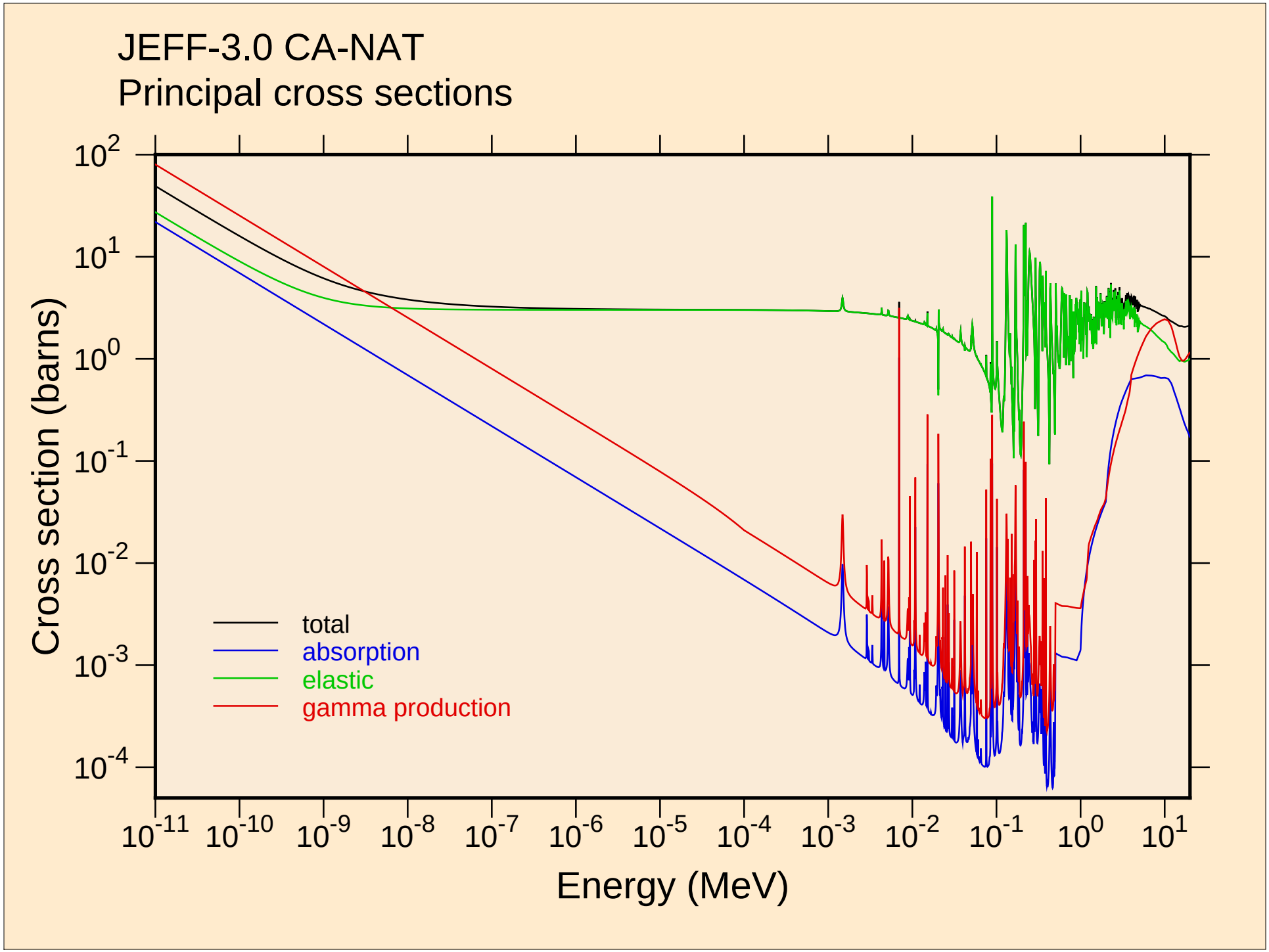
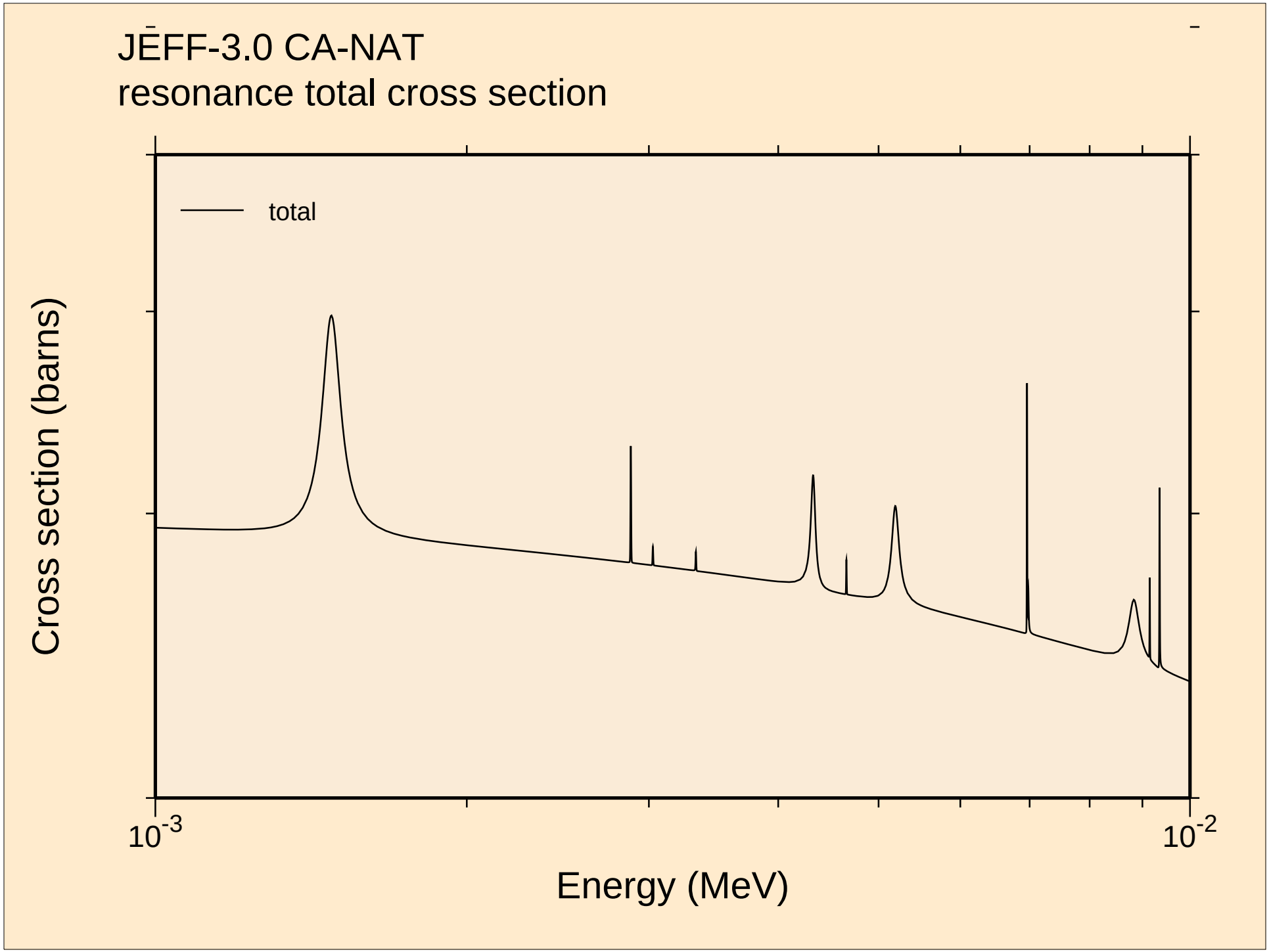
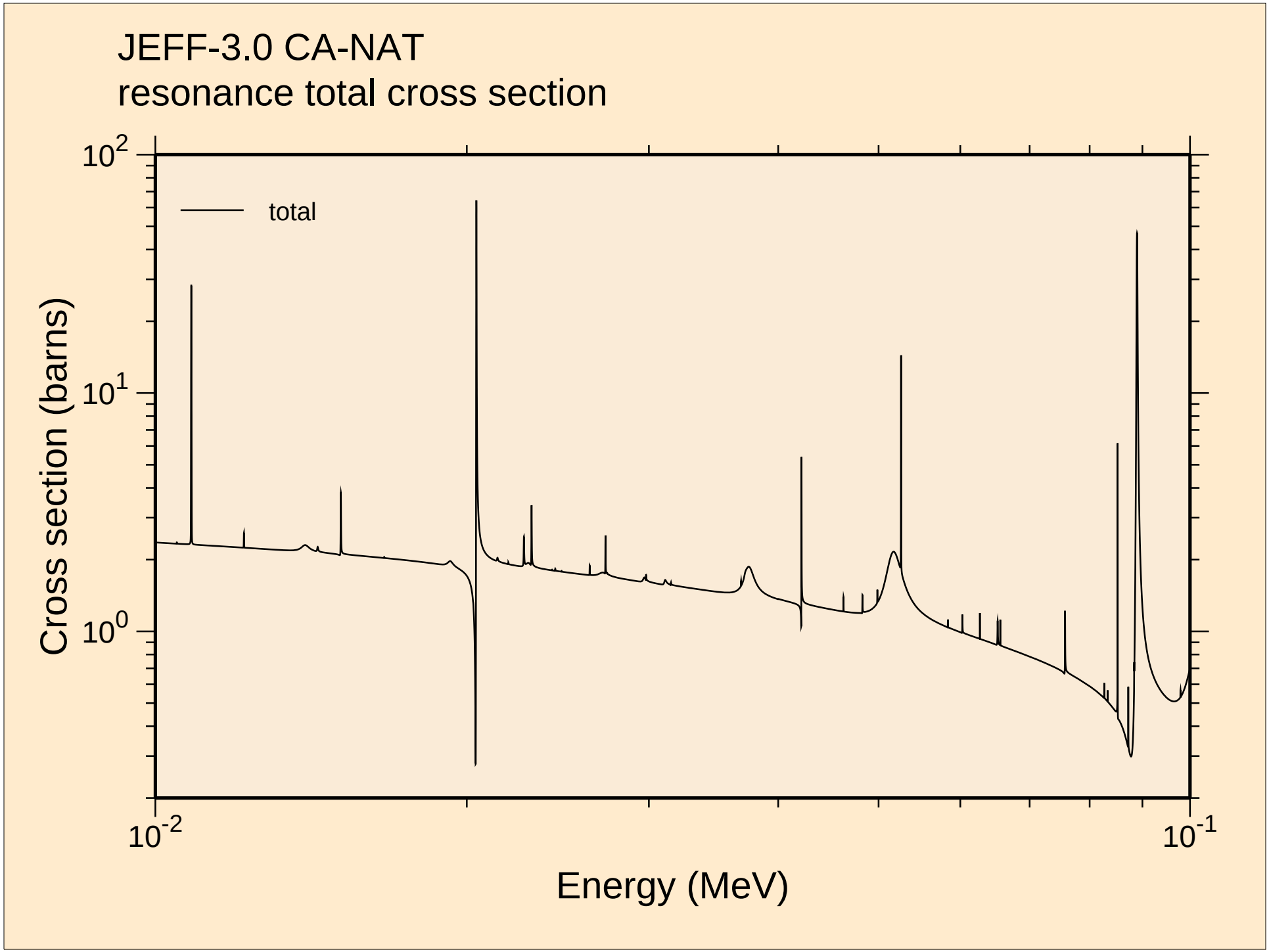
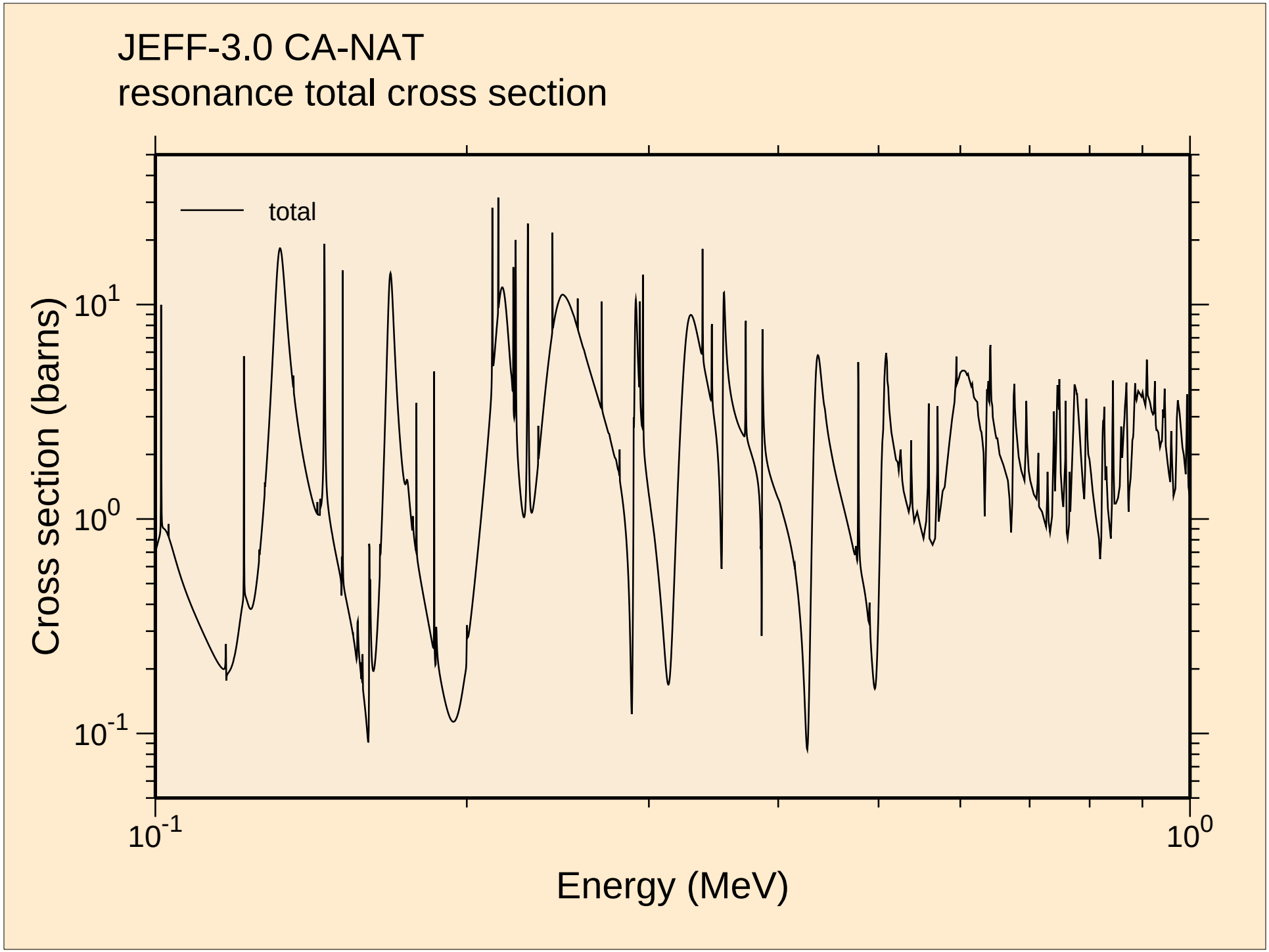
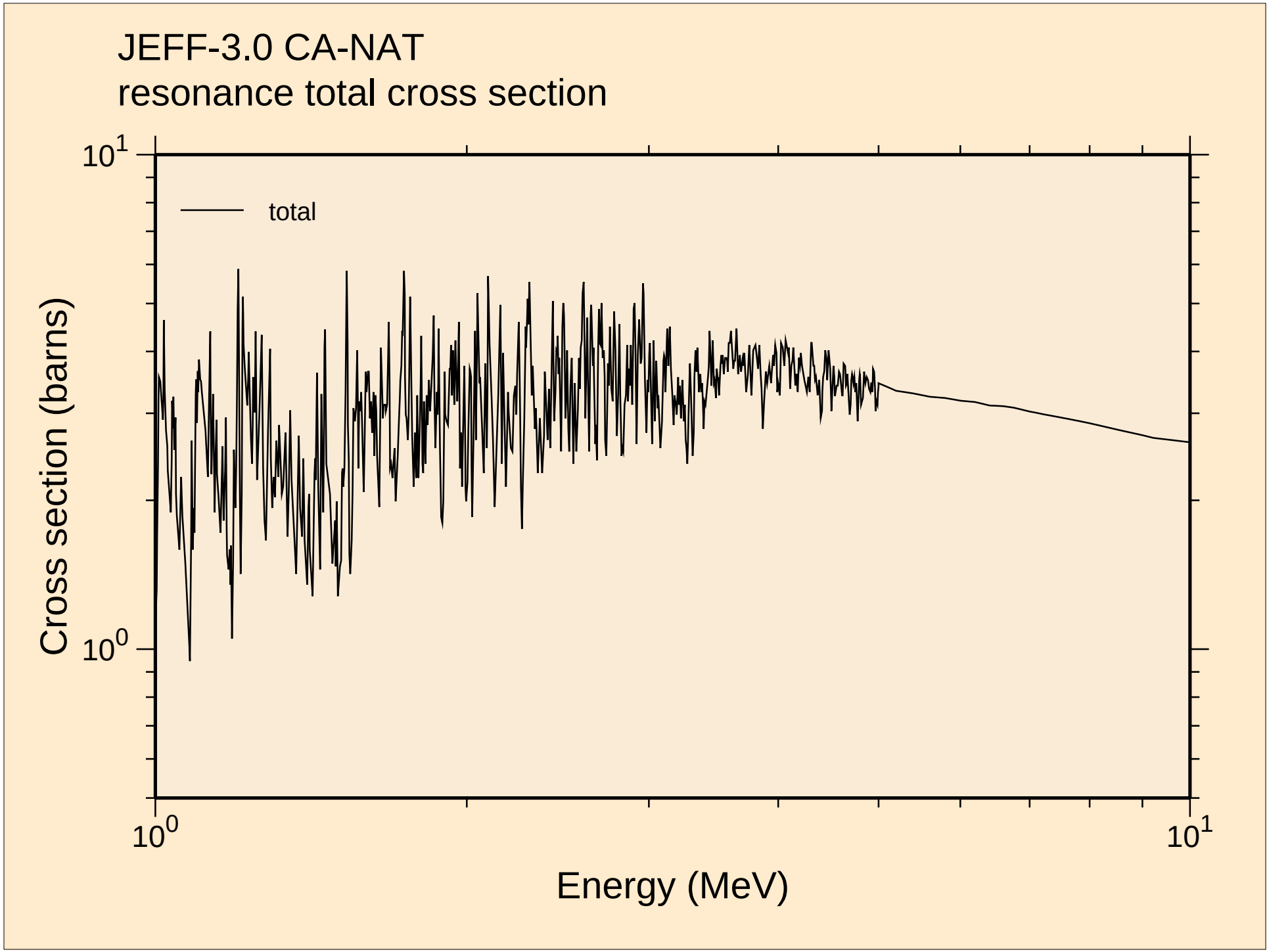

JEFF-3.0 CA-NAT
Principal cross sections
Cross section (barns)
Energy (MeV)
total
absorption
elastic
gamma production

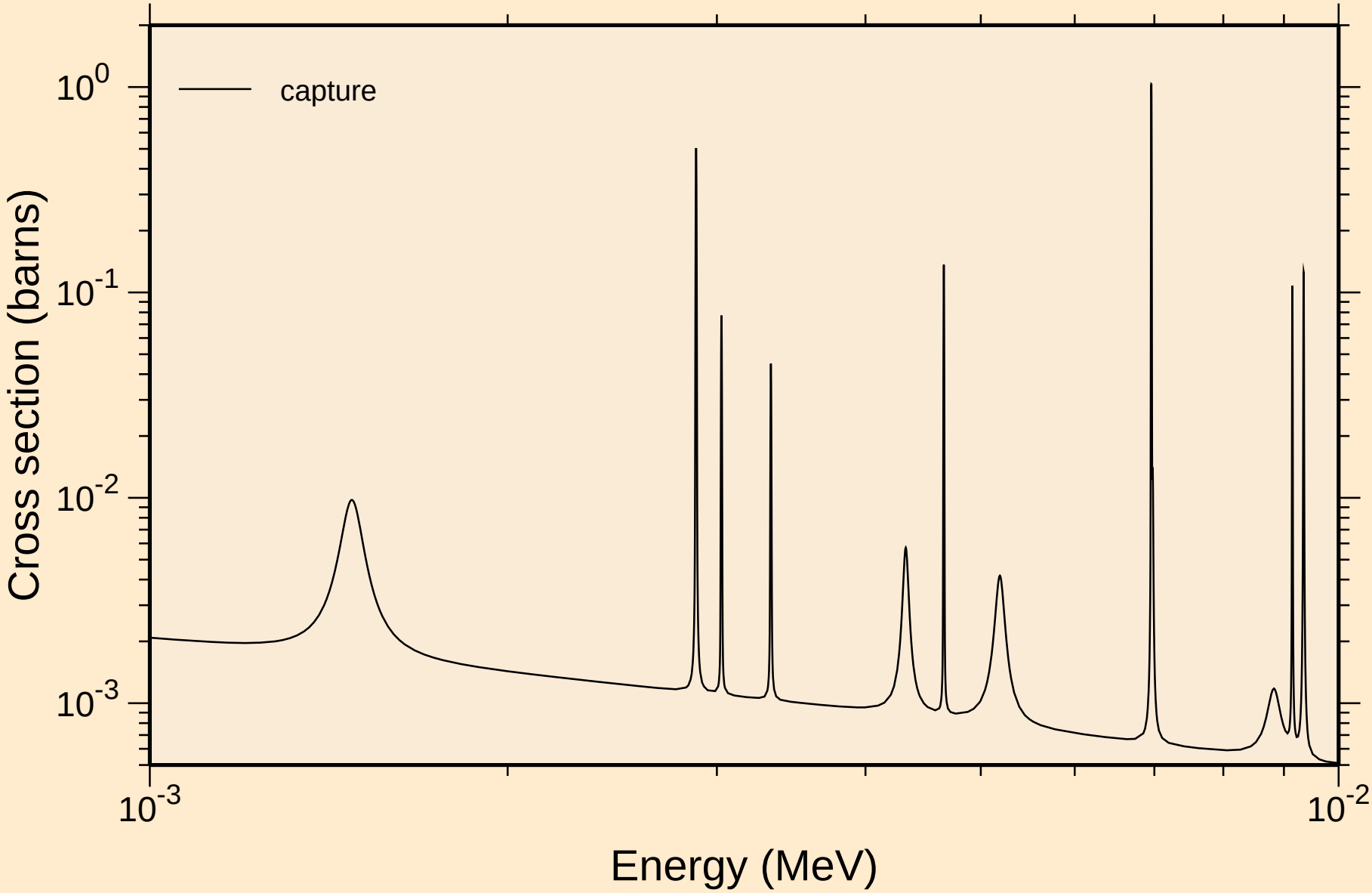

JĒFF-3.0 CA-NAT
resonance total cross section
total
Cross section (barns)
10-3
10-2
Energy (MeV)


JEFF-3.0 CA-NAT
resonance total cross section
total
Cross section (barns)
$10^2$
$10^1$
$10^0$
$10^{-2}$
$10^{-1}$
Energy (MeV)

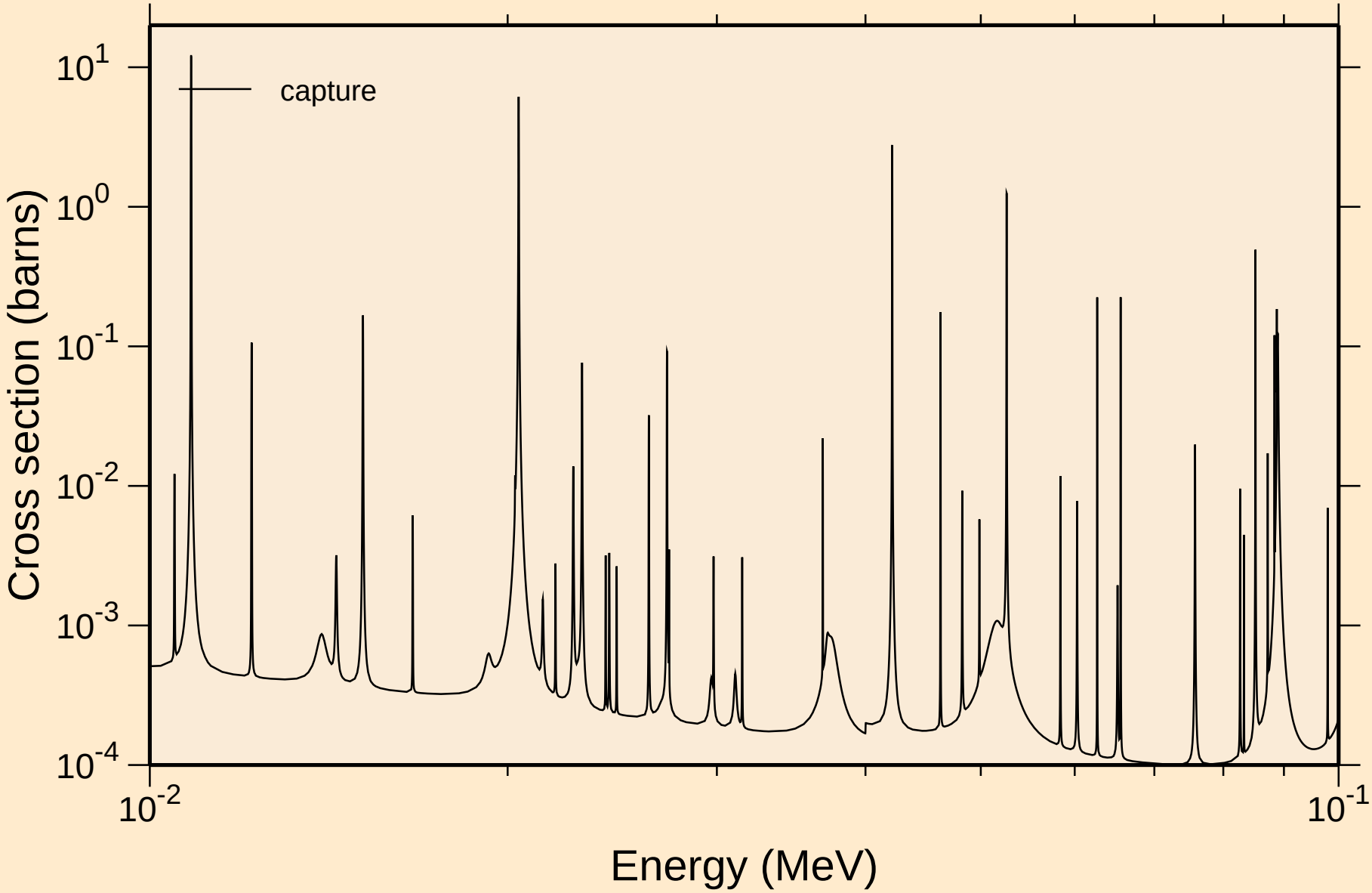

JEFF-3.0 CA-NAT
resonance total cross section
total
Cross section (barns)
10^1
10^0
10^-1
10^-1
10^0
Energy (MeV)

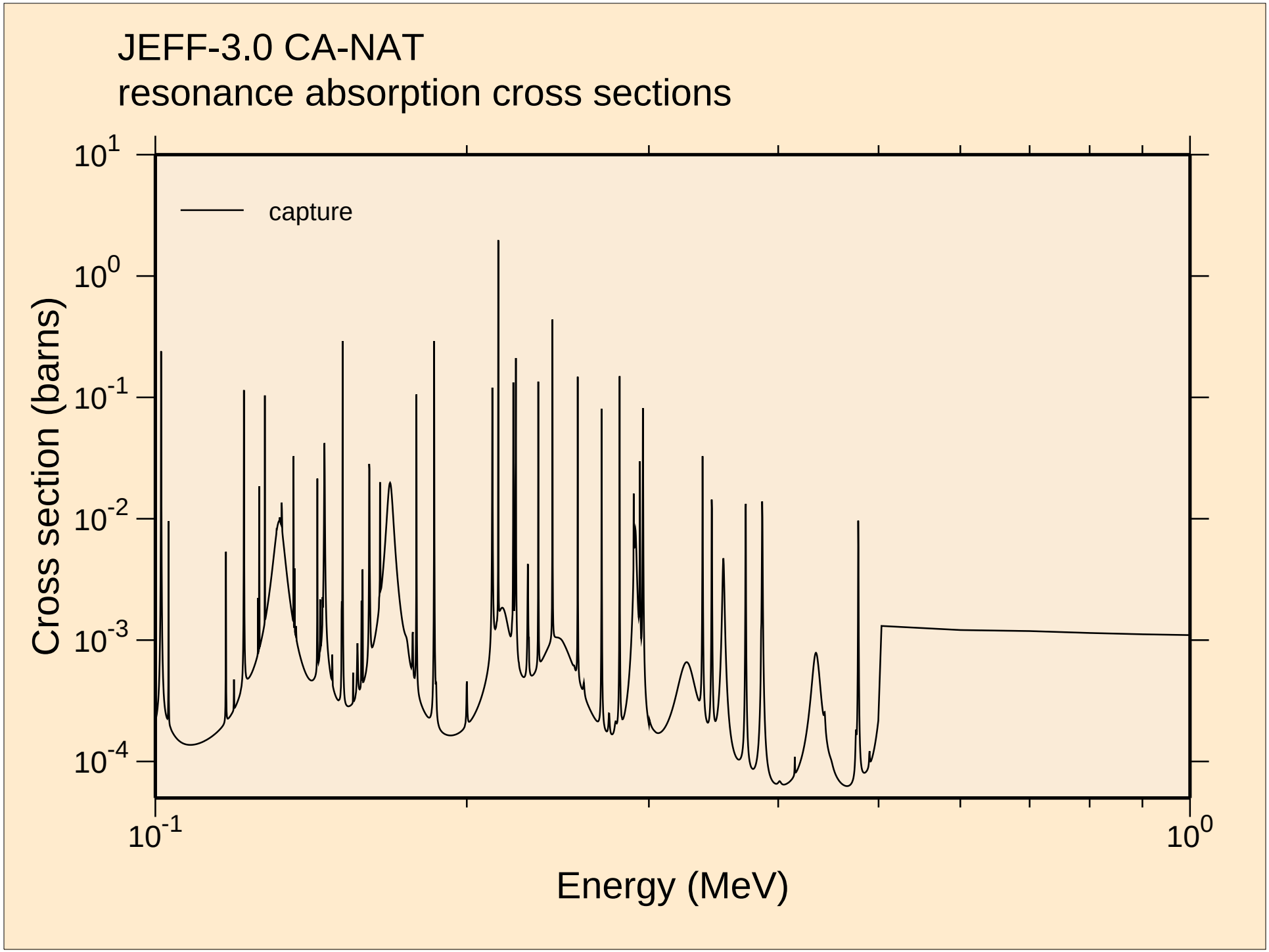

JEFF-3.0 CA-NAT
resonance total cross section
total
Cross section (barns)
$10^1$
$10^0$
$10^0$
$10^1$
Energy (MeV)

JEFF-3.0 CA-NAT
resonance absorption cross sections

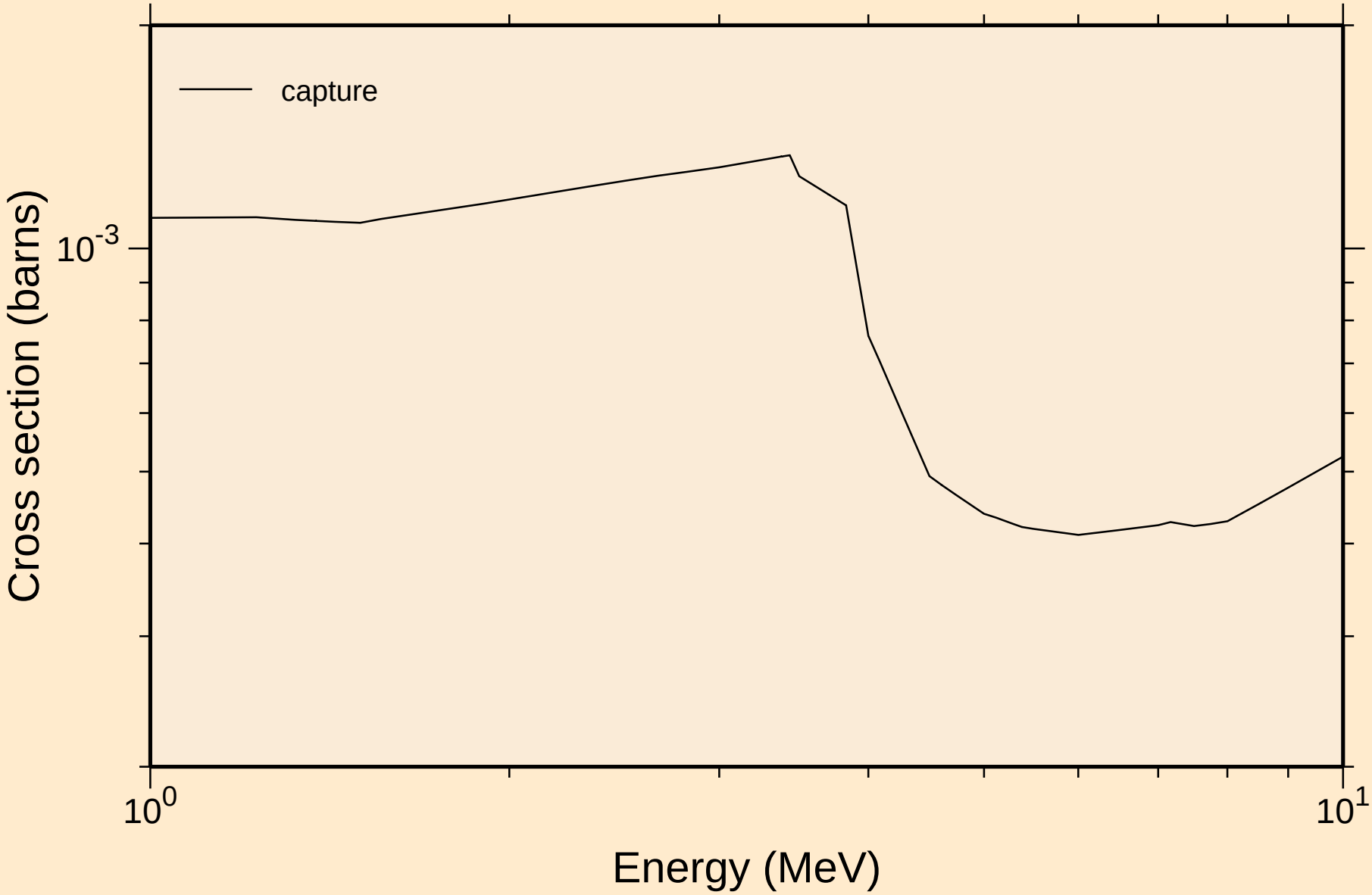


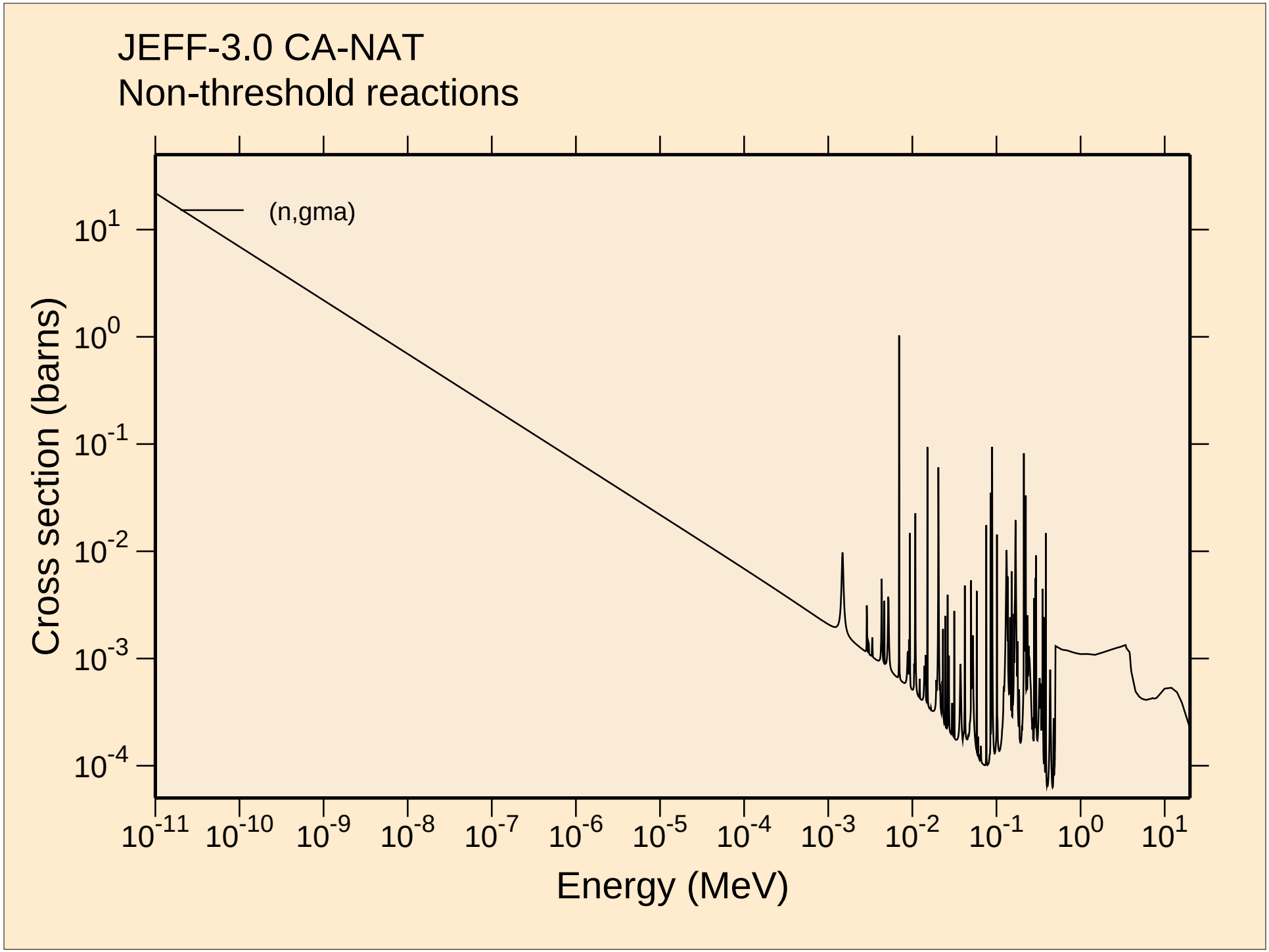
JEFF-3.0 CA-NAT
resonance absorption cross sections

