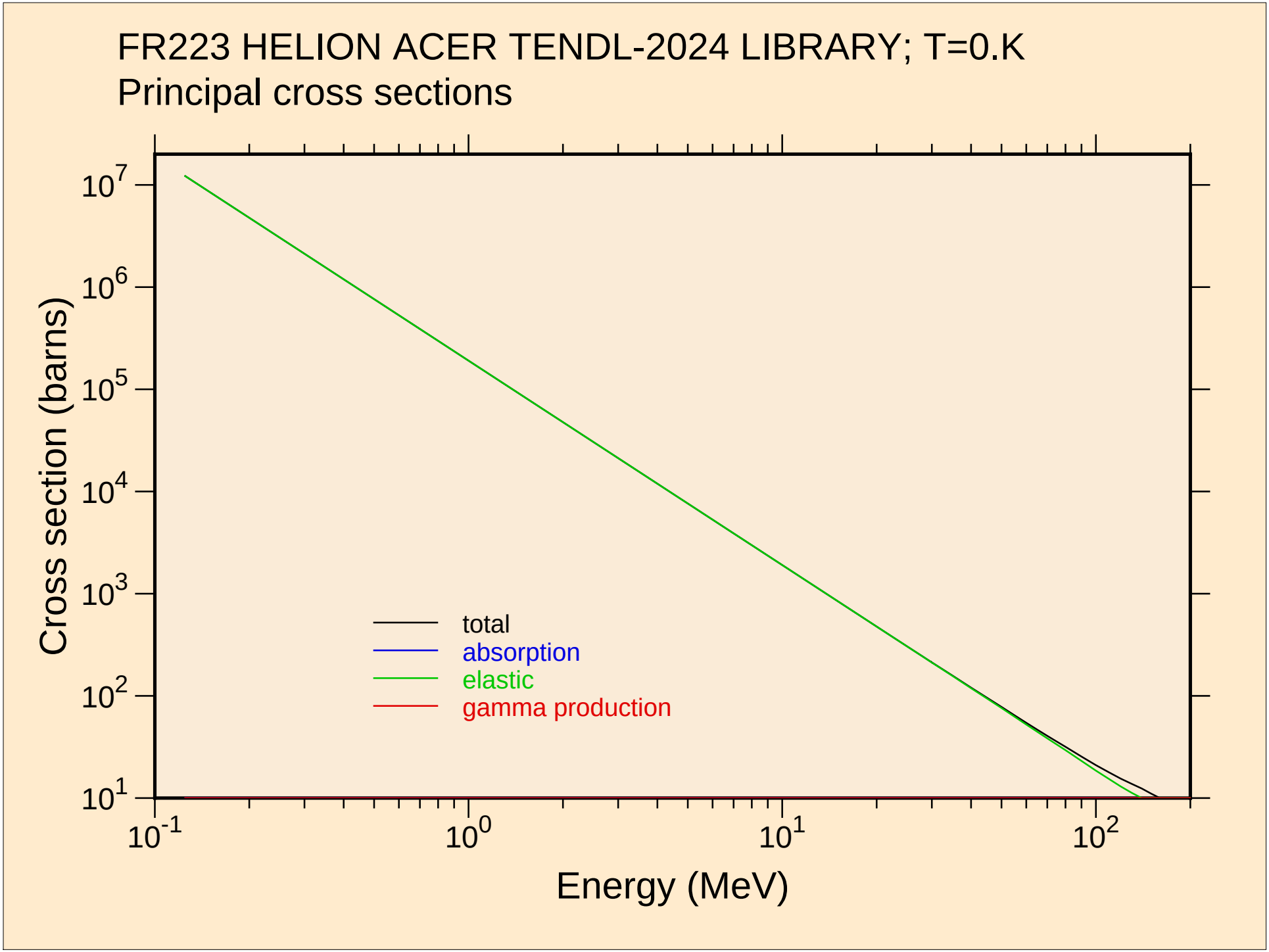
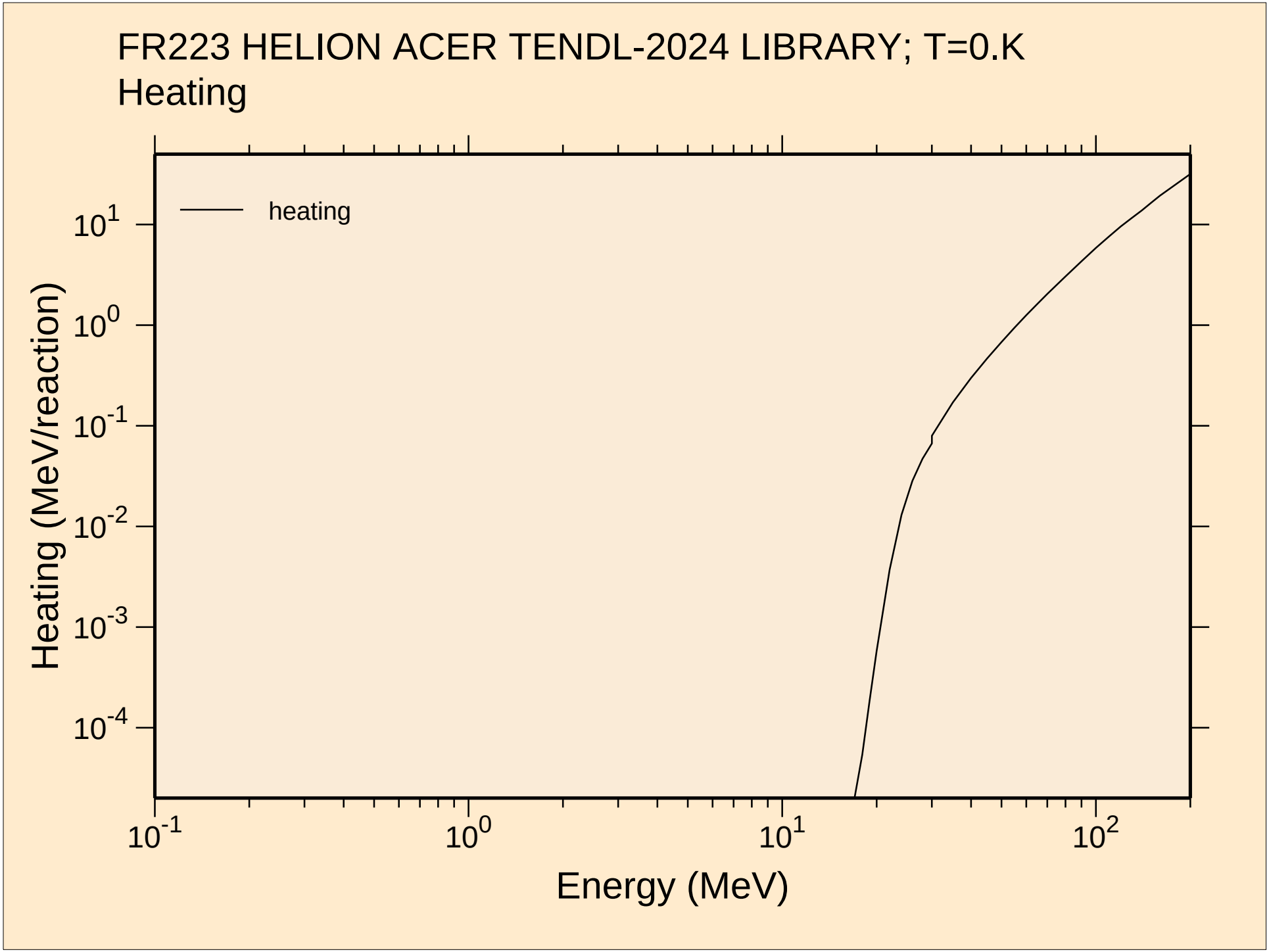
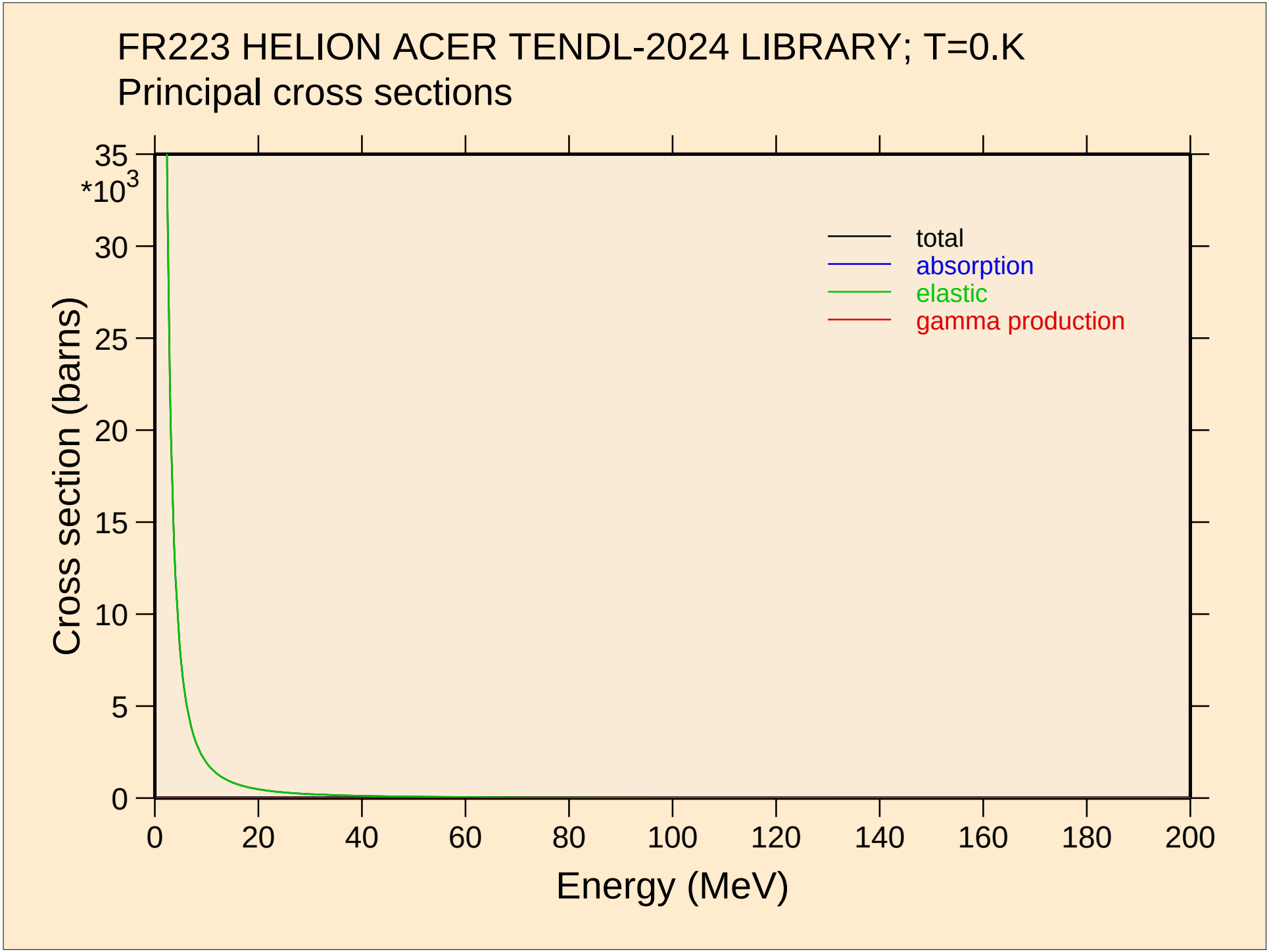
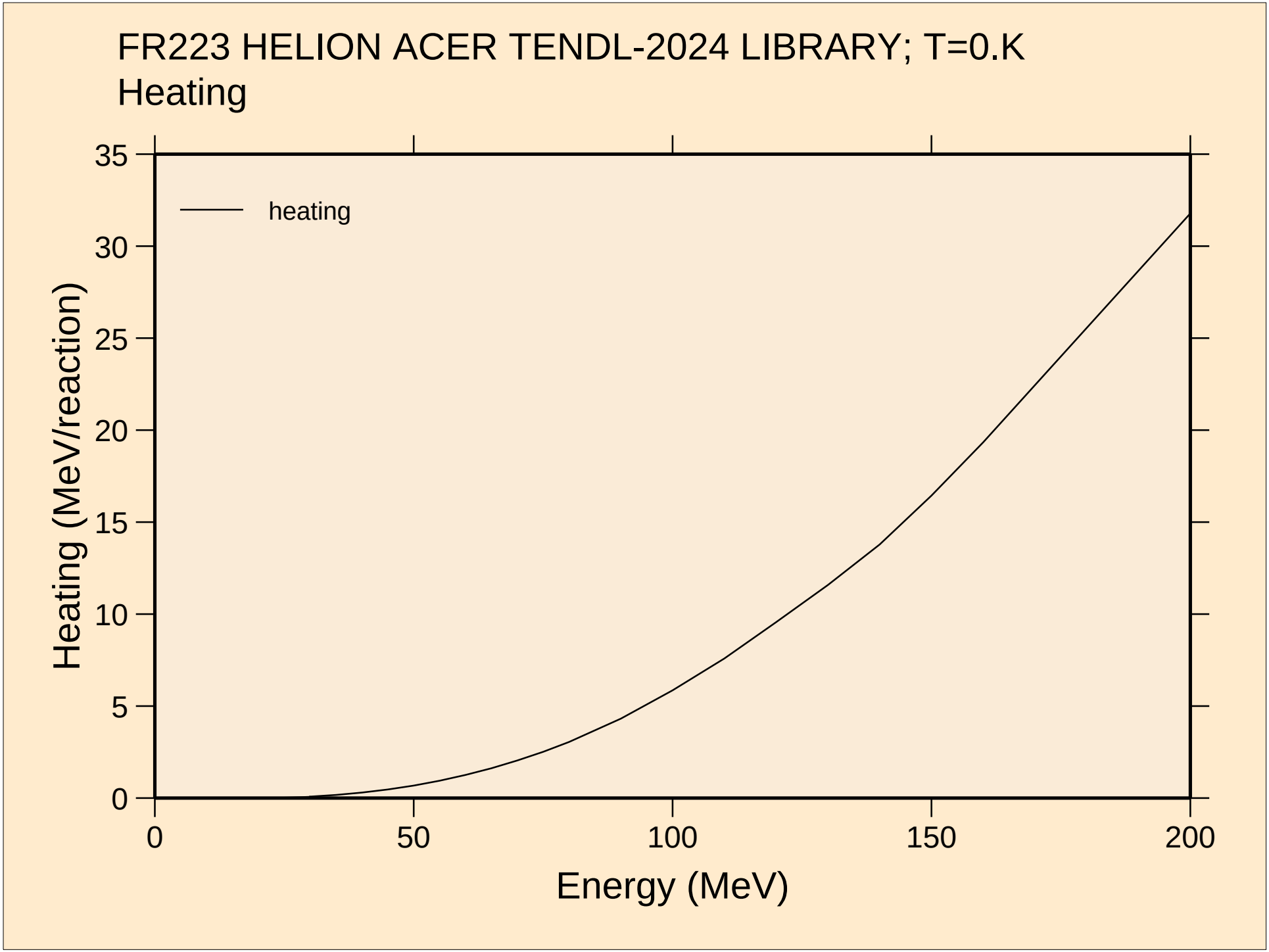
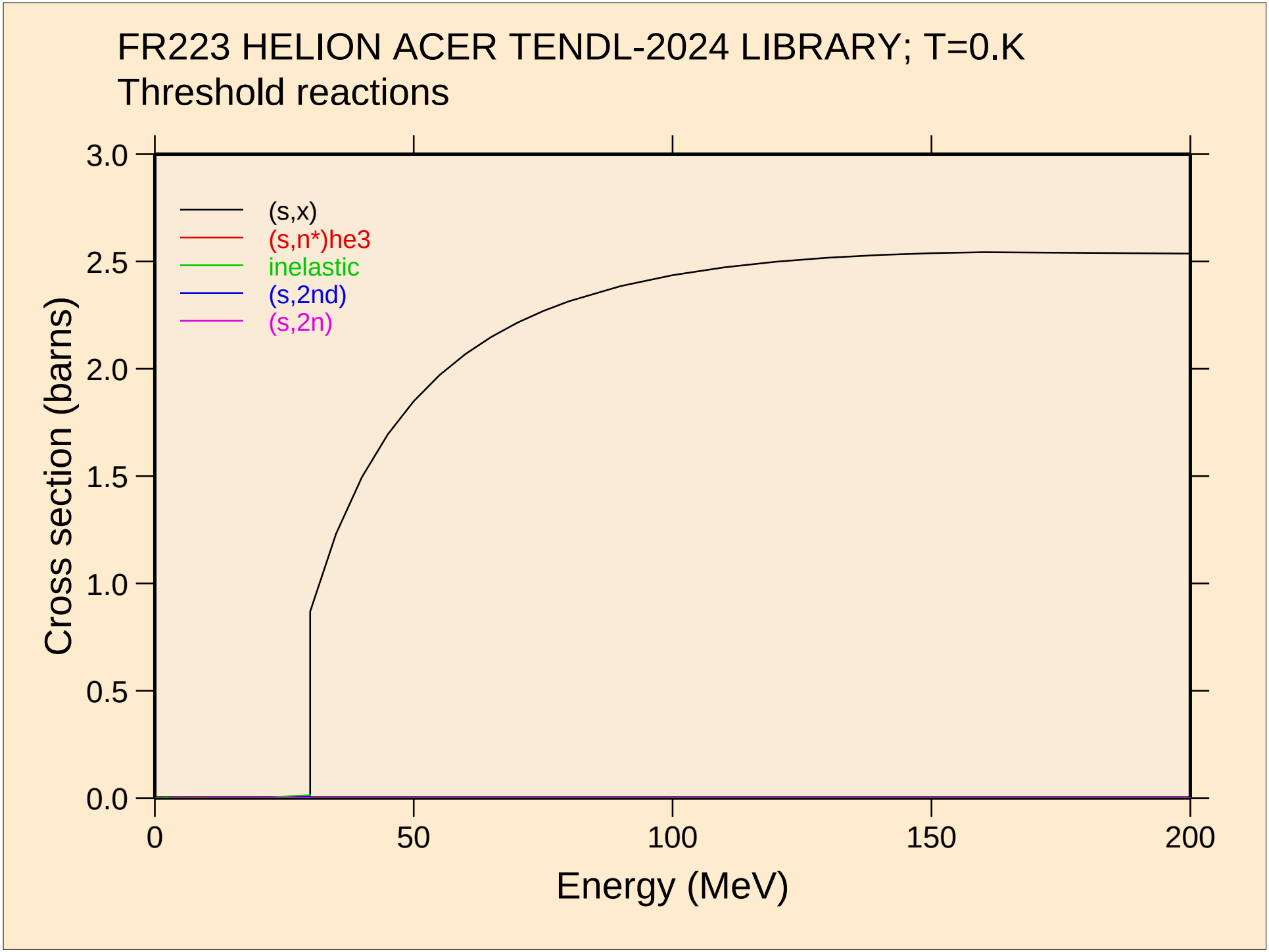
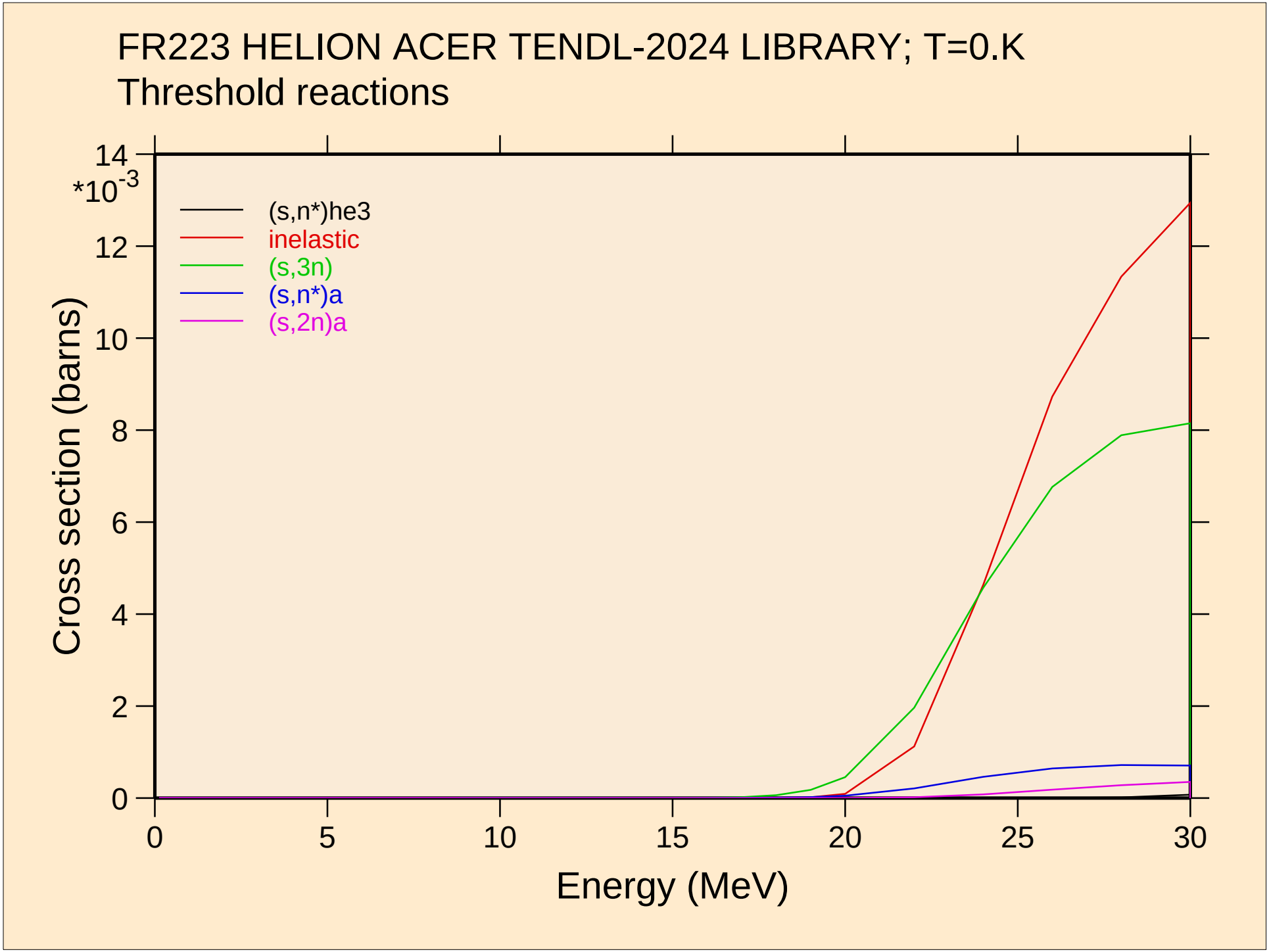

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Principal cross sections
Cross section (barns)
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^{-1}
10^0
10^1
10^2
Energy (MeV)
total
absorption
elastic
gamma production

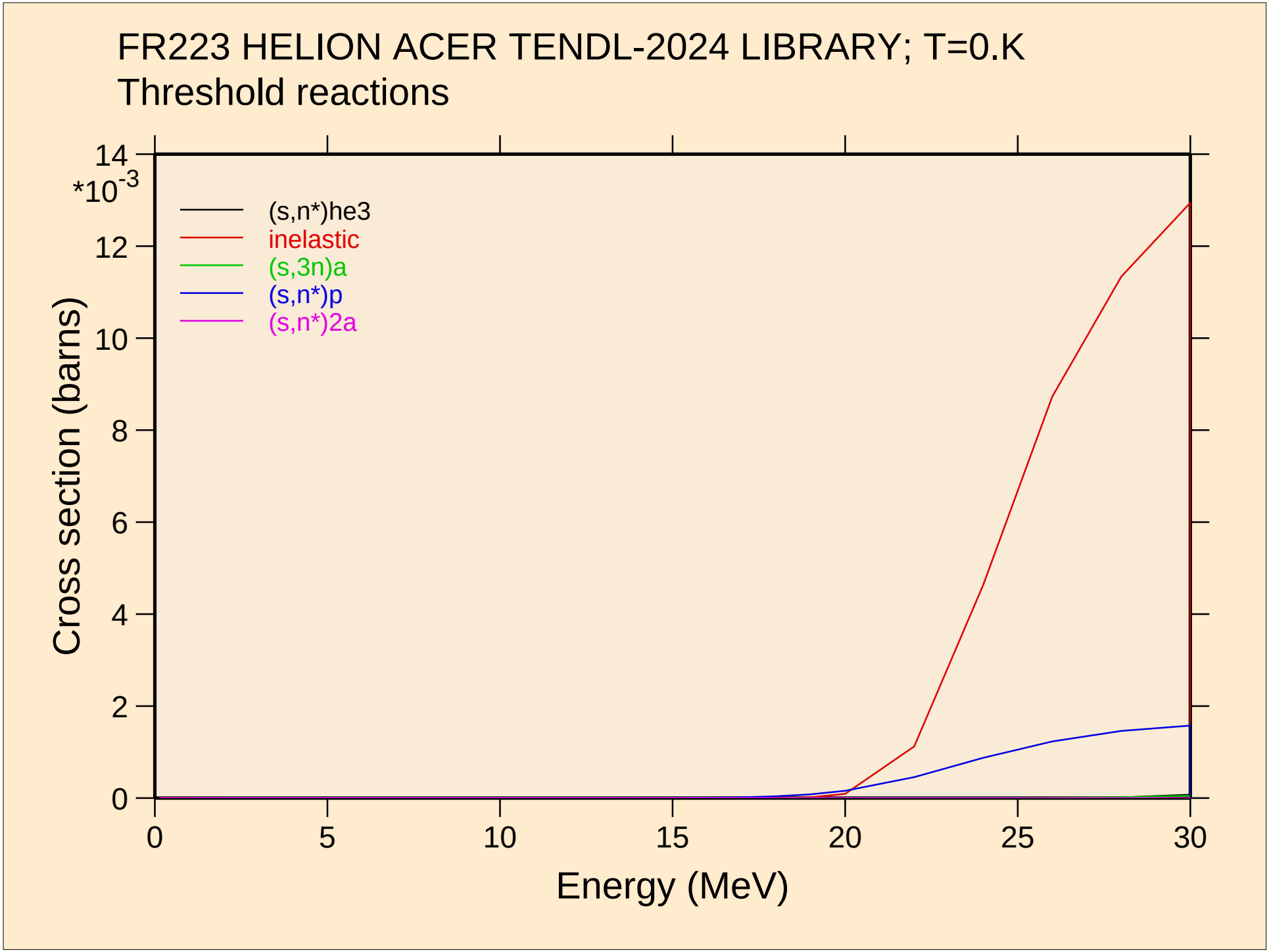

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Heating
heating
Heating (MeV/reaction)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-1}
10^{0}
10^{1}
10^{2}
Energy (MeV)

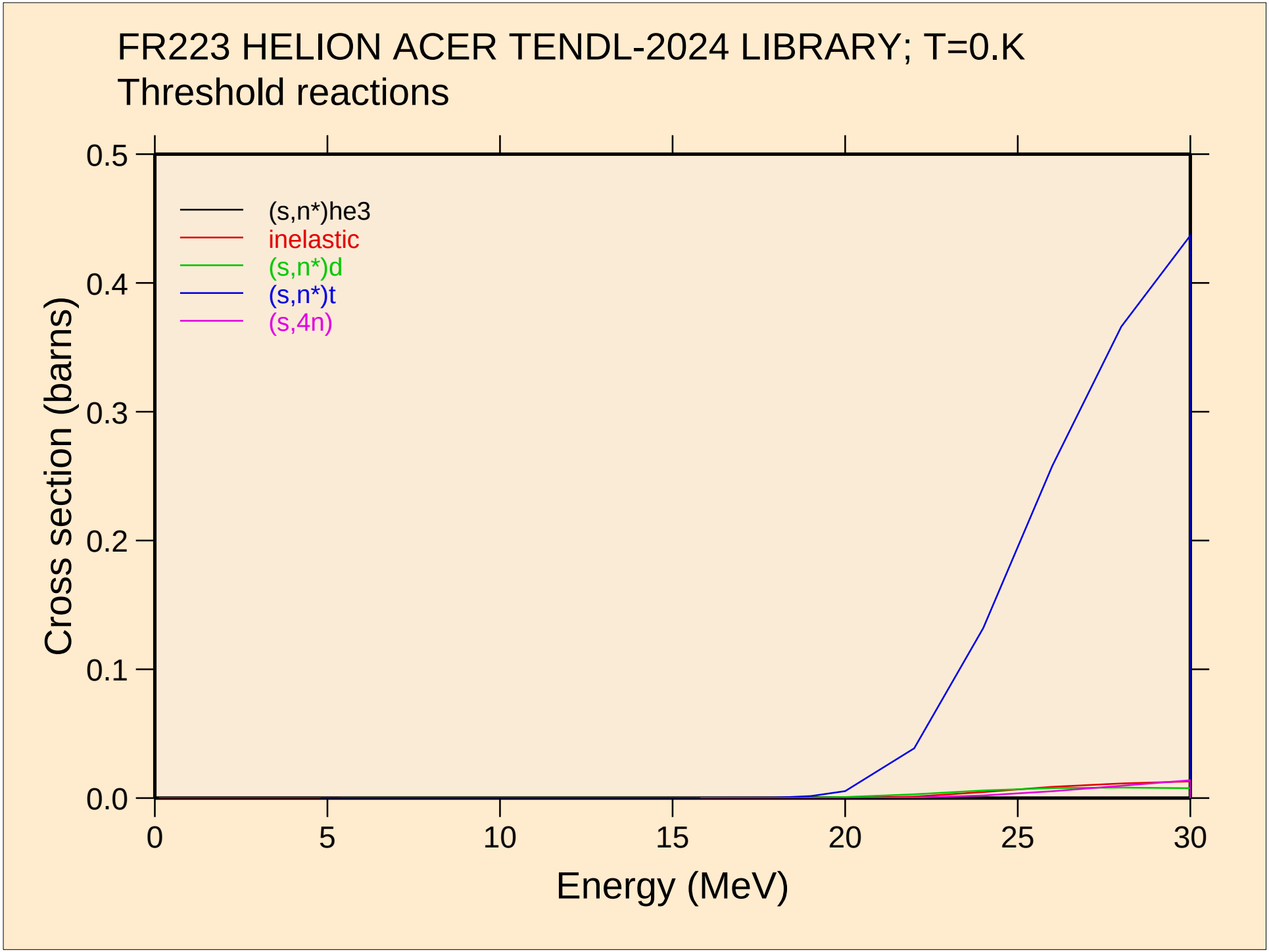

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Principal cross sections
Cross section (barns)
*10^3
35
30
25
20
15
10
5
0
0
20
40
60
80
100
120
140
160
180
200
Energy (MeV)
total
absorption
elastic
gamma production

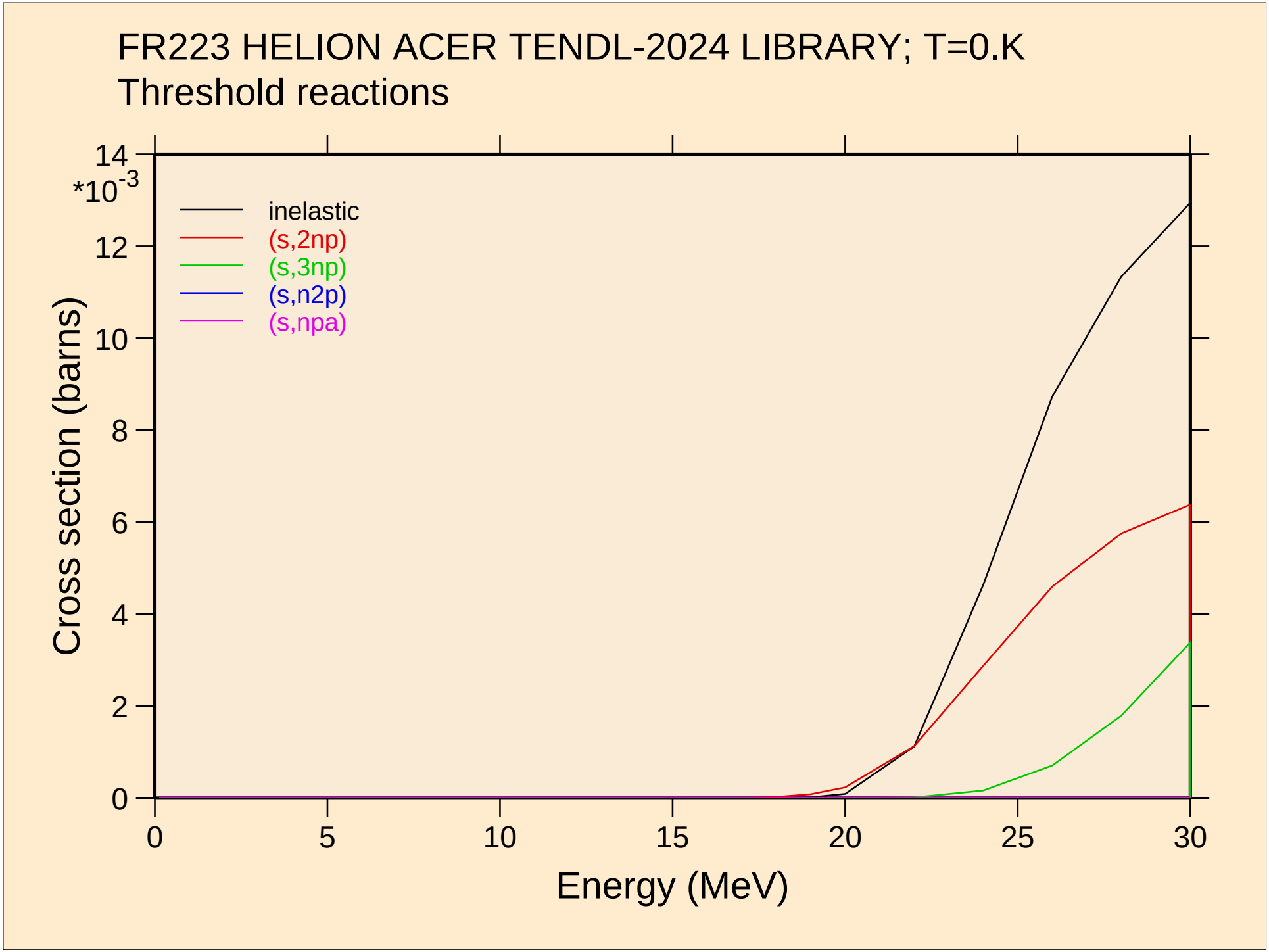

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Heating
heating
Heating (MeV/reaction)
Energy (MeV)
0
5
10
15
20
25
30
35
0
50
100
150
200

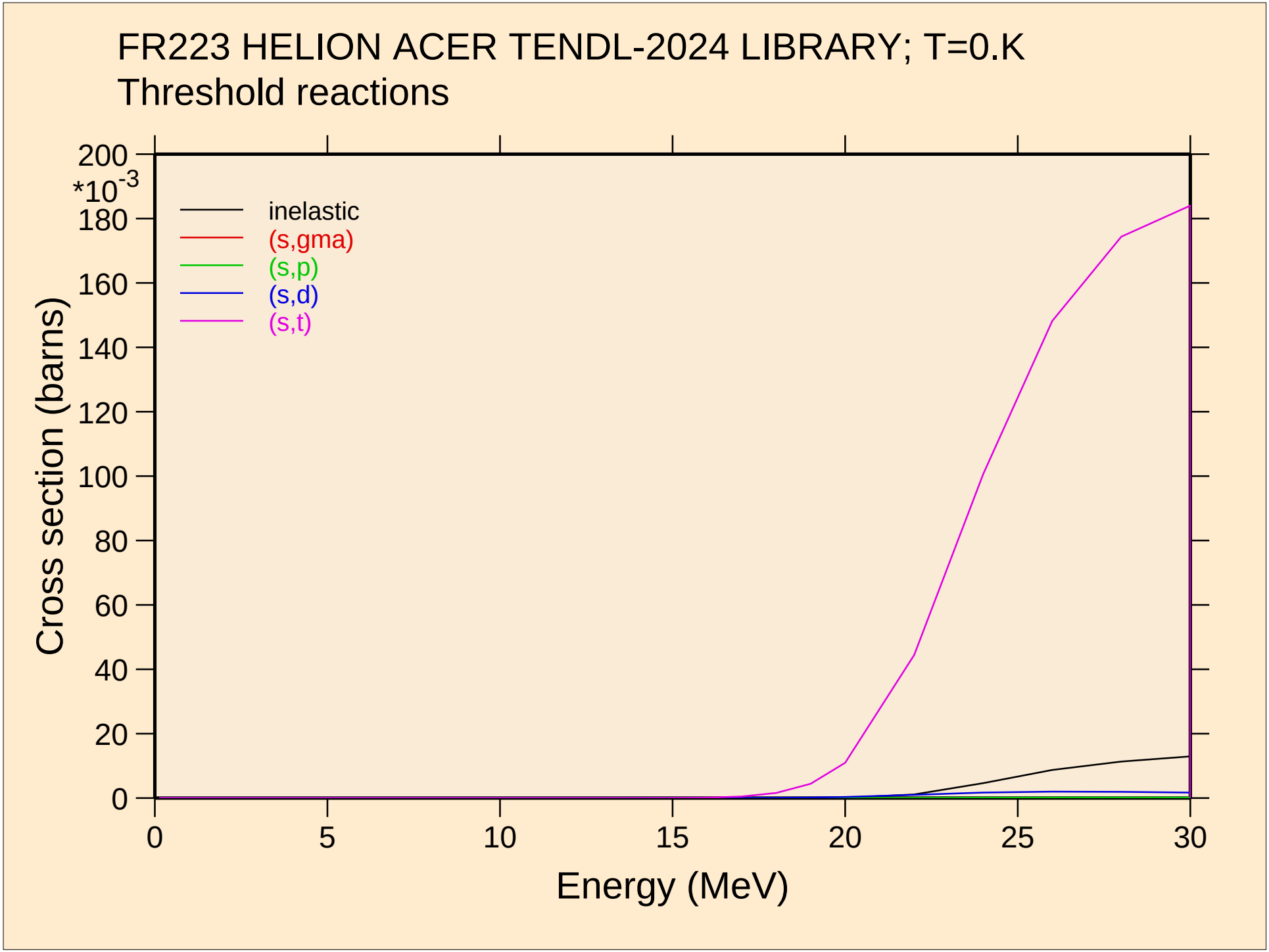

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Threshold reactions
(s,x)
(s,n*)he3
inelastic
(s,2nd)
(s,2n)
Cross section (barns)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
50
100
150
200
Energy (MeV)

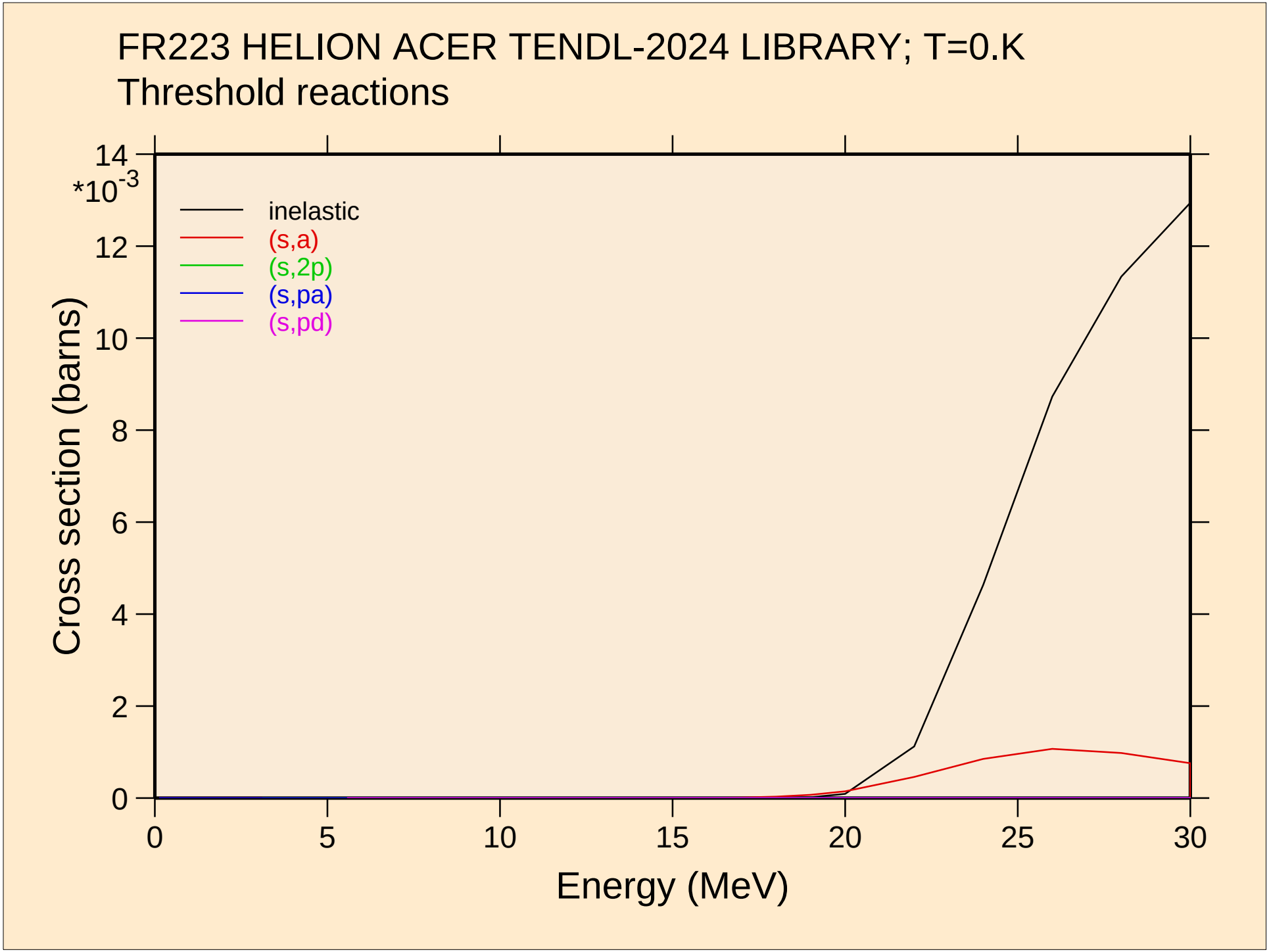

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Threshold reactions
*10-3
14
12
10
8
6
4
2
0
(s,n*)he3
inelastic
(s,3n)
(s,n*)a
(s,2n)a
Cross section (barns)
0
5
10
15
20
25
30
Energy (MeV)

