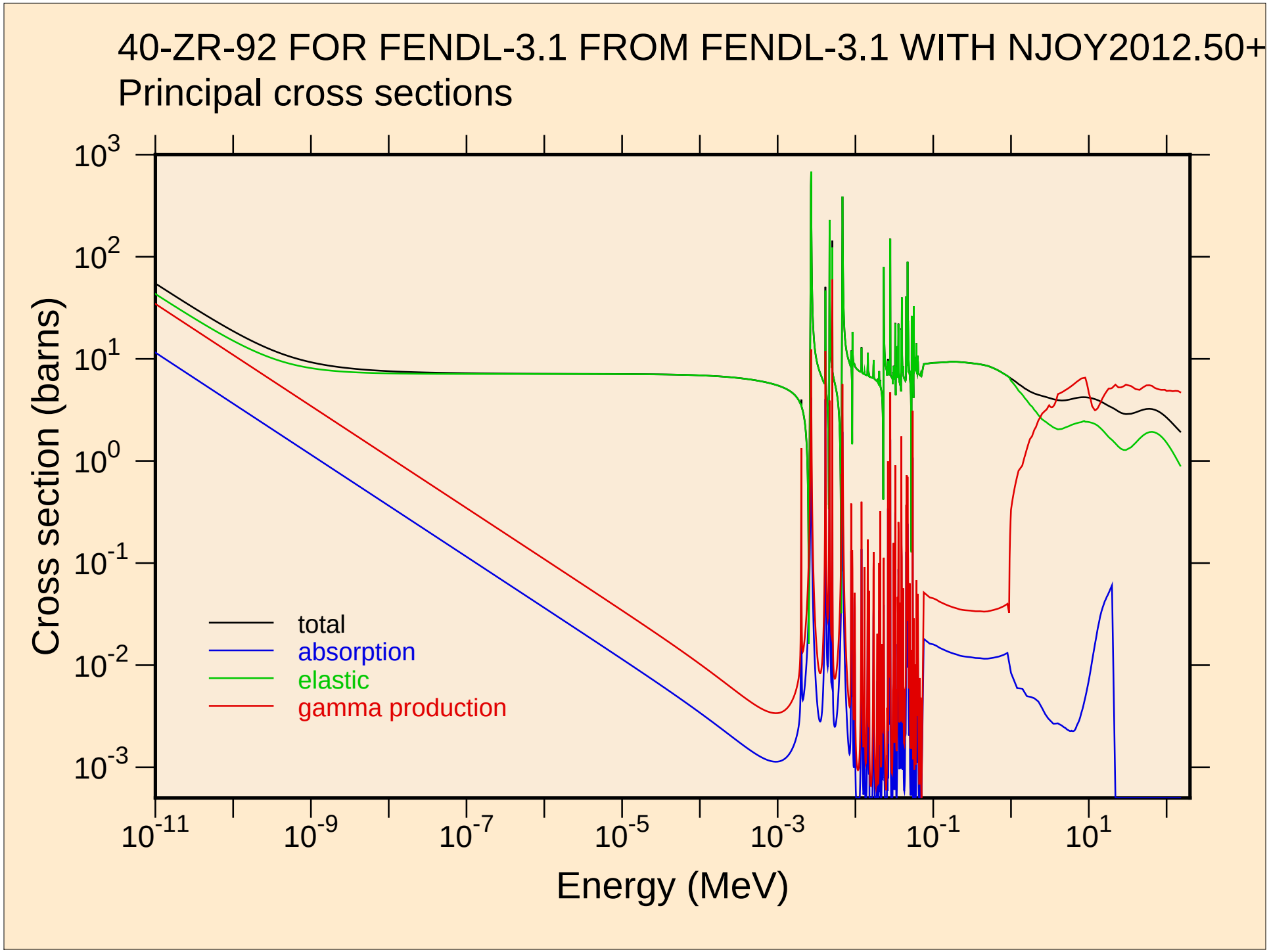
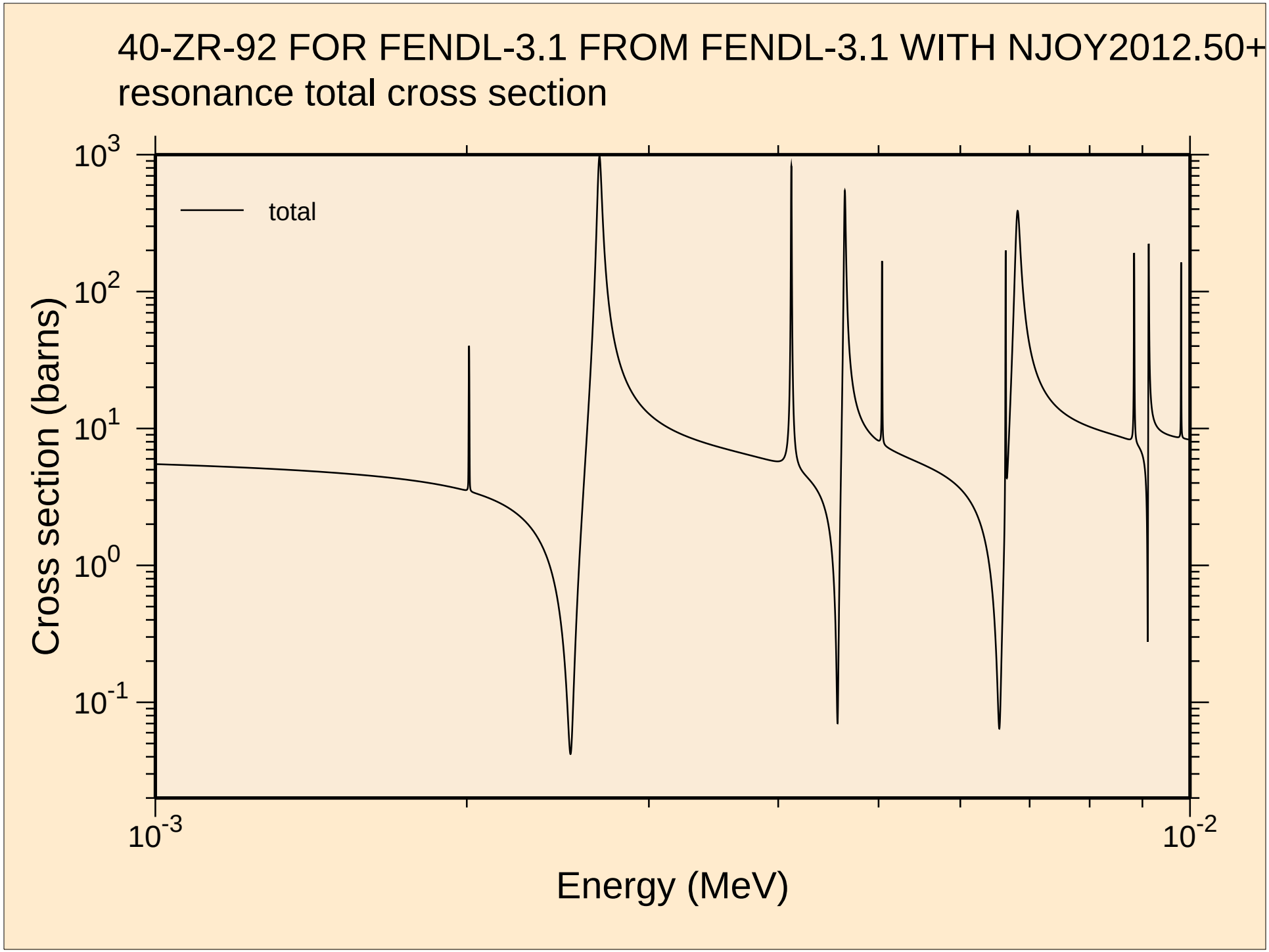
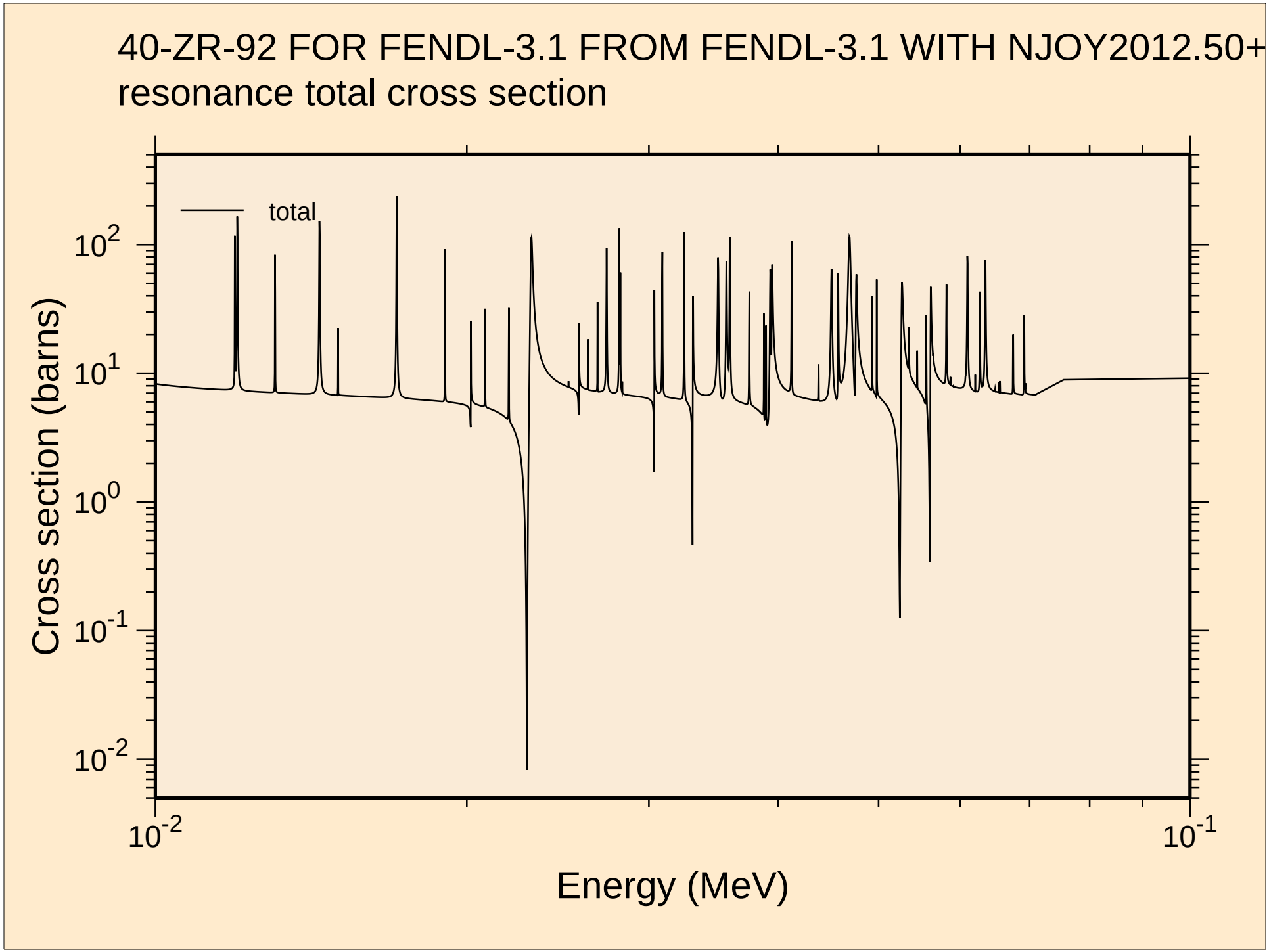
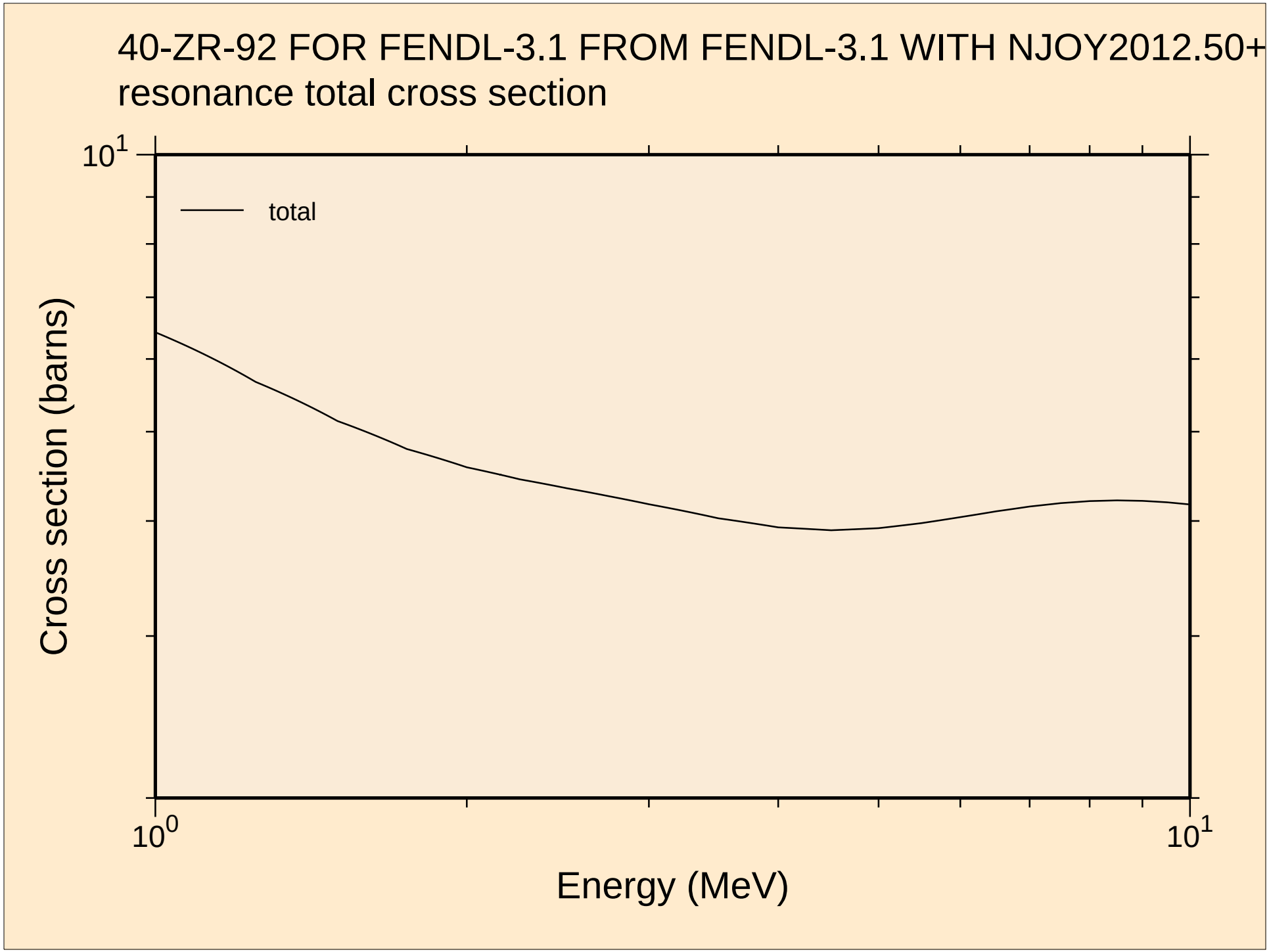
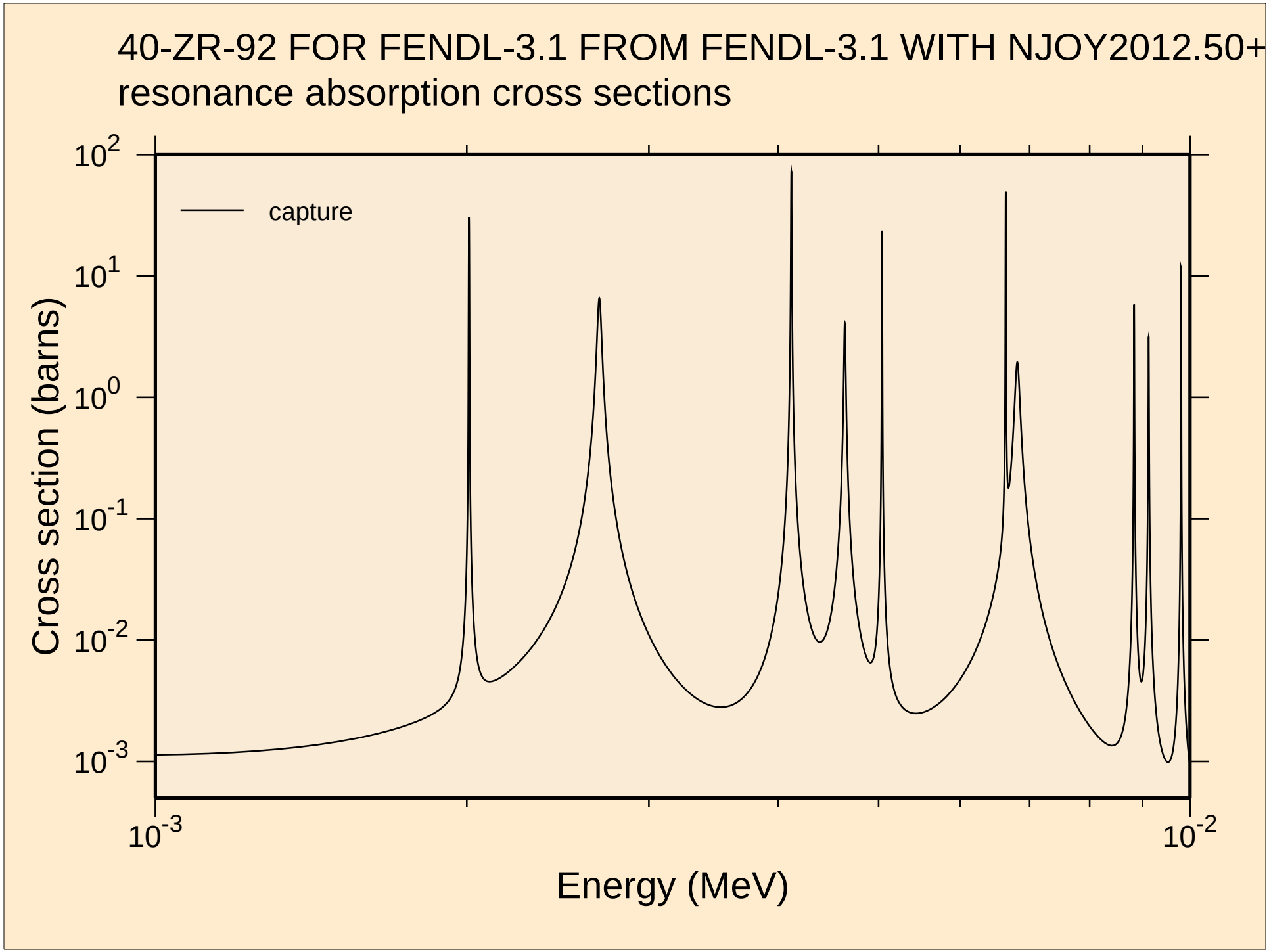
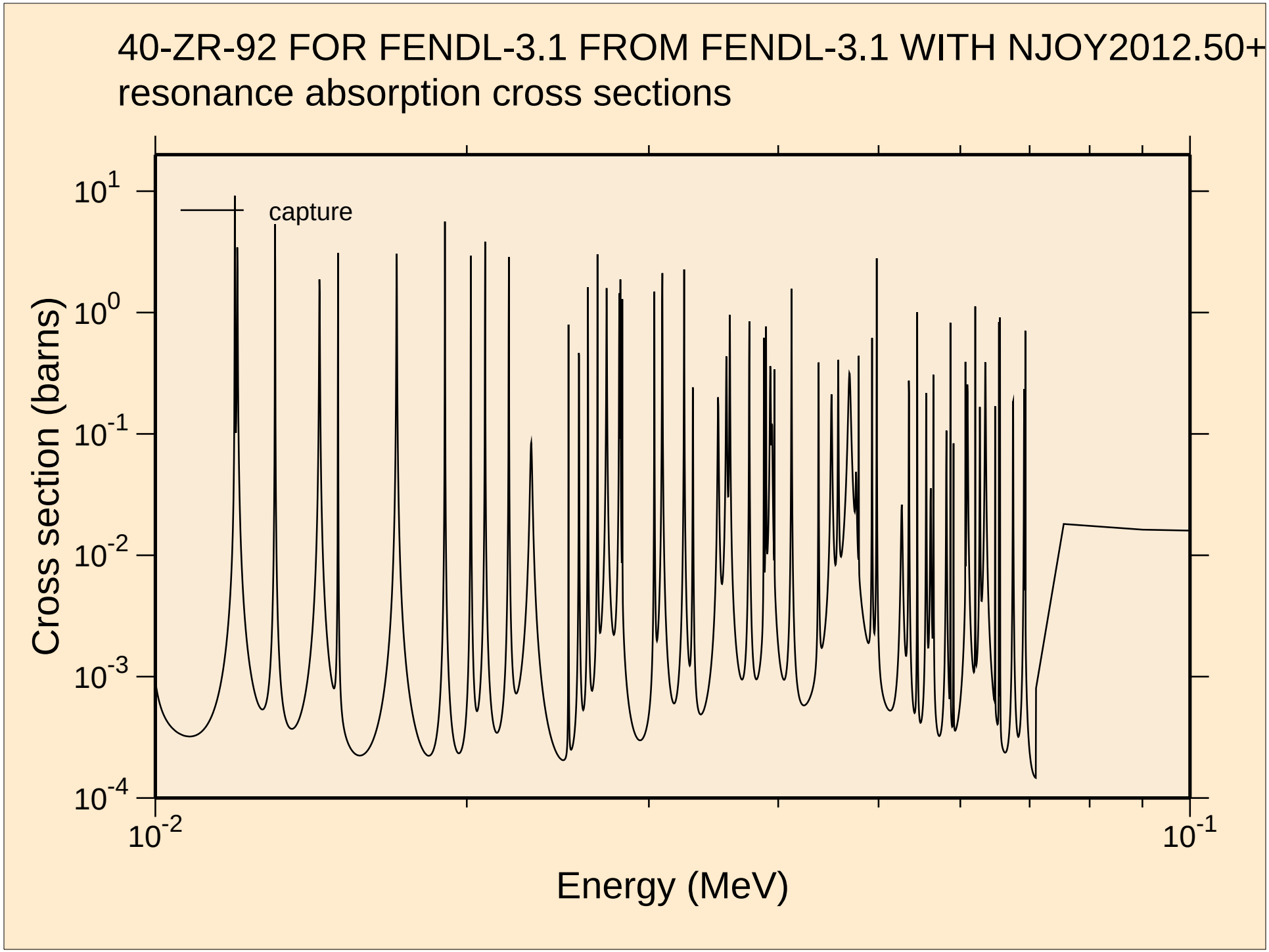

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Principal cross sections
Cross section (barns)
Energy (MeV)
total
absorption
elastic
gamma production

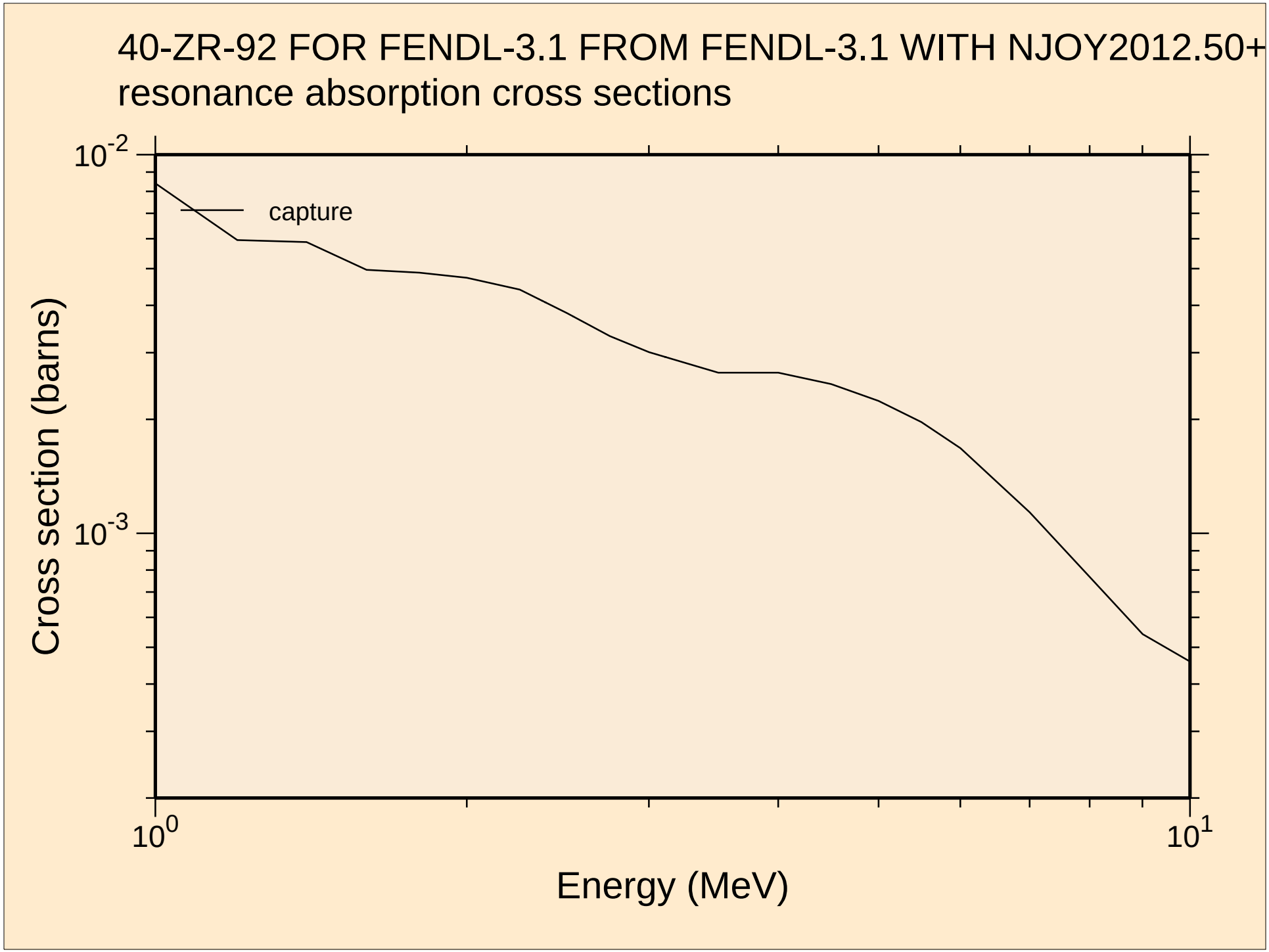

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
resonance total cross section
total
Cross section (barns)
10^3
10^2
10^1
10^0
10^-1
10^-3
10^-2
Energy (MeV)

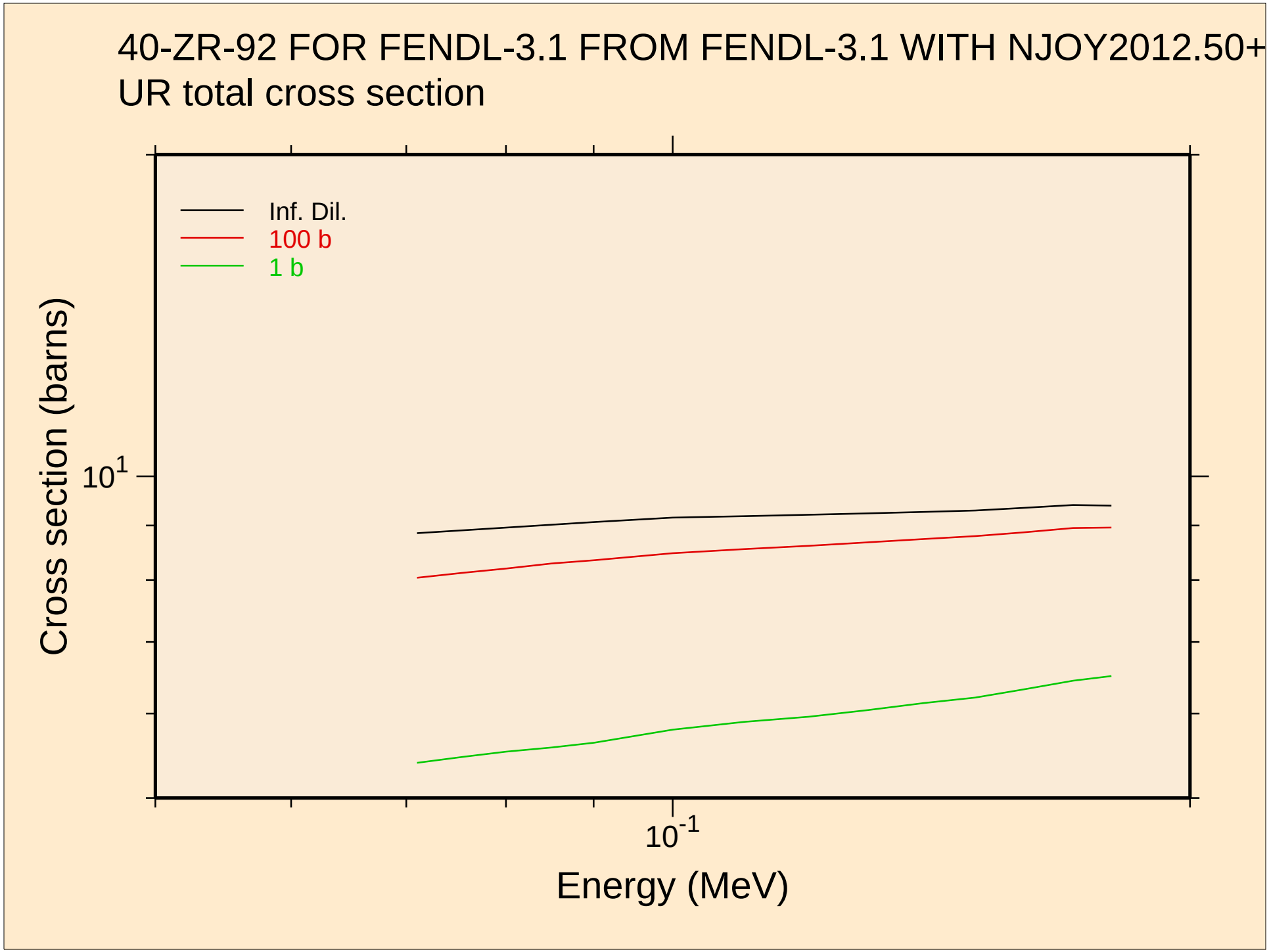

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
resonance total cross section
total
Cross section (barns)
10^2
10^1
10^0
10^-1
10^-2
10^-2
10^-1
Energy (MeV)

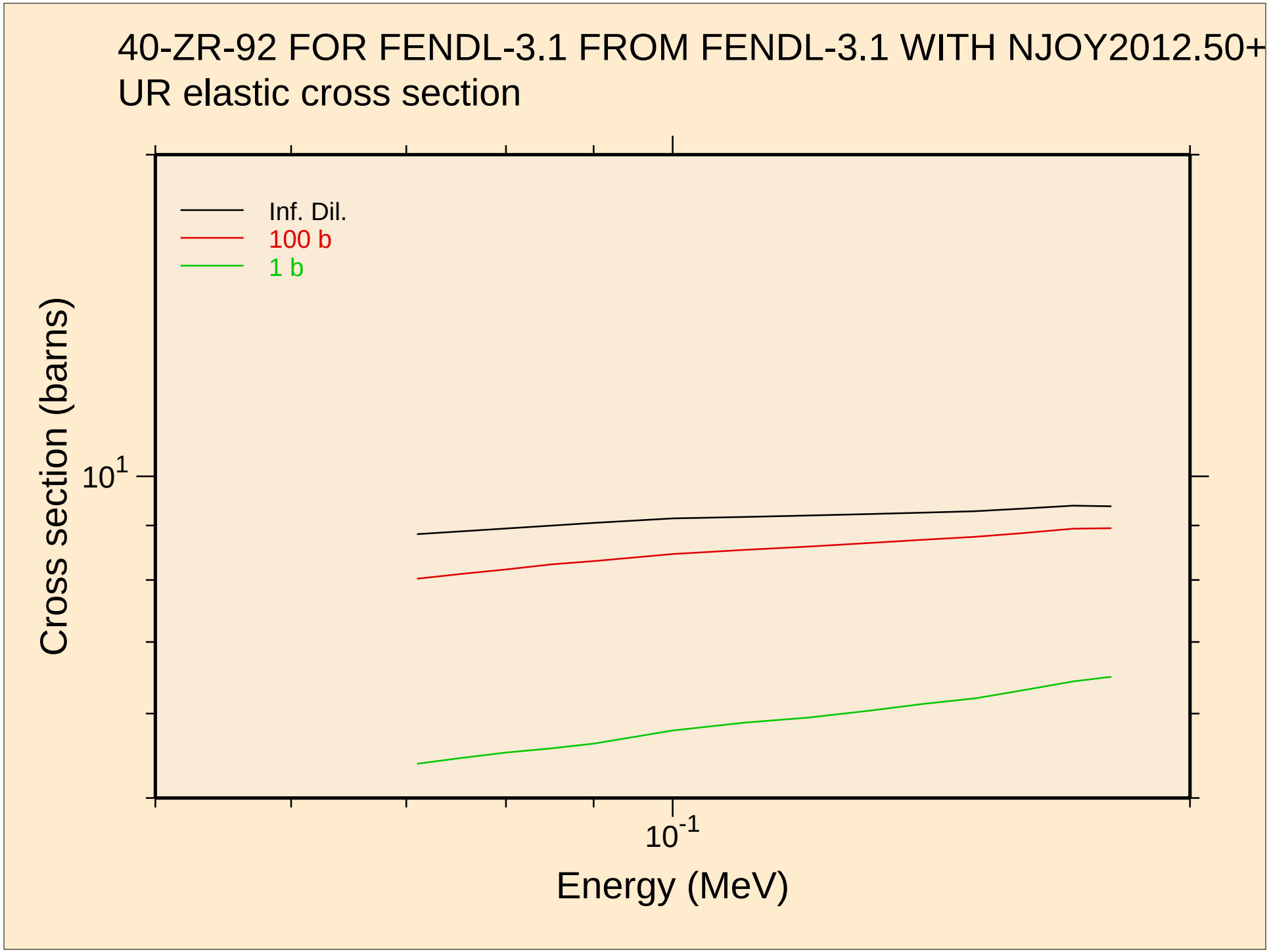

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
resonance total cross section
$10^1$
total
Cross section (barns)
$10^0$
$10^1$
Energy (MeV)

