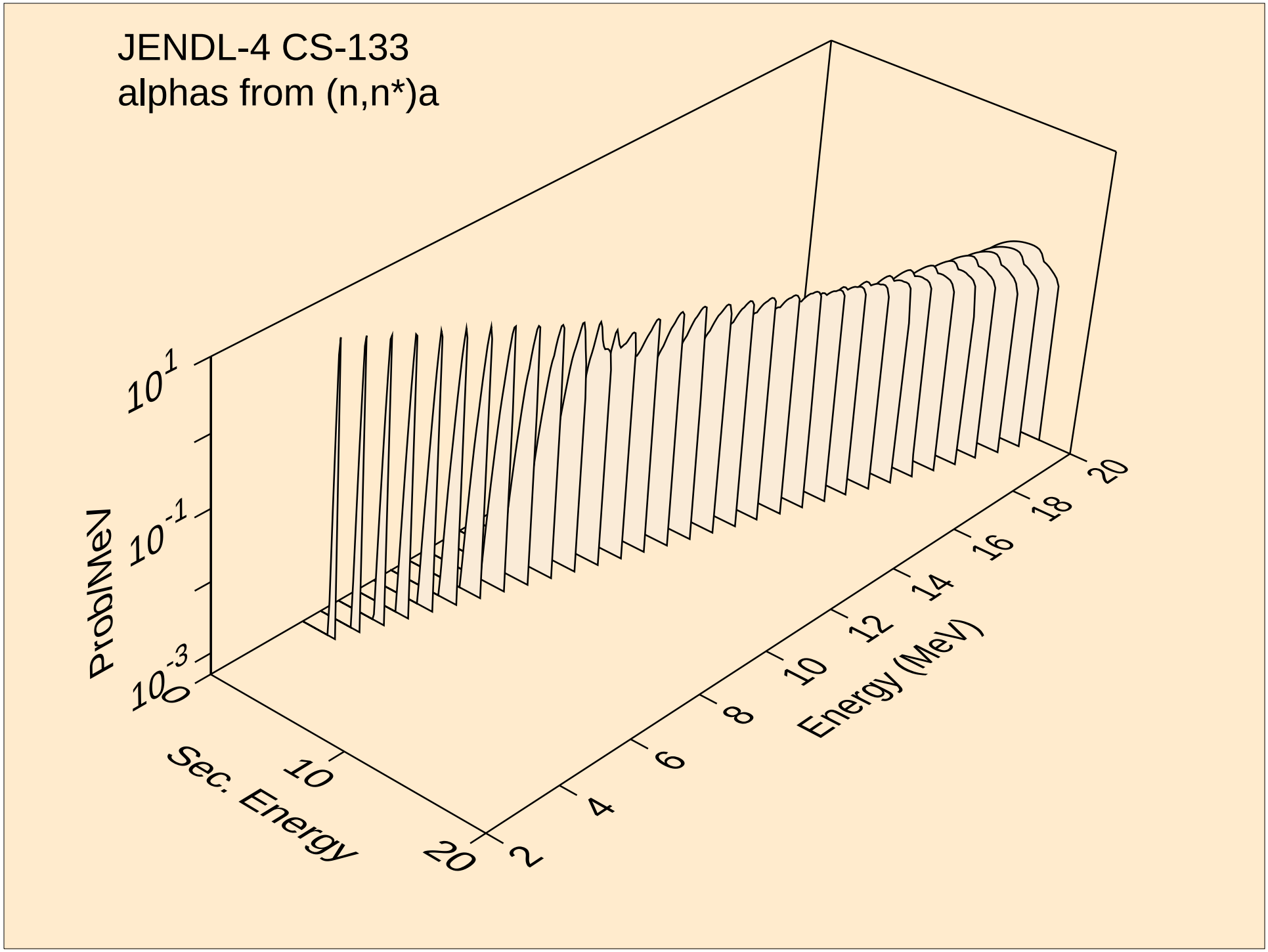

JENDL-4 CS-133
protons from (n,2np)
Prob/MeV
10^{1}
10^{-1}
10^{-3}
Sec. Energy
0
2
4
Energy (MeV)
15
16
17
18
19
20