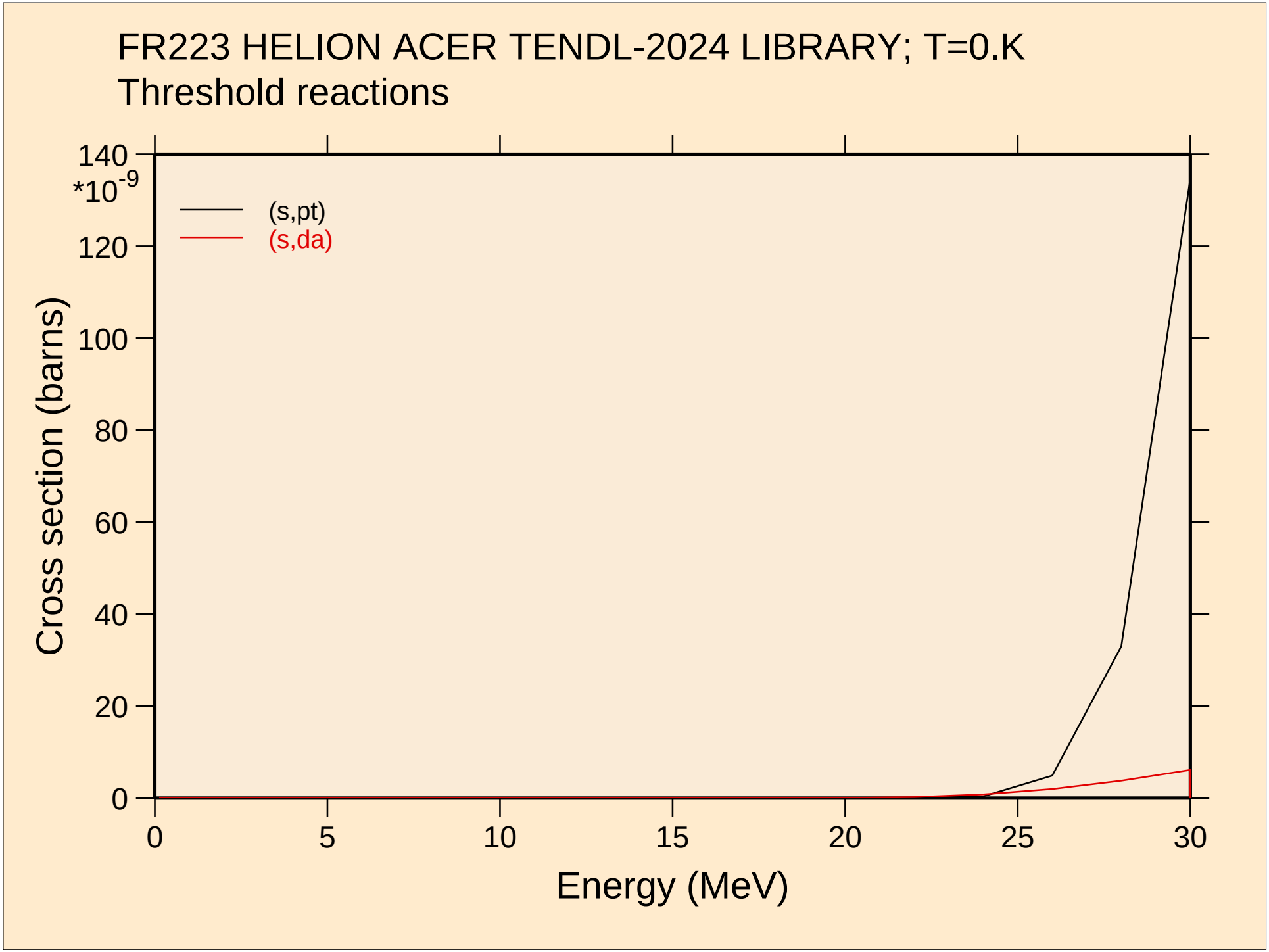

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Threshold reactions
*10-3
14
12
10
8
6
4
2
0
(s,n*)he3
inelastic
(s,3n)a
(s,n*)p
(s,n*)2a
Cross section (barns)
0
5
10
15
20
25
30
Energy (MeV)

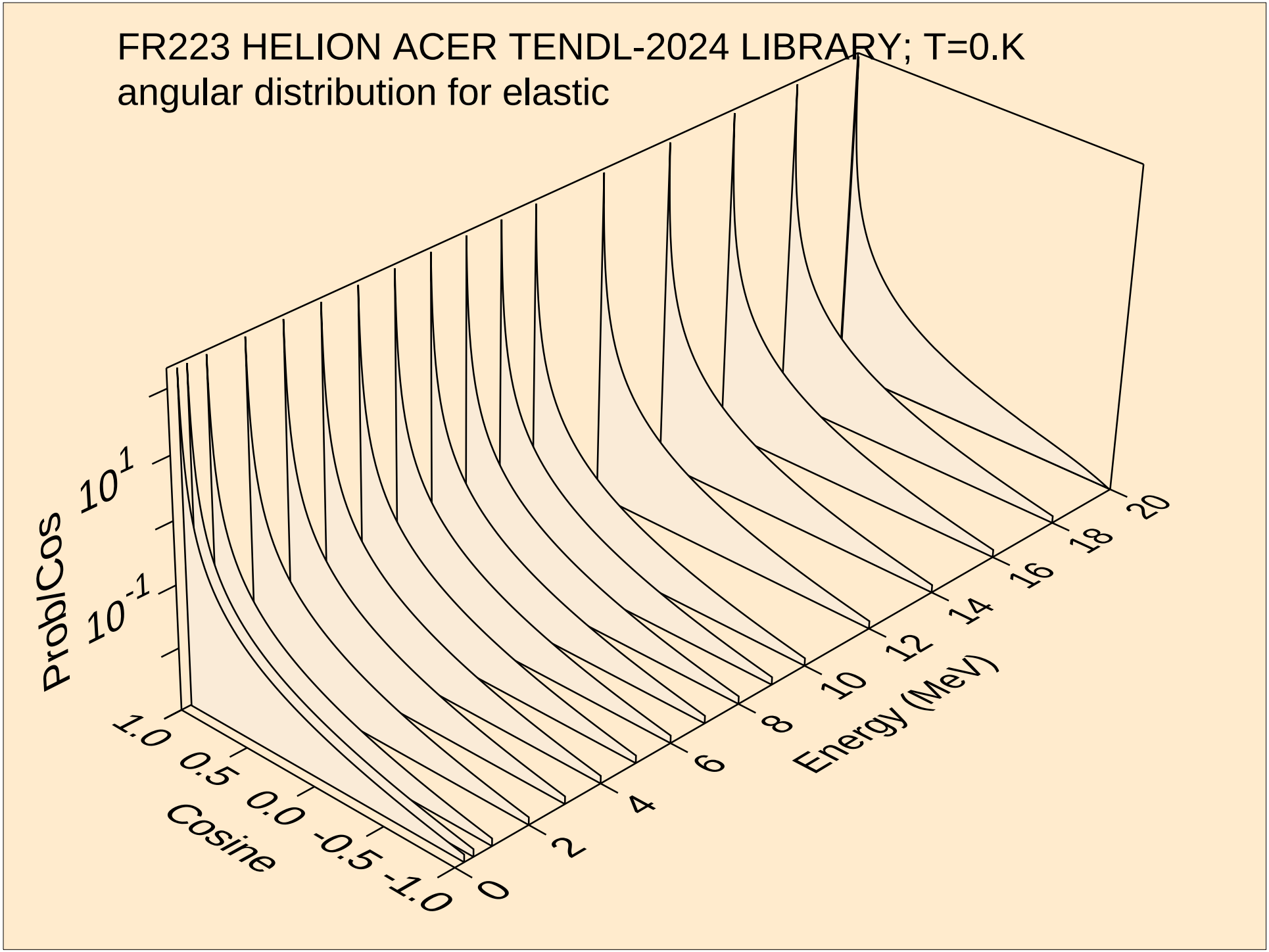

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Threshold reactions
(s,n*)he3
inelastic
(s,n*)d
(s,n*)t
(s,4n)
Cross section (barns)
0.0
0.1
0.2
0.3
0.4
0.5
0
5
10
15
20
25
30
Energy (MeV)

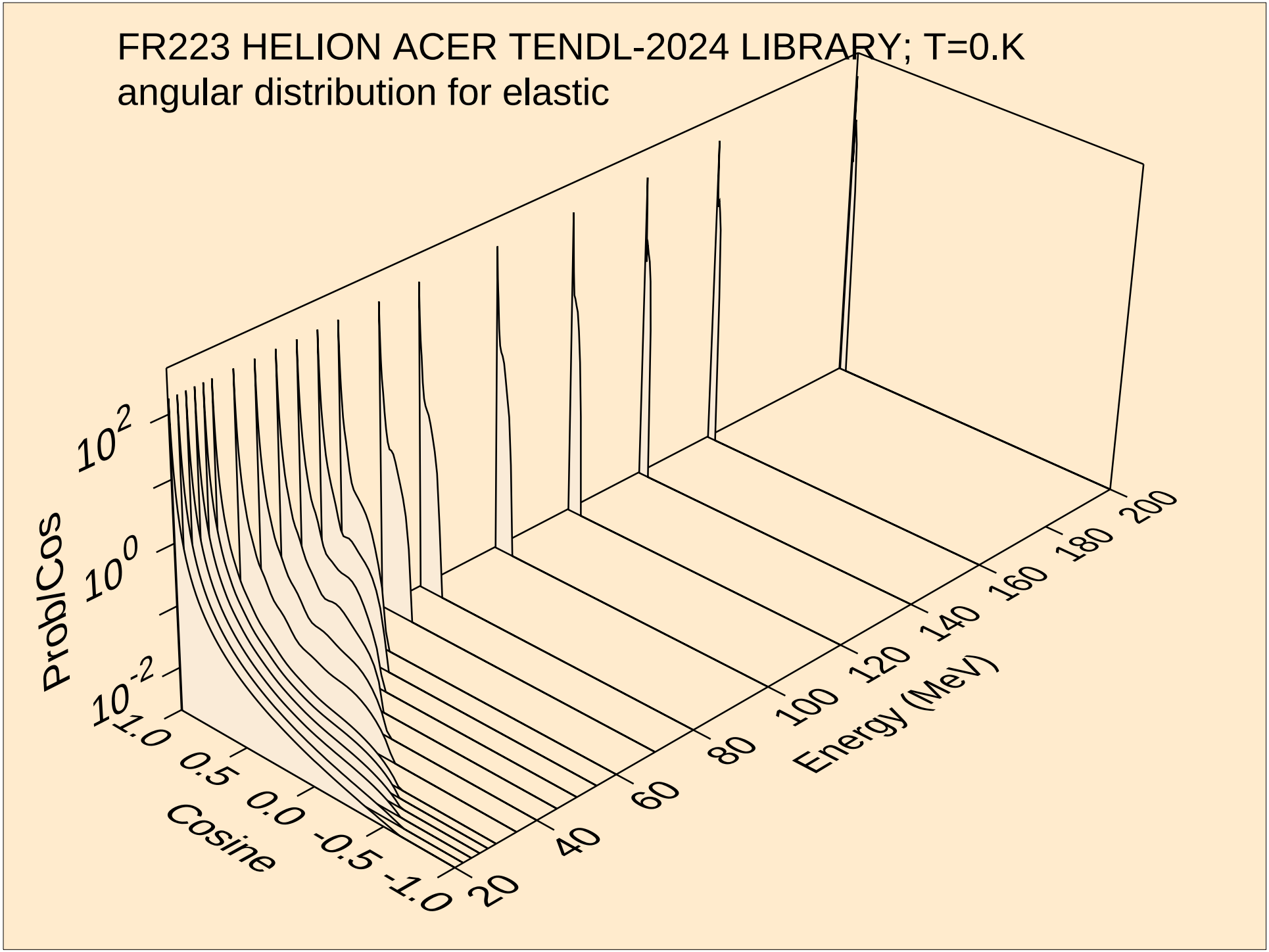

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Threshold reactions
*10-3
14
12
10
8
6
4
2
0
Cross section (barns)
inelastic
(s,2np)
(s,3np)
(s,n2p)
(s,npa)
0
5
10
15
20
25
30
Energy (MeV)

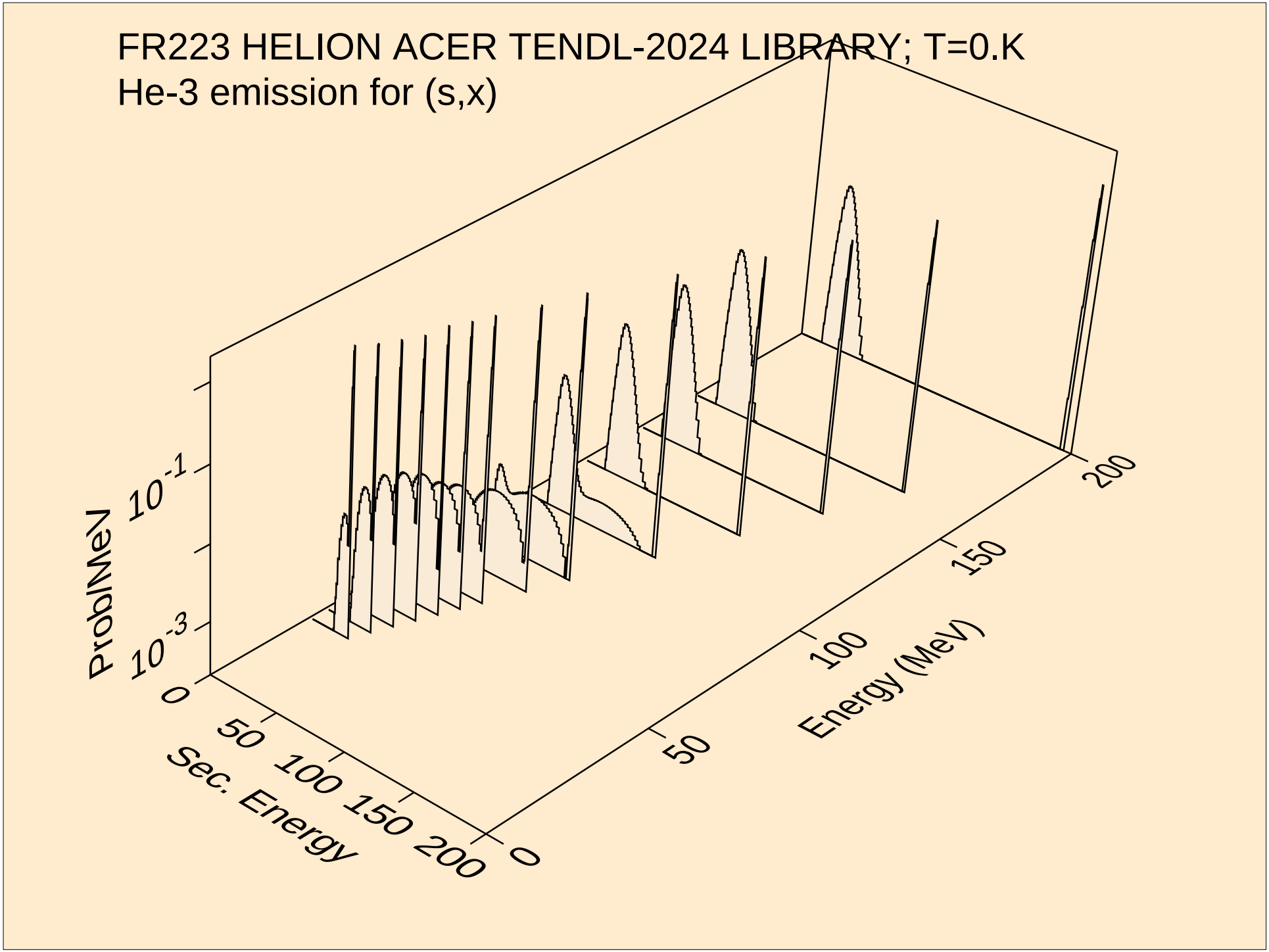

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Threshold reactions
*10-3
200
180
160
140
120
100
80
60
40
20
0
Cross section (barns)
inelastic
(s,gma)
(s,p)
(s,d)
(s,t)
0
5
10
15
20
25
30
Energy (MeV)

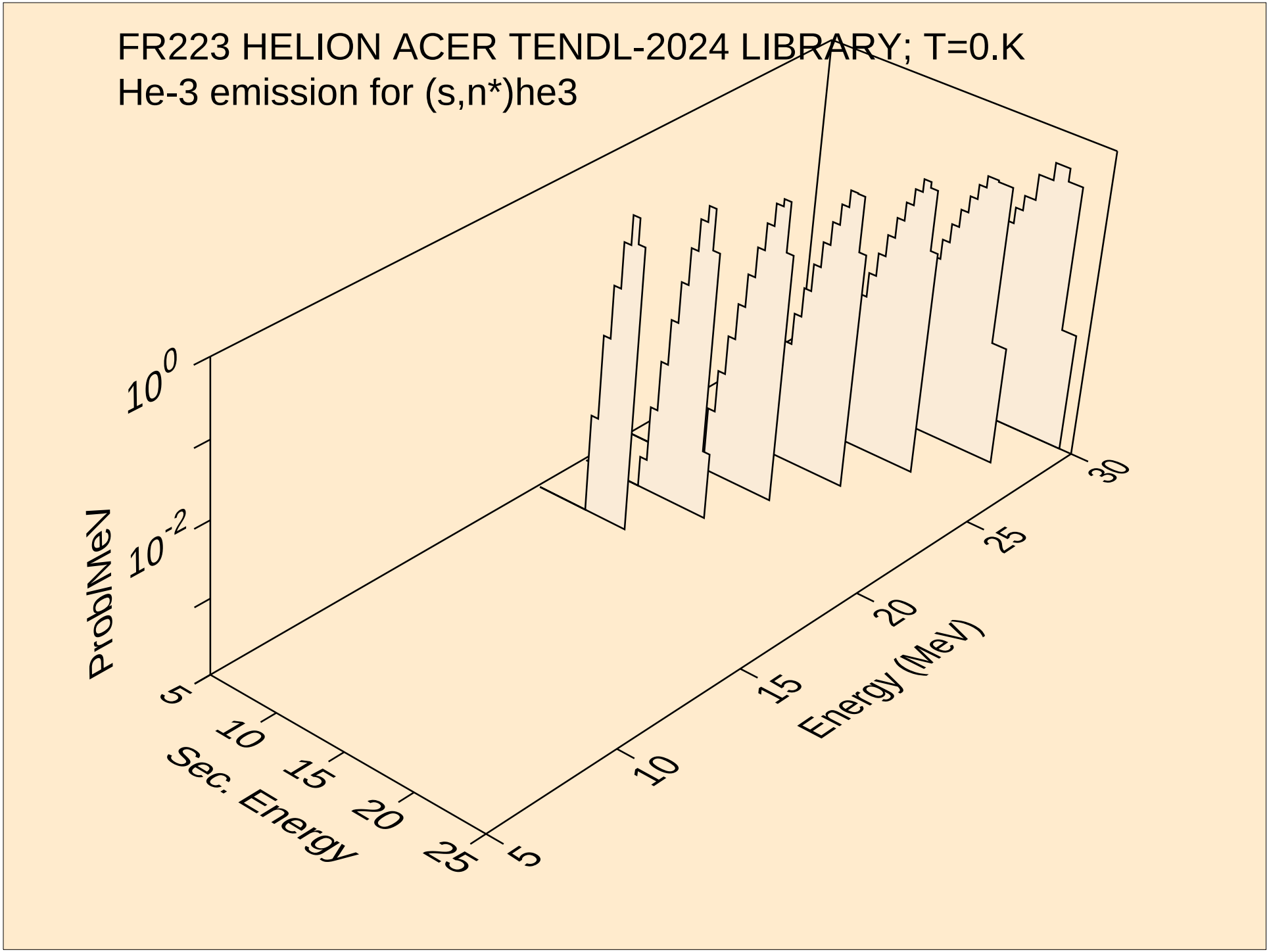

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Threshold reactions
*10-3
14
12
10
8
6
4
2
0
inelastic
(s,a)
(s,2p)
(s,pa)
(s,pd)
Cross section (barns)
0
5
10
15
20
25
30
Energy (MeV)

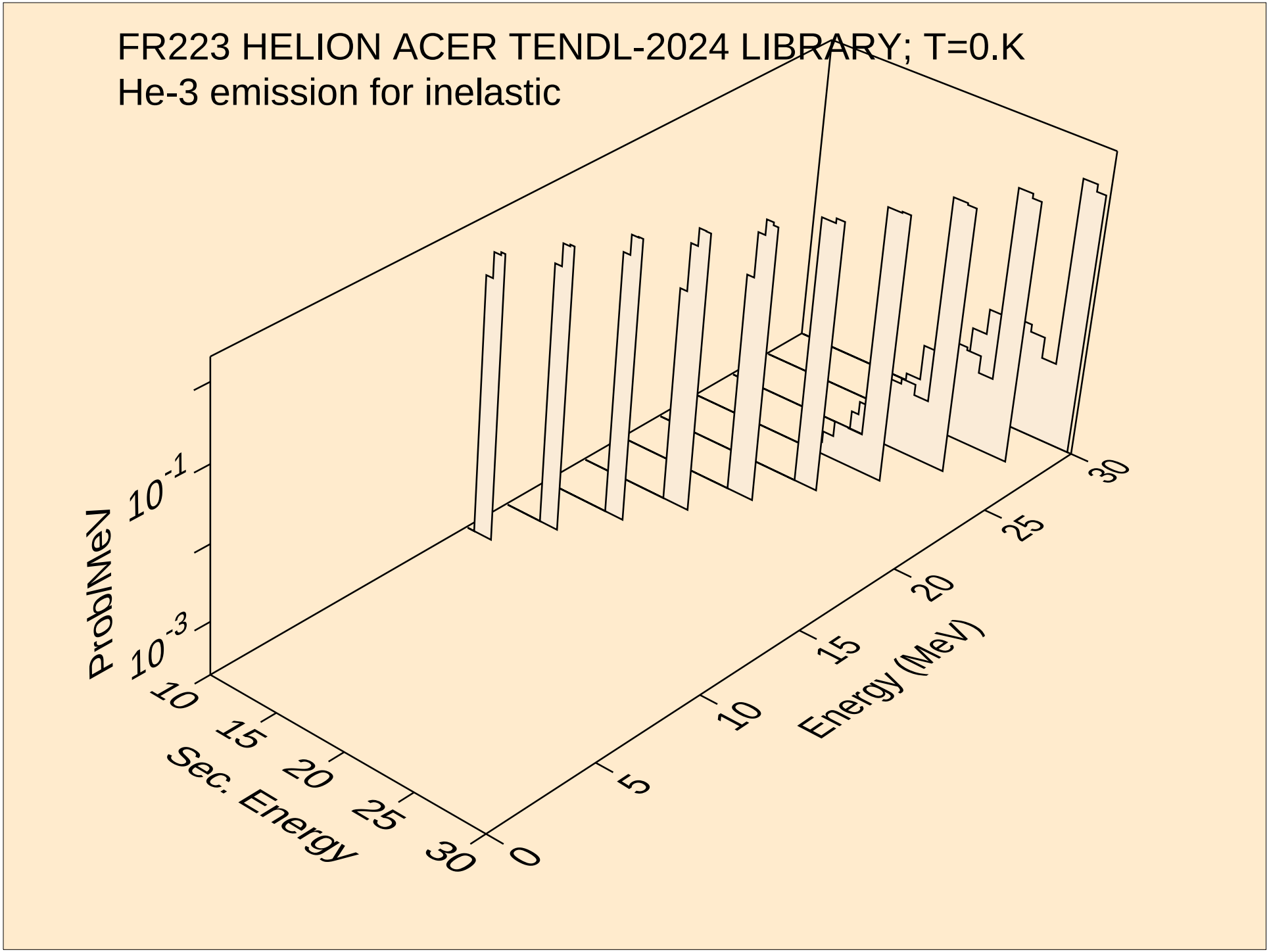

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Threshold reactions
*10-9
(s,pt)
(s,da)
Cross section (barns)
Energy (MeV)
0
20
40
60
80
100
120
140
0
5
10
15
20
25
30

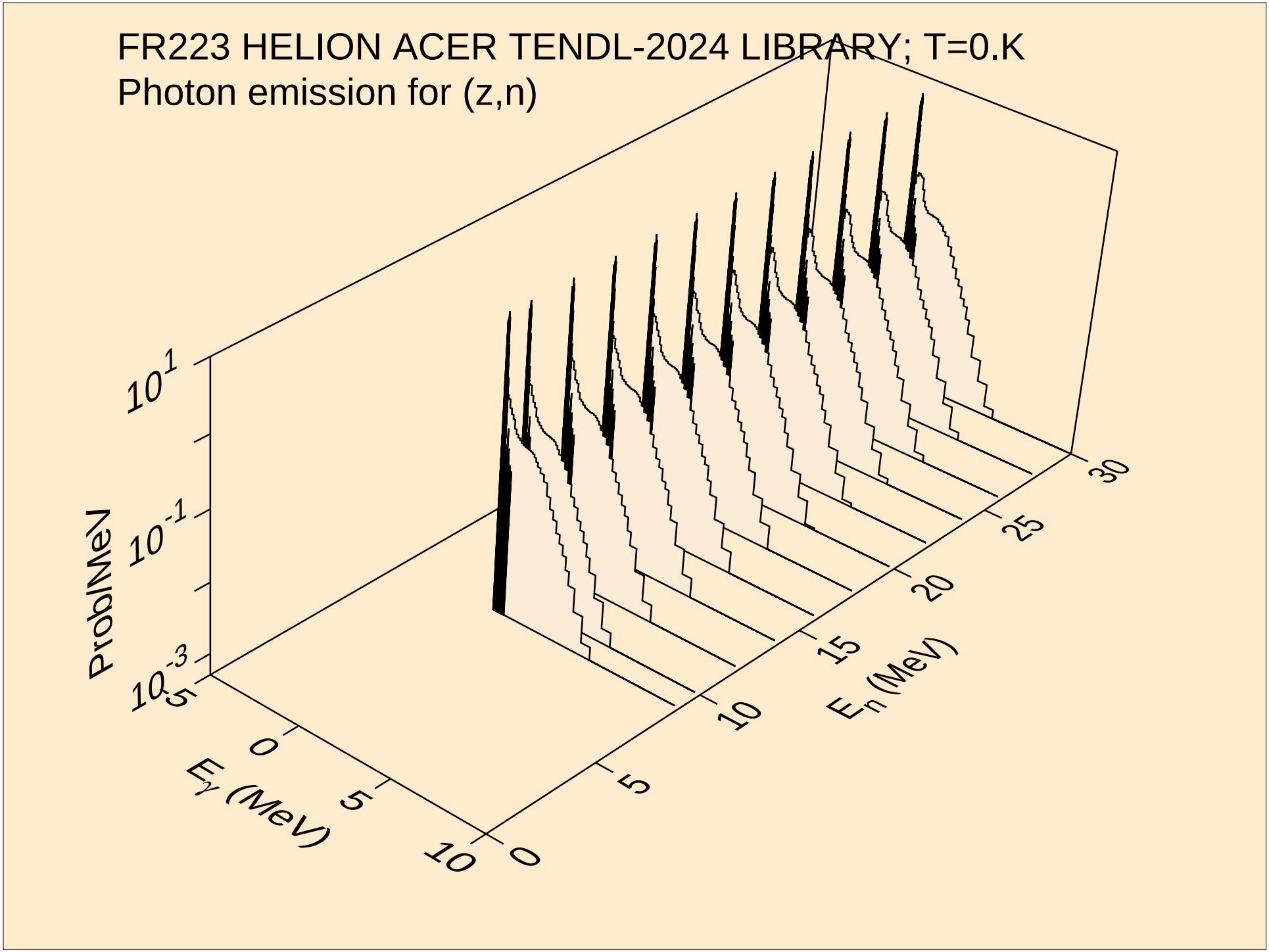

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
angular distribution for elastic
ProbICos
10^1
10^-1
1.0
0.5
0.0
-0.5
-1.0
Cosine
0
2
4
6
8
10
12
14
16
18
20
Energy (MeV)

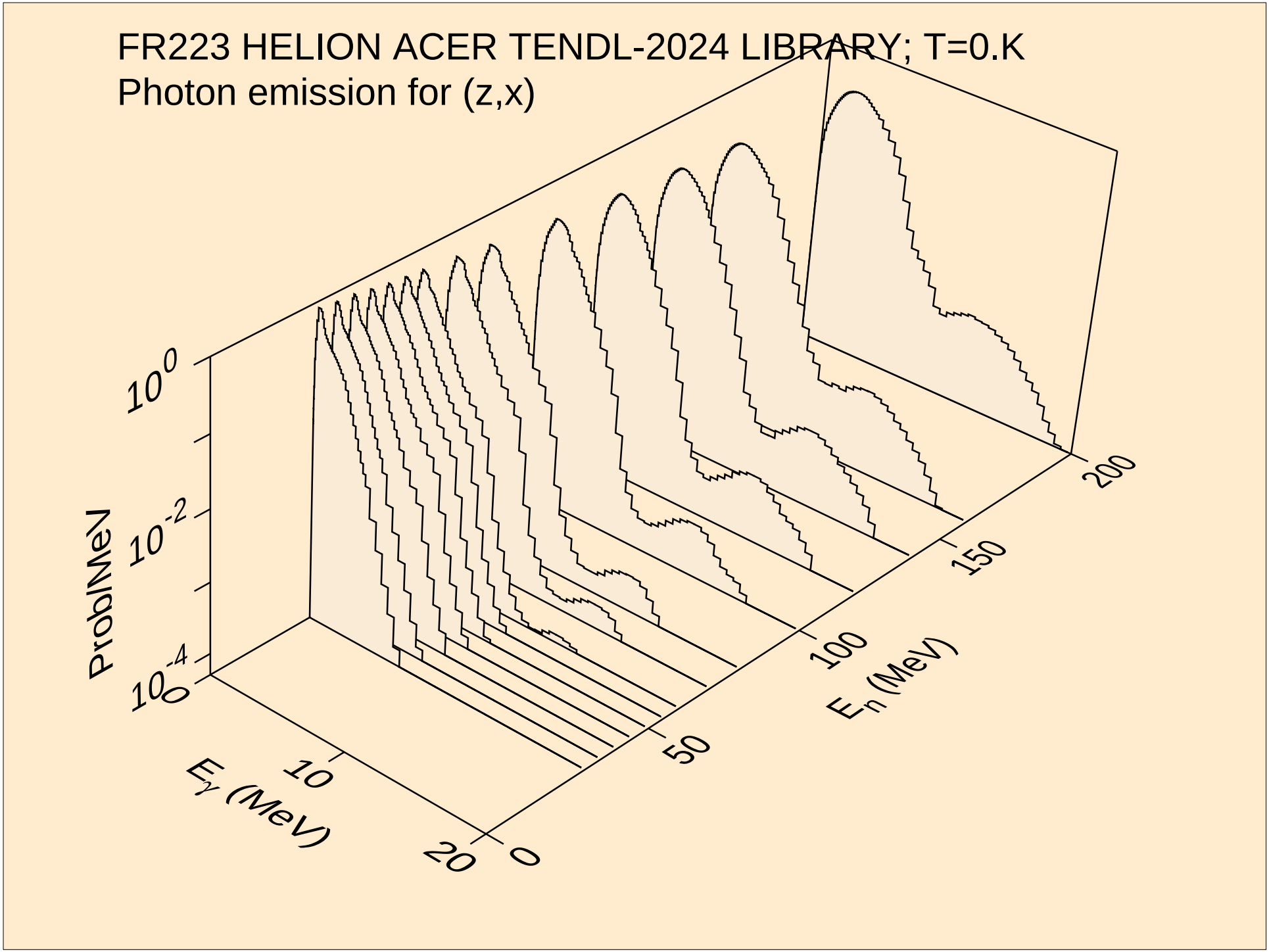

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
angular distribution for elastic
ProblCos
10^{2}
10^{0}
10^{-2}
1.0
0.5
0.0
-0.5
-1.0
Cosine
20
40
60
80
100
120
140
160
180
200
Energy (MeV)

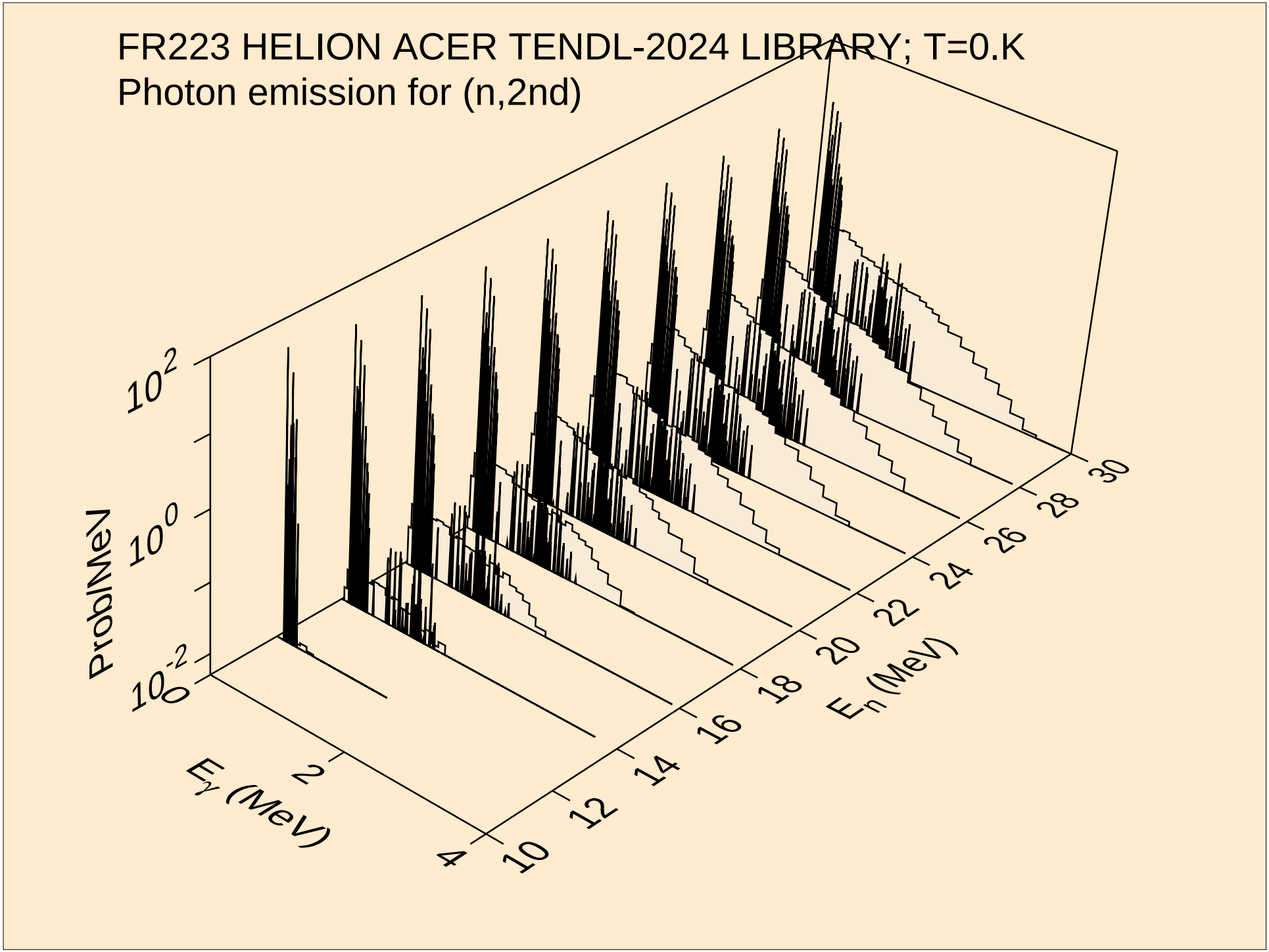

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
He-3 emission for (s,x)
Prob/MeV
10-1
10-3
0
50
100
150
200
Sec. Energy
0
50
100
150
200
Energy (MeV)

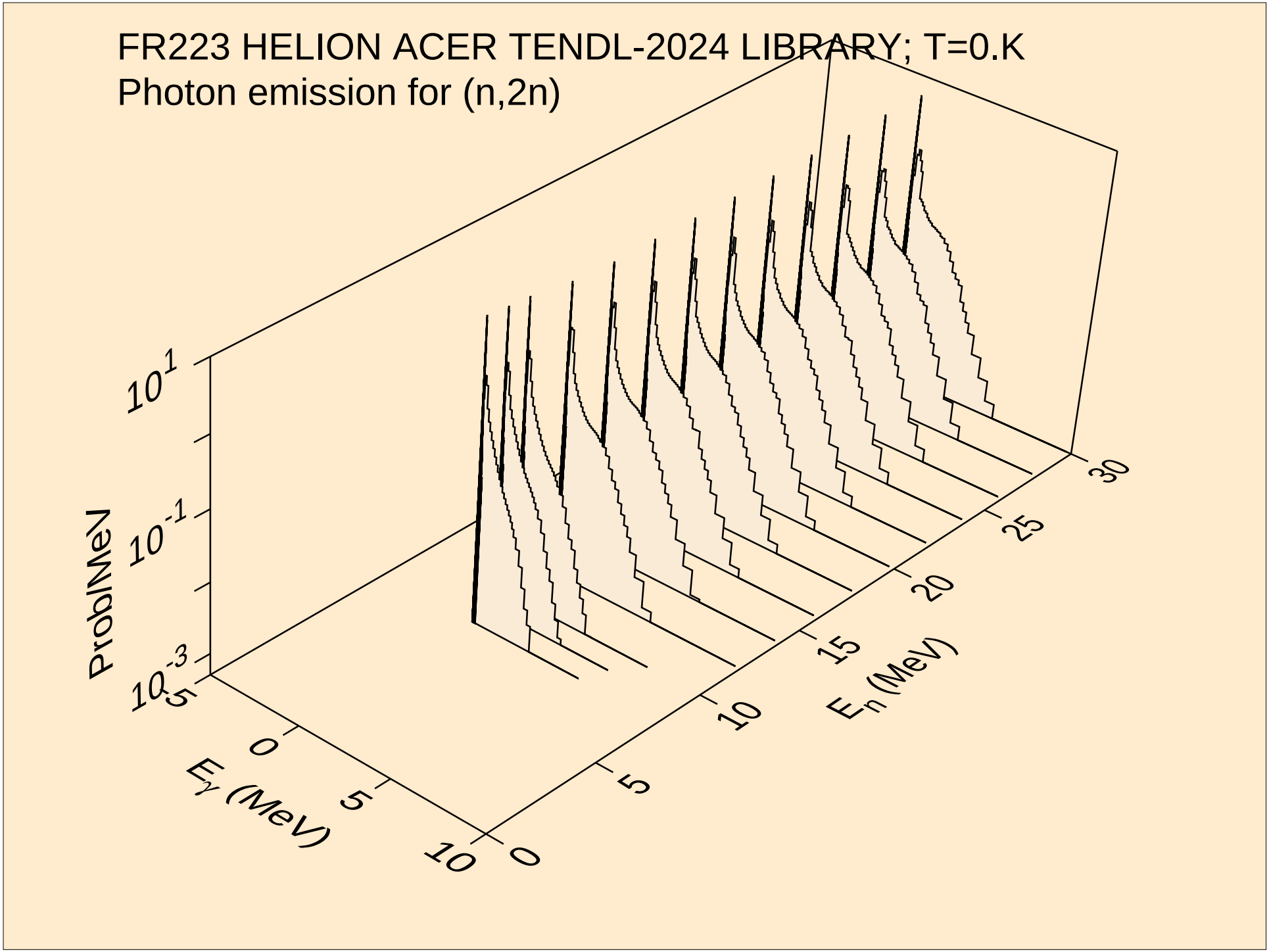

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
He-3 emission for (s,n*)he3
Prob/MeV
10^0
10^-2
5
10
15
20
25
Sec. Energy
5
10
15
20
25
30
Energy (MeV)