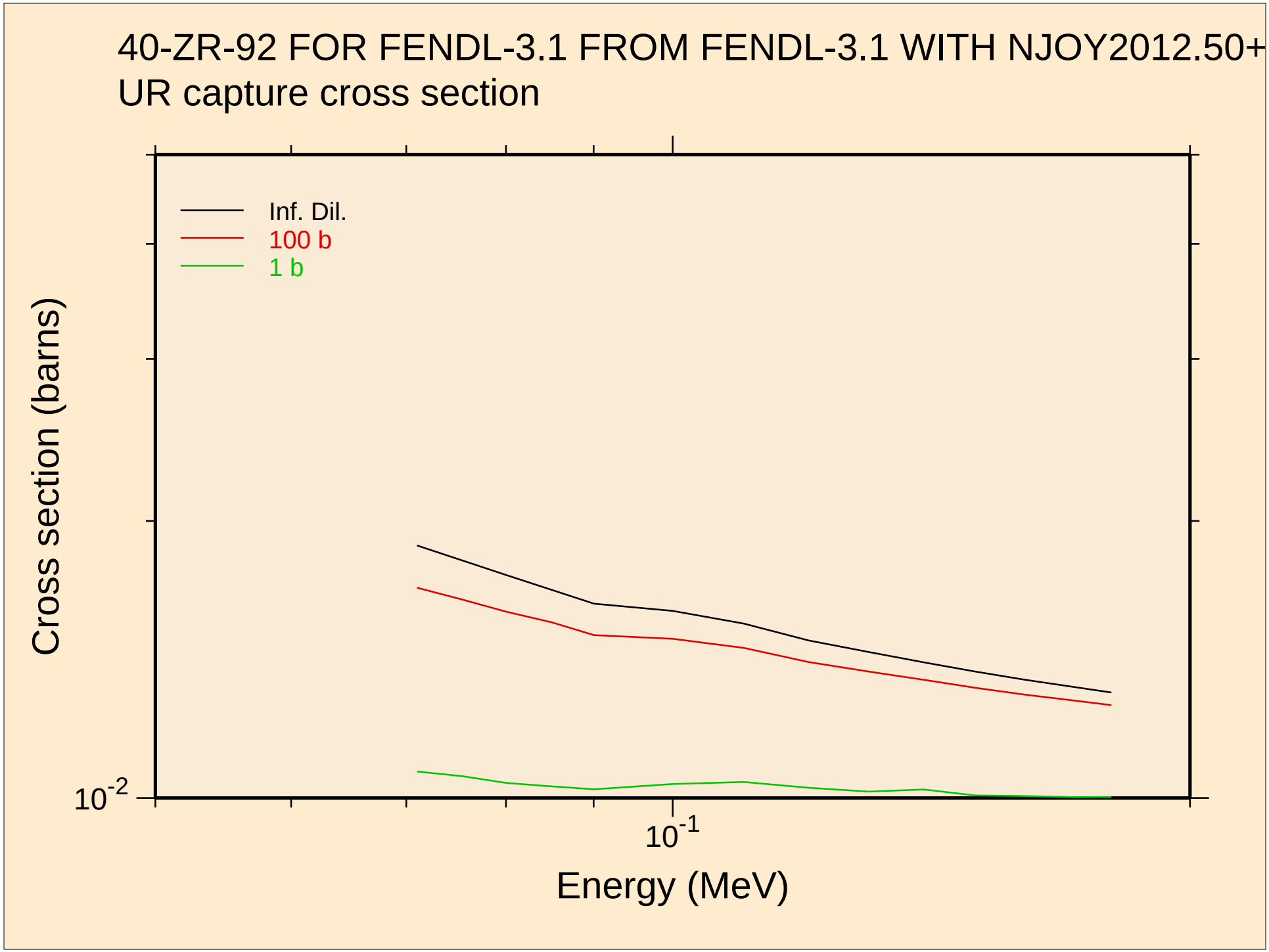

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
resonance absorption cross sections
capture
Cross section (barns)
10^2
10^1
10^0
10^-1
10^-2
10^-3
10^-3
10^-2
Energy (MeV)

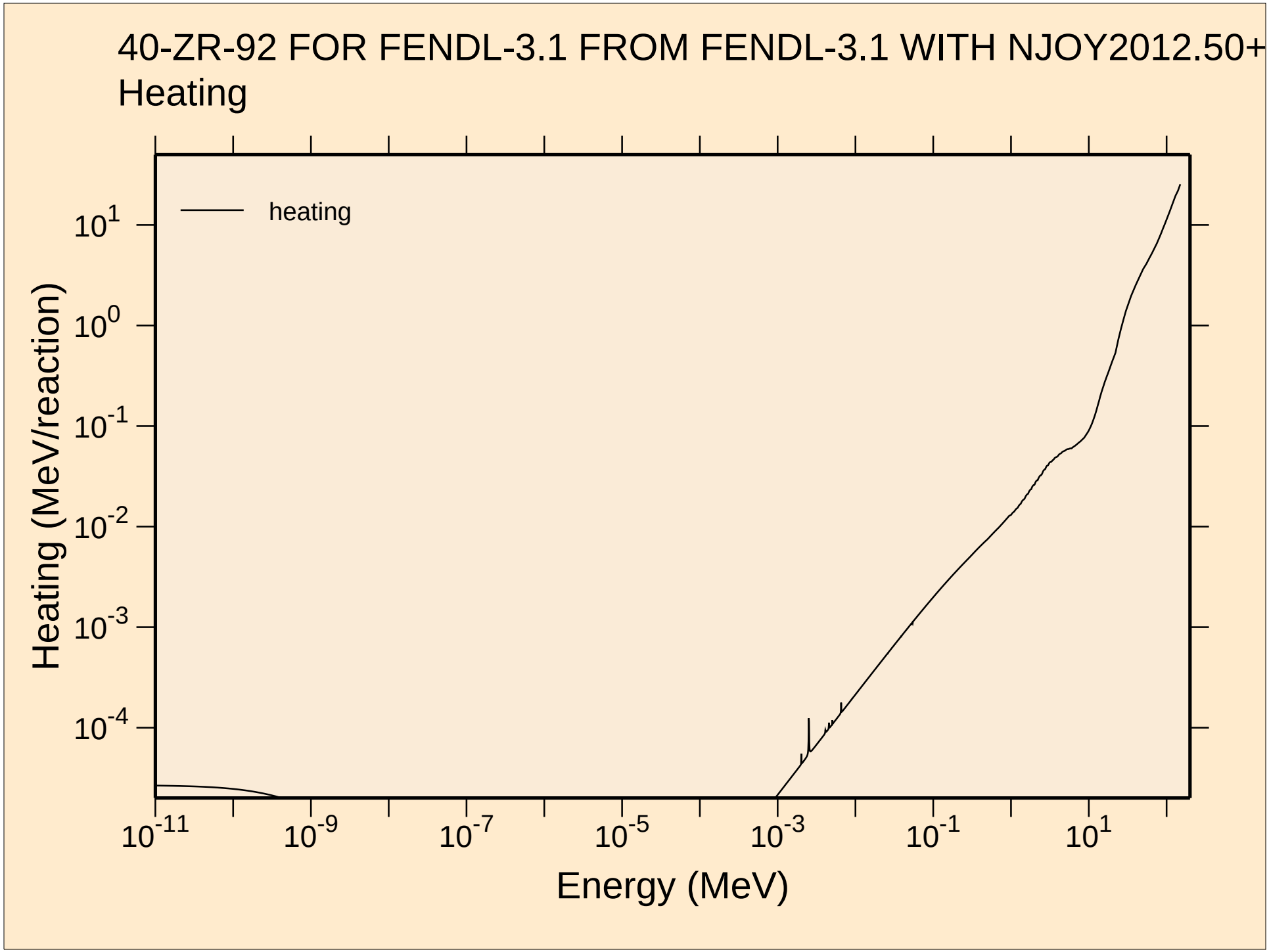

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
resonance absorption cross sections
capture
Cross section (barns)
10^1
10^0
10^-1
10^-2
10^-3
10^-4
10^-2
10^-1
Energy (MeV)

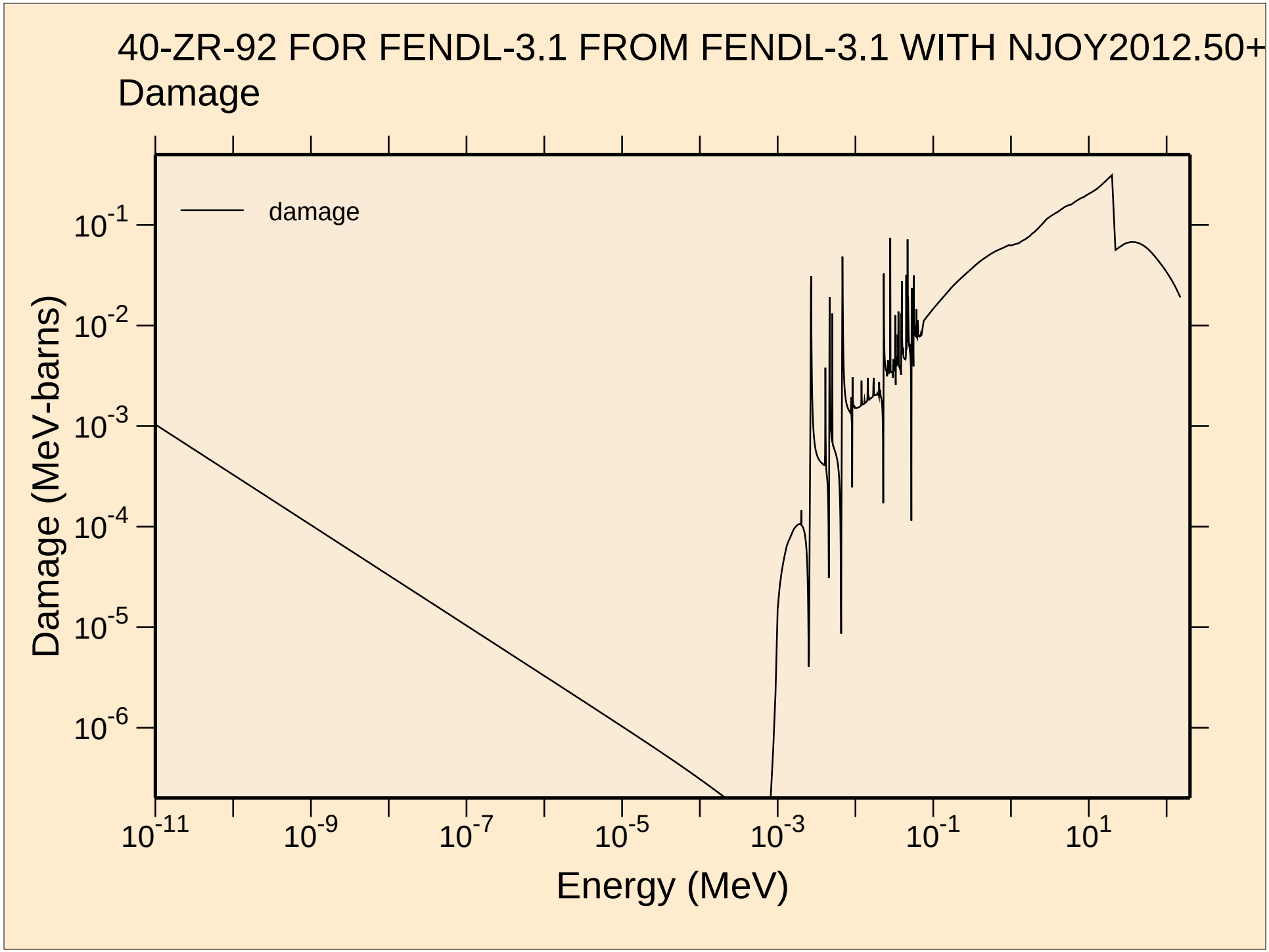

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
resonance absorption cross sections
capture
Cross section (barns)
10-2
10-3
100
101
Energy (MeV)

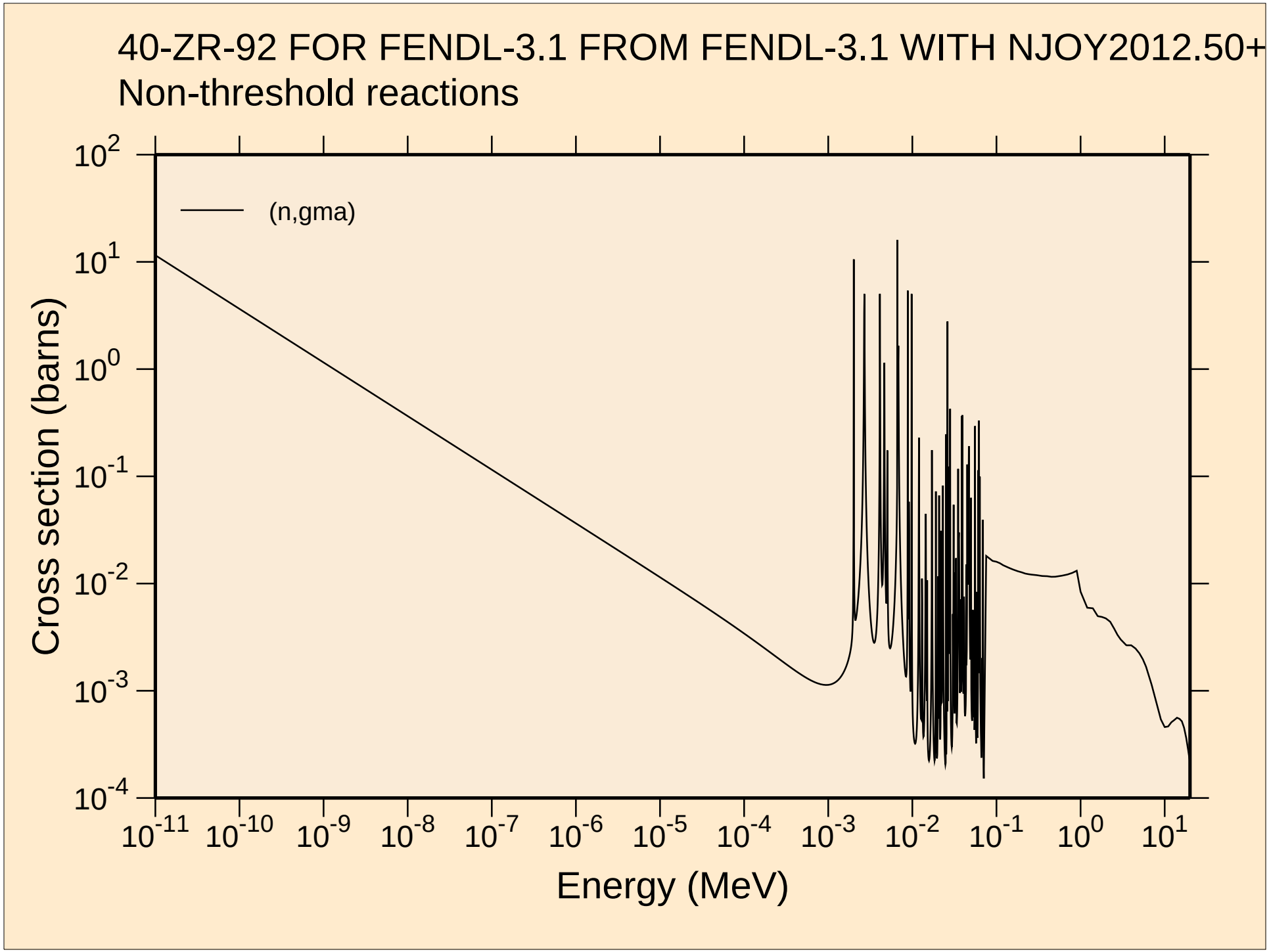

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
UR total cross section
Inf. Dil.
100 b
1 b
Cross section (barns)
10^1
10^-1
Energy (MeV)

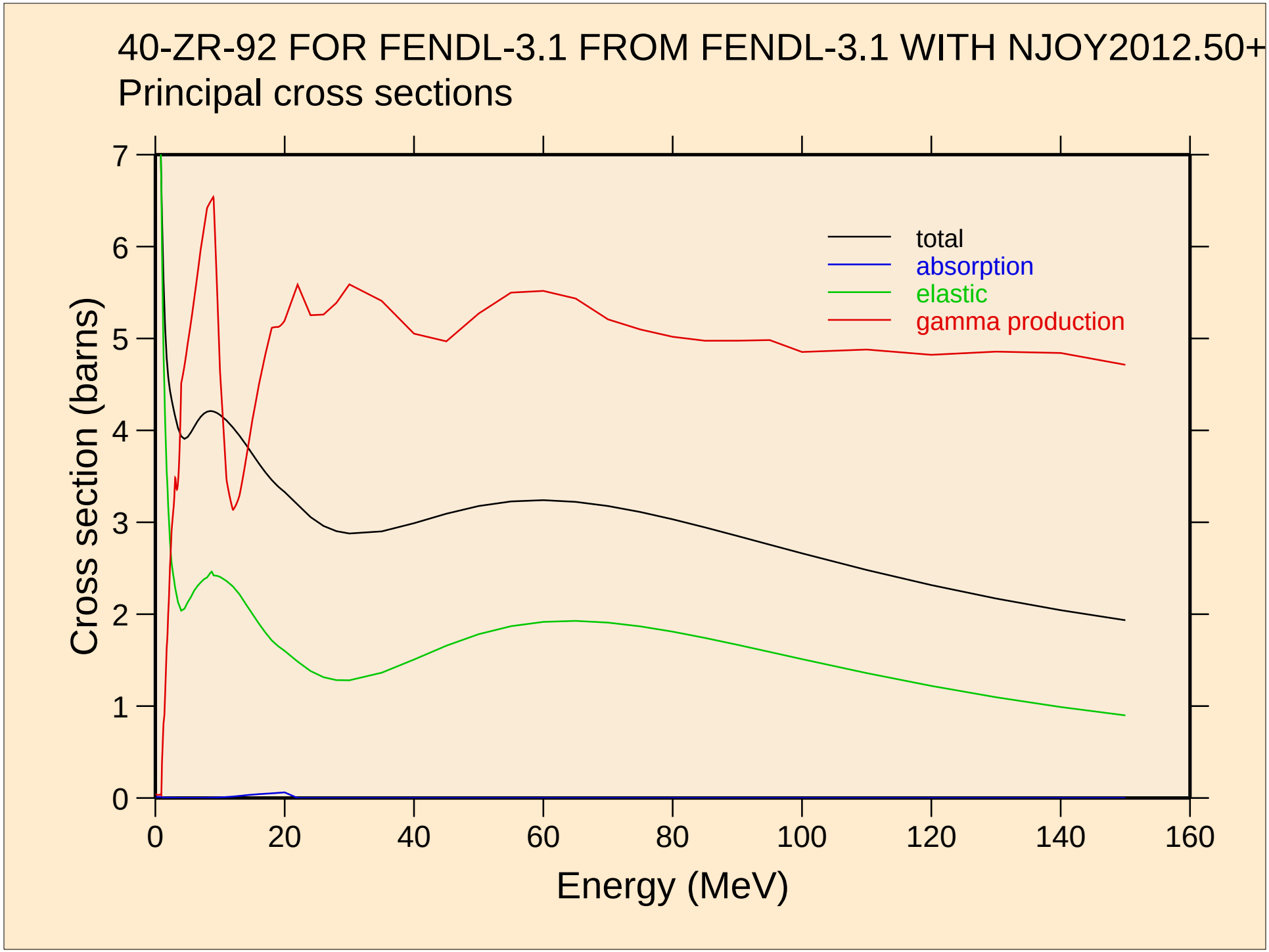

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
UR elastic cross section
Inf. Dil.
100 b
1 b
Cross section (barns)
10^1
10^-1
Energy (MeV)

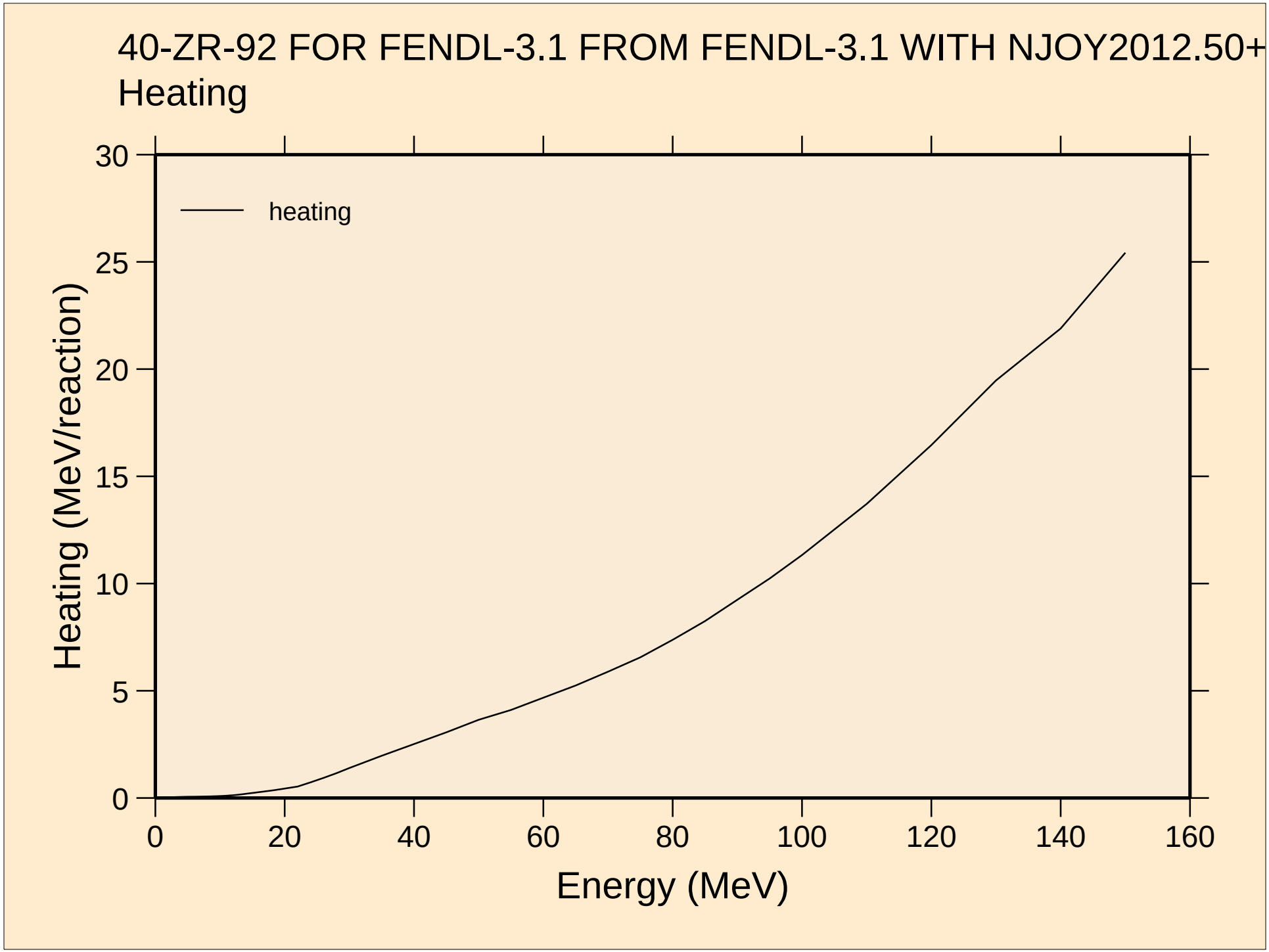

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
UR capture cross section
Inf. Dil.
100 b
1 b
Cross section (barns)
10-2
10-1
Energy (MeV)

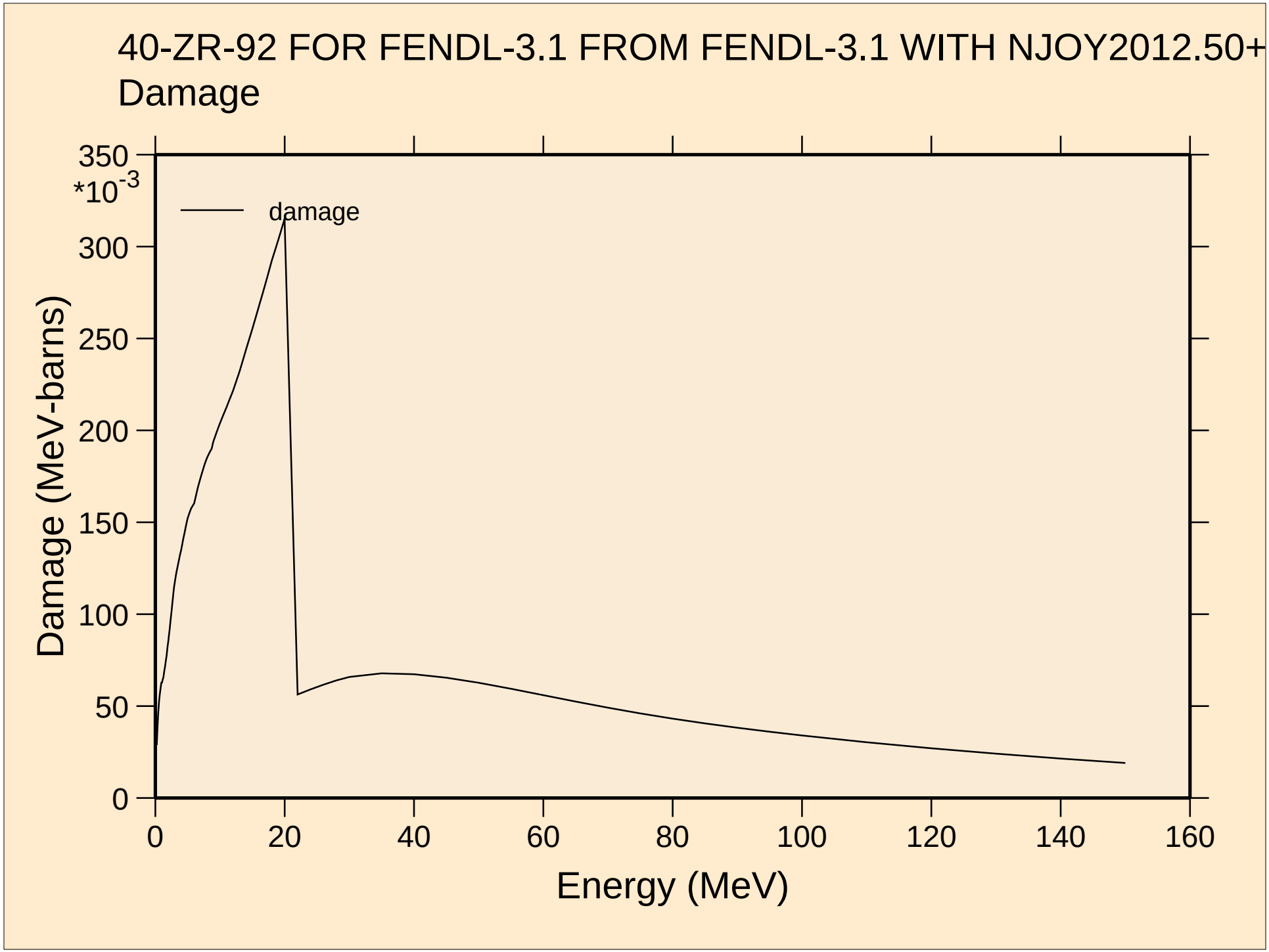

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Heating
heating
Heating (MeV/reaction)
10^1
10^0
10^-1
10^-2
10^-3
10^-4
10^-11
10^-9
10^-7
10^-5
10^-3
10^-1
10^1
Energy (MeV)

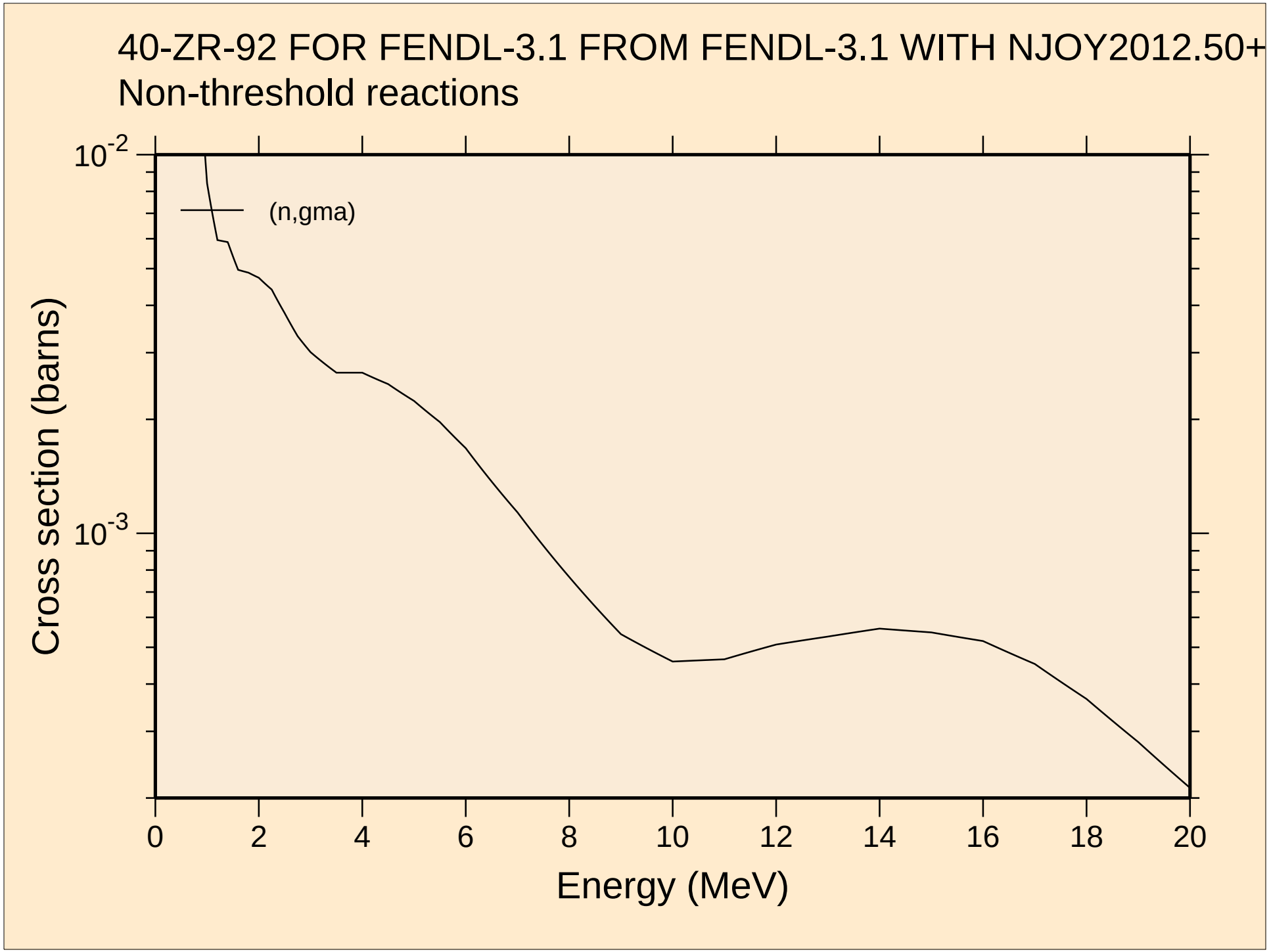

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Damage
damage
Damage (MeV-barns)
10-1
10-2
10-3
10-4
10-5
10-6
10-11
10-9
10-7
10-5
10-3
10-1
101
Energy (MeV)

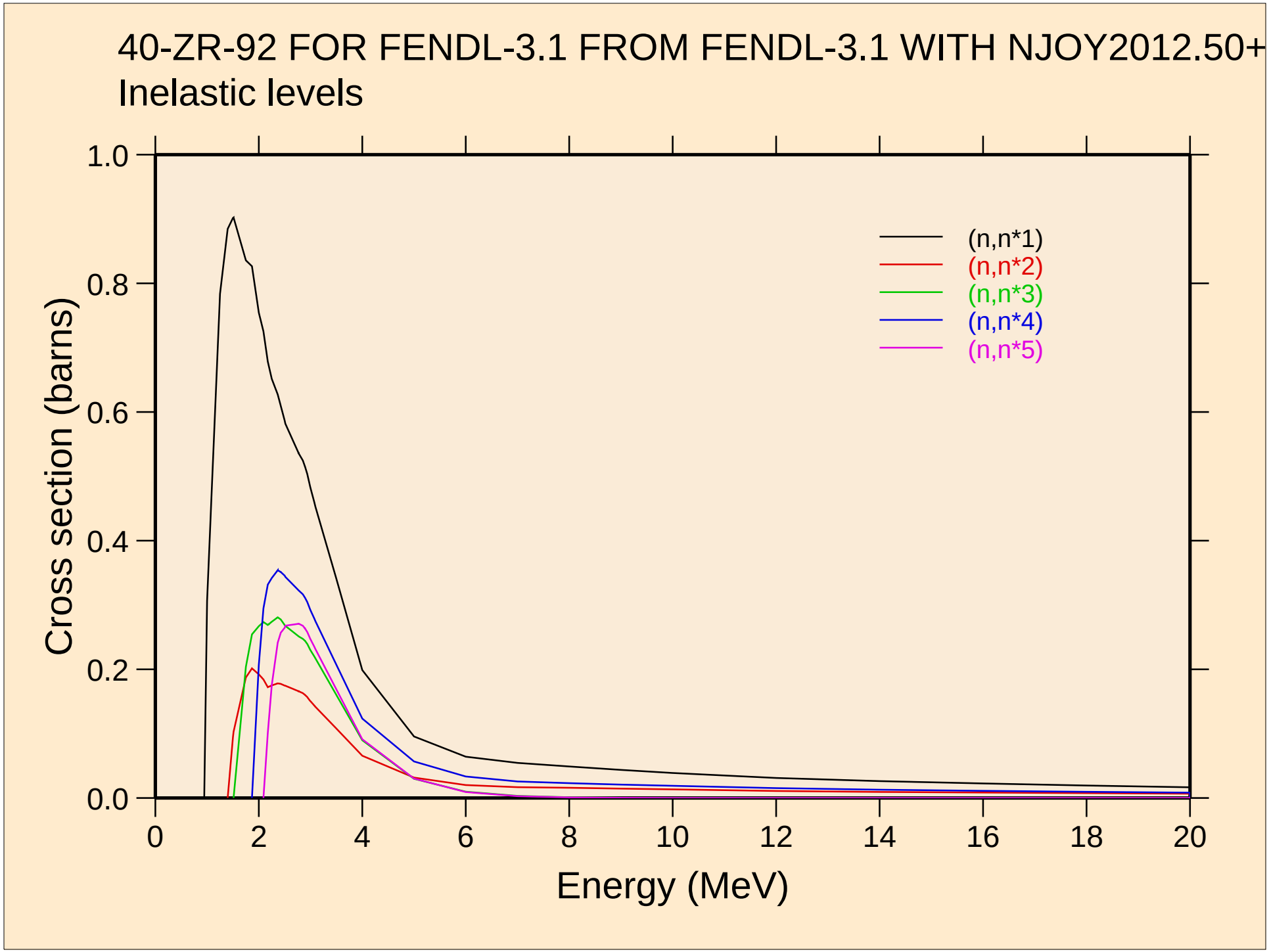

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Non-threshold reactions
(n,gma)
Cross section (barns)
Energy (MeV)
10^2
10^1
10^0
10^-1
10^-2
10^-3
10^-4
10^-11
10^-10
10^-9
10^-8
10^-7
10^-6
10^-5
10^-4
10^-3
10^-2
10^-1
10^0
10^1