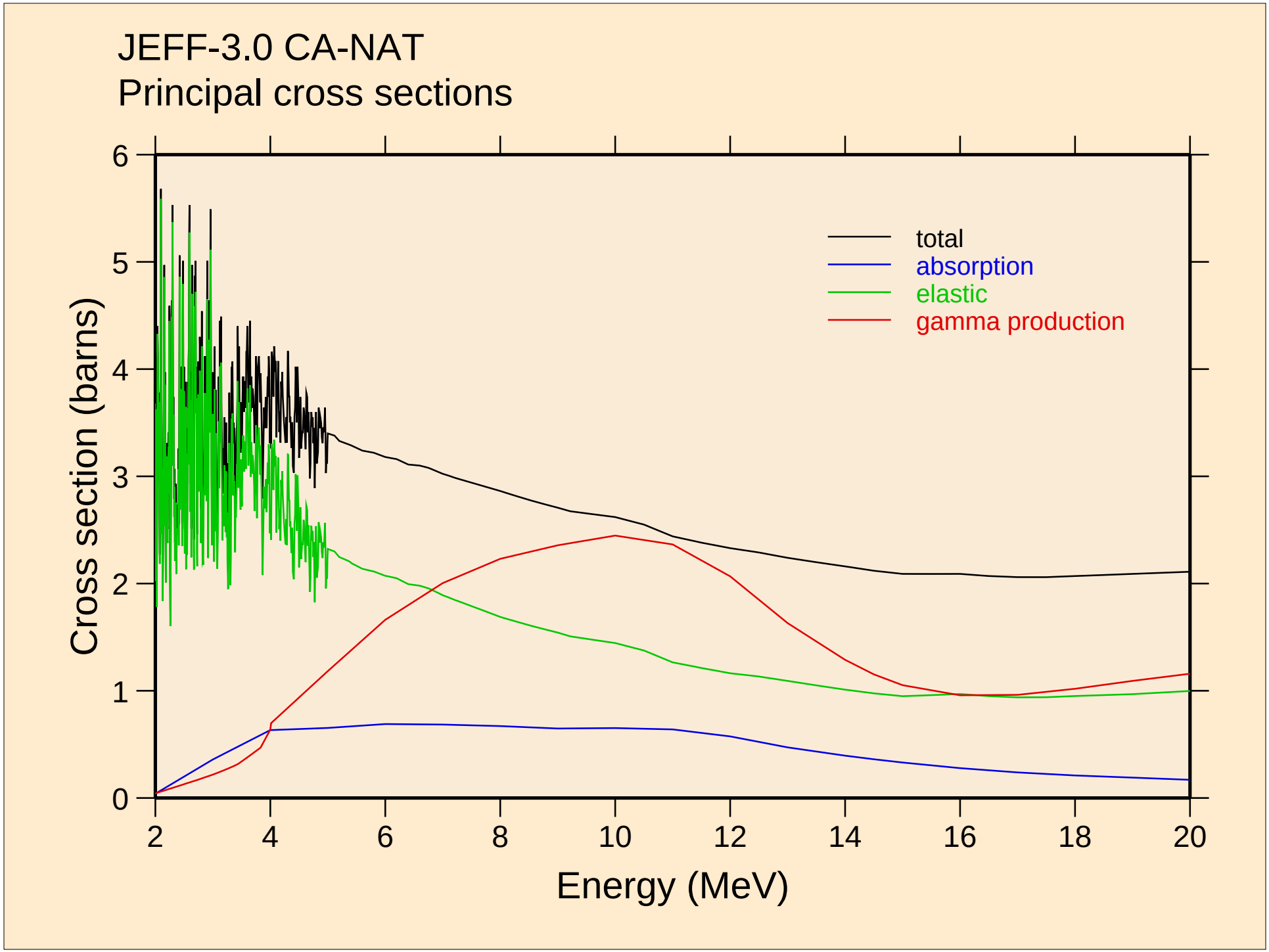


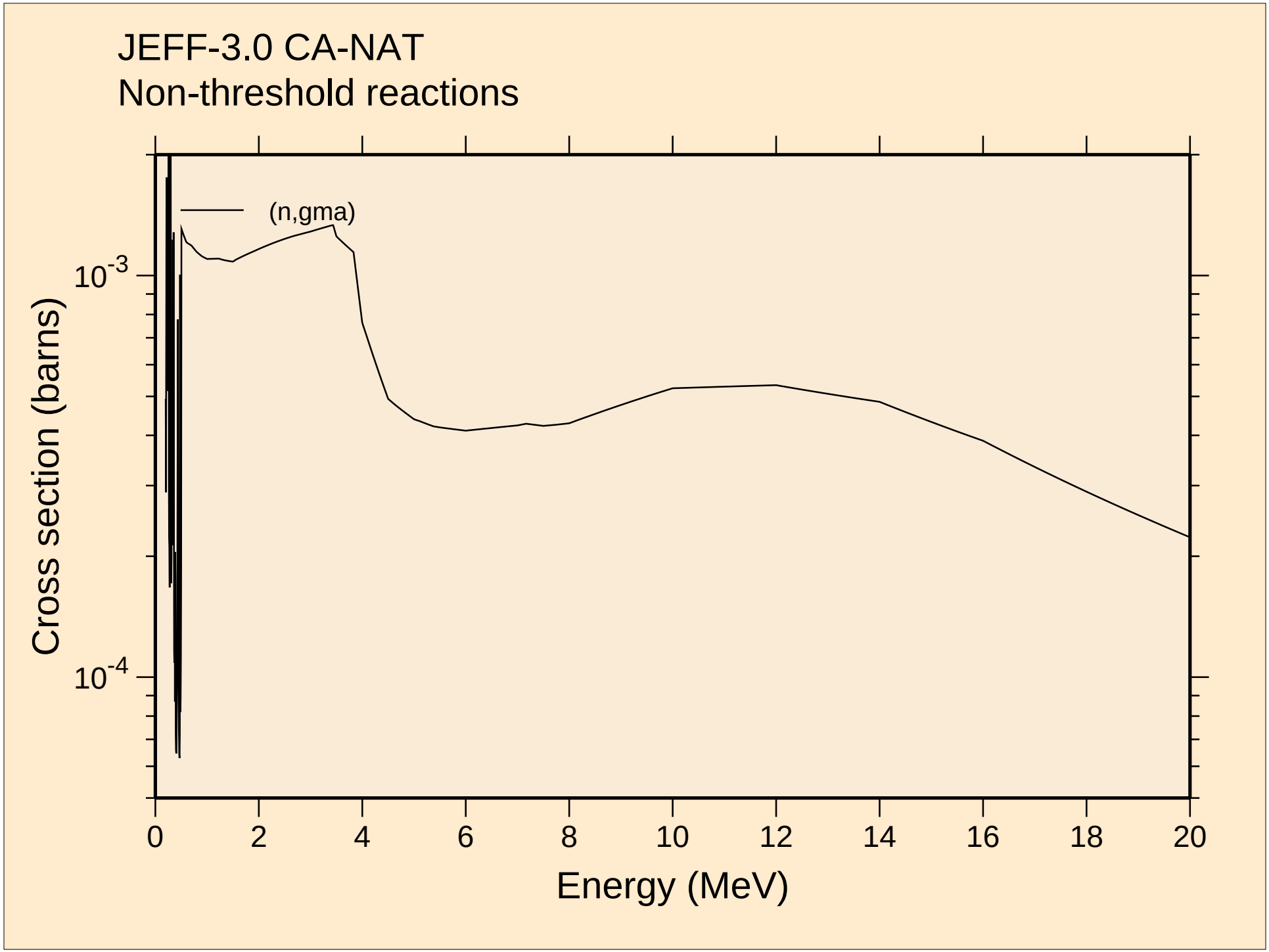

JEFF-3.0 CA-NAT
resonance absorption cross sections
capture
Cross section (barns)
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-1}$
$10^{0}$
Energy (MeV)

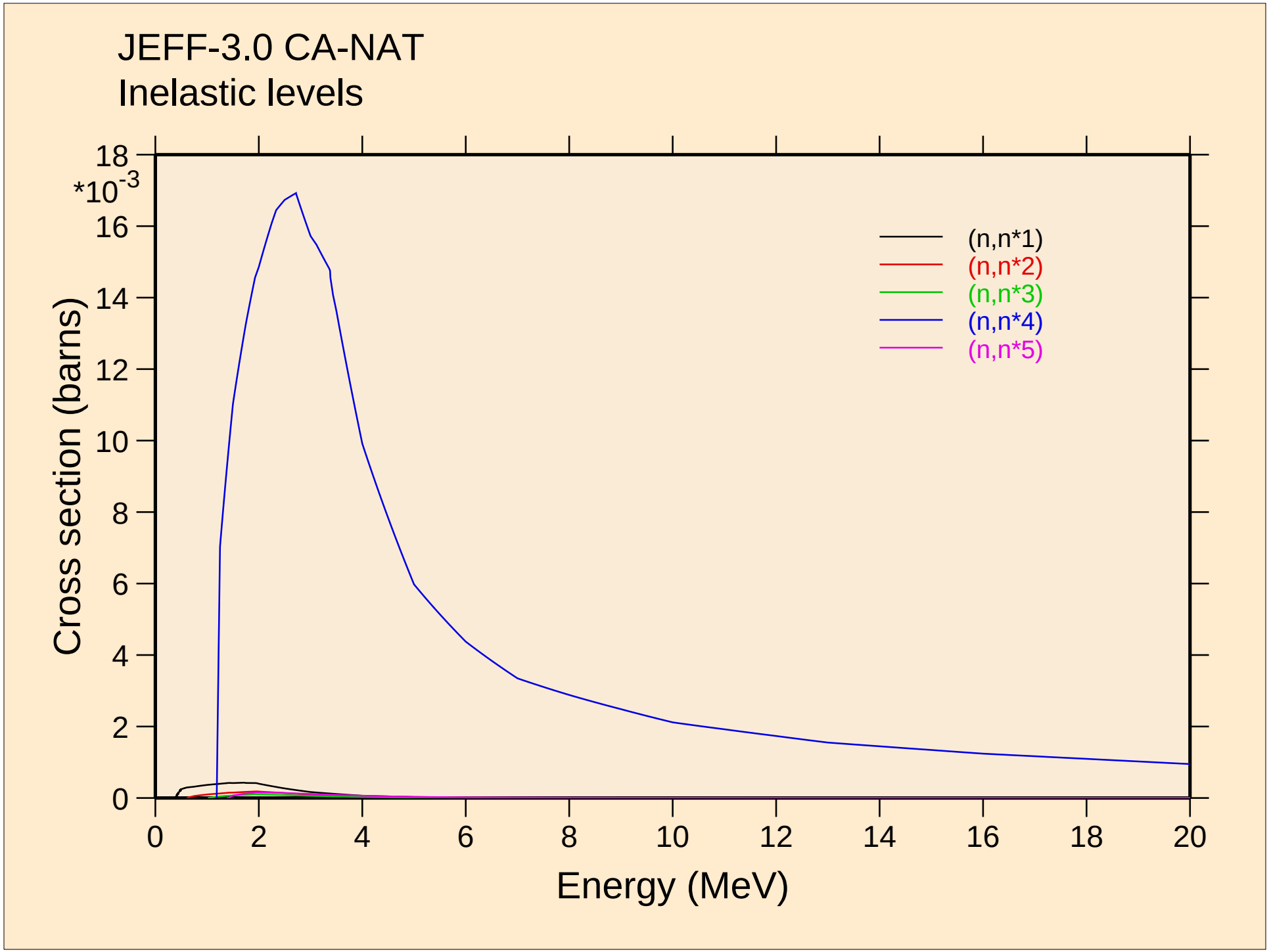
JEFF-3.0 CA-NAT
resonance absorption cross sections

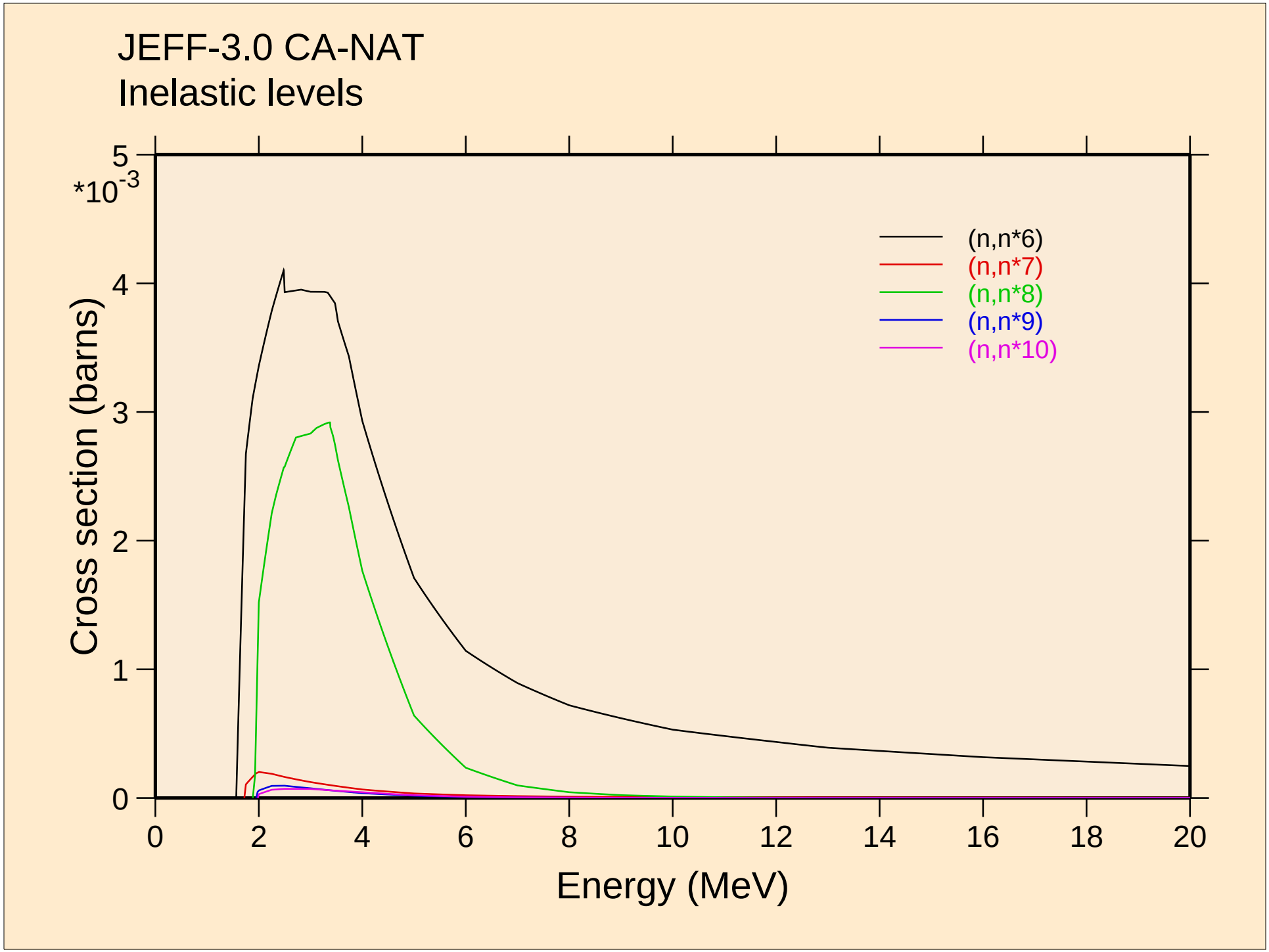


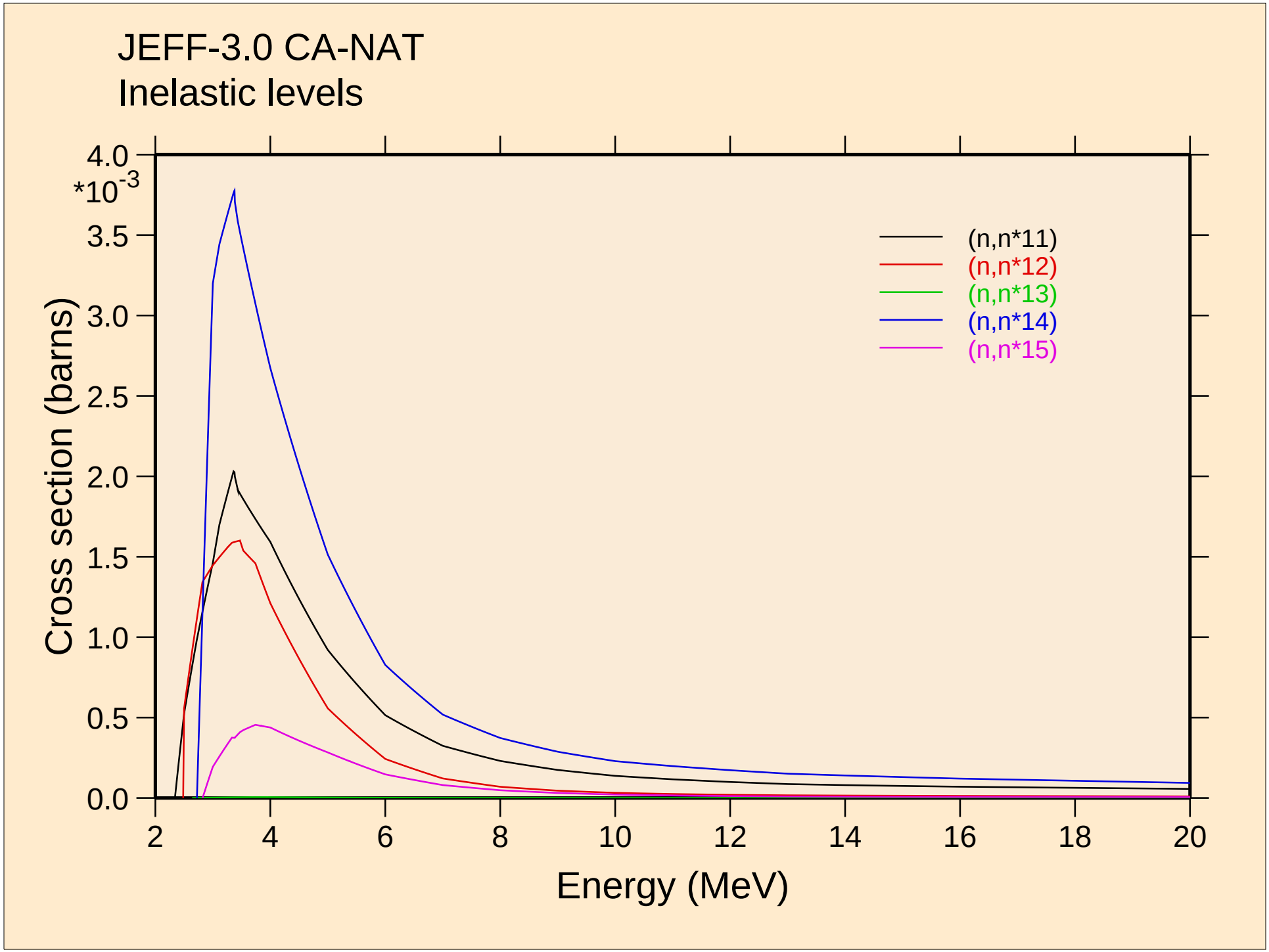

JEFF-3.0 CA-NAT
Non-threshold reactions
(n,gma)
Cross section (barns)
10^1
10^0
10^-1
10^-2
10^-3
10^-4
10^-11 10^-10 10^-9 10^-8 10^-7 10^-6 10^-5 10^-4 10^-3 10^-2 10^-1 10^0 10^1
Energy (MeV)

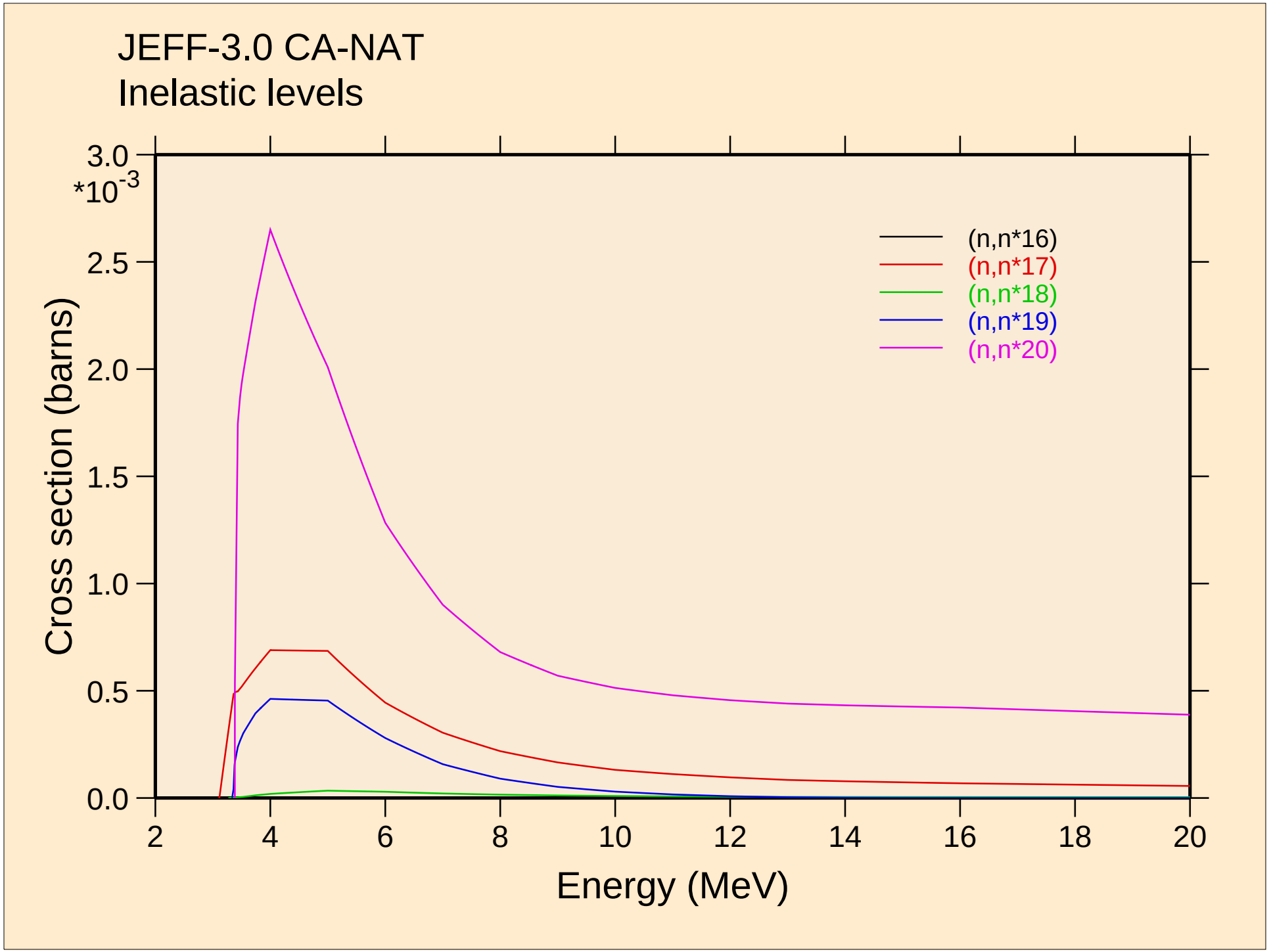

JEFF-3.0 CA-NAT
Principal cross sections
Cross section (barns)
Energy (MeV)
0
1
2
3
4
5
6
2
4
6
8
10
12
14
16
18
20
total
absorption
elastic
gamma production

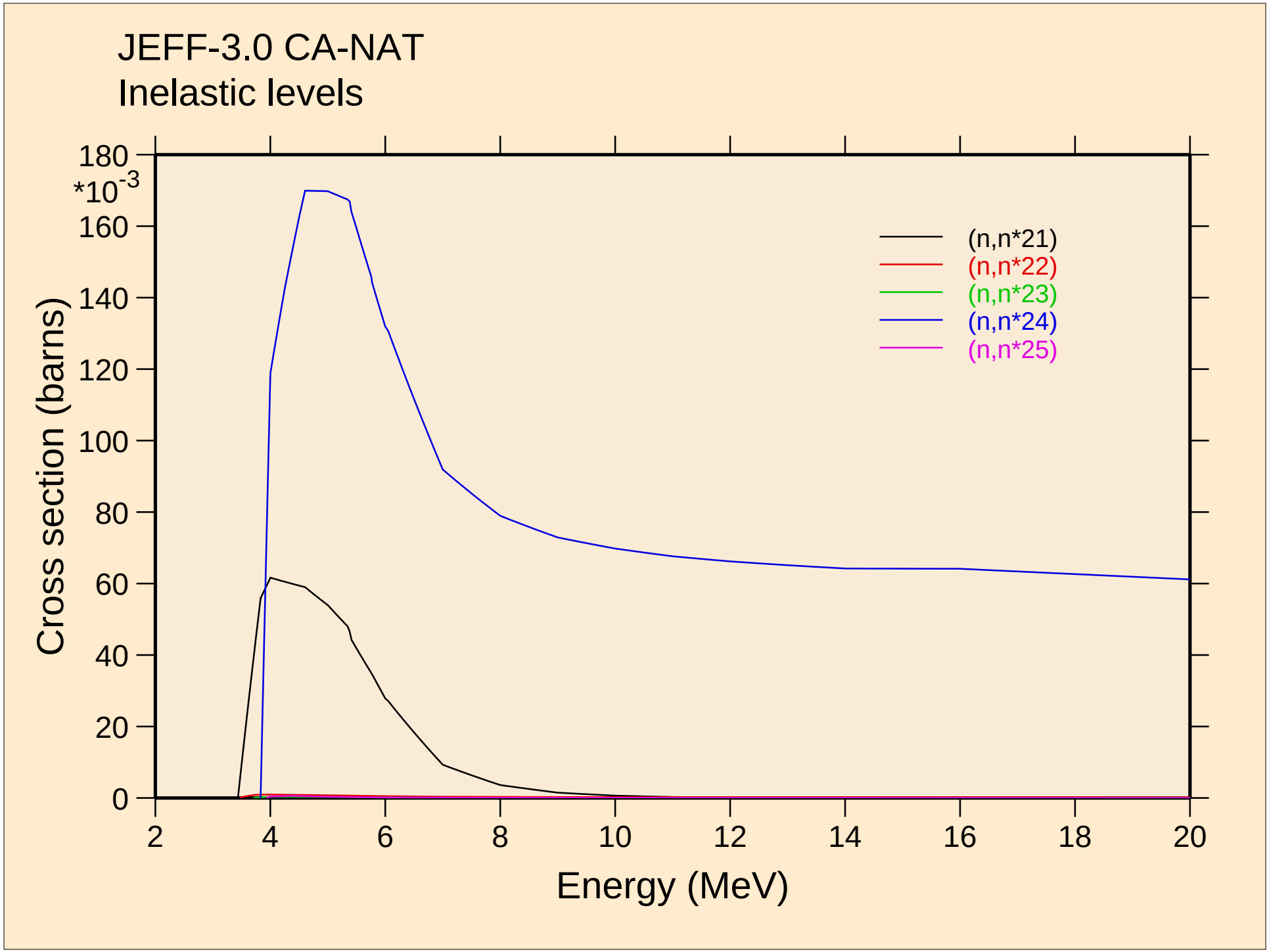

JEFF-3.0 CA-NAT
Non-threshold reactions
(n,gma)
Cross section (barns)
10-3
10-4
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

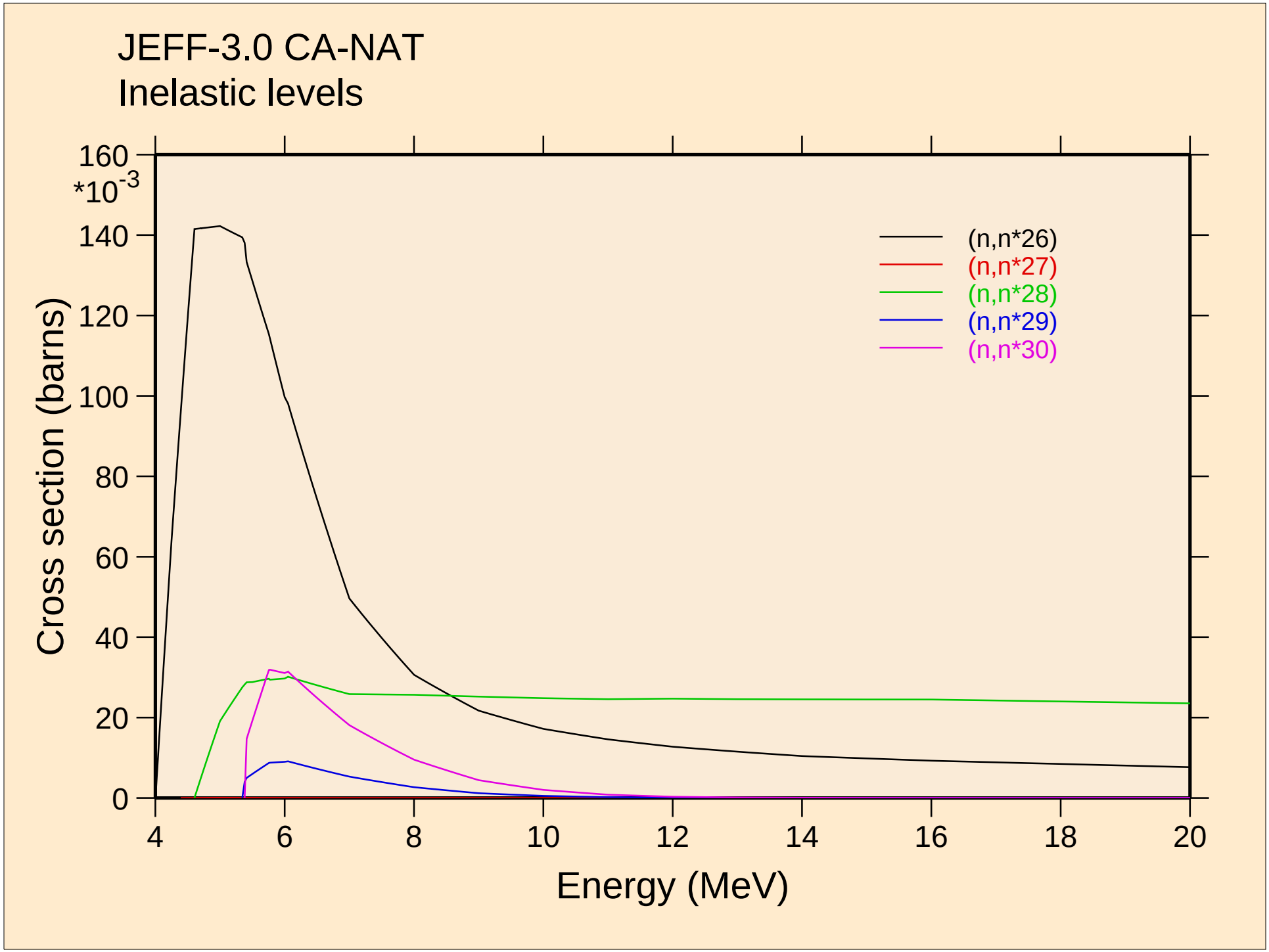

JEFF-3.0 CA-NAT
Inelastic levels
Cross section (barns)
*10-3
18
16
14
12
10
8
6
4
2
0
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)
(n,n*1)
(n,n*2)
(n,n*3)
(n,n*4)
(n,n*5)