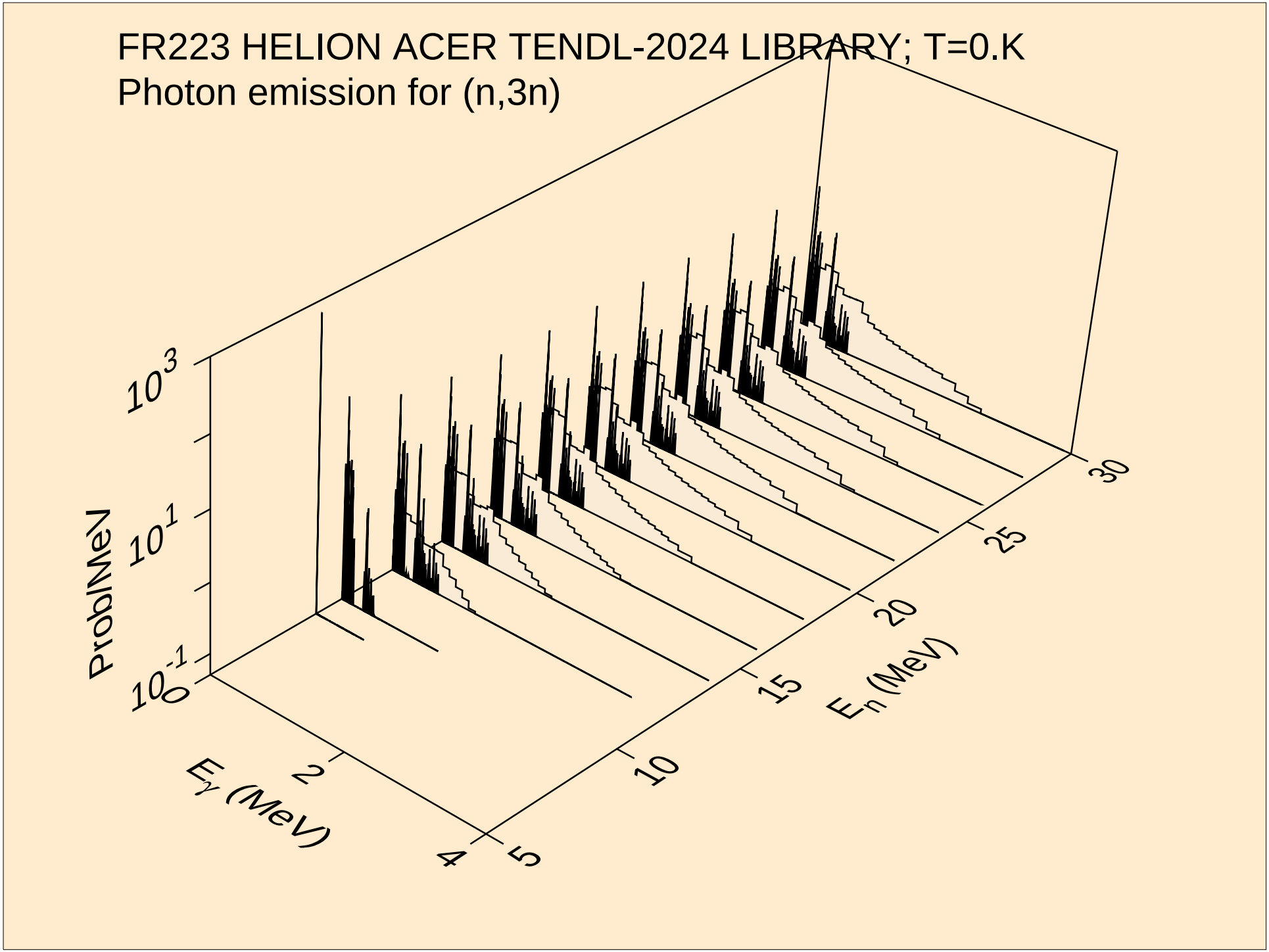

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
He-3 emission for inelastic
Prob/MeV
10-1
10-3
10
15
20
25
30
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)

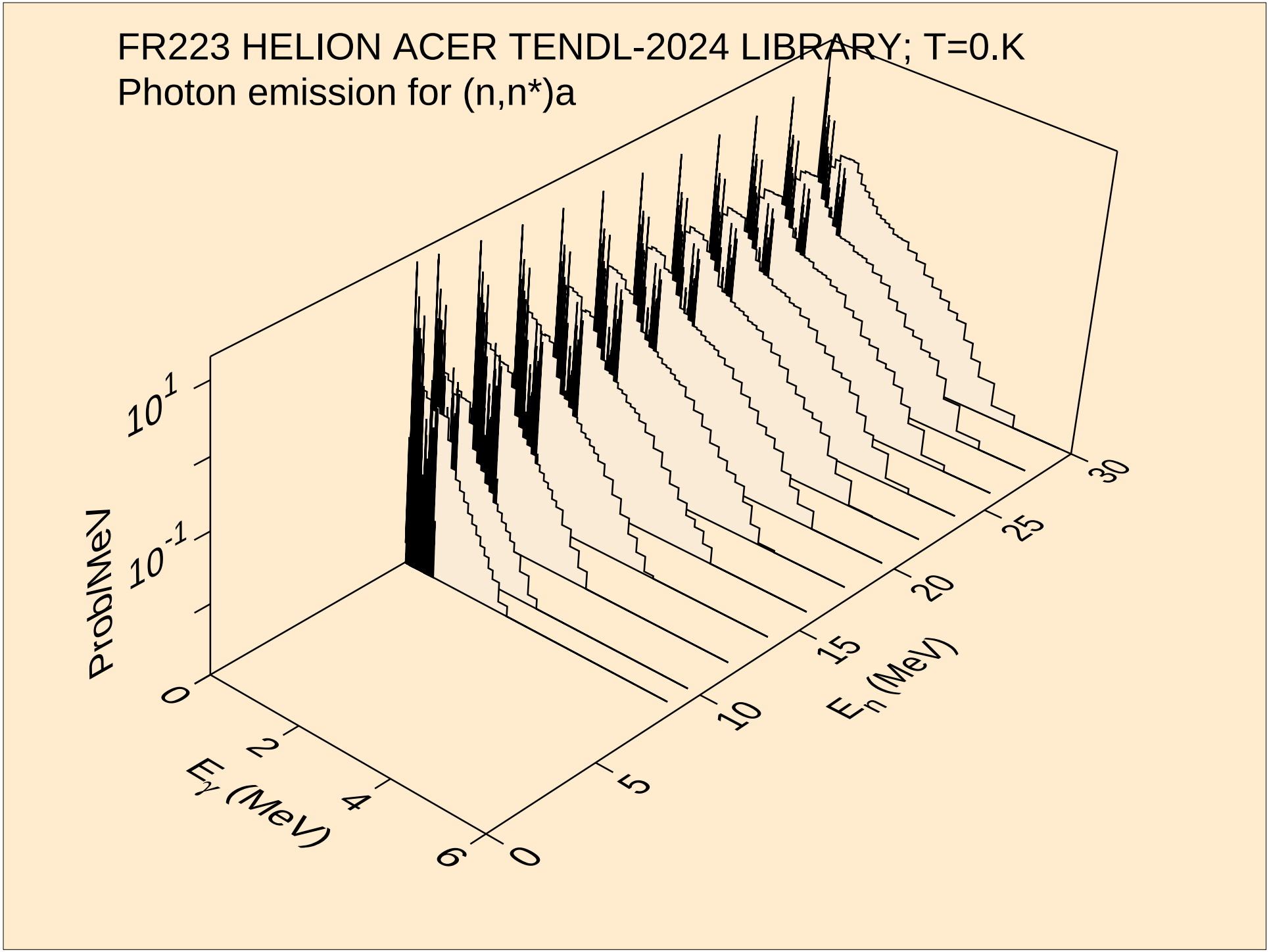

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (z,n)
Prob/MeV
10^{1}
10^{-1}
10^{-3}
E_γ (MeV)
-5
0
5
10
E_n (MeV)
0
5
10
15
20
25
30

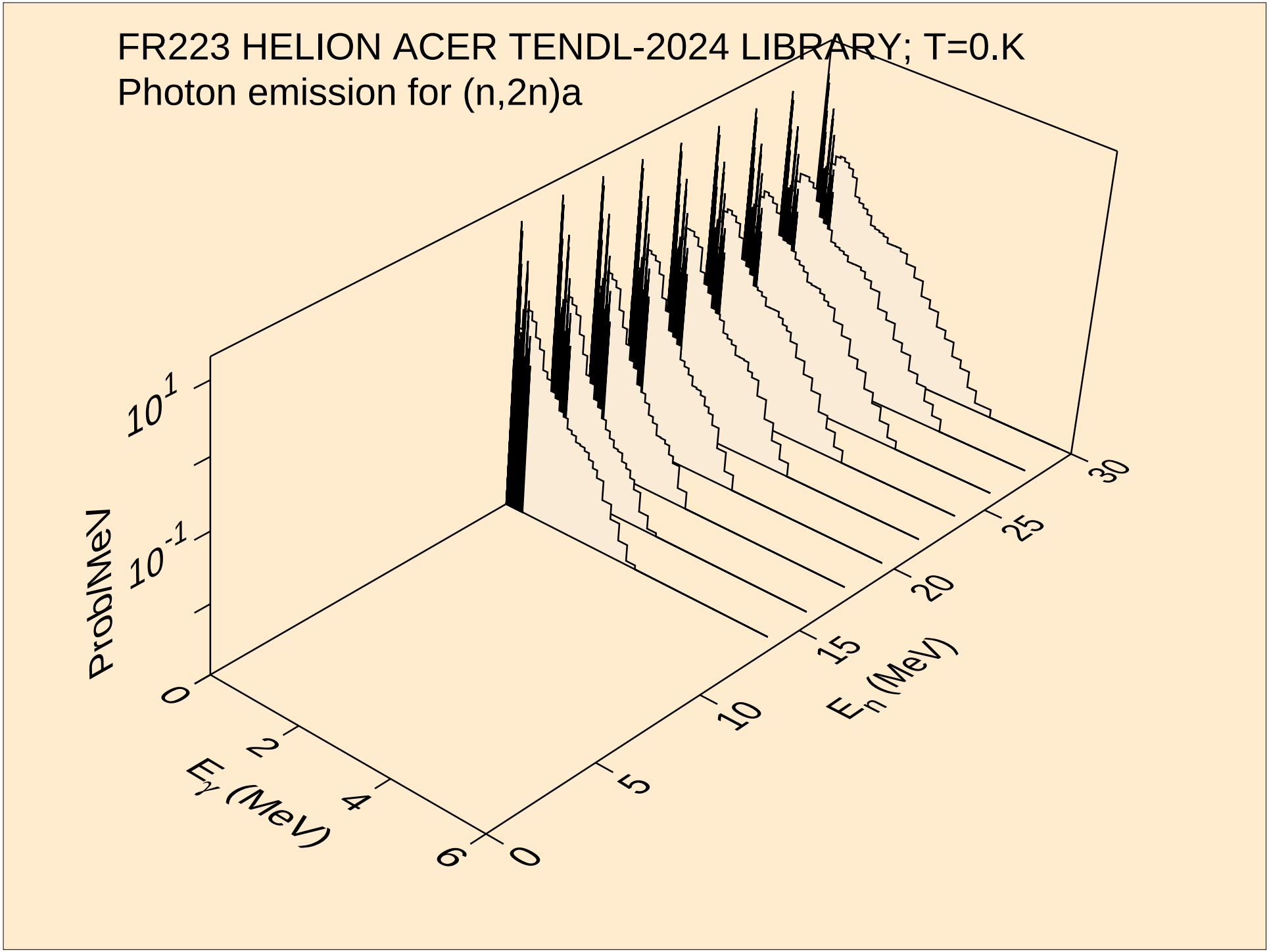

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (z,x)
Prob/MeV
10^{0}
10^{-2}
10^{-4}
0
10
20
E_γ (MeV)
0
50
100
150
200
E_n (MeV)

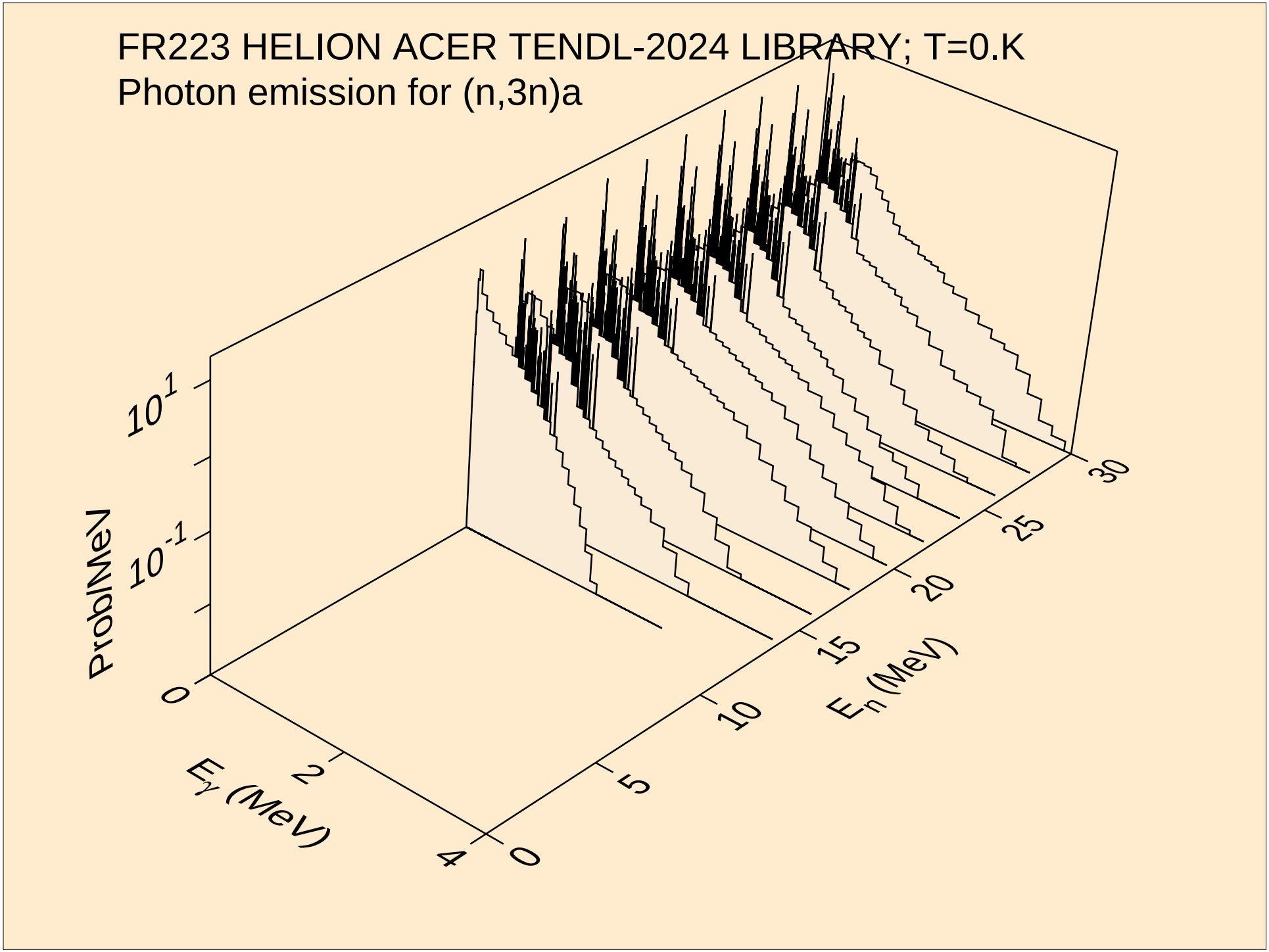

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,2nd)
Prob/MeV
10^{2}
10^{0}
10^{-2}
0
2
4
E_γ (MeV)
10
12
14
16
18
20
22
24
26
28
30
E_n (MeV)

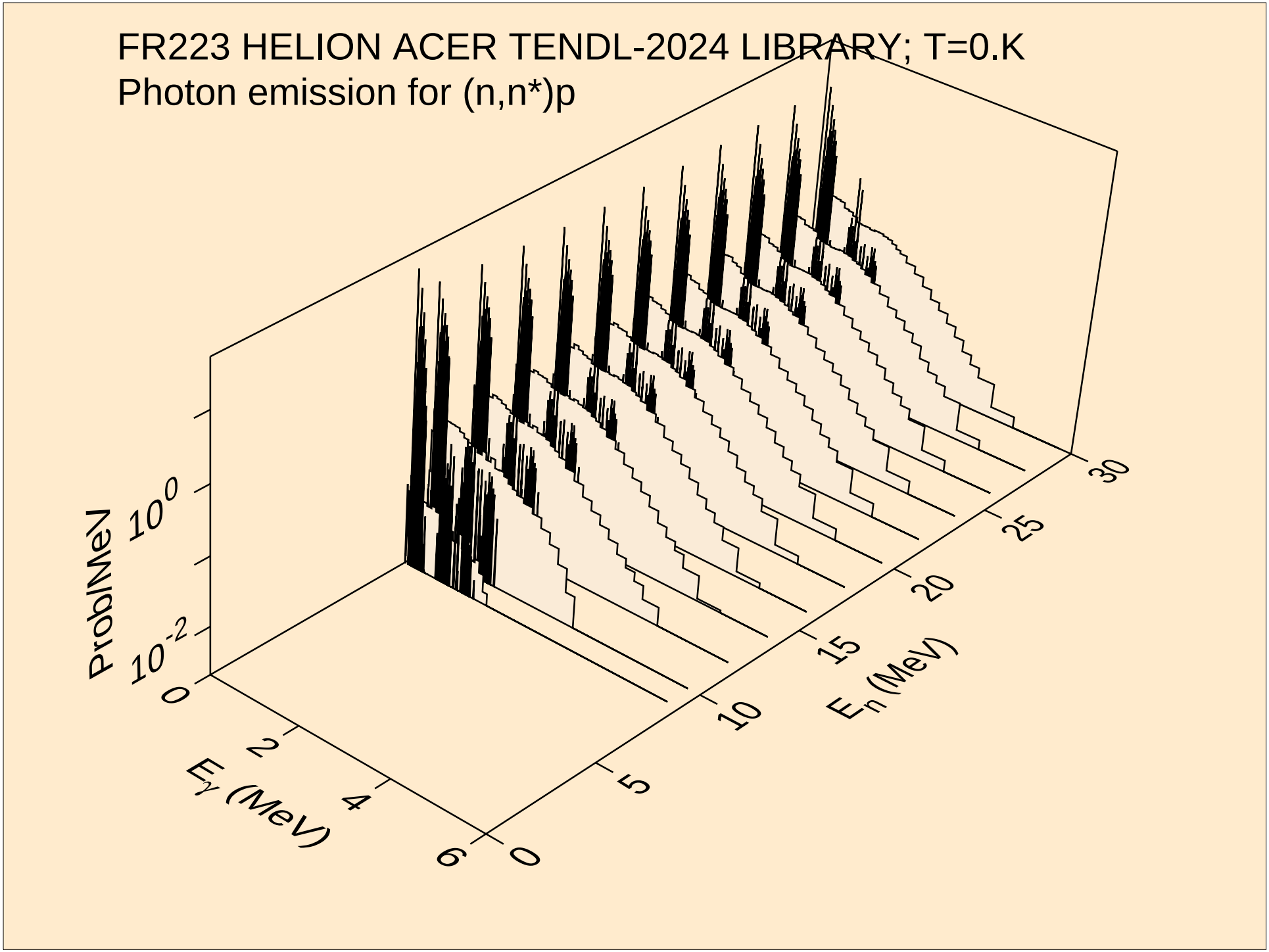

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,2n)
Prob/MeV
10^{1}
10^{-1}
10^{-3}
E_γ (MeV)
-5
0
5
10
E_n (MeV)
0
5
10
15
20
25
30

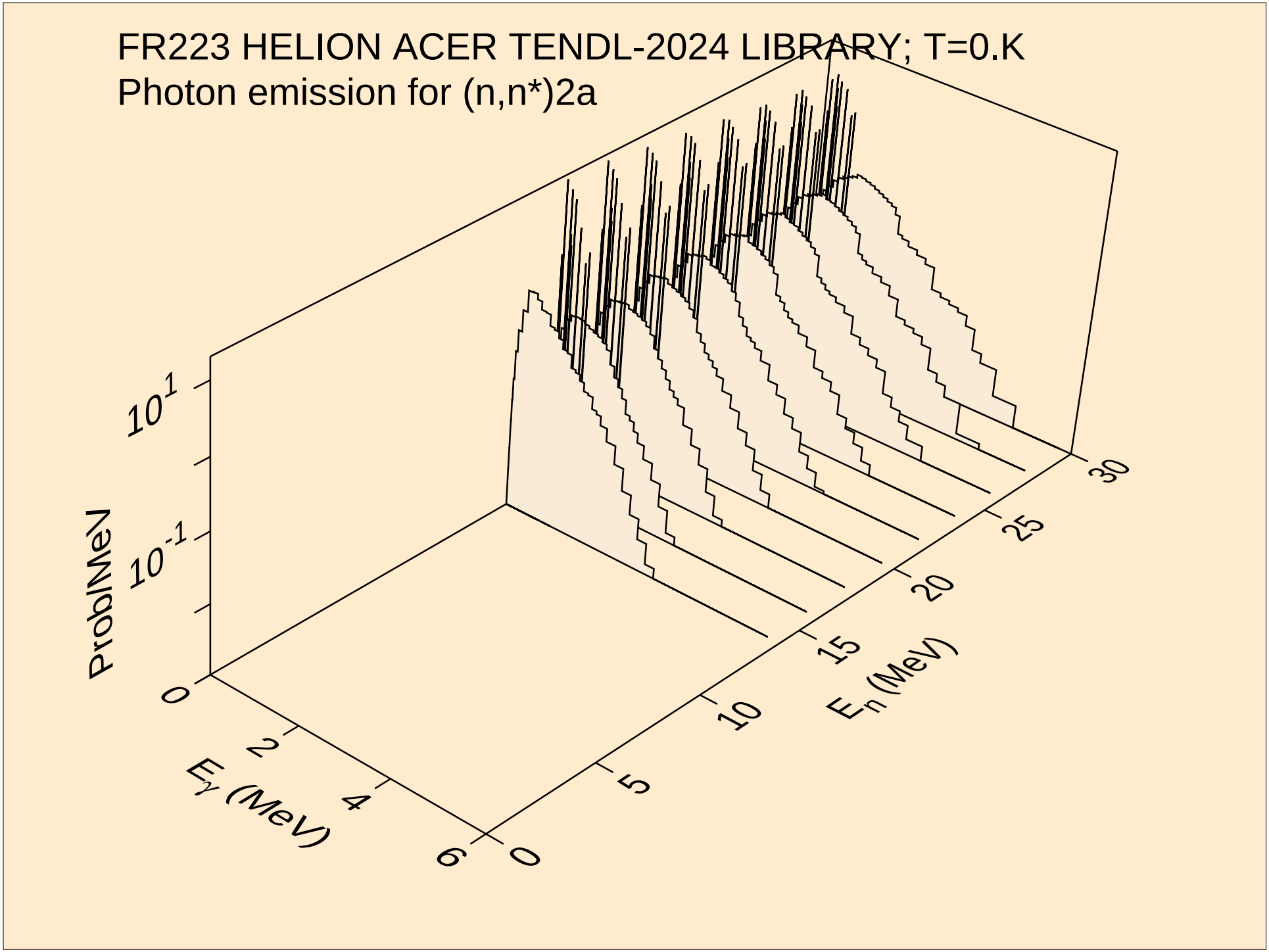

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,3n)
Prob/MeV
10^{3}
10^{1}
10^{-1}
0
2
4
E_γ (MeV)
5
10
15
20
25
30
E_n (MeV)

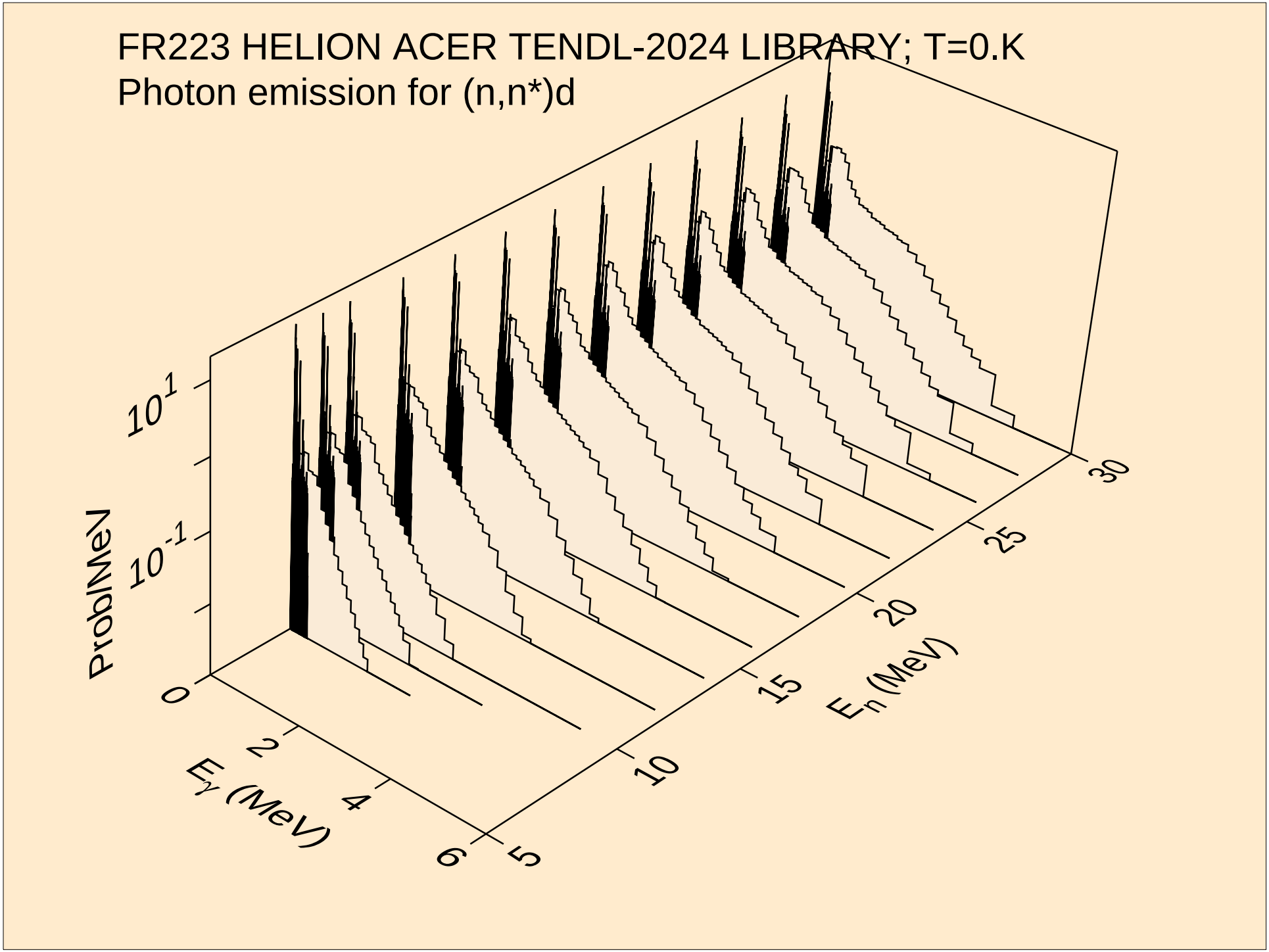

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,n*)a
Prob/MeV
10^{1}
10^{-1}
0
2
4
6
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

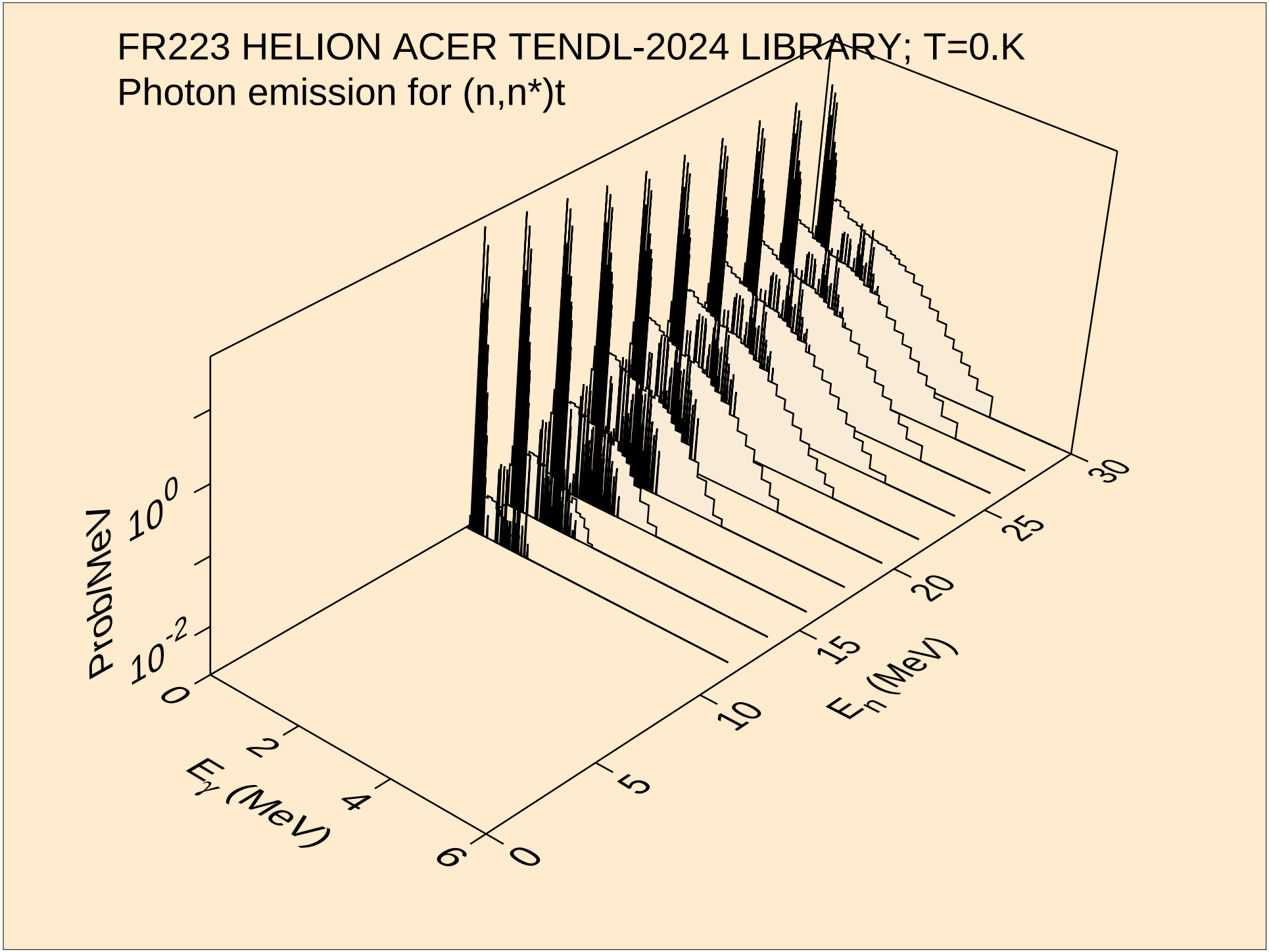

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,2n)a
Prob/MeV
10^1
10^-1
0
2
4
6
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

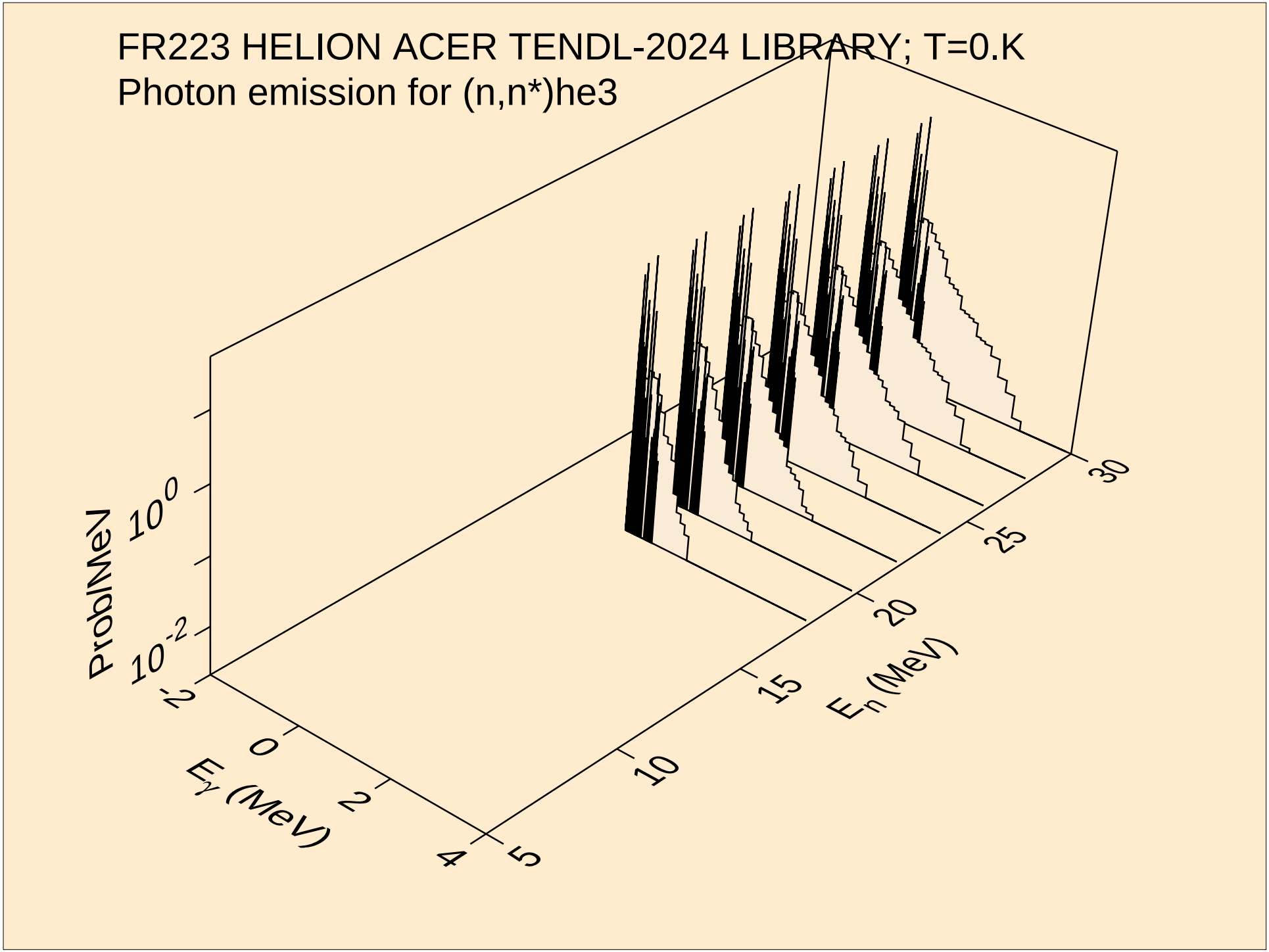

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,3n)a
Prob/MeV
10^1
10^-1
0
2
4
Eγ (MeV)
0
5
10
15
20
25
30
En (MeV)

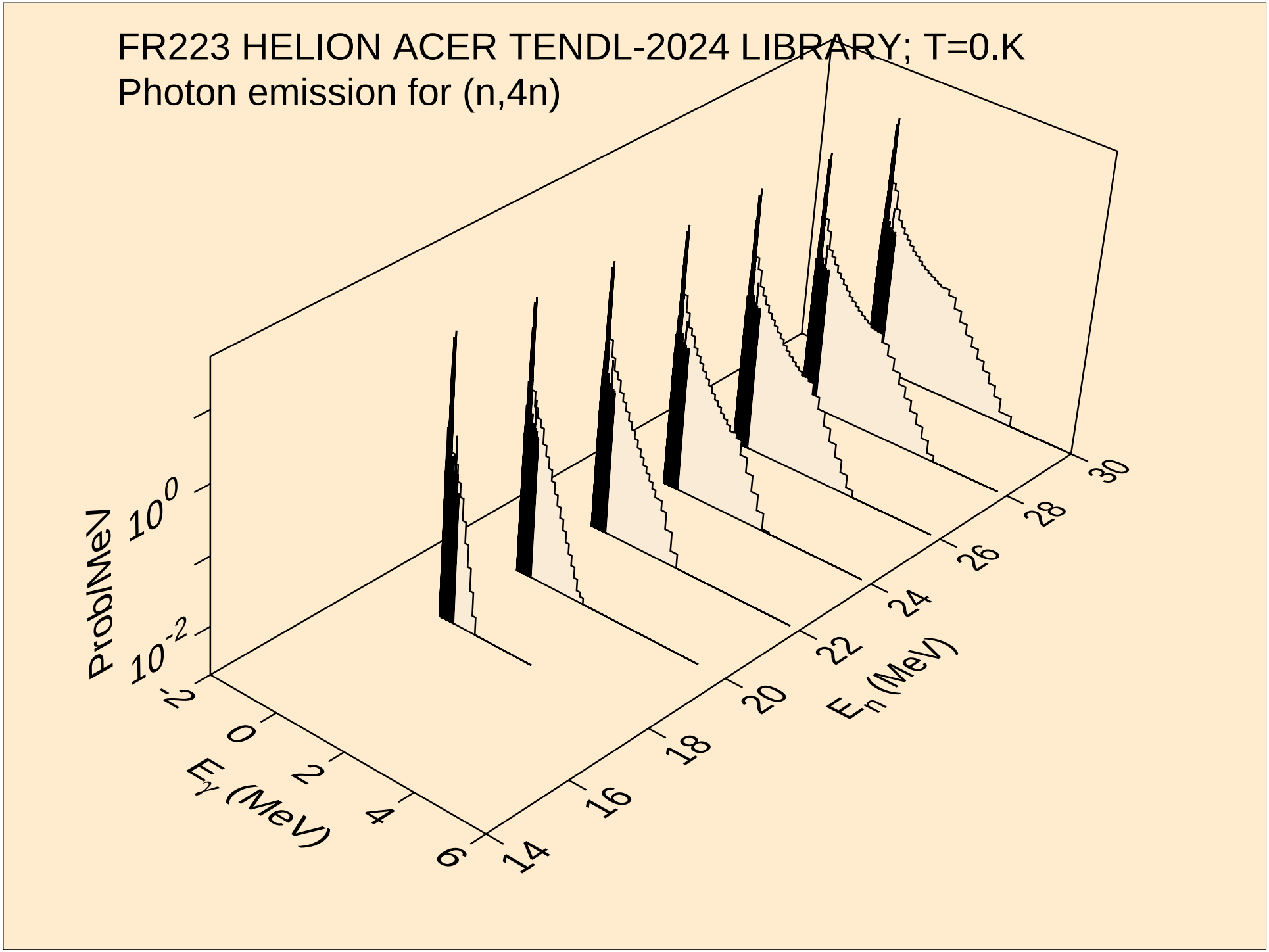

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,n*)p
Prob/MeV
10^{0}
10^{-2}
0
2
4
6
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

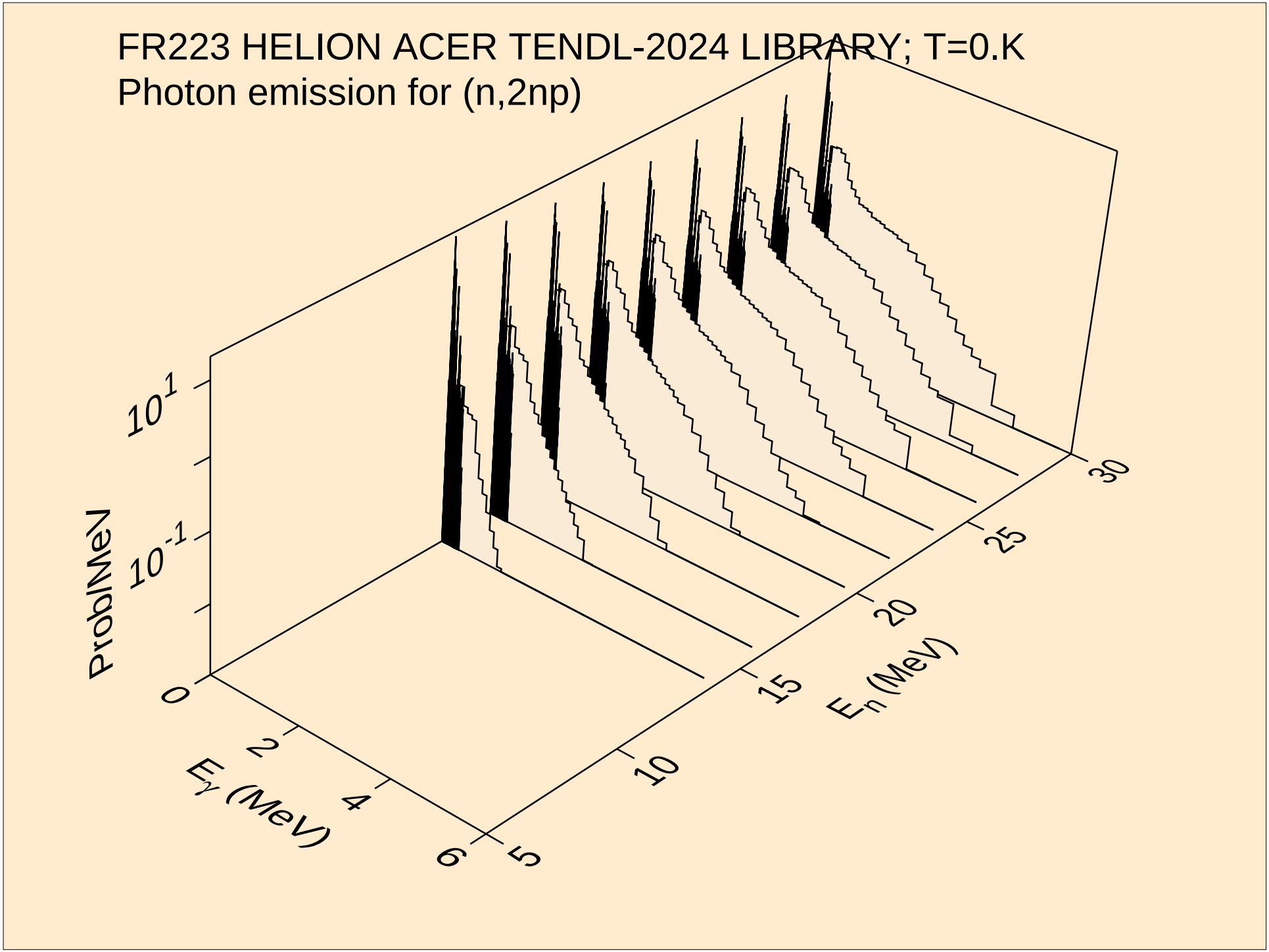

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,n*)2a
Prob/MeV
10^{1}
10^{-1}
0
2
4
6
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