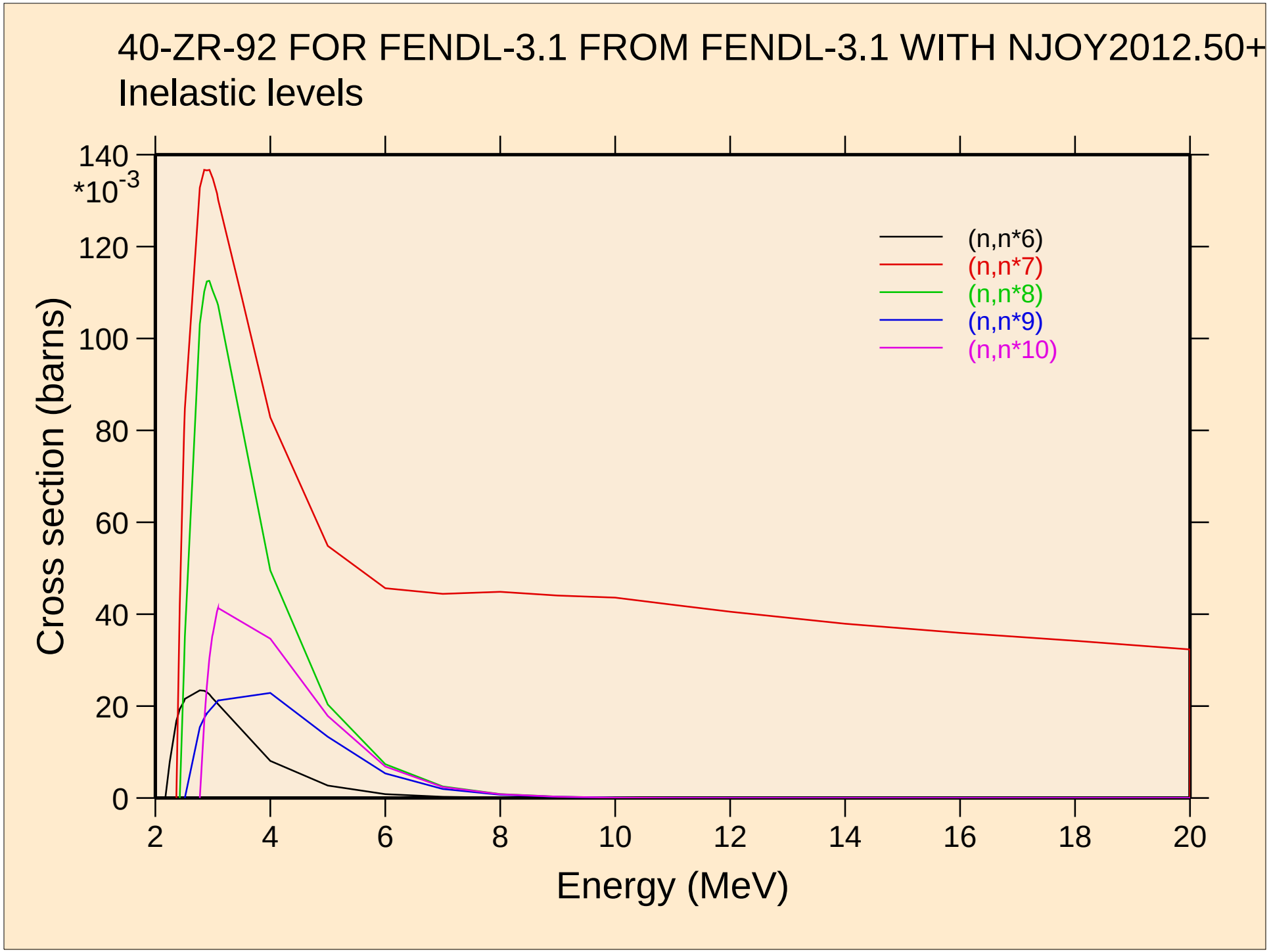

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Principal cross sections
Cross section (barns)
Energy (MeV)
0
1
2
3
4
5
6
7
0
20
40
60
80
100
120
140
160
total
absorption
elastic
gamma production

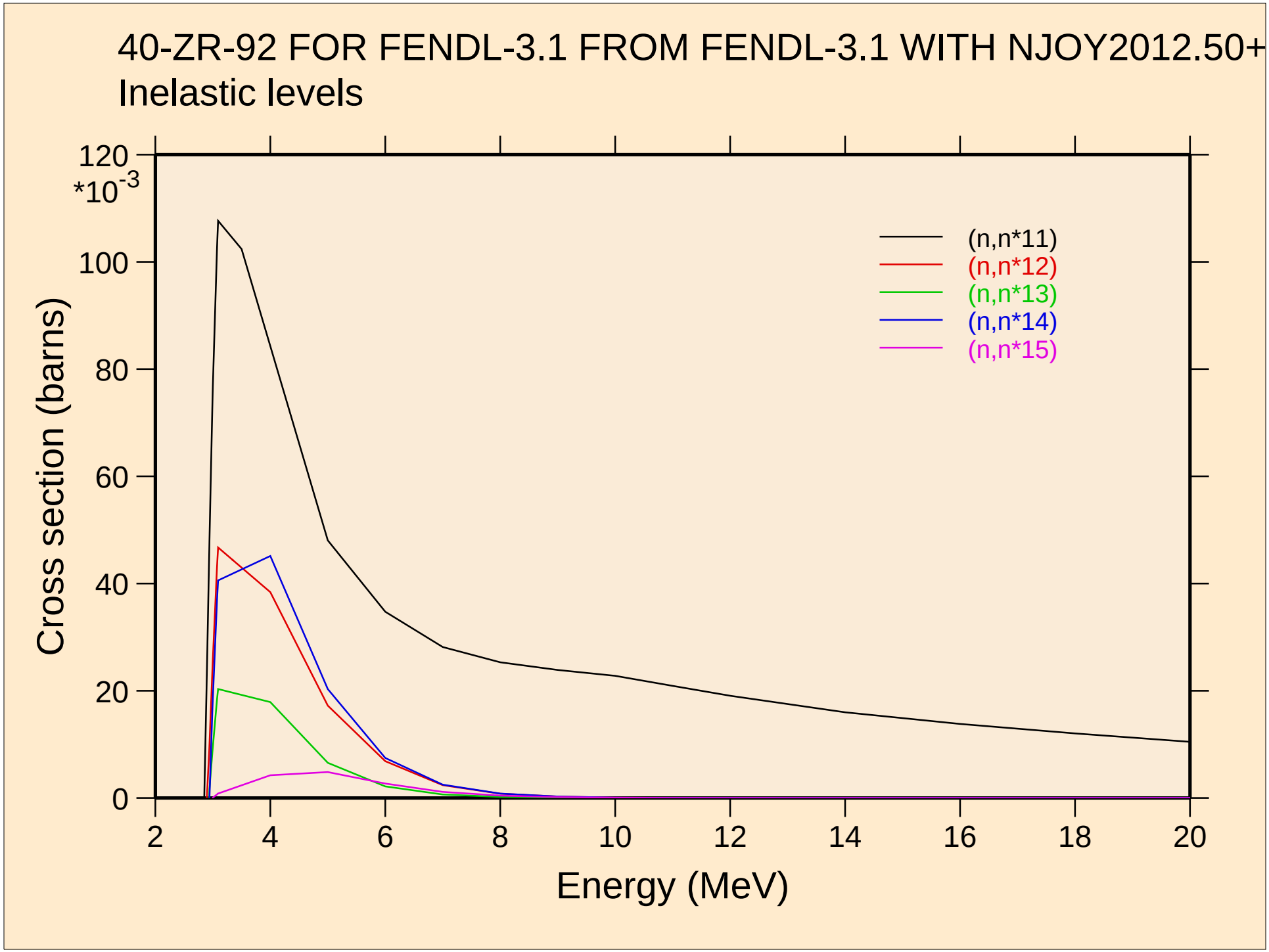

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Heating
heating
Heating (MeV/reaction)
Energy (MeV)
0
5
10
15
20
25
30
0
20
40
60
80
100
120
140
160

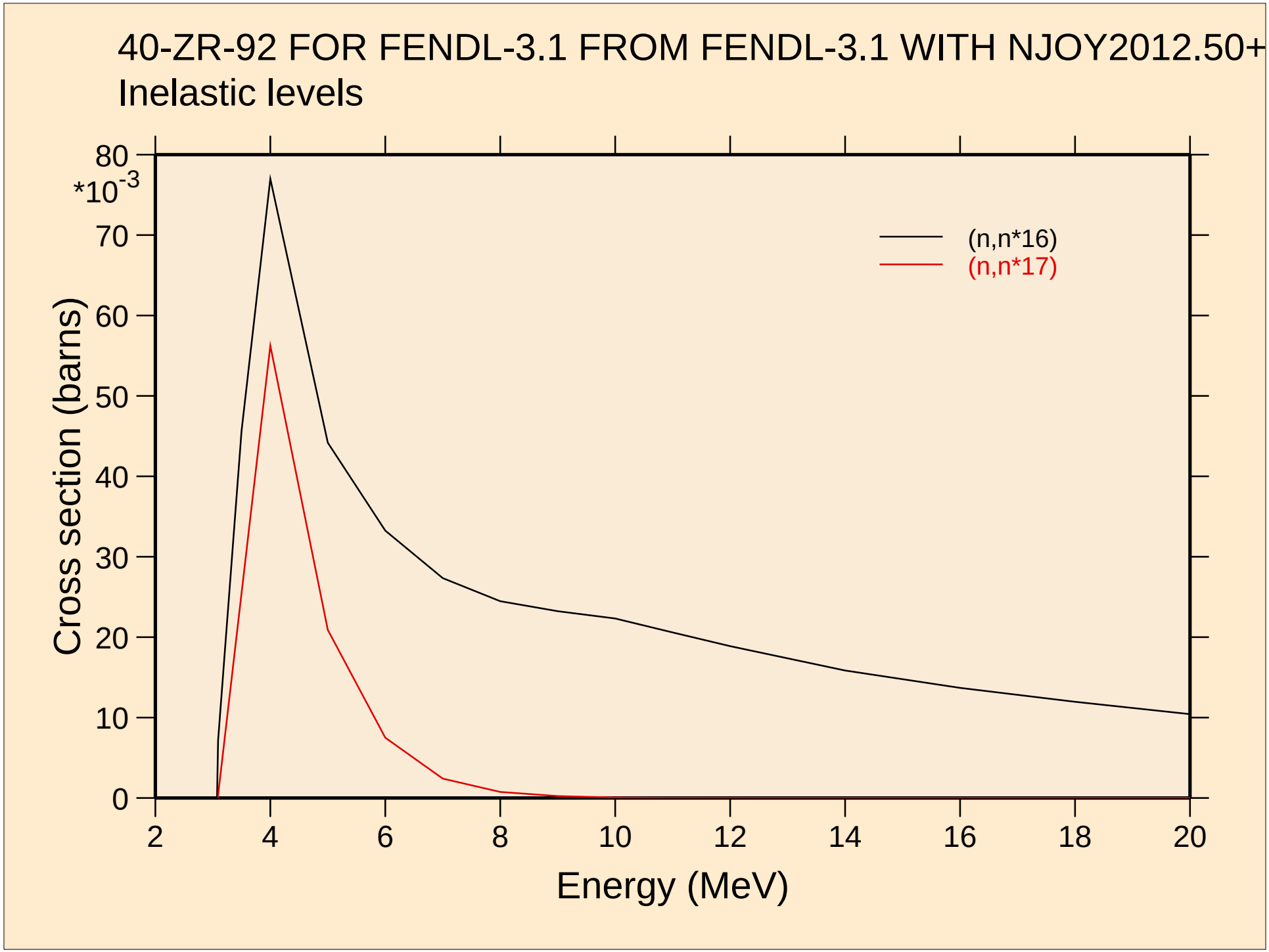

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Damage
*10-3
damage
Damage (MeV-barns)
350
300
250
200
150
100
50
0
0
20
40
60
80
100
120
140
160
Energy (MeV)

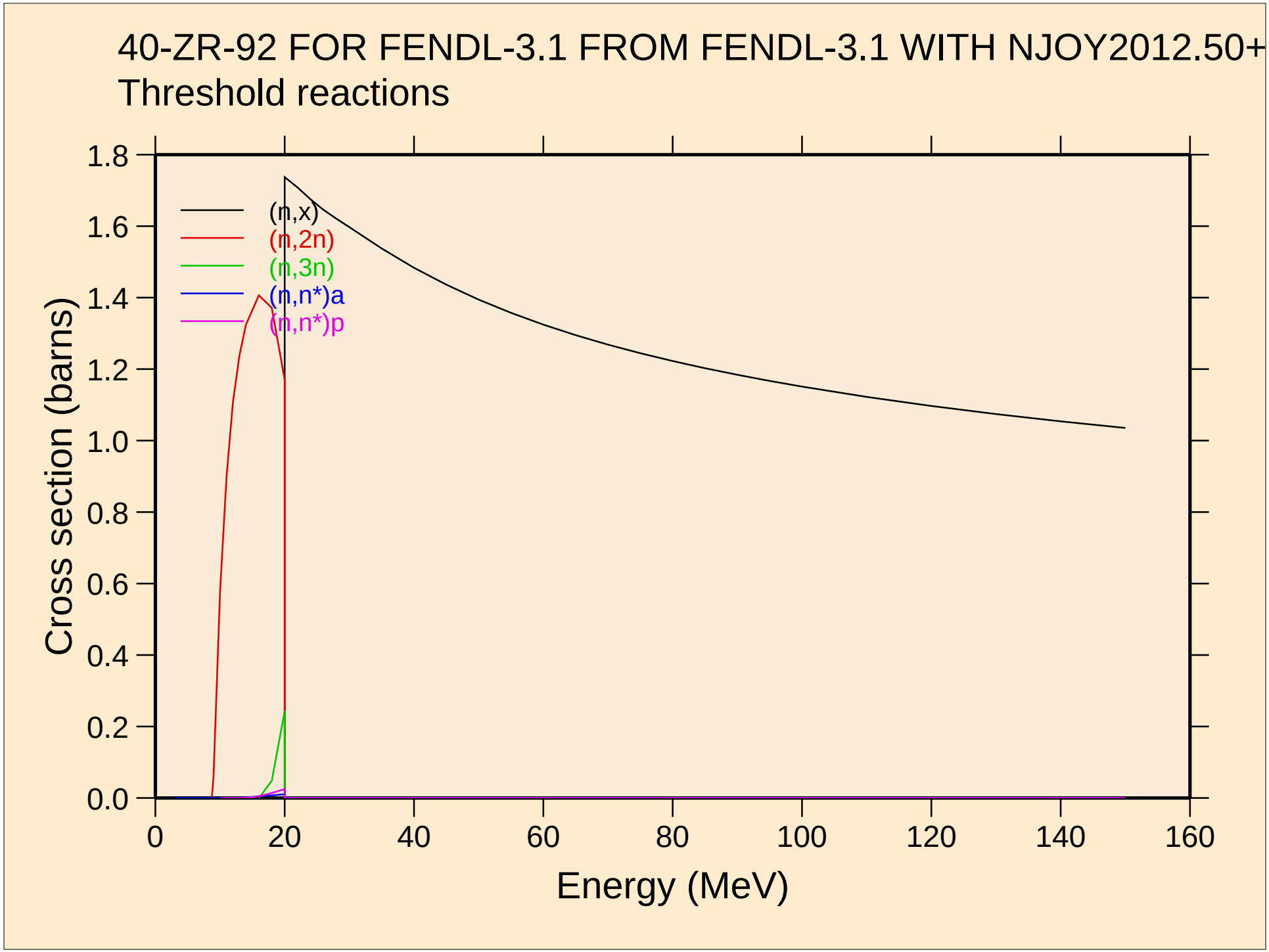

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Non-threshold reactions
(n,gma)
Cross section (barns)
10-2
10-3
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

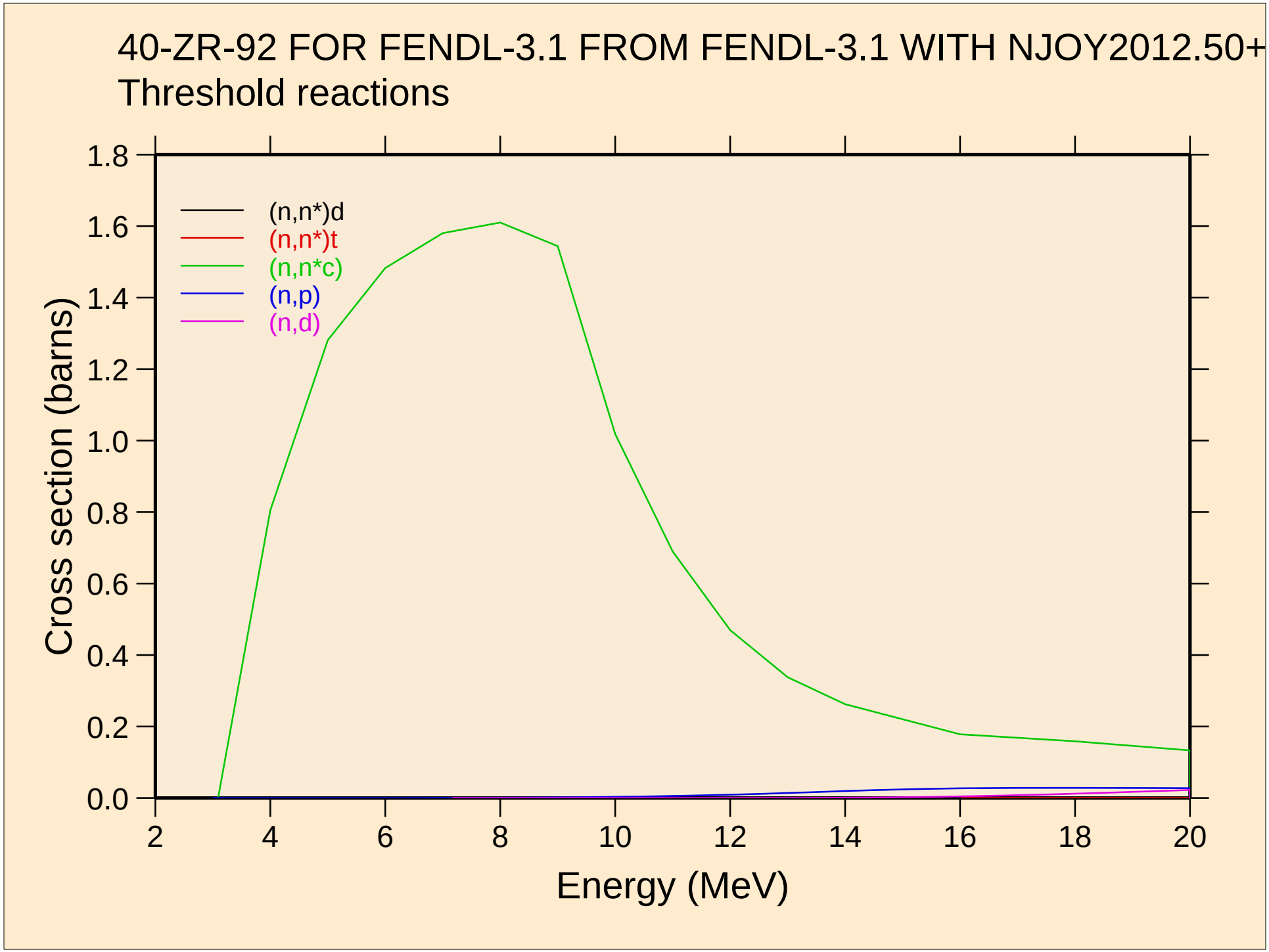

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Inelastic levels
Cross section (barns)
Energy (MeV)
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
12
14
16
18
20
(n,n*1)
(n,n*2)
(n,n*3)
(n,n*4)
(n,n*5)

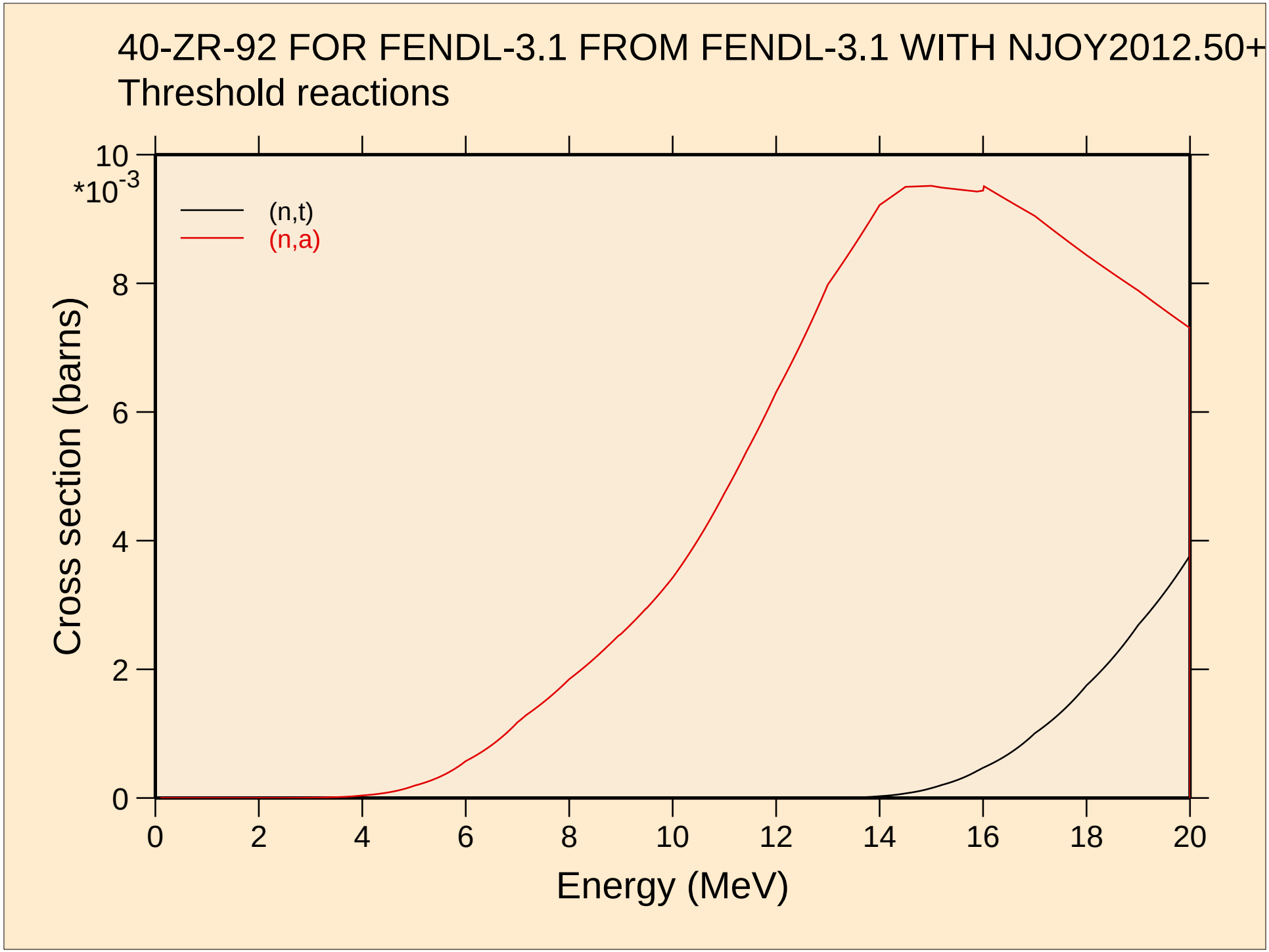

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Inelastic levels
Cross section (barns)
*10-3
140
120
100
80
60
40
20
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)
(n,n*6)
(n,n*7)
(n,n*8)
(n,n*9)
(n,n*10)

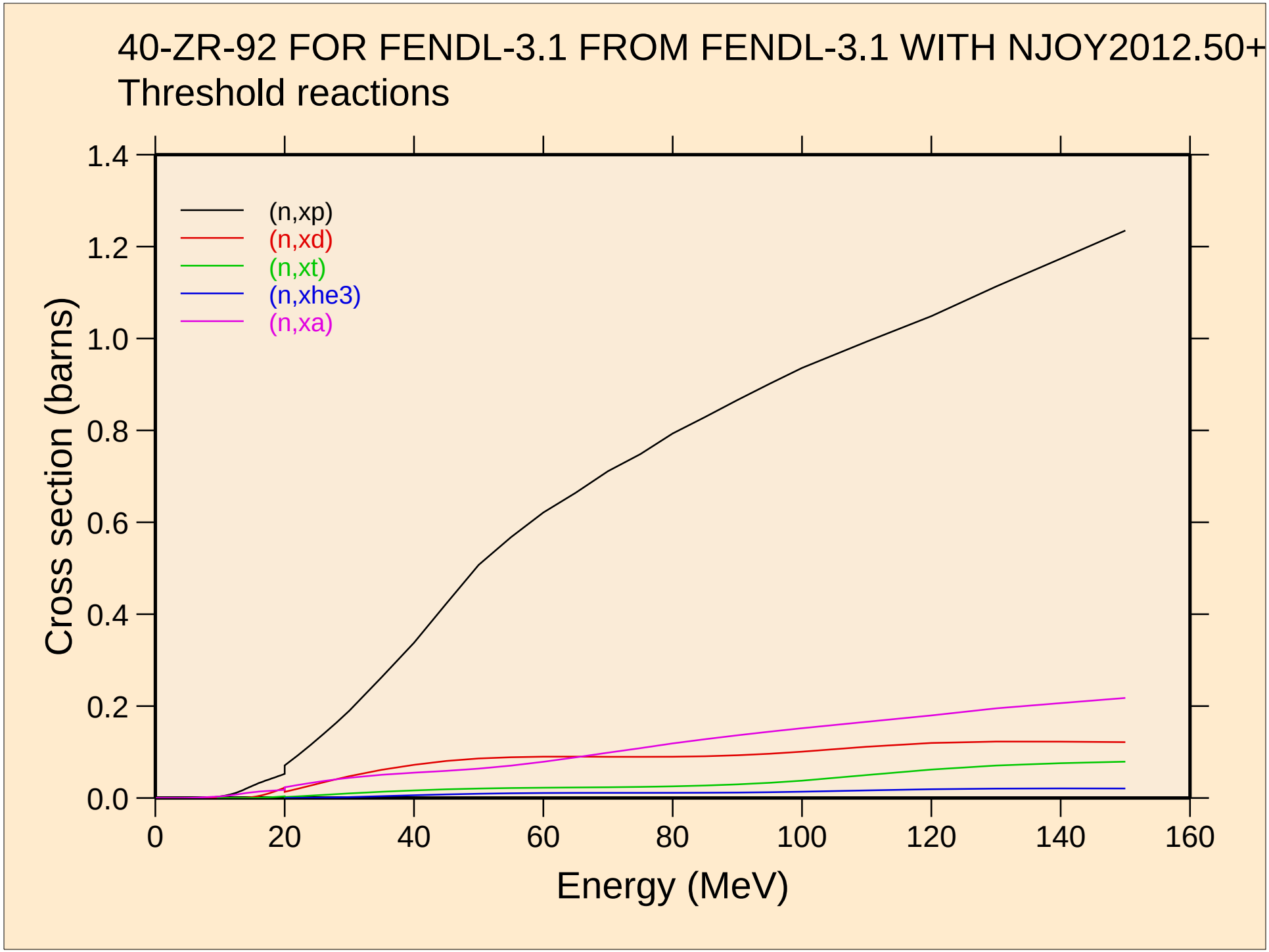

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Inelastic levels
Cross section (barns)
*10-3
120
100
80
60
40
20
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)
(n,n*11)
(n,n*12)
(n,n*13)
(n,n*14)
(n,n*15)

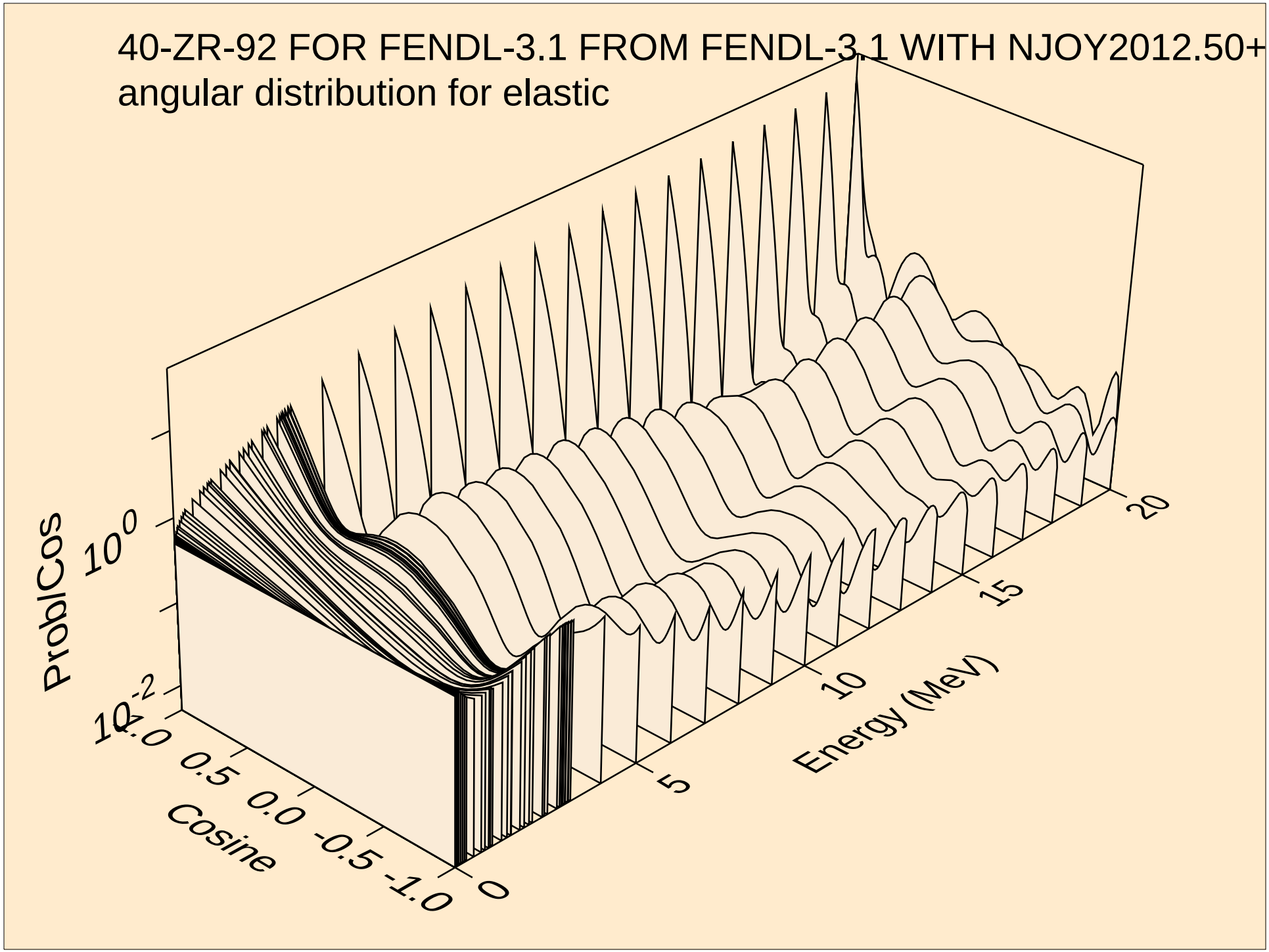

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Inelastic levels
Cross section (barns)
*10-3
80
70
60
50
40
30
20
10
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)
(n,n*16)
(n,n*17)

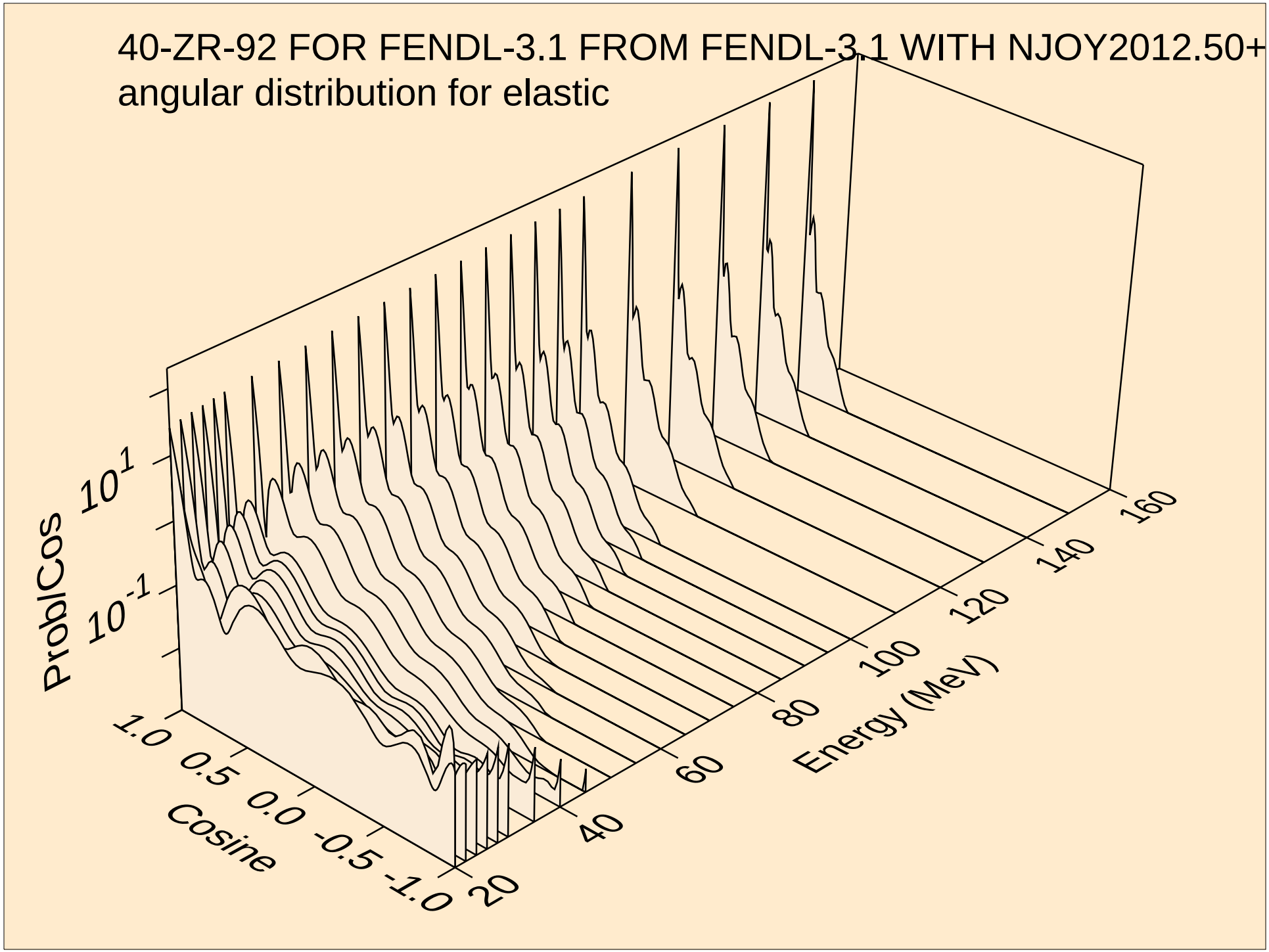

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Threshold reactions
Cross section (barns)
Energy (MeV)
(n,x)
(n,2n)
(n,3n)
(n,n*)a
(n,n*)p
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
0
20
40
60
80
100
120
140
160