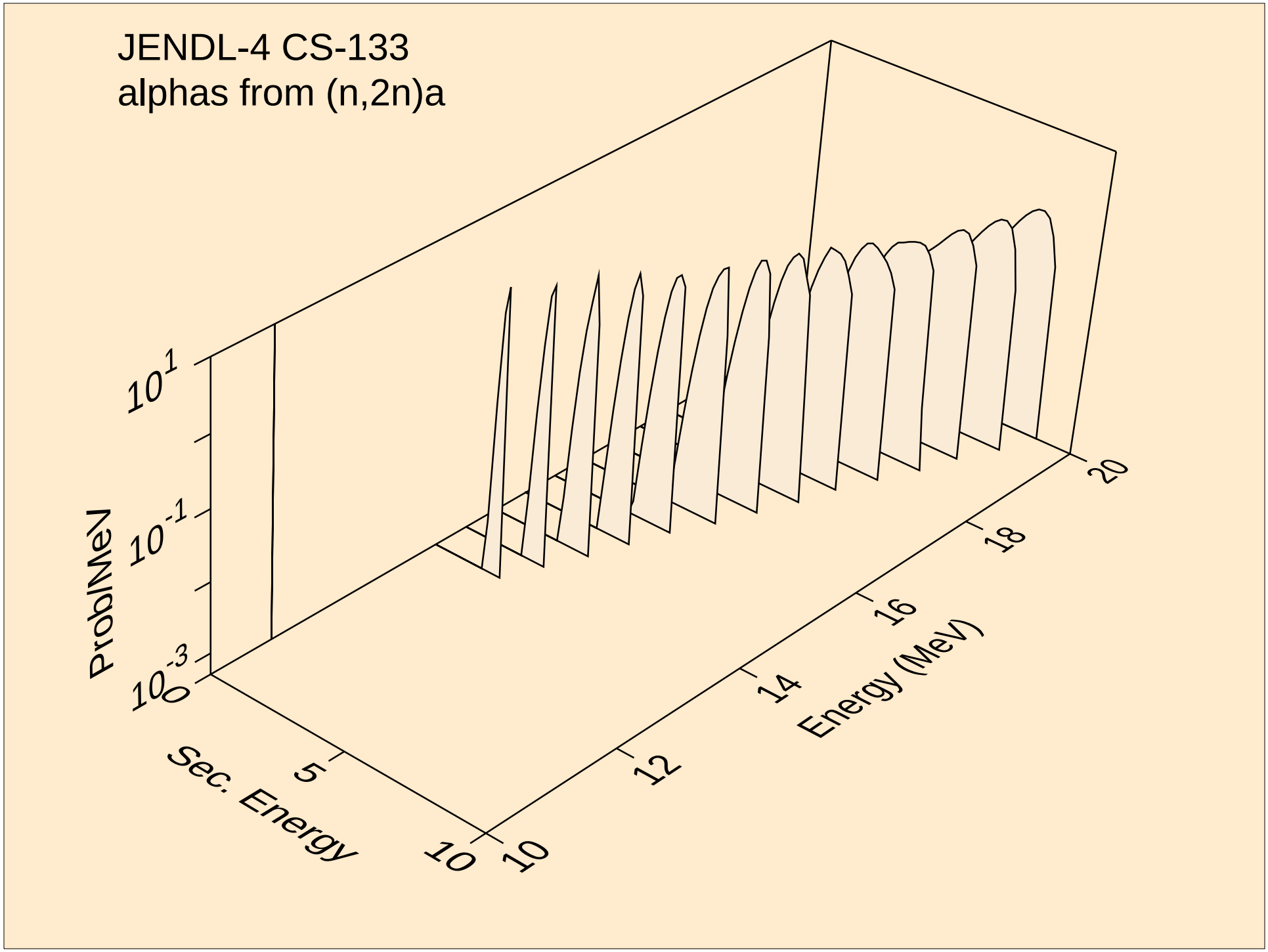

JENDL-4 CS-133
protons from (n,npa)
Prob/MeV
10^{1}
10^{-1}
10^{-3}
Sec. Energy
0
5
10
Energy (MeV)
8
10
12
14
16
18
20