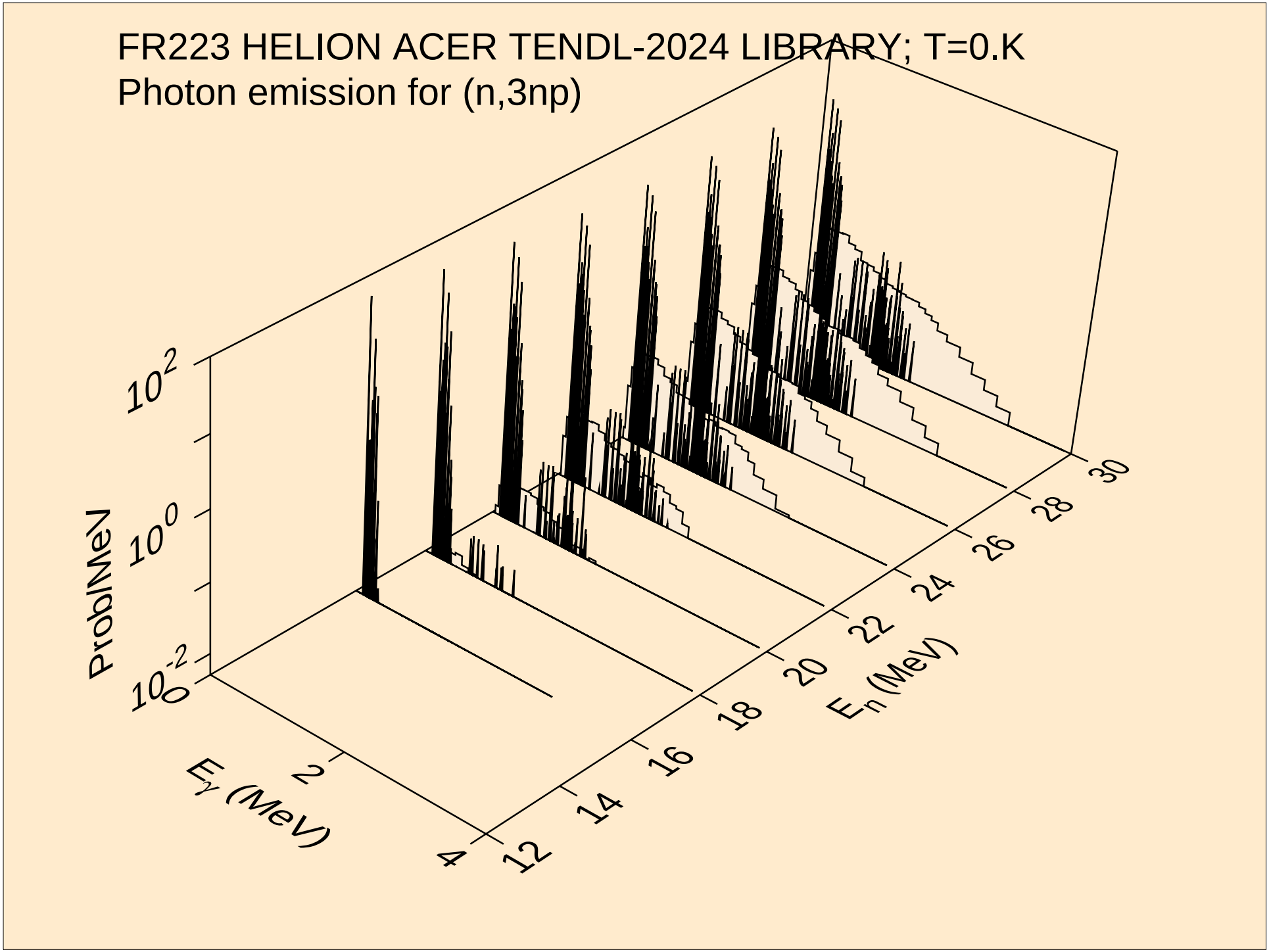

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,n*)d
Prob/MeV
10^{1}
10^{-1}
0
2
4
6
E_γ (MeV)
5
10
15
20
25
30
E_n (MeV)

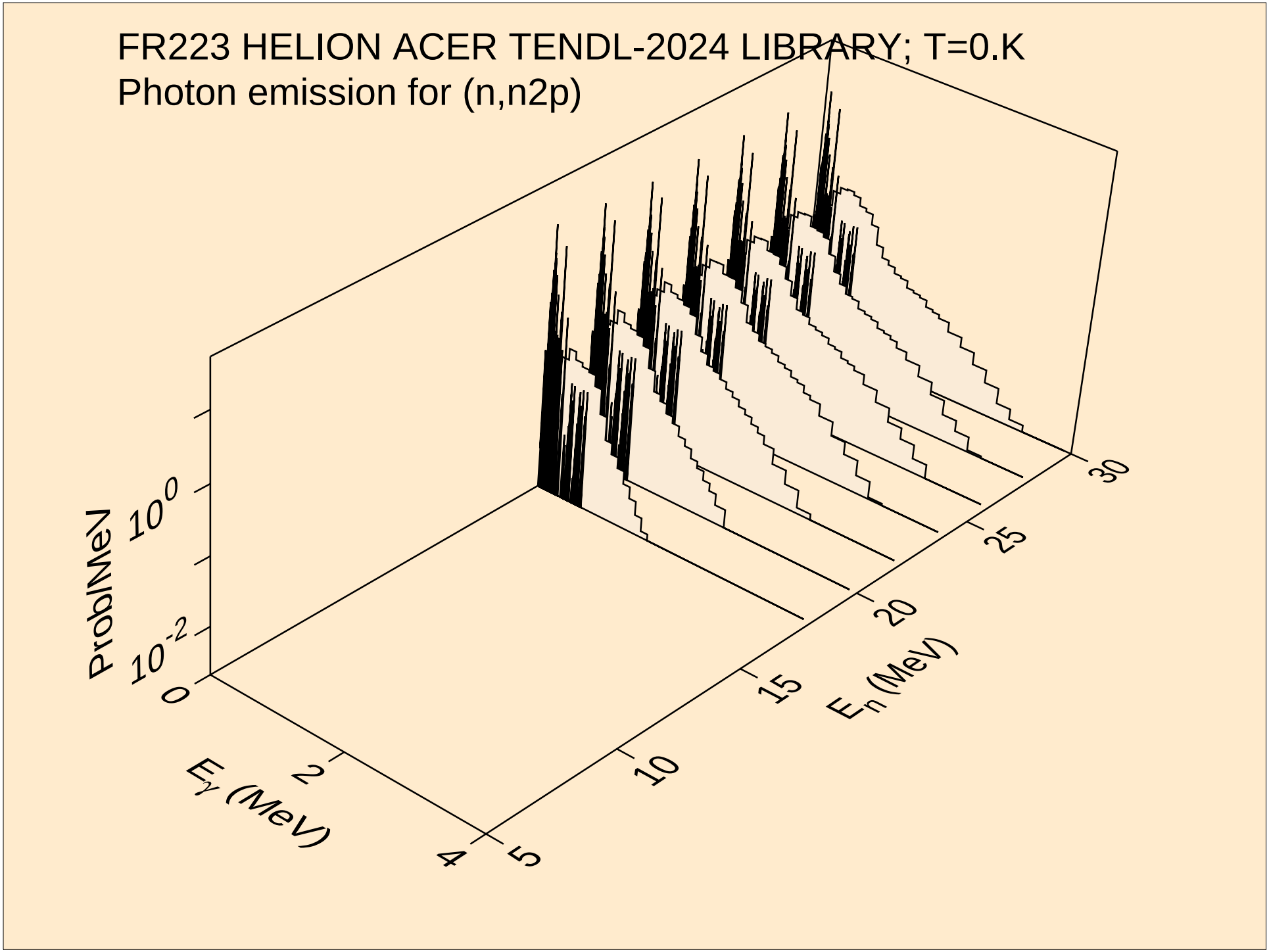

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,n*)t
Prob/MeV
10^0
10^-2
0
2
4
6
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

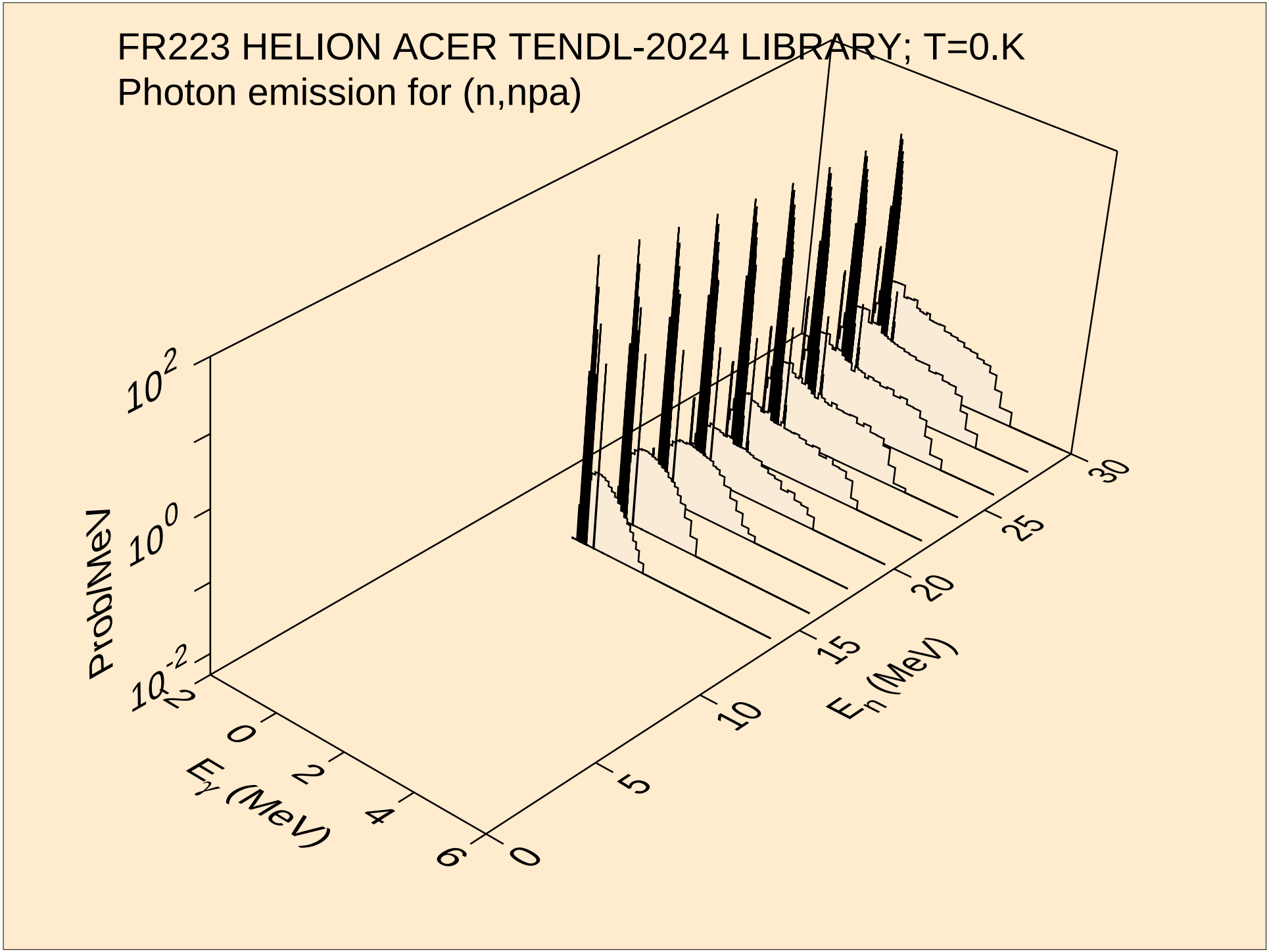

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,n*)he3
Prob/MeV
10^{0}
10^{-2}
-2
0
2
4
E_γ (MeV)
5
10
15
20
25
30
E_n (MeV)

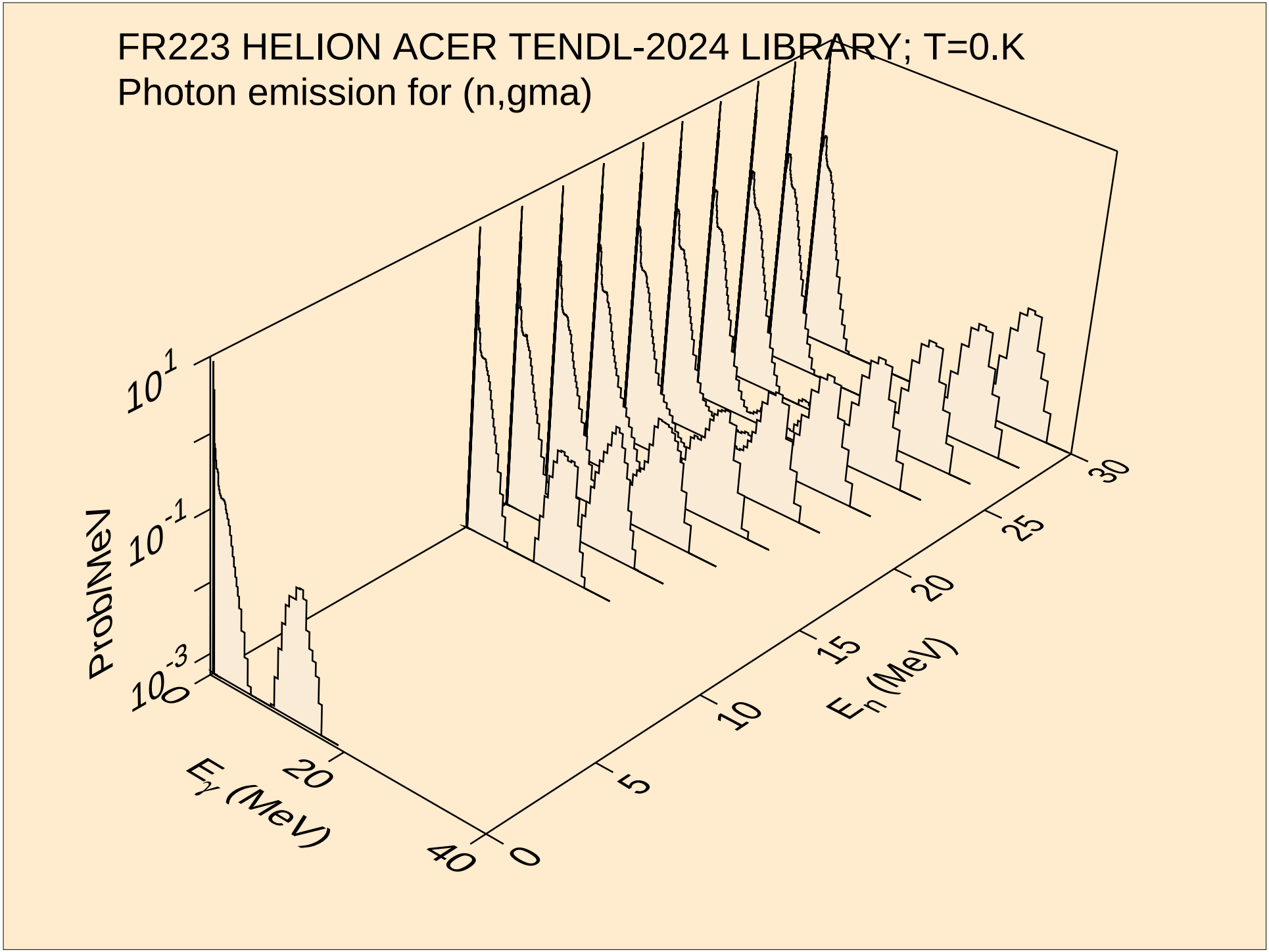

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,4n)
Prob/MeV
10^{0}
10^{-2}
-2
0
2
4
6
E_γ (MeV)
14
16
18
20
22
24
26
28
30
E_n (MeV)

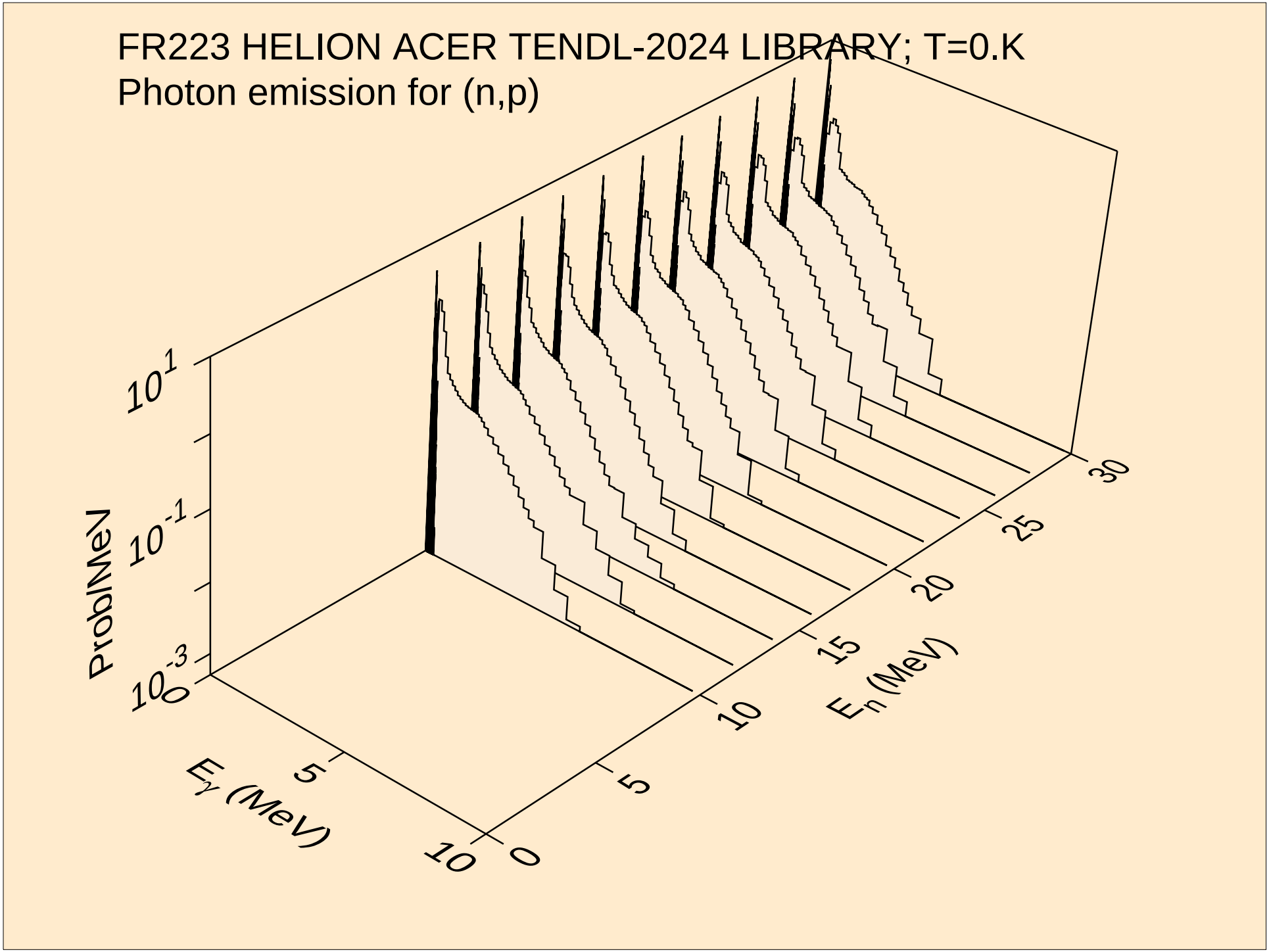

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,2np)
Prob/MeV
10^{1}
10^{-1}
0
2
4
6
E_γ (MeV)
5
10
15
20
25
30
E_n (MeV)

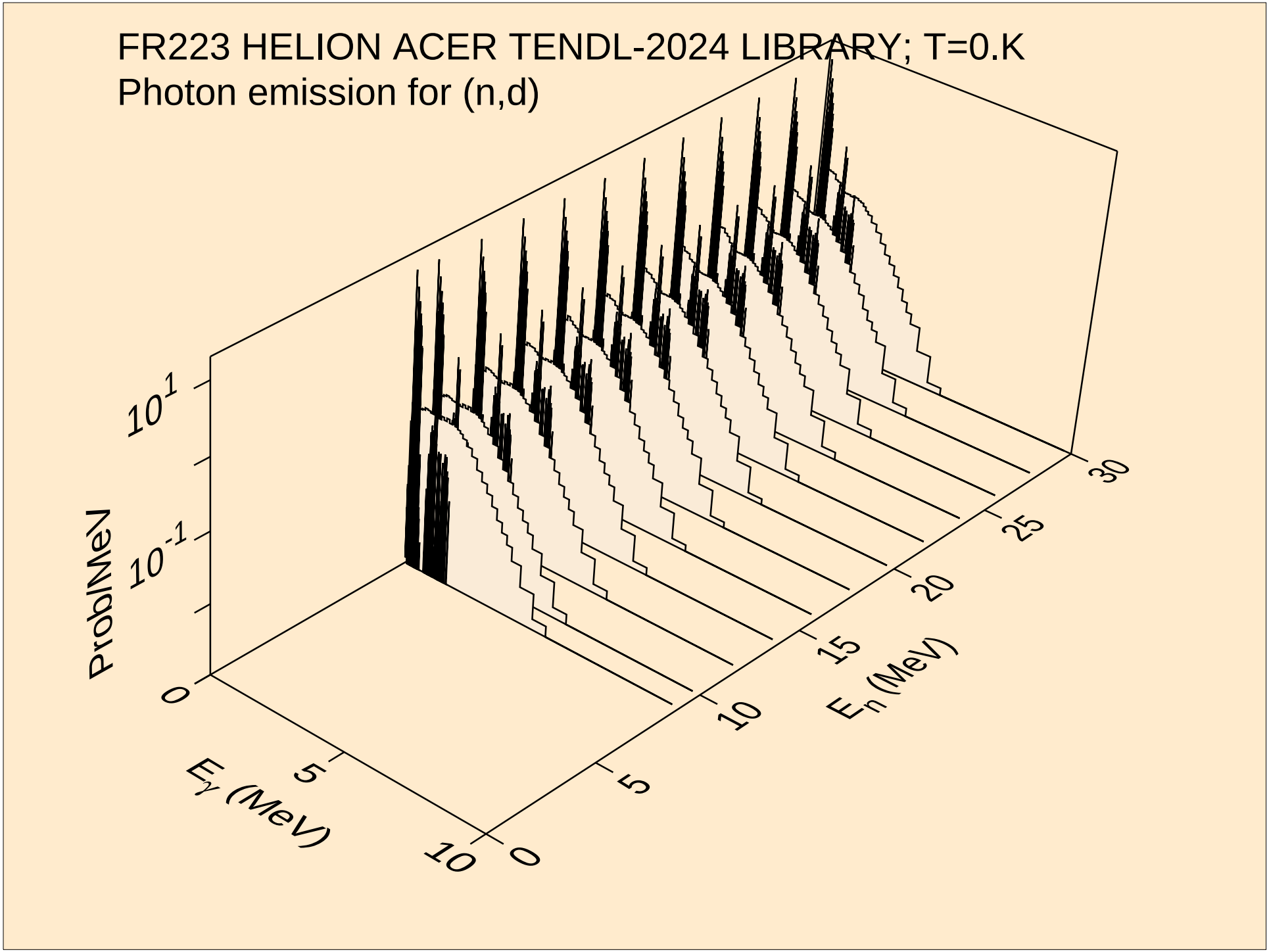

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,3np)
Prob/MeV
10^{2}
10^{0}
10^{-2}
0
2
4
E_γ (MeV)
12
14
16
18
20
22
24
26
28
30
E_n (MeV)

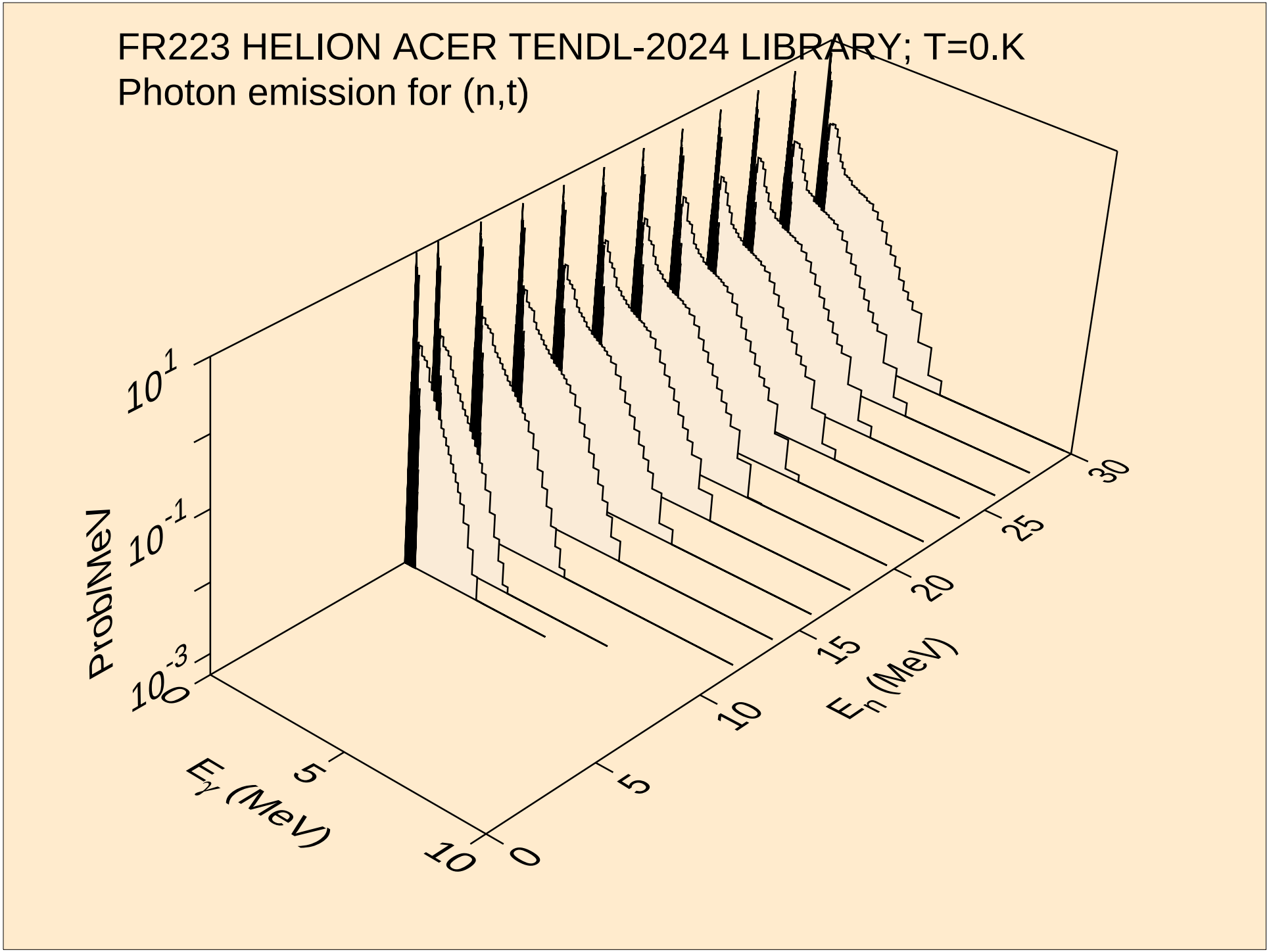

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,n2p)
Prob/MeV
10^0
10^-2
0
2
4
E_γ (MeV)
5
10
15
20
25
30
E_n (MeV)

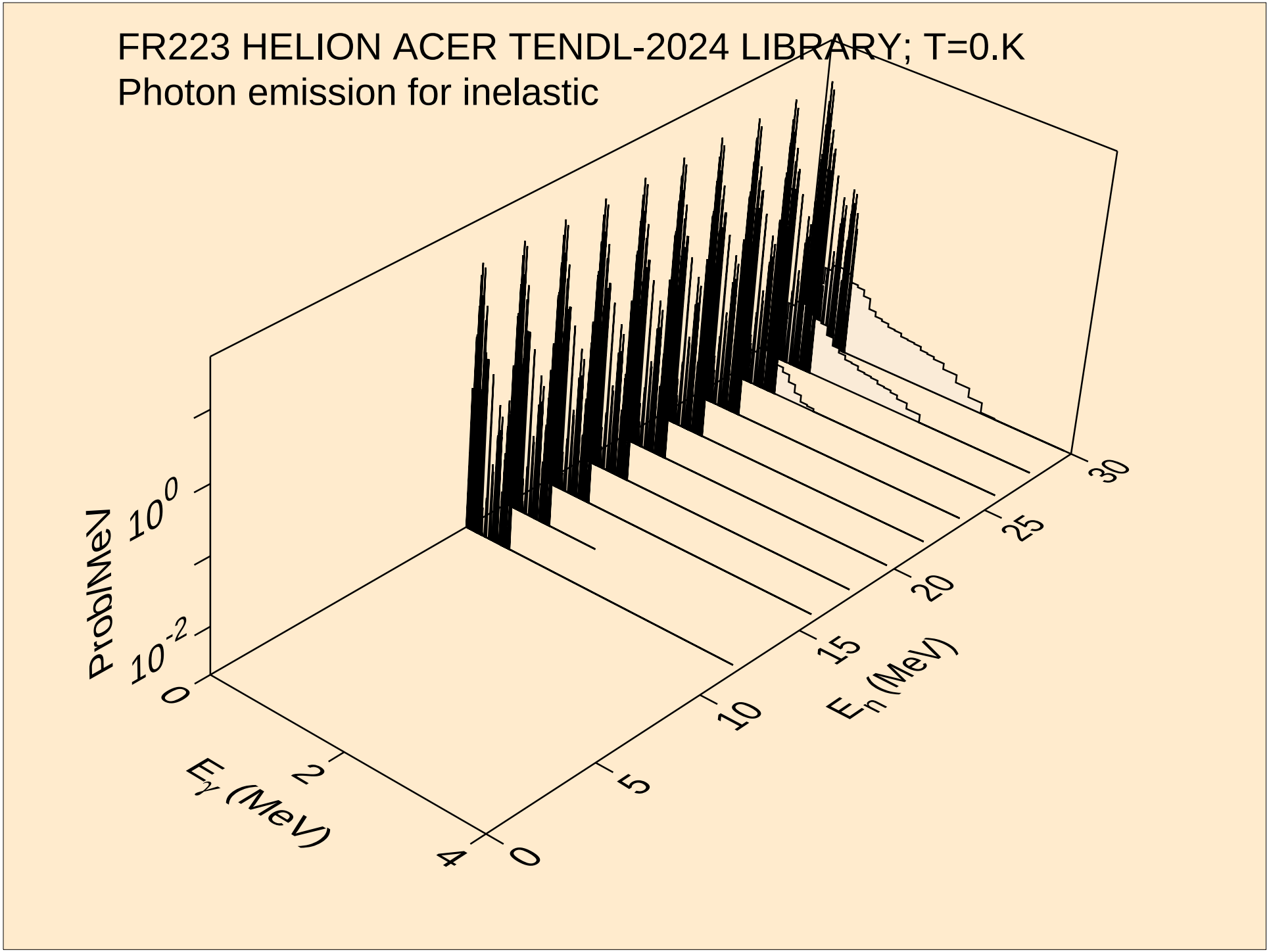

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,npa)
Prob/MeV
10^{2}
10^{0}
10^{-2}
E_γ (MeV)
0
2
4
6
E_n (MeV)
0
5
10
15
20
25
30

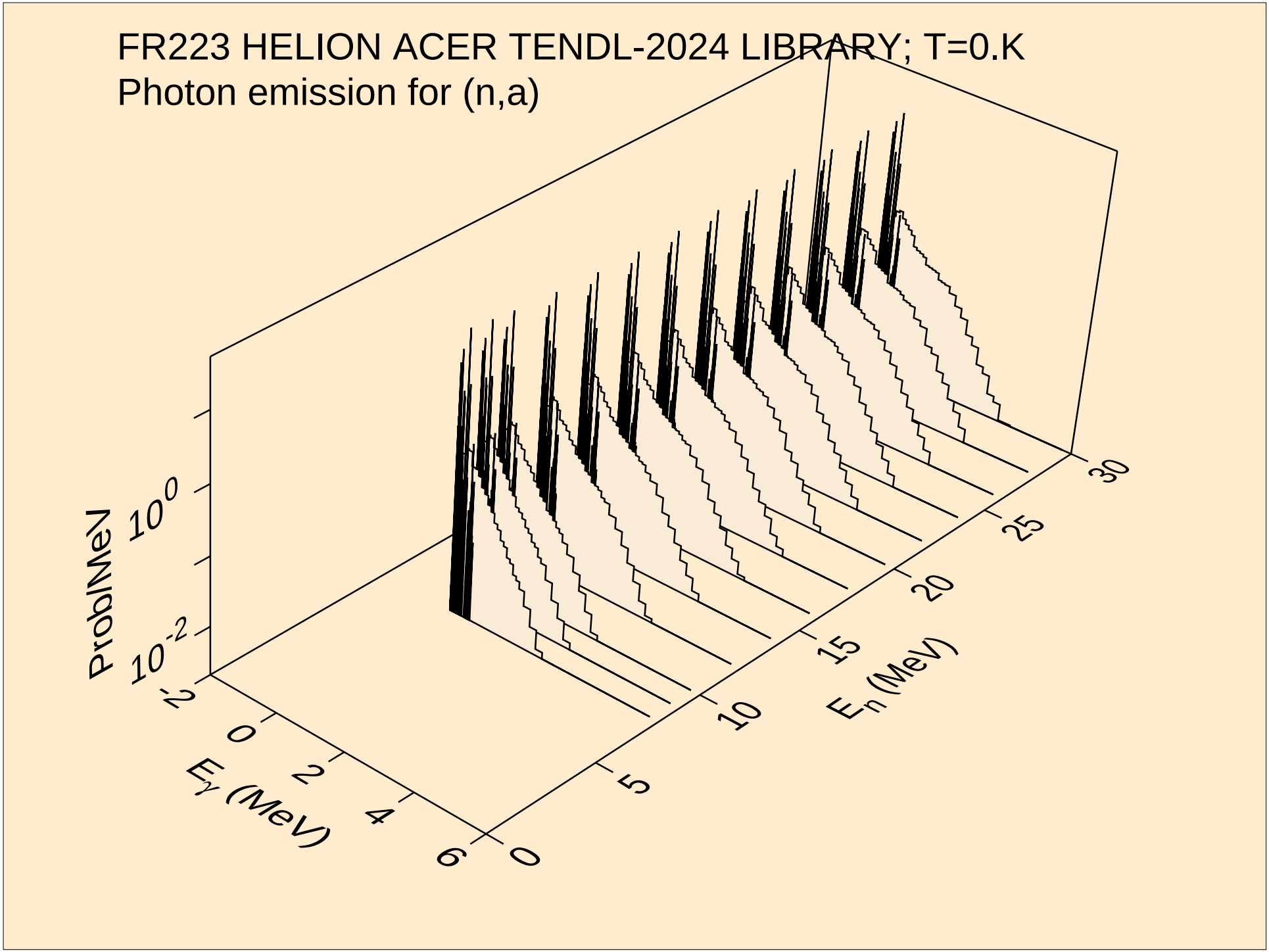

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,gma)
Prob/MeV
10^{1}
10^{-1}
10^{-3}
0
20
40
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

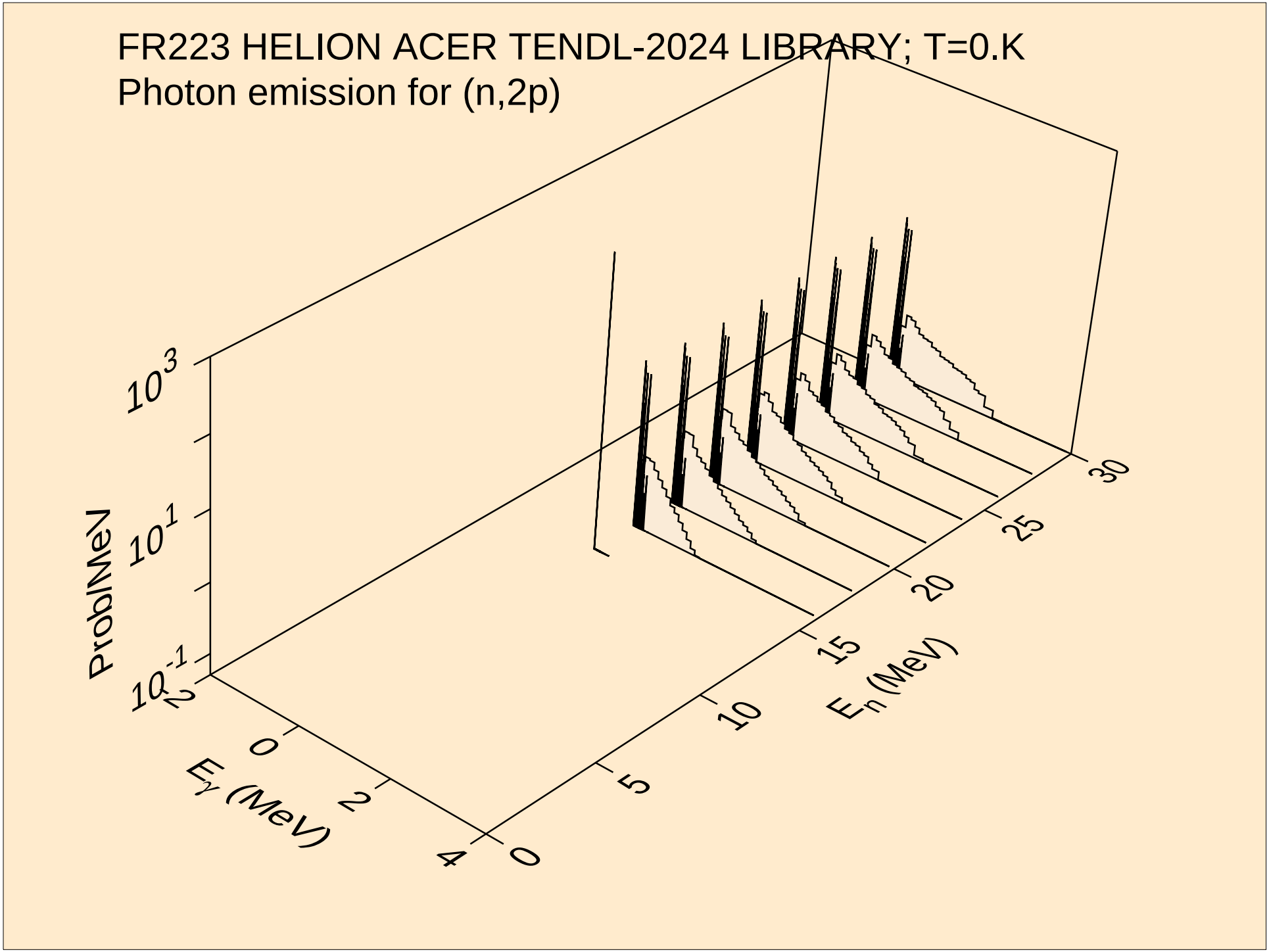

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,p)
Prob/MeV
10^{1}
10^{-1}
10^{-3}
E_γ (MeV)
0
5
10
E_n (MeV)
0
5
10
15
20
25
30

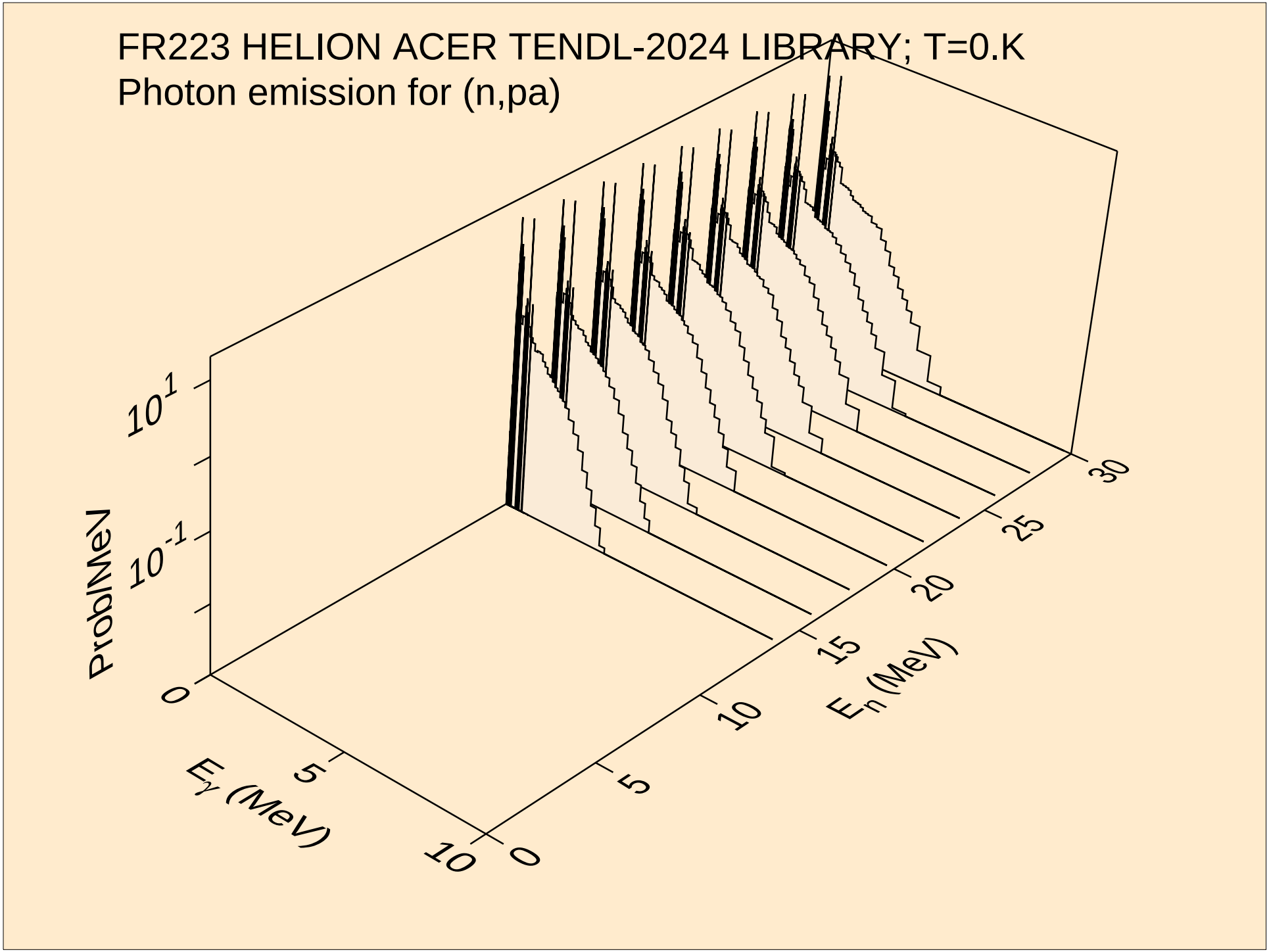

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,d)
Prob/MeV
10^{1}
10^{-1}
0
5
10
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