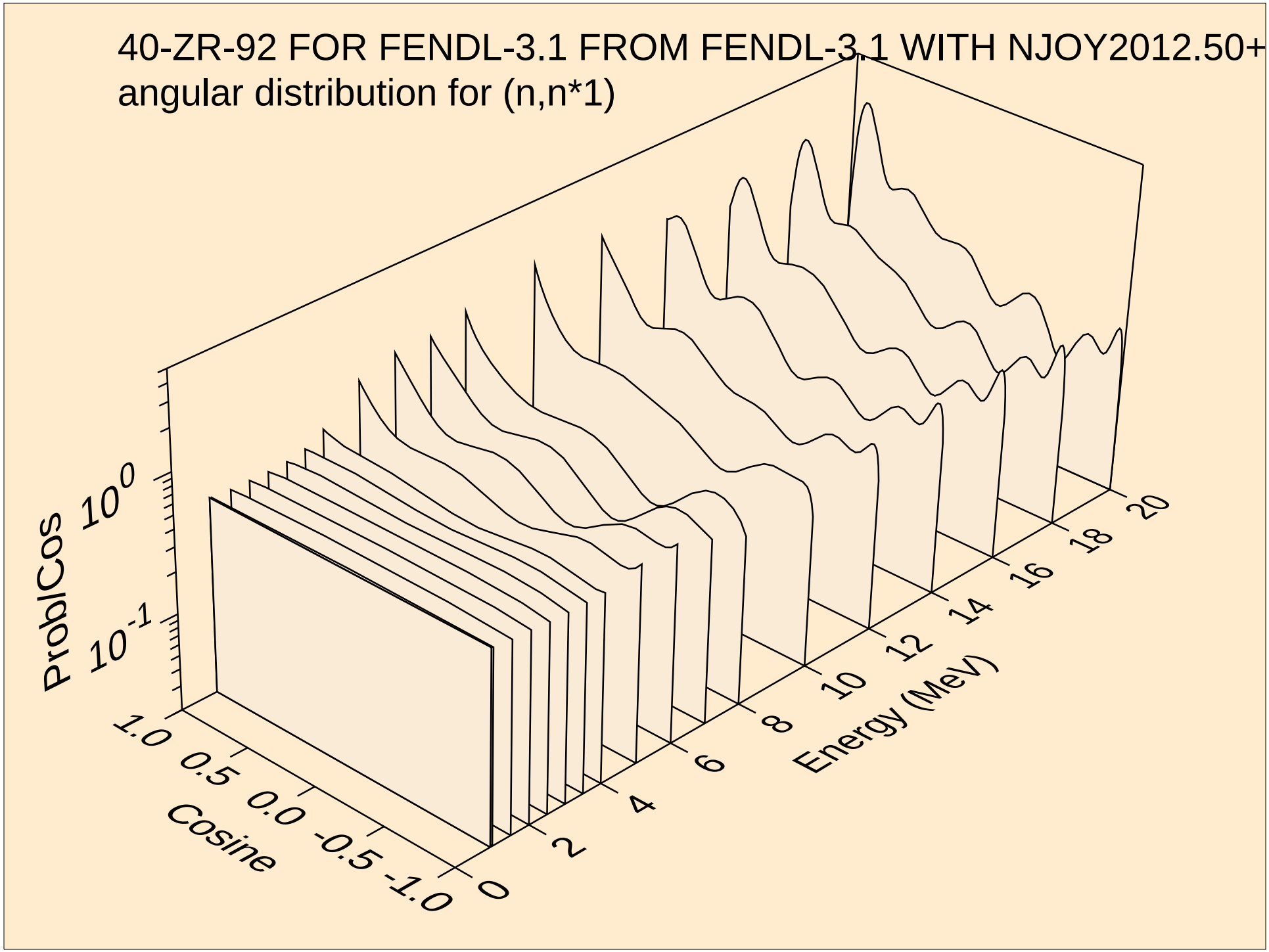

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Threshold reactions
Cross section (barns)
Energy (MeV)
(n,n*)d
(n,n*)t
(n,n*c)
(n,p)
(n,d)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2
4
6
8
10
12
14
16
18
20

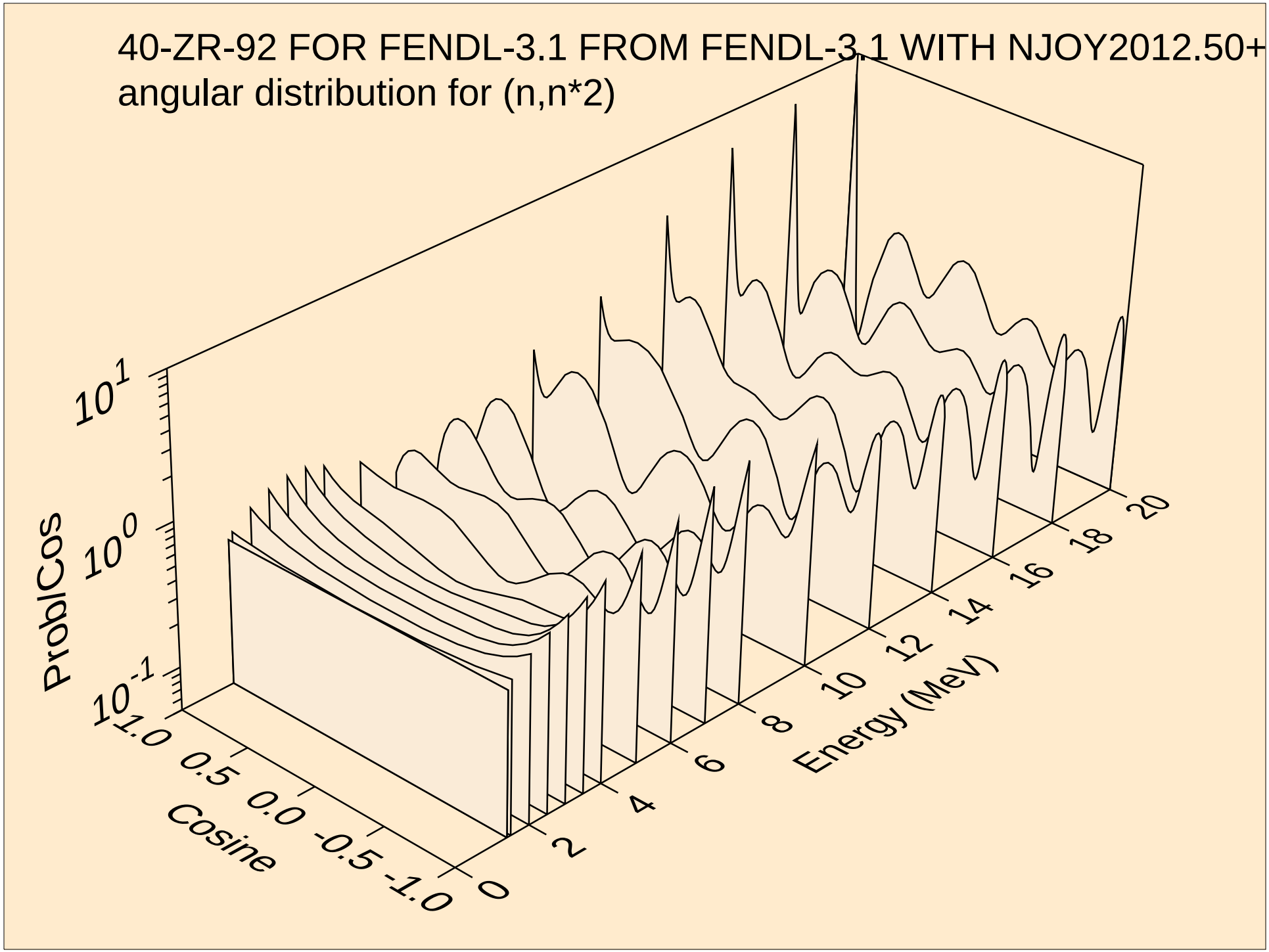

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Threshold reactions
10
*10-3
8
6
4
2
0
(n,t)
(n,a)
Cross section (barns)
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

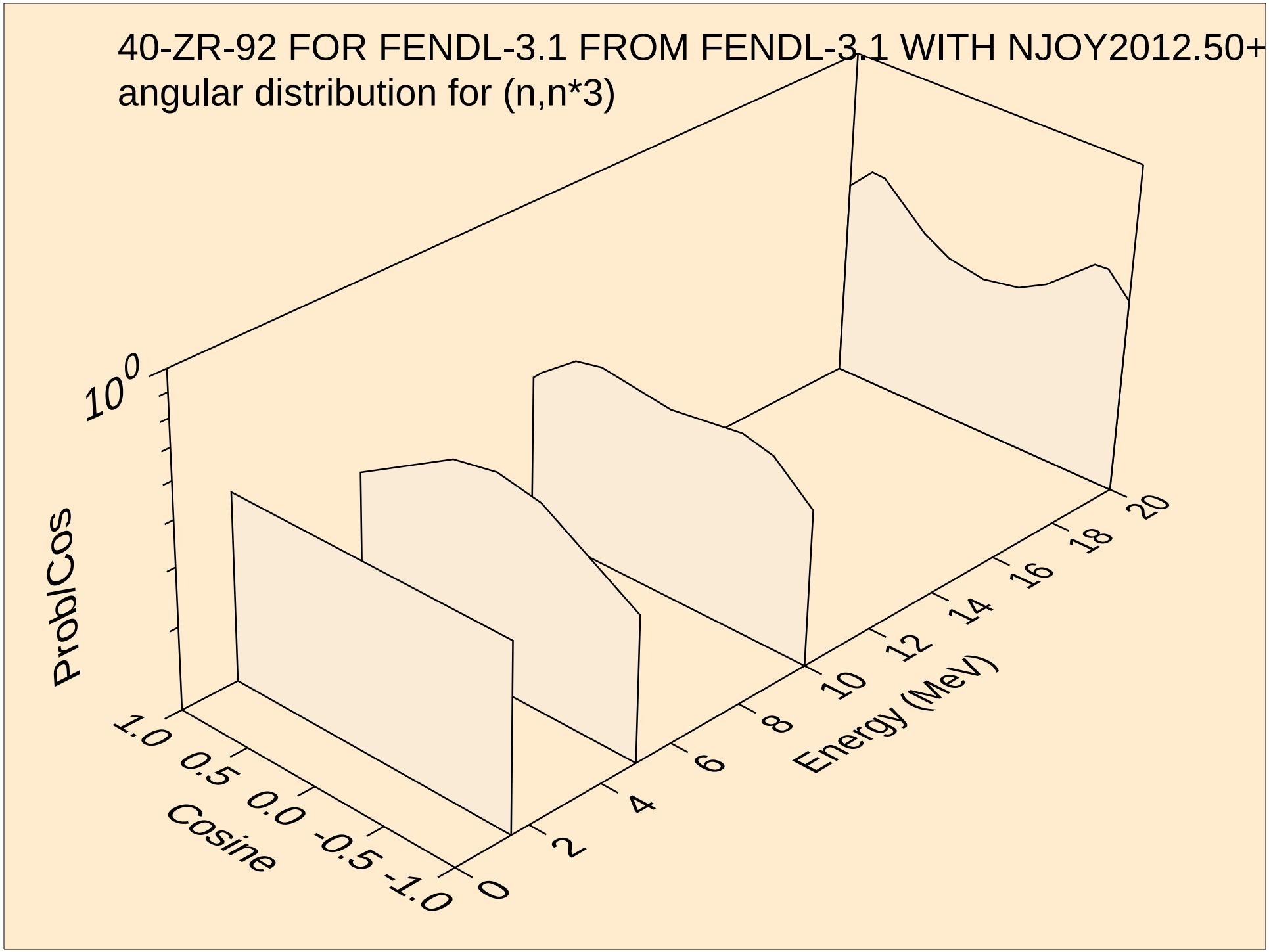

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Threshold reactions
(n,xp)
(n,xd)
(n,xt)
(n,xhe3)
(n,xa)
Cross section (barns)
Energy (MeV)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
0
20
40
60
80
100
120
140
160

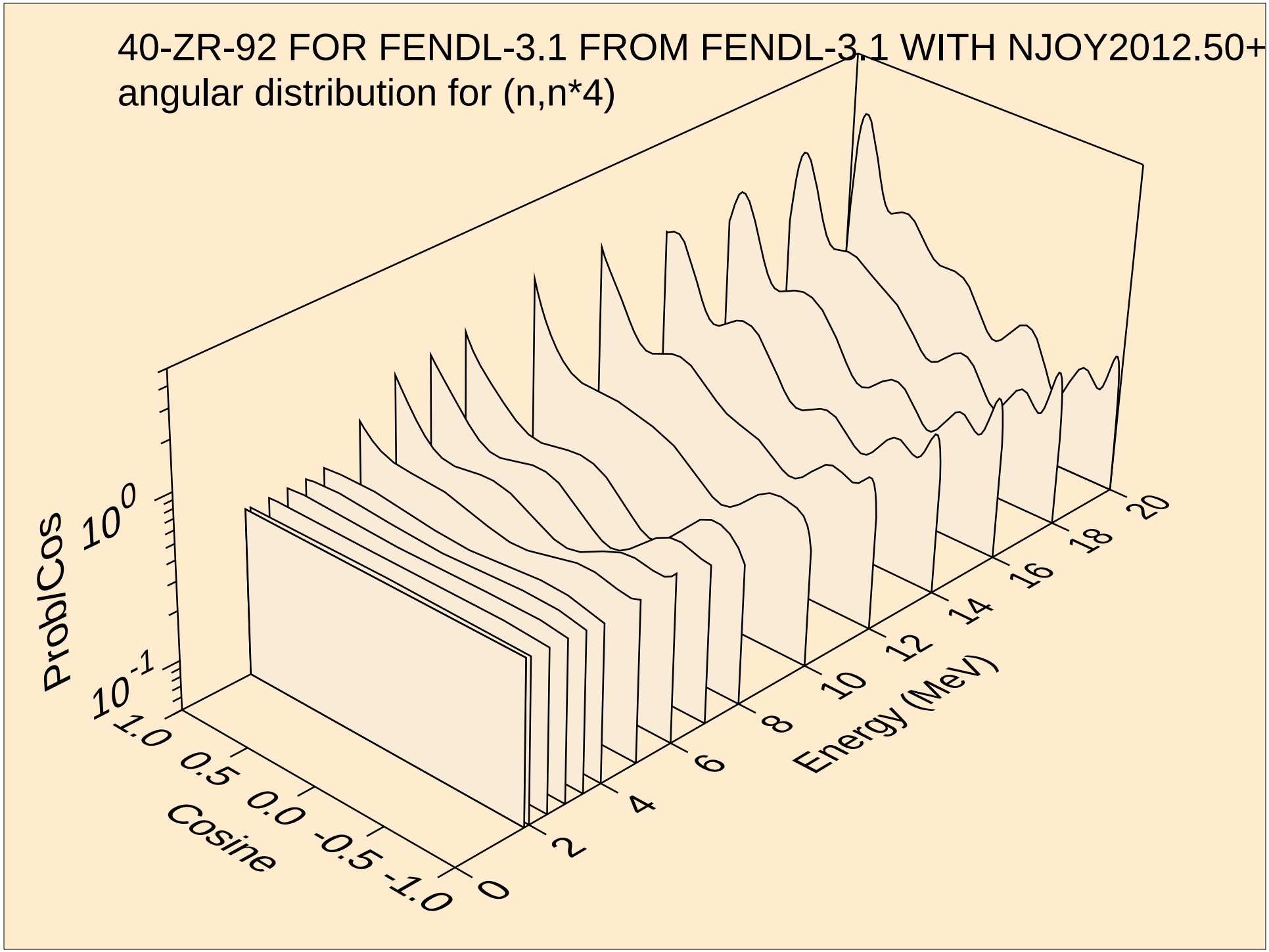

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for elastic
ProblCos
$10^{0}$
$10^{-2}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
5
10
15
20
Energy (MeV)

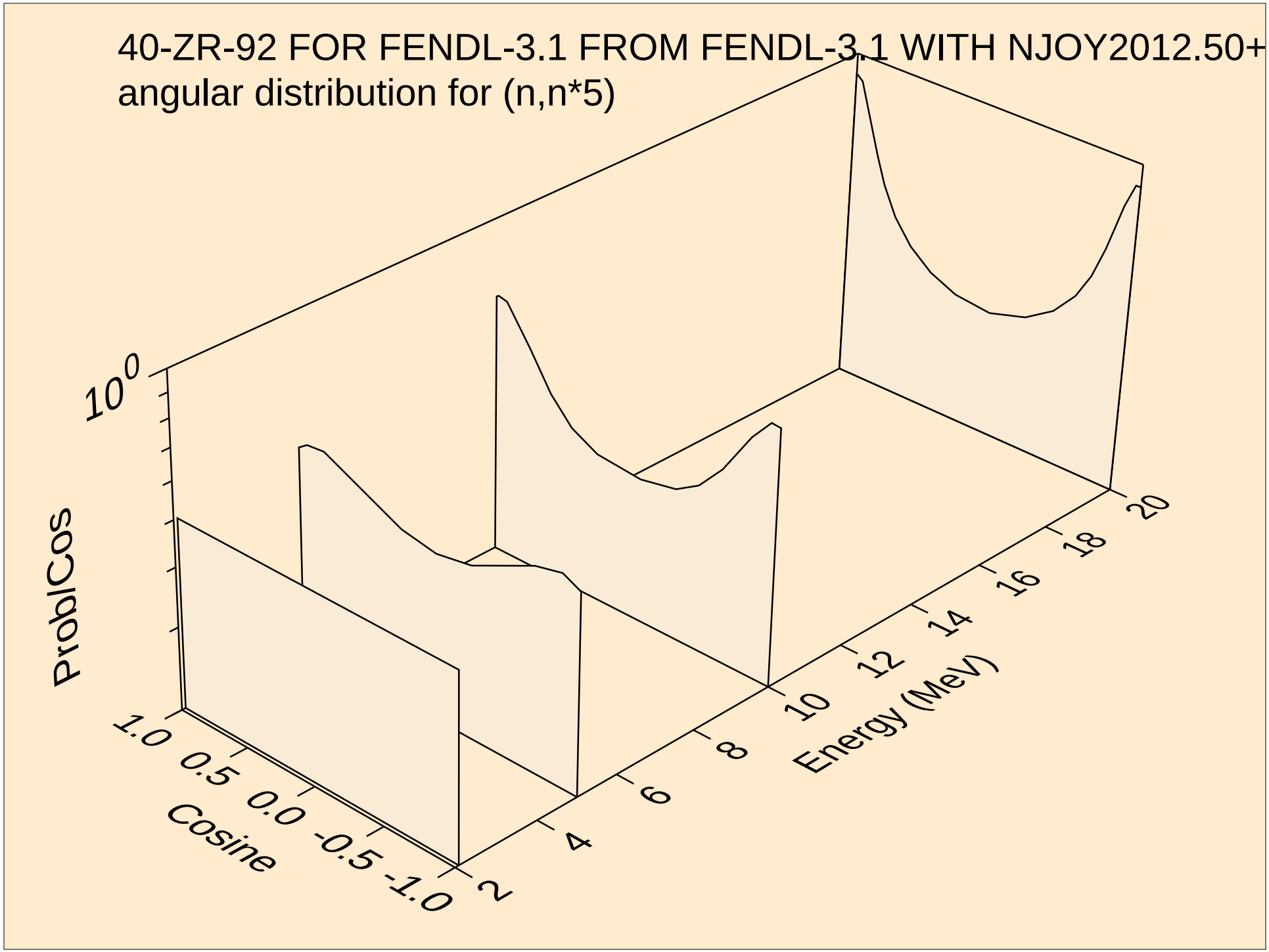

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for elastic
ProbICos
10^1
10^-1
1.0
0.5
0.0
-0.5
-1.0
Cosine
20
40
60
80
100
120
140
160
Energy (MeV)

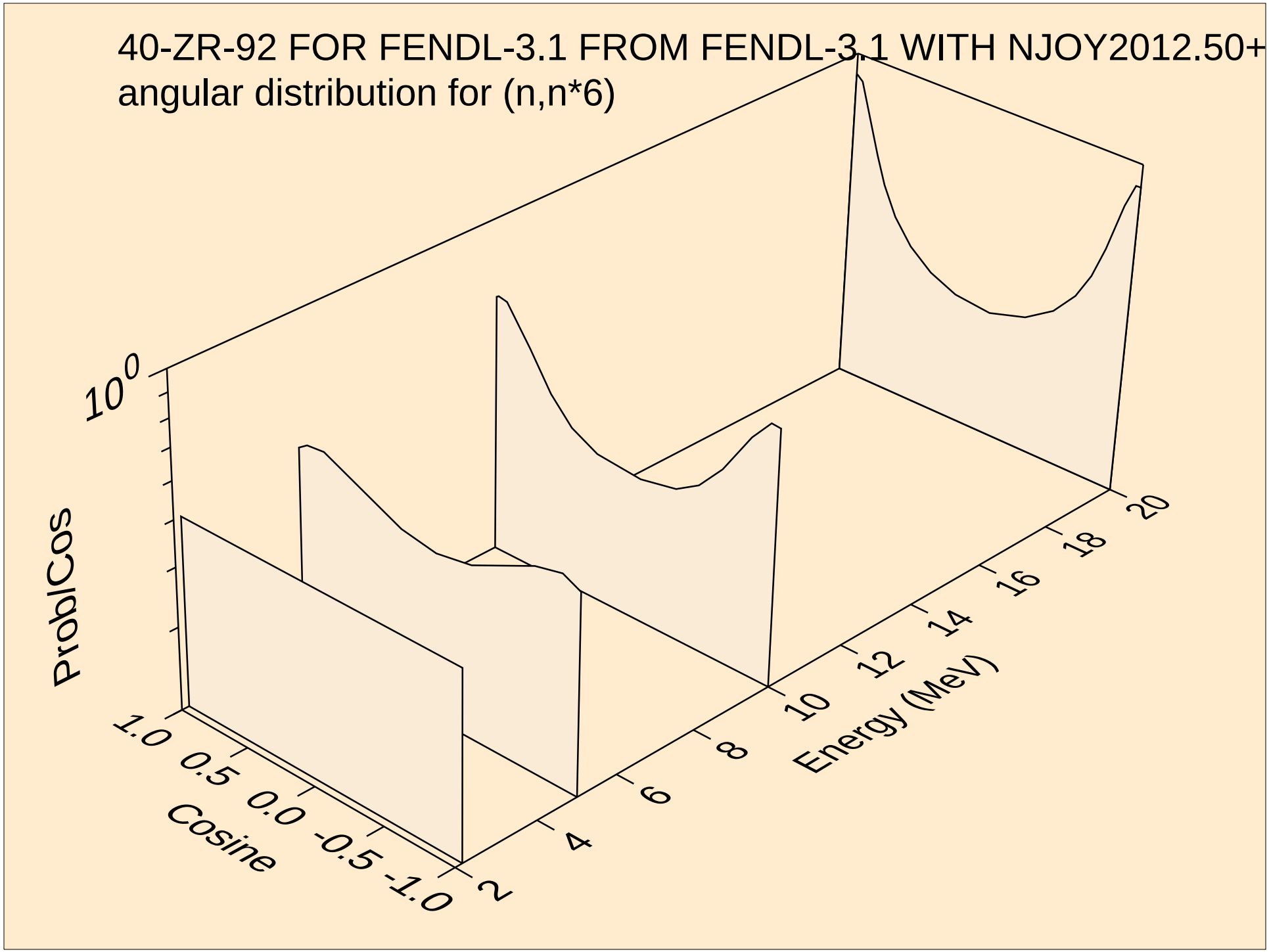

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*1)
ProbICos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

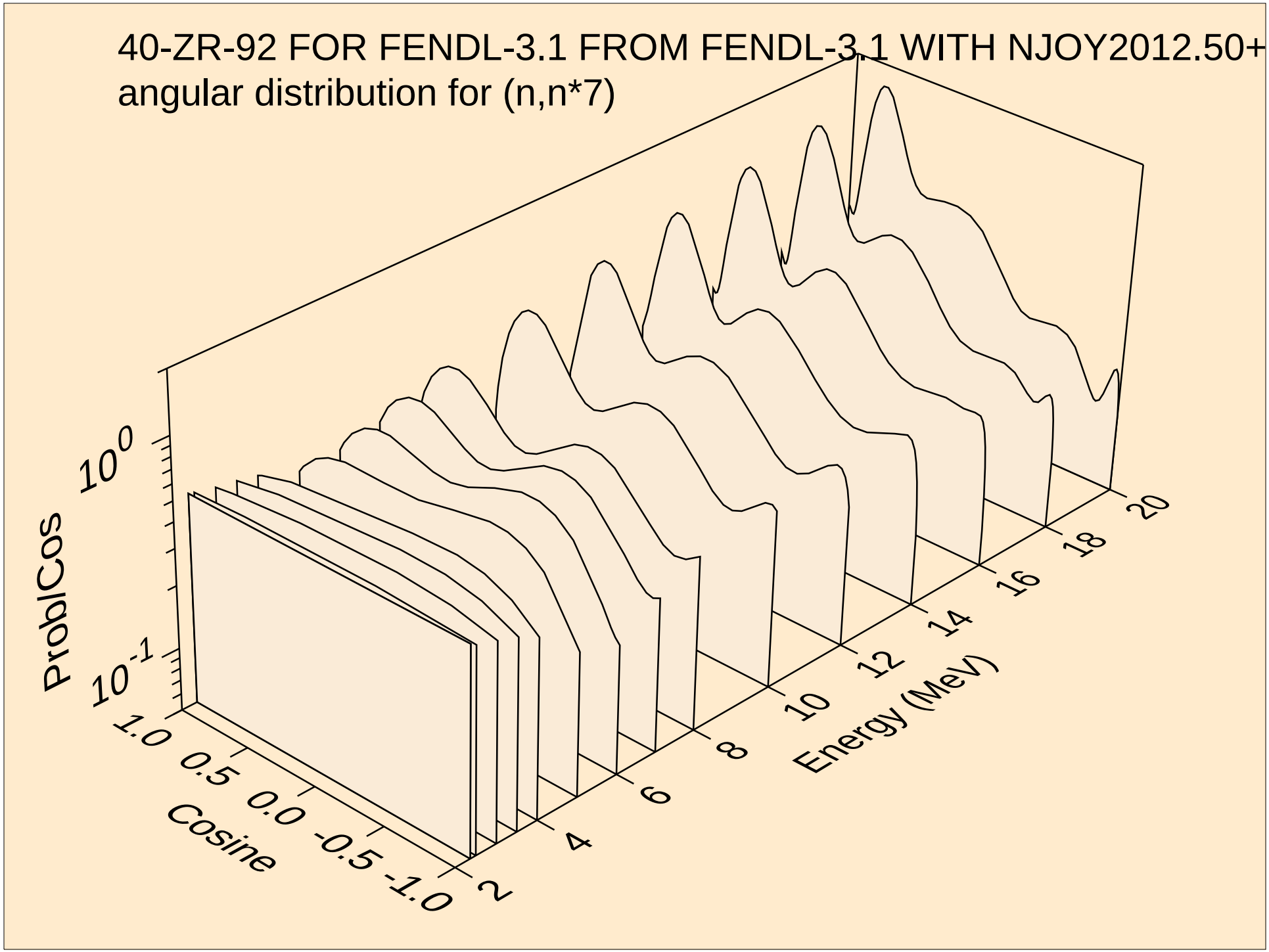

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*2)
ProbICos
10^1
10^0
10^-1
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

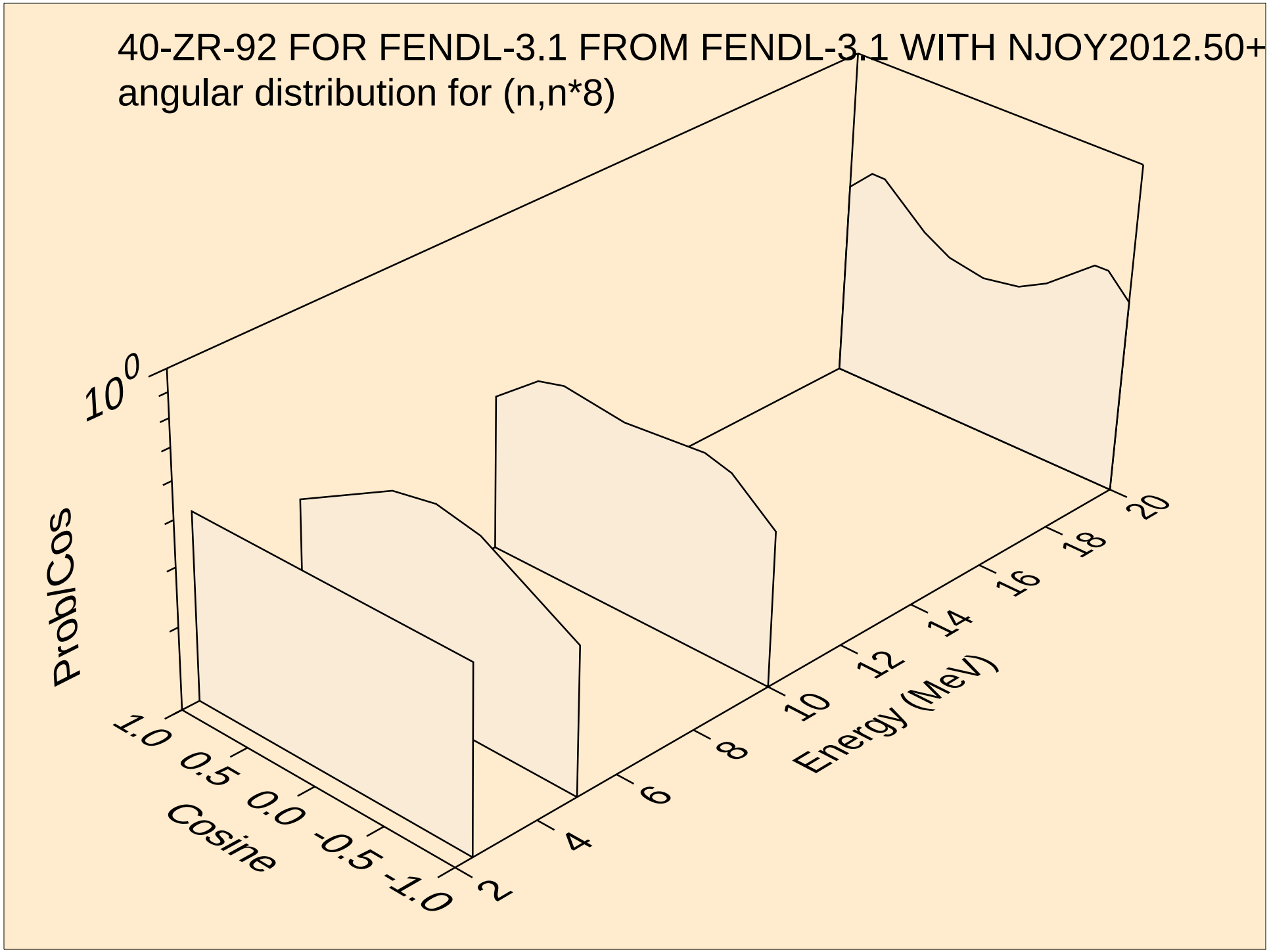

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*3)
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

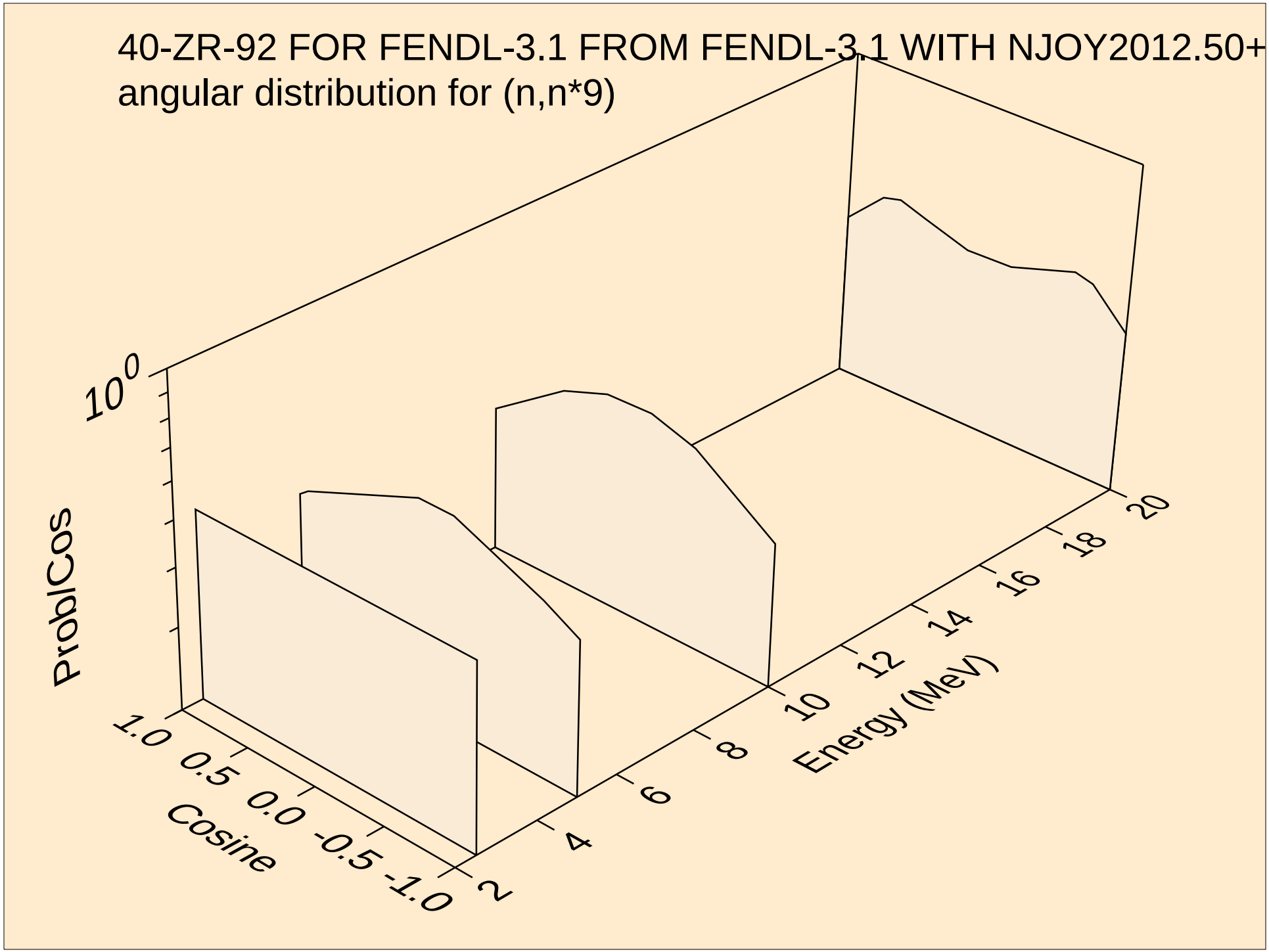

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*4)
ProbICos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