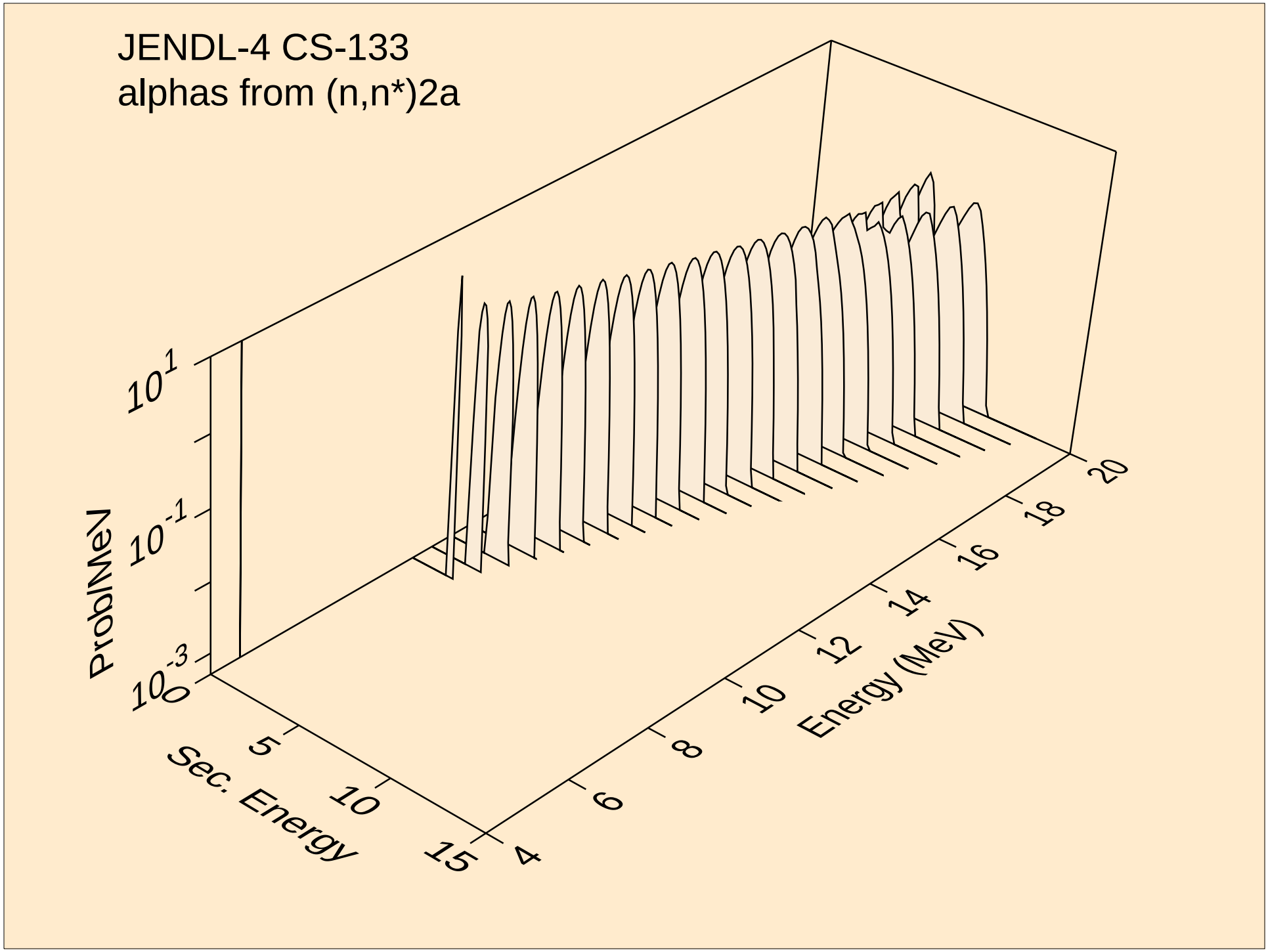

JENDL-4 CS-133
deuterons from (n,n*)d
Prob/MeV
10^1
10^-1
10^-3
Sec. Energy
0
5
10
Energy (MeV)
12
13
14
15
16
17
18
19
20