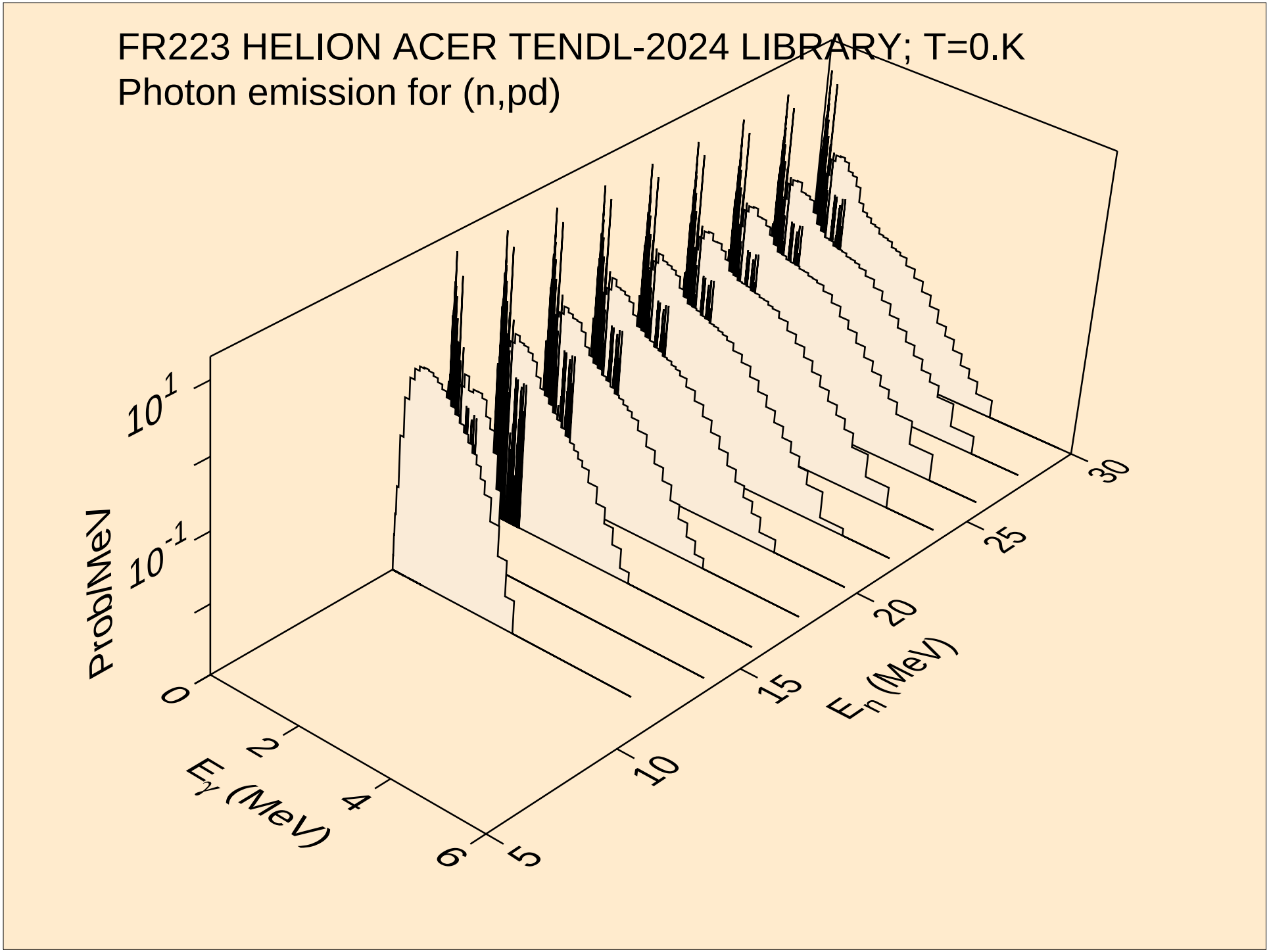

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,t)
Prob/MeV
10^{1}
10^{-1}
10^{-3}
E_γ (MeV)
0
5
10
E_n (MeV)
0
5
10
15
20
25
30

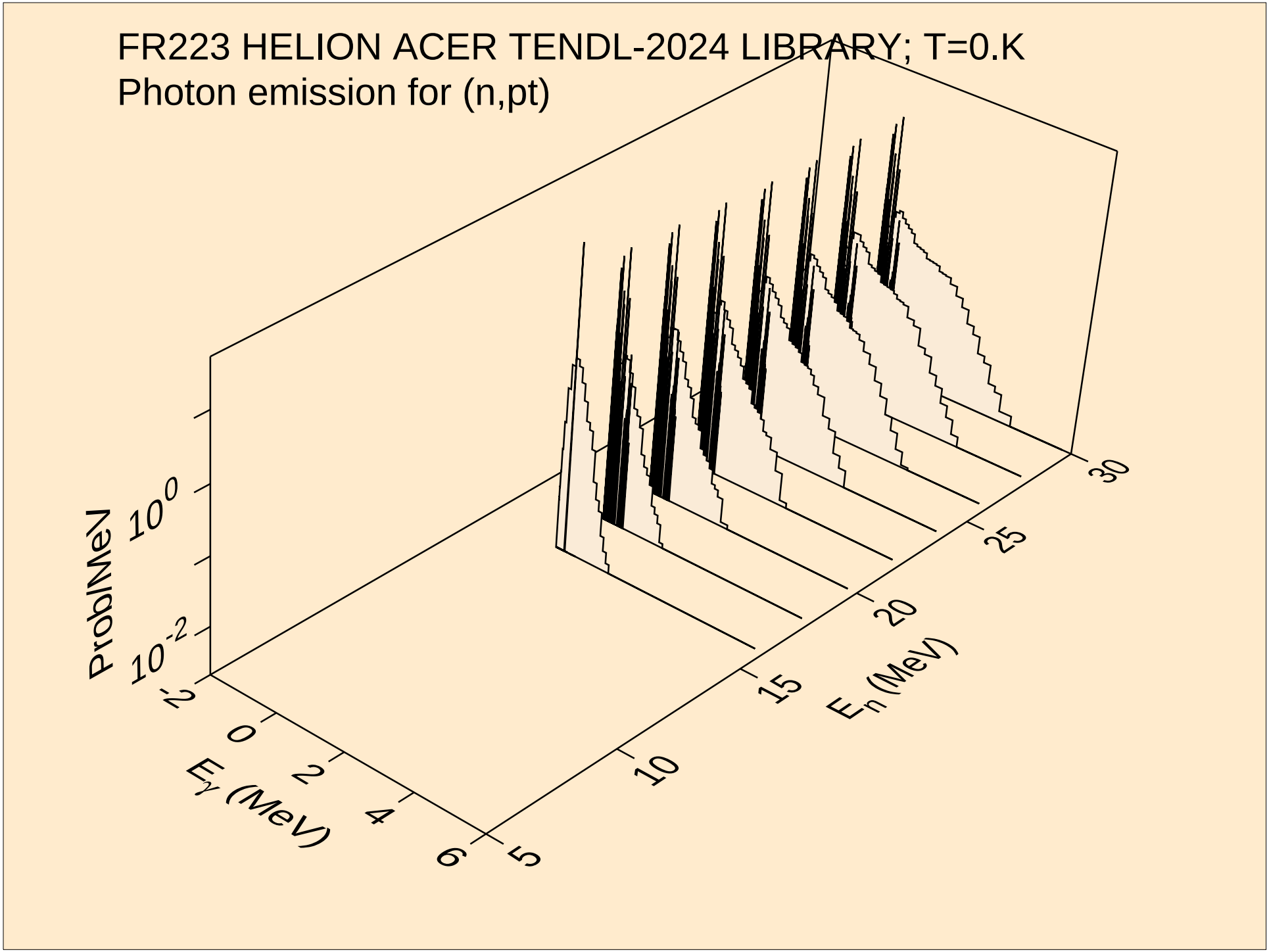

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for inelastic
Prob/MeV
10^{0}
10^{-2}
0
E_γ (MeV)
2
4
0
5
10
15
20
25
30
E_n (MeV)

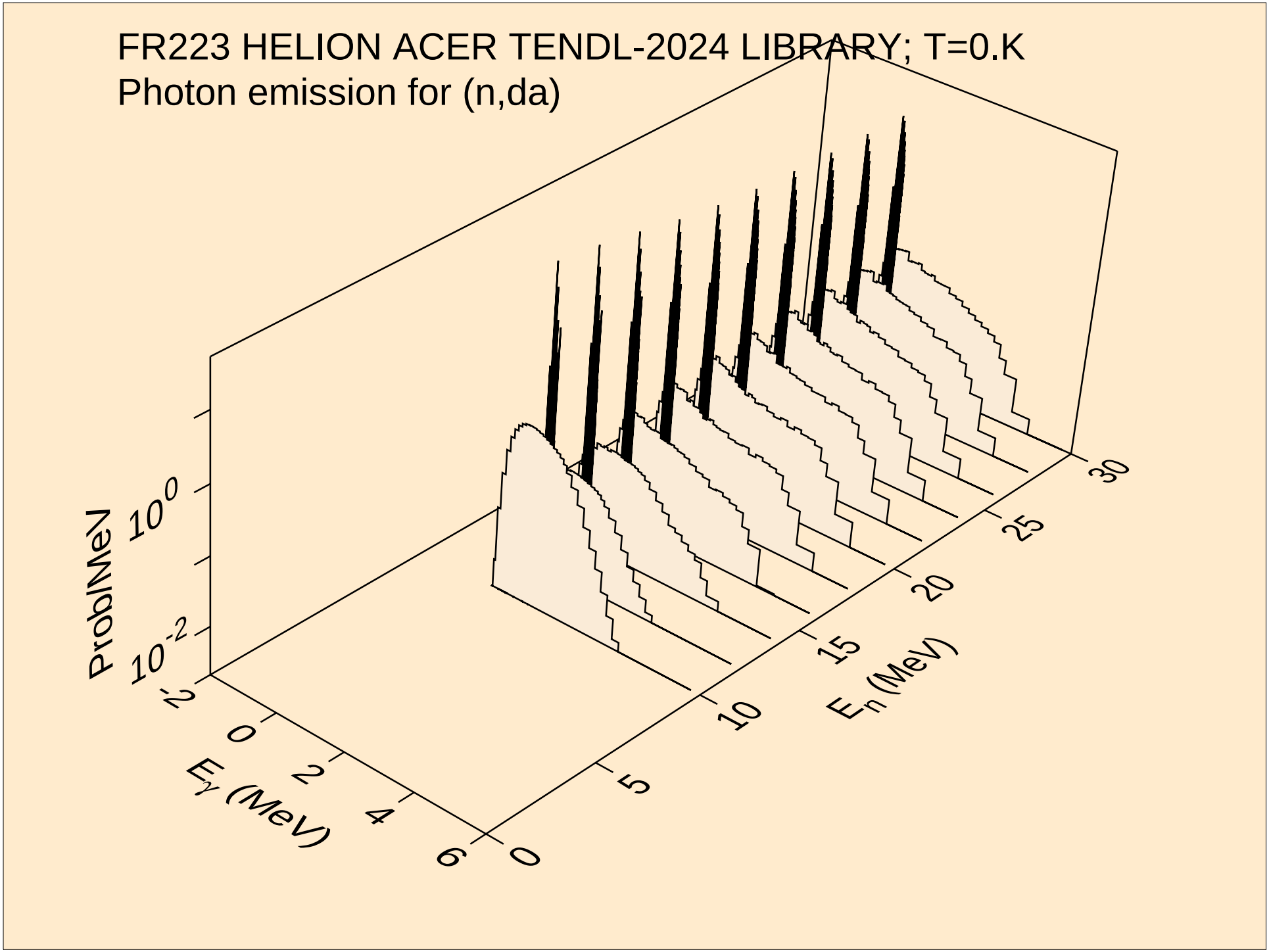

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,a)
Prob/MeV
10^0
10^-2
-2
0
2
4
6
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

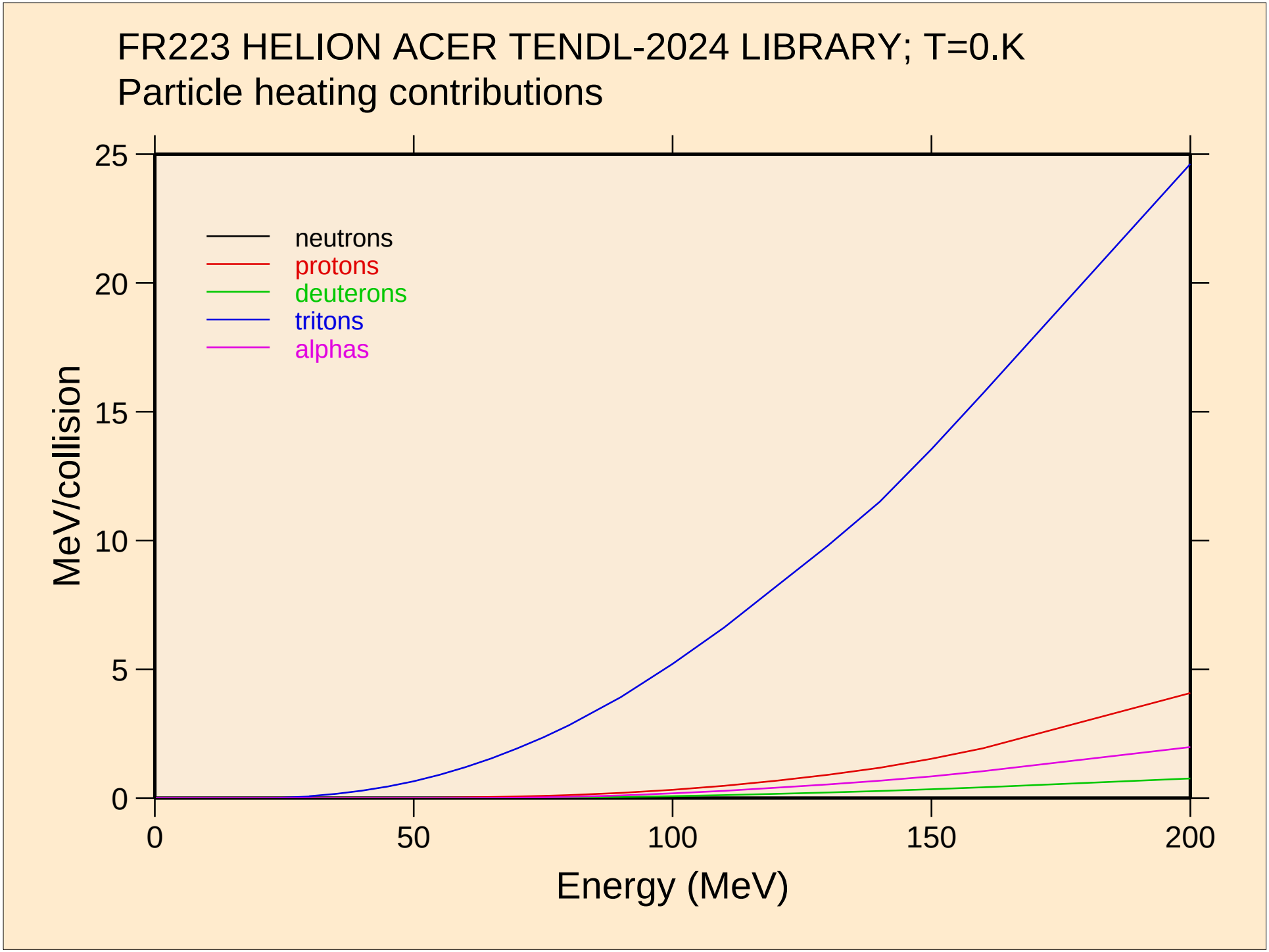

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,2p)
Prob/MeV
10^{3}
10^{1}
10^{-1}
E_γ (MeV)
-2
0
2
4
E_n (MeV)
0
5
10
15
20
25
30

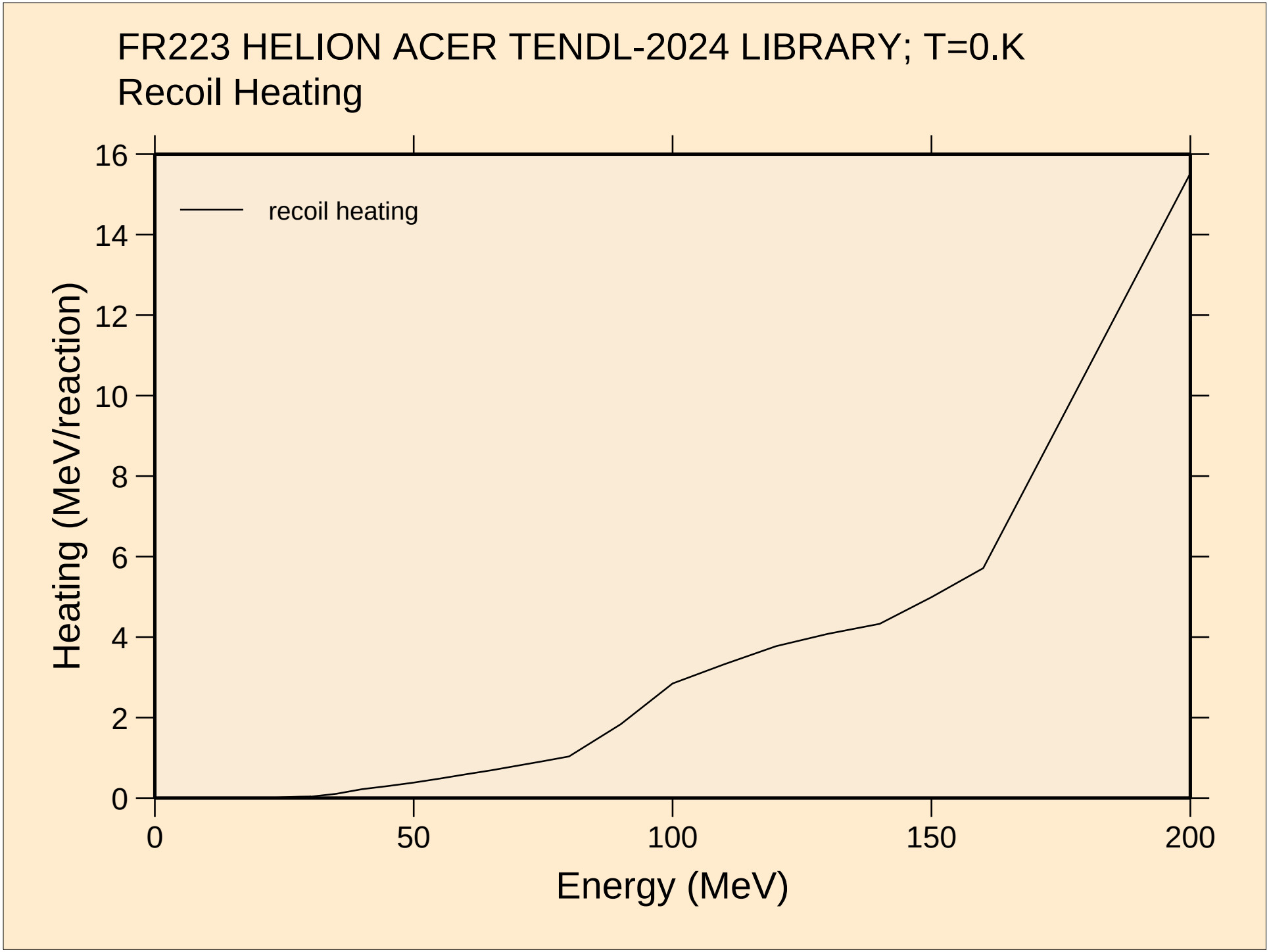

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,pa)
Prob/MeV
10^{1}
10^{-1}
0
5
10
E_γ (MeV)
0
5
10
15
20
25
30
E_n (MeV)

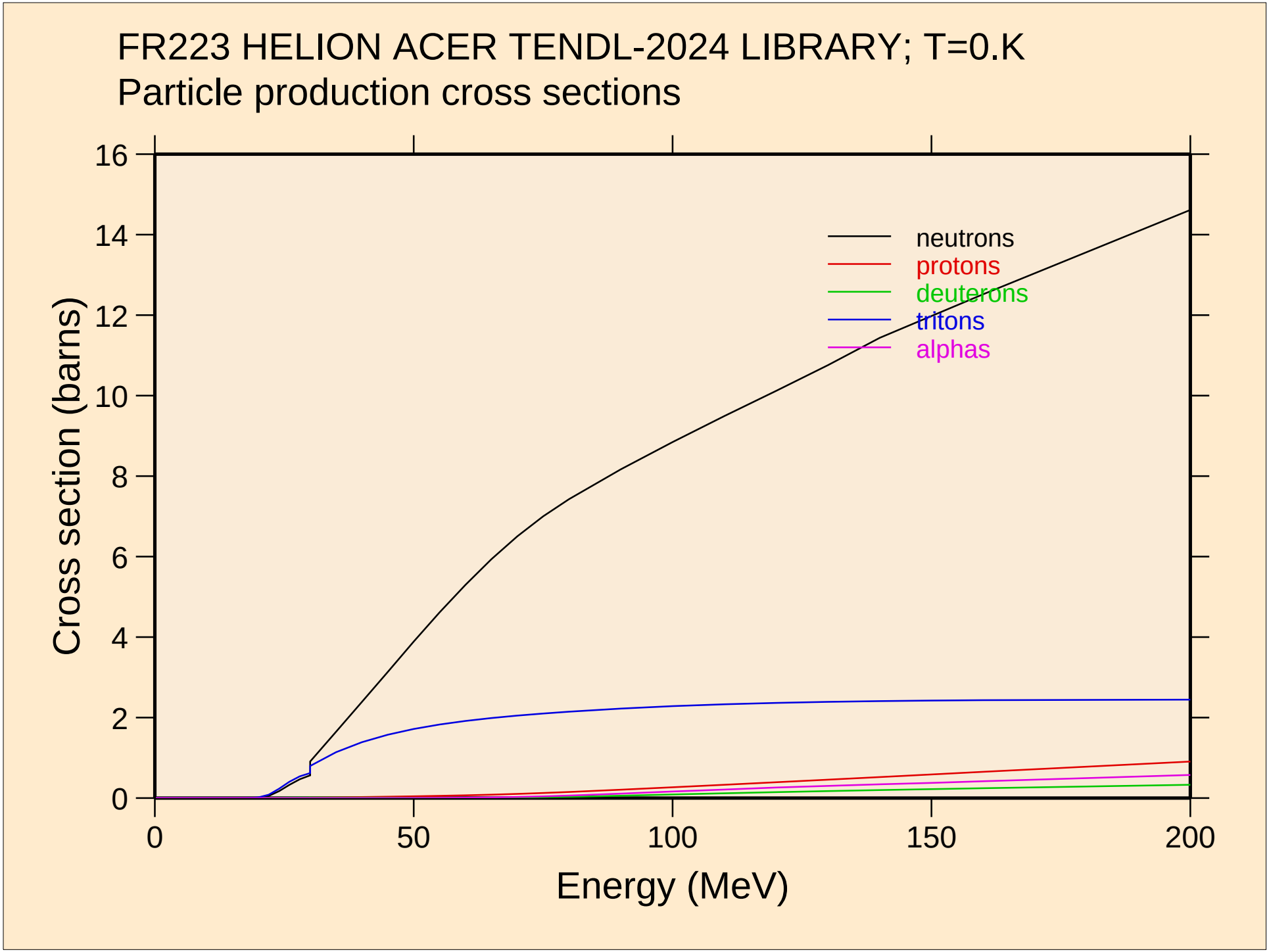

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,pd)
Prob/MeV
10^{1}
10^{-1}
0
2
4
6
E_γ (MeV)
5
10
15
20
25
30
E_n (MeV)

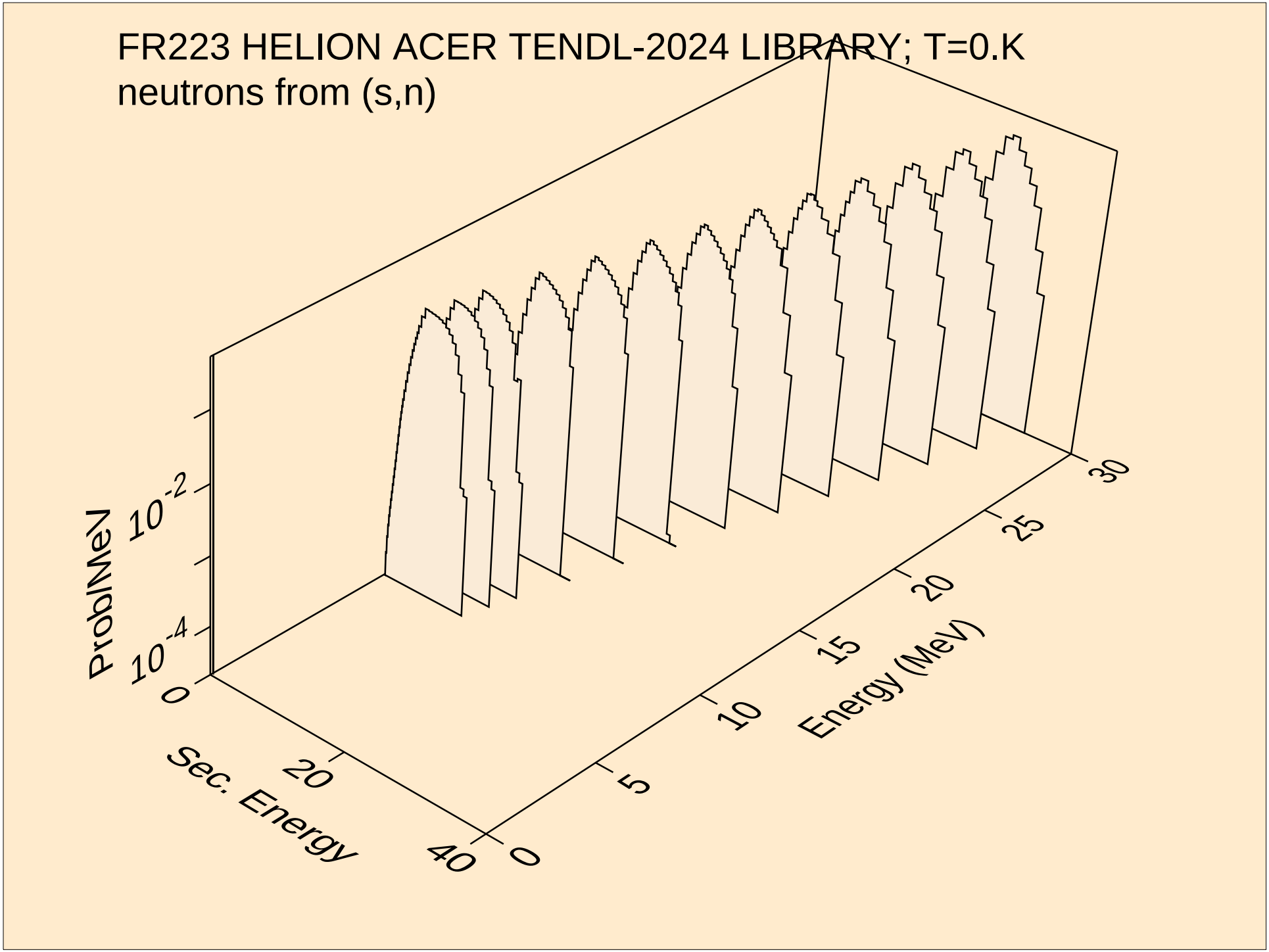

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,pt)
Prob/MeV
10^{0}
10^{-2}
-2
0
2
4
6
E_γ (MeV)
5
10
15
20
25
30
E_n (MeV)

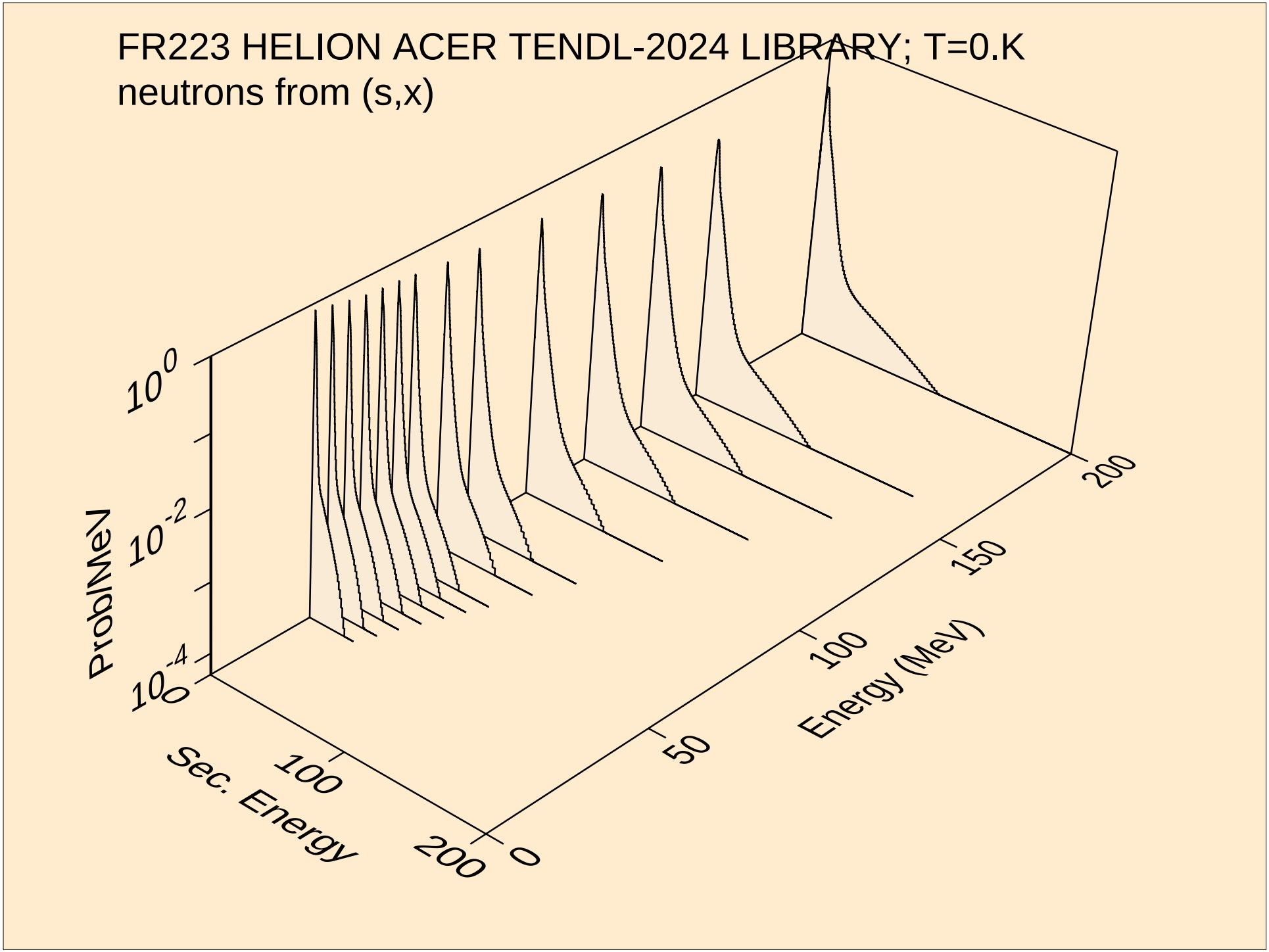

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Photon emission for (n,da)
Prob/MeV
10^{0}
10^{-2}
E_γ (MeV)
-2
0
2
4
6
E_n (MeV)
0
5
10
15
20
25
30

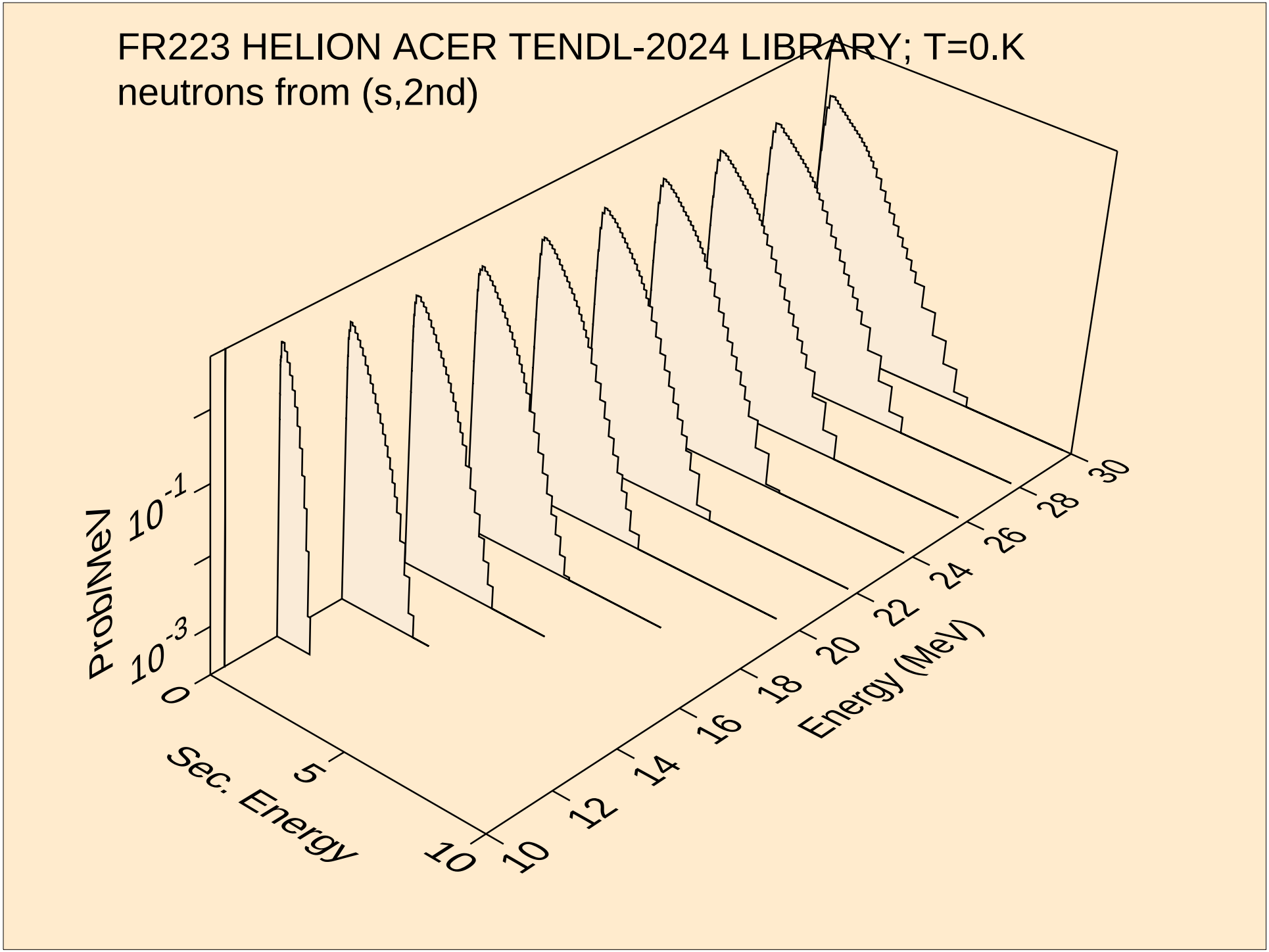

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Particle heating contributions
neutrons
protons
deuterons
tritons
alphas
MeV/collision
Energy (MeV)
0
5
10
15
20
25
0
50
100
150
200

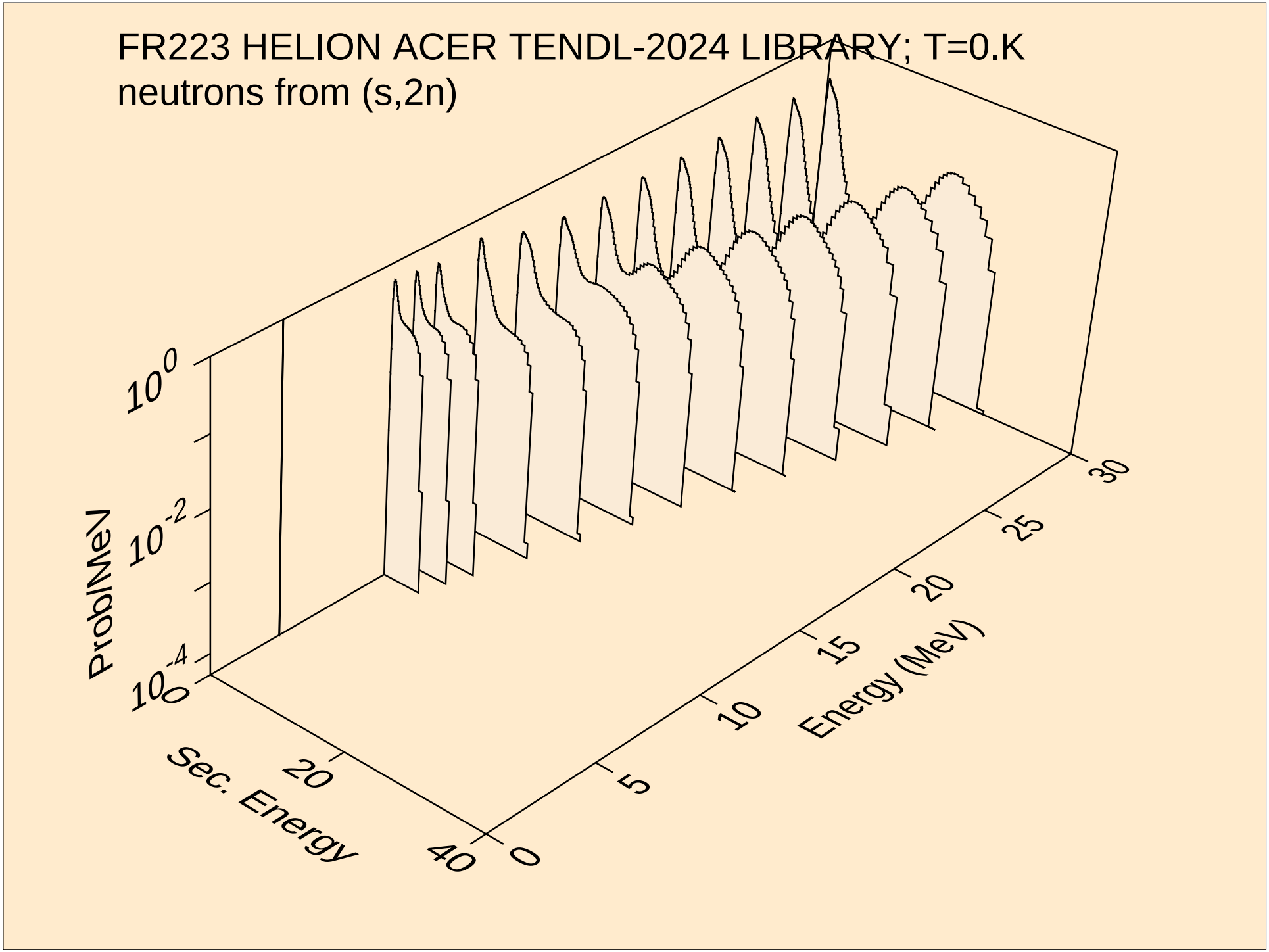

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Recoil Heating
recoil heating
Heating (MeV/reaction)
Energy (MeV)
0
2
4
6
8
10
12
14
16
0
50
100
150
200

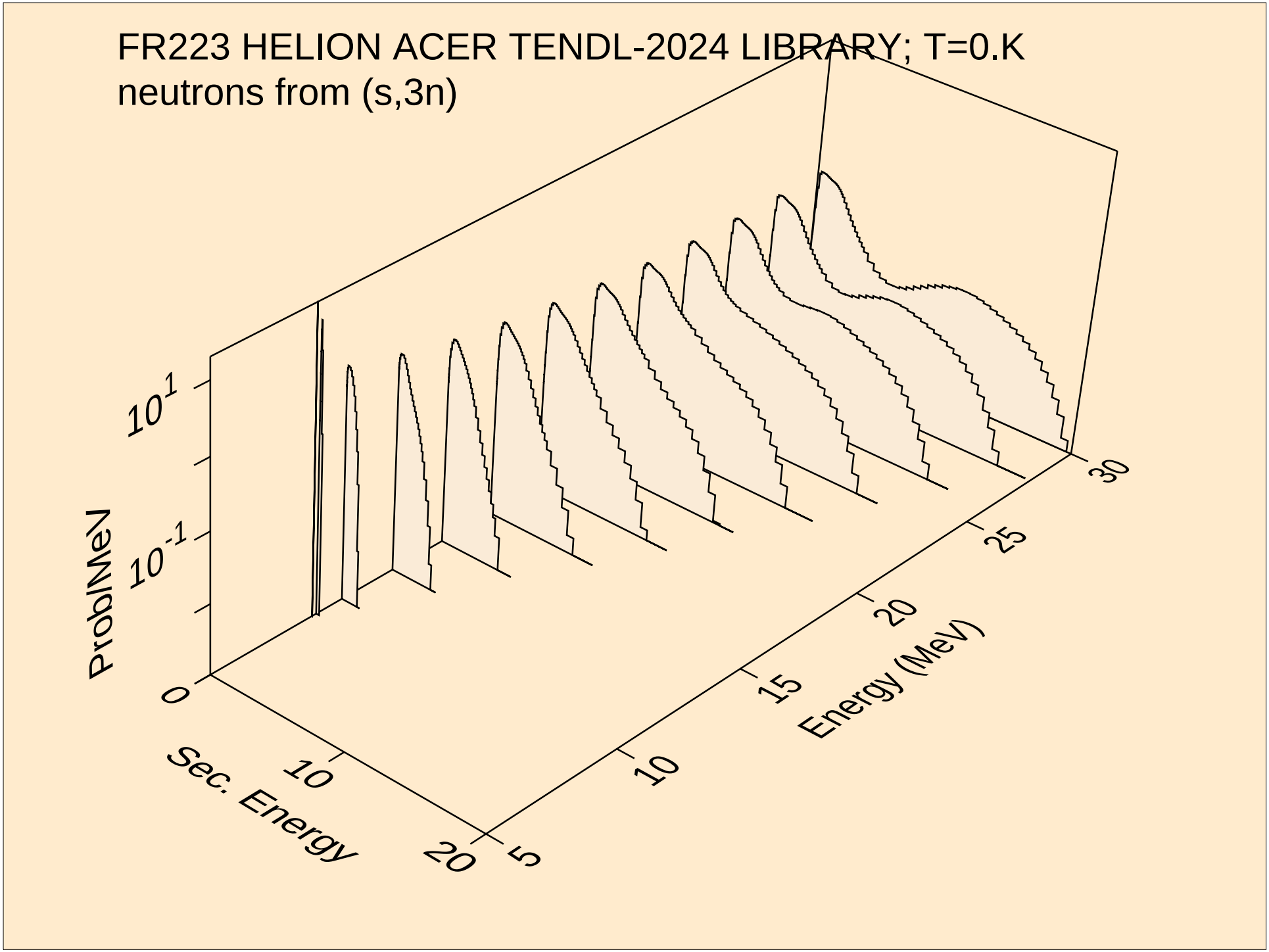

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
Particle production cross sections
Cross section (barns)
Energy (MeV)
0
2
4
6
8
10
12
14
16
0
50
100
150
200
neutrons
protons
deuterons
tritons
alphas