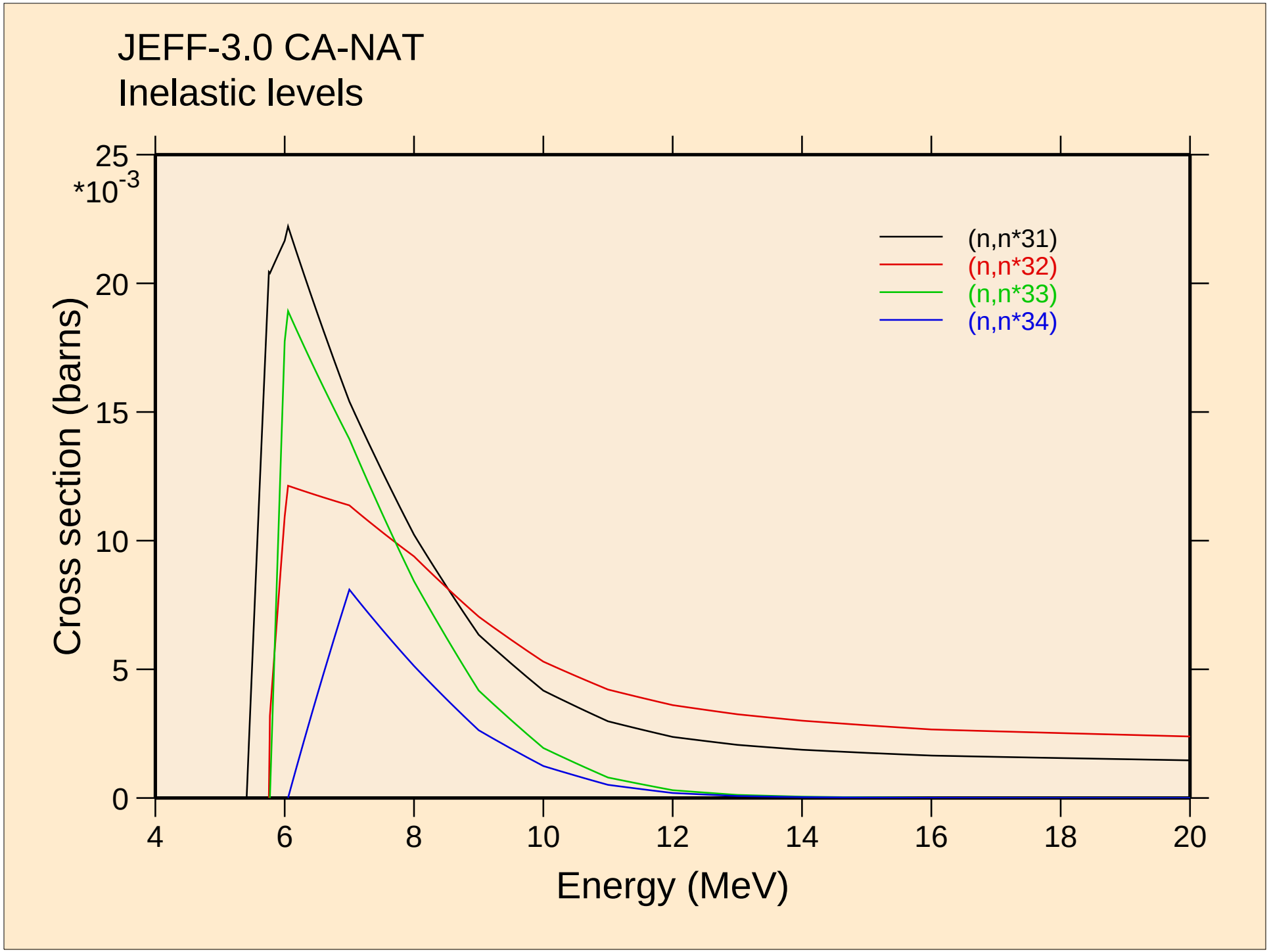

JEFF-3.0 CA-NAT
Inelastic levels
*10-3
Cross section (barns)
0
1
2
3
4
5
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)
(n,n*6)
(n,n*7)
(n,n*8)
(n,n*9)
(n,n*10)

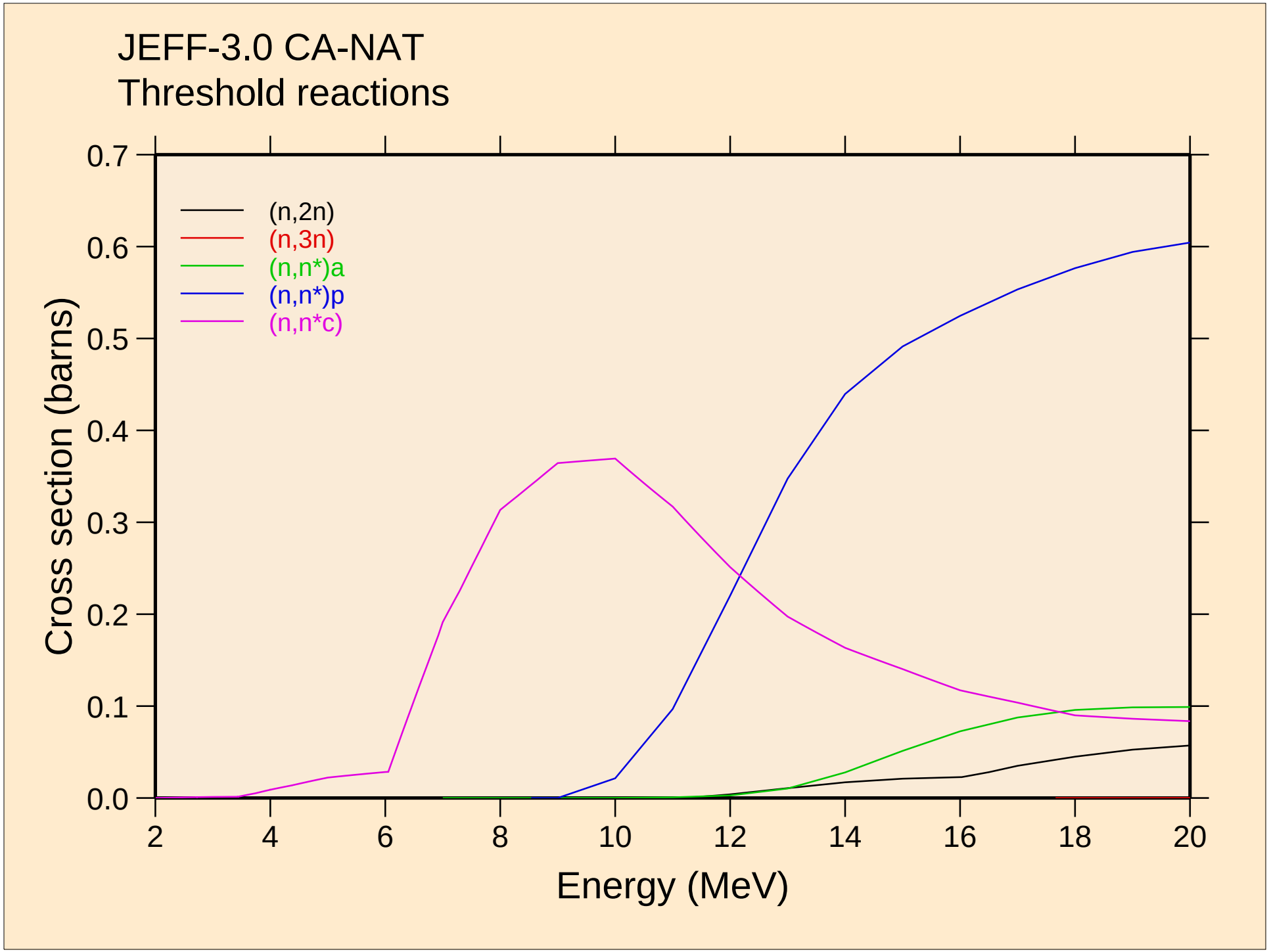

JEFF-3.0 CA-NAT
Inelastic levels
Cross section (barns)
*10-3
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)
(n,n*11)
(n,n*12)
(n,n*13)
(n,n*14)
(n,n*15)

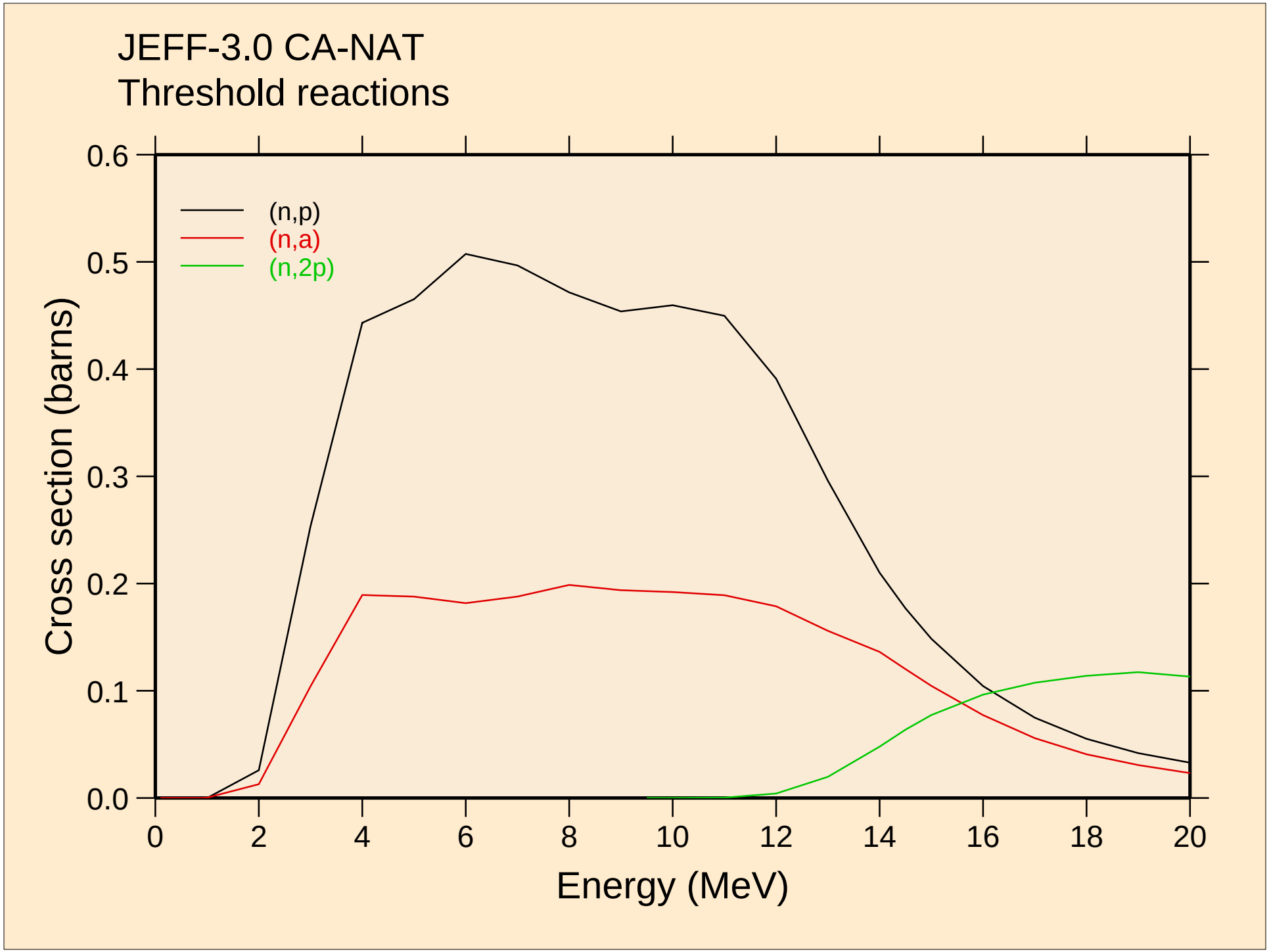

JEFF-3.0 CA-NAT
Inelastic levels
3.0
*10-3
2.5
2.0
1.5
1.0
0.5
0.0
Cross section (barns)
2
4
6
8
10
12
14
16
18
20
Energy (MeV)
(n,n*16)
(n,n*17)
(n,n*18)
(n,n*19)
(n,n*20)

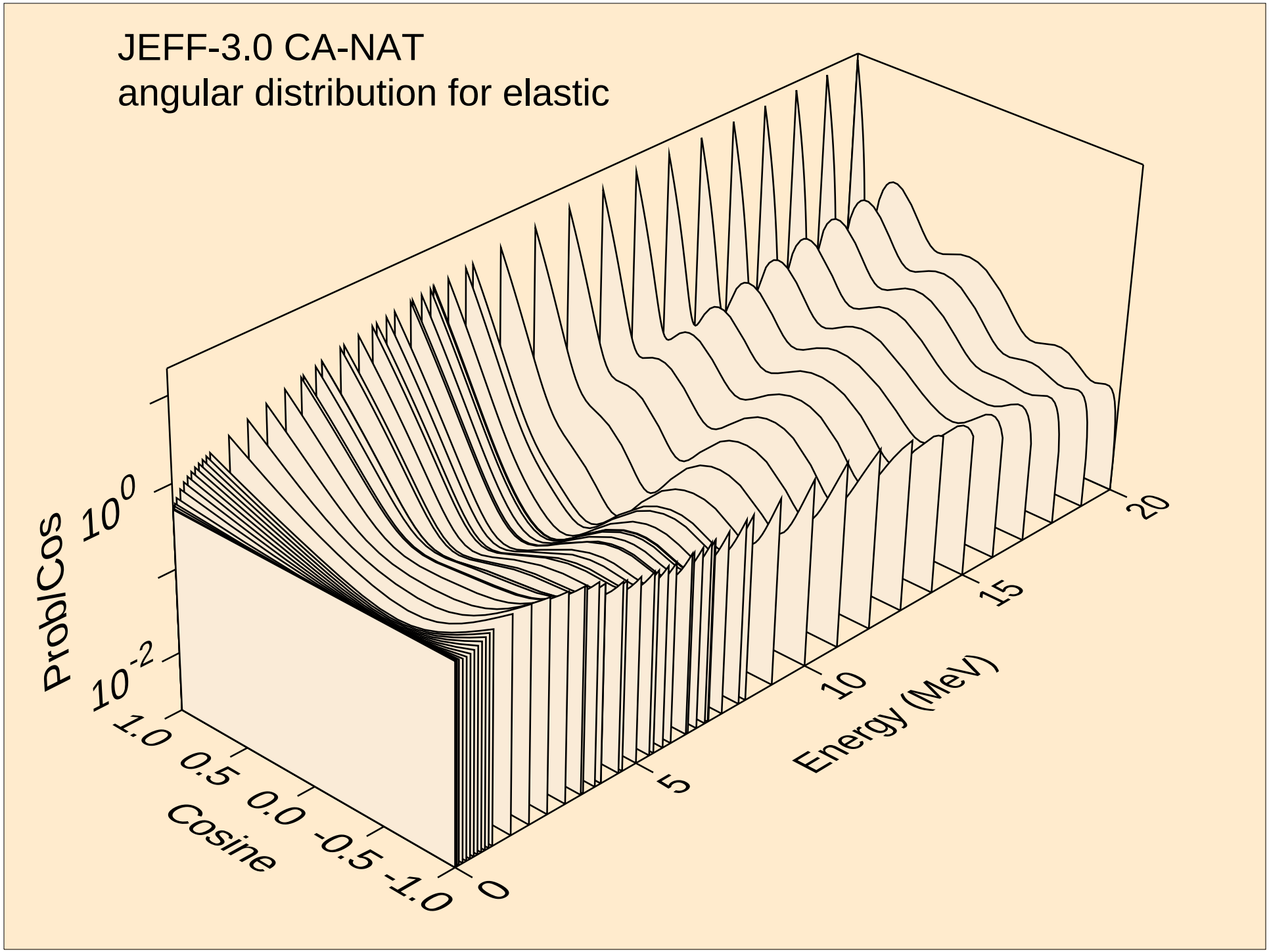

JEFF-3.0 CA-NAT
Inelastic levels
Cross section (barns)
*10-3
180
160
140
120
100
80
60
40
20
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)
(n,n*21)
(n,n*22)
(n,n*23)
(n,n*24)
(n,n*25)

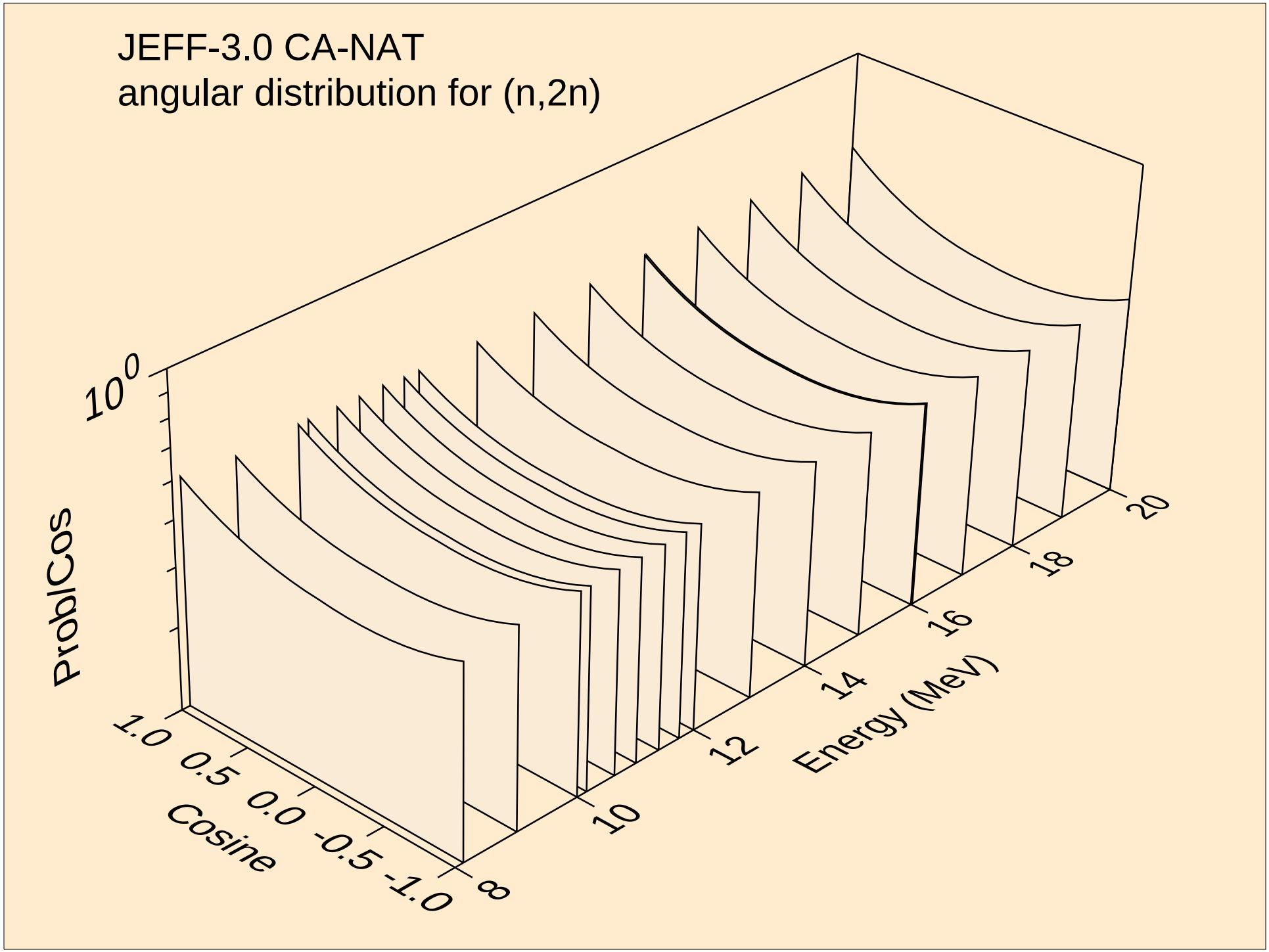

JEFF-3.0 CA-NAT
Inelastic levels
Cross section (barns)
*10-3
160
140
120
100
80
60
40
20
0
4
6
8
10
12
14
16
18
20
Energy (MeV)
(n,n*26)
(n,n*27)
(n,n*28)
(n,n*29)
(n,n*30)

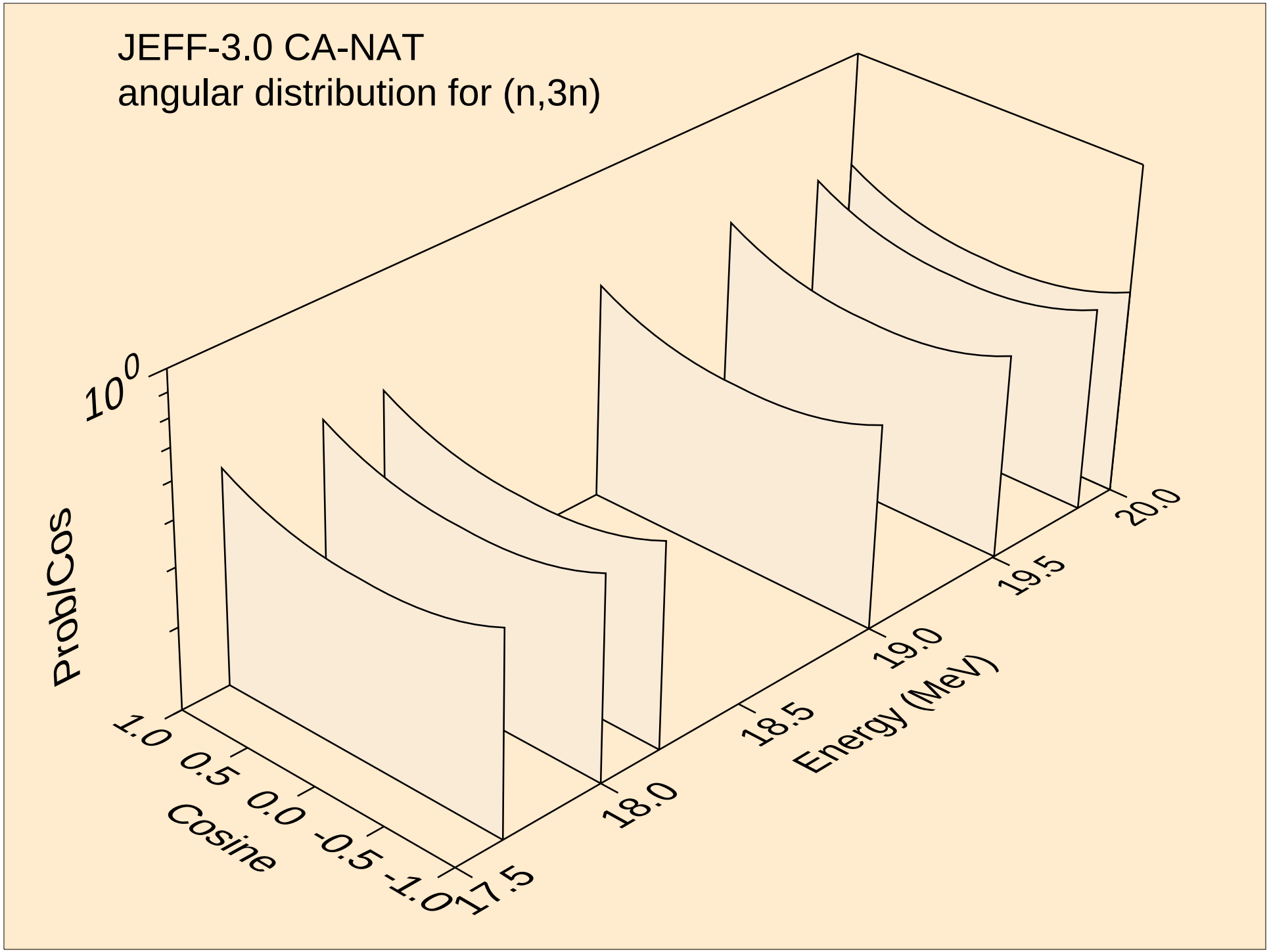

JEFF-3.0 CA-NAT
Inelastic levels
Cross section (barns)
*10-3
25
20
15
10
5
0
4
6
8
10
12
14
16
18
20
Energy (MeV)
(n,n*31)
(n,n*32)
(n,n*33)
(n,n*34)

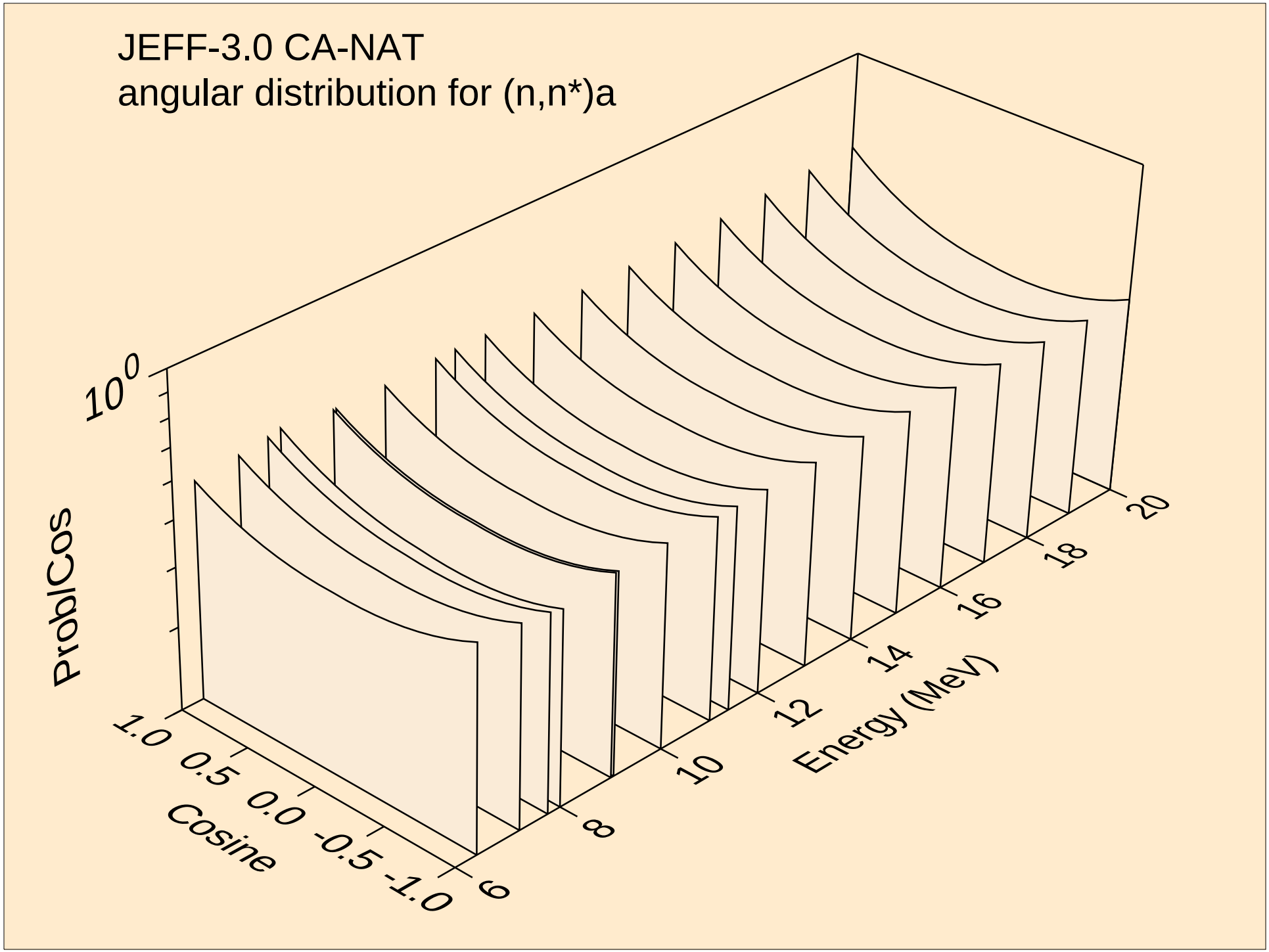

JEFF-3.0 CA-NAT
Threshold reactions
(n,2n)
(n,3n)
(n,n*)a
(n,n*)p
(n,n*c)
Cross section (barns)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

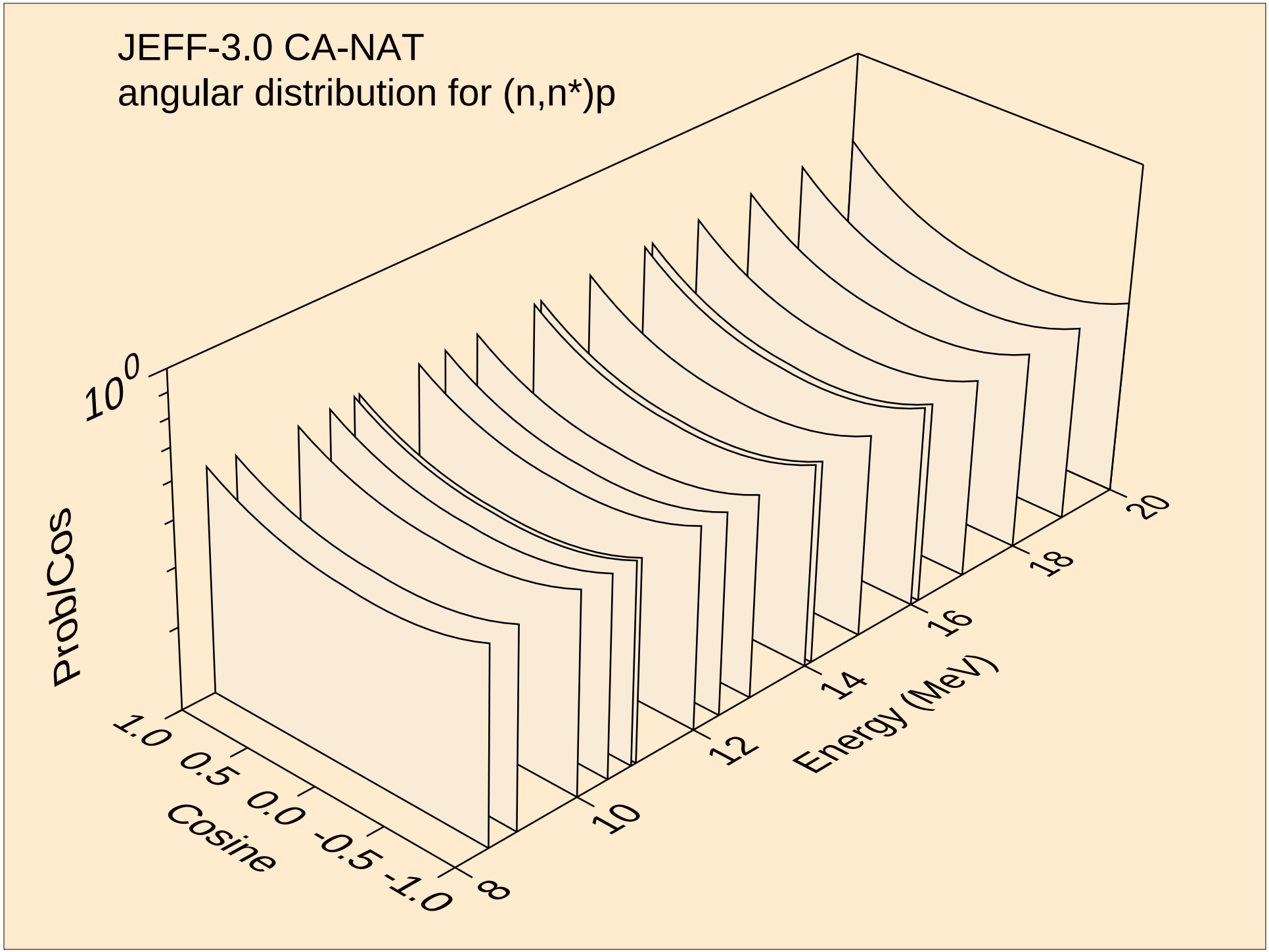

JEFF-3.0 CA-NAT
Threshold reactions
(n,p)
(n,a)
(n,2p)
Cross section (barns)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

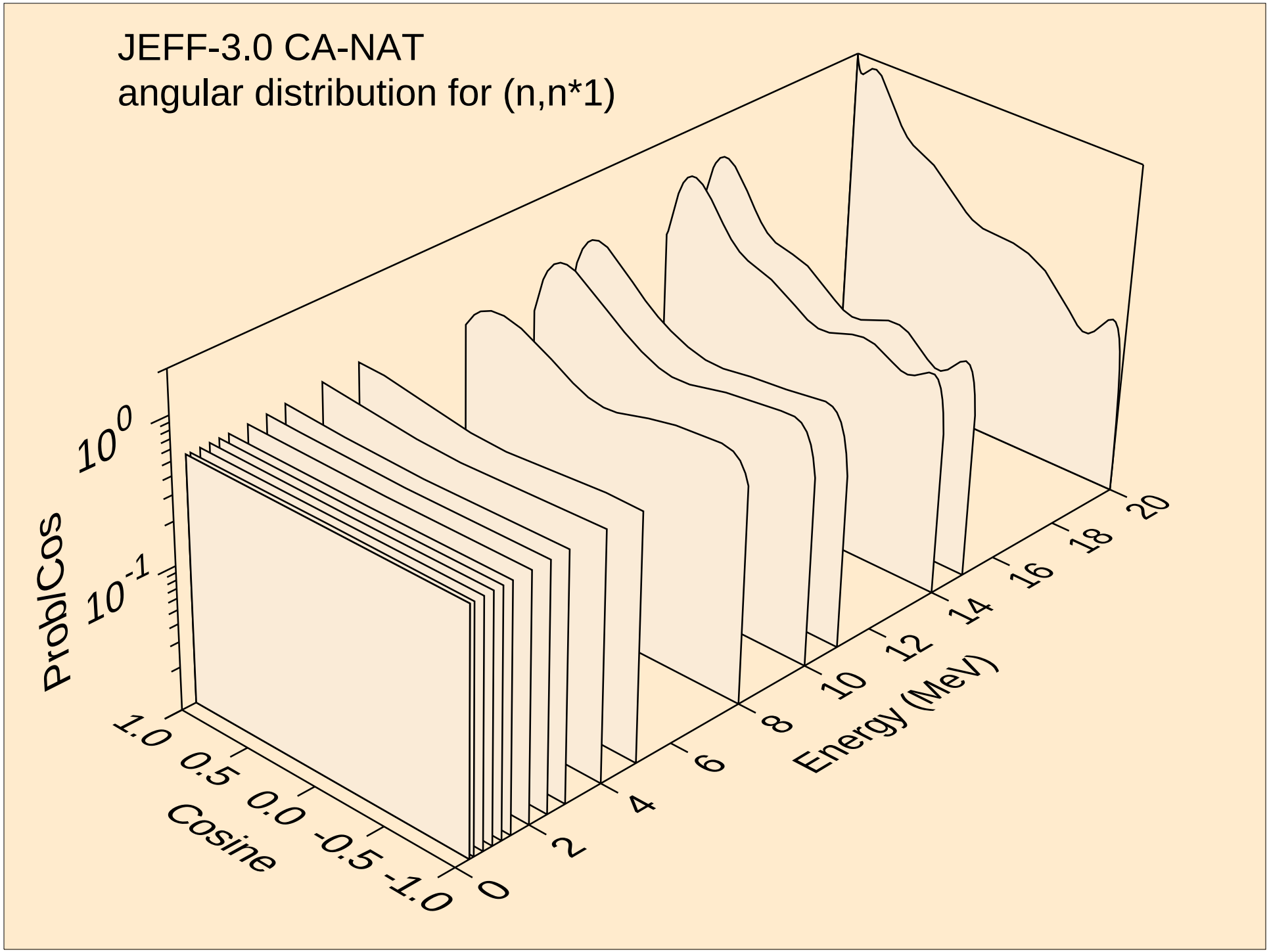

JEFF-3.0 CA-NAT
angular distribution for elastic
ProblCos
$10^{0}$
$10^{-2}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
5
10
15
20
Energy (MeV)