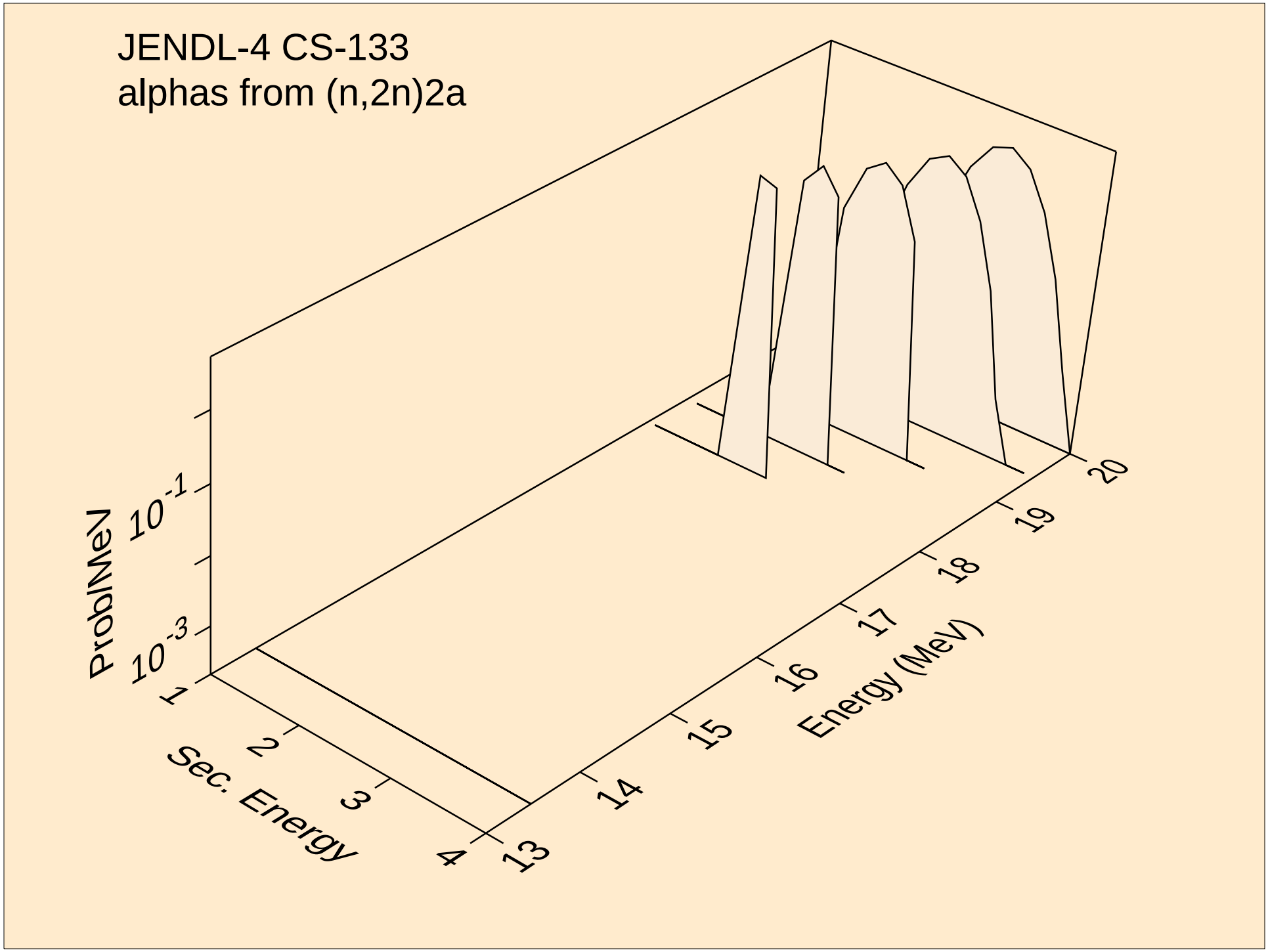

JENDL-4 CS-133
tritons from (n,n*)t
Prob/MeV
10^1
10^-1
10^-3
Sec. Energy
0
5
10
Energy (MeV)
13
14
15
16
17
18
19
20