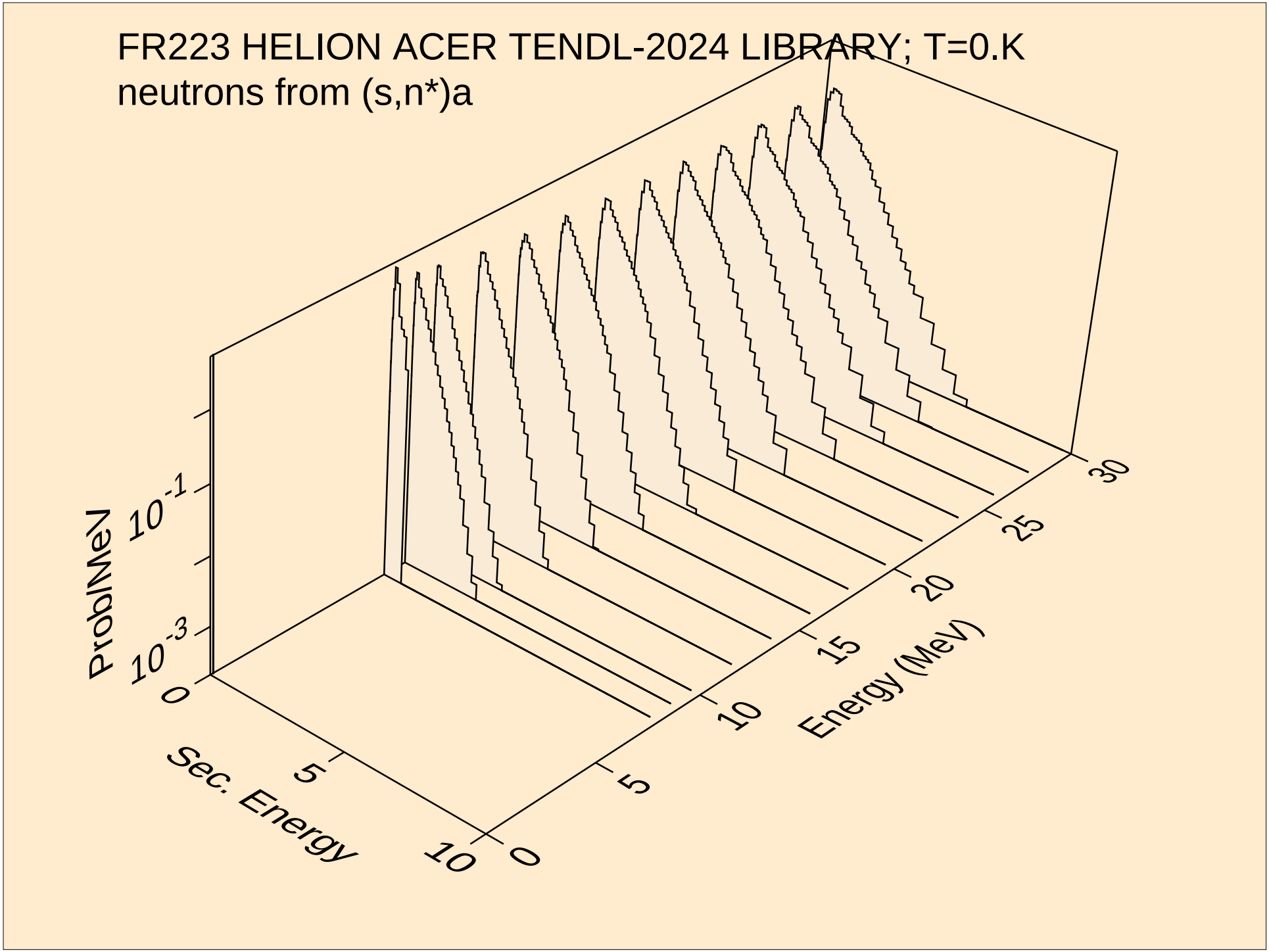

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,n)
Prob/MeV
10-2
10-4
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)

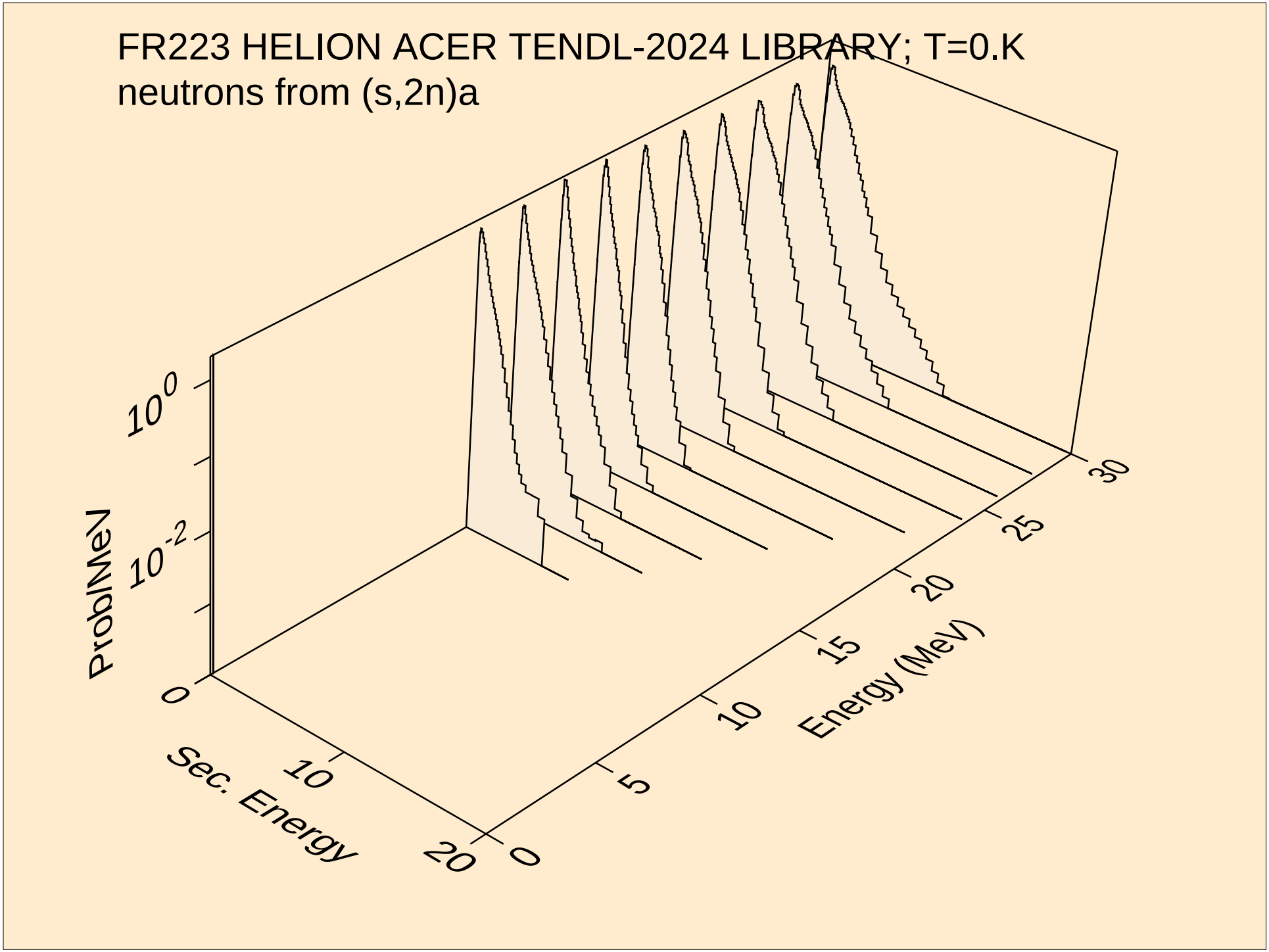

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,x)
Prob/MeV
10^0
10^-2
10^-4
0
100
200
Sec. Energy
0
50
100
150
200
Energy (MeV)

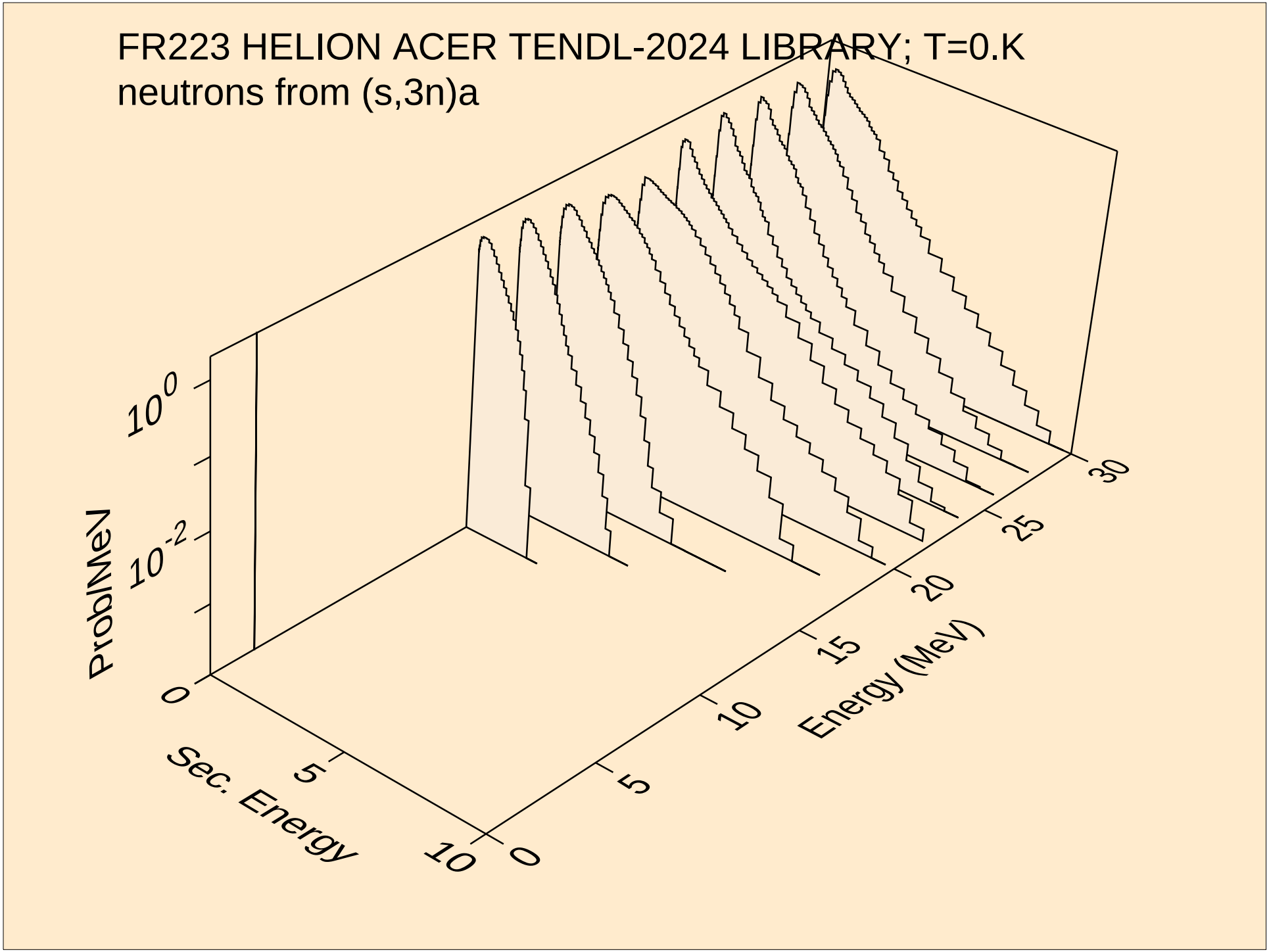

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,2nd)
Prob/MeV
10^-1
10^-3
0
Sec. Energy
5
10
Energy (MeV)
10
12
14
16
18
20
22
24
26
28
30

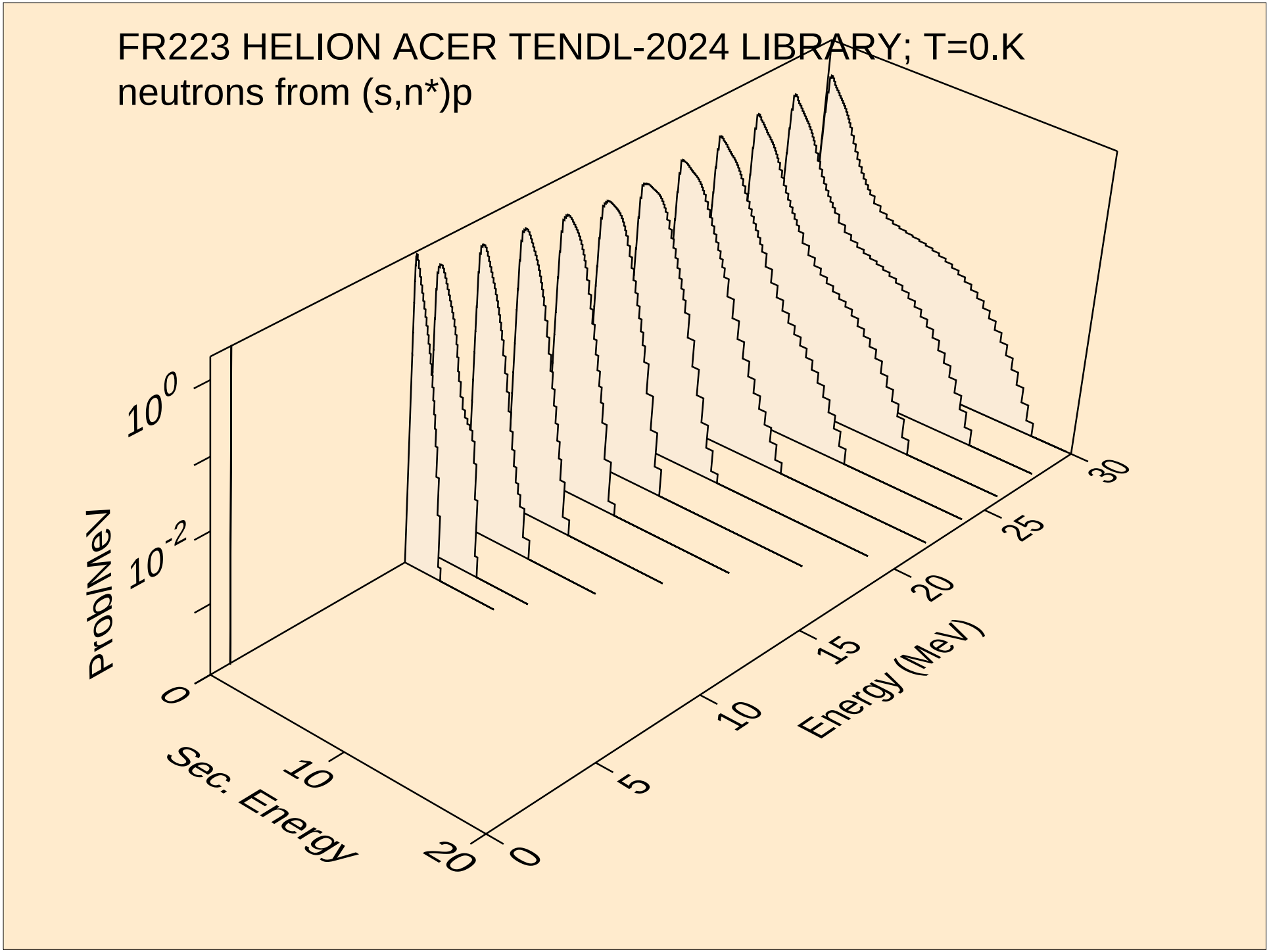

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,2n)
Prob/MeV
10^0
10^-2
10^-4
0
20
40
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)

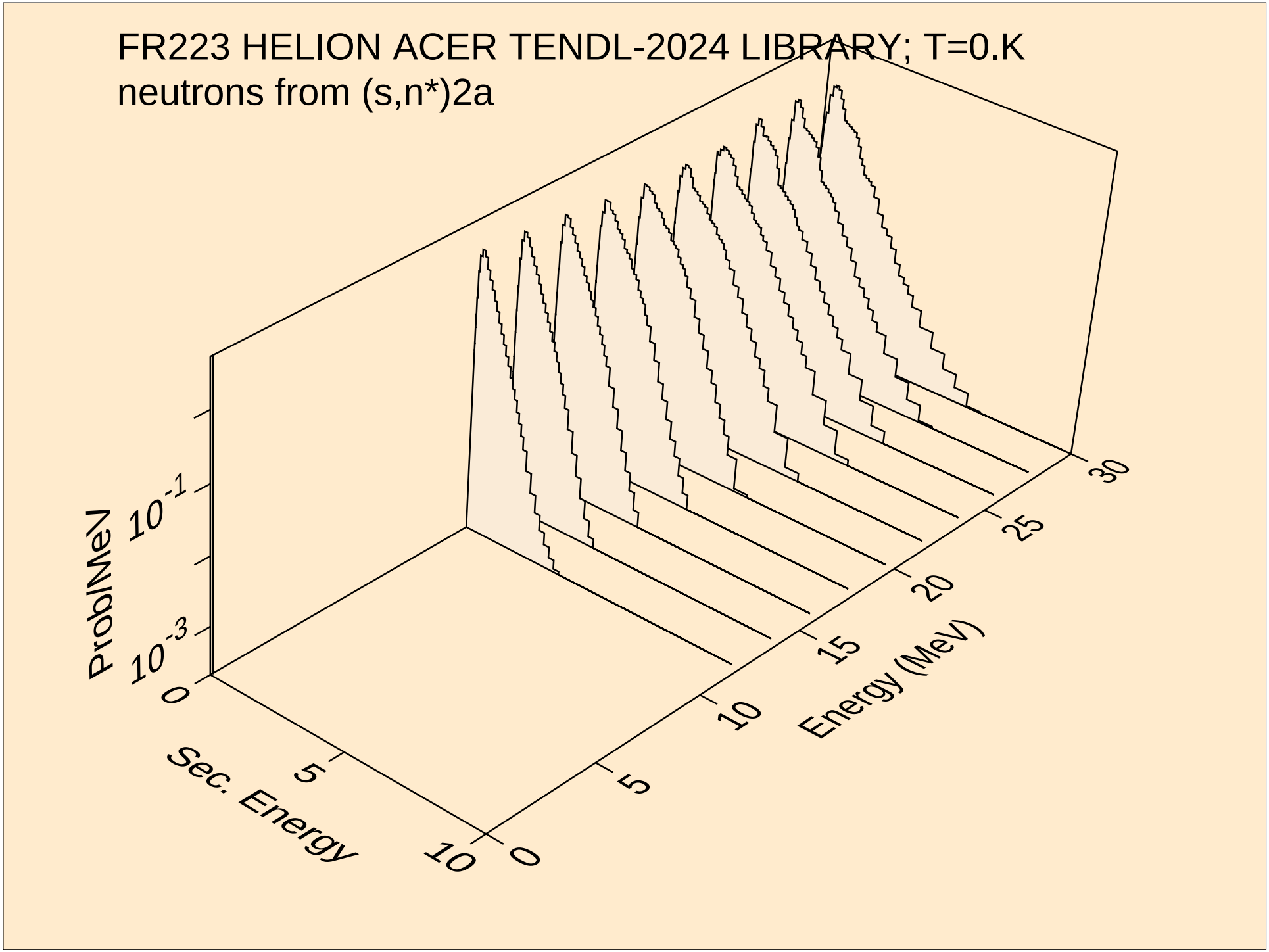

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,3n)
Prob/MeV
10^1
10^-1
0
Sec. Energy
10
20
5
10
15
20
25
30
Energy (MeV)

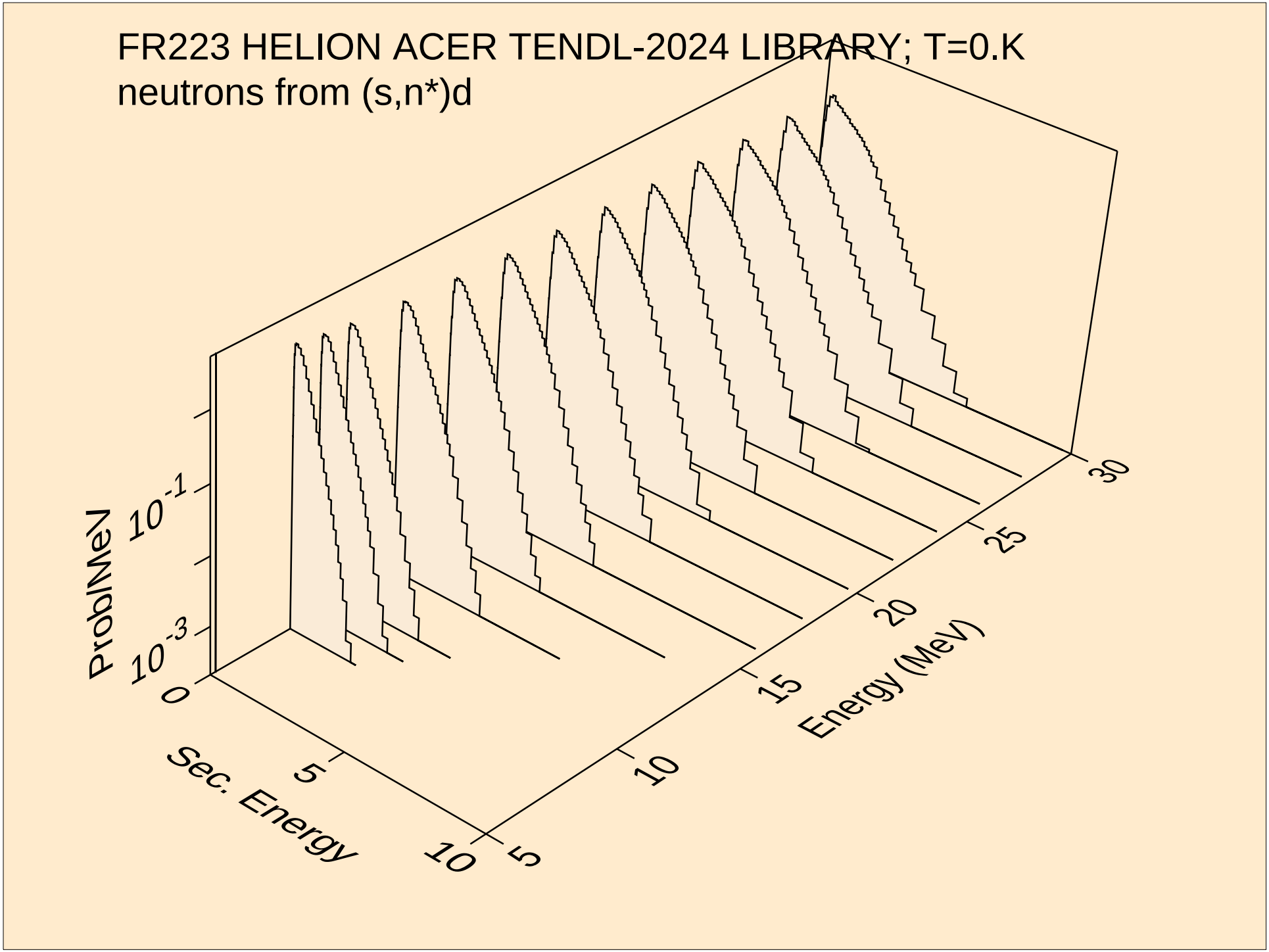

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,n*)a
Prob/MeV
10-1
10-3
0
Sec. Energy
5
10
0
5
10
15
20
25
30
Energy (MeV)

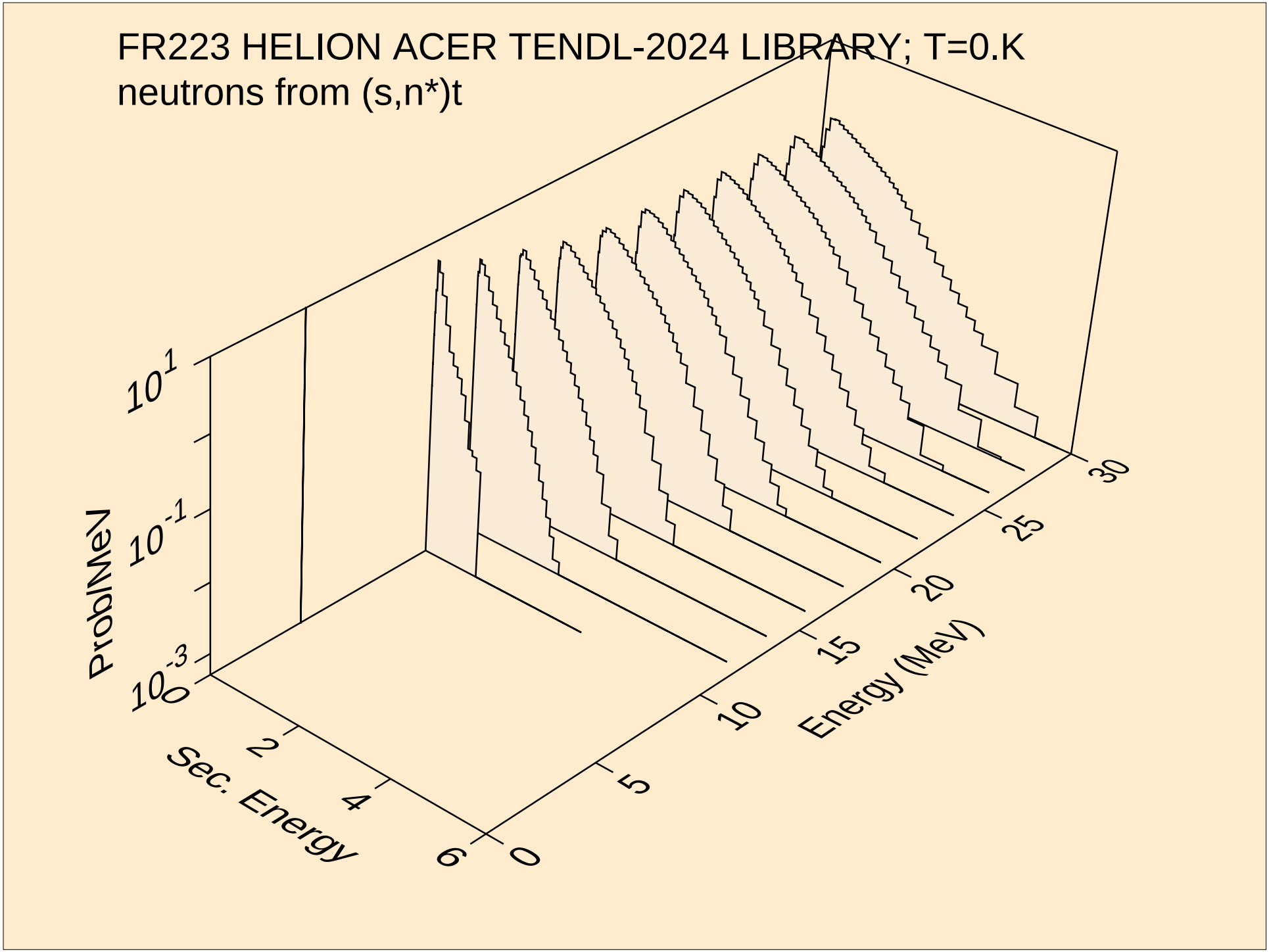

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,2n)a
Prob/MeV
10^0
10^-2
0
Sec. Energy
10
20
0
5
10
15
20
25
30
Energy (MeV)

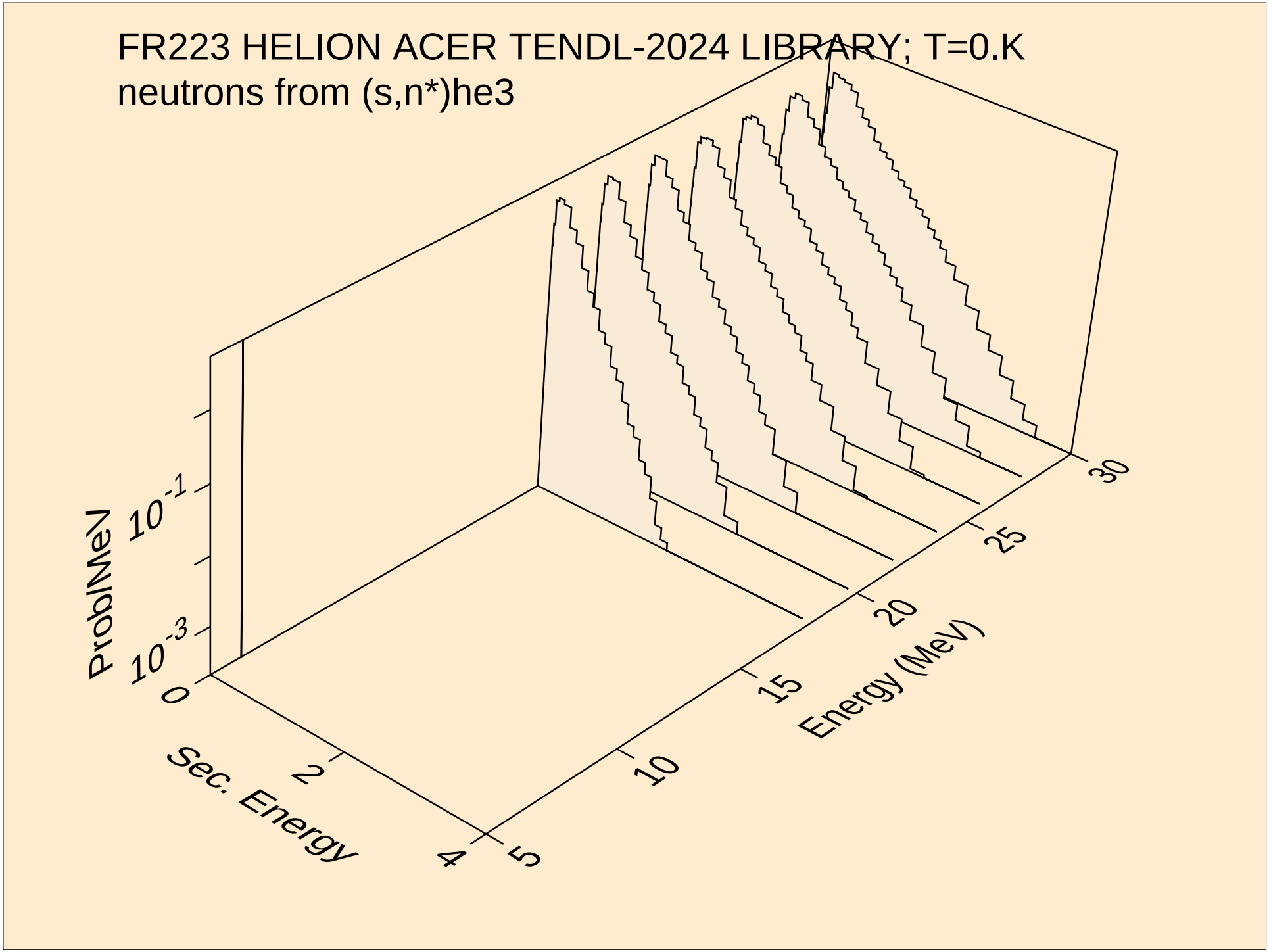

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,3n)a
Prob/MeV
10^0
10^-2
0
Sec. Energy
5
10
0
5
10
15
20
25
30
Energy (MeV)

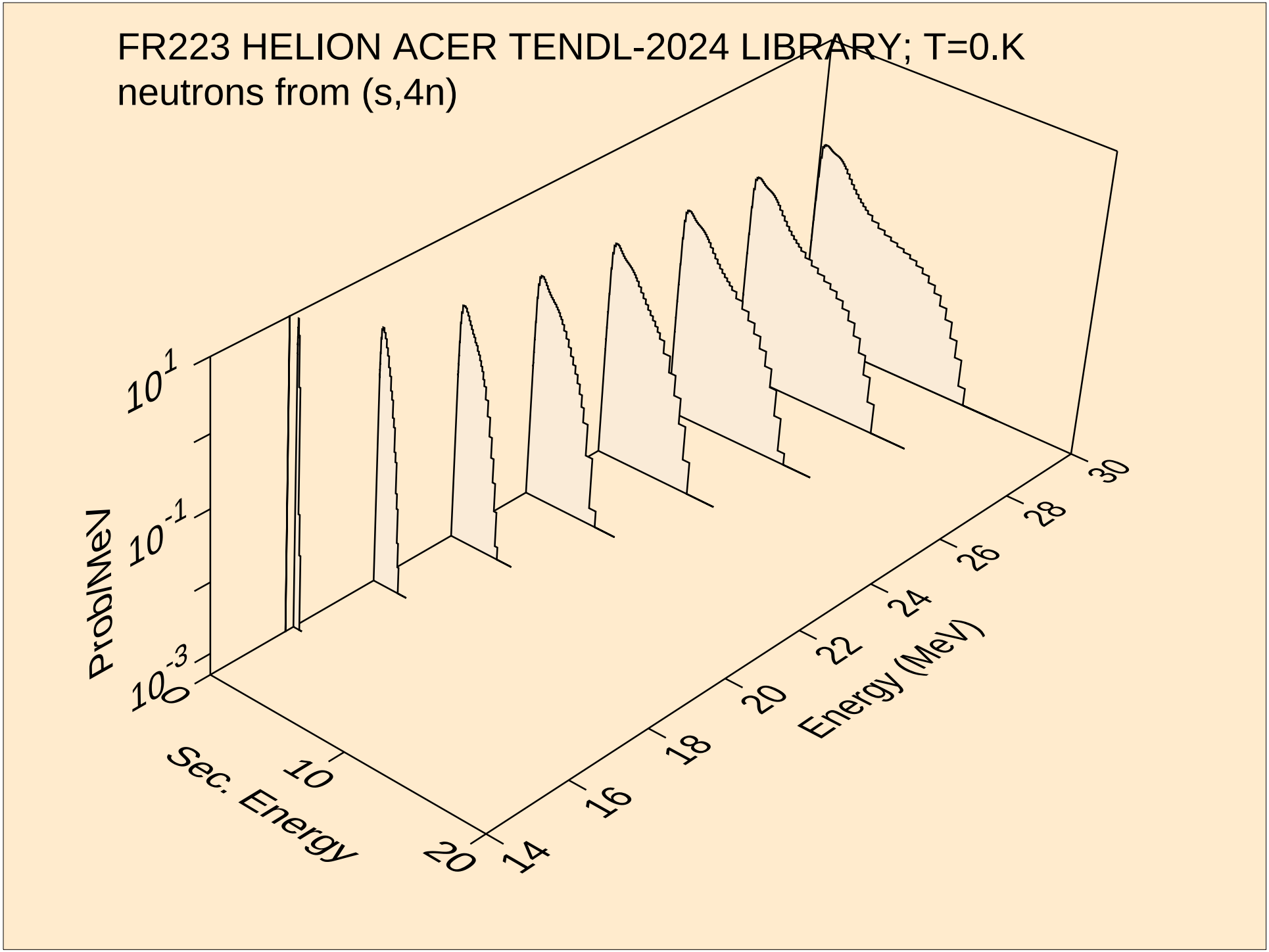

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,n*)p
Prob/MeV
10^0
10^-2
0
Sec. Energy
10
20
0
5
10
15
20
25
30
Energy (MeV)

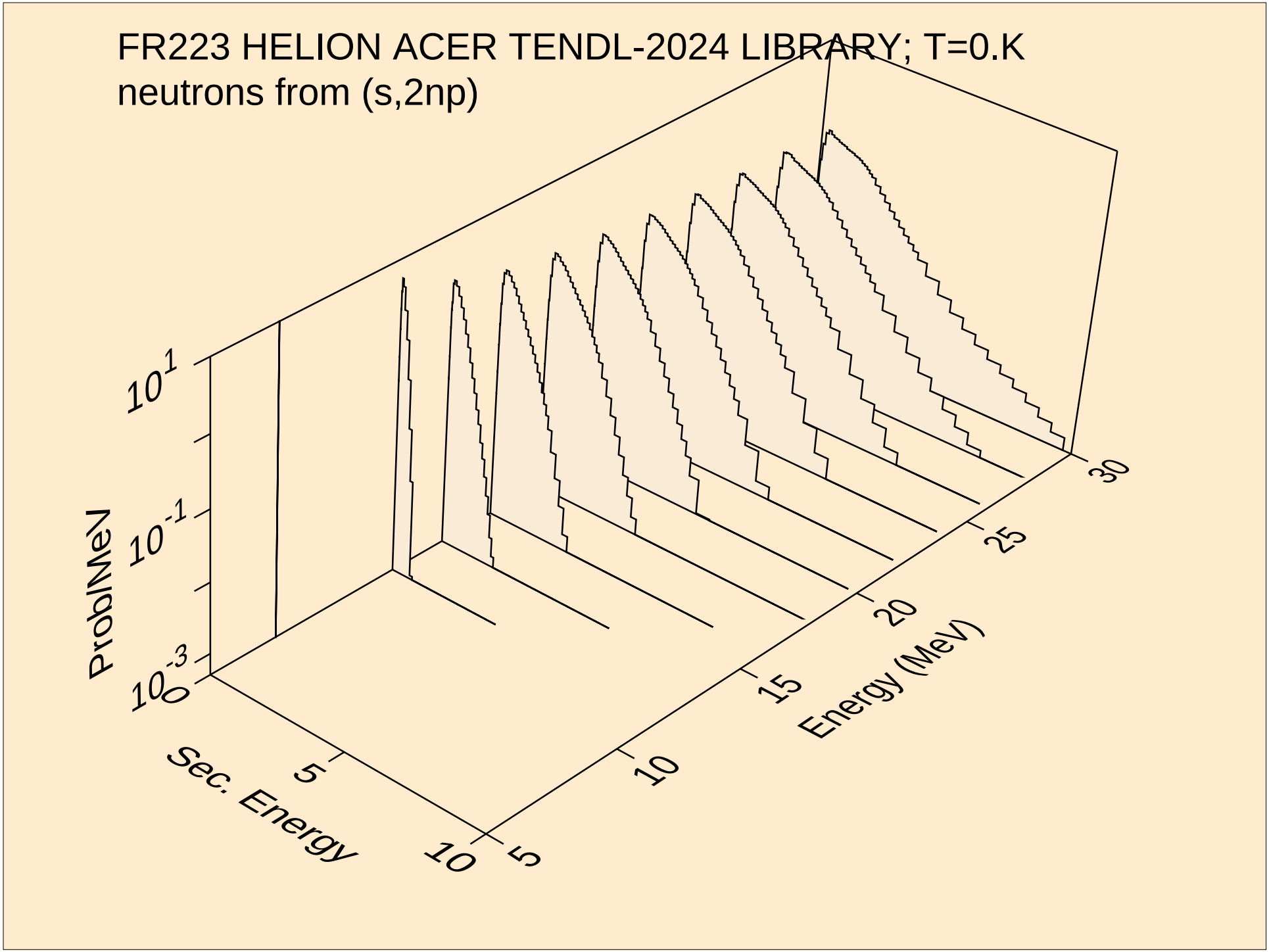

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,n*)2a
Prob/MeV
10-1
10-3
0
Sec. Energy
5
10
0
5
10
15
20
25
30
Energy (MeV)

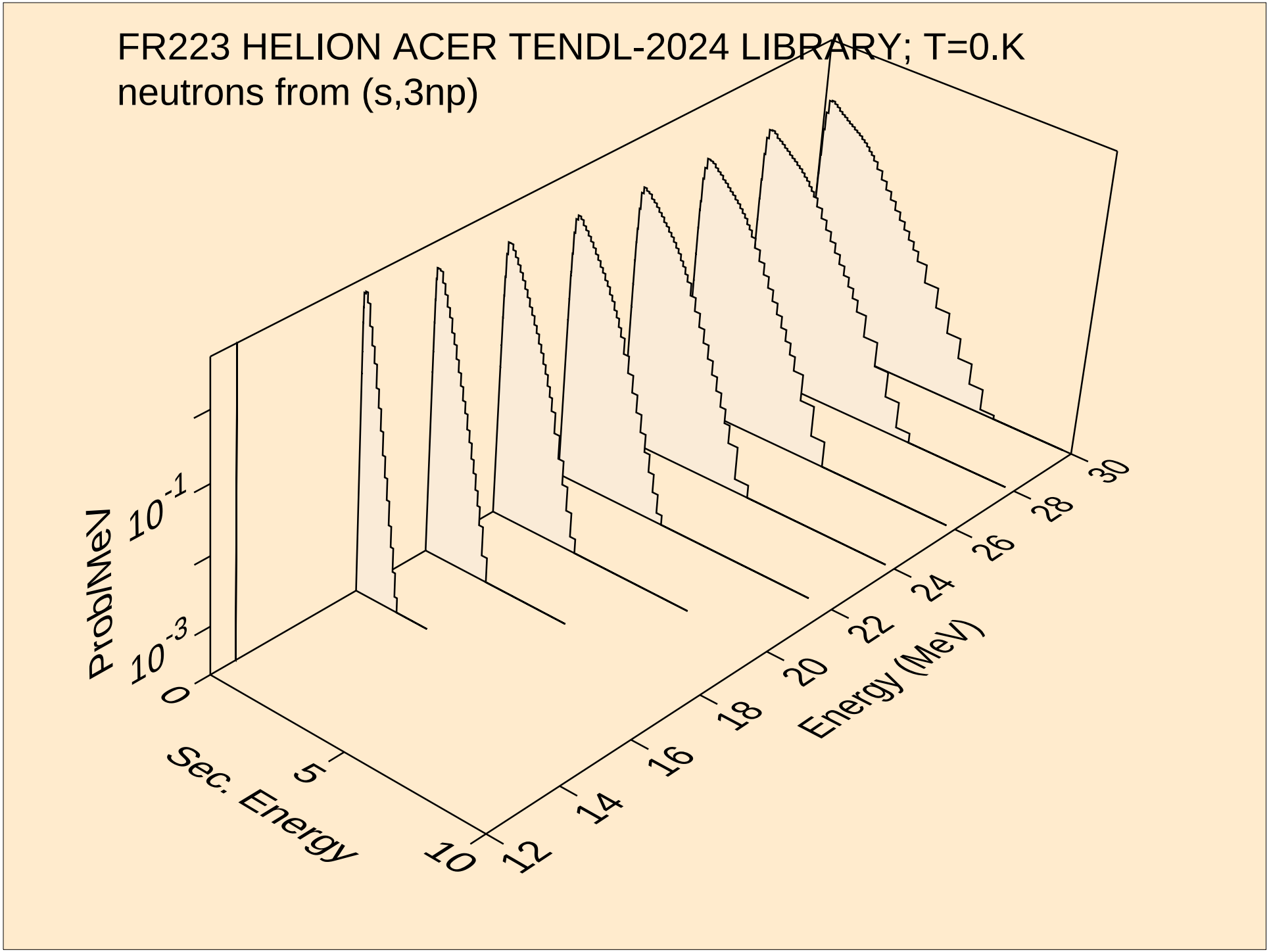

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,n*)d
Prob/MeV
10-1
10-3
0
Sec. Energy
5
10
5
10
15
20
25
30
Energy (MeV)