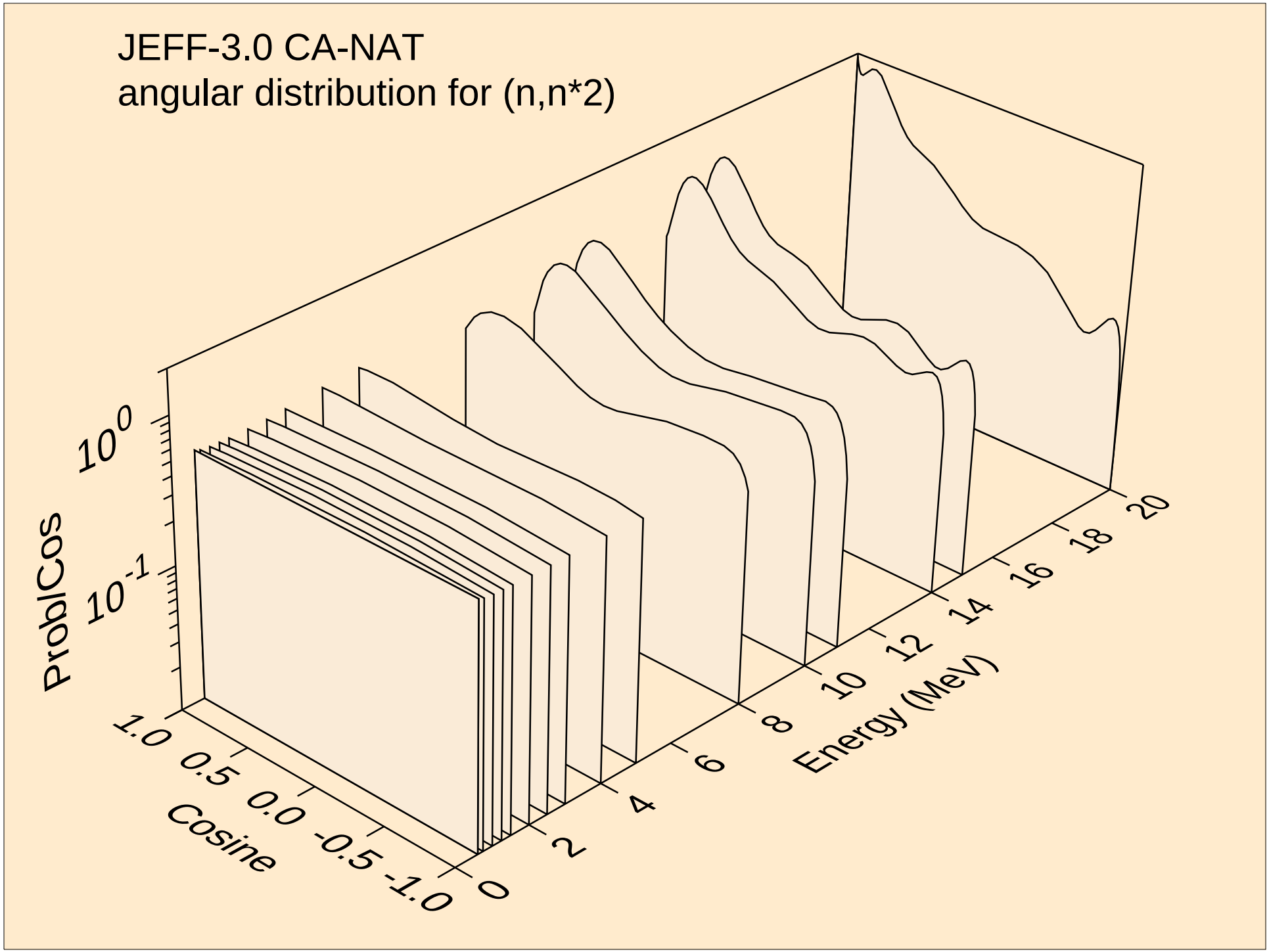

JEFF-3.0 CA-NAT
angular distribution for (n,2n)
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
8
10
12
14
16
18
20
Energy (MeV)

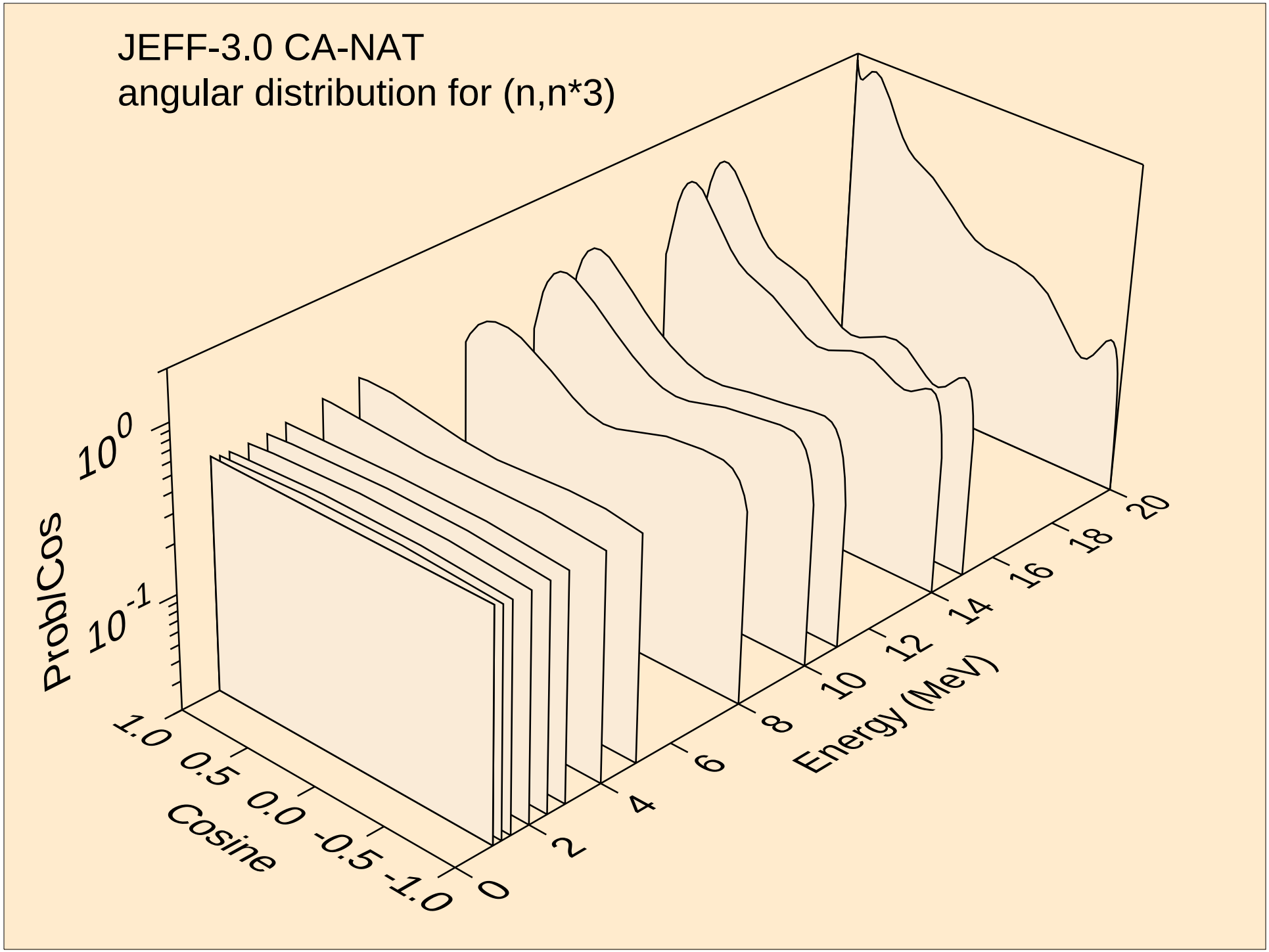

JEFF-3.0 CA-NAT
angular distribution for (n,3n)
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
17.5
18.0
18.5
19.0
19.5
20.0
Energy (MeV)

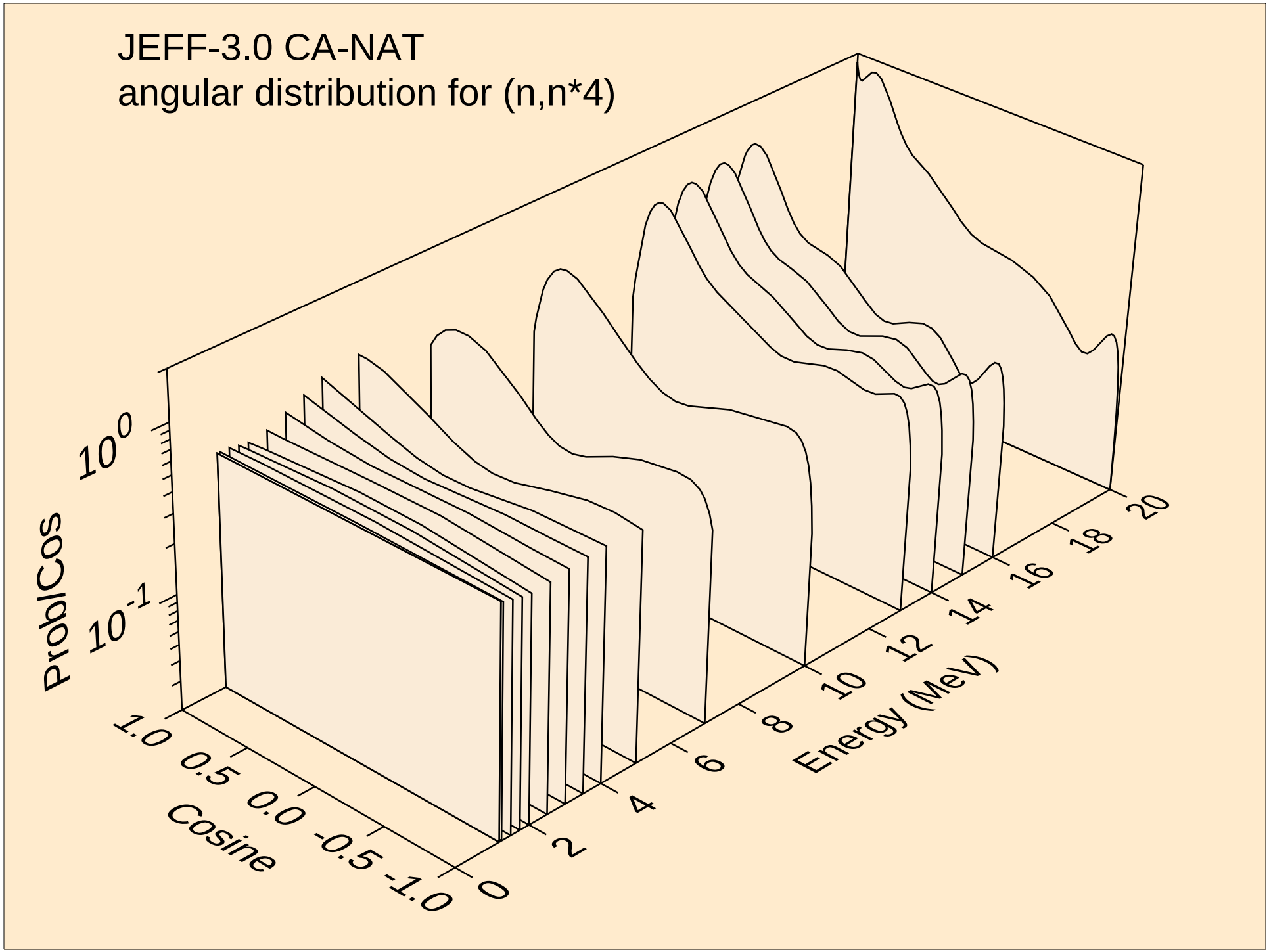

JEFF-3.0 CA-NAT
angular distribution for (n,n*)a
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
6
8
10
12
14
16
18
20
Energy (MeV)

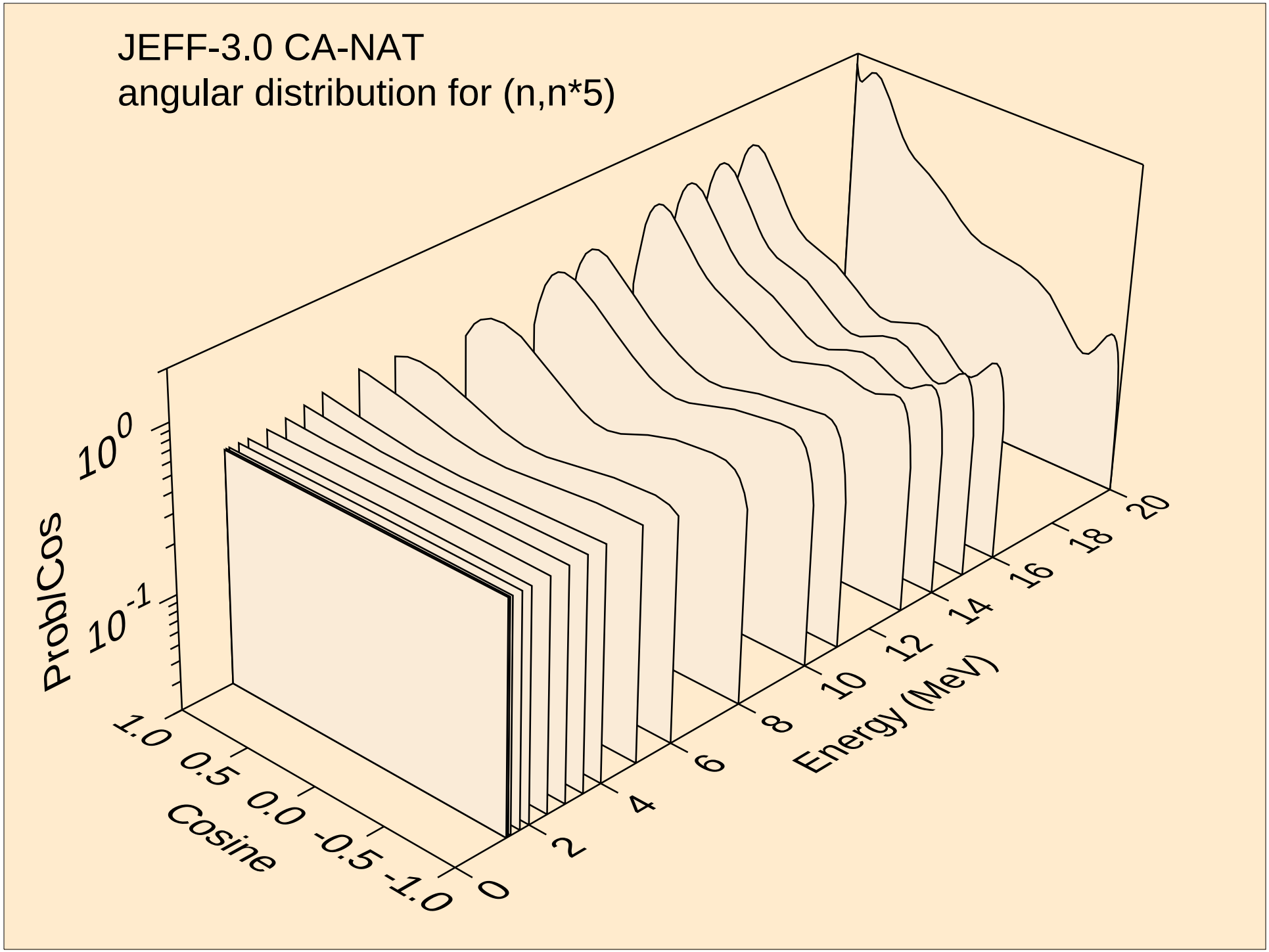

JEFF-3.0 CA-NAT
angular distribution for (n,n*)p
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
8
10
12
14
16
18
20
Energy (MeV)

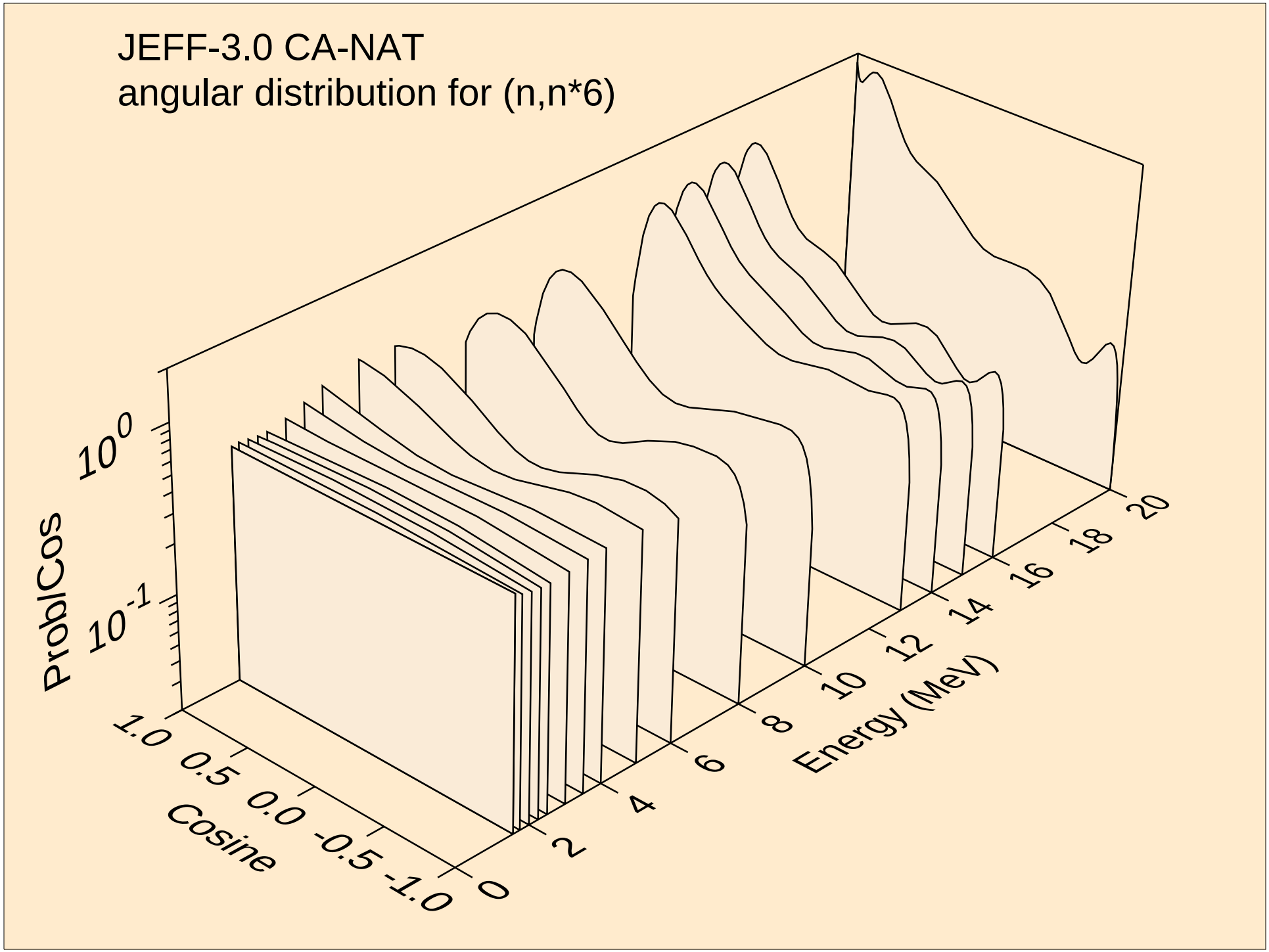

JEFF-3.0 CA-NAT
angular distribution for (n,n*1)
Prob\Cos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

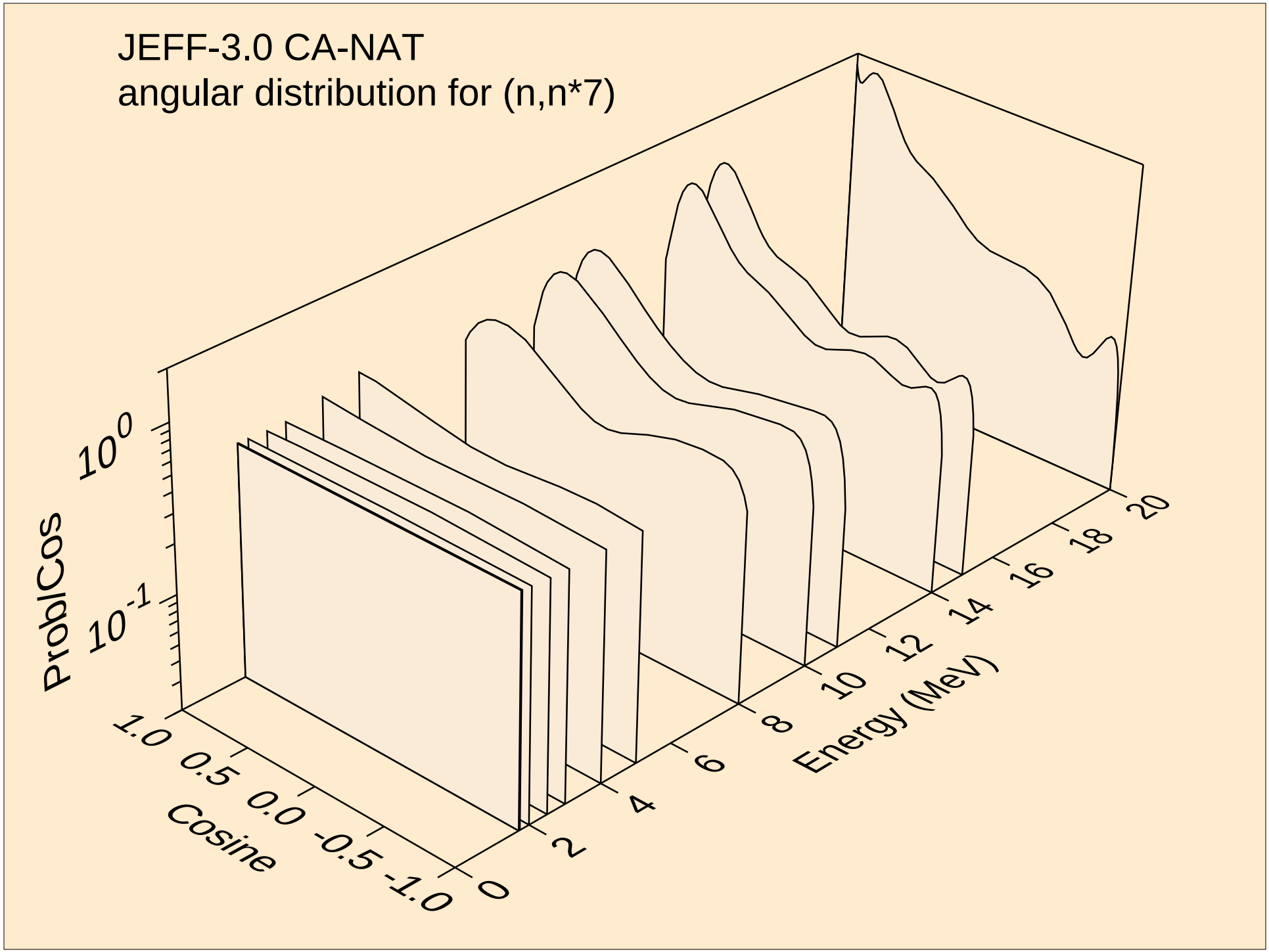

JEFF-3.0 CA-NAT
angular distribution for (n,n*2)
ProbCos
$10^{0}$
$10^{-1}$
Cosine
1.0
0.5
0.0
-0.5
-1.0
Energy (MeV)
0
2
4
6
8
10
12
14
16
18
20

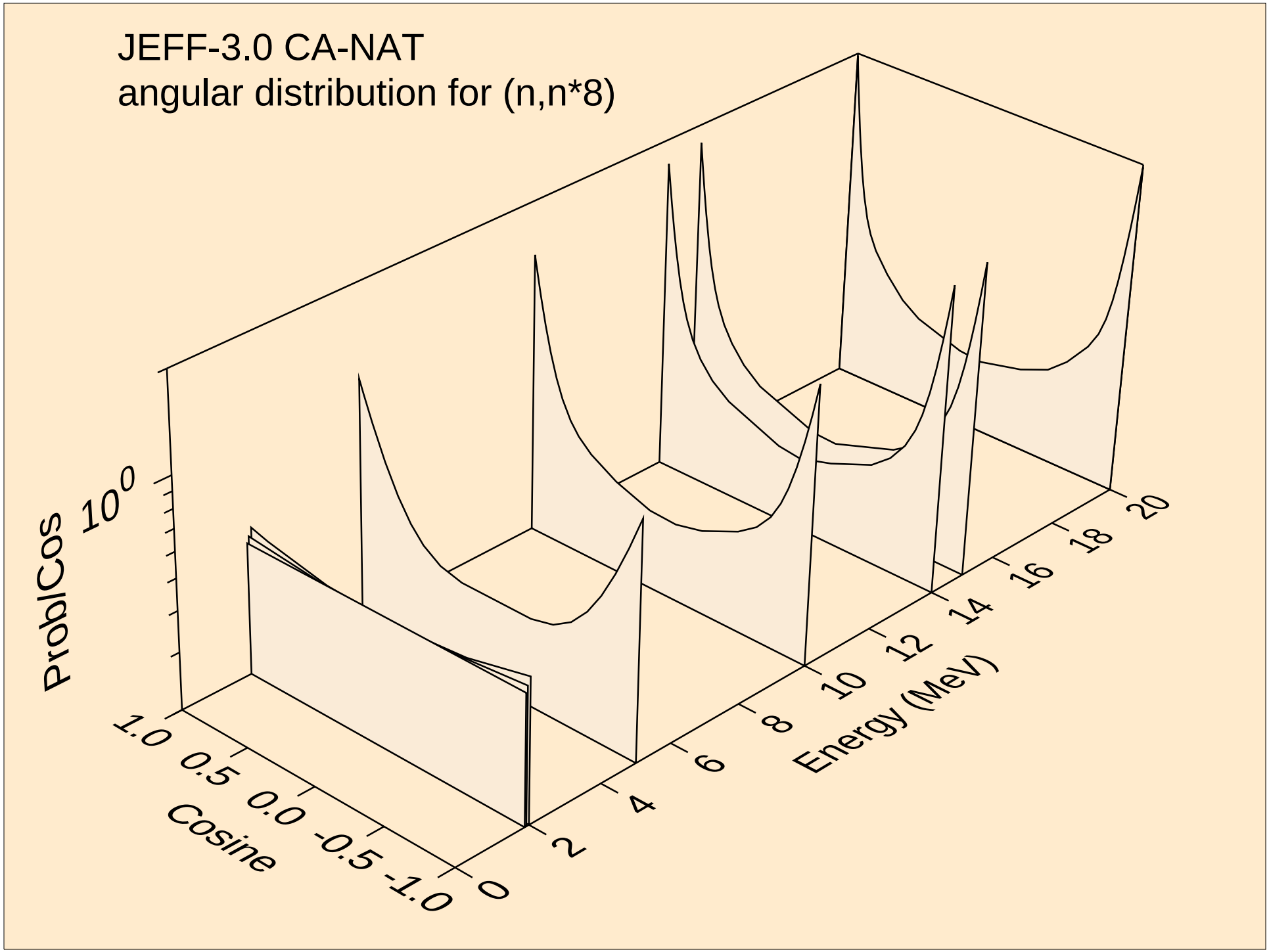

JEFF-3.0 CA-NAT
angular distribution for (n,n*3)
ProbICos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

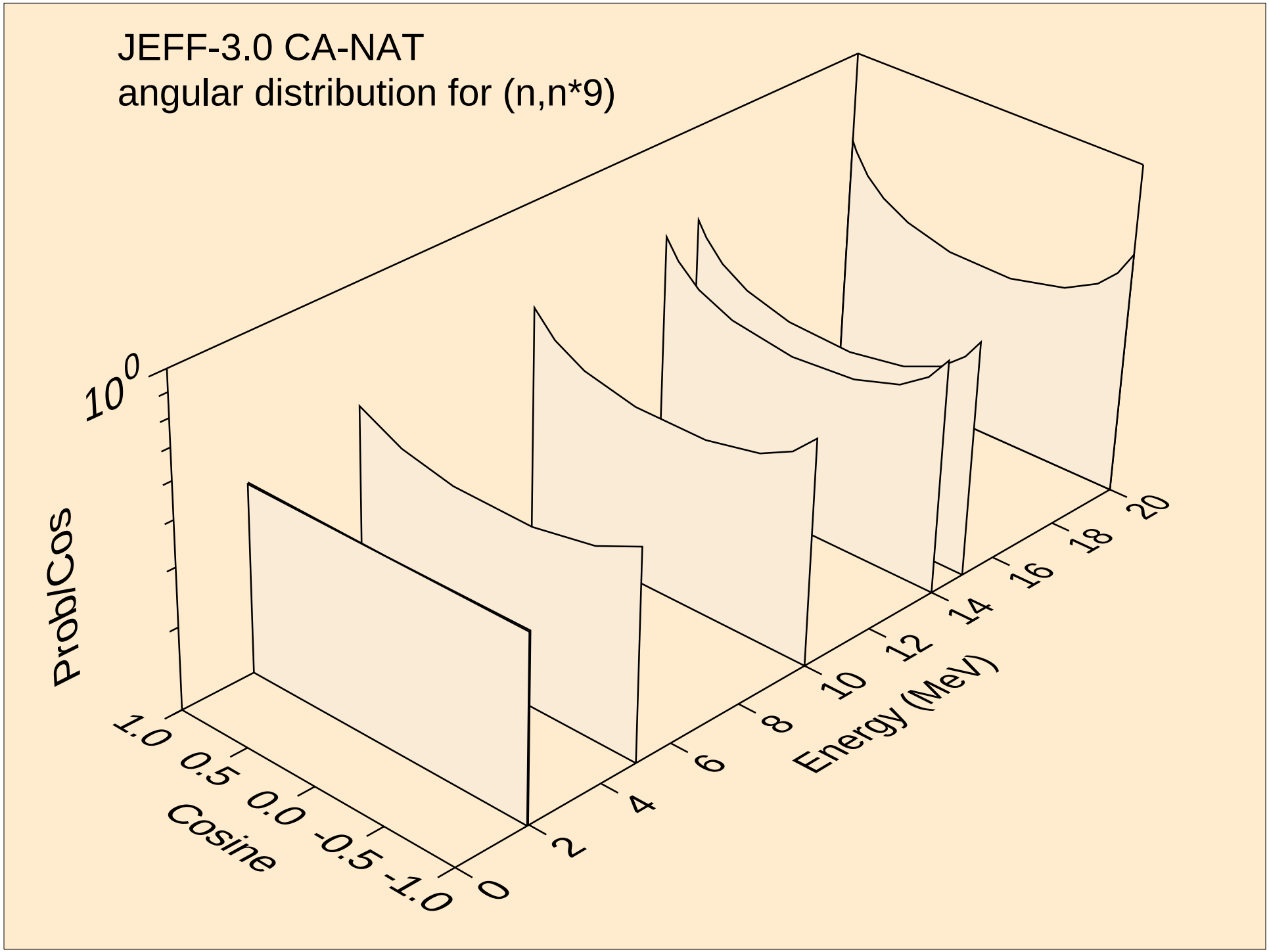

JEFF-3.0 CA-NAT
angular distribution for (n,n*4)
ProbCos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

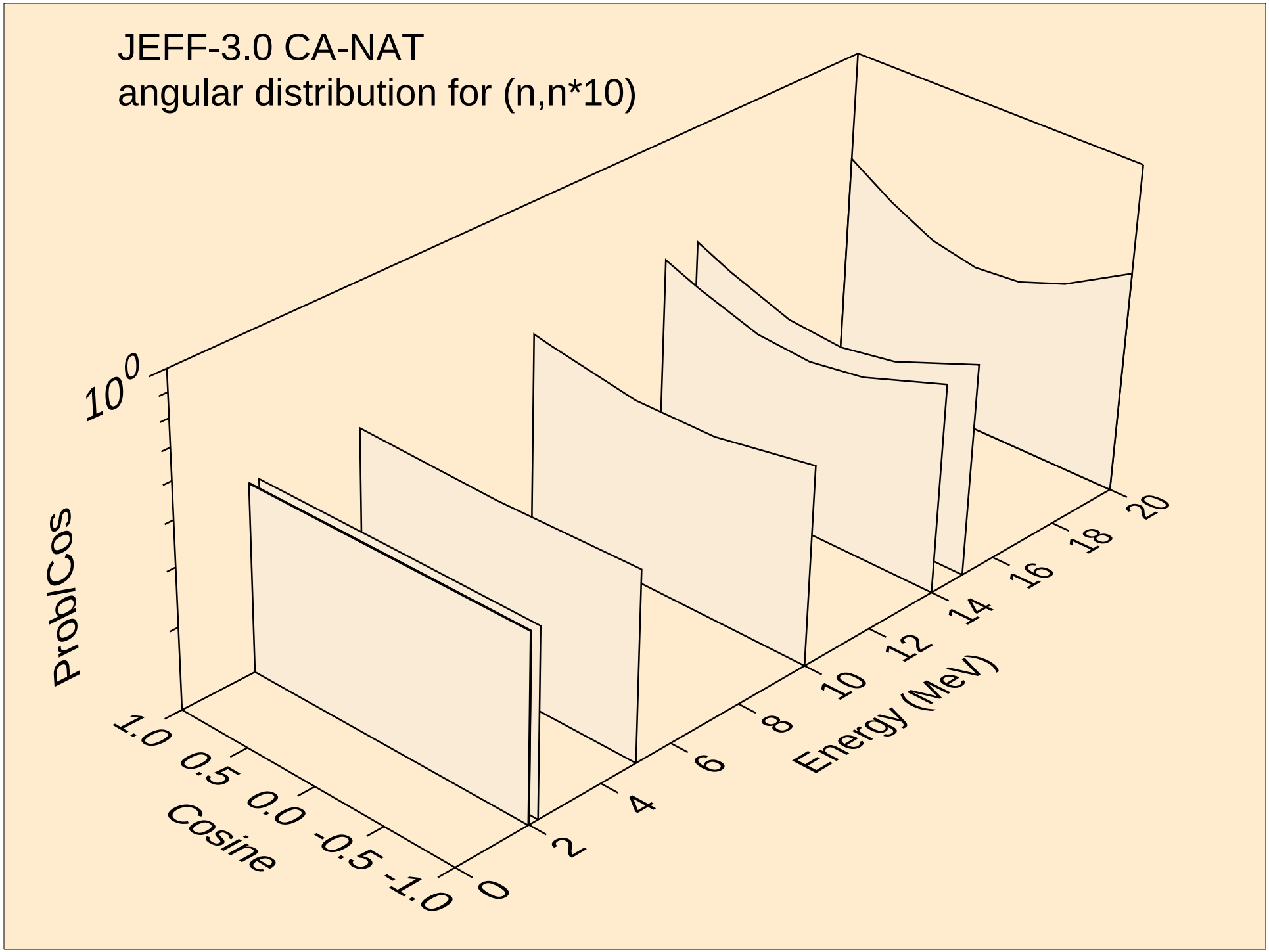

JEFF-3.0 CA-NAT
angular distribution for (n,n*5)
ProbICos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