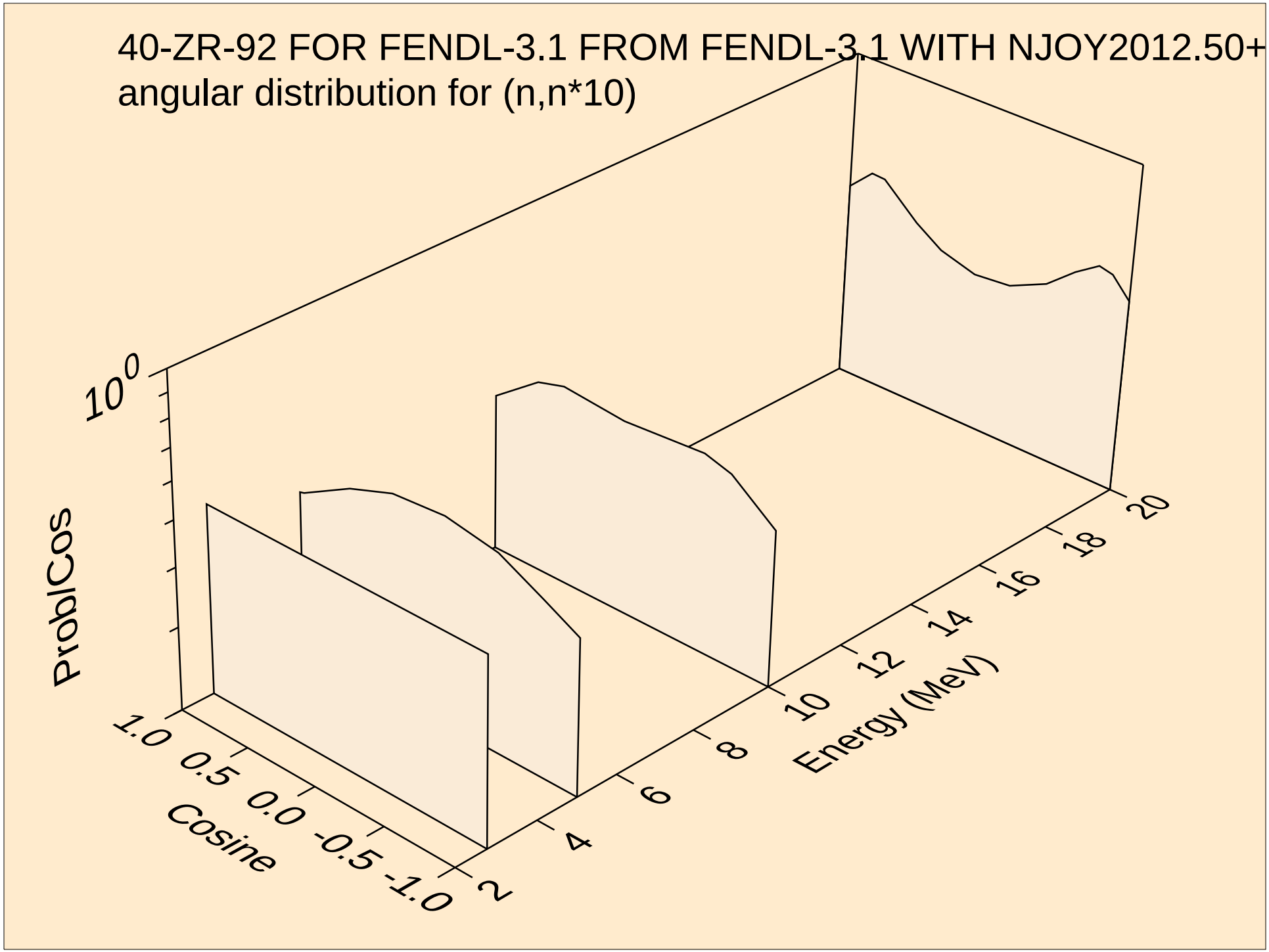

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*5)
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

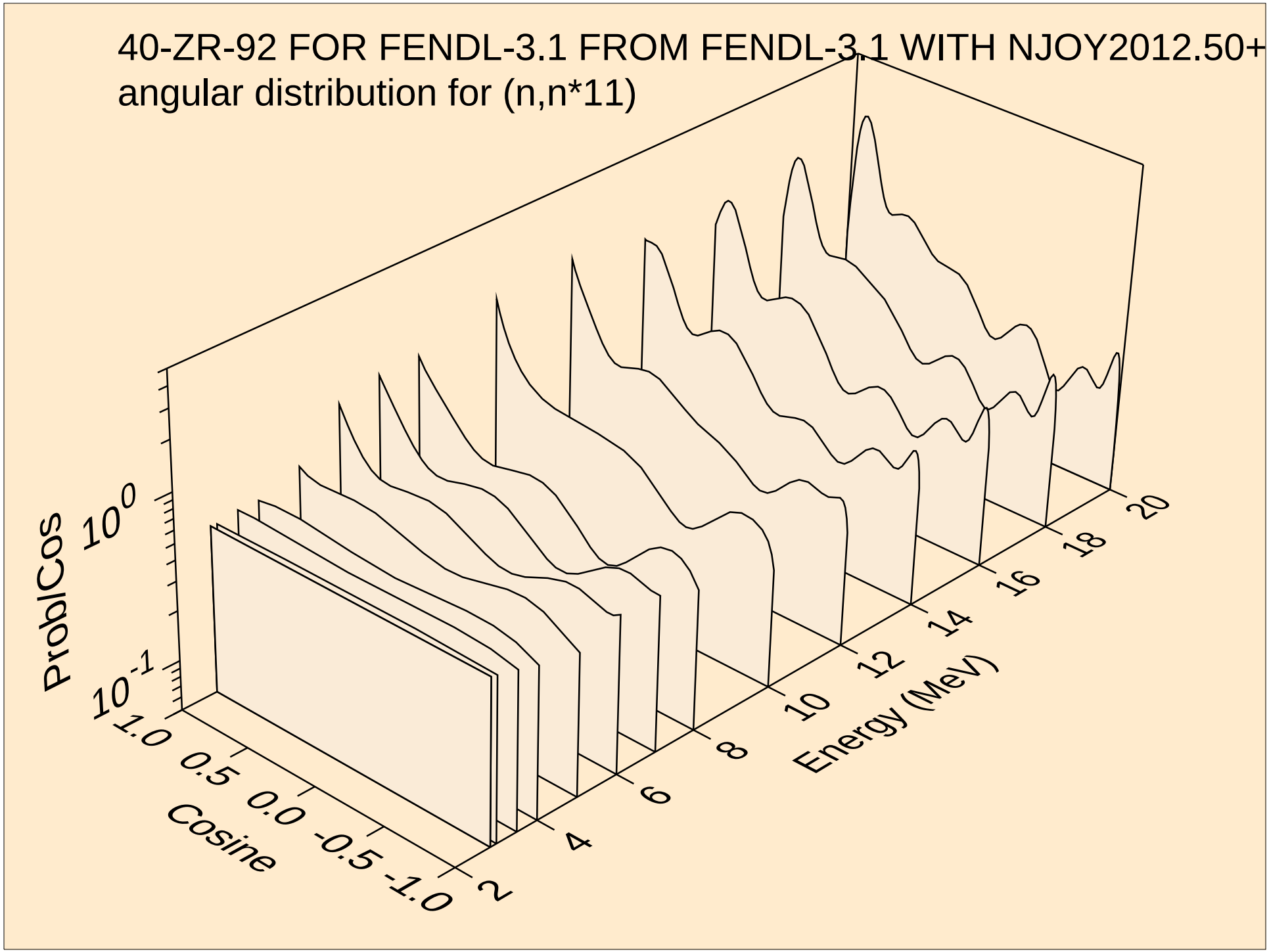

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*6)
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

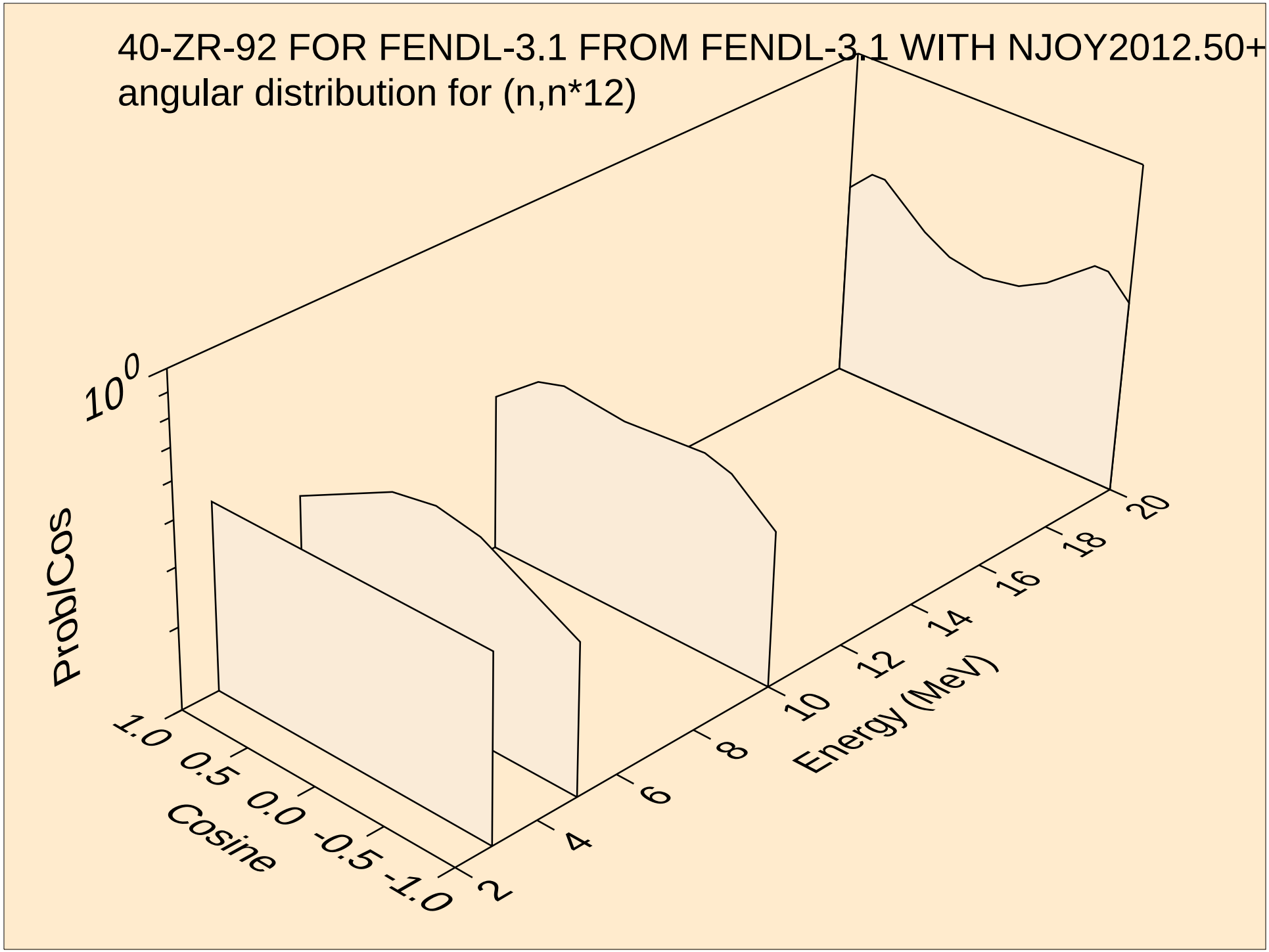

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*7)
ProbICos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

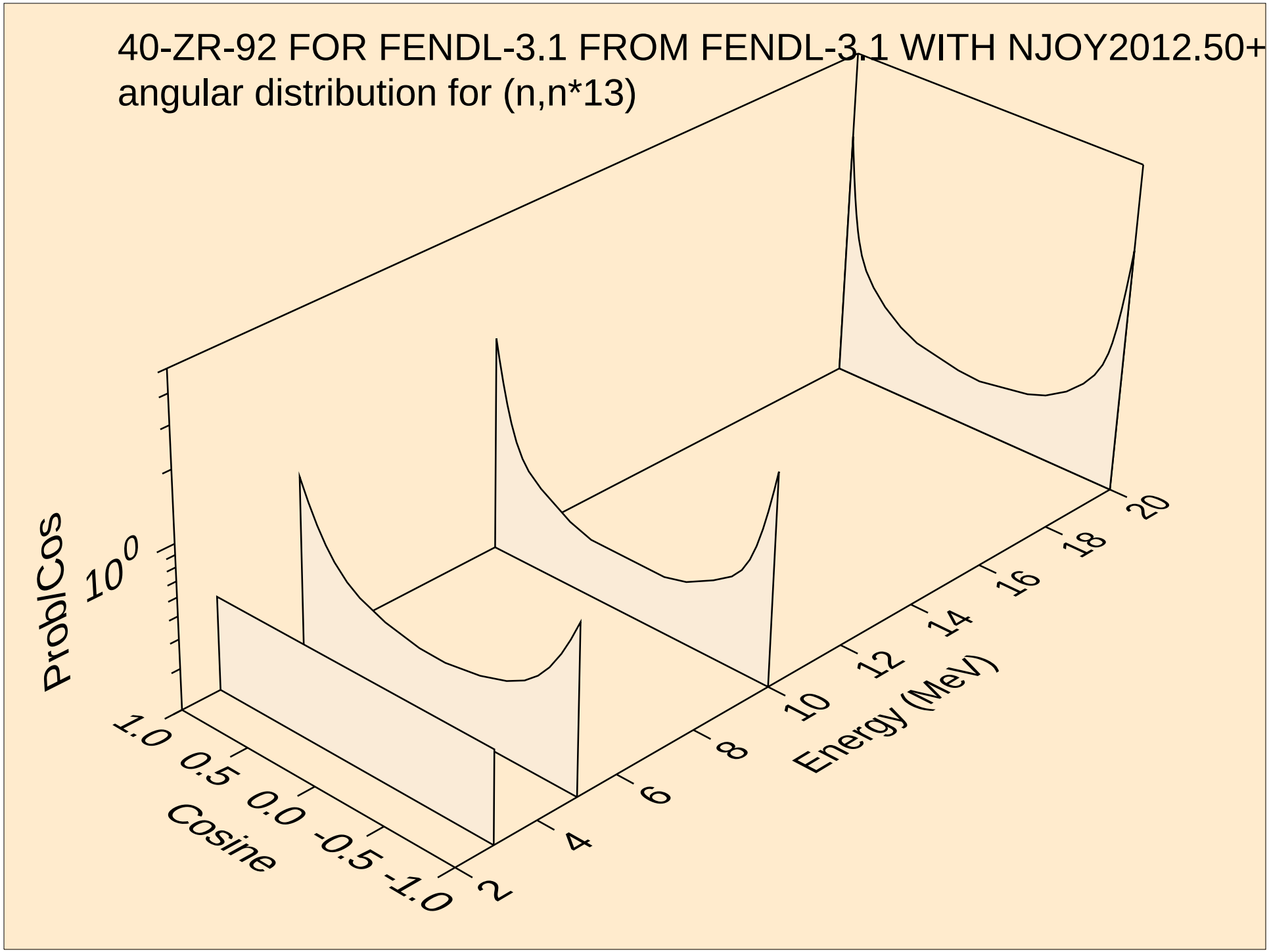

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*8)
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

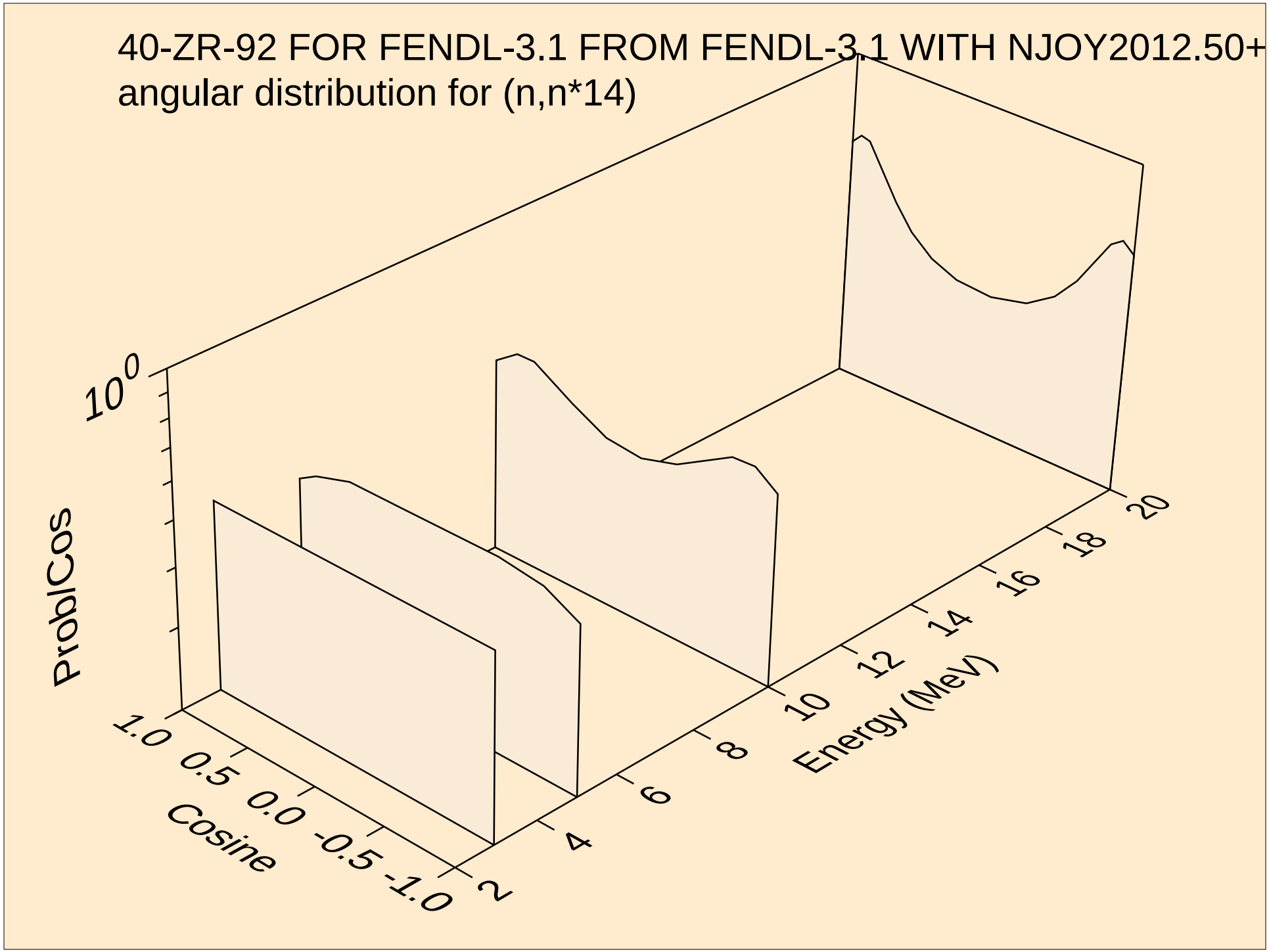

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*9)
ProbICos
10^0
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

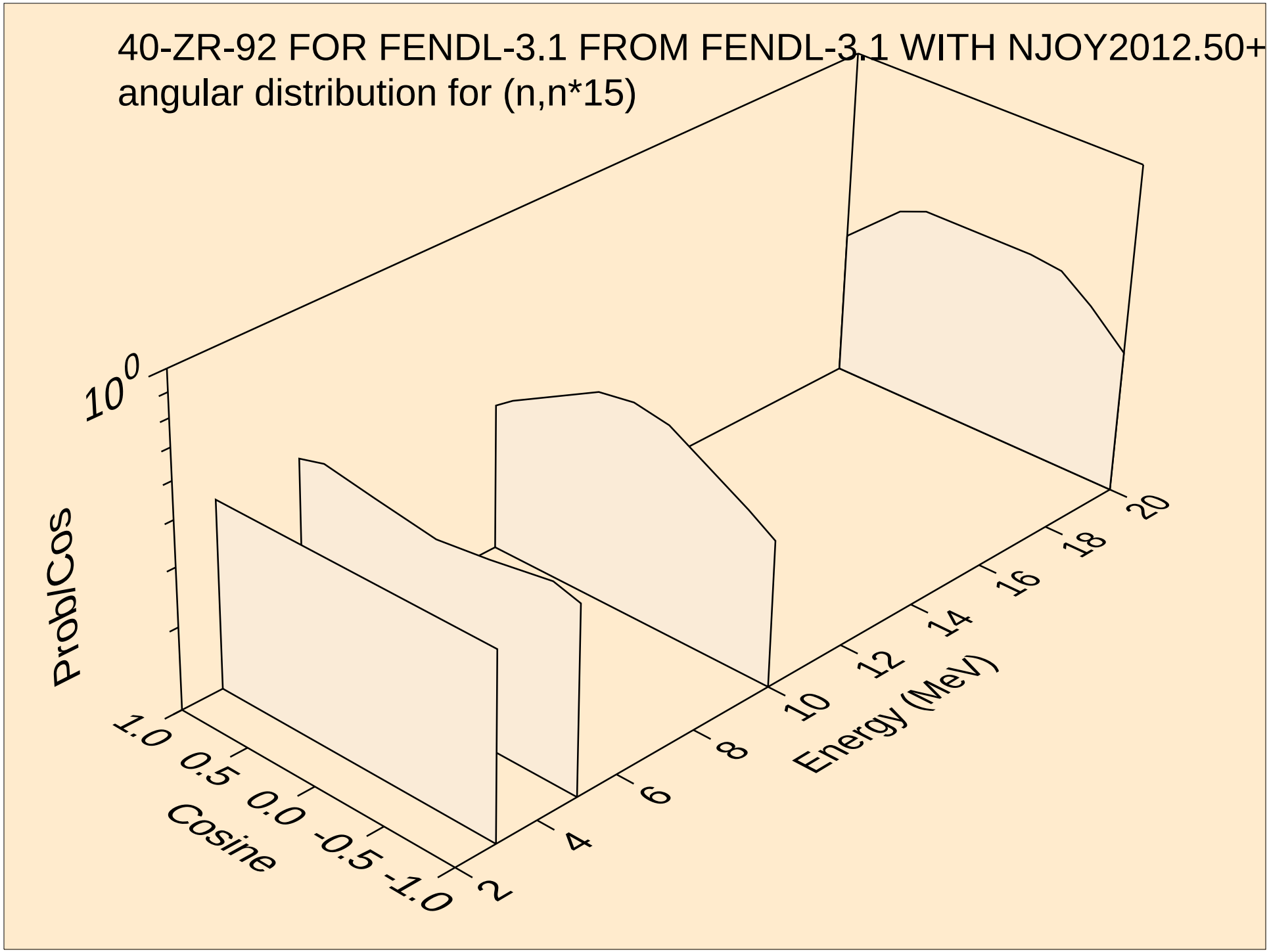

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*10)
$10^0$
Prob\Cos
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

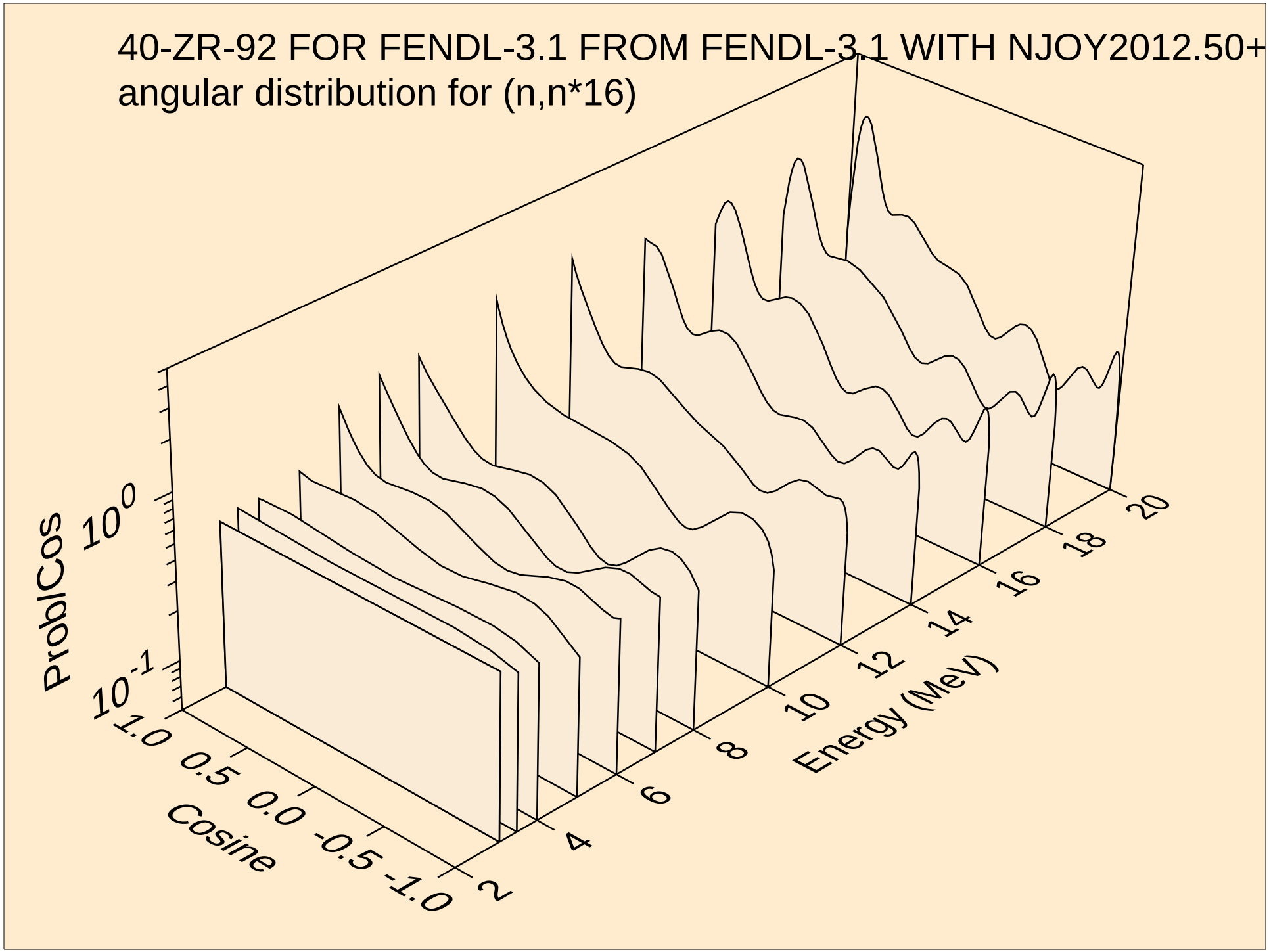

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*11)
Prob\Cos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

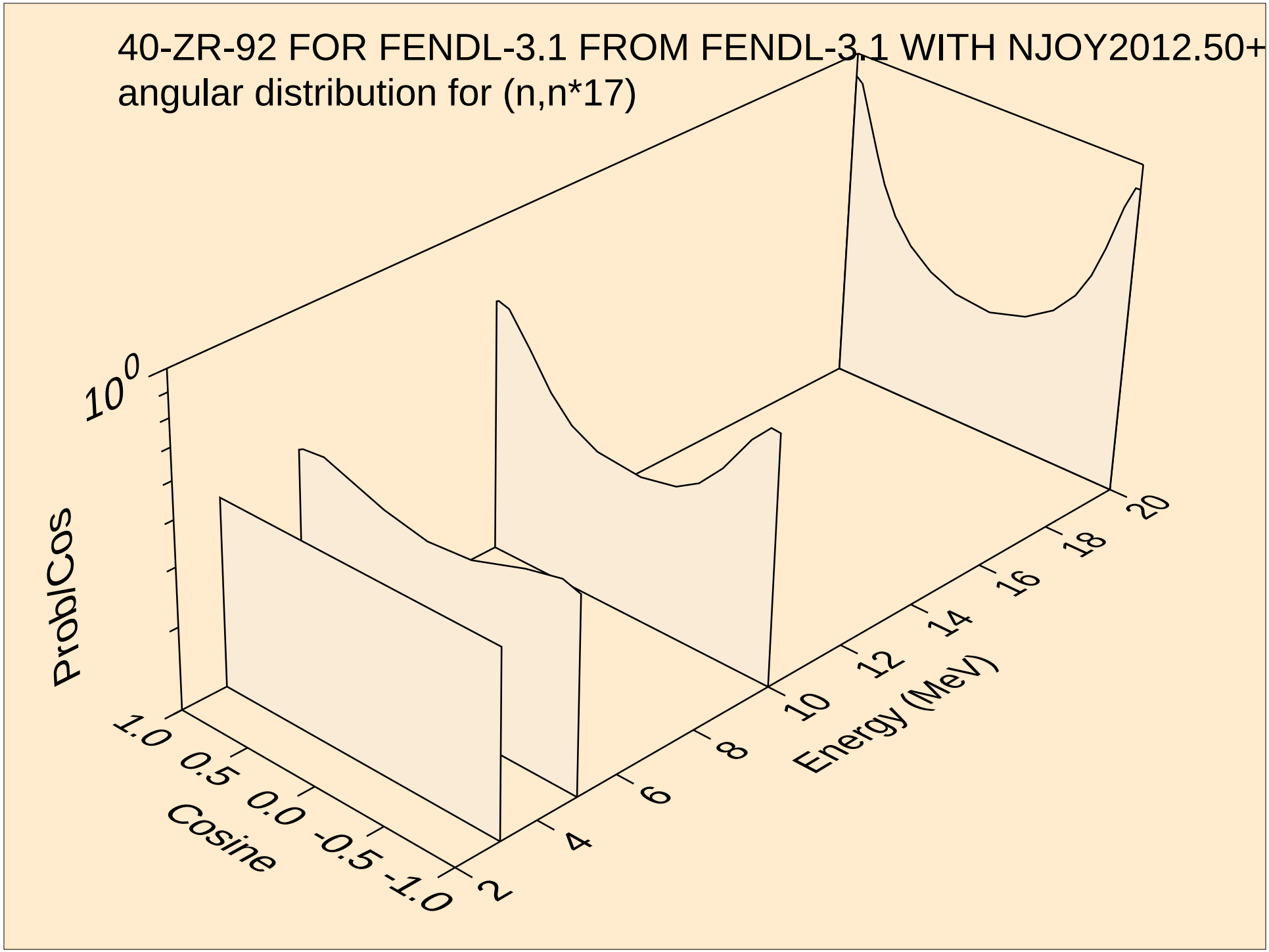

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*12)
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

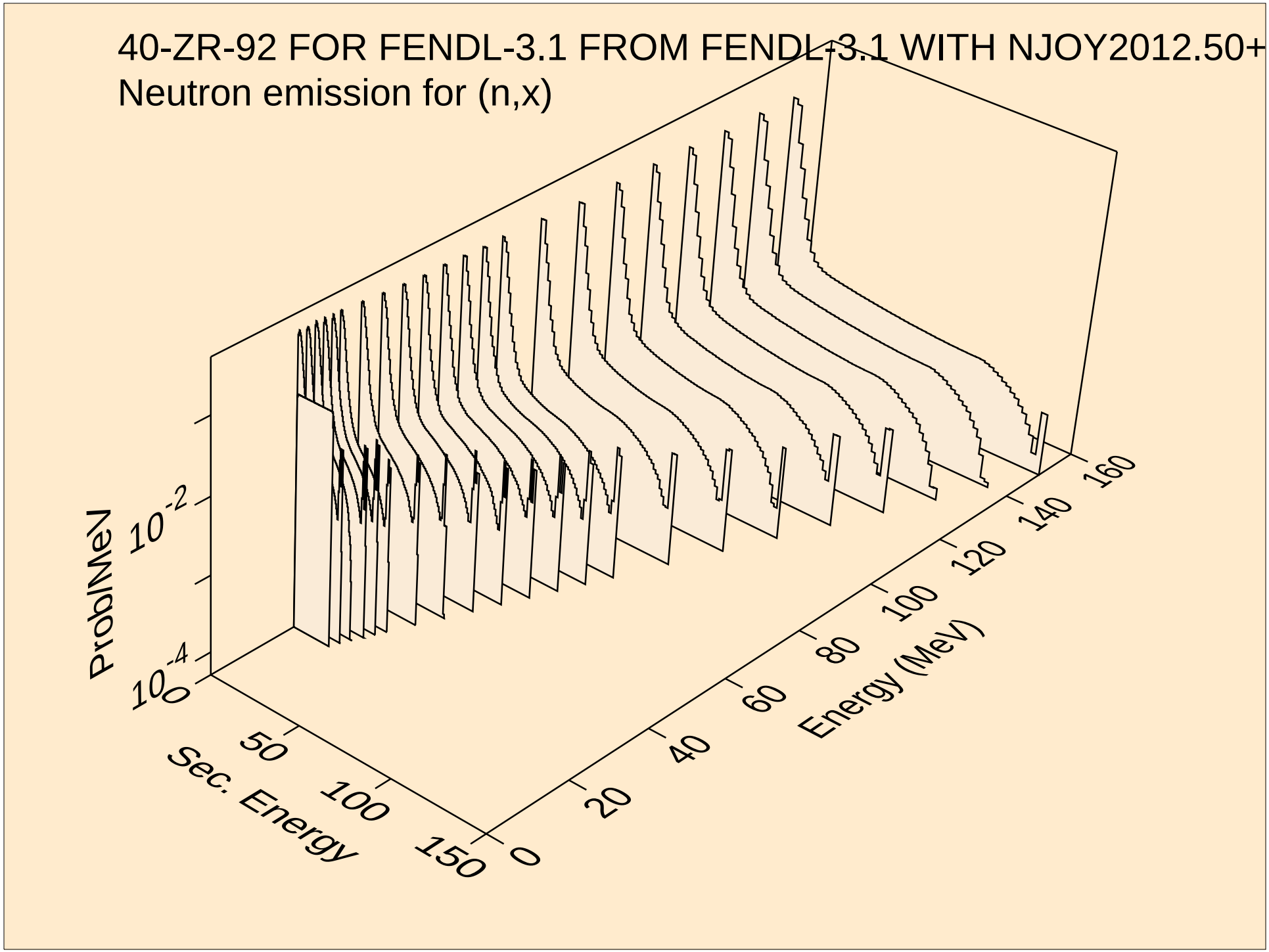

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*13)
ProbICos
$10^0$
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