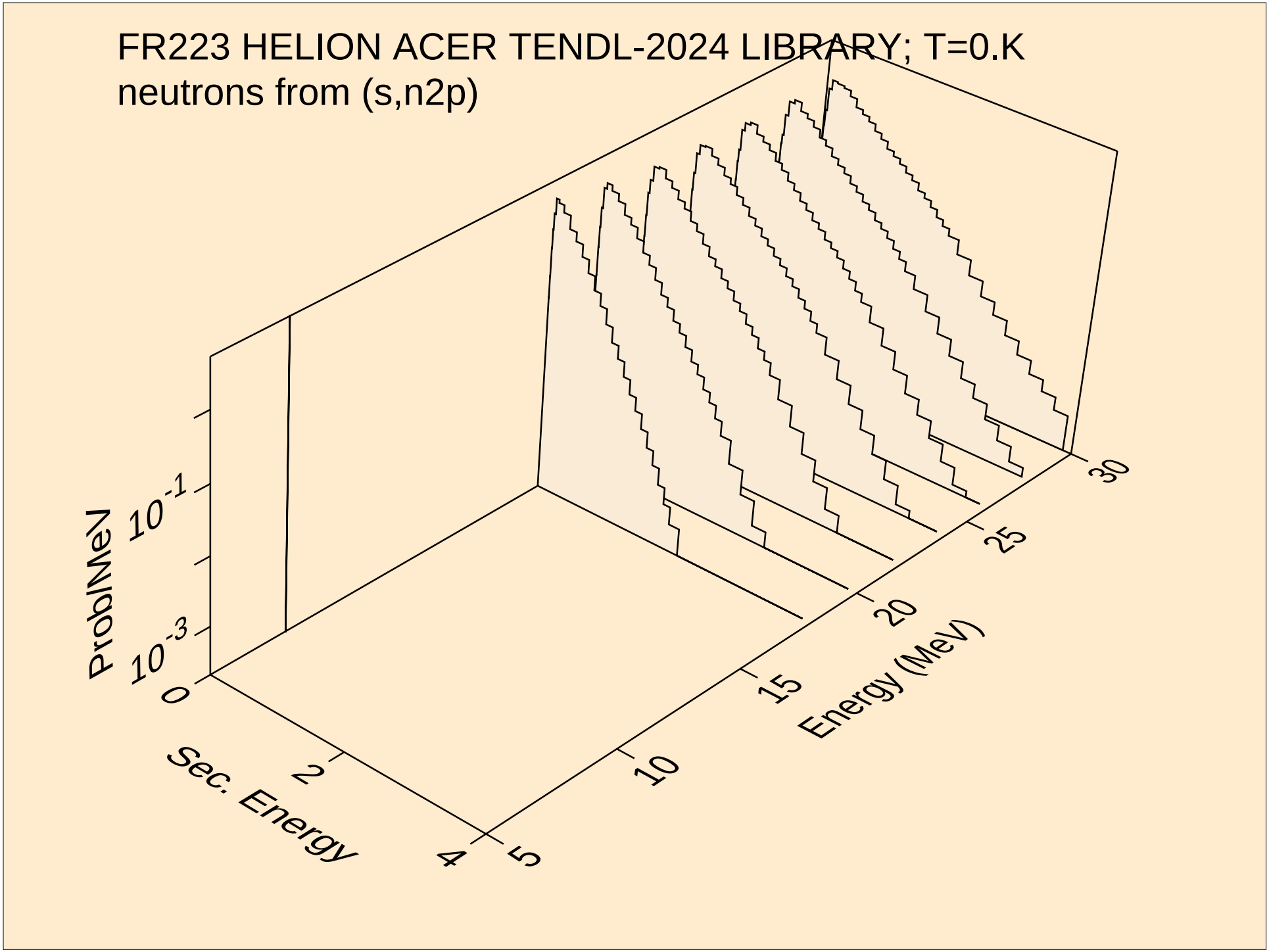

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,n*)t
Prob/MeV
10^1
10^-1
10^-3
0
2
4
6
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)

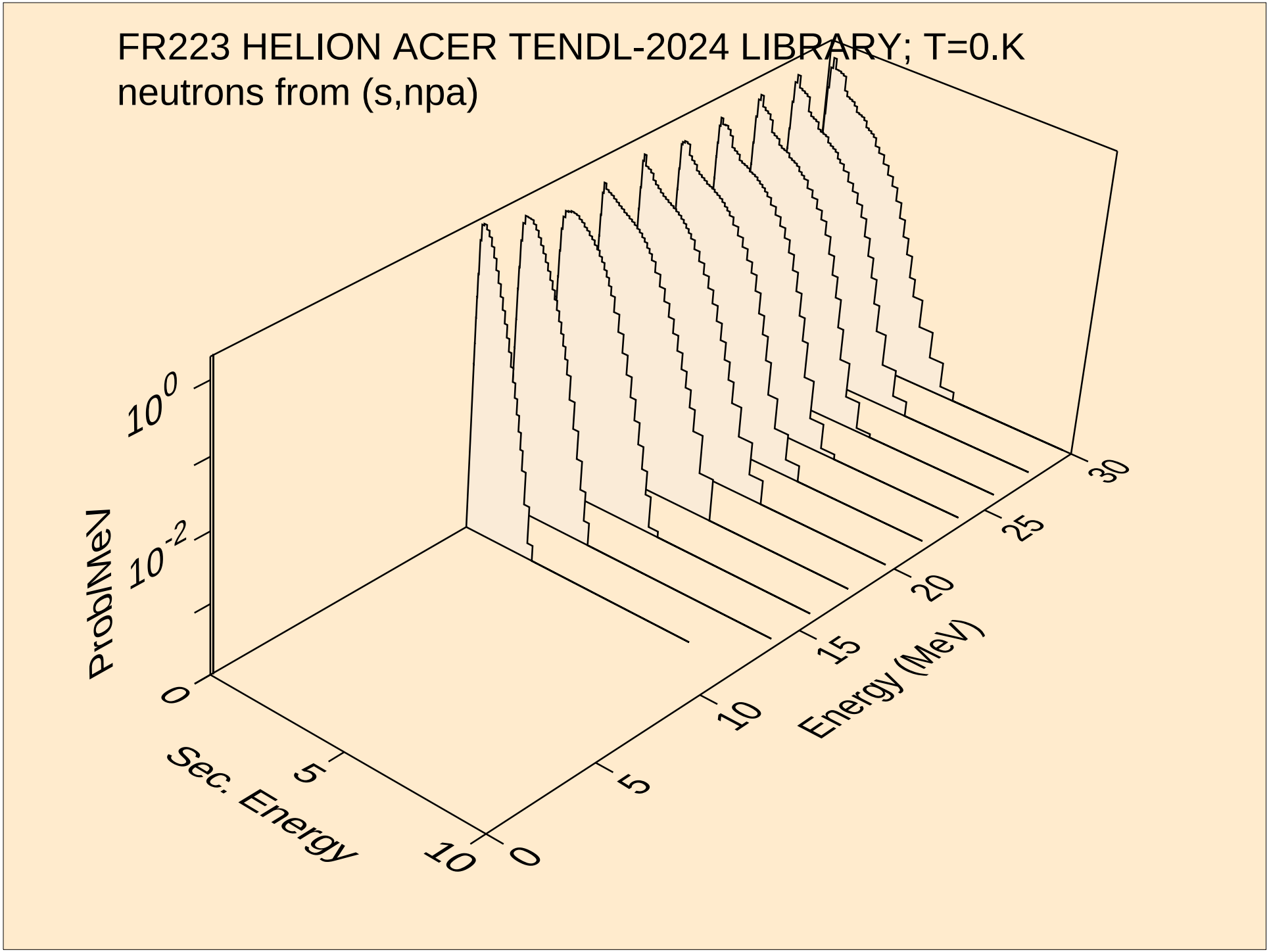

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,n*)he3
Prob/MeV
10-1
10-3
0
Sec. Energy
2
4
10
15
20
25
30
Energy (MeV)
5

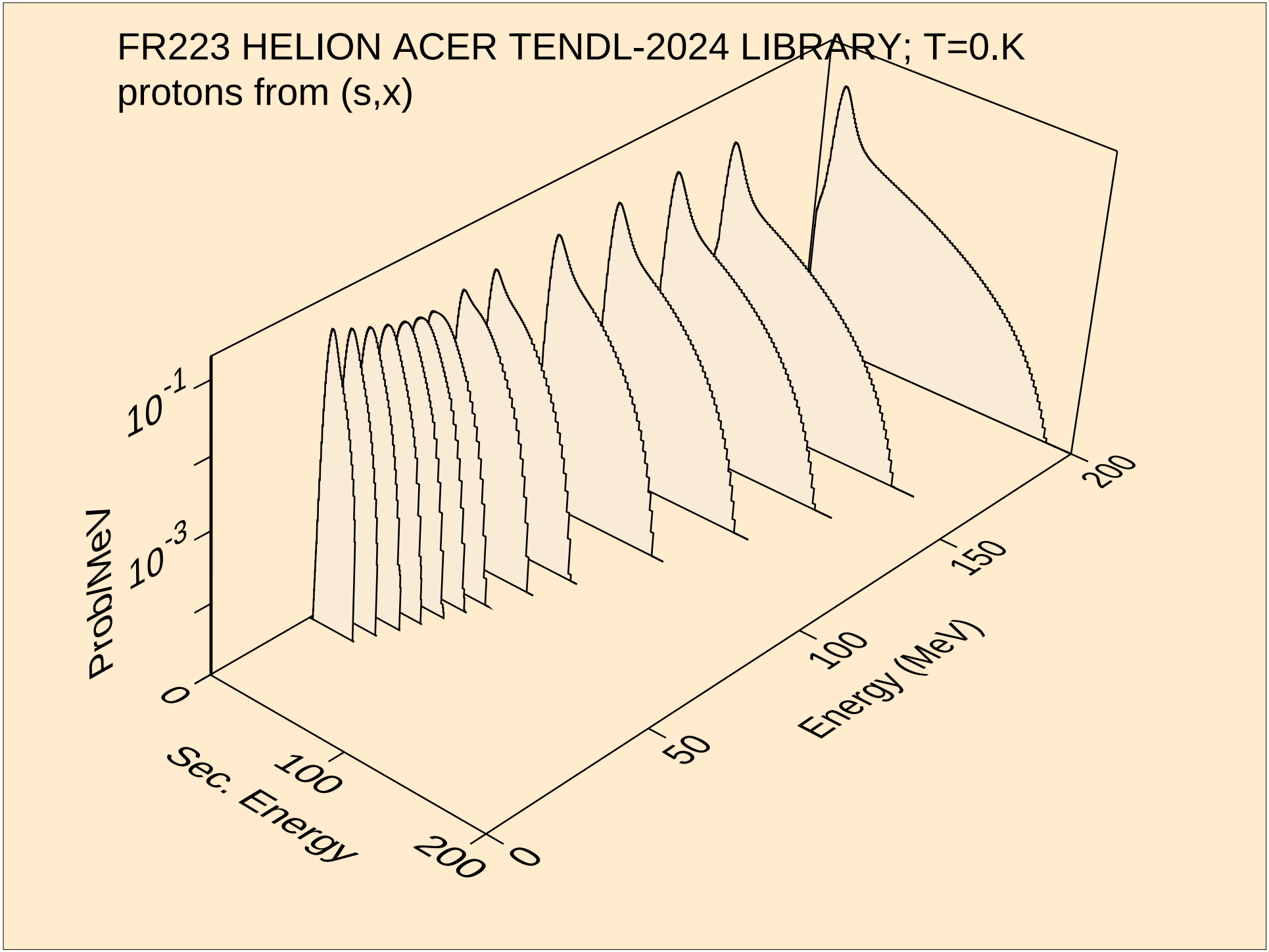

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,4n)
Prob/MeV
10^{1}
10^{-1}
10^{-3}
0
Sec. Energy
10
20
14
16
18
20
22
24
26
28
30
Energy (MeV)

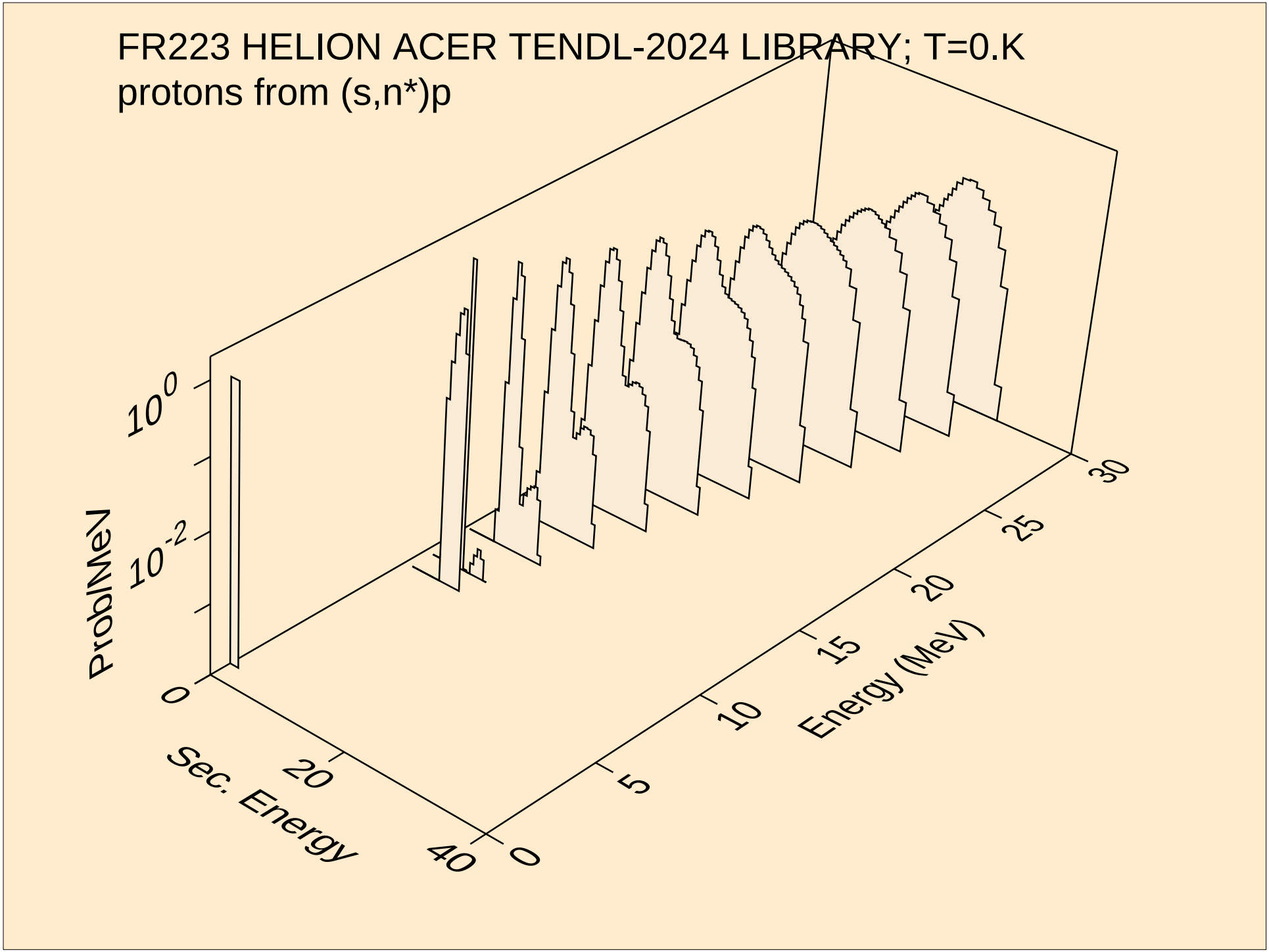

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,2np)
Prob/MeV
10^1
10^-1
10^-3
0
Sec. Energy
5
10
5
10
15
20
25
30
Energy (MeV)

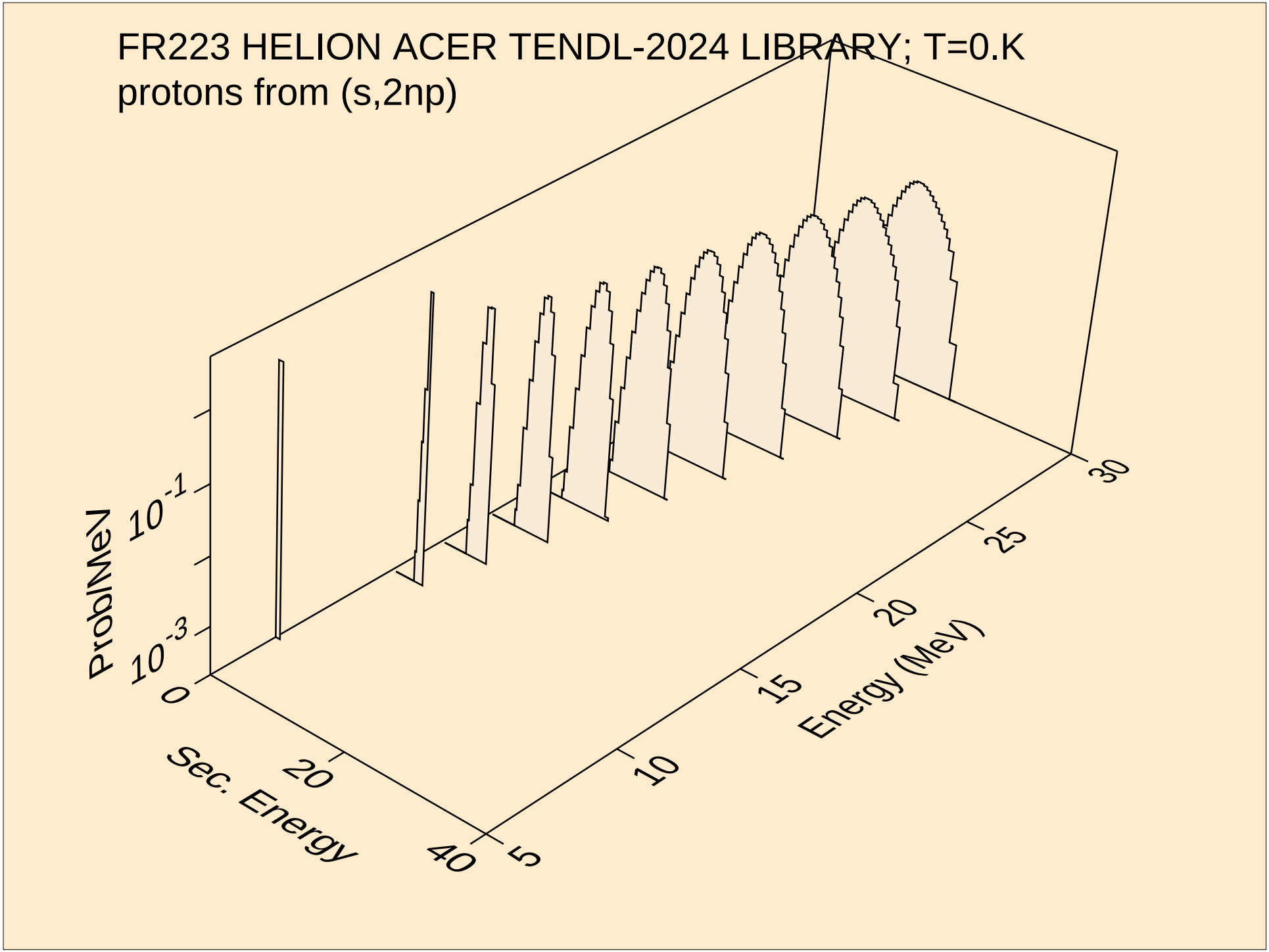

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,3np)
Prob/MeV
10-1
10-3
0
Sec. Energy
5
10
12
14
16
18
20
22
24
26
28
30
Energy (MeV)

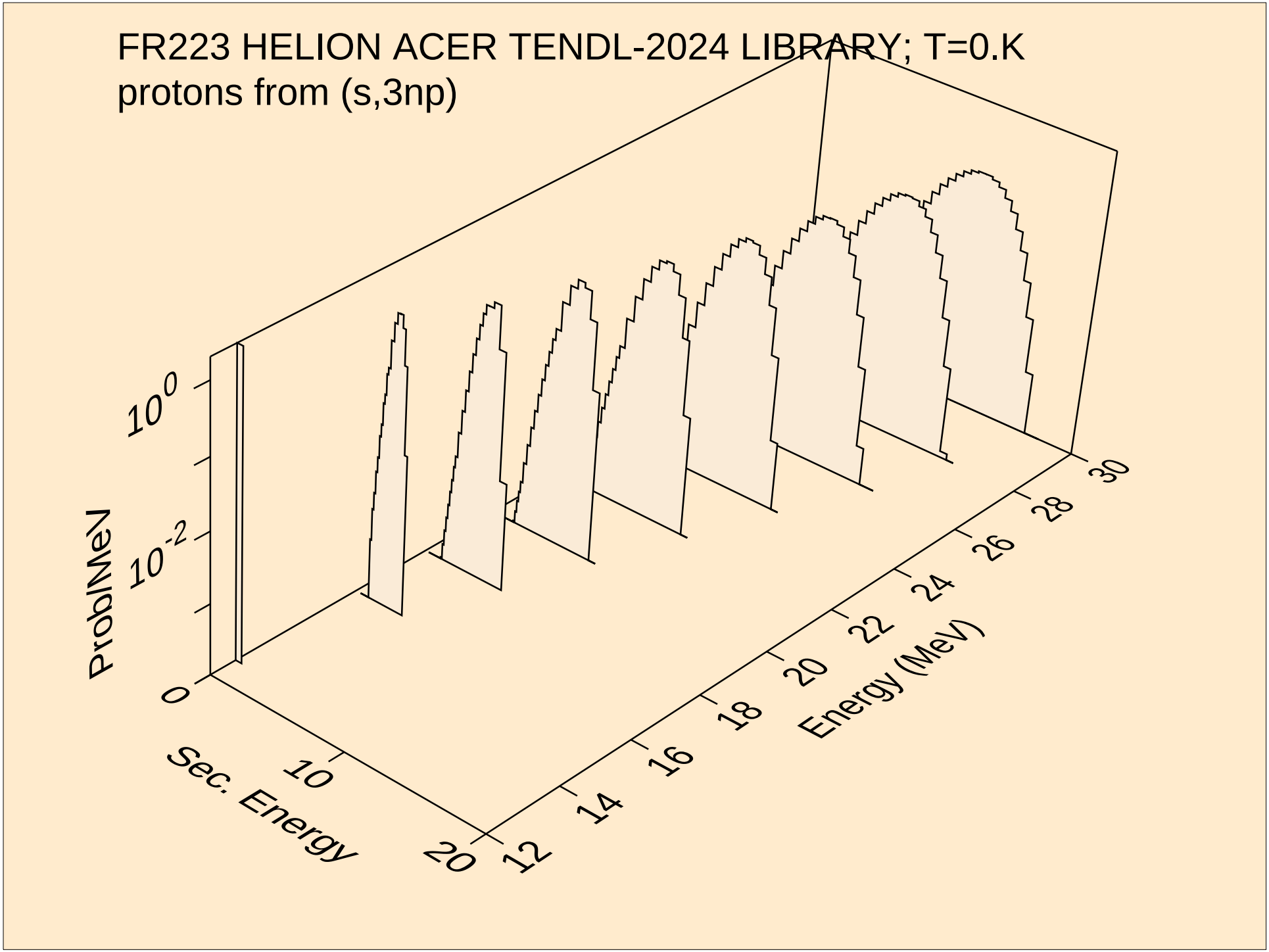

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,n2p)
Prob/MeV
10-1
10-3
0
Sec. Energy
2
4
5
10
15
20
25
30
Energy (MeV)

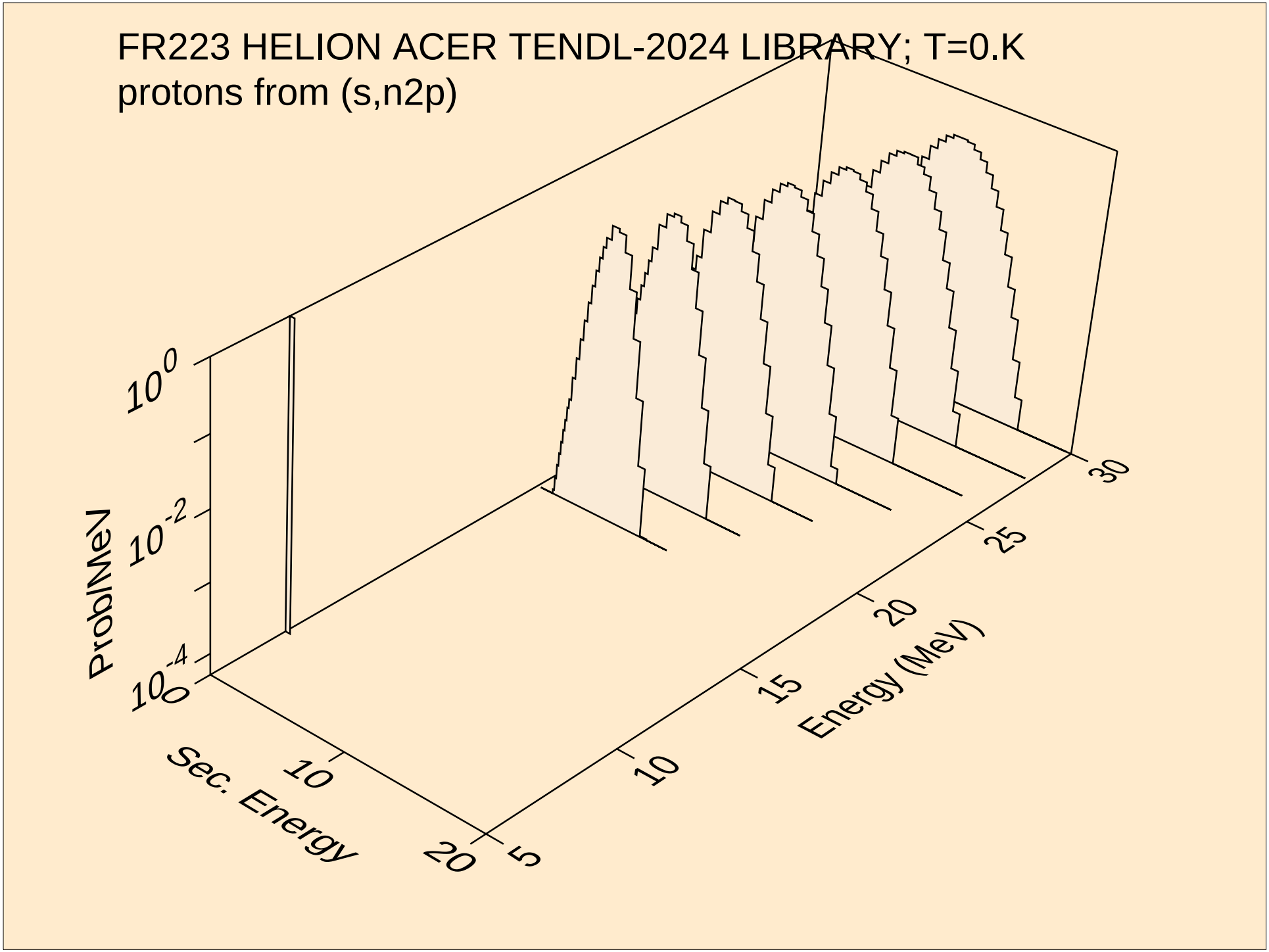

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
neutrons from (s,npa)
Prob/MeV
10^0
10^-2
0
Sec. Energy
5
10
0
5
10
15
20
25
30
Energy (MeV)

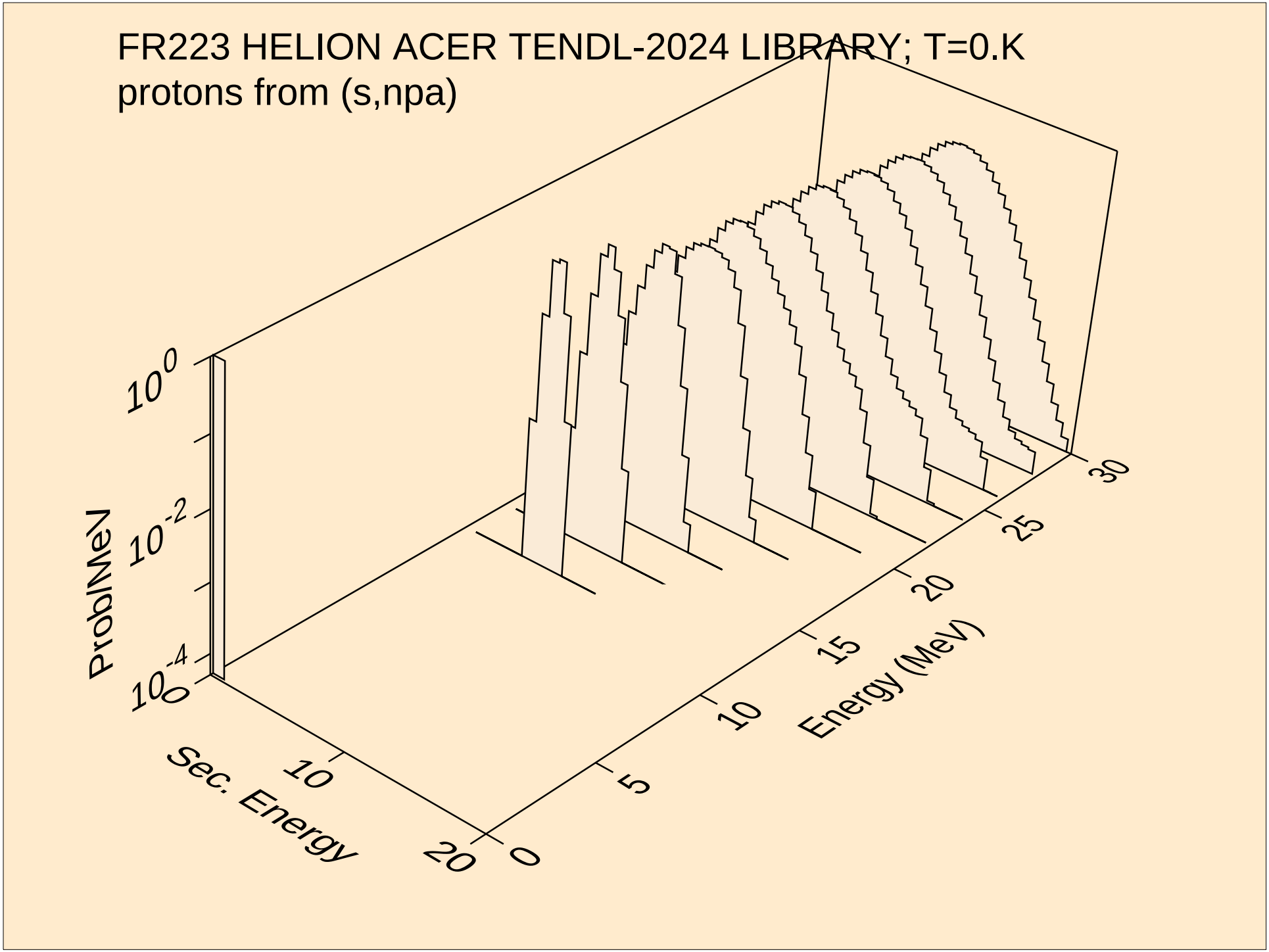

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
protons from (s,x)
Prob/MeV
10-1
10-3
0
Sec. Energy
100
200
0
50
100
150
200
Energy (MeV)

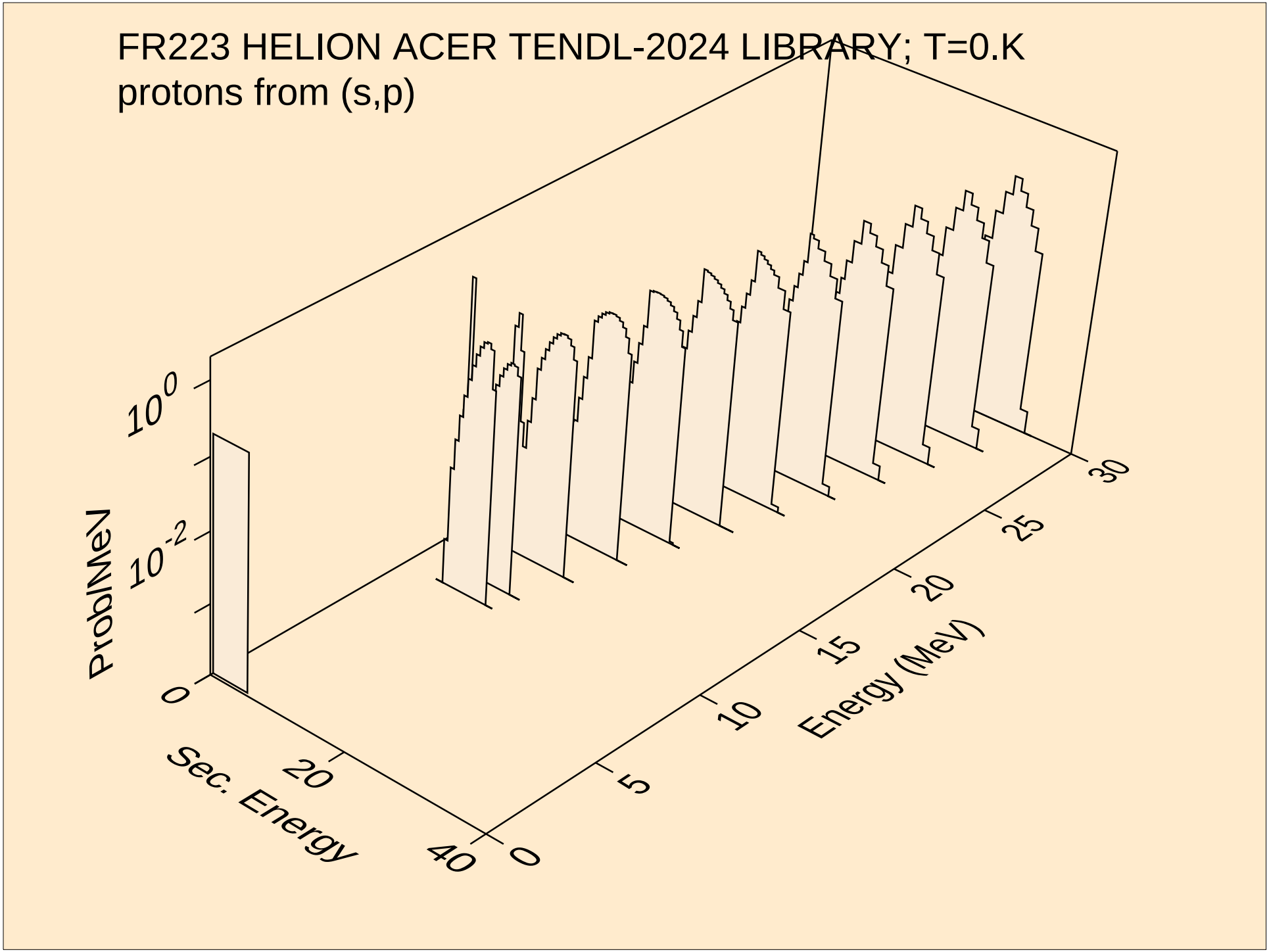

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
protons from (s,n*)p
Prob/MeV
10^0
10^-2
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)

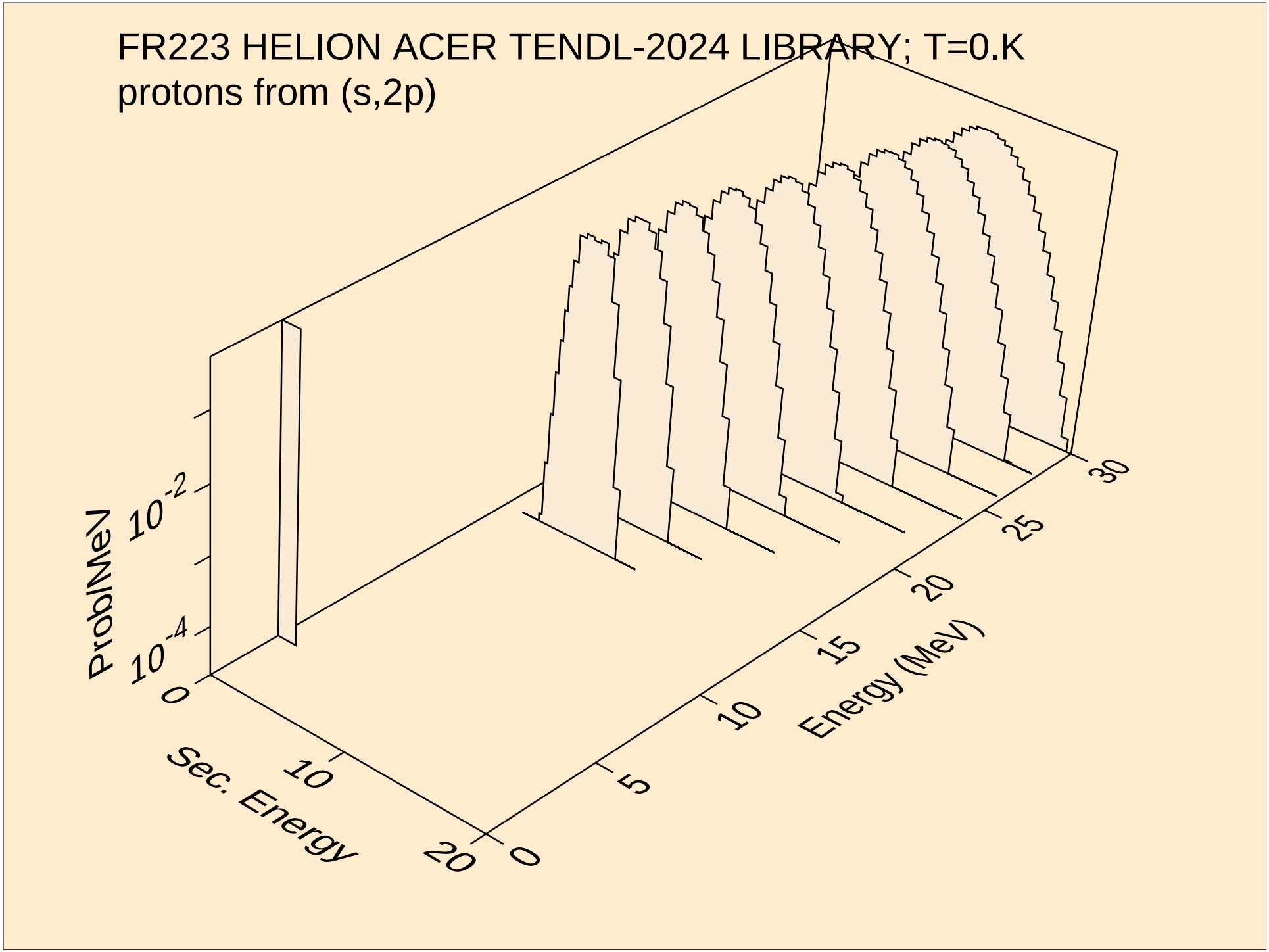

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
protons from (s,2np)
Prob/MeV
10-1
10-3
0
Sec. Energy
20
40
5
10
15
20
25
30
Energy (MeV)