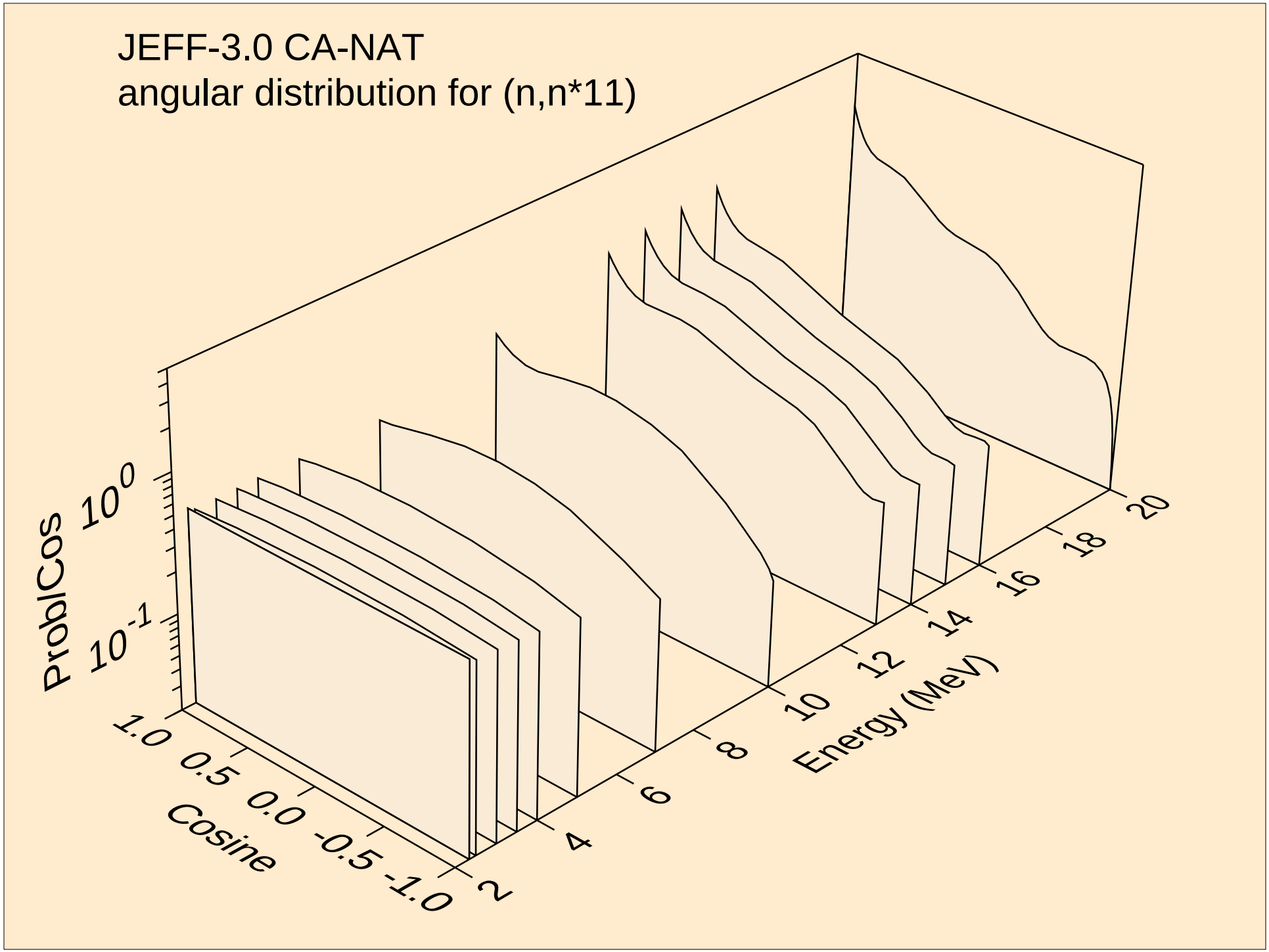

JEFF-3.0 CA-NAT
angular distribution for (n,n*6)
ProbICos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

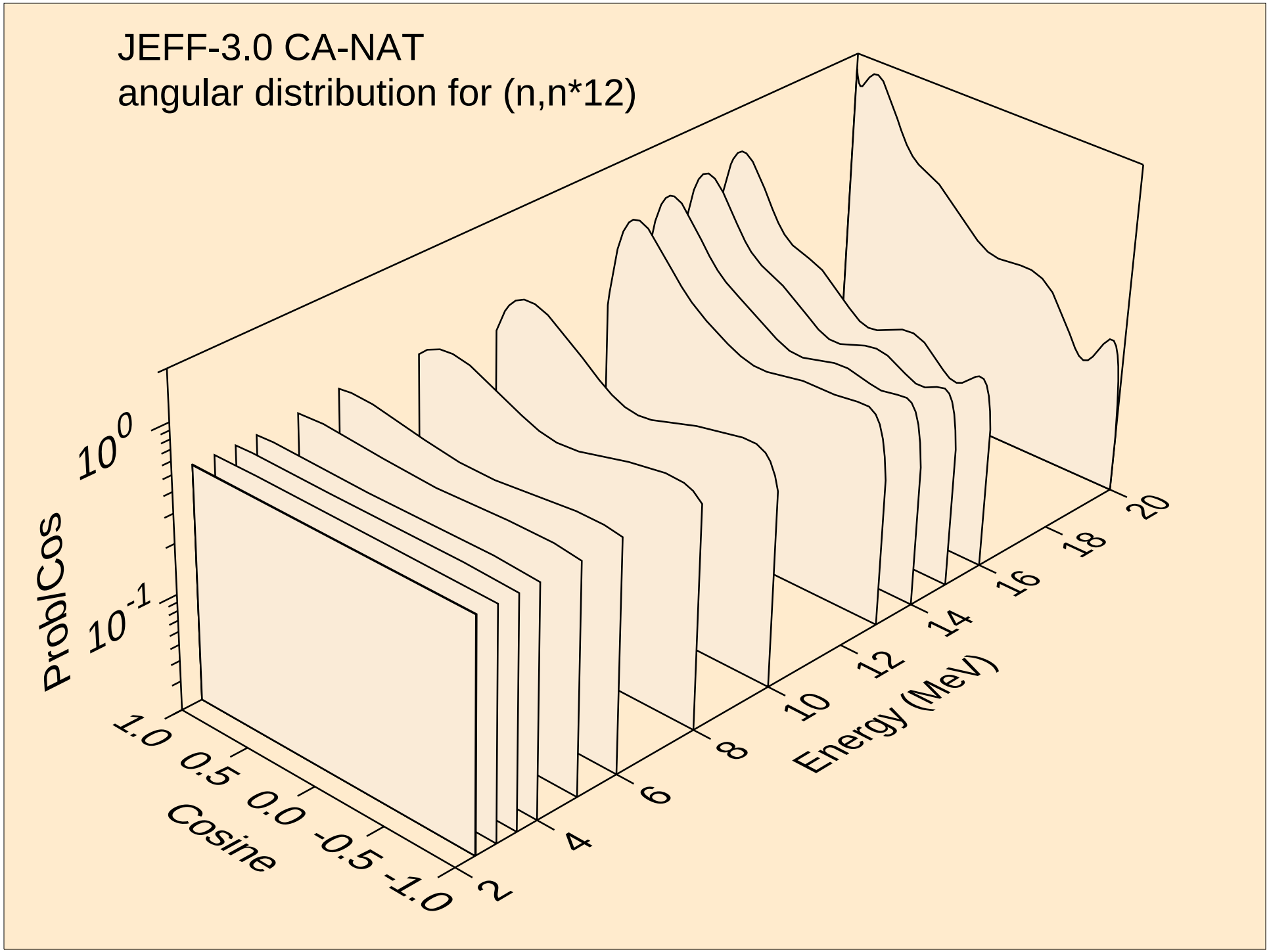

JEFF-3.0 CA-NAT
angular distribution for (n,n*7)
ProbICos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

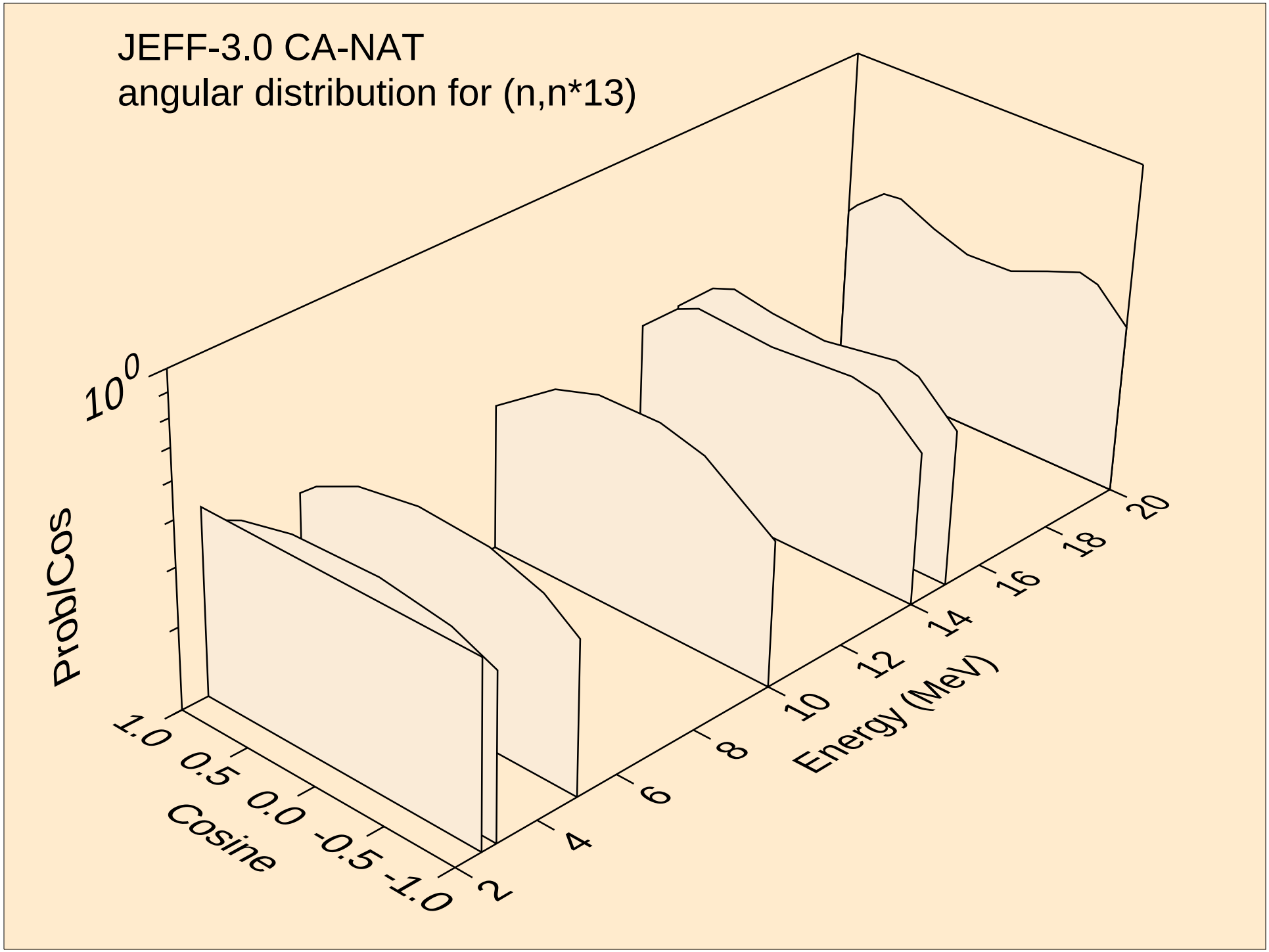

JEFF-3.0 CA-NAT
angular distribution for (n,n*8)
ProbICos
$10^0$
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

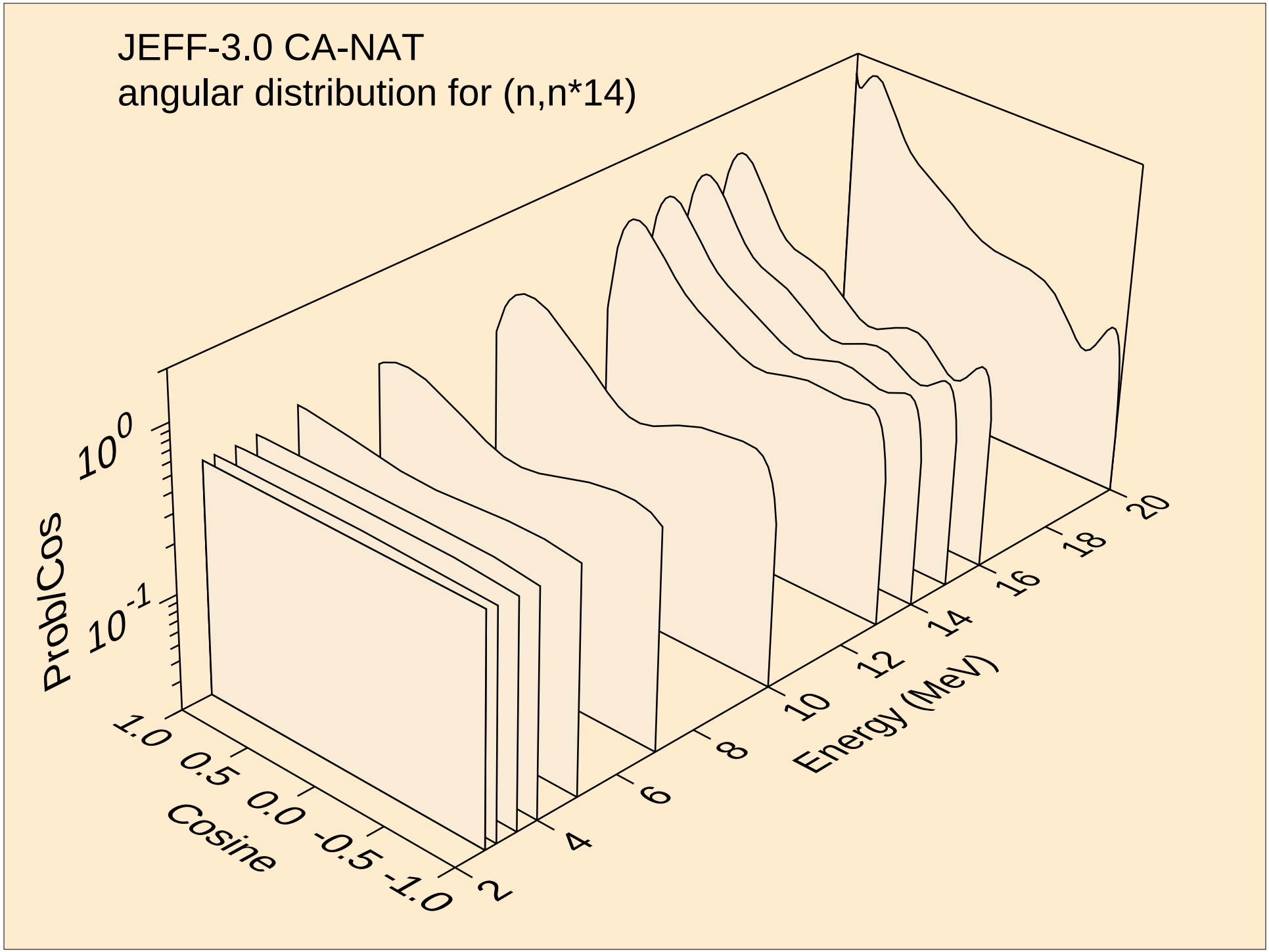

JEFF-3.0 CA-NAT
angular distribution for (n,n*9)
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

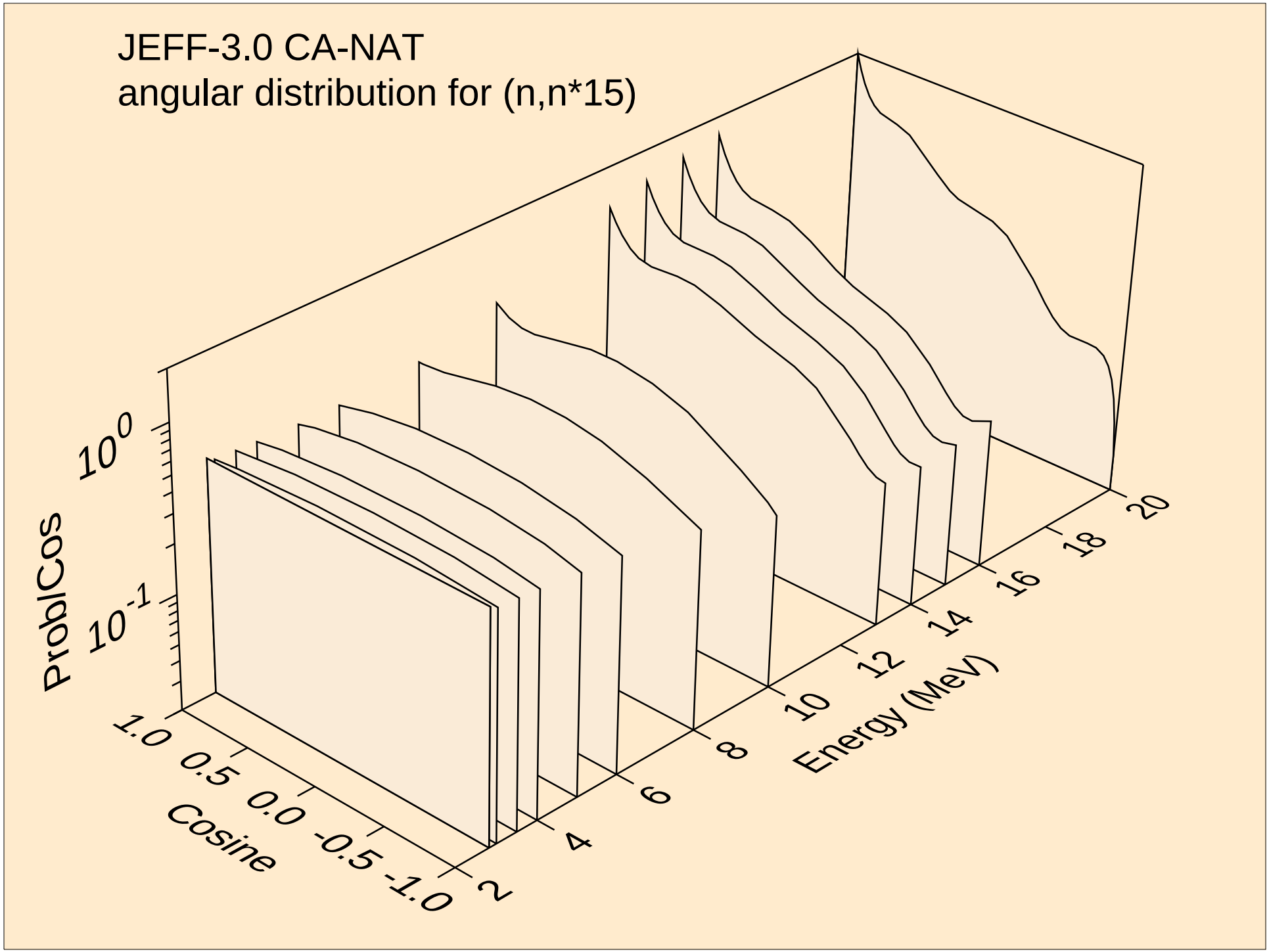

JEFF-3.0 CA-NAT
angular distribution for (n,n*10)
$10^0$
Prob\Cos
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

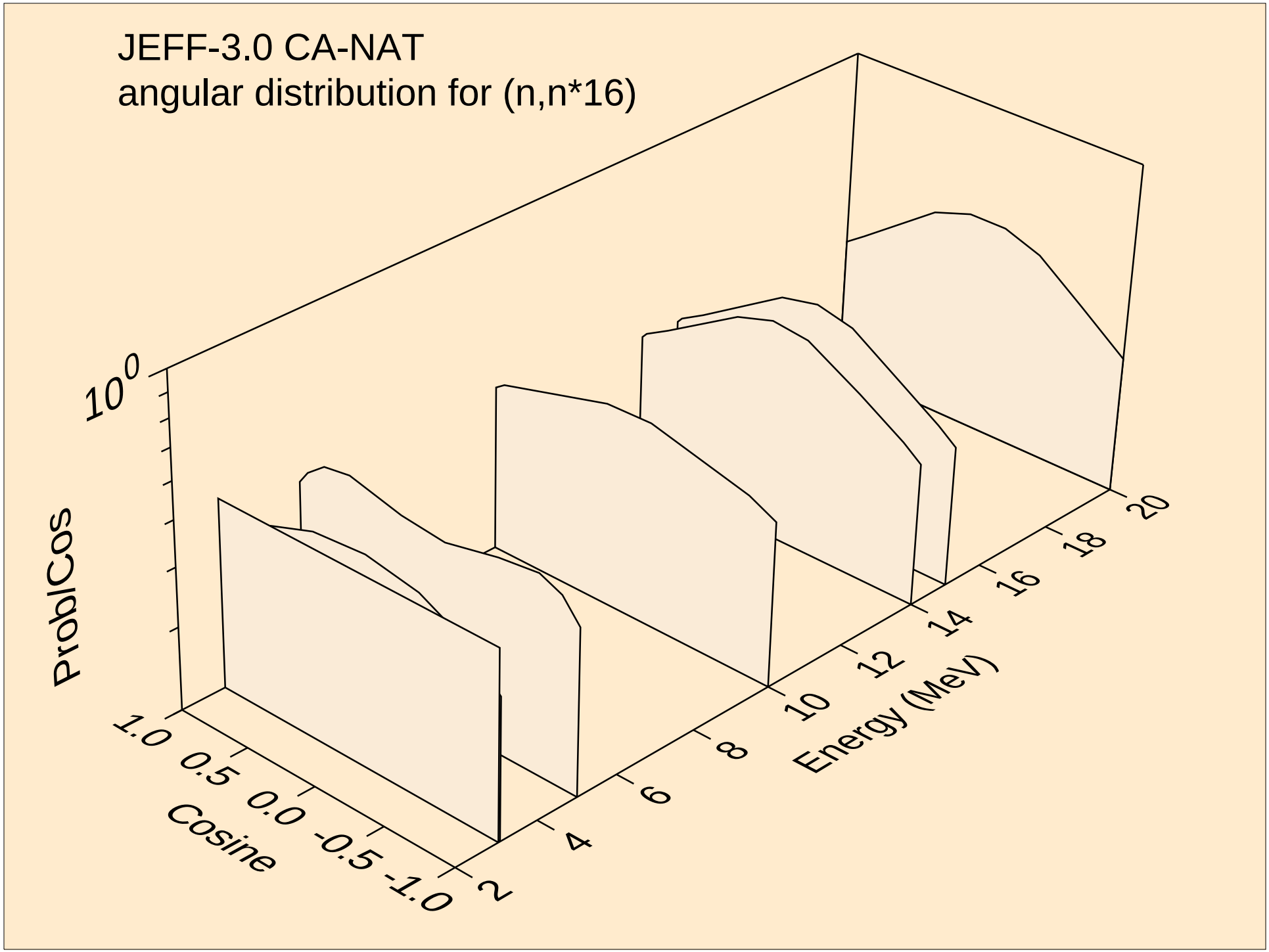

JEFF-3.0 CA-NAT
angular distribution for (n,n*11)
ProbICos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

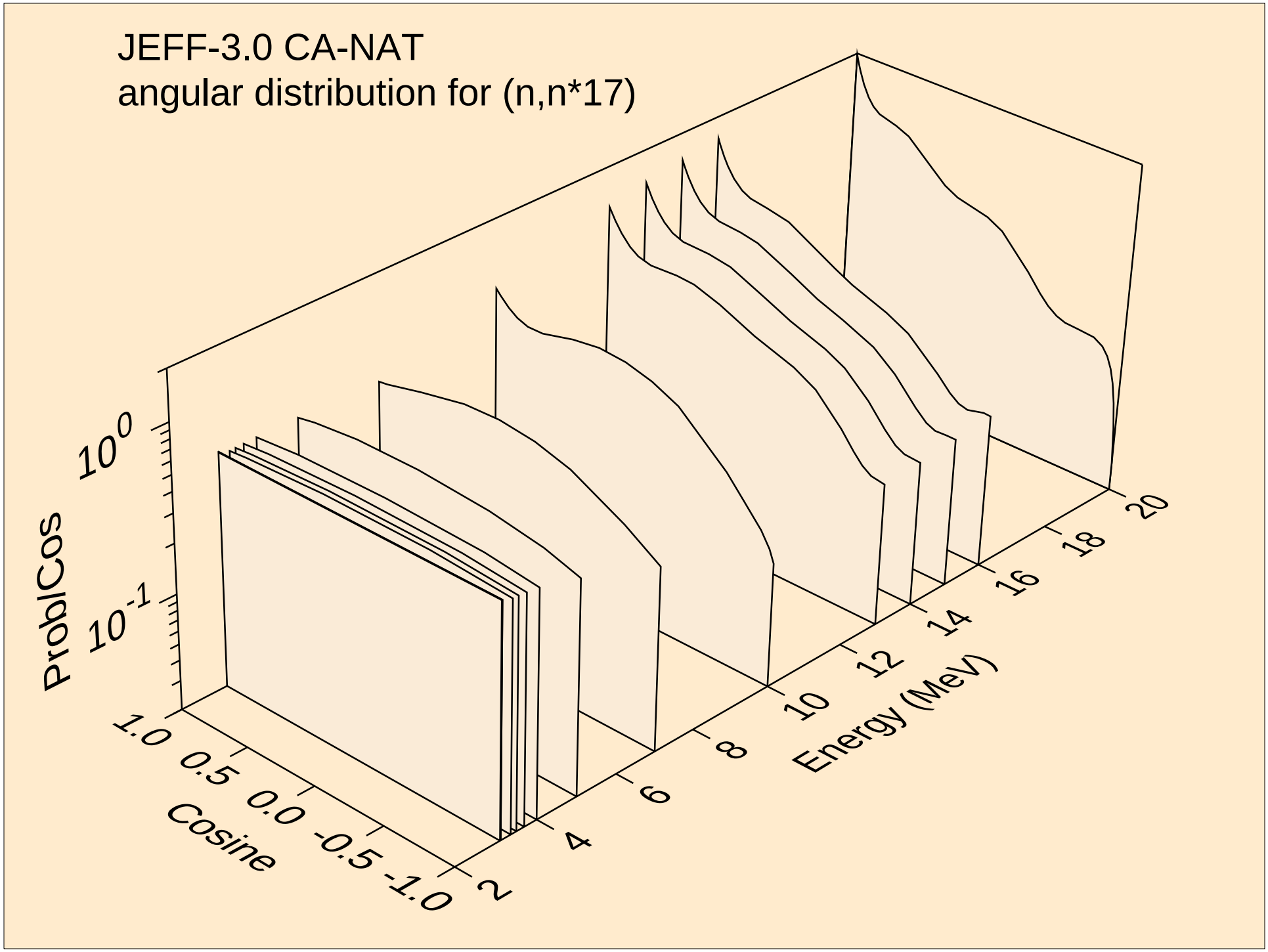

JEFF-3.0 CA-NAT
angular distribution for (n,n*12)
ProbICos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

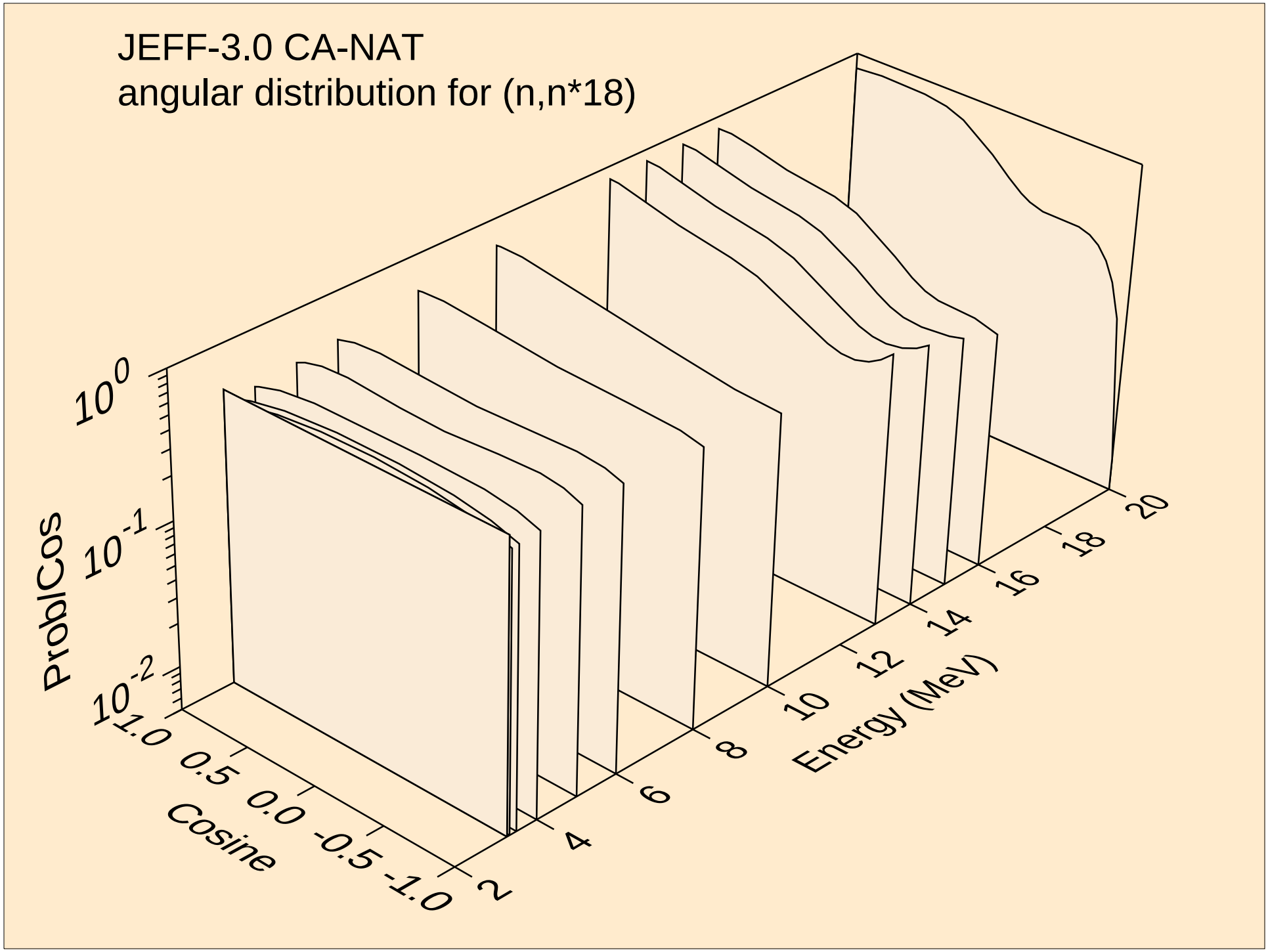

JEFF-3.0 CA-NAT
angular distribution for (n,n*13)
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

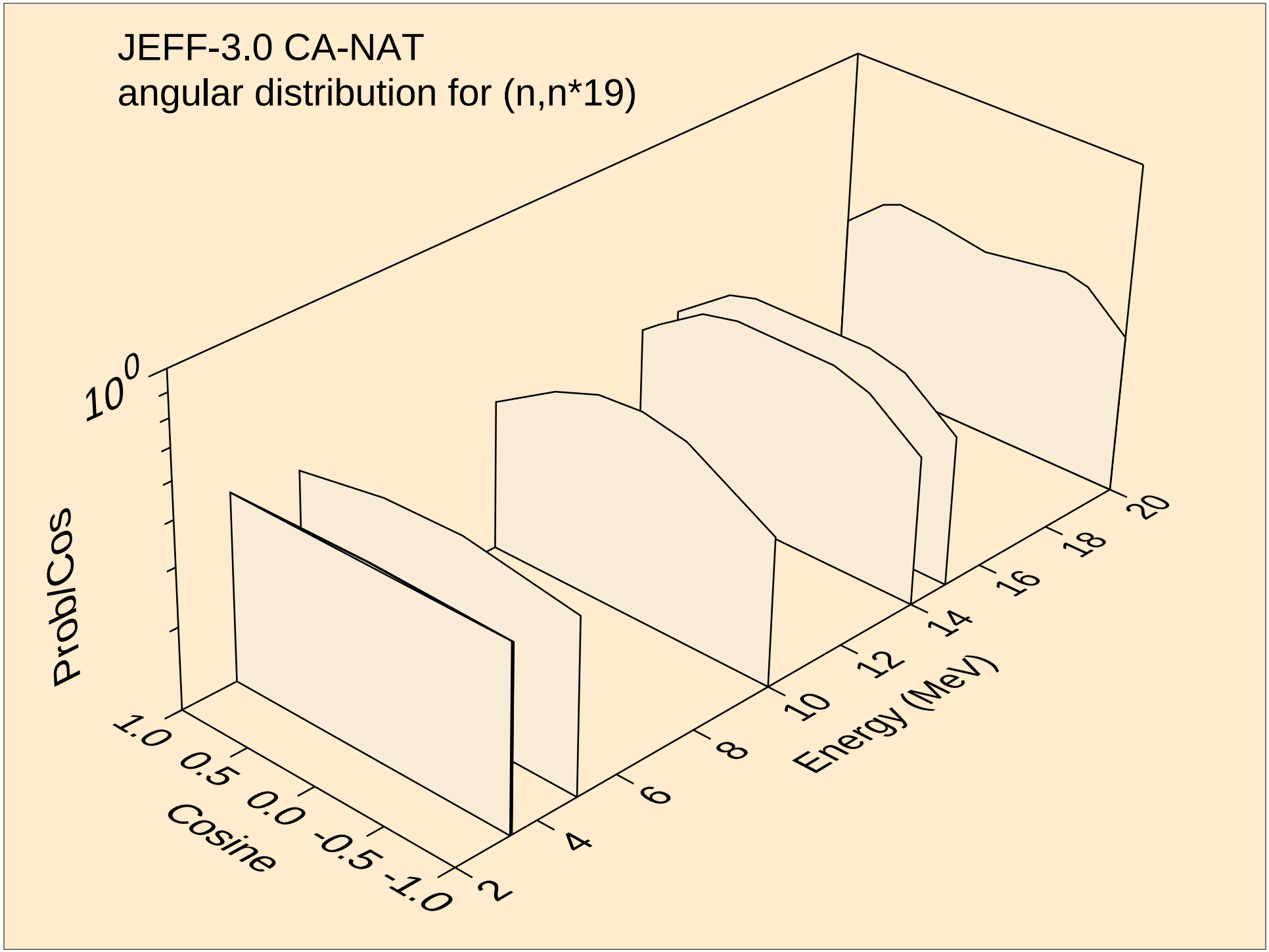

JEFF-3.0 CA-NAT
angular distribution for (n,n*14)
ProbCos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