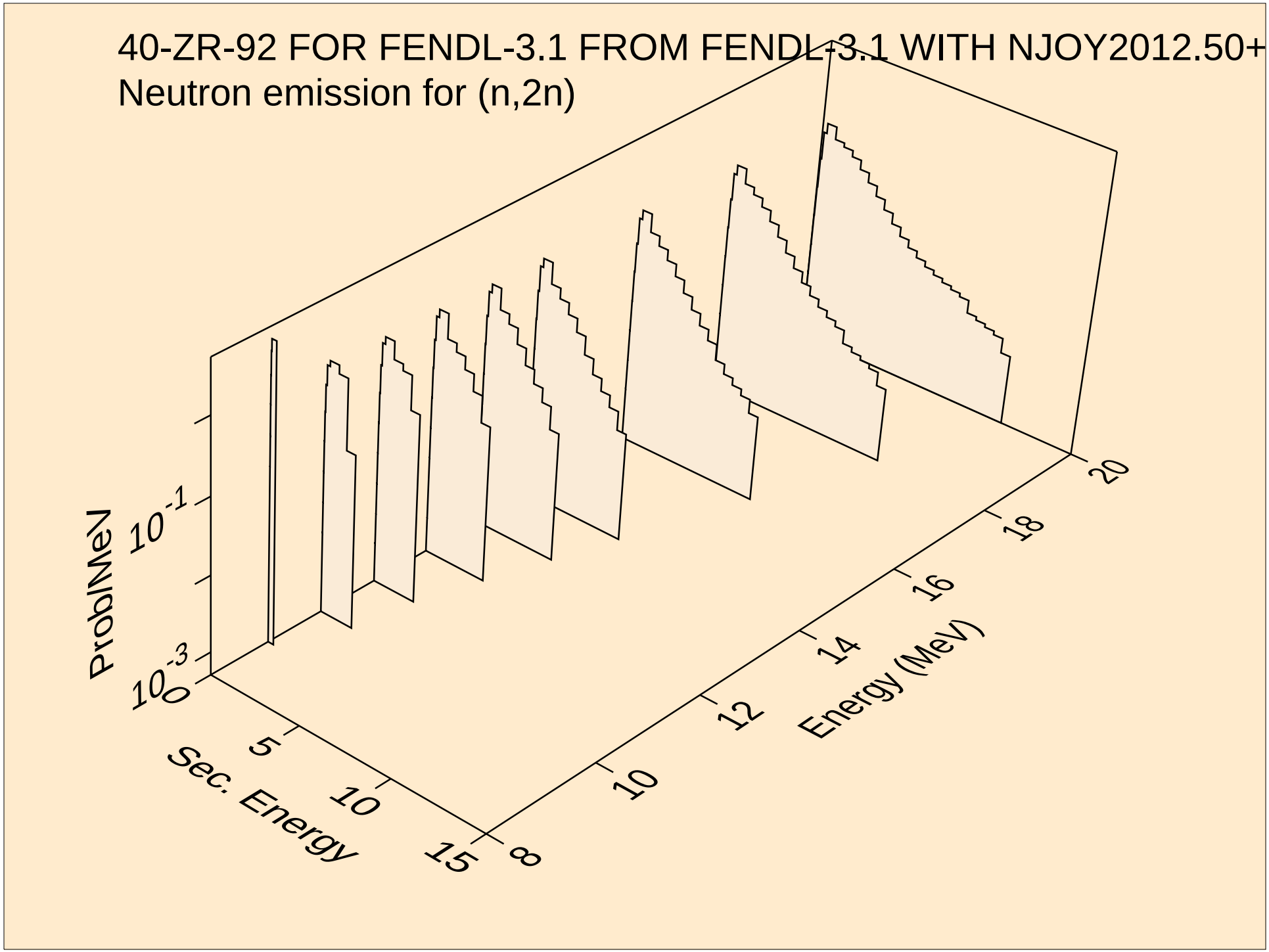

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*14)
$10^0$
ProbICos
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

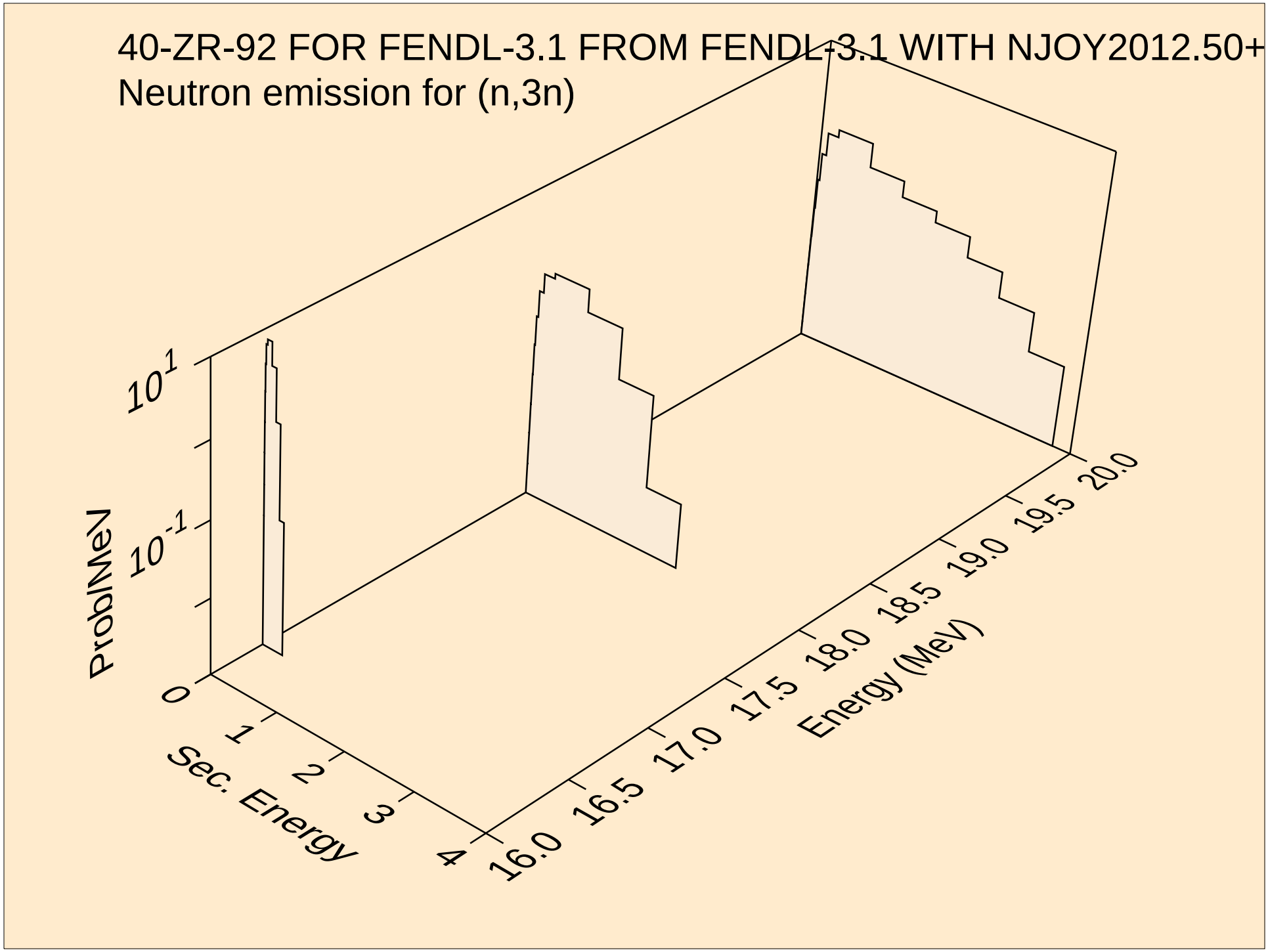

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*15)
ProbICos
10^0
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

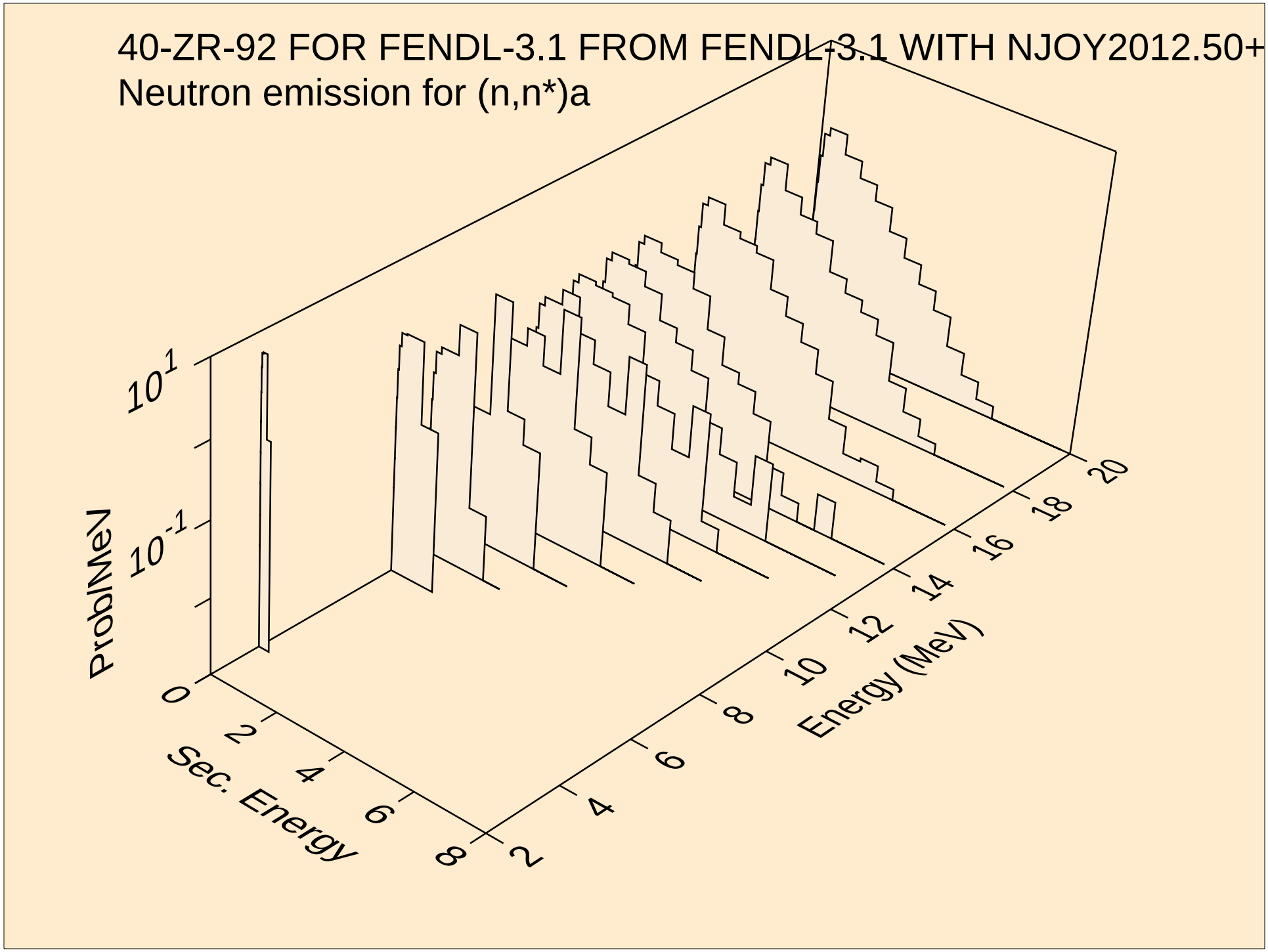

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*16)
ProbICos
$10^{0}$
$10^{-1}$
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

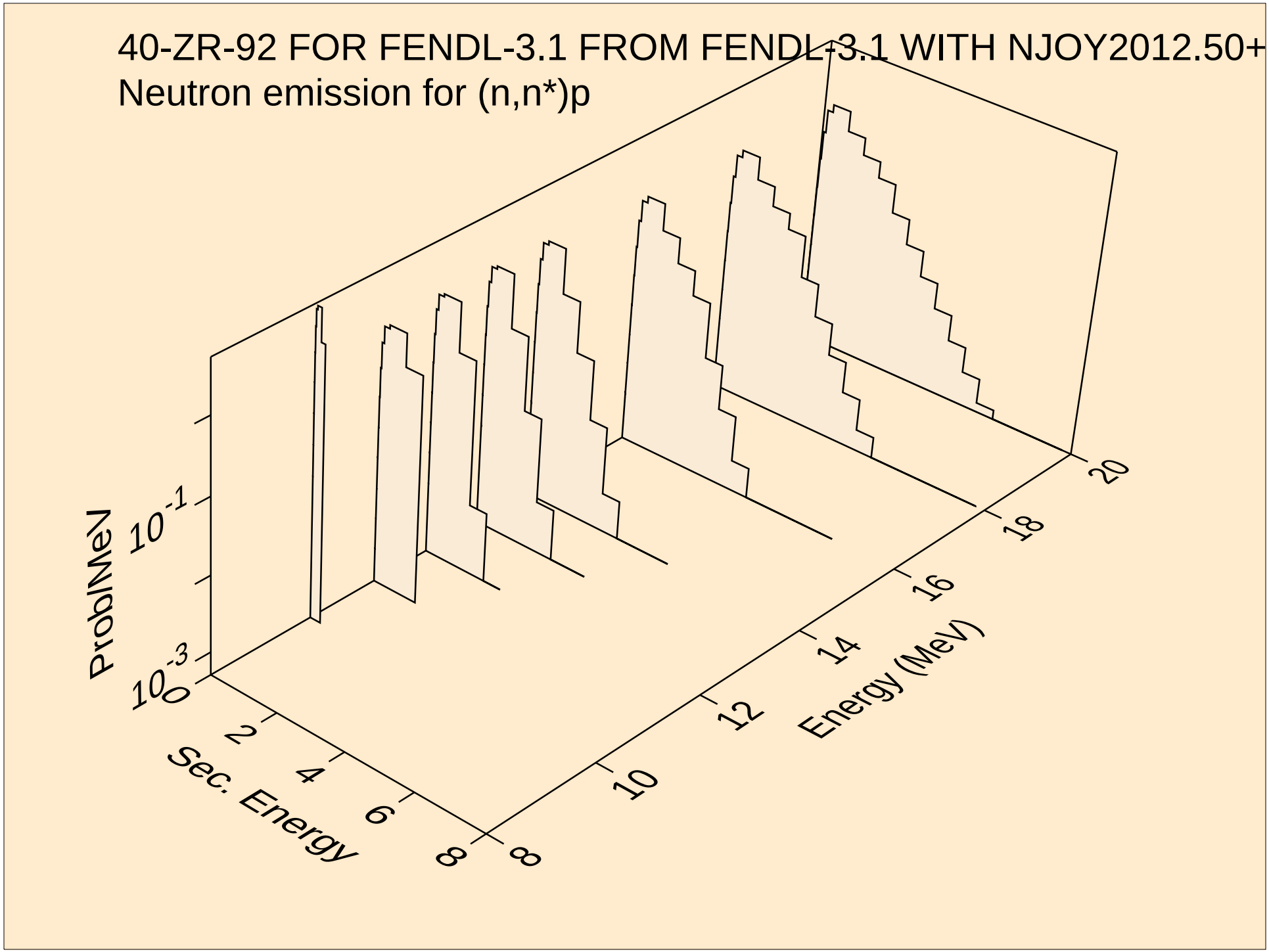

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
angular distribution for (n,n*17)
$10^0$
Prob\Cos
1.0
0.5
0.0
-0.5
-1.0
Cosine
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

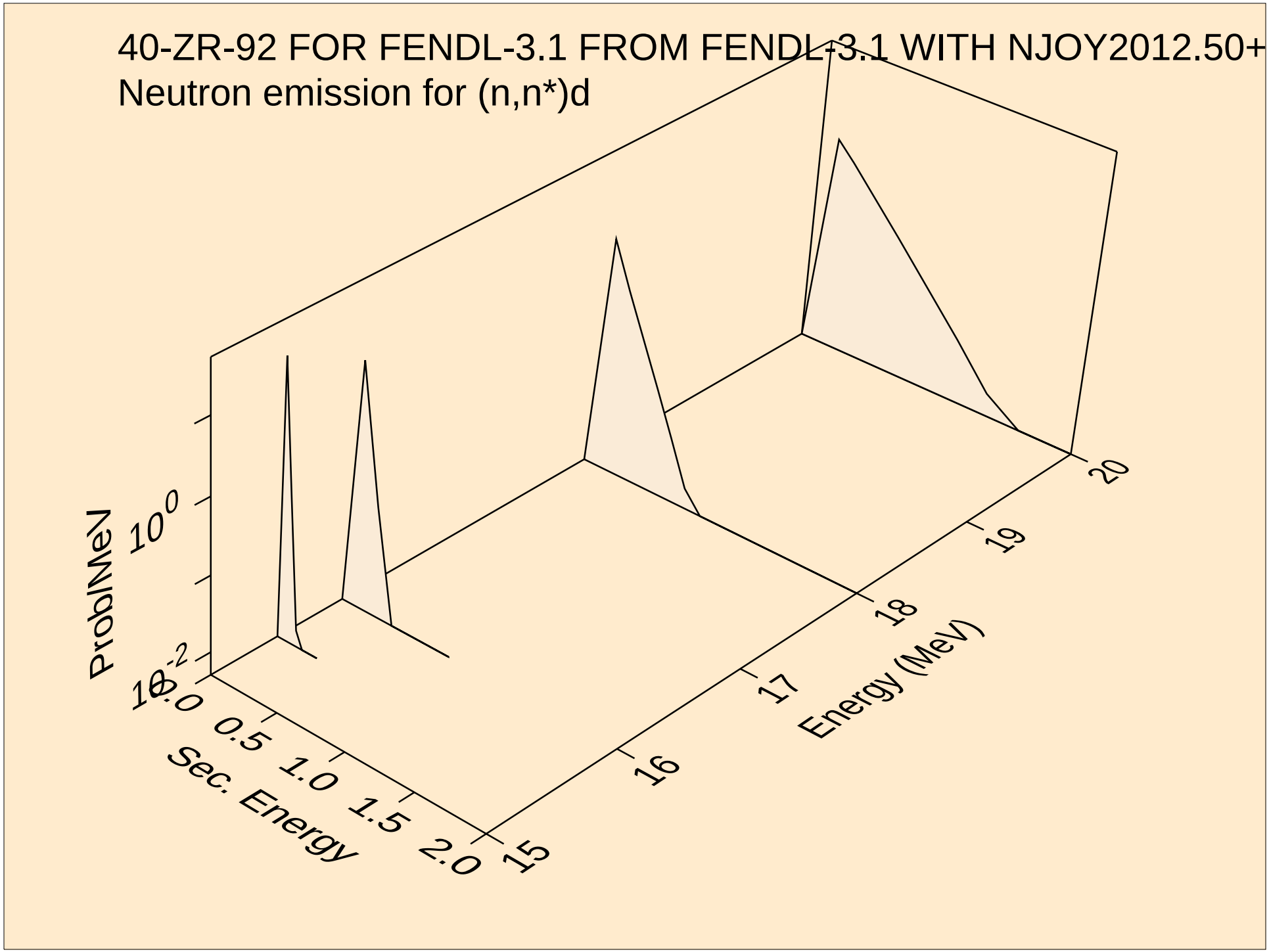

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Neutron emission for (n,x)
Prob/MeV
10-2
10-4
0
50
100
150
Sec. Energy
0
20
40
60
80
100
120
140
160
Energy (MeV)

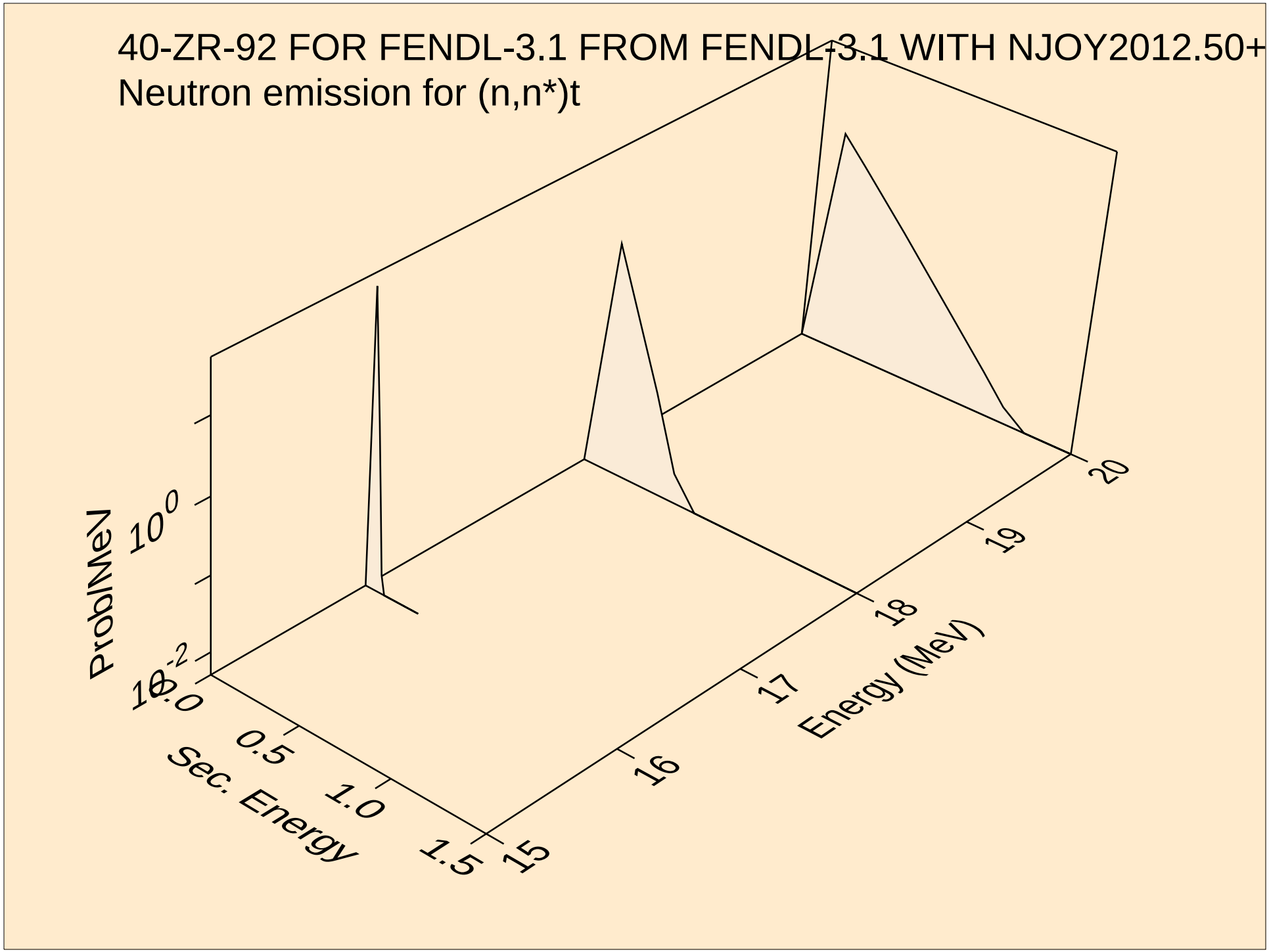

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Neutron emission for (n,2n)
Prob/MeV
10-1
10-3
0
5
10
15
Sec. Energy
8
10
12
14
16
18
20
Energy (MeV)

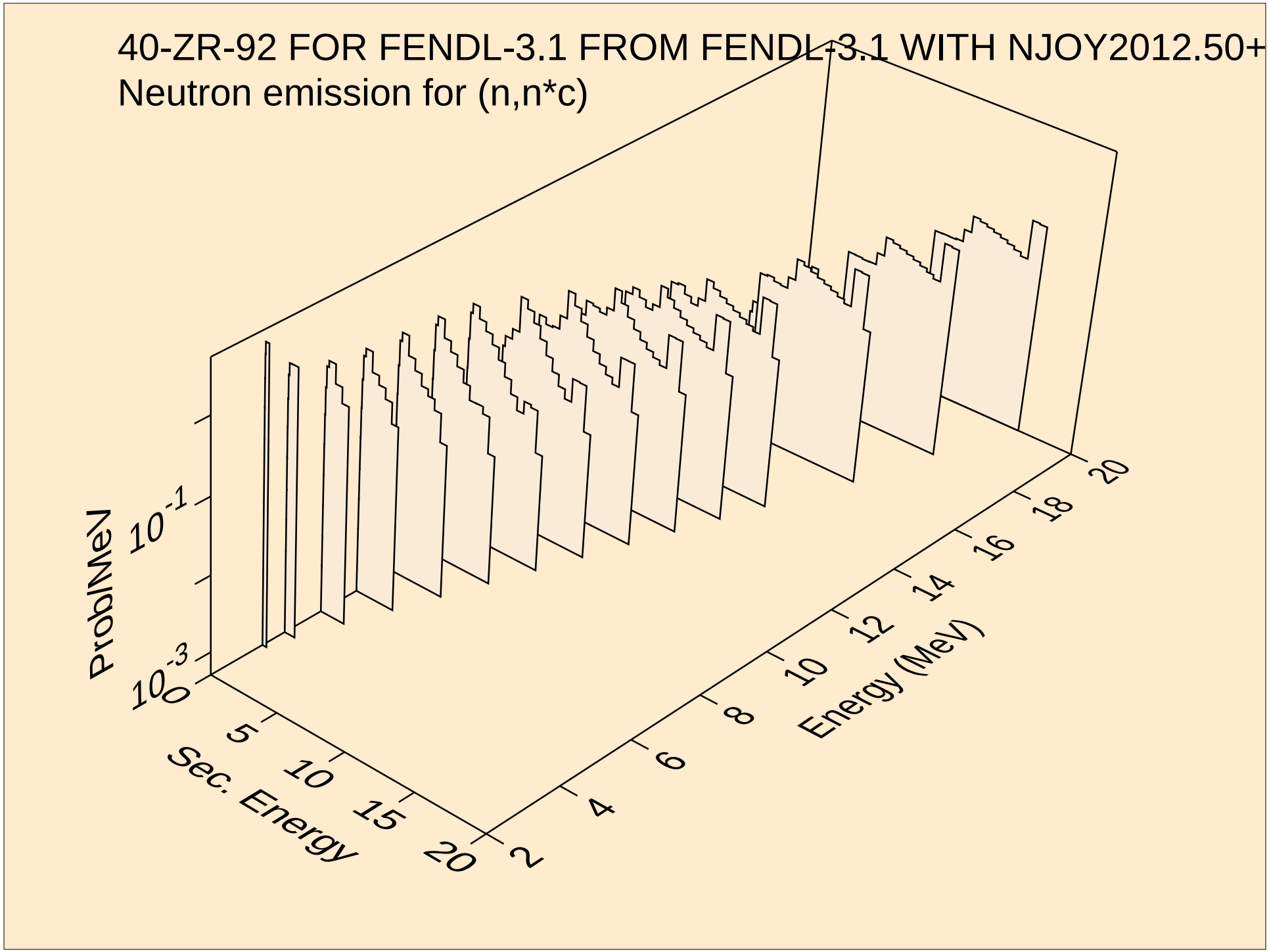

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Neutron emission for (n,3n)
Prob/MeV
$10^{1}$
$10^{-1}$
0
1
2
3
4
Sec. Energy
16.0
16.5
17.0
17.5
18.0
18.5
19.0
19.5
20.0
Energy (MeV)

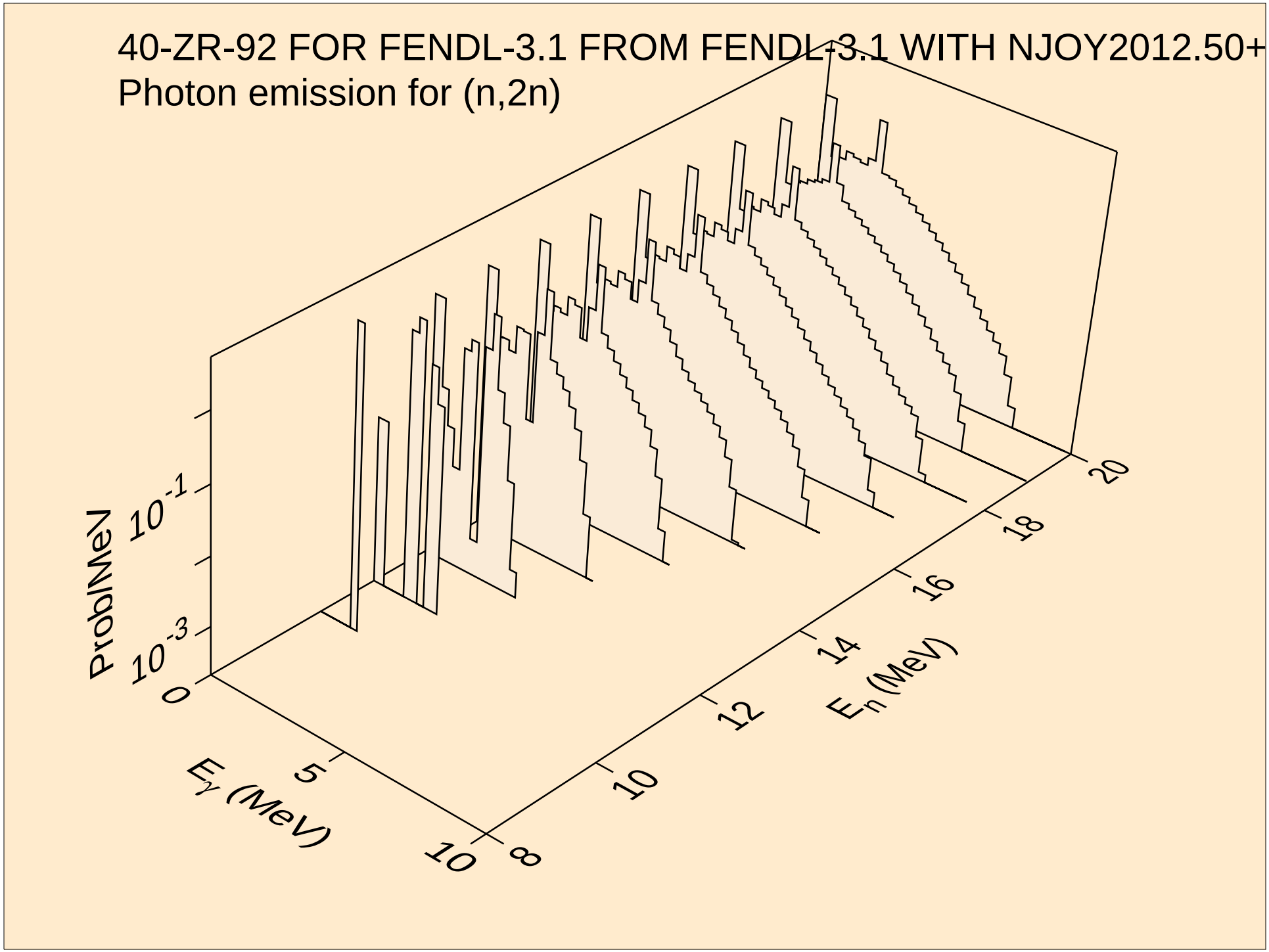

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Neutron emission for (n,n*)a
Prob/MeV
10^1
10^-1
0
Sec. Energy
2
4
6
8
Energy (MeV)
2
4
6
8
10
12
14
16
18
20

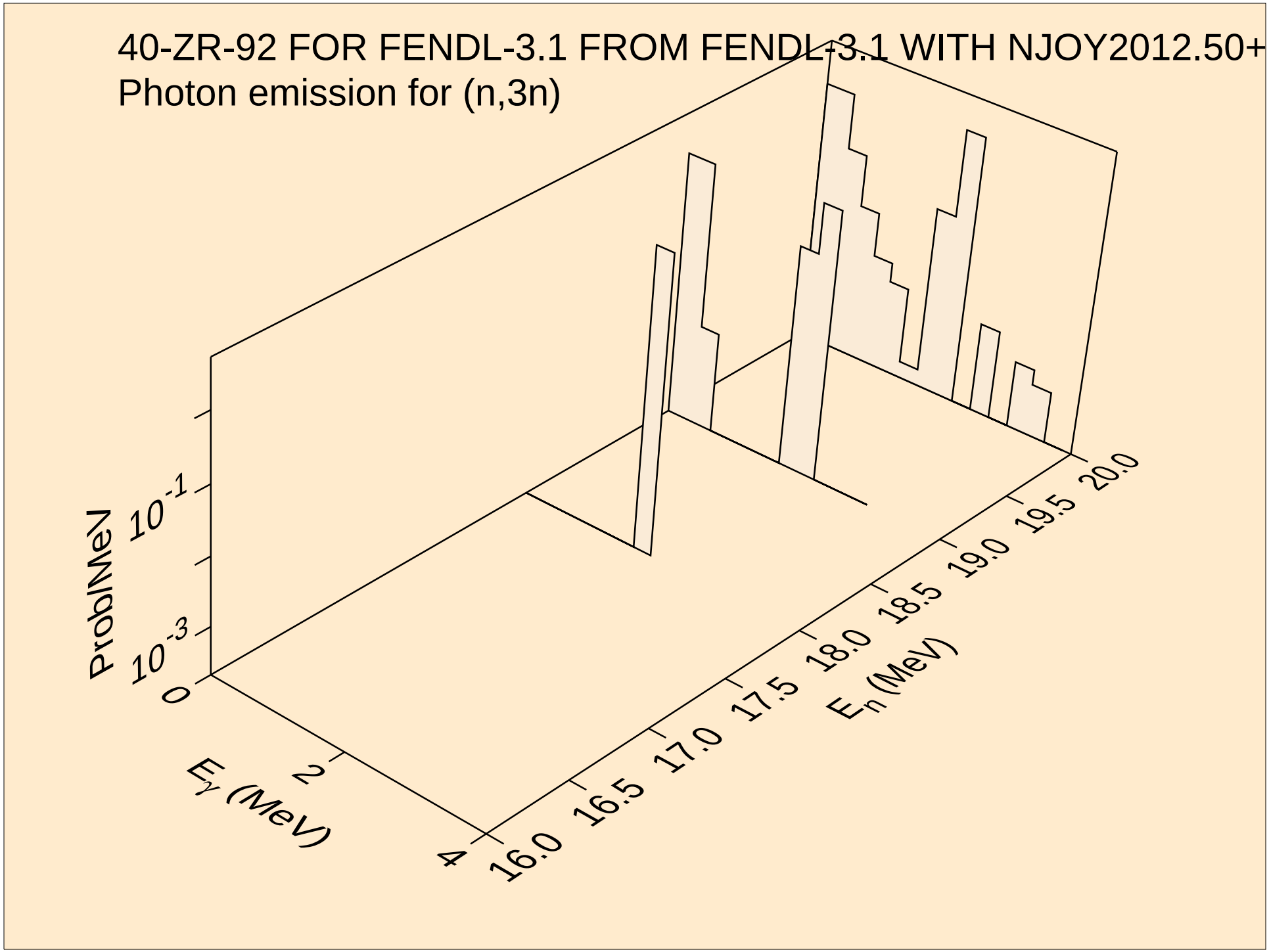

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Neutron emission for (n,n*)p
Prob/MeV
10-1
10-3
0
2
4
6
8
Sec. Energy
8
10
12
14
16
18
20
Energy (MeV)