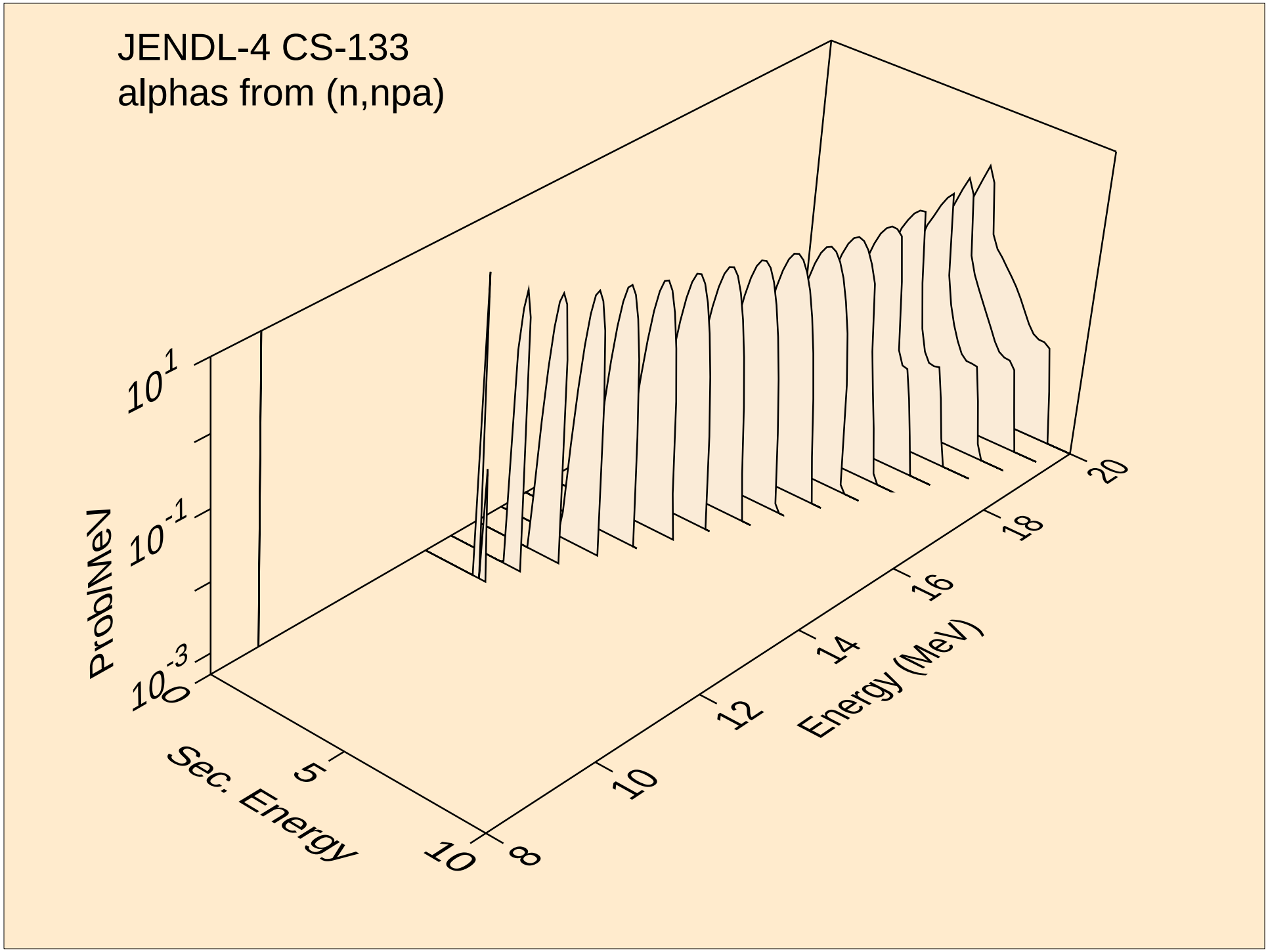

JENDL-4 CS-133
he3s from (n,n*)he3
Prob/MeV
10^1
10^-1
10^-3
Sec. Energy
3
4
16.0
16.5
17.0
17.5
18.0
18.5
19.0
19.5
20.0
Energy (MeV)


JENDL-4 CS-133
alphas from (n,n*)a
Prob/MeV
10^1
10^-1
10^-3
Sec. Energy
0
10
20
Energy (MeV)
2
4
6
8
10
12
14
16
18
20


JENDL-4 CS-133
alphas from (n,2n)a
Prob/MeV
10^1
10^-1
10^-3
Sec. Energy
0
5
10
Energy (MeV)
10
12
14
16
18
20


JENDL-4 CS-133
alphas from (n,n*)2a
Prob/MeV
10^1
10^-1
10^-3
Sec. Energy
0
5
10
15
Energy (MeV)
4
6
8
10
12
14
16
18
20


JENDL-4 CS-133
alphas from (n,2n)2a
Prob/MeV
10^-1
10^-3
Sec. Energy
1
2
3
4
Energy (MeV)
13
14
15
16
17
18
19
20


JENDL-4 CS-133
alphas from (n,npa)
Prob/MeV
10^1
10^-1
10^-3
Sec. Energy
0
5
10
Energy (MeV)
8
10
12
14
16
18
20