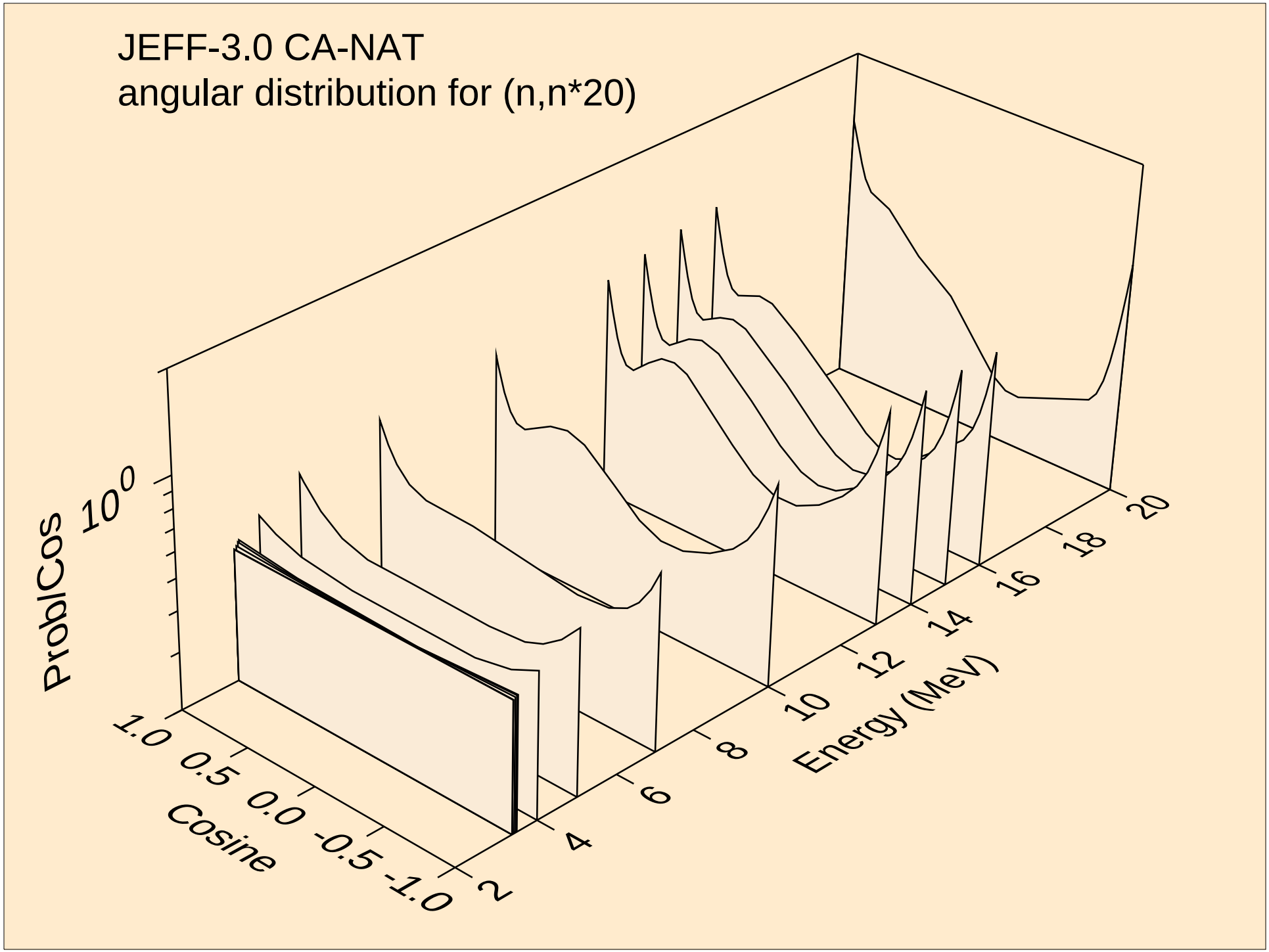

JEFF-3.0 CA-NAT
angular distribution for (n,n*15)
ProbICos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

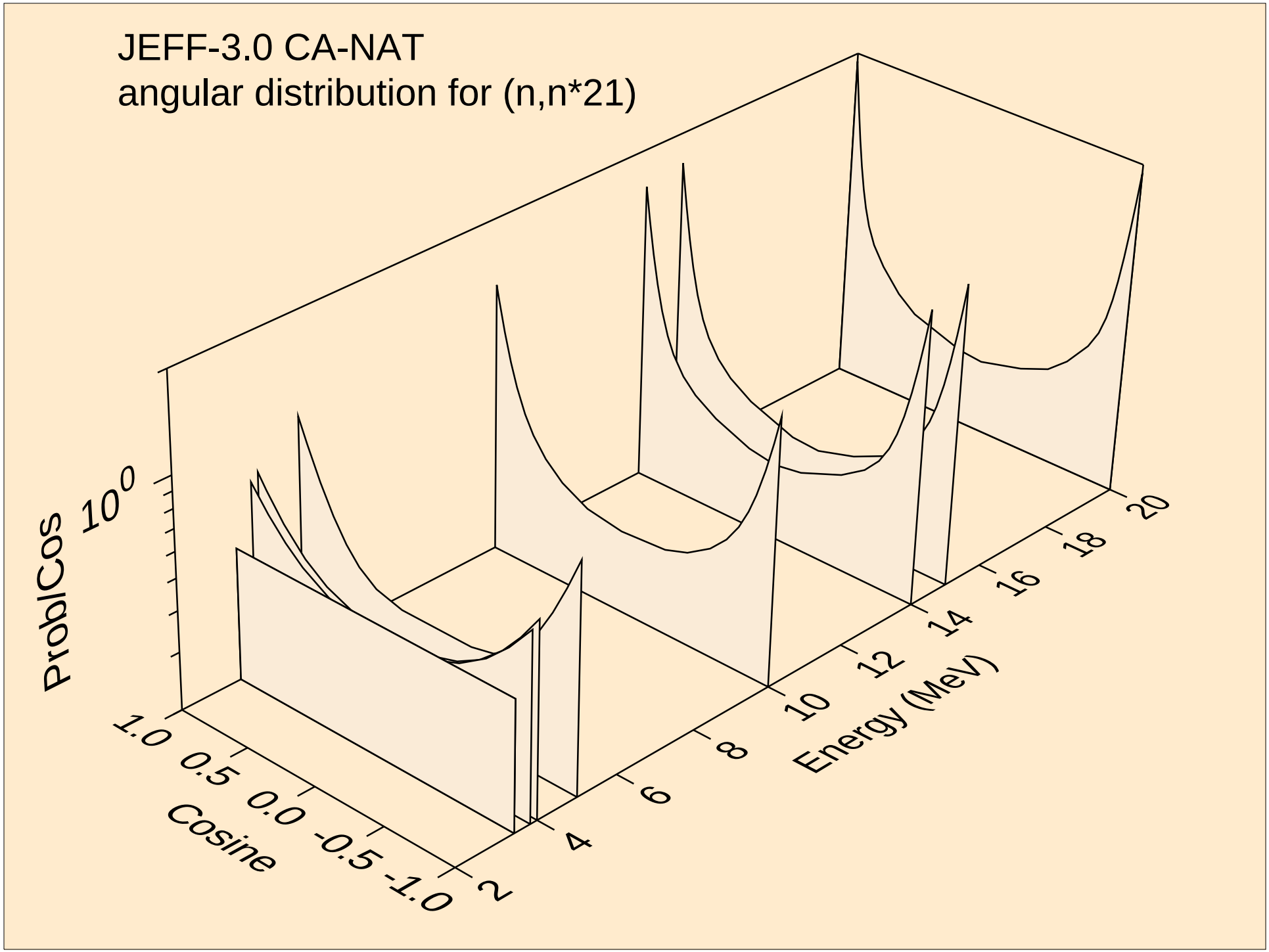

JEFF-3.0 CA-NAT
angular distribution for (n,n*16)
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

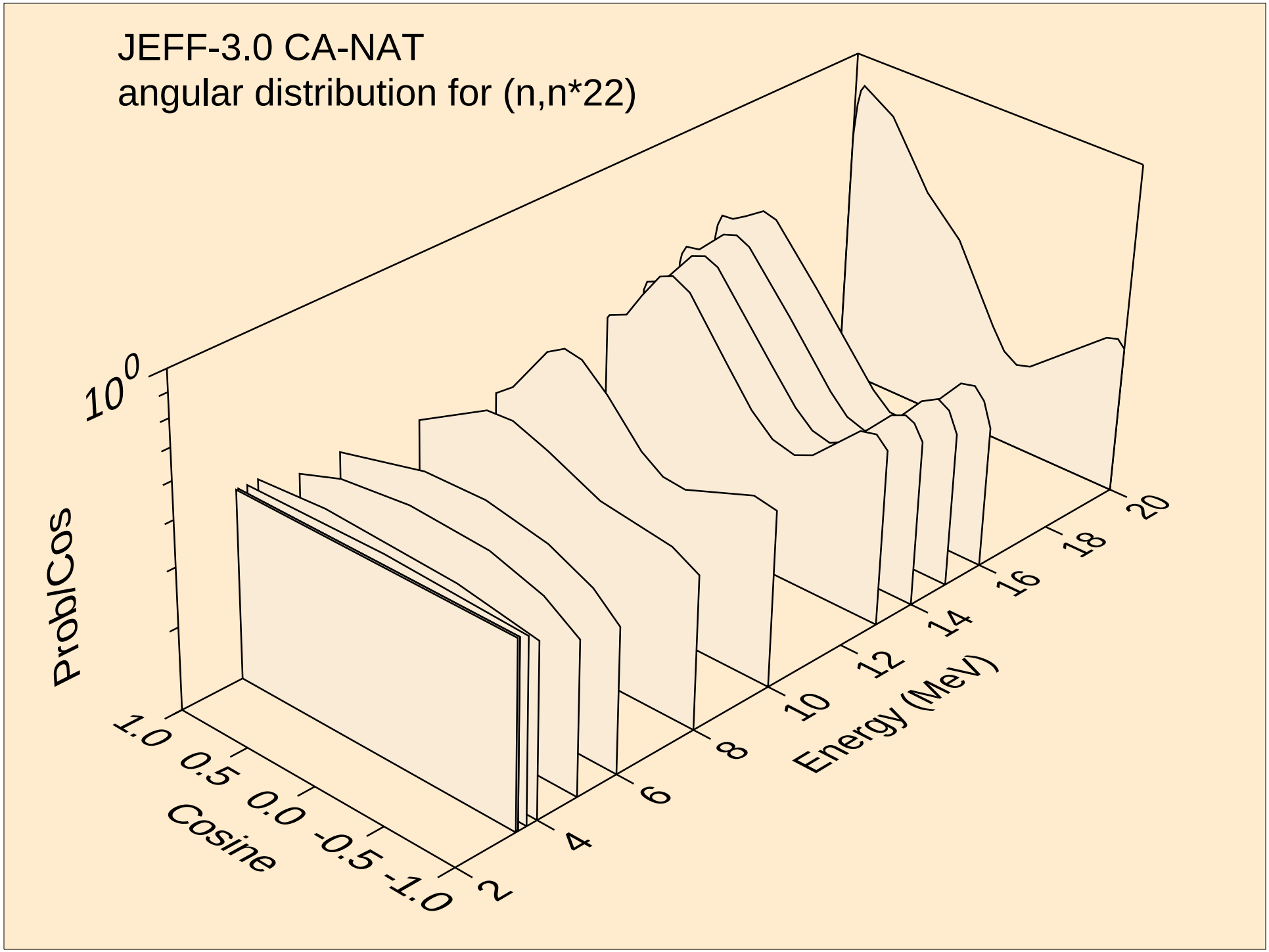

JEFF-3.0 CA-NAT
angular distribution for (n,n*17)
ProbICos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

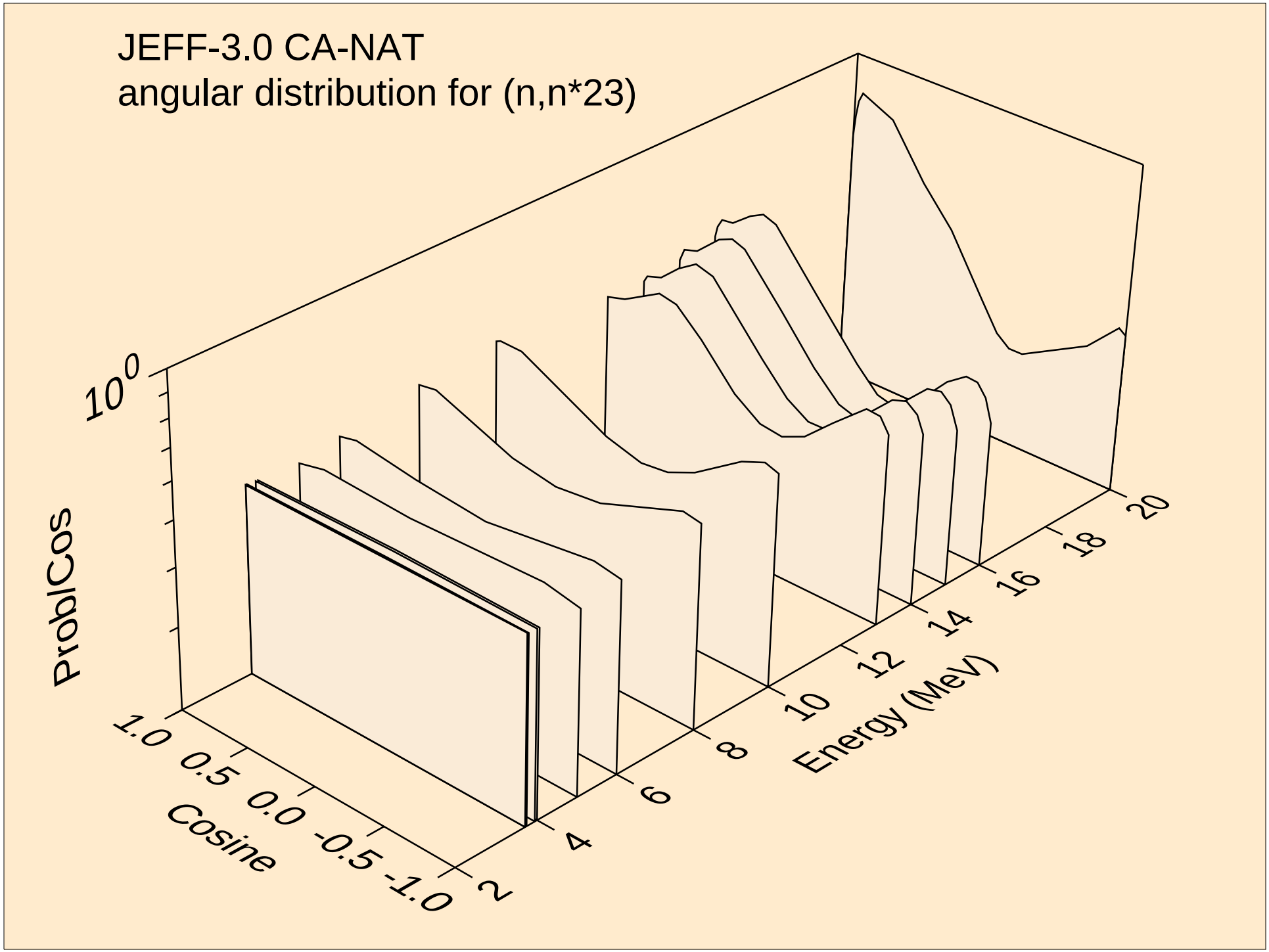

JEFF-3.0 CA-NAT
angular distribution for (n,n*18)
ProbICos
$10^{0}$
$10^{-1}$
$10^{-2}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

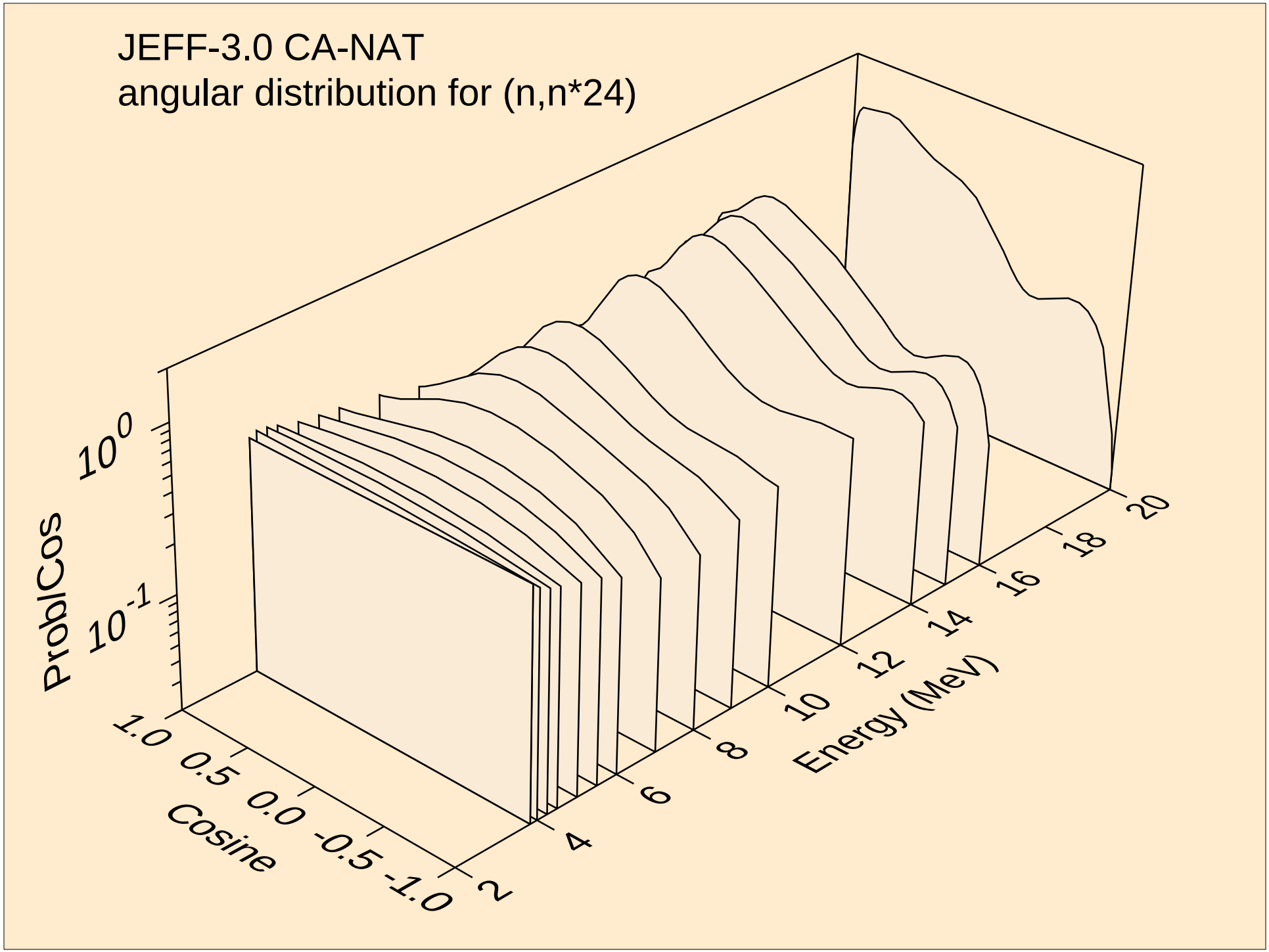

JEFF-3.0 CA-NAT
angular distribution for (n,n*19)
$10^0$
Prob\Cos
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

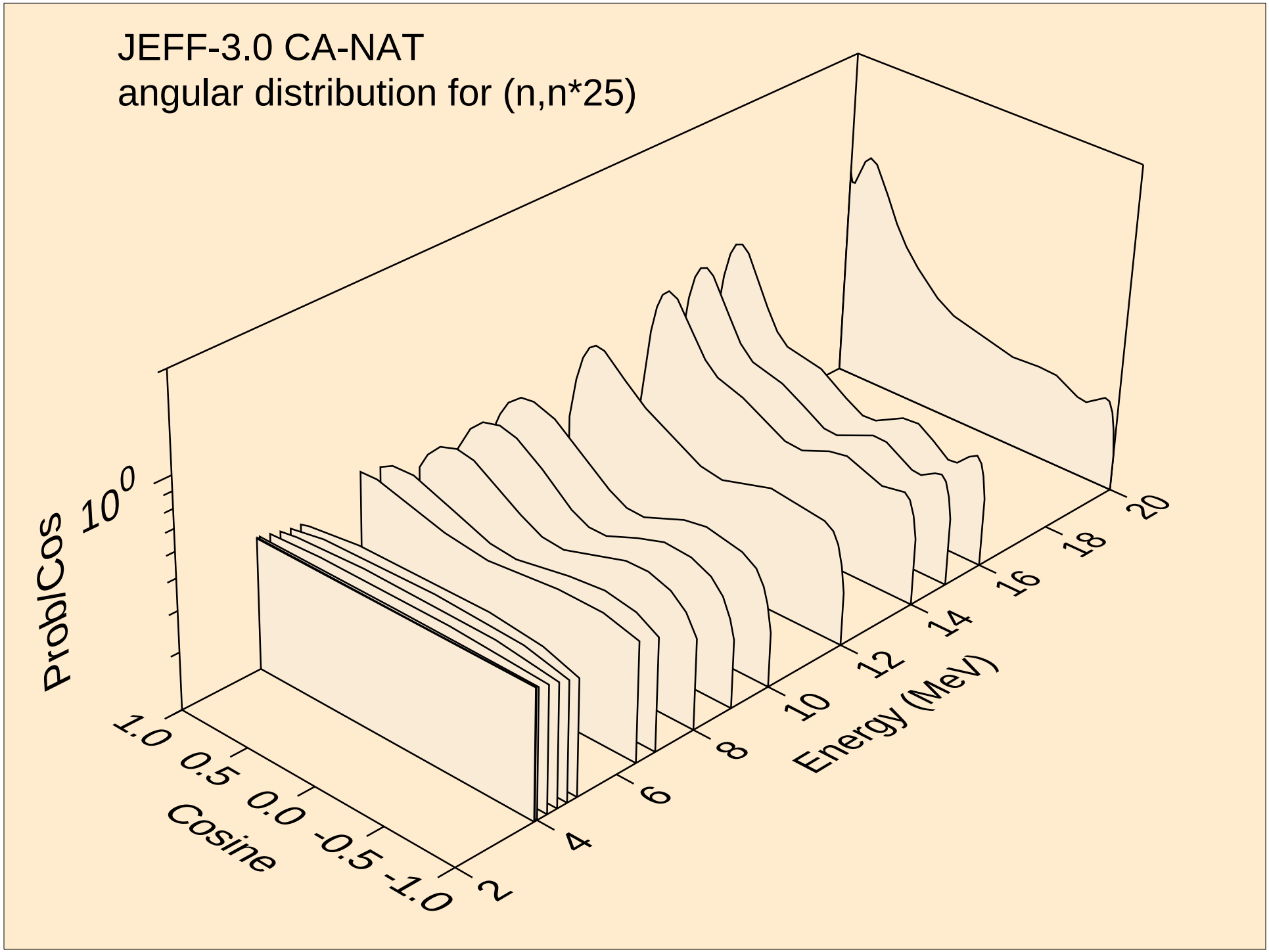

JEFF-3.0 CA-NAT
angular distribution for (n,n*20)
ProbICos
$10^0$
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

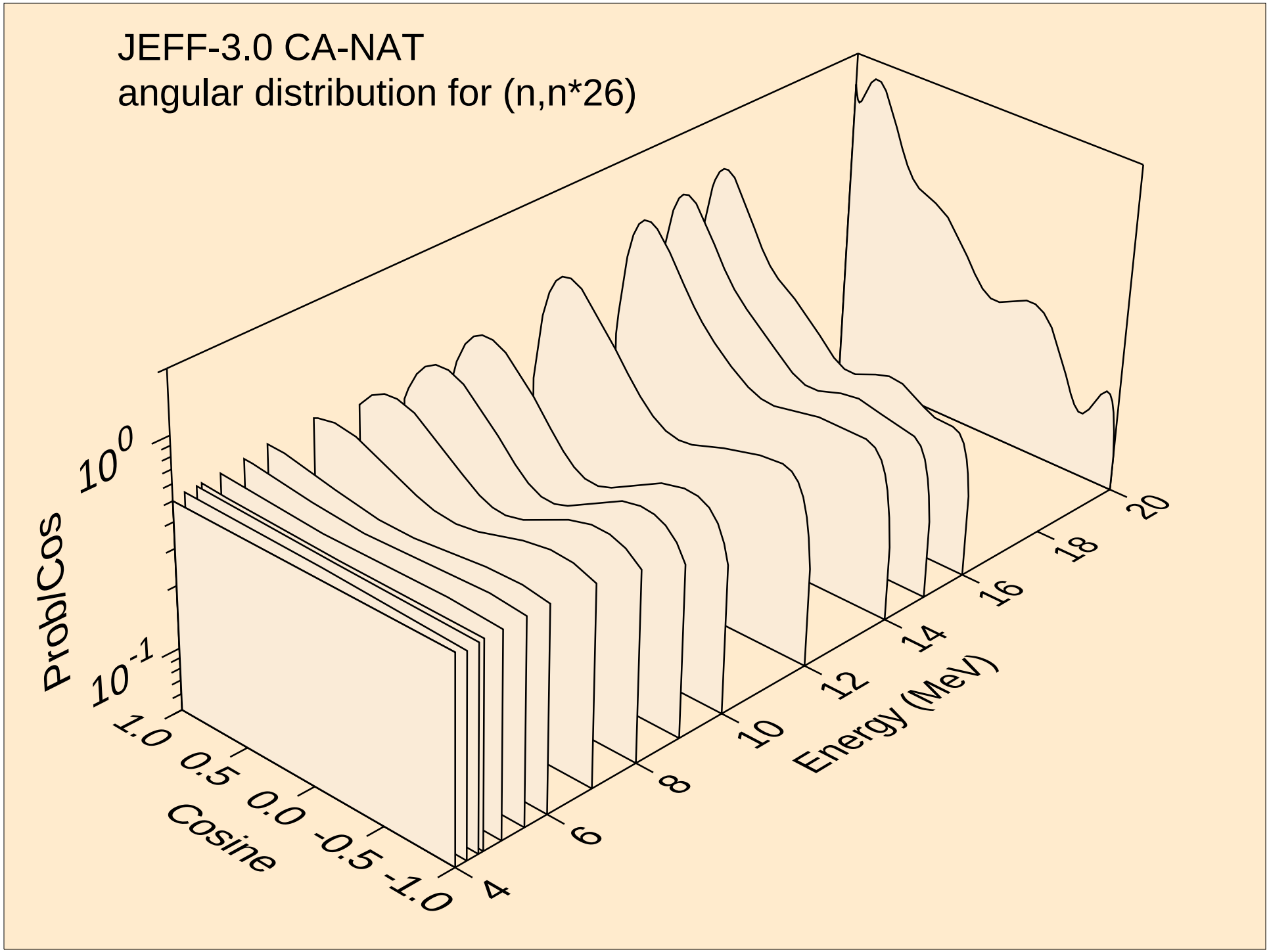

JEFF-3.0 CA-NAT
angular distribution for (n,n*21)
ProbICos
$10^0$
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

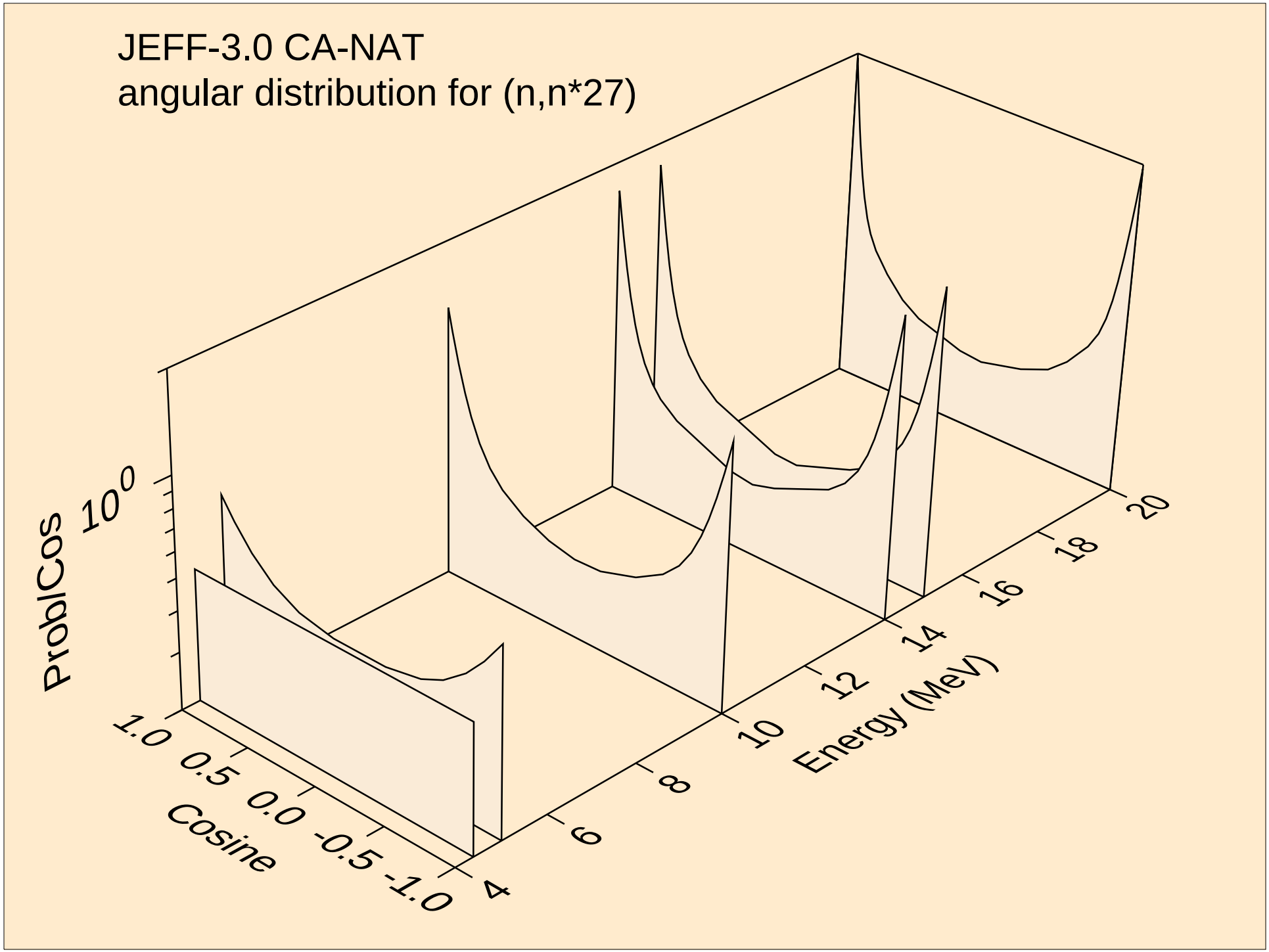

JEFF-3.0 CA-NAT
angular distribution for (n,n*22)
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

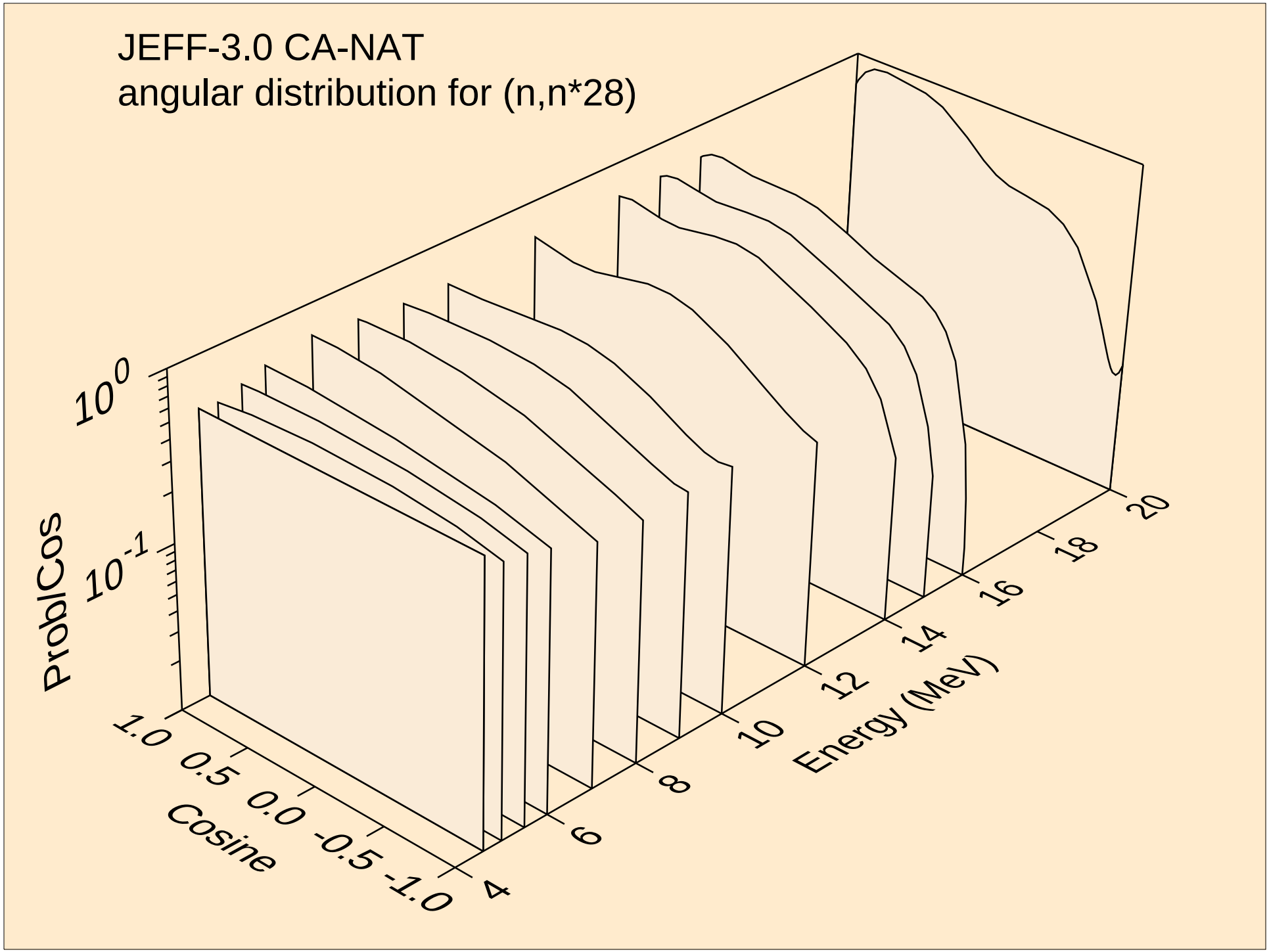

JEFF-3.0 CA-NAT
angular distribution for (n,n*23)
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