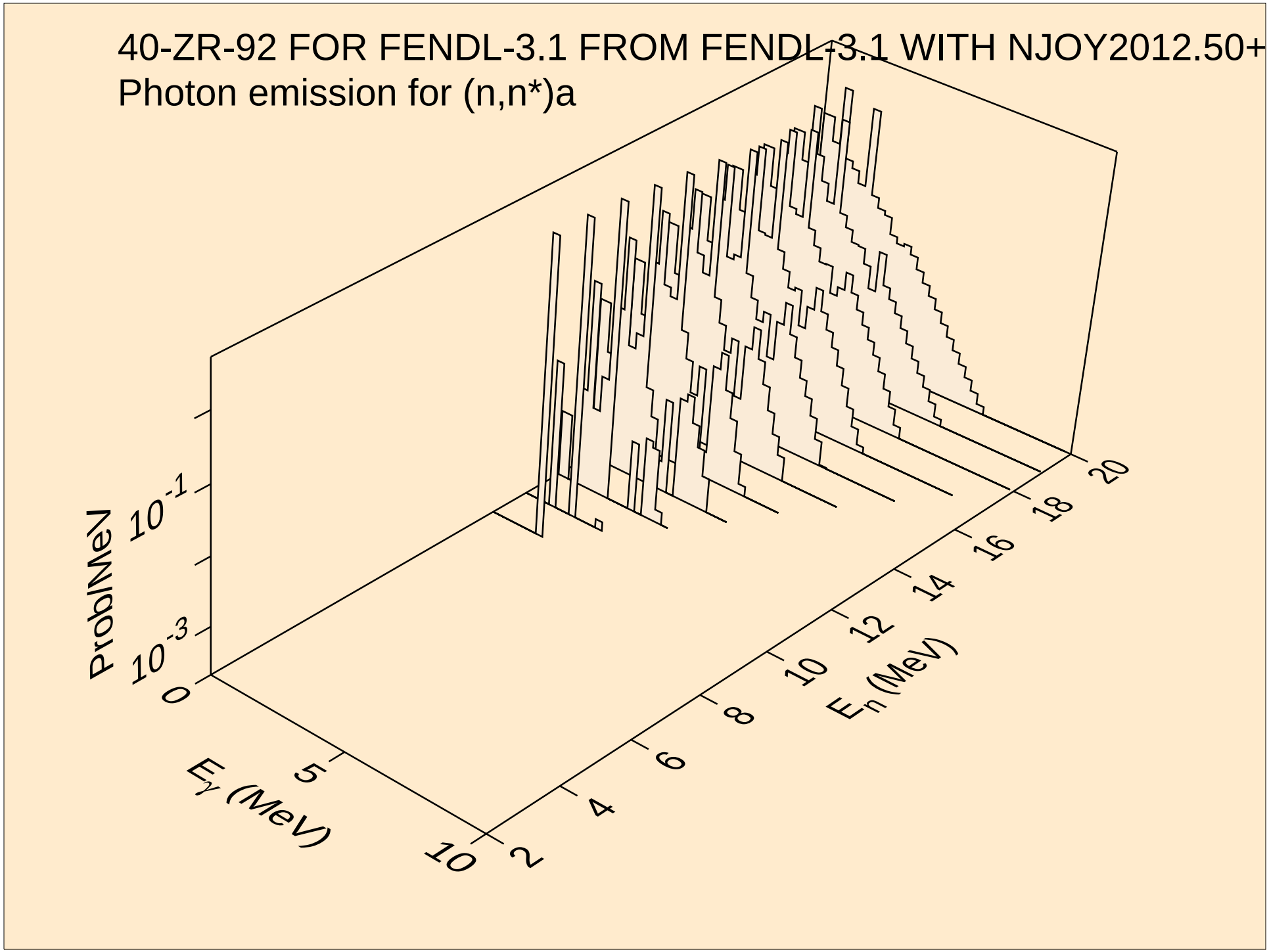

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Neutron emission for (n,n*)d
Prob/MeV
10^0
10^-2
0.0
0.5
1.0
1.5
2.0
Sec. Energy
15
16
17
18
19
20
Energy (MeV)

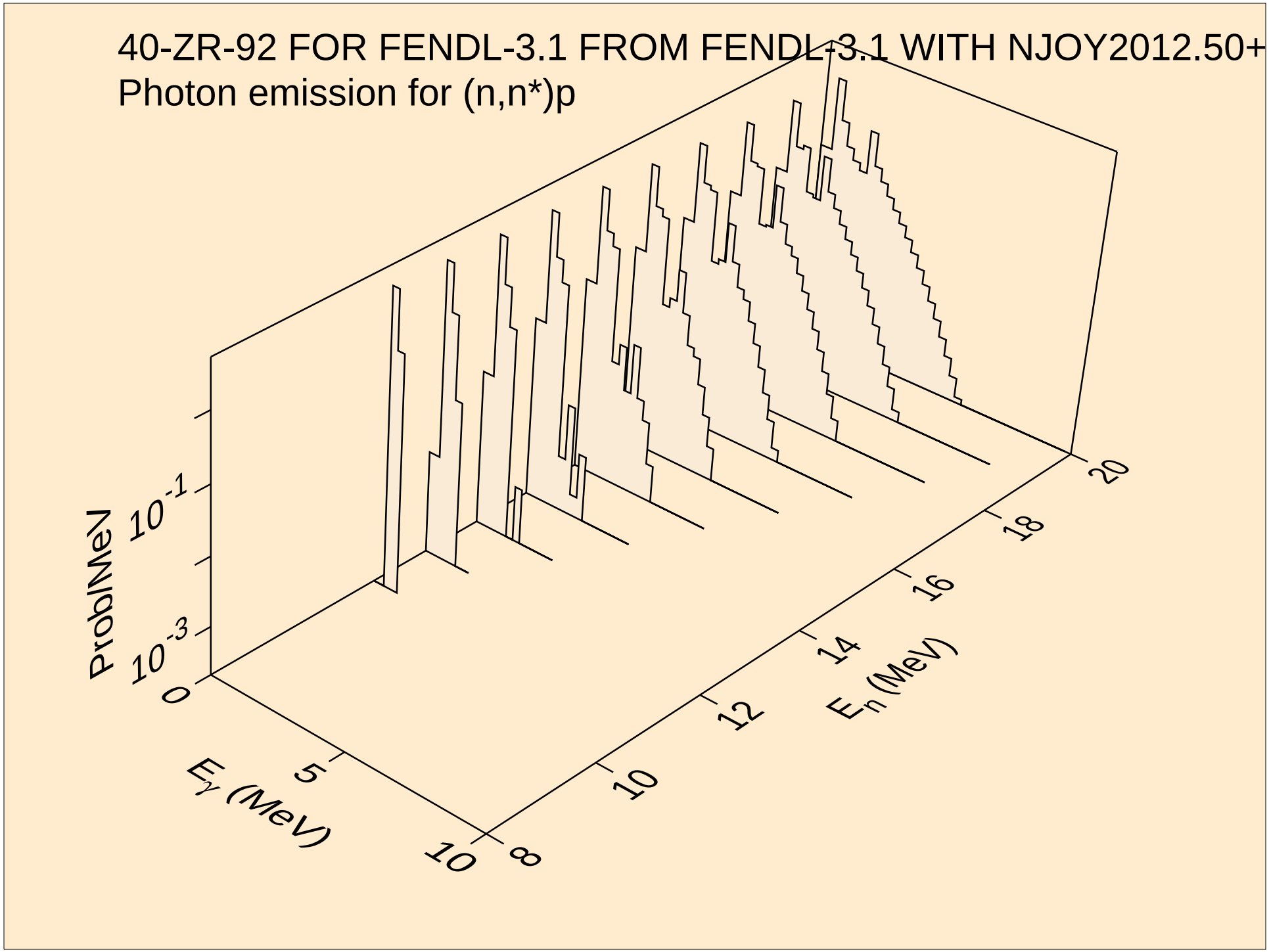

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Neutron emission for (n,n*)t
Prob/MeV
10^0
10^-2
0.0
0.5
1.0
1.5
Sec. Energy
15
16
17
18
19
20
Energy (MeV)

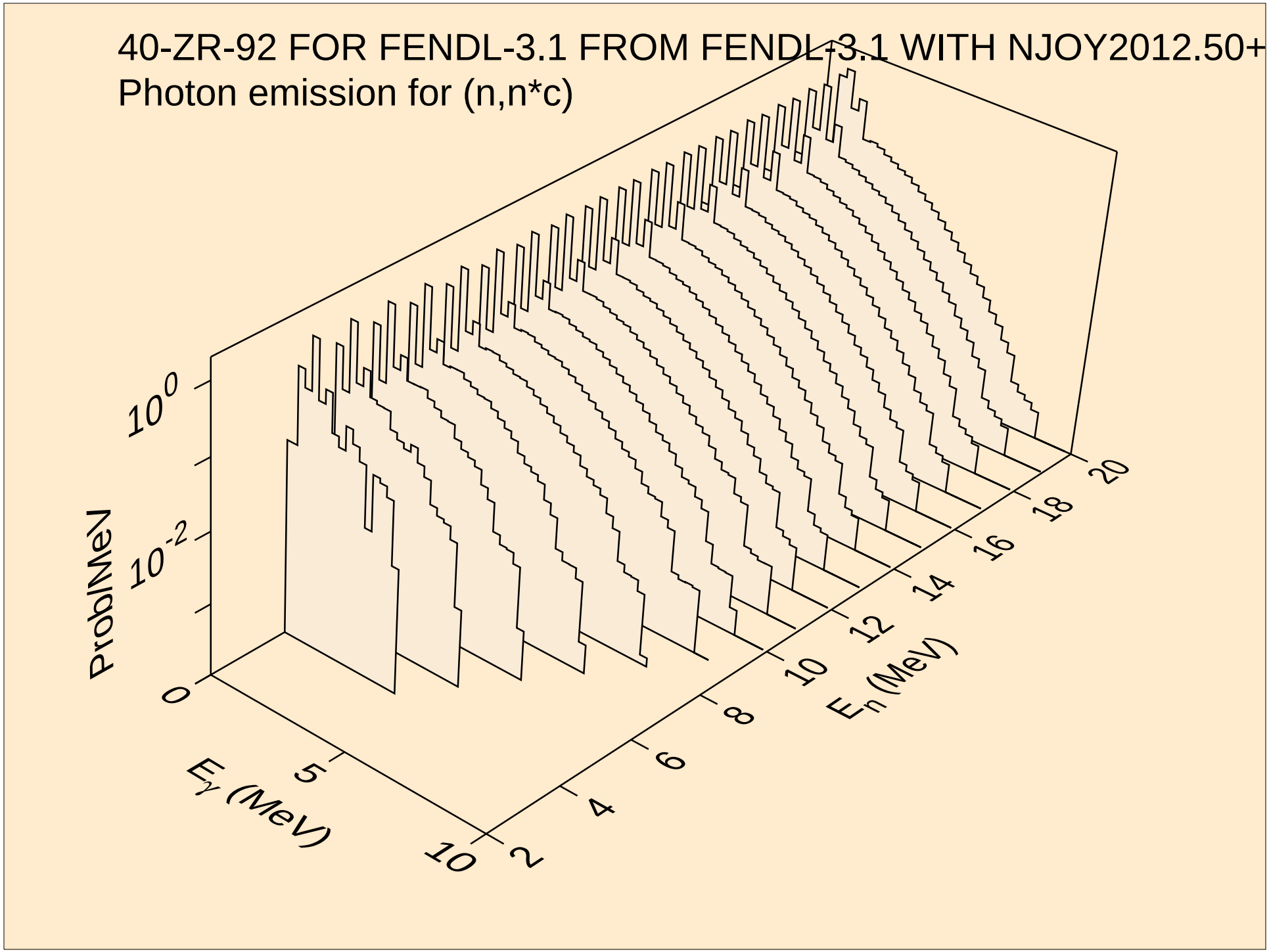

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Neutron emission for (n,n*c)
Prob/MeV
10-1
10-3
0
5
10
15
20
Sec. Energy
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

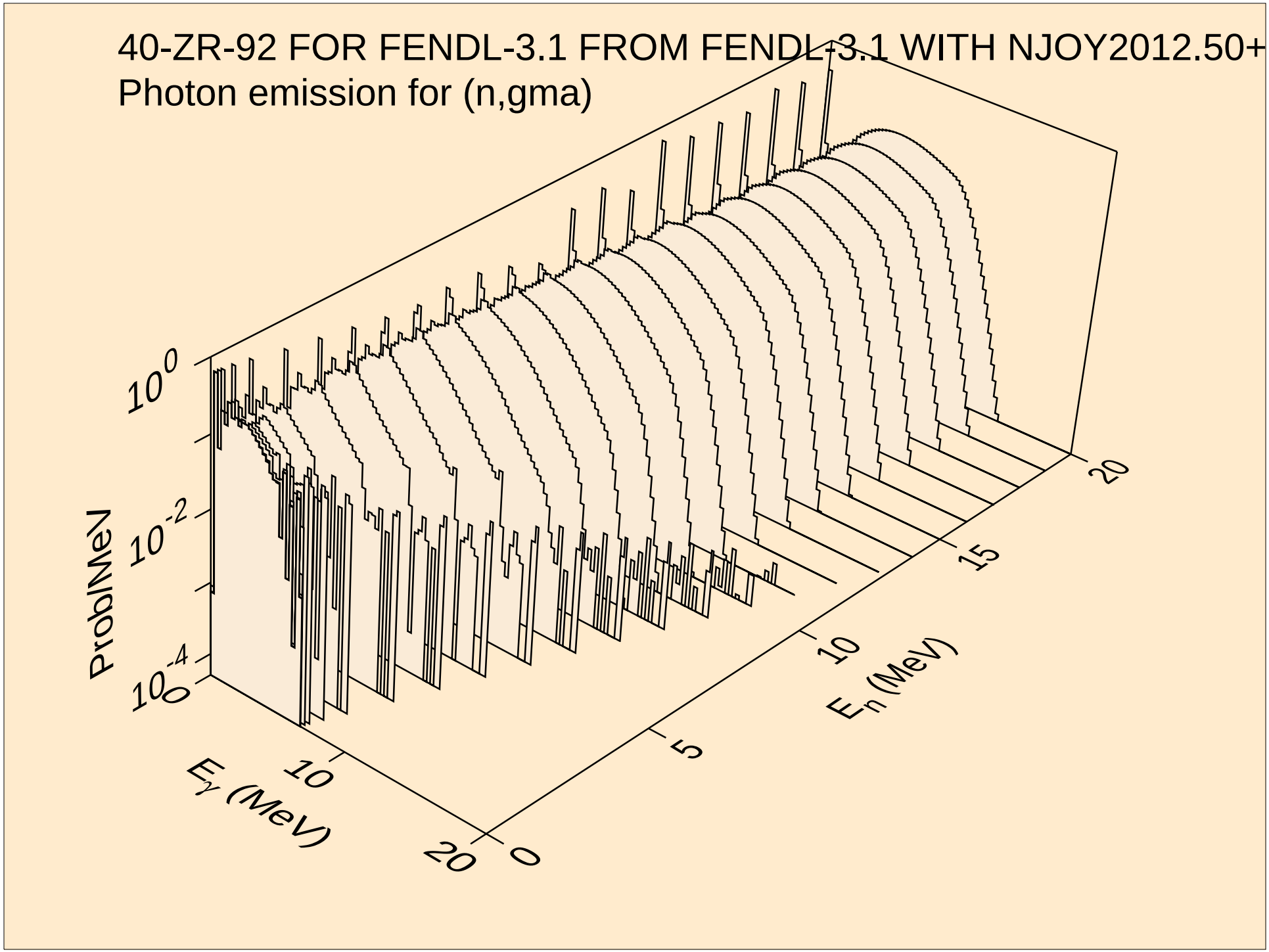

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Photon emission for (n,2n)
Prob/MeV
10-1
10-3
0
5
10
Eγ (MeV)
8
10
12
14
16
18
20
En (MeV)

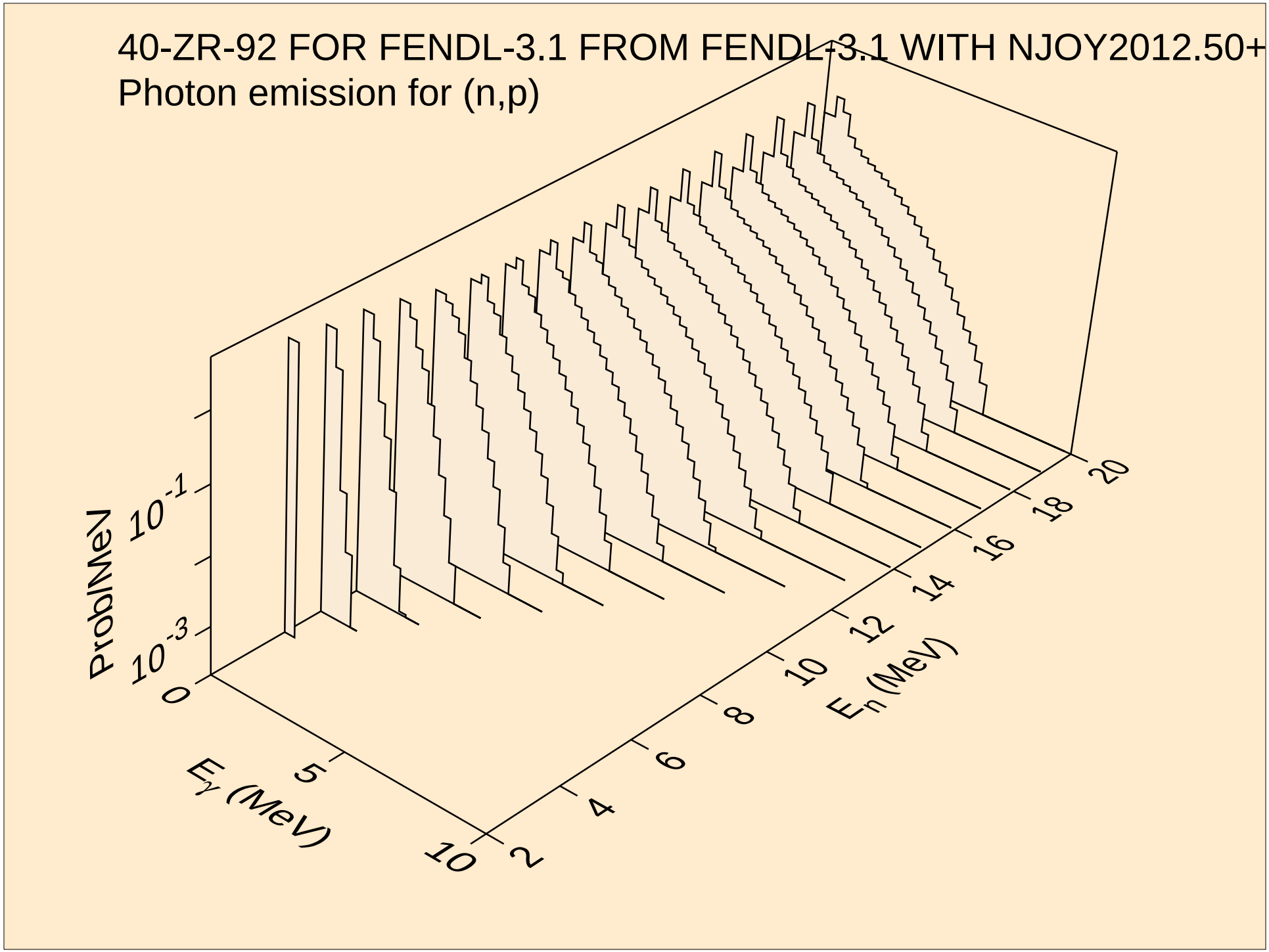

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Photon emission for (n,3n)
Prob/MeV
10-1
10-3
0
2
4
Eγ (MeV)
16.0
16.5
17.0
17.5
18.0
18.5
19.0
19.5
20.0
En (MeV)

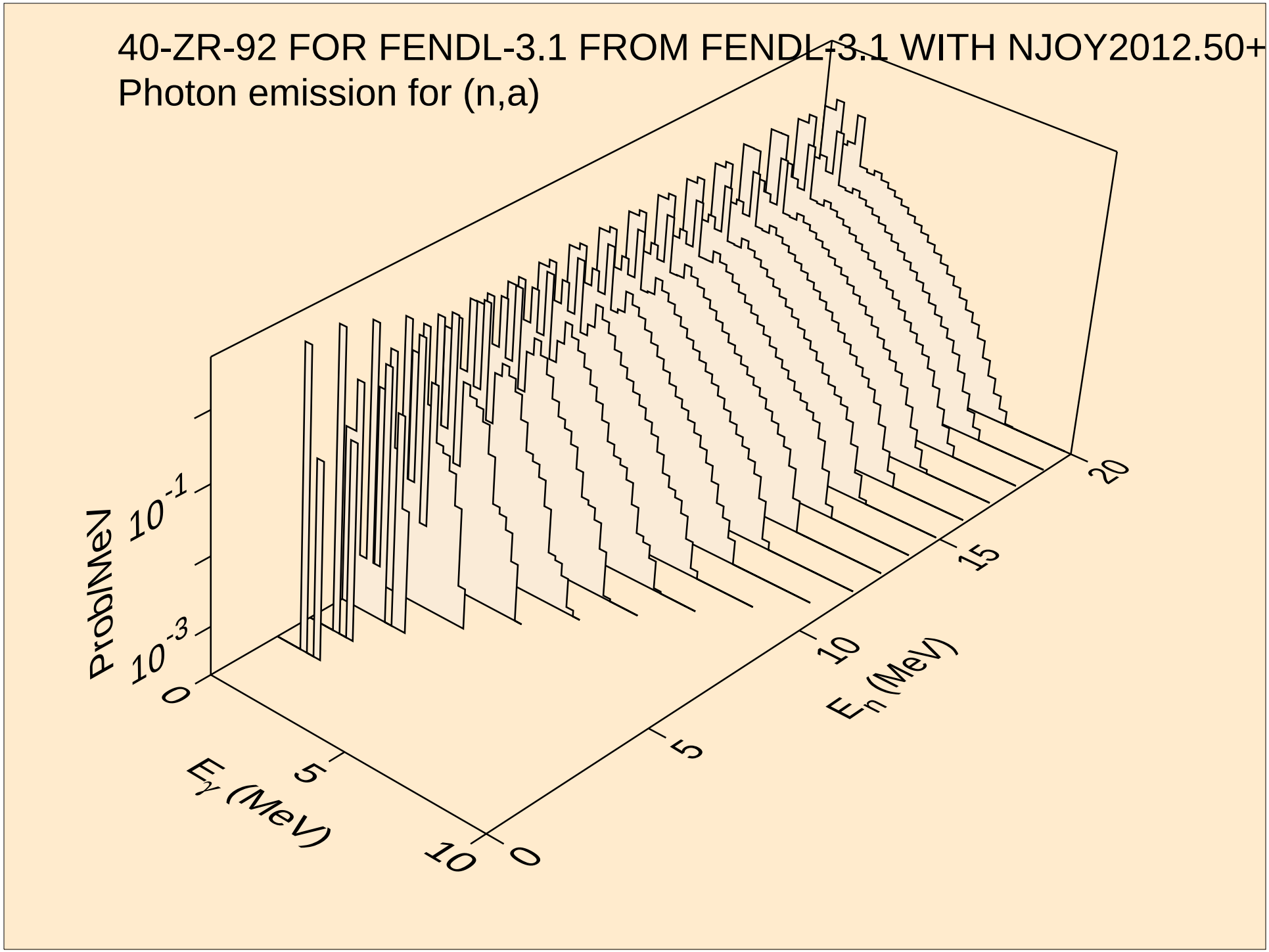

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Photon emission for (n,n*)a
Prob/MeV
10-1
10-3
0
Eγ (MeV)
5
10
2
4
6
8
10
12
14
16
18
20
En (MeV)

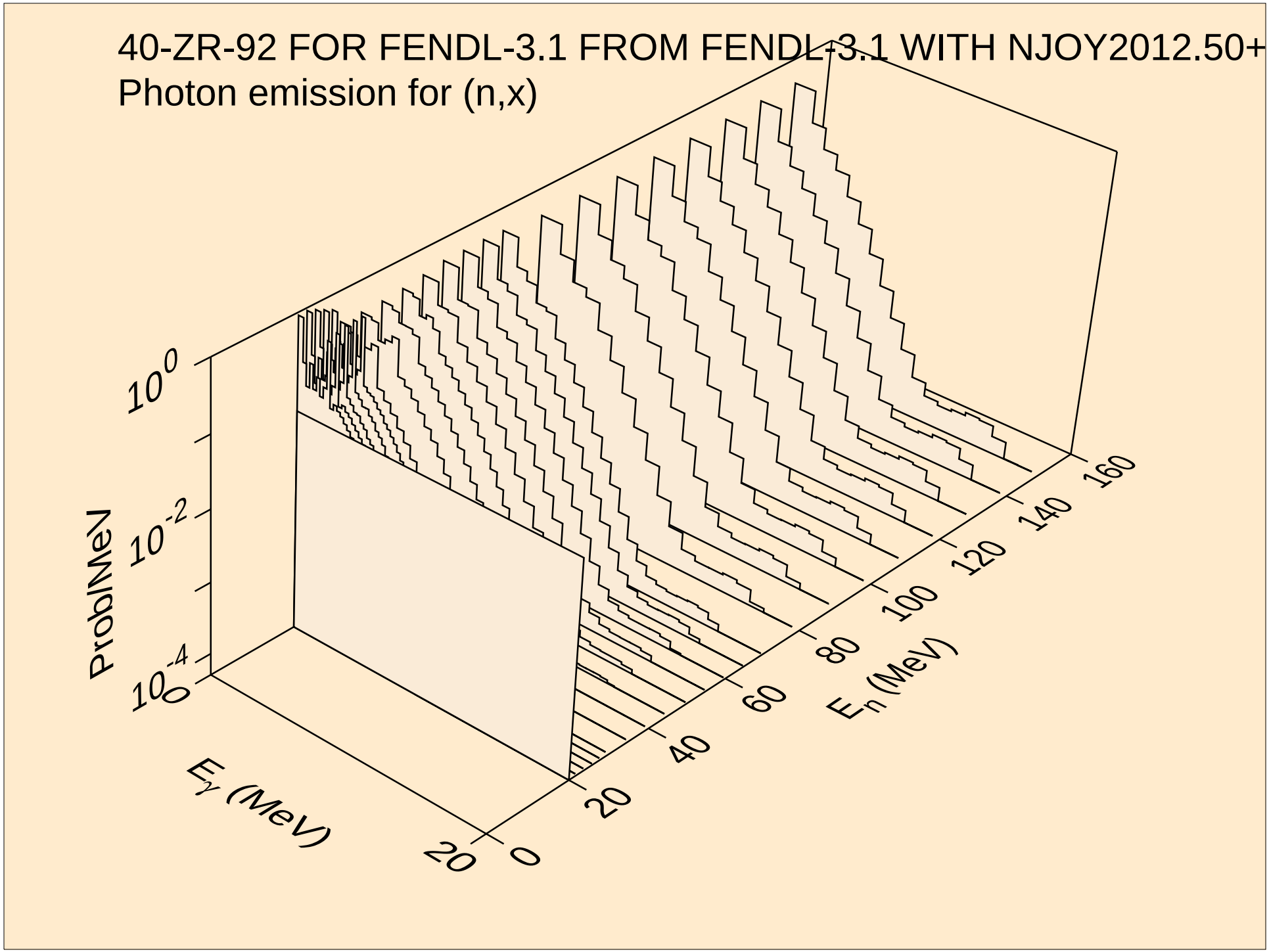

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Photon emission for (n,n*)p
Prob/MeV
10-1
10-3
0
Eγ (MeV)
5
10
8
10
12
14
16
18
20
En (MeV)

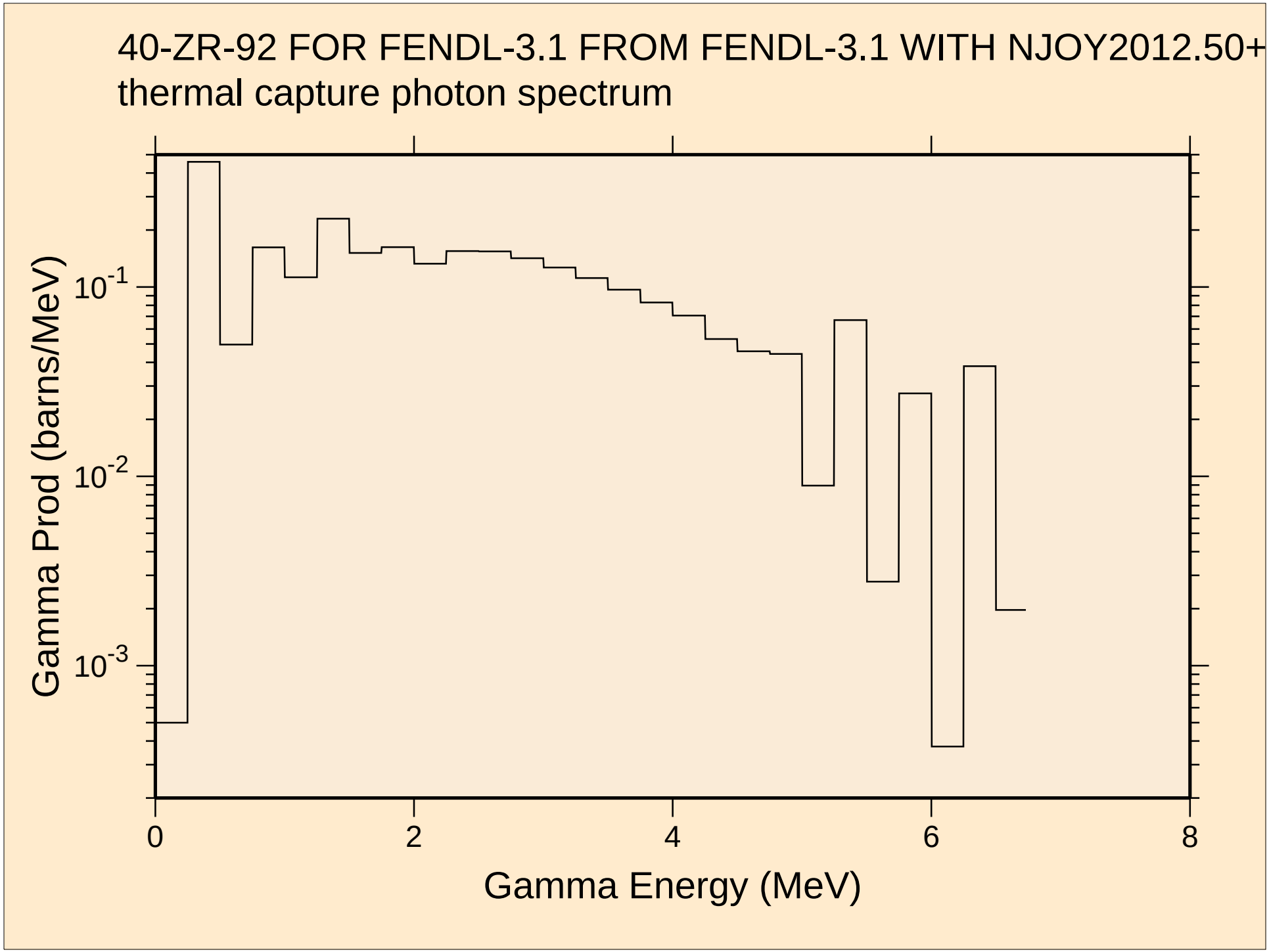

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Photon emission for (n,n*c)
Prob/MeV
$10^0$
$10^{-2}$
0
5
10
$E_\gamma$ (MeV)
2
4
6
8
10
12
14
16
18
20
$E_n$ (MeV)

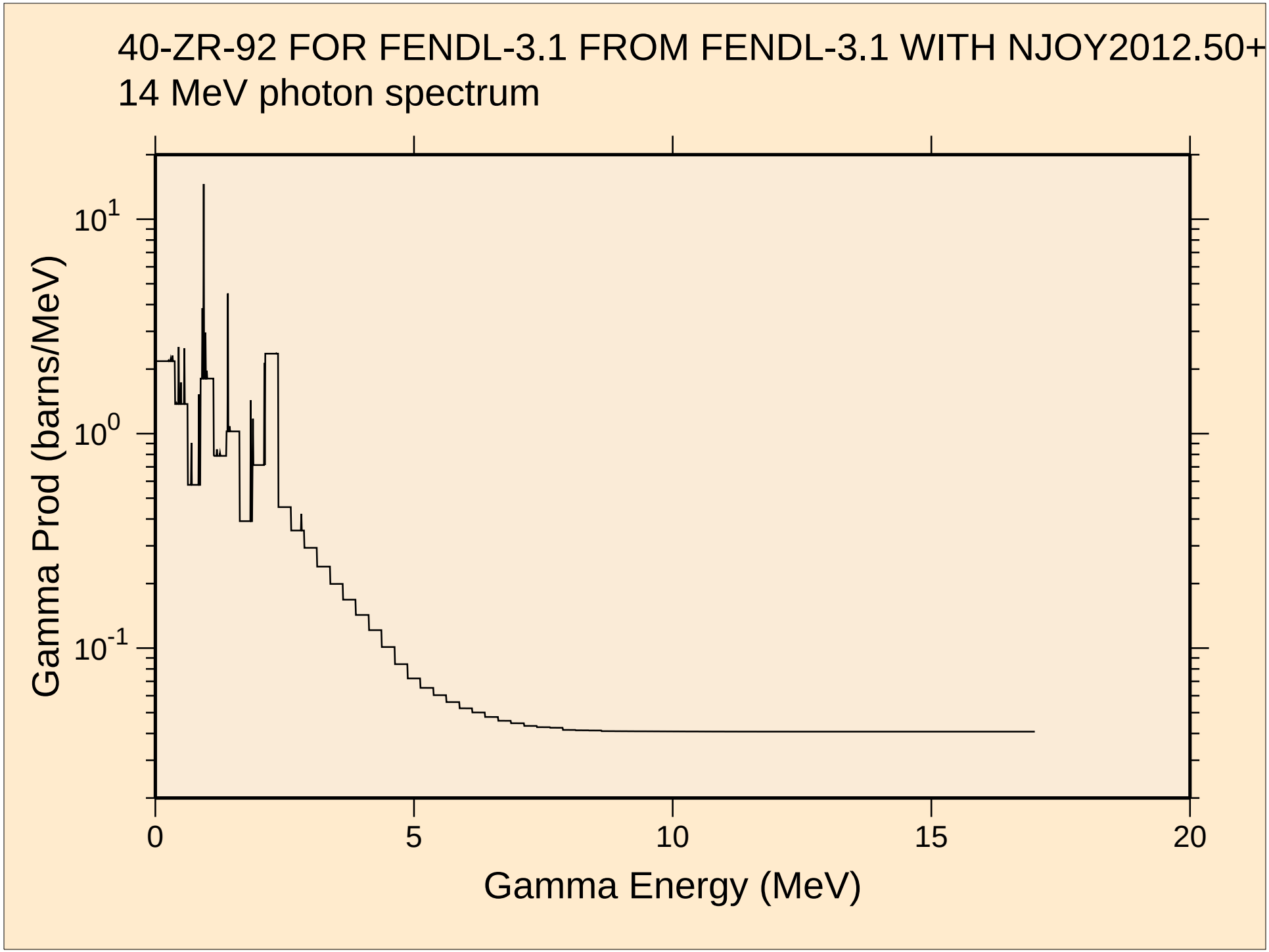

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Photon emission for (n,gma)
Prob/MeV
$10^{0}$
$10^{-2}$
$10^{-4}$
$E_\gamma$ (MeV)
0
10
20
$E_n$ (MeV)
5
10
15
20

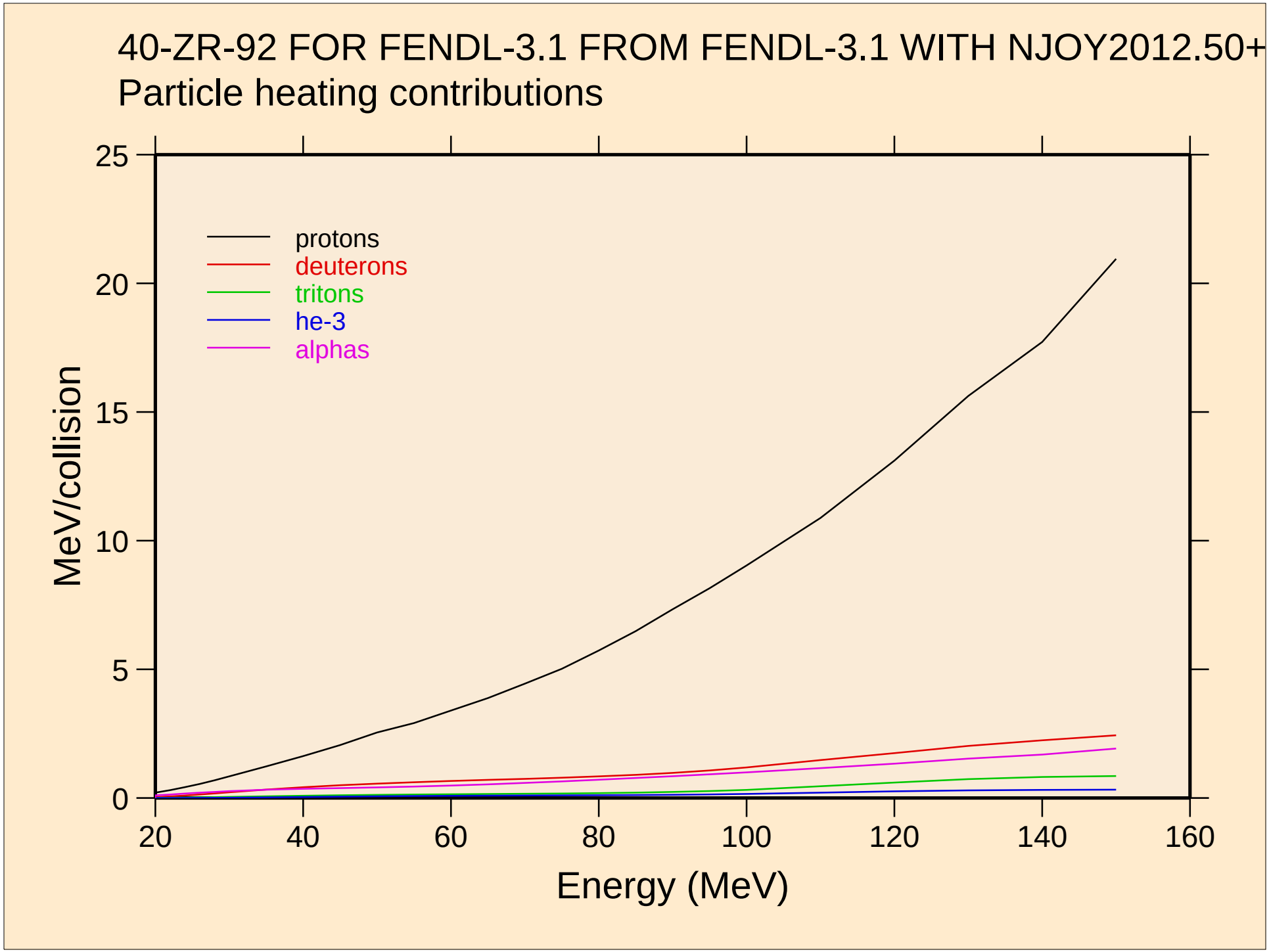

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Photon emission for (n,p)
Prob/MeV
10-1
10-3
0
Eγ (MeV)
5
10
2
4
6
8
10
12
14
16
18
20
En (MeV)

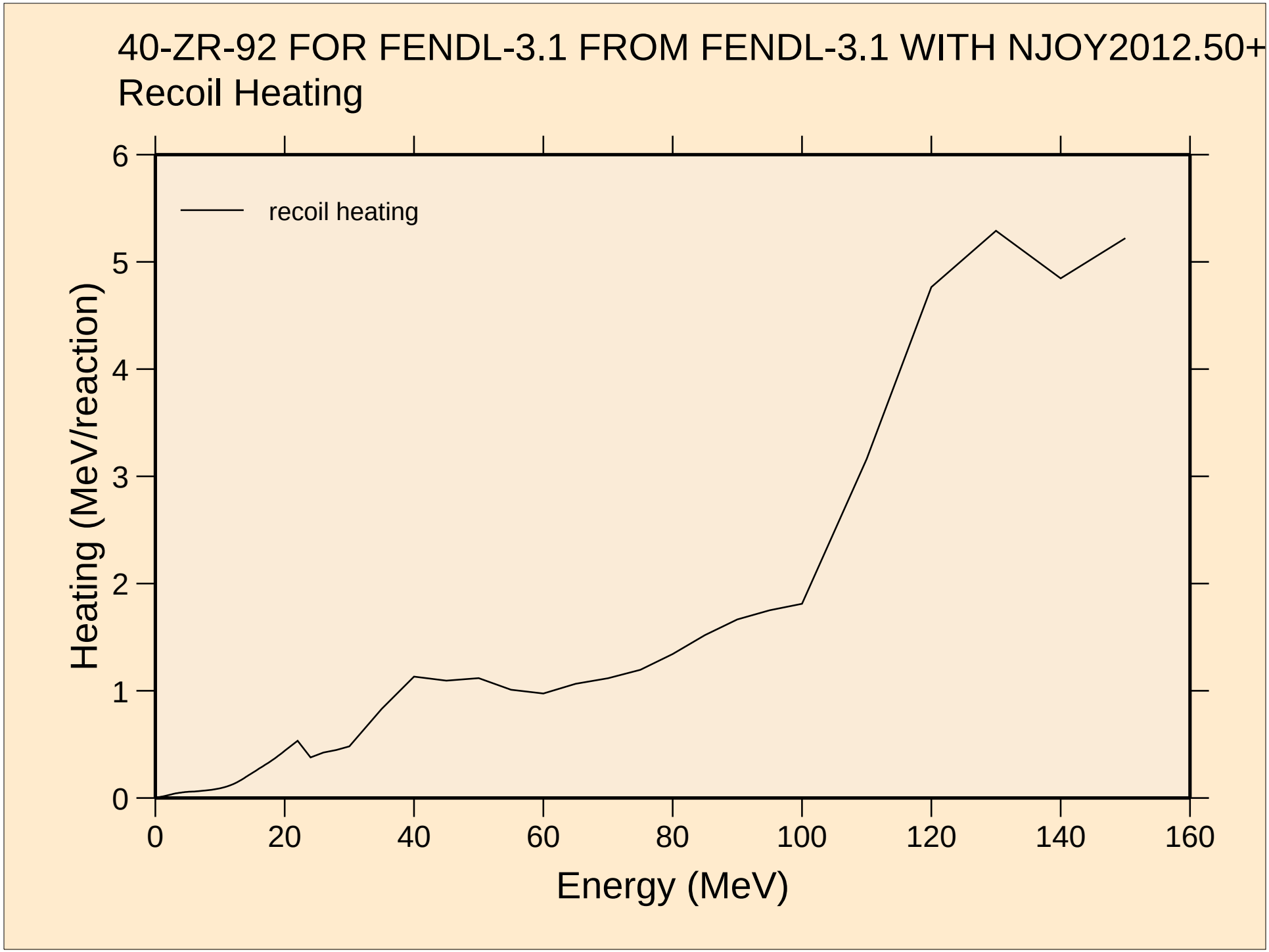

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Photon emission for (n,a)
Prob/MeV
10-1
10-3
0
5
10
Eγ (MeV)
0
5
10
15
20
En (MeV)

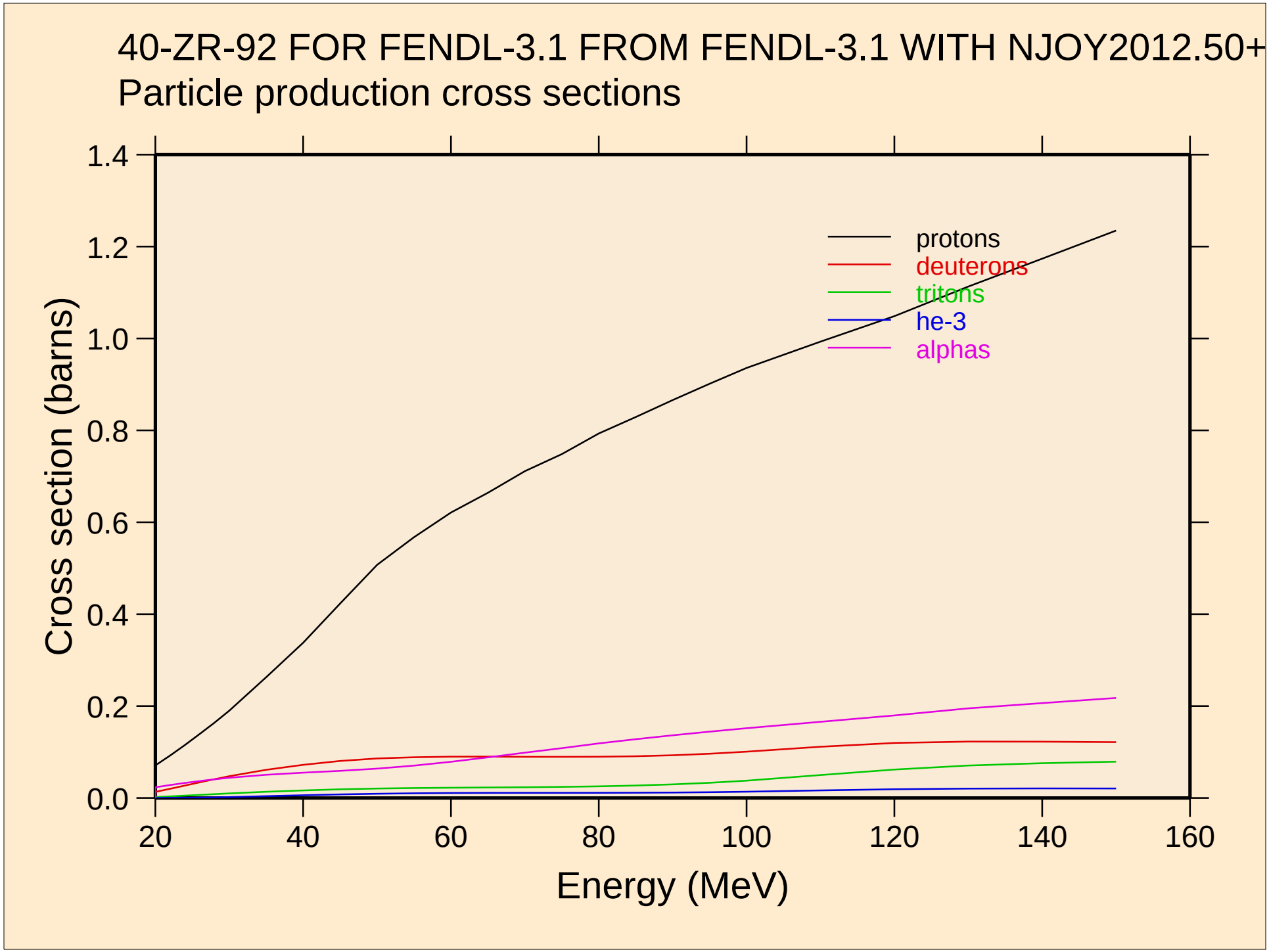

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Photon emission for (n,x)
Prob/MeV
$10^{0}$
$10^{-2}$
$10^{-4}$
$E_\gamma$ (MeV)
0
20
$E_n$ (MeV)
0
20
40
60
80
100
120
140
160

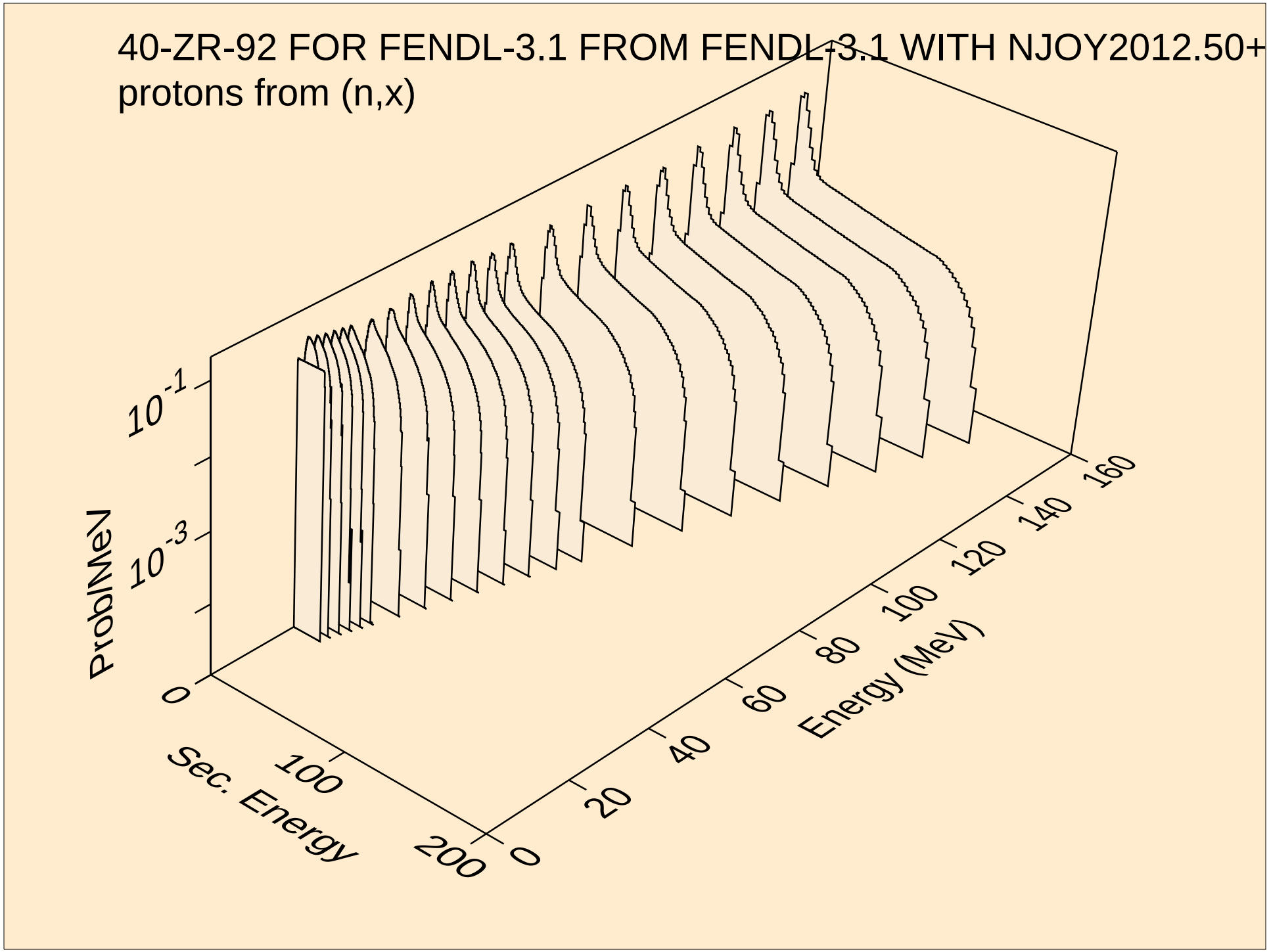

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
thermal capture photon spectrum
Gamma Prod (barns/MeV)
10-1
10-2
10-3
0
2
4
6
8
Gamma Energy (MeV)

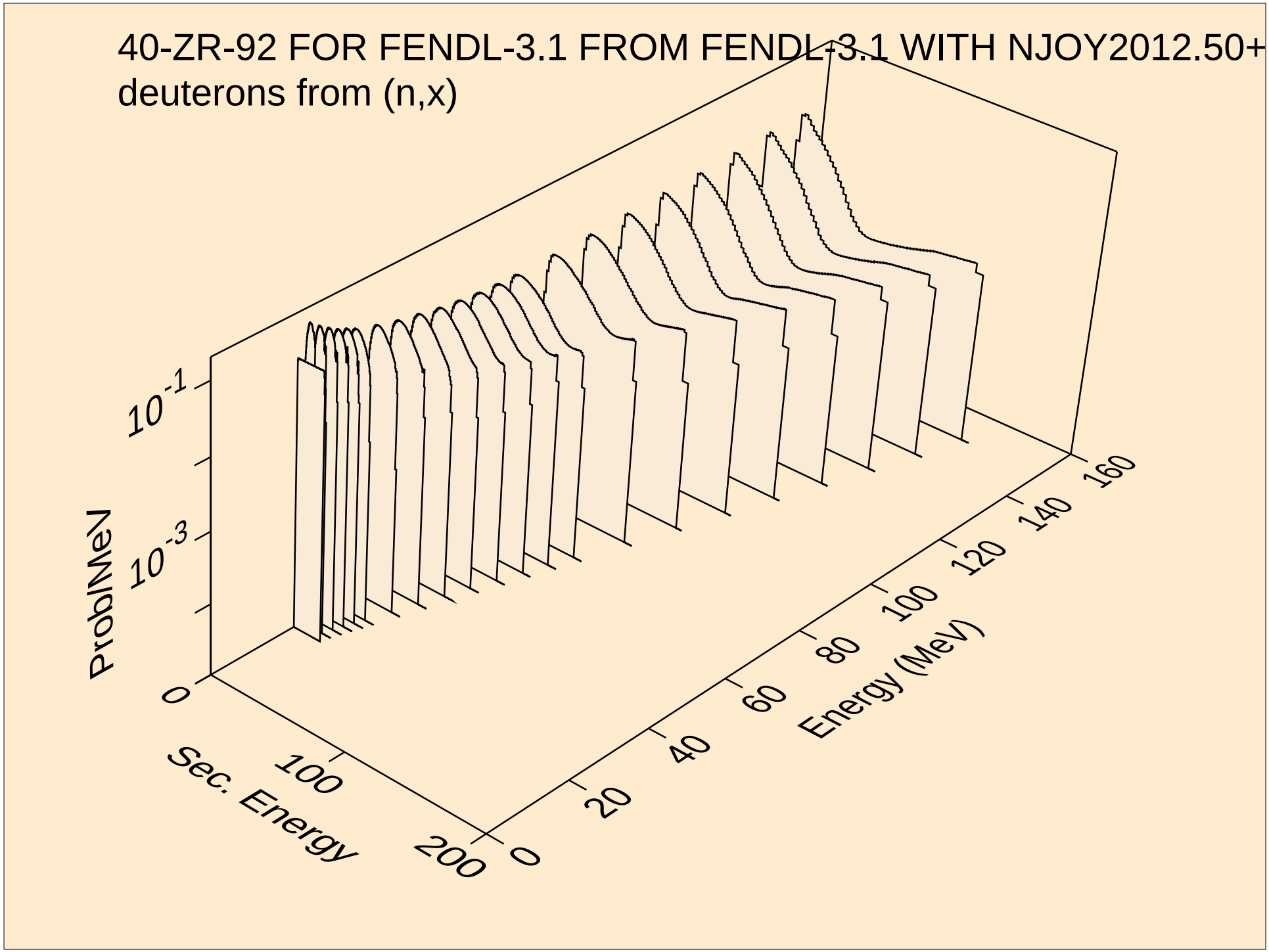

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
14 MeV photon spectrum
Gamma Prod (barns/MeV)
10^1
10^0
10^-1
0
5
10
15
20
Gamma Energy (MeV)

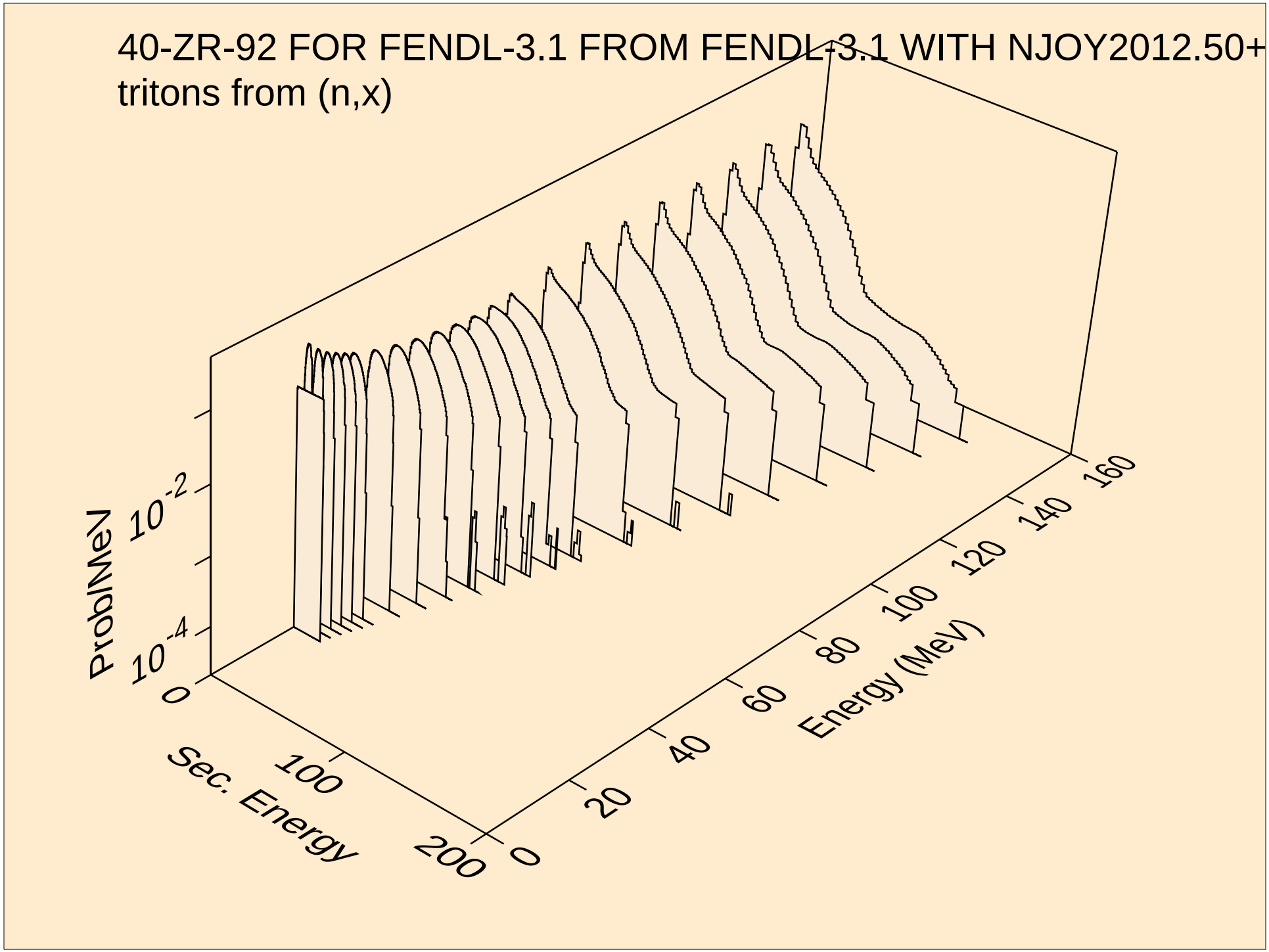

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Particle heating contributions
protons
deuterons
tritons
he-3
alphas
MeV/collision
Energy (MeV)
0
5
10
15
20
25
20
40
60
80
100
120
140
160

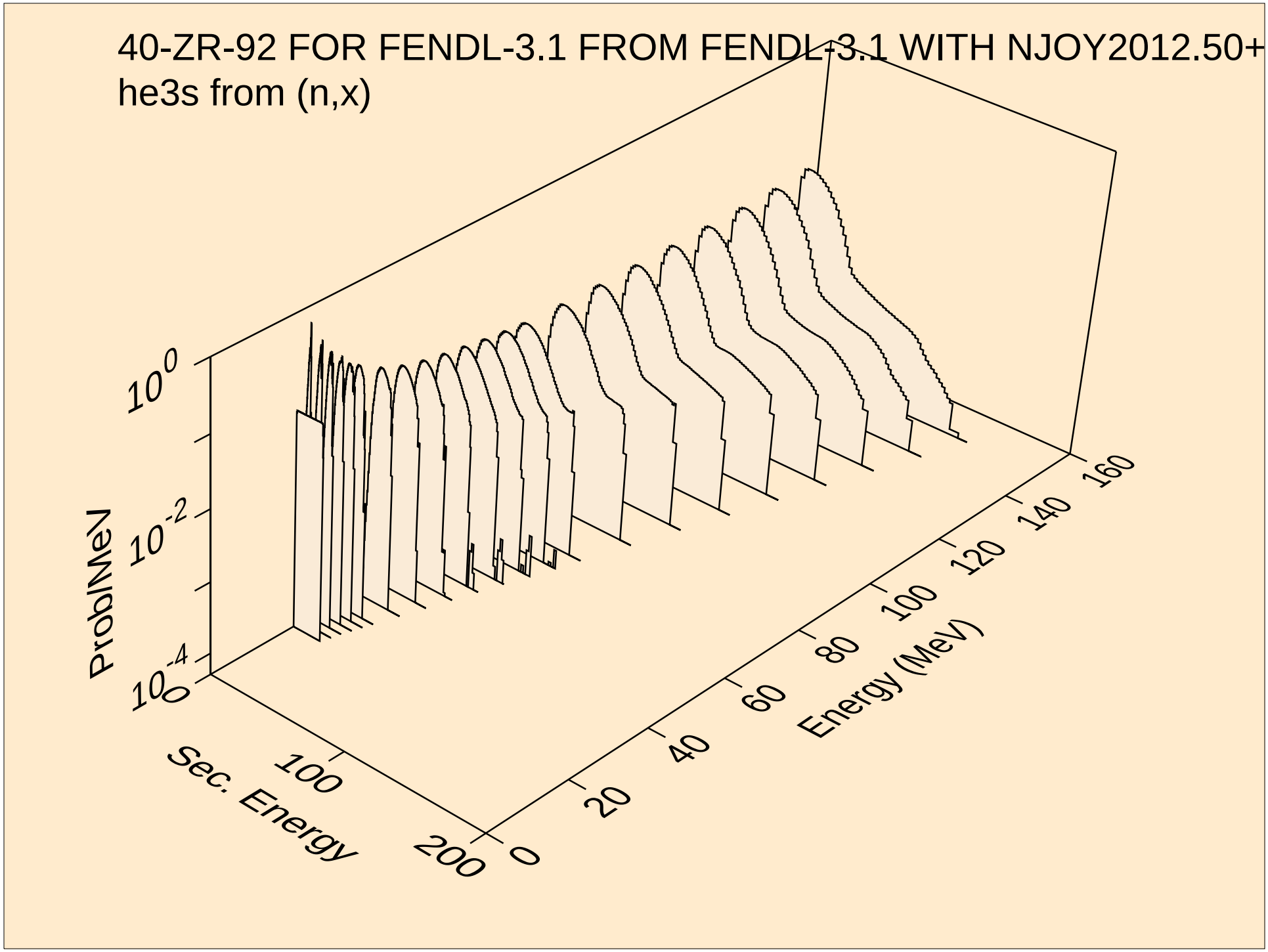

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Recoil Heating
recoil heating
Heating (MeV/reaction)
Energy (MeV)
0
1
2
3
4
5
6
0
20
40
60
80
100
120
140
160

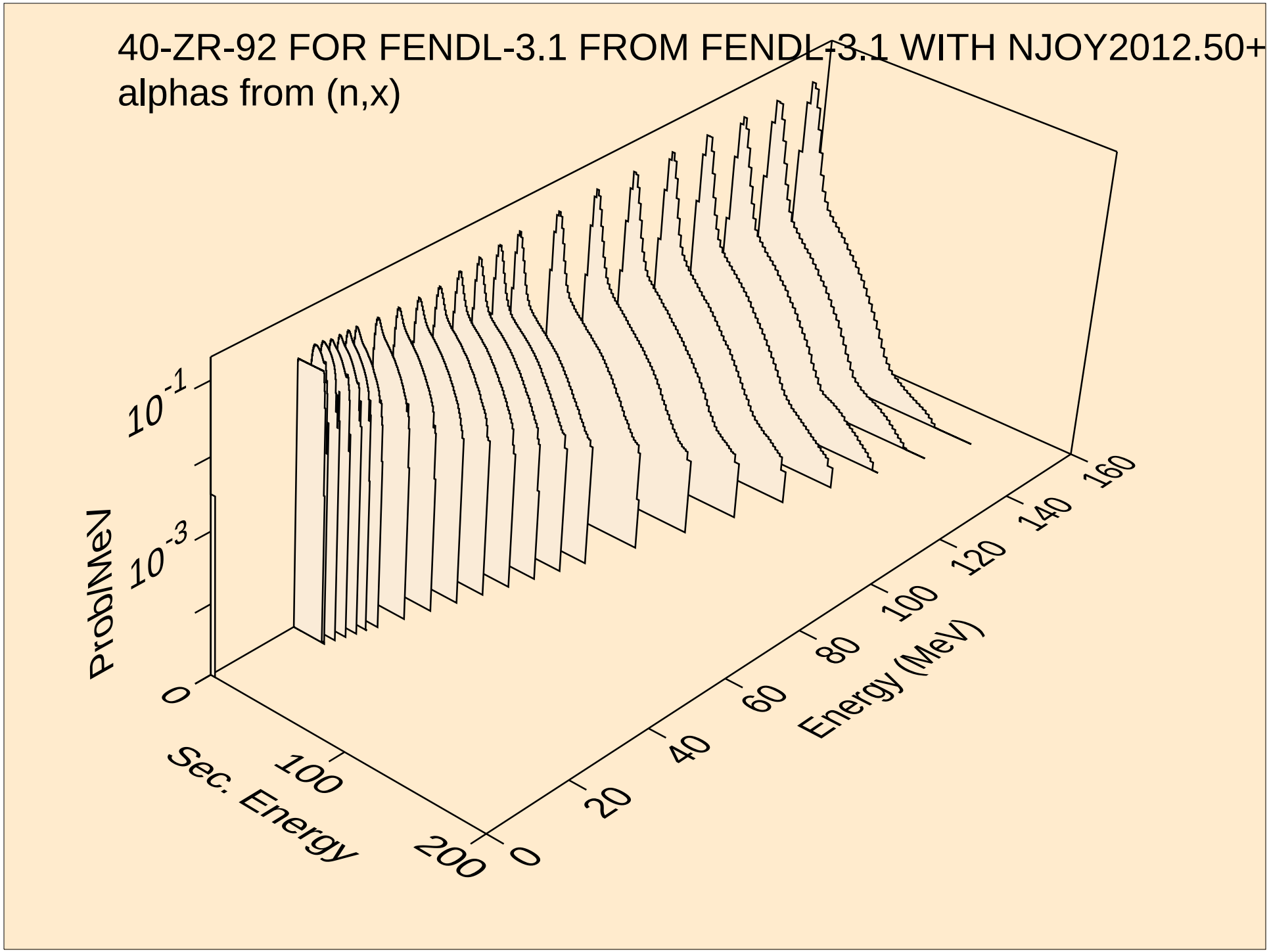

40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
Particle production cross sections
Cross section (barns)
Energy (MeV)
protons
deuterons
tritons
he-3
alphas
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
20
40
60
80
100
120
140
160


40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
protons from (n,x)
Prob/MeV
10-1
10-3
0
Sec. Energy
100
200
0
20
40
60
80
100
120
140
160
Energy (MeV)


40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
deuterons from (n,x)
Prob/MeV
10-1
10-3
0
Sec. Energy
100
200
0
20
40
60
80
100
120
140
160
Energy (MeV)


40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
tritons from (n,x)
Prob/MeV
10-2
10-4
0
Sec. Energy
100
200
0
20
40
60
80
100
120
140
160
Energy (MeV)


40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
he3s from (n,x)
Prob/MeV
10^0
10^-2
10^-4
Sec. Energy
0
100
200
Energy (MeV)
0
20
40
60
80
100
120
140
160


40-ZR-92 FOR FENDL-3.1 FROM FENDL-3.1 WITH NJOY2012.50+
alphas from (n,x)
Prob/MeV
10-1
10-3
0
Sec. Energy
100
200
0
20
40
60
80
100
120
140
160
Energy (MeV)