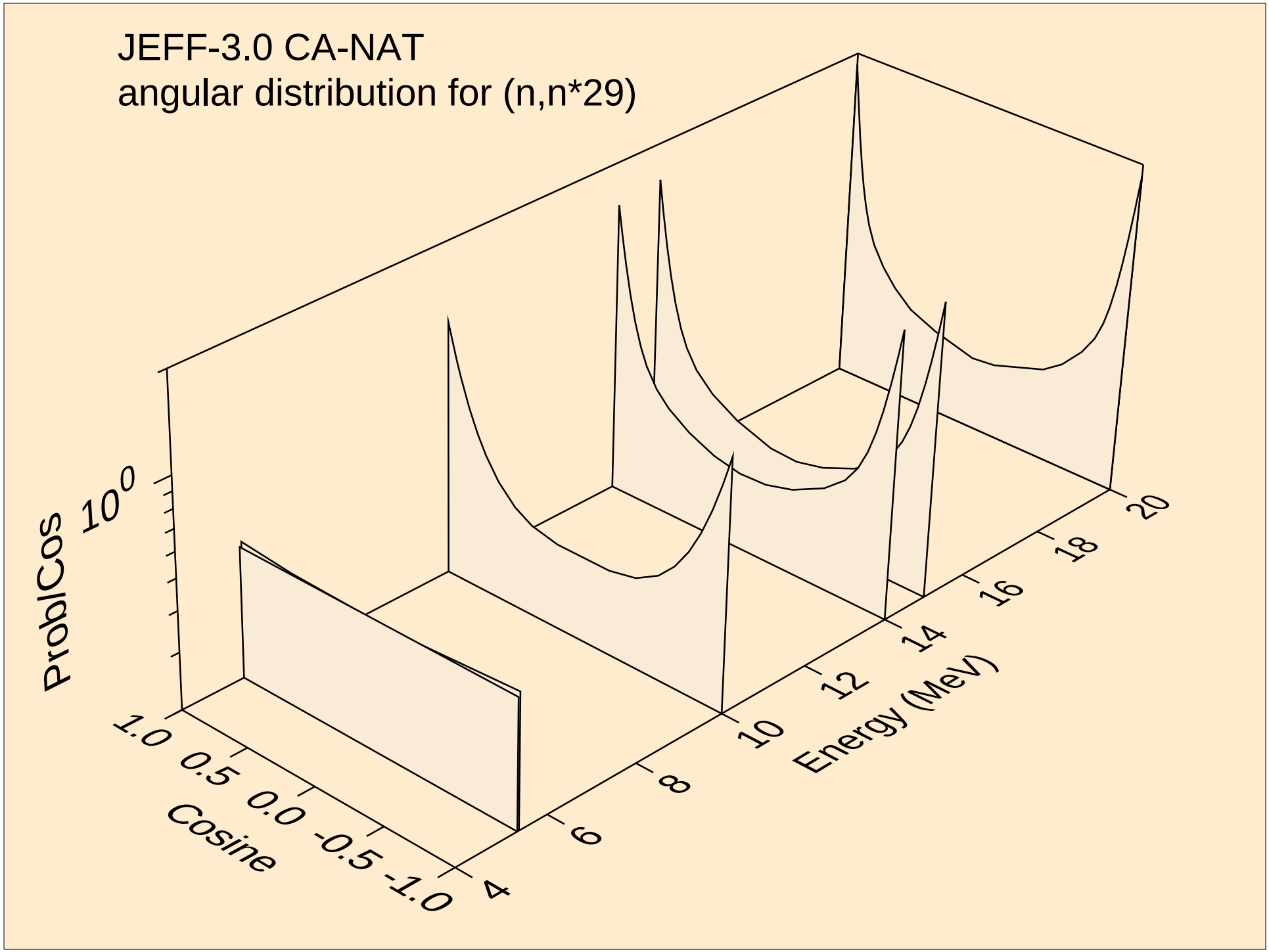

JEFF-3.0 CA-NAT
angular distribution for (n,n*24)
ProbCos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

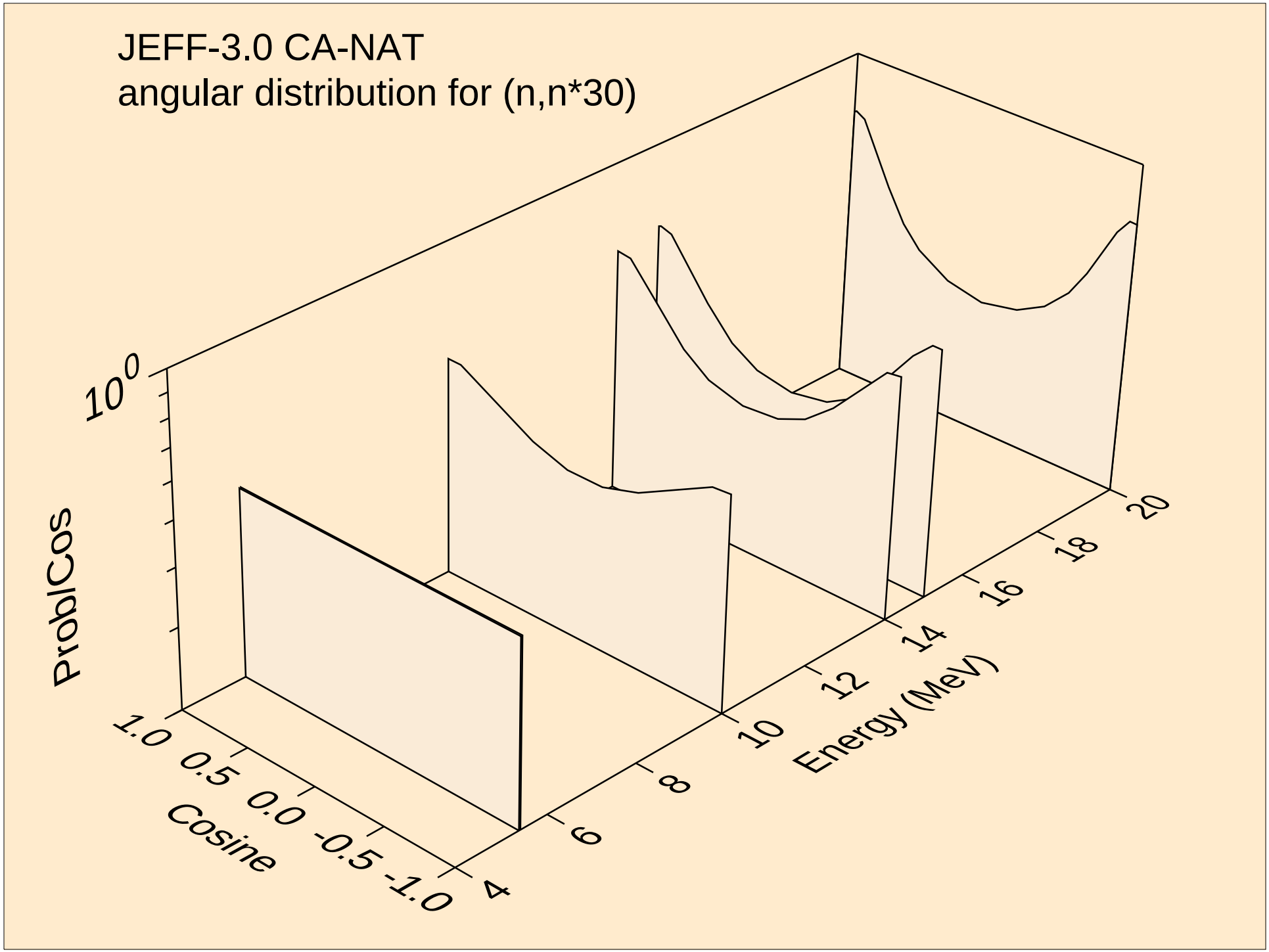

JEFF-3.0 CA-NAT
angular distribution for (n,n*25)
ProbICos
$10^0$
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

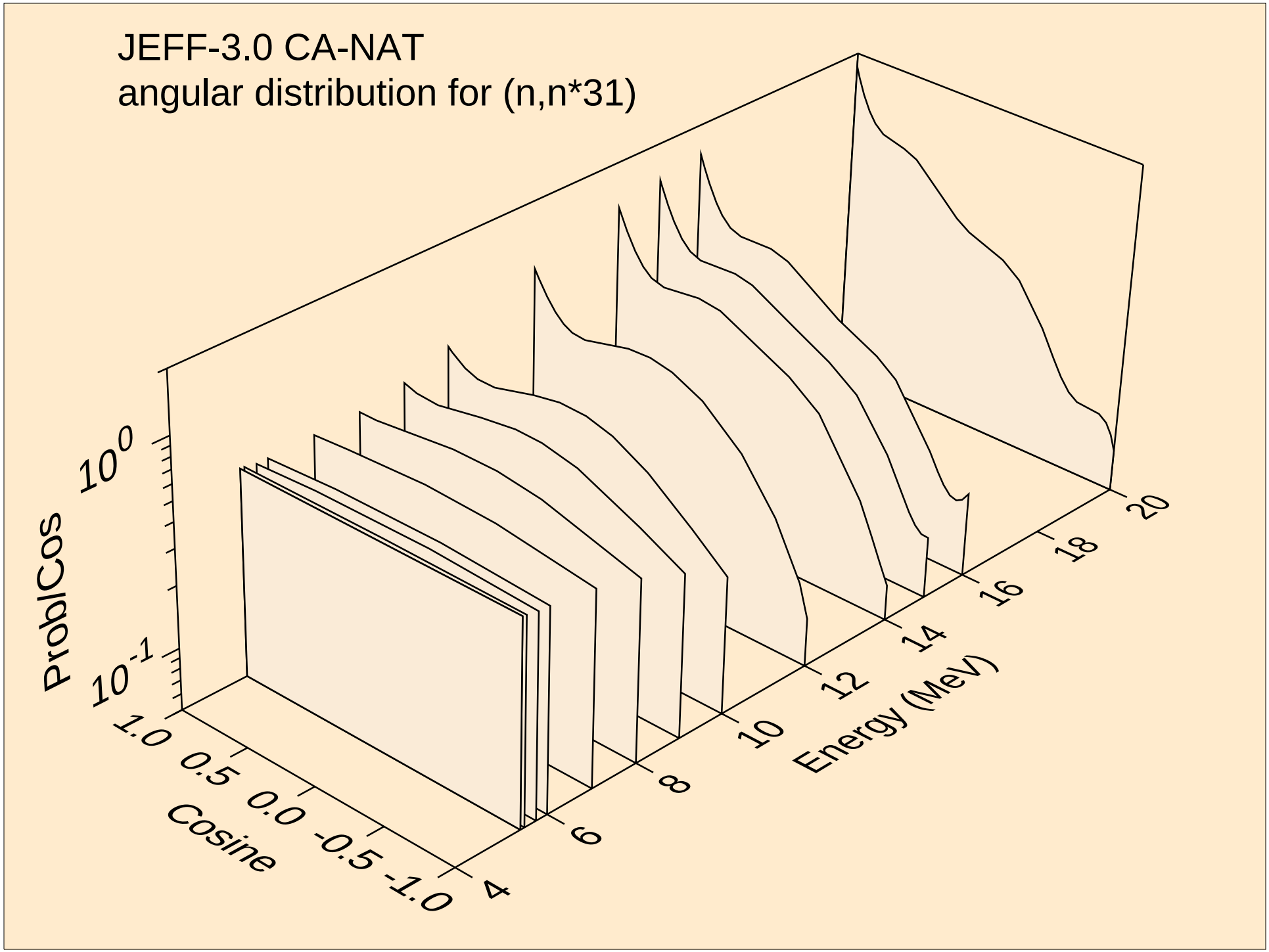

JEFF-3.0 CA-NAT
angular distribution for (n,n*26)
ProbICos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
4
6
8
10
12
14
16
18
20
Energy (MeV)

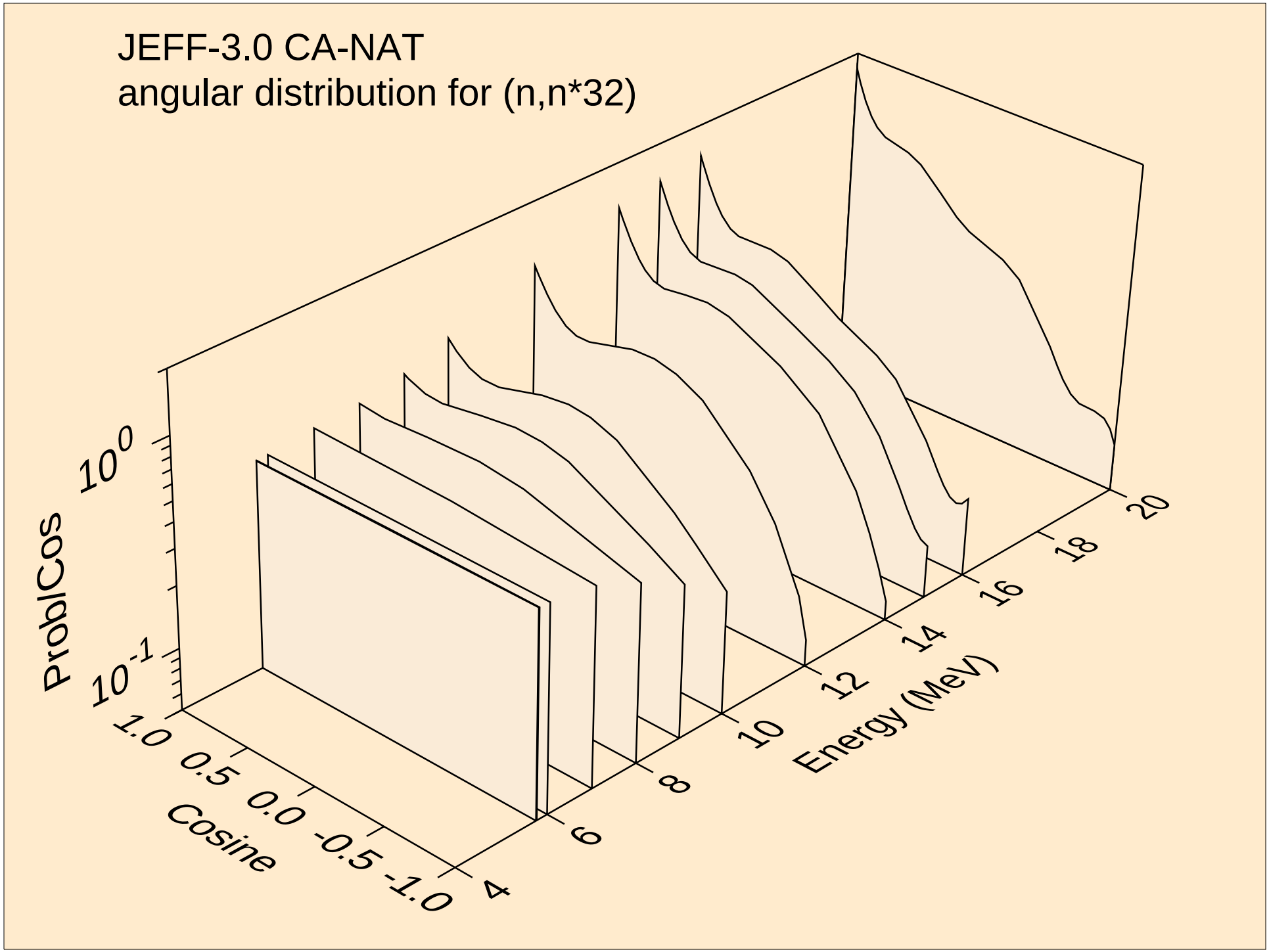

JEFF-3.0 CA-NAT
angular distribution for (n,n*27)
ProbICos
$10^0$
1.0
0.5
0.0
-0.5
-1.0
Cosine
4
6
8
10
12
14
16
18
20
Energy (MeV)

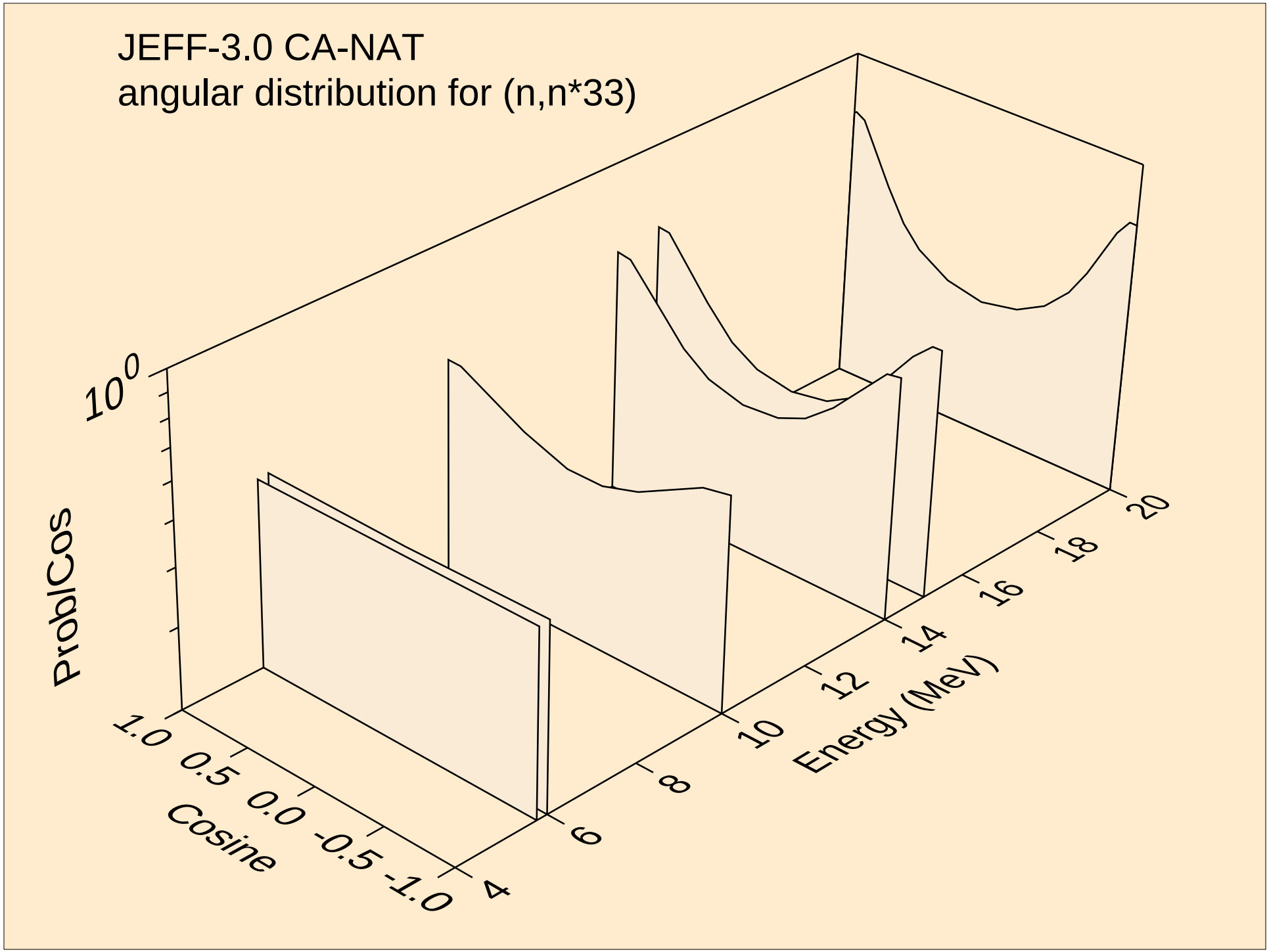

JEFF-3.0 CA-NAT
angular distribution for (n,n*28)
Prob\Cos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
4
6
8
10
12
14
16
18
20
Energy (MeV)

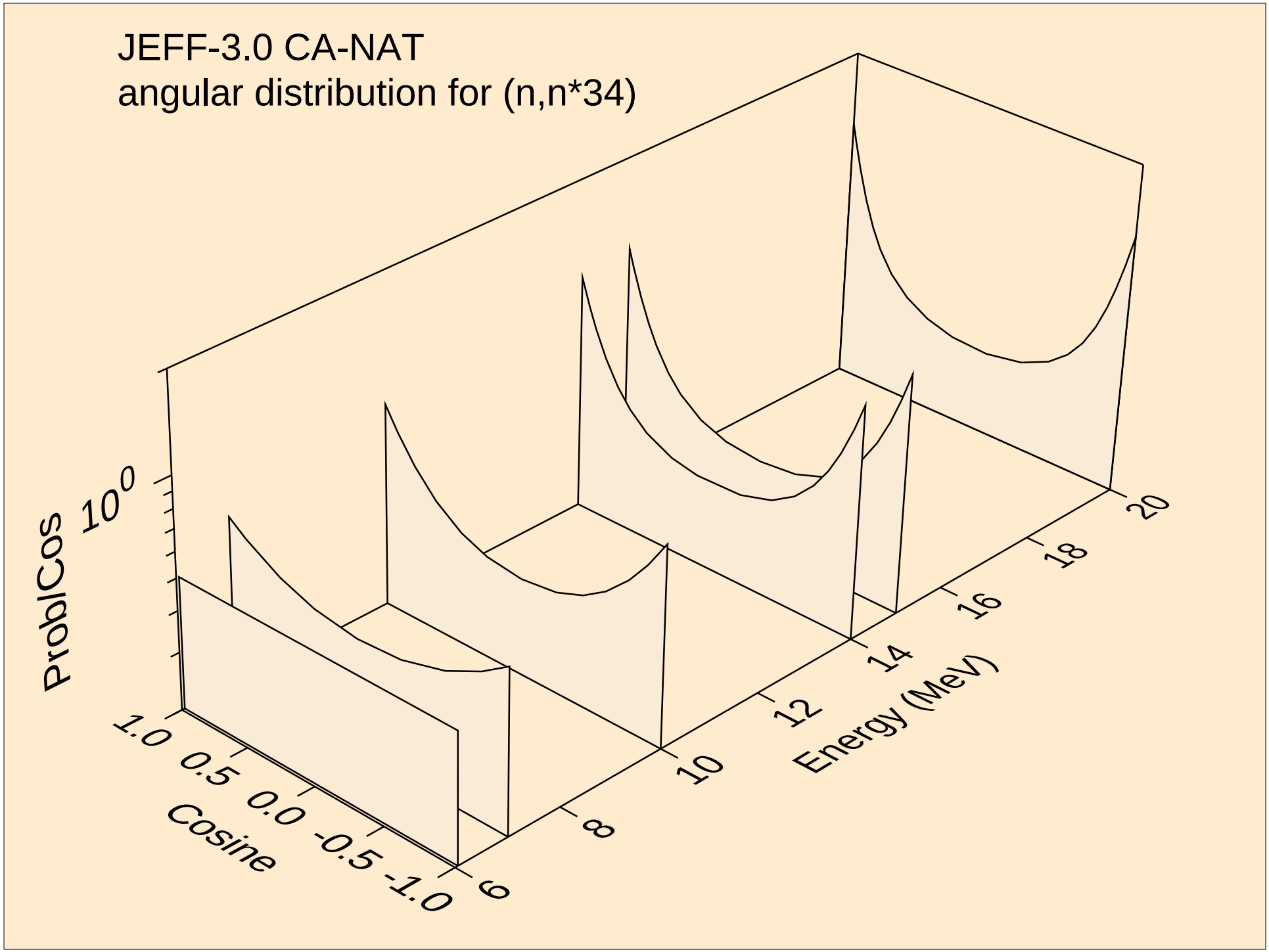

JEFF-3.0 CA-NAT
angular distribution for (n,n*29)
ProbICos
$10^0$
1.0
0.5
0.0
-0.5
-1.0
Cosine
4
6
8
10
12
14
16
18
20
Energy (MeV)

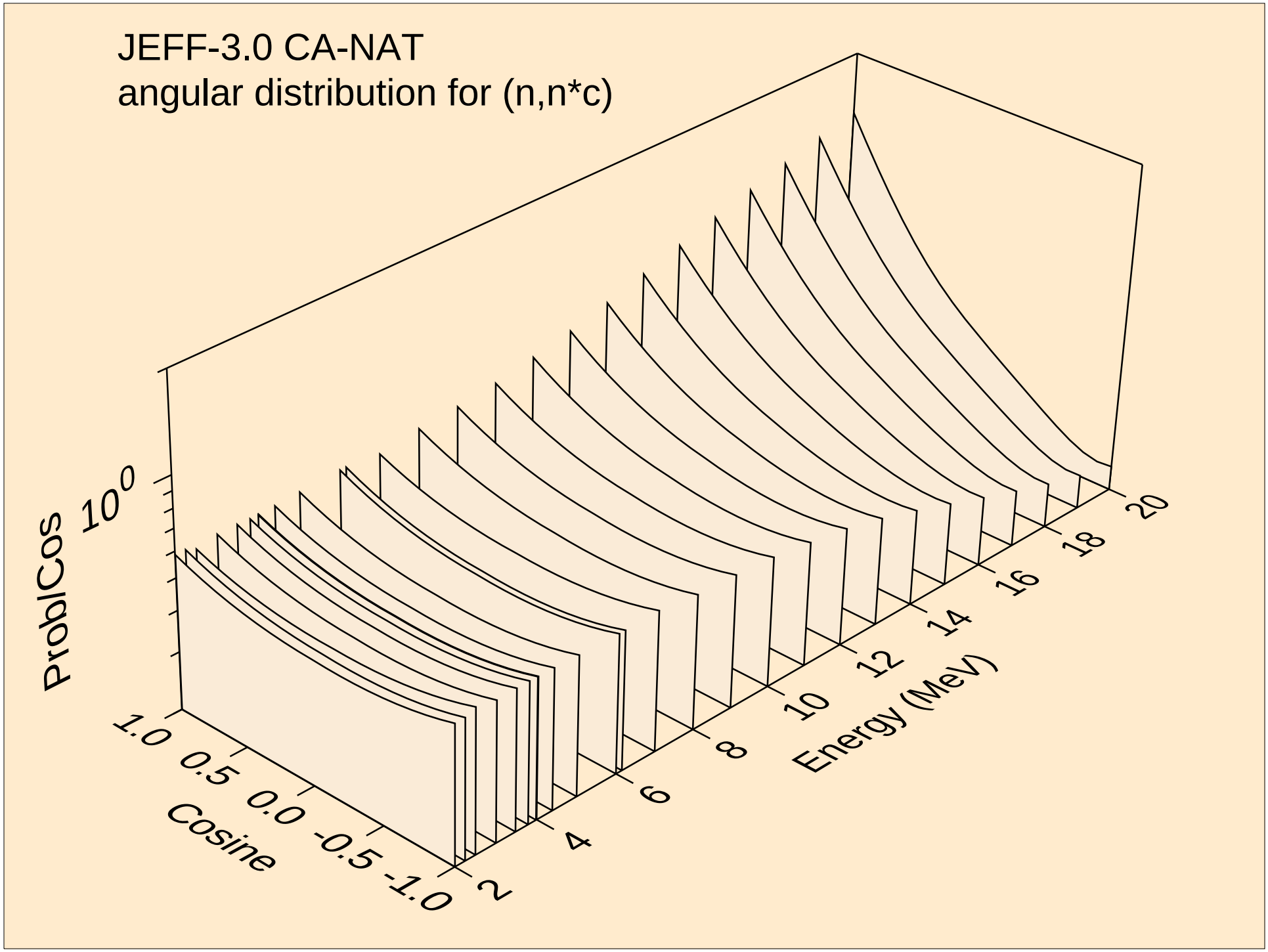

JEFF-3.0 CA-NAT
angular distribution for (n,n*30)
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
4
6
8
10
12
14
16
18
20
Energy (MeV)

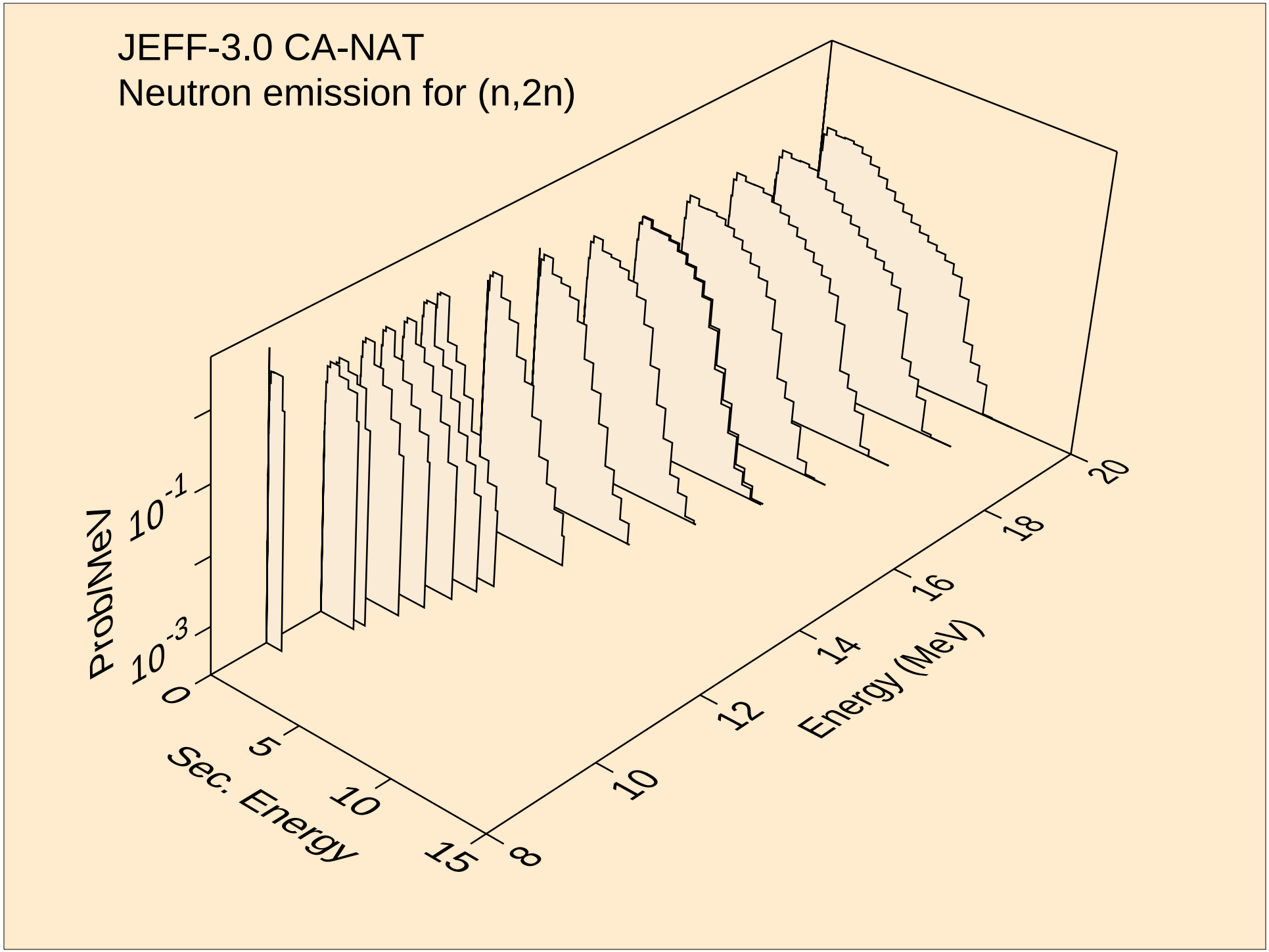

JEFF-3.0 CA-NAT
angular distribution for (n,n*31)
ProbICos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
4
6
8
10
12
14
16
18
20
Energy (MeV)

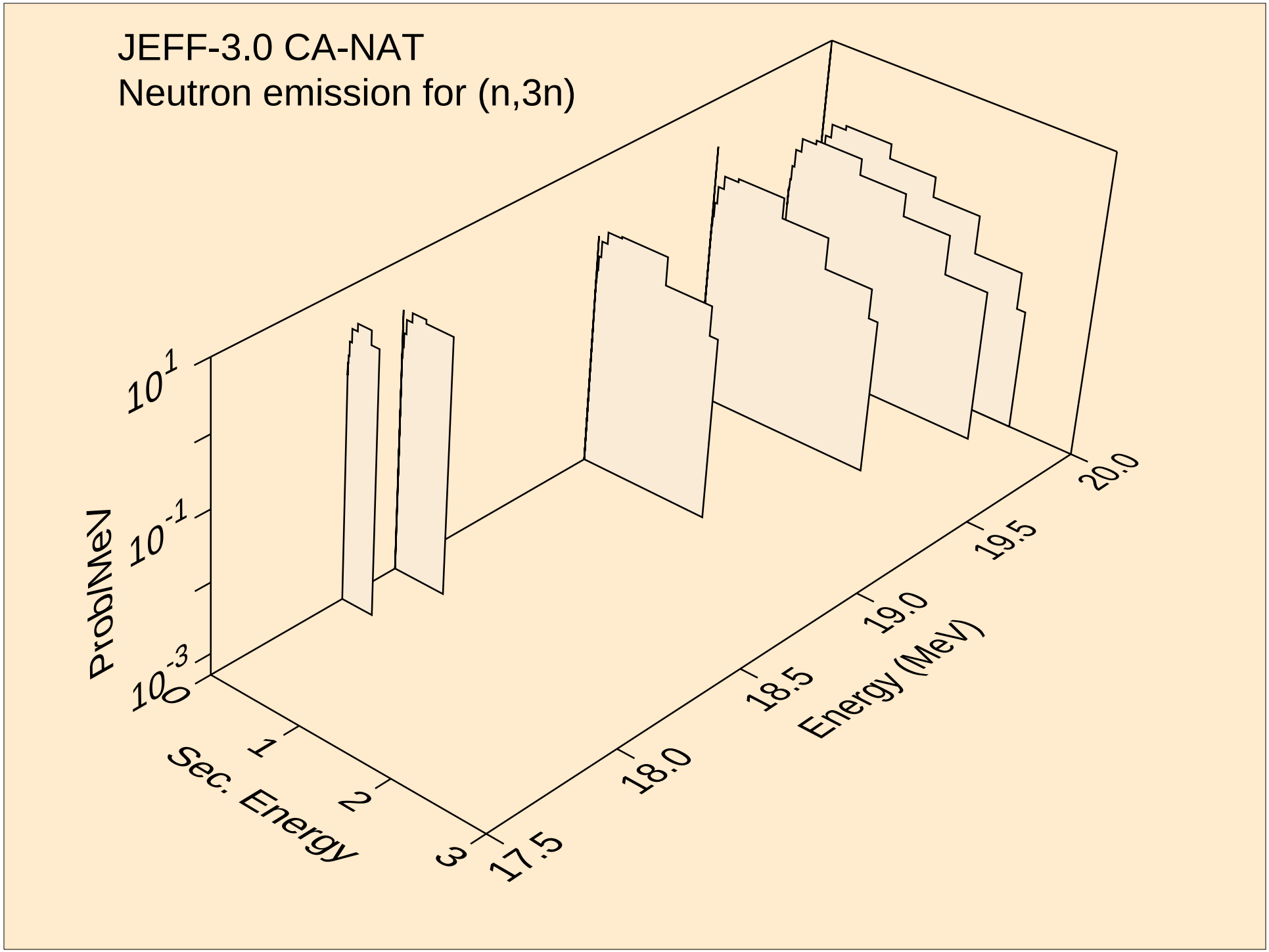

JEFF-3.0 CA-NAT
angular distribution for (n,n*32)
ProbICos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
4
6
8
10
12
14
16
18
20
Energy (MeV)

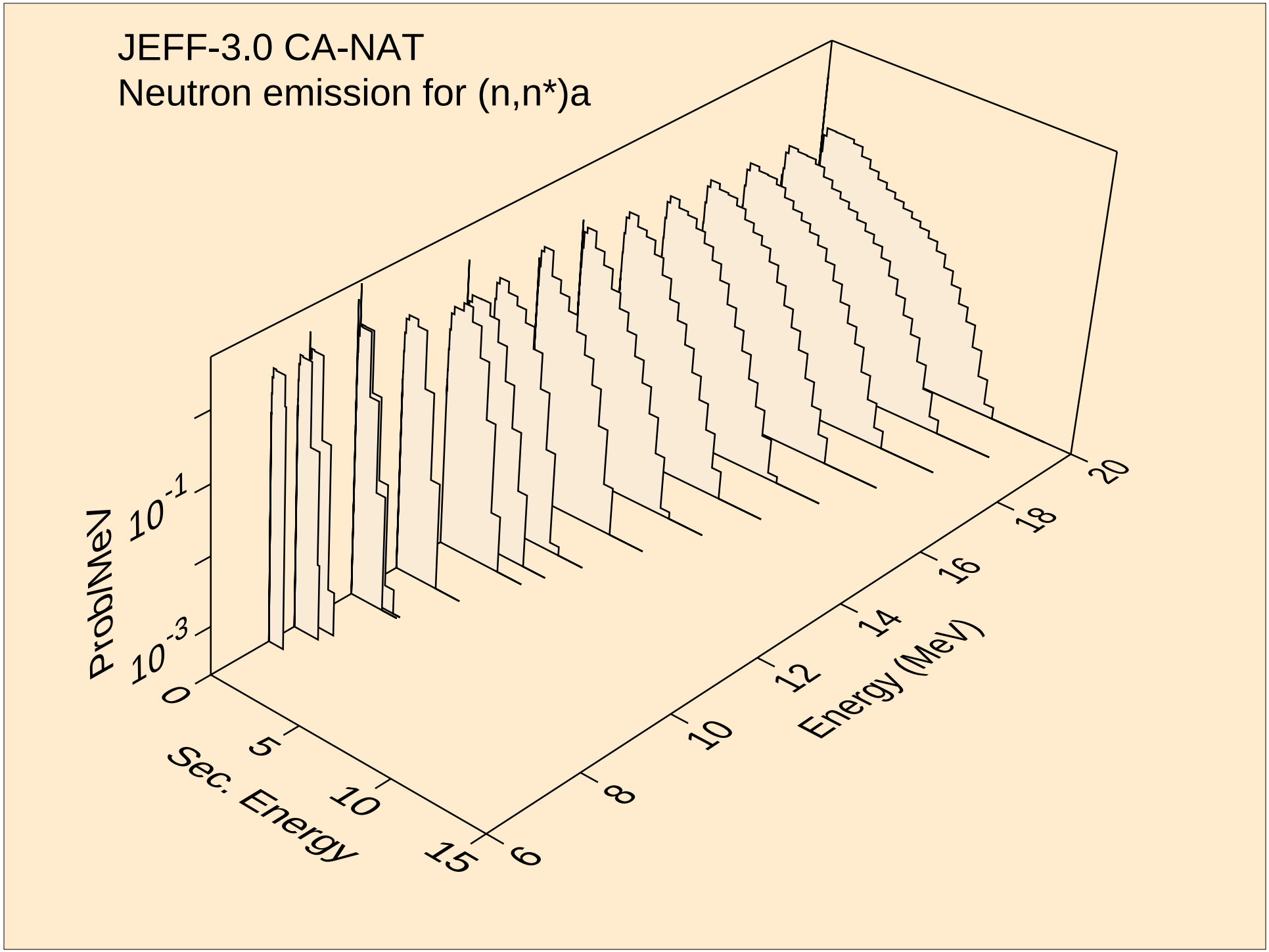

JEFF-3.0 CA-NAT
angular distribution for (n,n*33)
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
4
6
8
10
12
14
16
18
20
Energy (MeV)

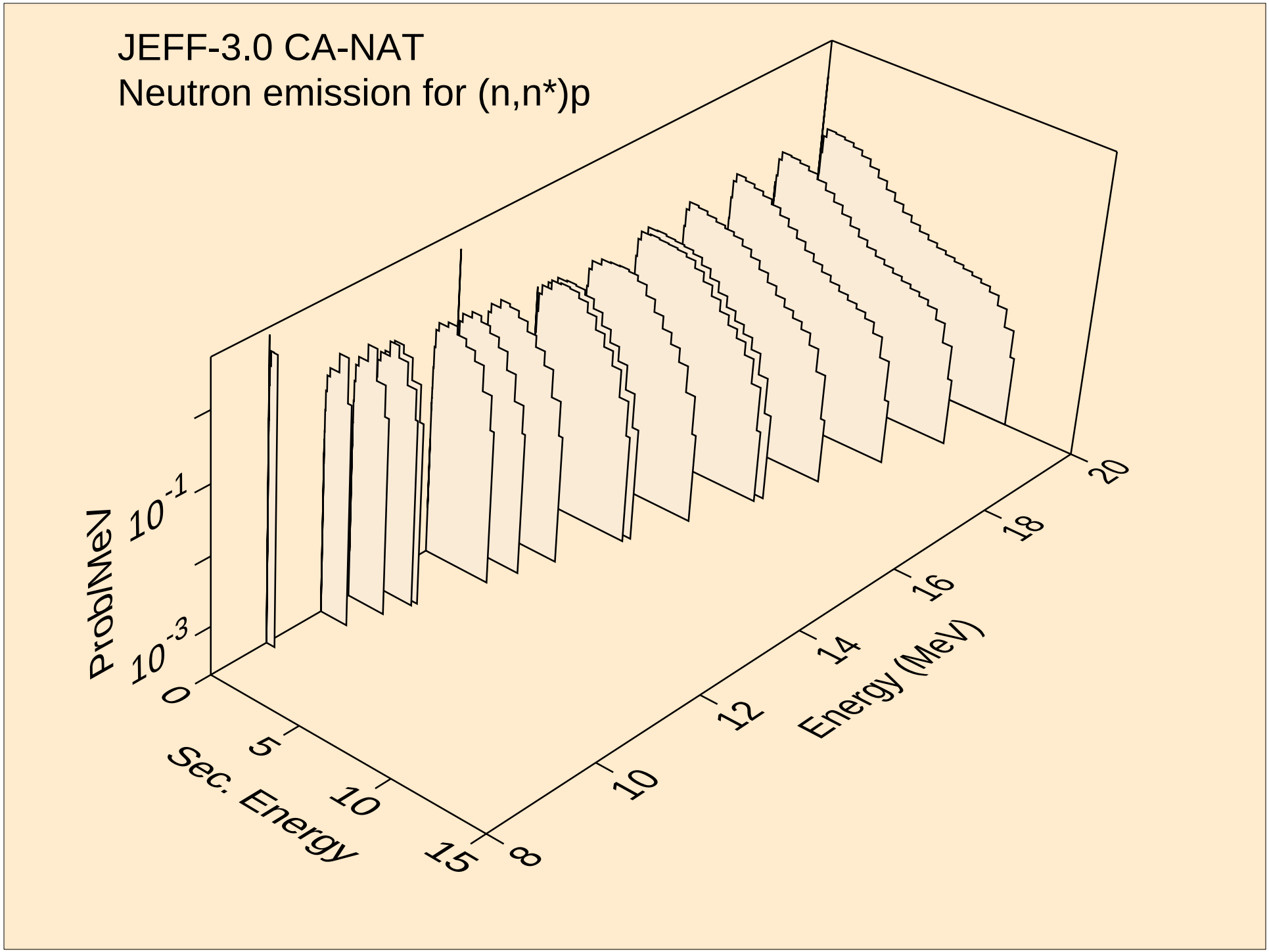

JEFF-3.0 CA-NAT
angular distribution for (n,n*34)
ProblCos
$10^0$
1.0
0.5
0.0
-0.5
-1.0
Cosine
6
8
10
12
14
16
18
20
Energy (MeV)

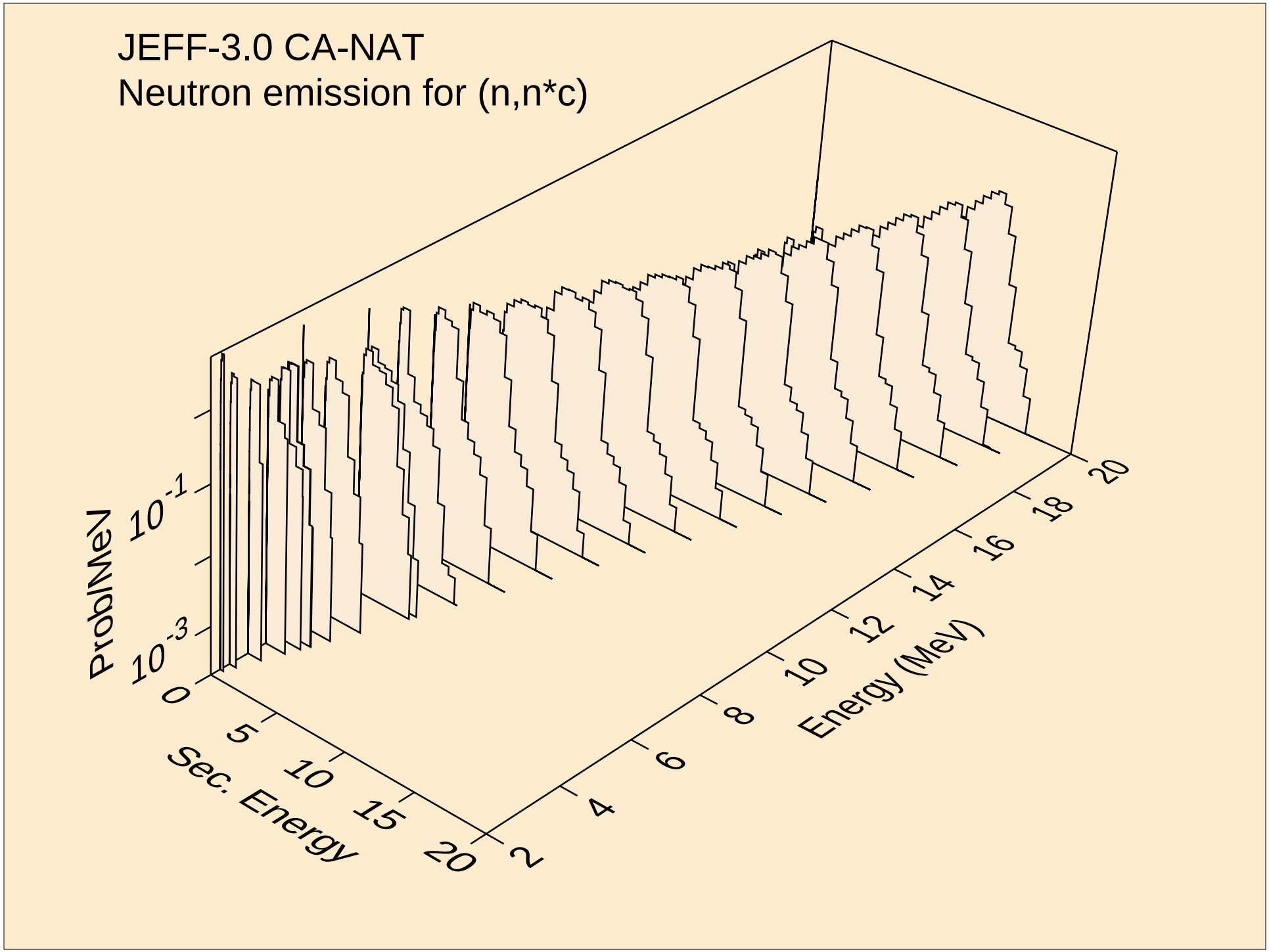

JEFF-3.0 CA-NAT
angular distribution for (n,n*c)
ProbICos
$10^0$
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

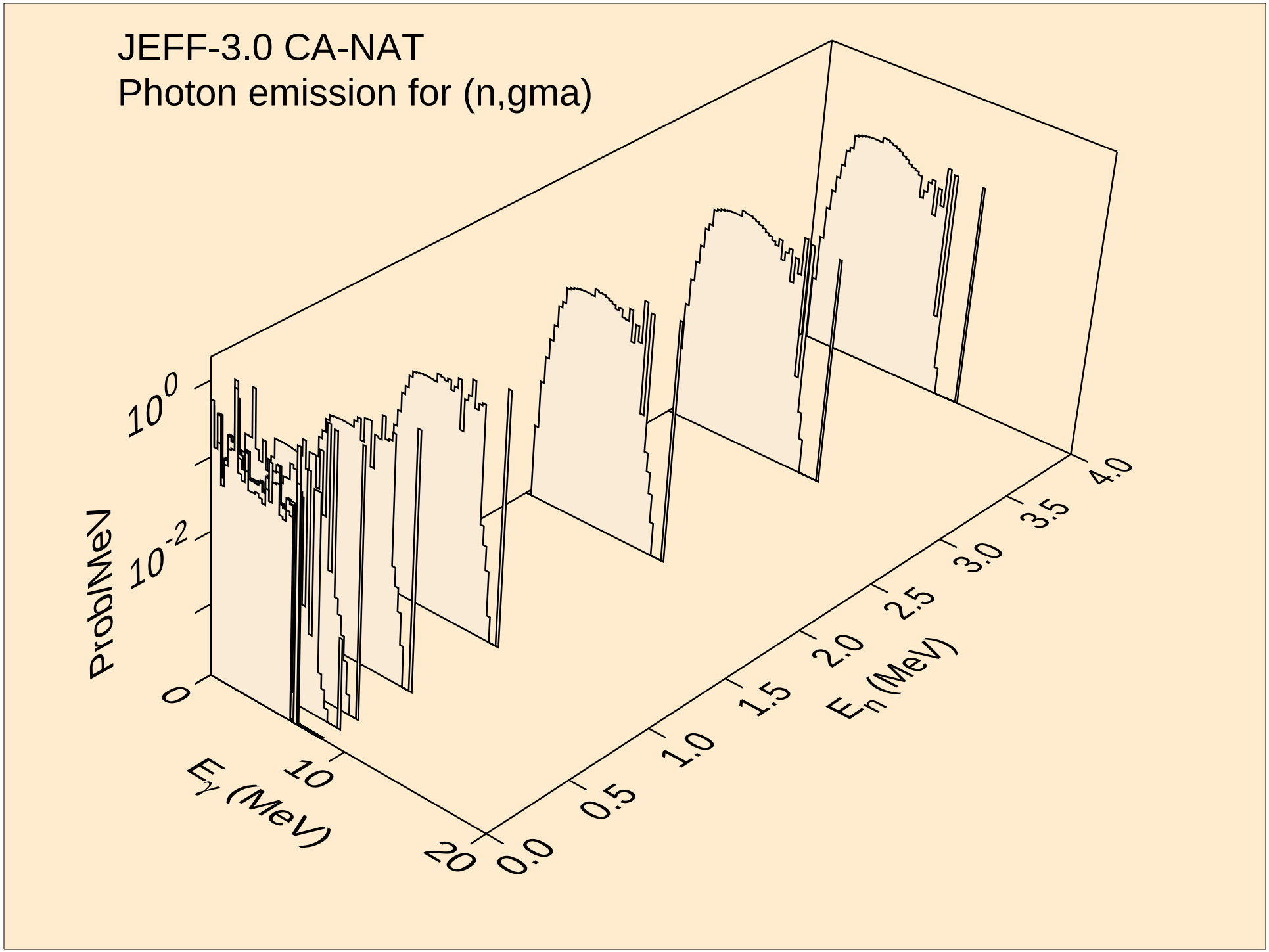

JEFF-3.0 CA-NAT
Neutron emission for (n,2n)
Prob/MeV
10^-1
10^-3
0
Sec. Energy
5
10
15
8
10
12
14
16
18
20
Energy (MeV)

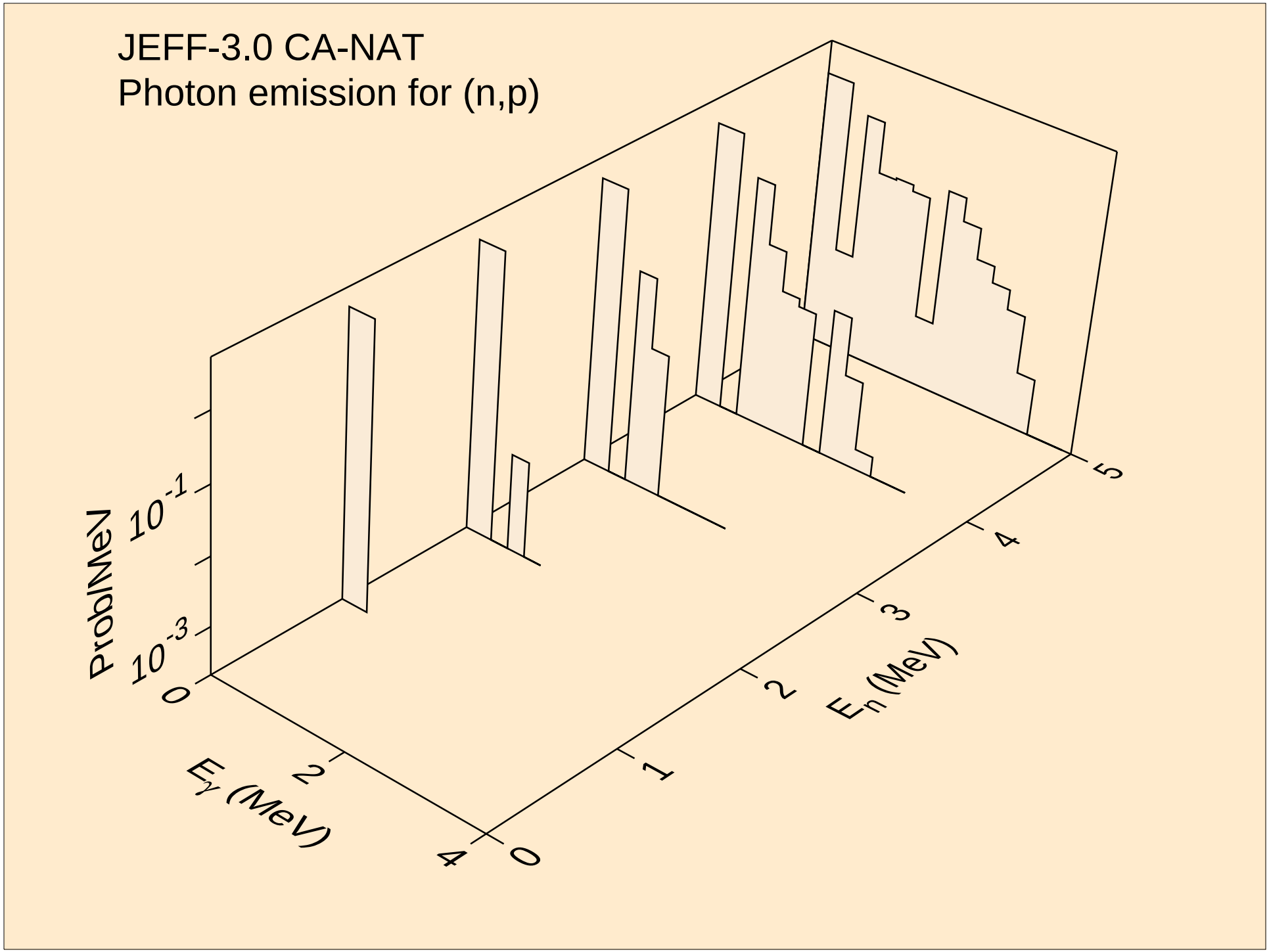

JEFF-3.0 CA-NAT
Neutron emission for (n,3n)
Prob/MeV
$10^{1}$
$10^{-1}$
$10^{-3}$
0
Sec. Energy
1
2
3
17.5
18.0
18.5
19.0
19.5
20.0
Energy (MeV)

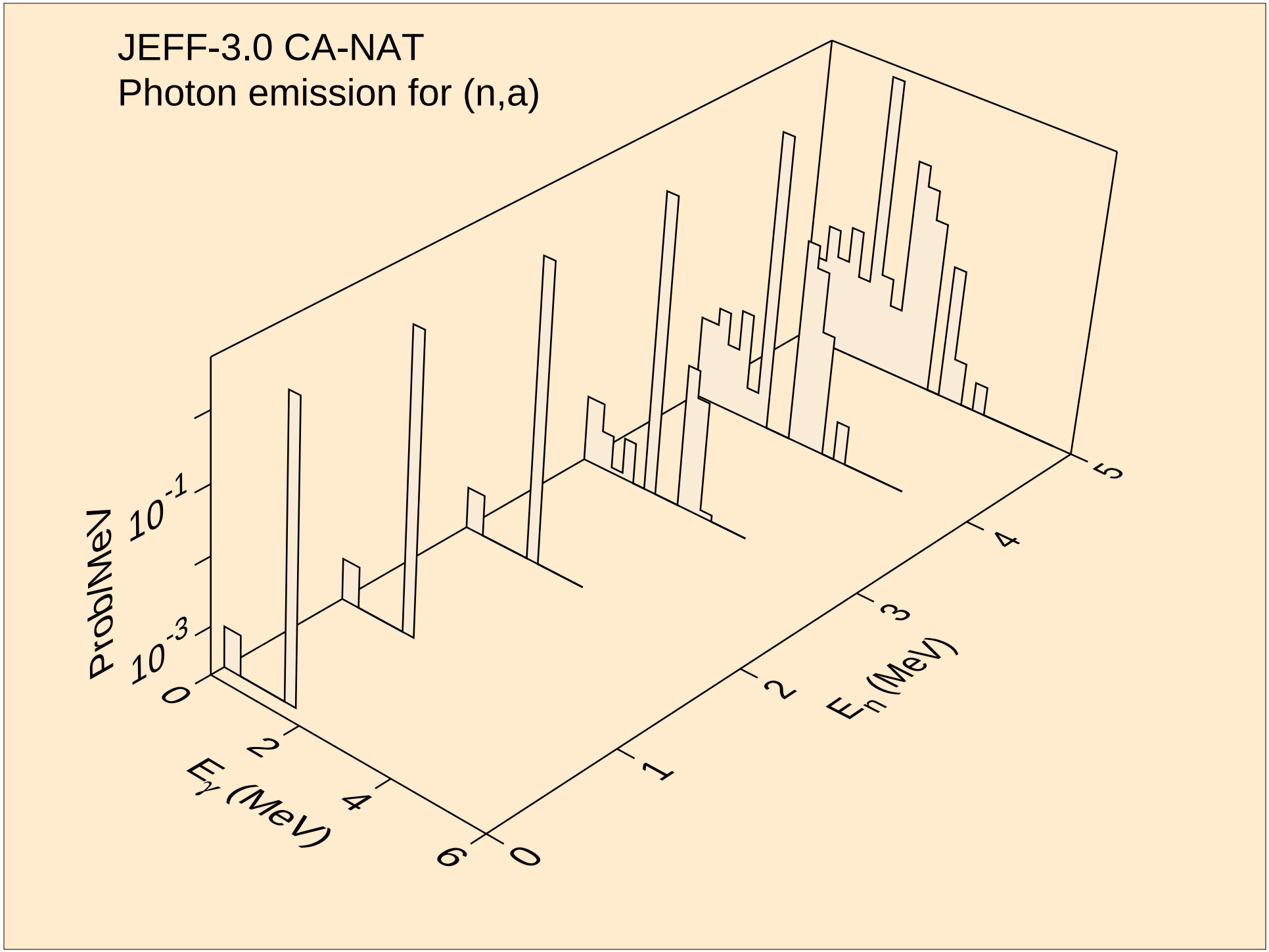

JEFF-3.0 CA-NAT
Neutron emission for (n,n*)a
Prob/MeV
10-1
10-3
0
Sec. Energy
5
10
15
6
8
10
12
14
16
18
20
Energy (MeV)

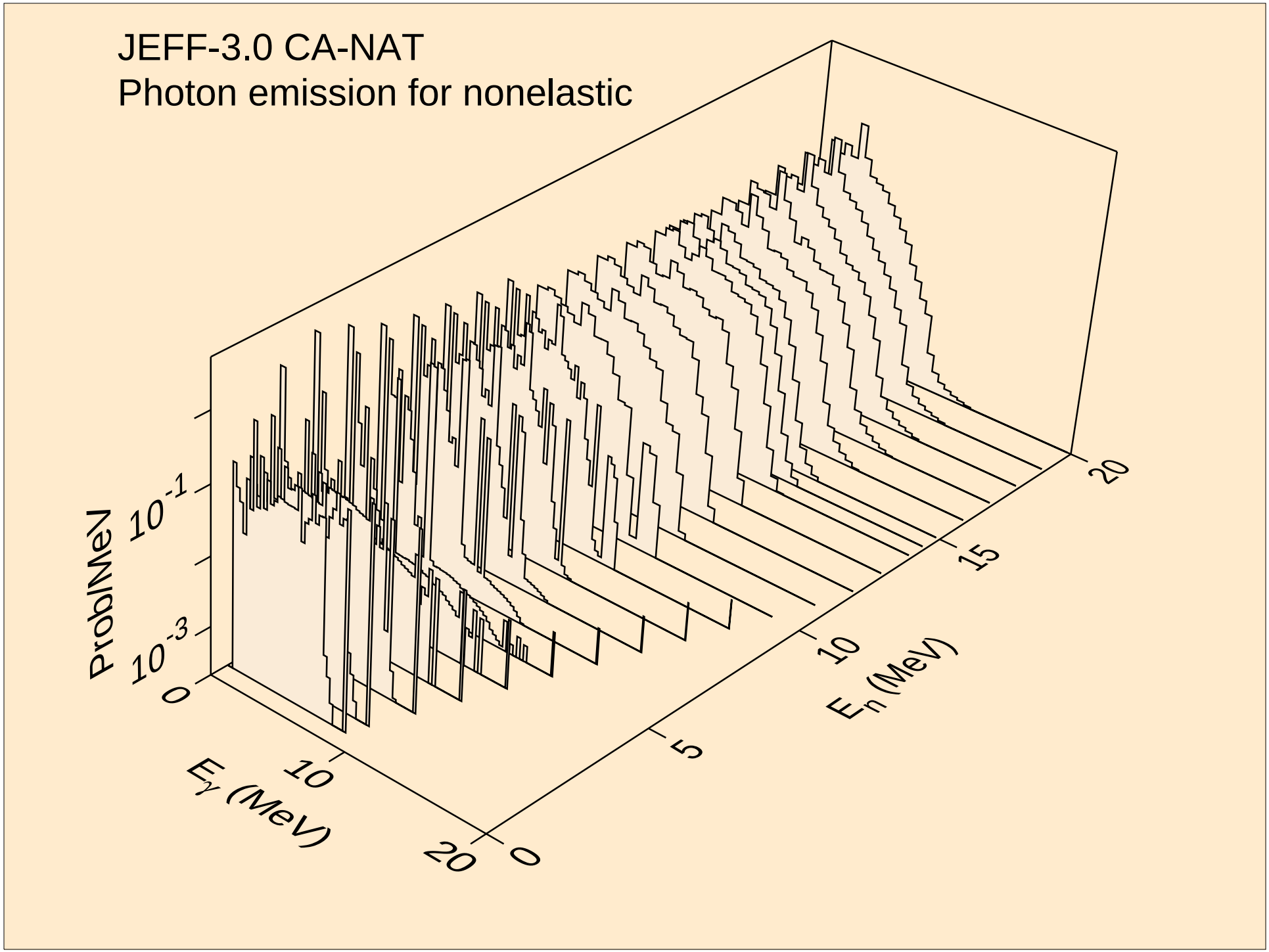

JEFF-3.0 CA-NAT
Neutron emission for (n,n*)p
Prob/MeV
10-1
10-3
0
Sec. Energy
5
10
15
8
10
12
14
16
18
20
Energy (MeV)

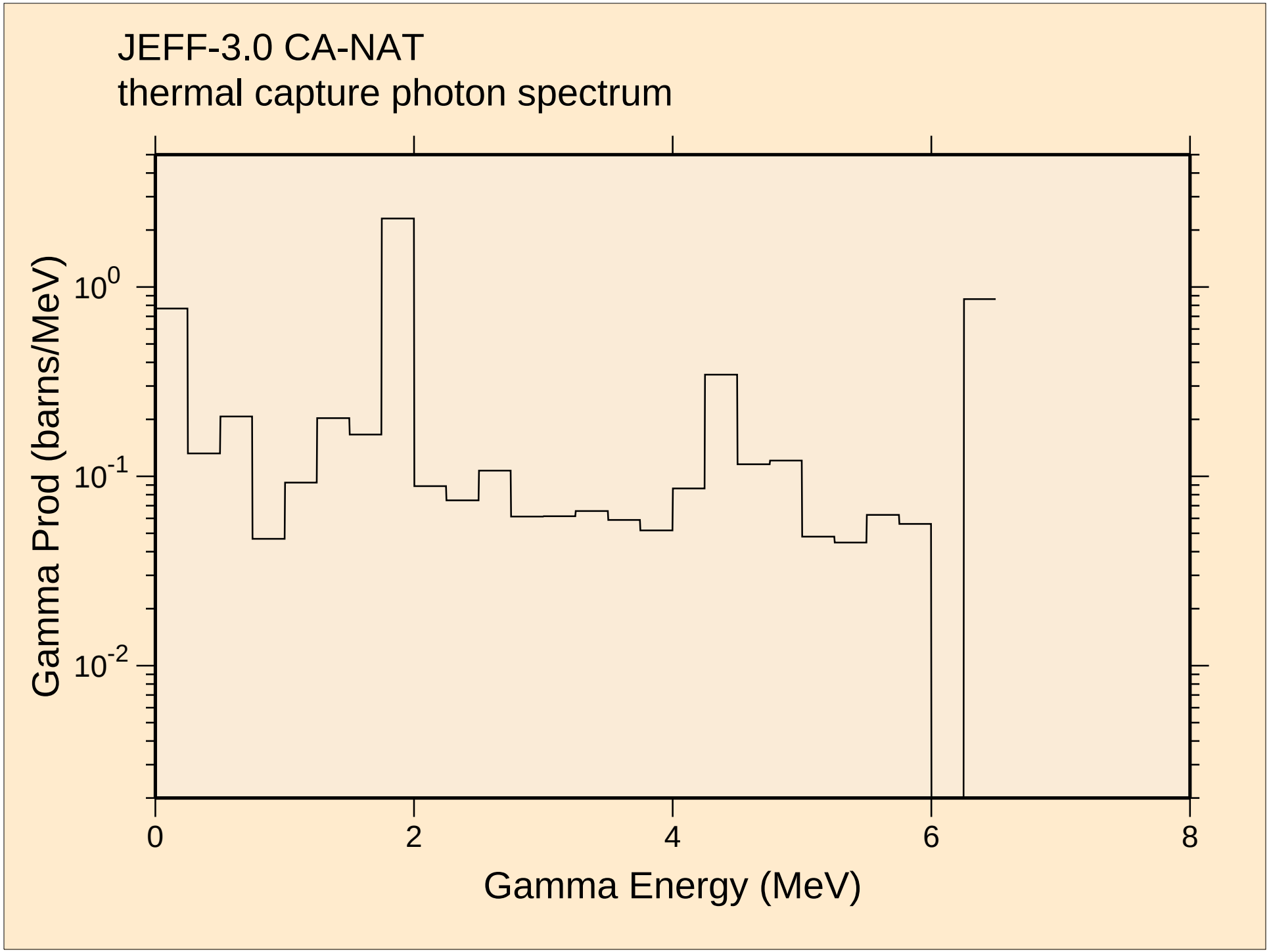

JEFF-3.0 CA-NAT
Neutron emission for (n,n*c)
Prob/MeV
10-1
10-3
0
5
10
15
20
Sec. Energy
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

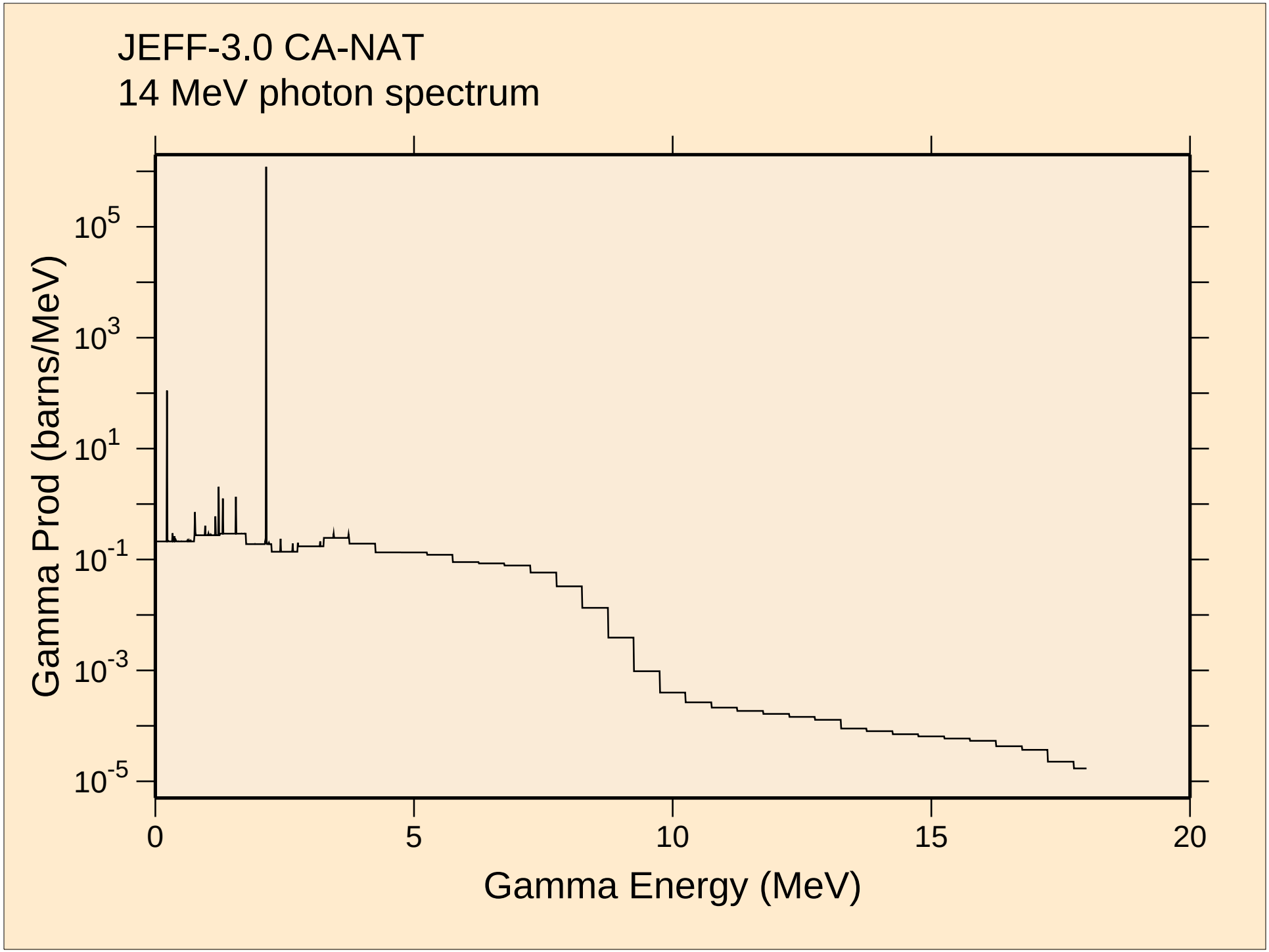

JEFF-3.0 CA-NAT
Photon emission for (n,gma)
Prob/MeV
$10^{0}$
$10^{-2}$
0
10
20
$E_\gamma$ (MeV)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
$E_n$ (MeV)


JEFF-3.0 CA-NAT
Photon emission for (n,p)
Prob/MeV
10-1
10-3
0
Eγ (MeV)
2
4
0
1
2
En (MeV)
3
4
5


JEFF-3.0 CA-NAT
Photon emission for (n,a)
Prob/MeV
10-1
10-3
0
2
4
6
Eγ (MeV)
0
1
2
3
4
5
En (MeV)


JEFF-3.0 CA-NAT
Photon emission for nonelastic
Prob/MeV
10-1
10-3
0
Eγ (MeV)
10
20
0
5
10
15
20
En (MeV)


JEFF-3.0 CA-NAT
thermal capture photon spectrum
Gamma Prod (barns/MeV)
10^0
10^-1
10^-2
0
2
4
6
8
Gamma Energy (MeV)


JEFF-3.0 CA-NAT
14 MeV photon spectrum
Gamma Prod (barns/MeV)
10^5
10^3
10^1
10^-1
10^-3
10^-5
0
5
10
15
20
Gamma Energy (MeV)