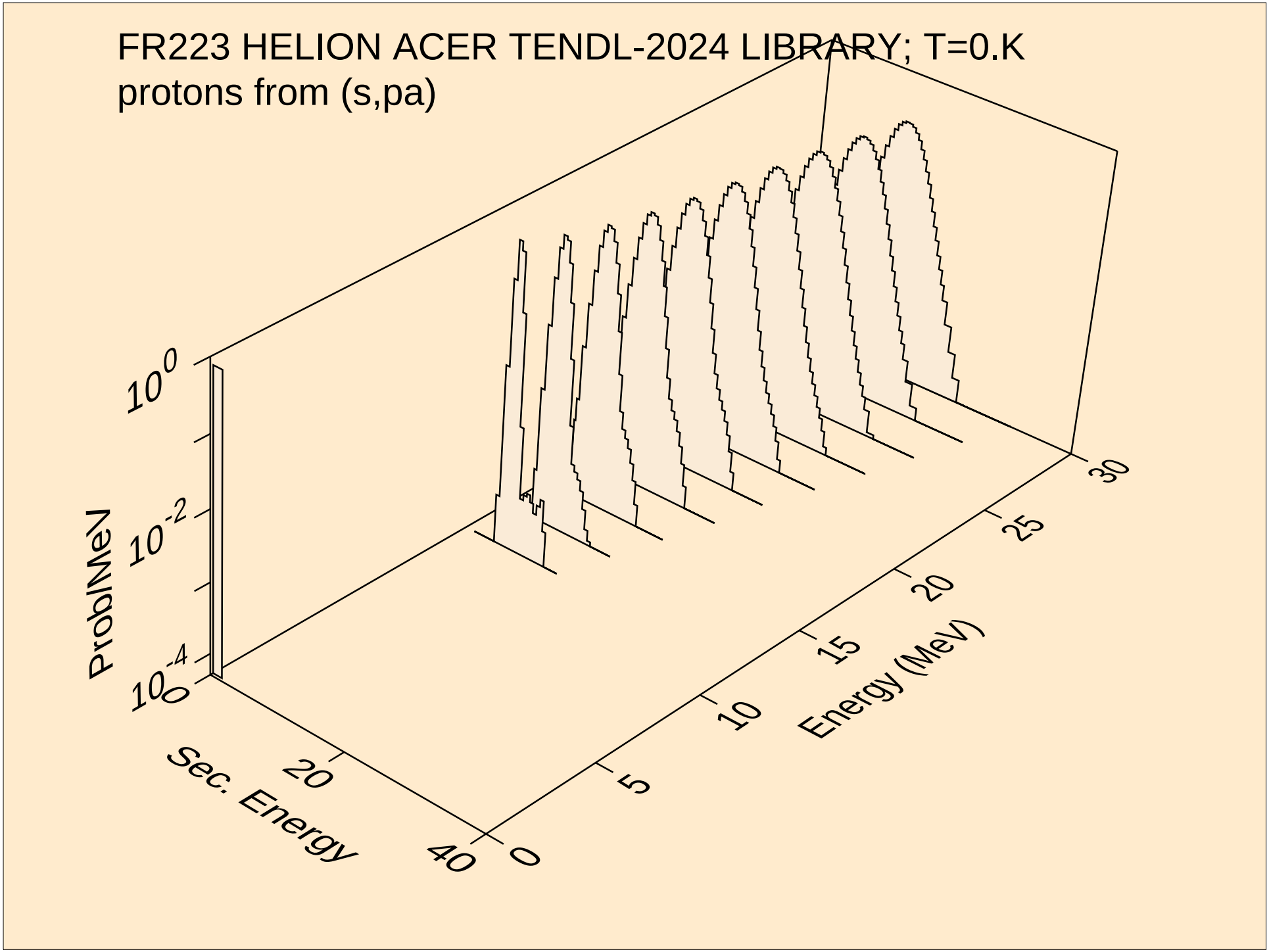

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
protons from (s,3np)
Prob/MeV
10^0
10^-2
0
Sec. Energy
10
20
12
14
16
18
20
22
24
26
28
30
Energy (MeV)

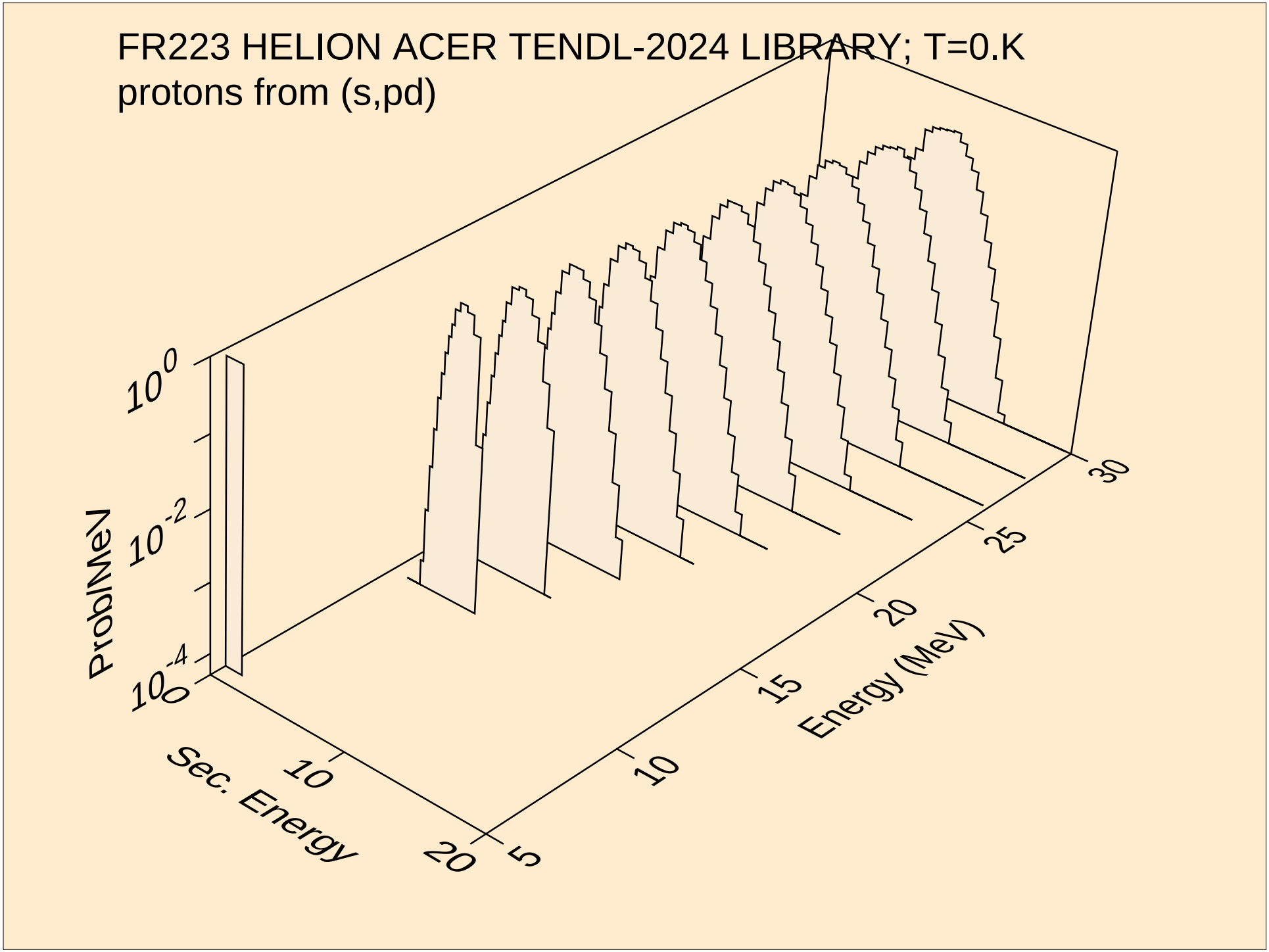

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
protons from (s,n2p)
Prob/MeV
10^0
10^-2
10^-4
0
10
20
Sec. Energy
5
10
15
20
25
30
Energy (MeV)

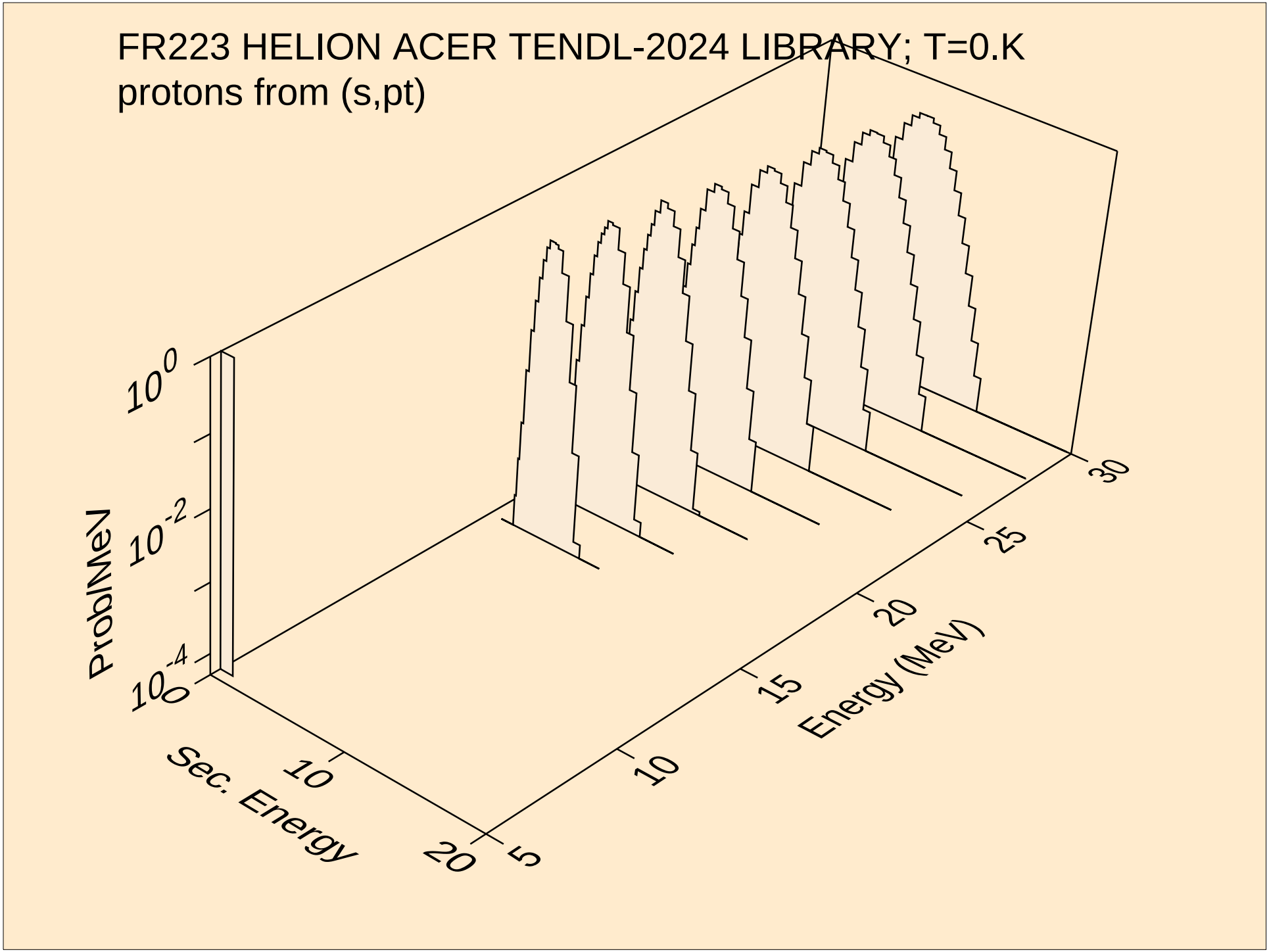

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
protons from (s,npa)
Prob/MeV
10^0
10^-2
10^-4
Sec. Energy
0
10
20
Energy (MeV)
0
5
10
15
20
25
30

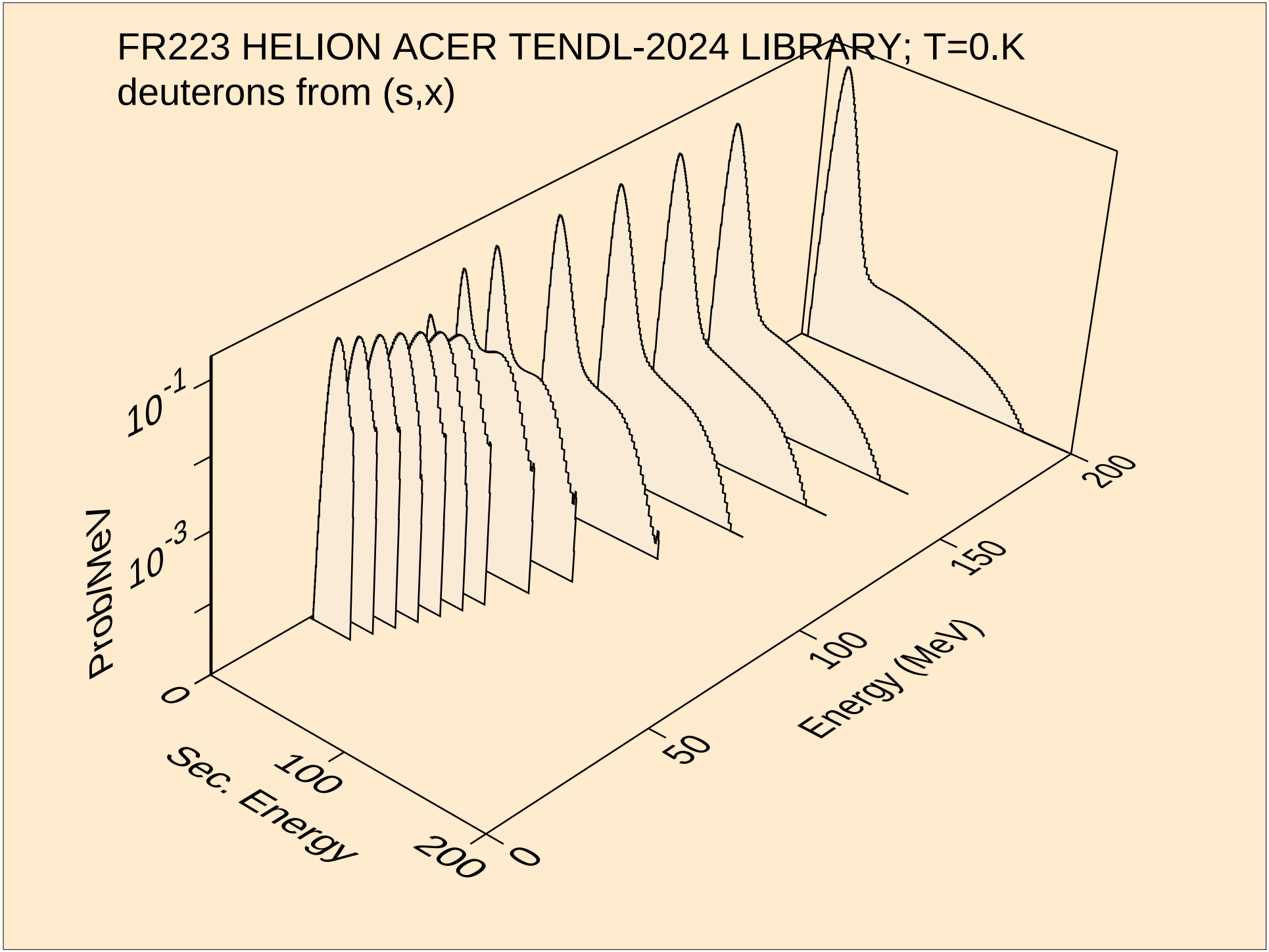

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
protons from (s,p)
Prob/MeV
10^0
10^-2
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)

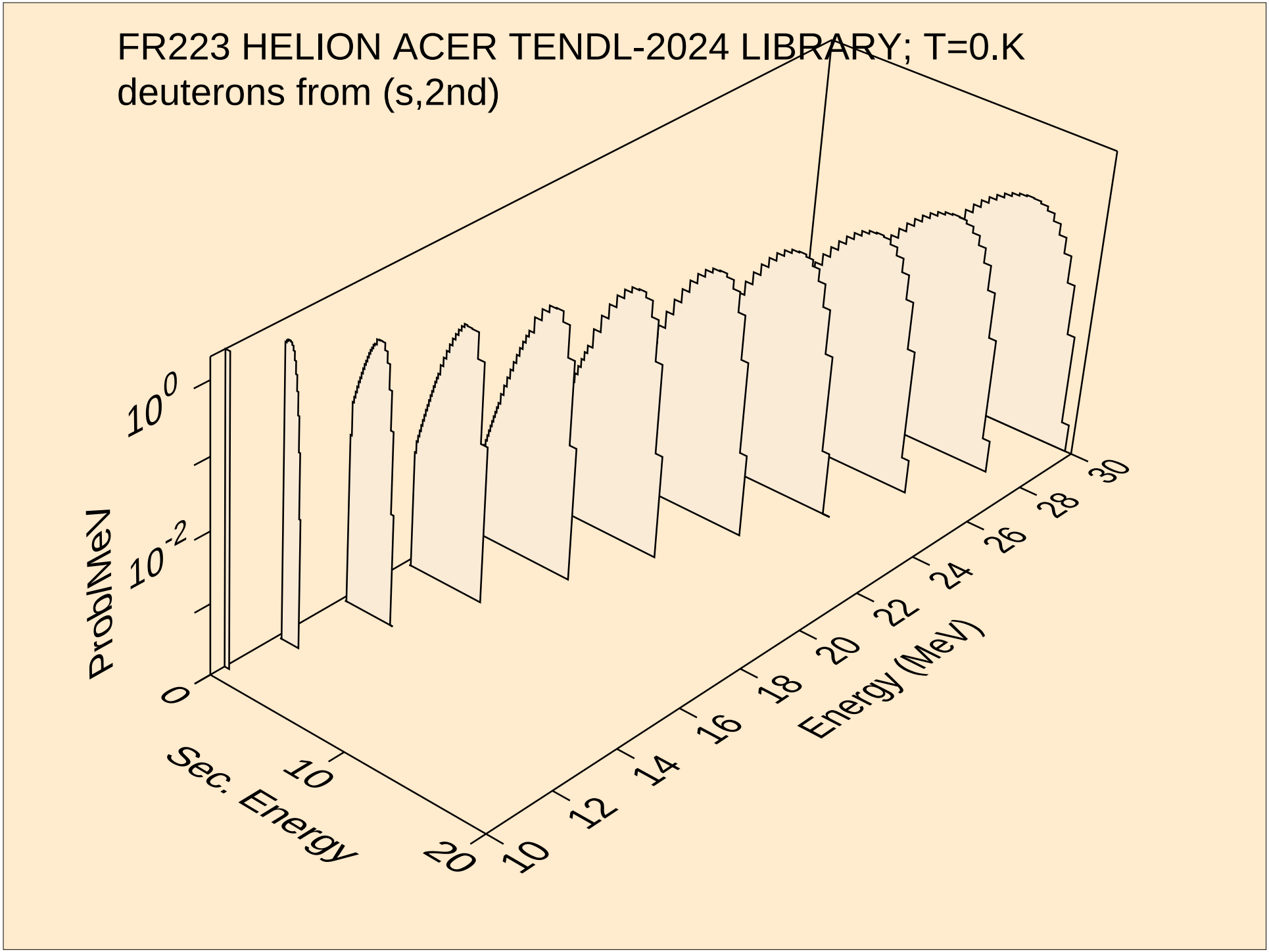

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
protons from (s,2p)
Prob/MeV
10-2
10-4
0
Sec. Energy
10
20
0
5
10
15
20
25
30
Energy (MeV)

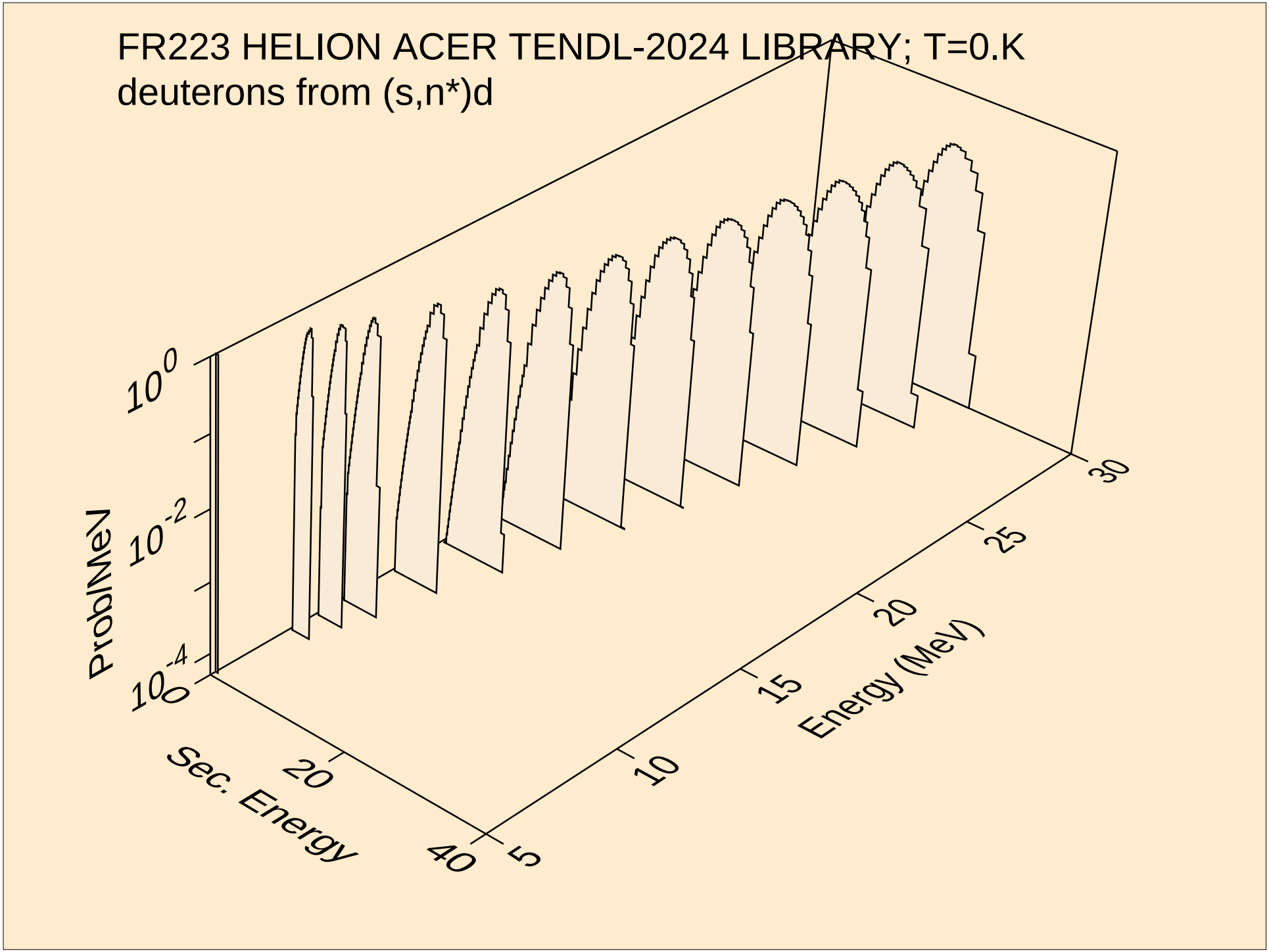

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
protons from (s,pa)
Prob/MeV
10^0
10^-2
10^-4
0
20
40
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)

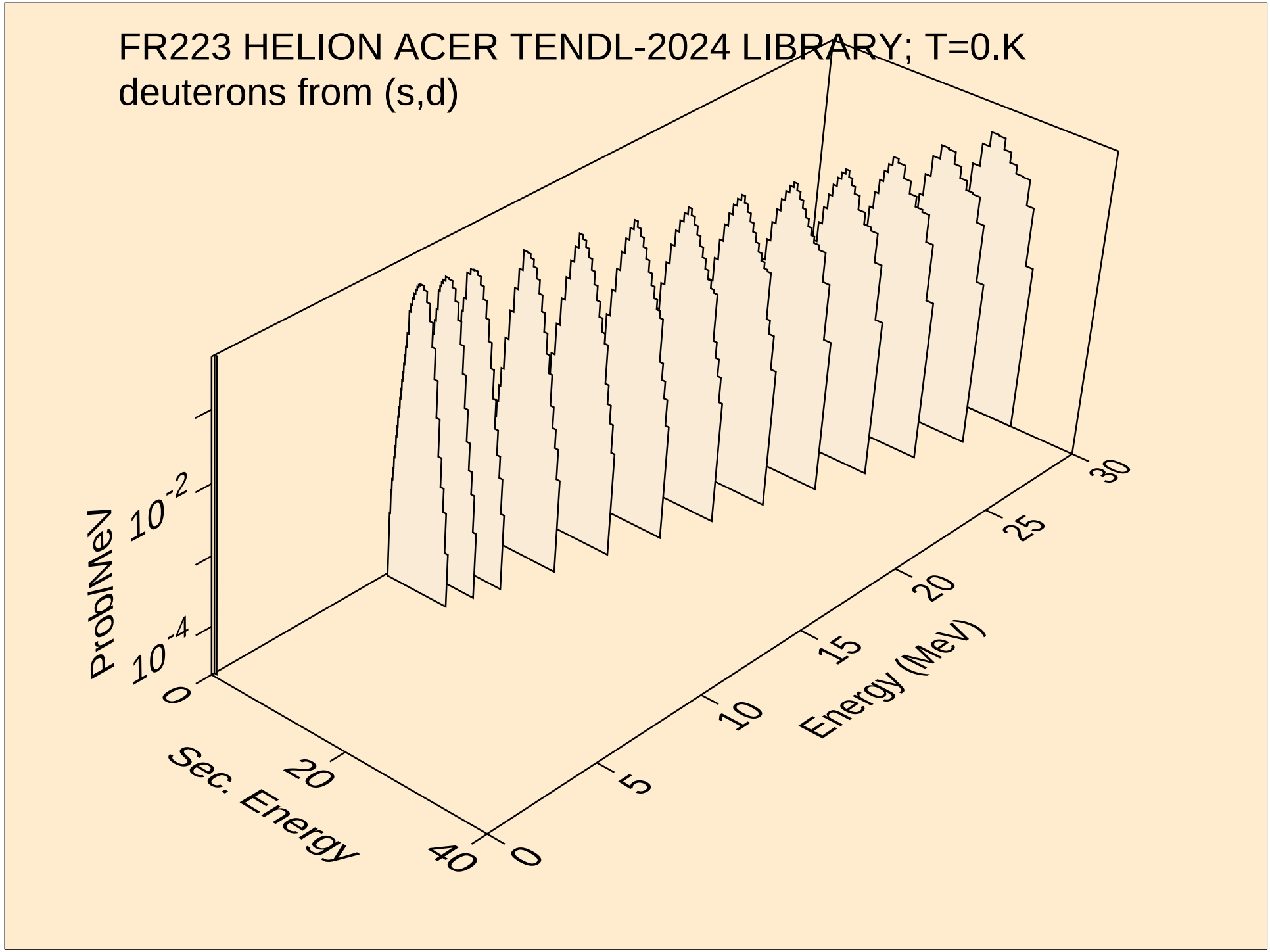

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
protons from (s,pd)
Prob/MeV
10^0
10^-2
10^-4
0
Sec. Energy
10
20
5
10
15
20
25
30
Energy (MeV)

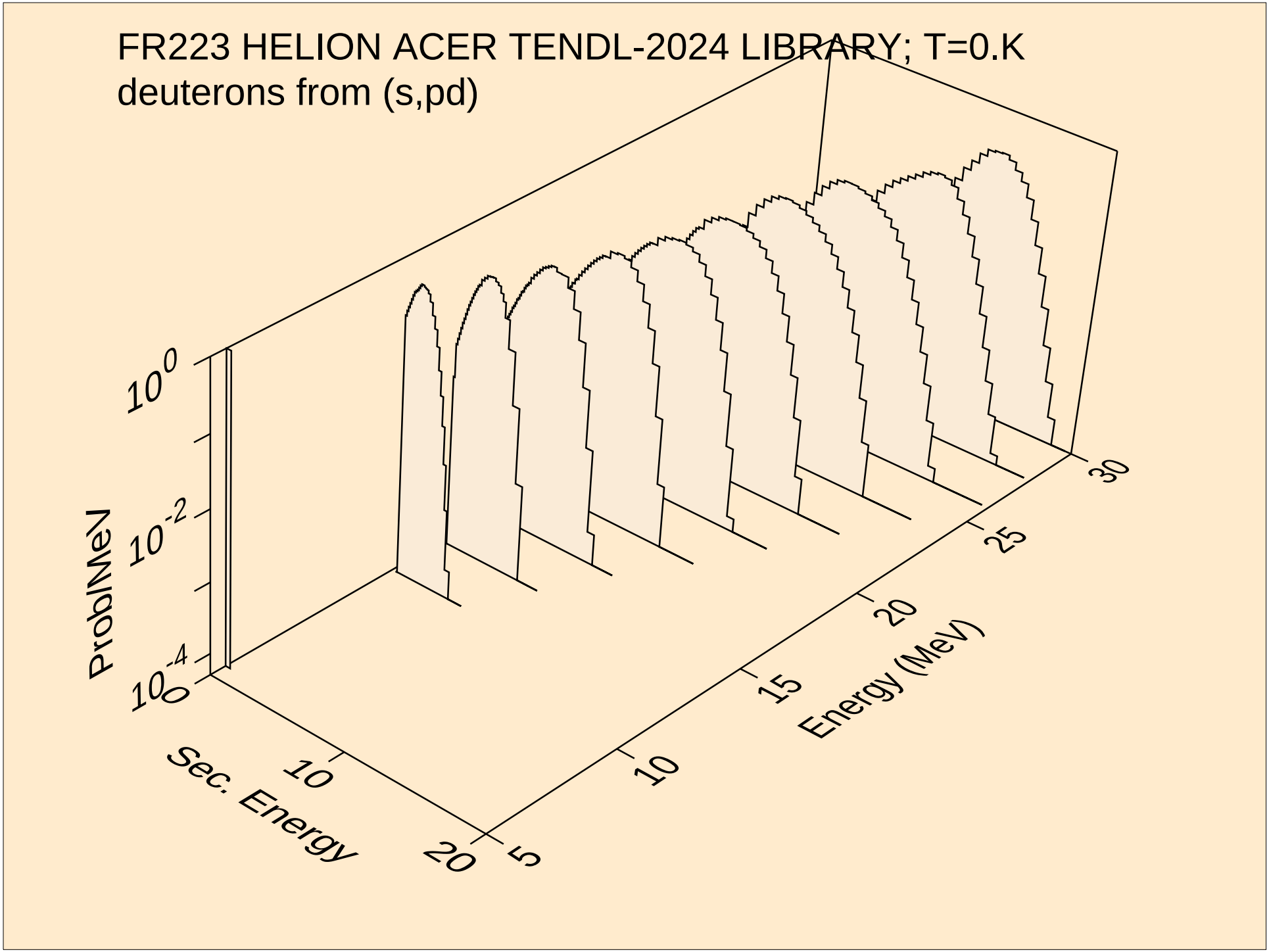

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
protons from (s,pt)
Prob/MeV
10^0
10^-2
10^-4
0
Sec. Energy
10
20
5
10
15
20
25
30
Energy (MeV)

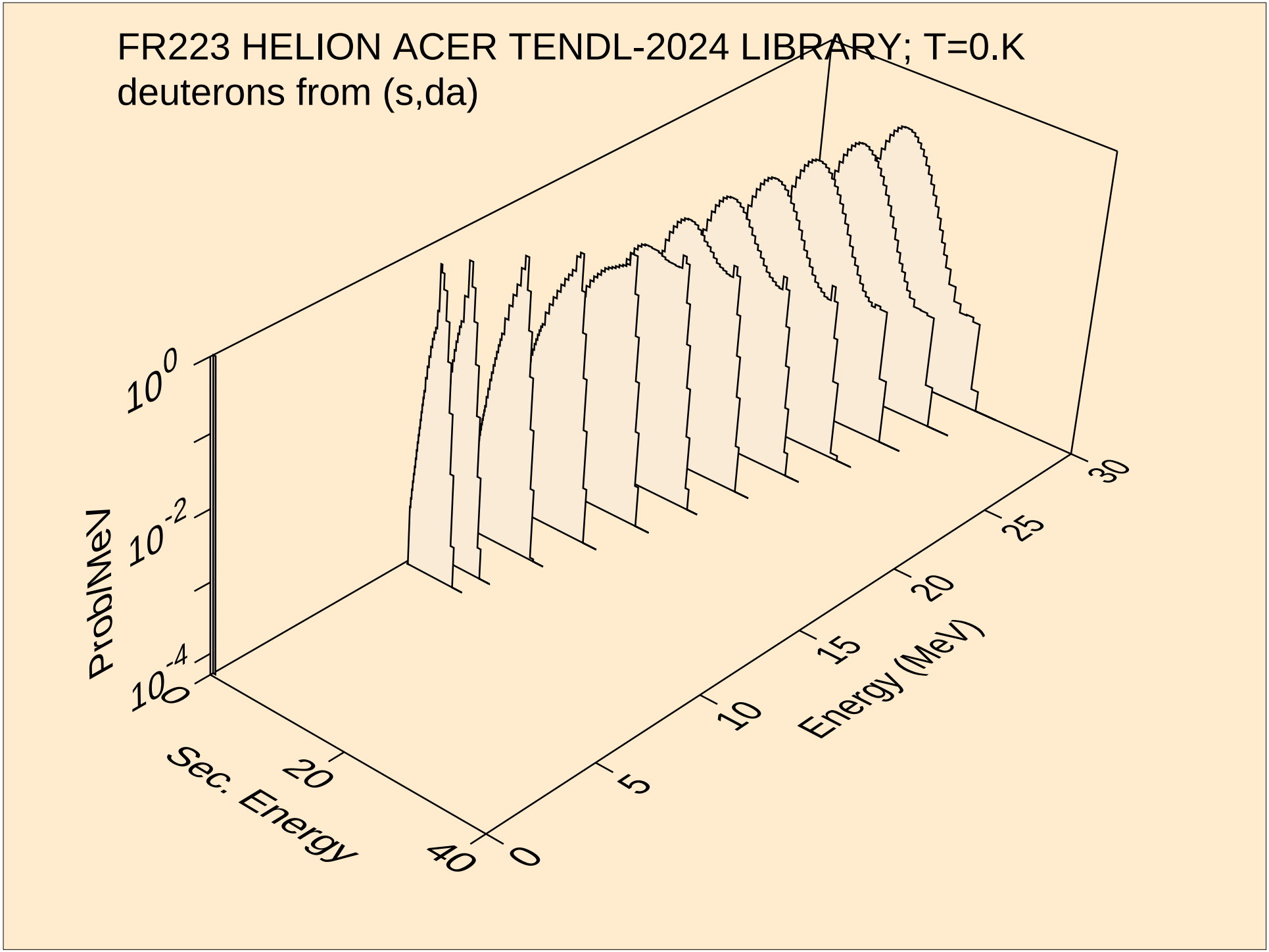

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
deuterons from (s,x)
Prob/MeV
10-1
10-3
0
Sec. Energy
100
200
0
50
100
150
200
Energy (MeV)

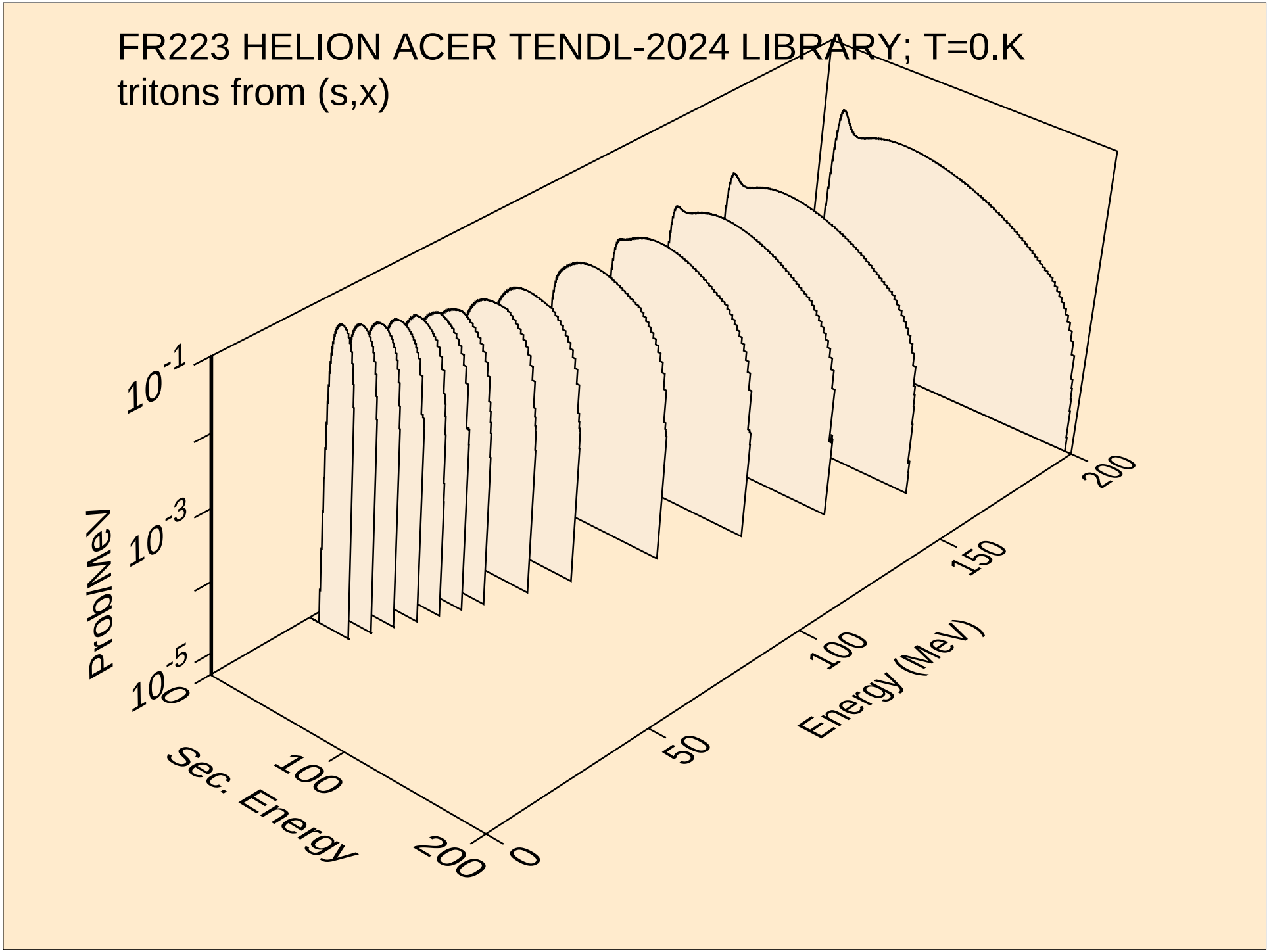

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
deuterons from (s,2nd)
Prob/MeV
10^{0}
10^{-2}
0
Sec. Energy
10
20
Energy (MeV)
10
12
14
16
18
20
22
24
26
28
30

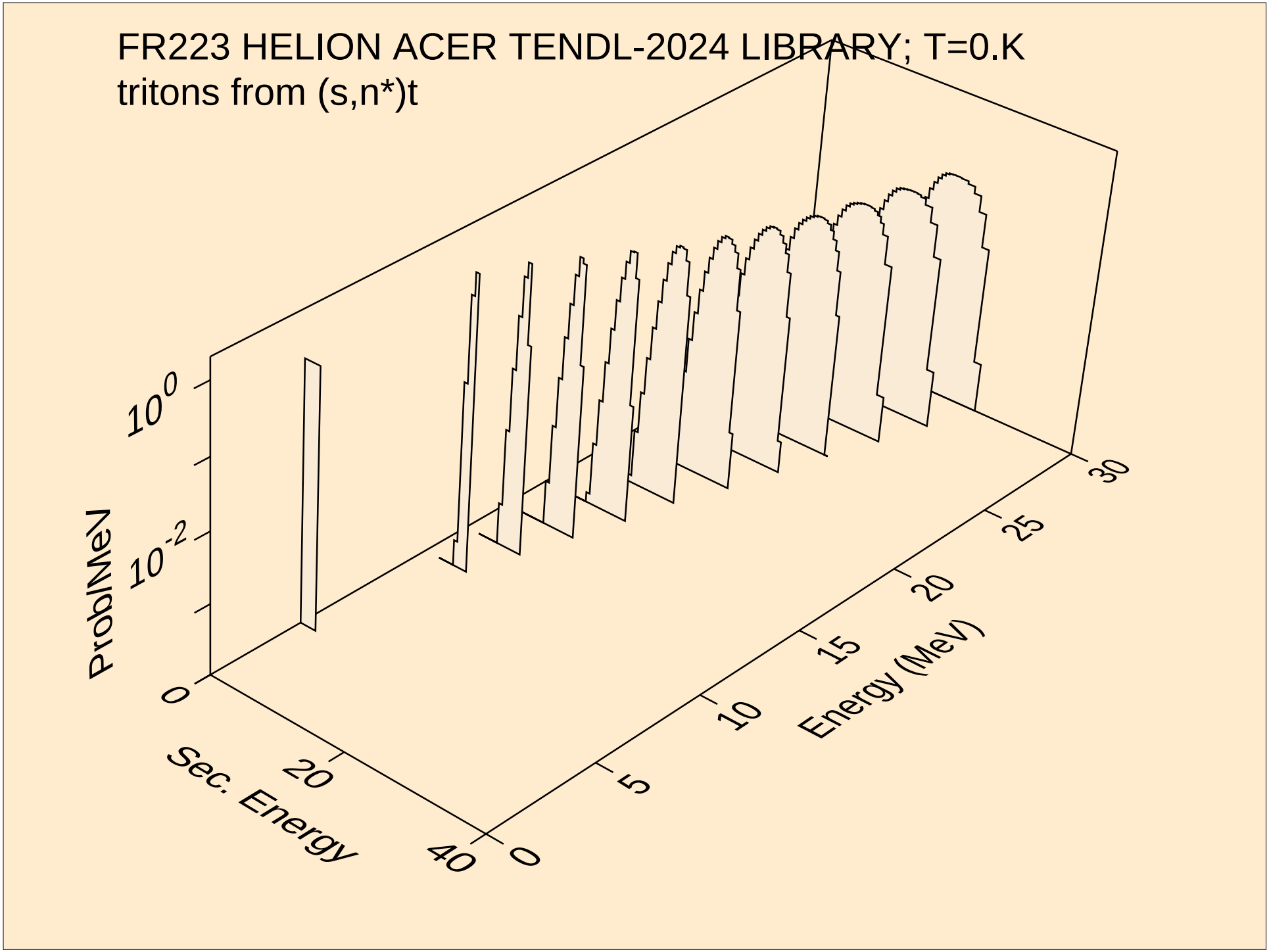

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
deuterons from (s,n*)d
Prob/MeV
10^0
10^-2
10^-4
0
Sec. Energy
20
40
5
10
15
Energy (MeV)
20
25
30

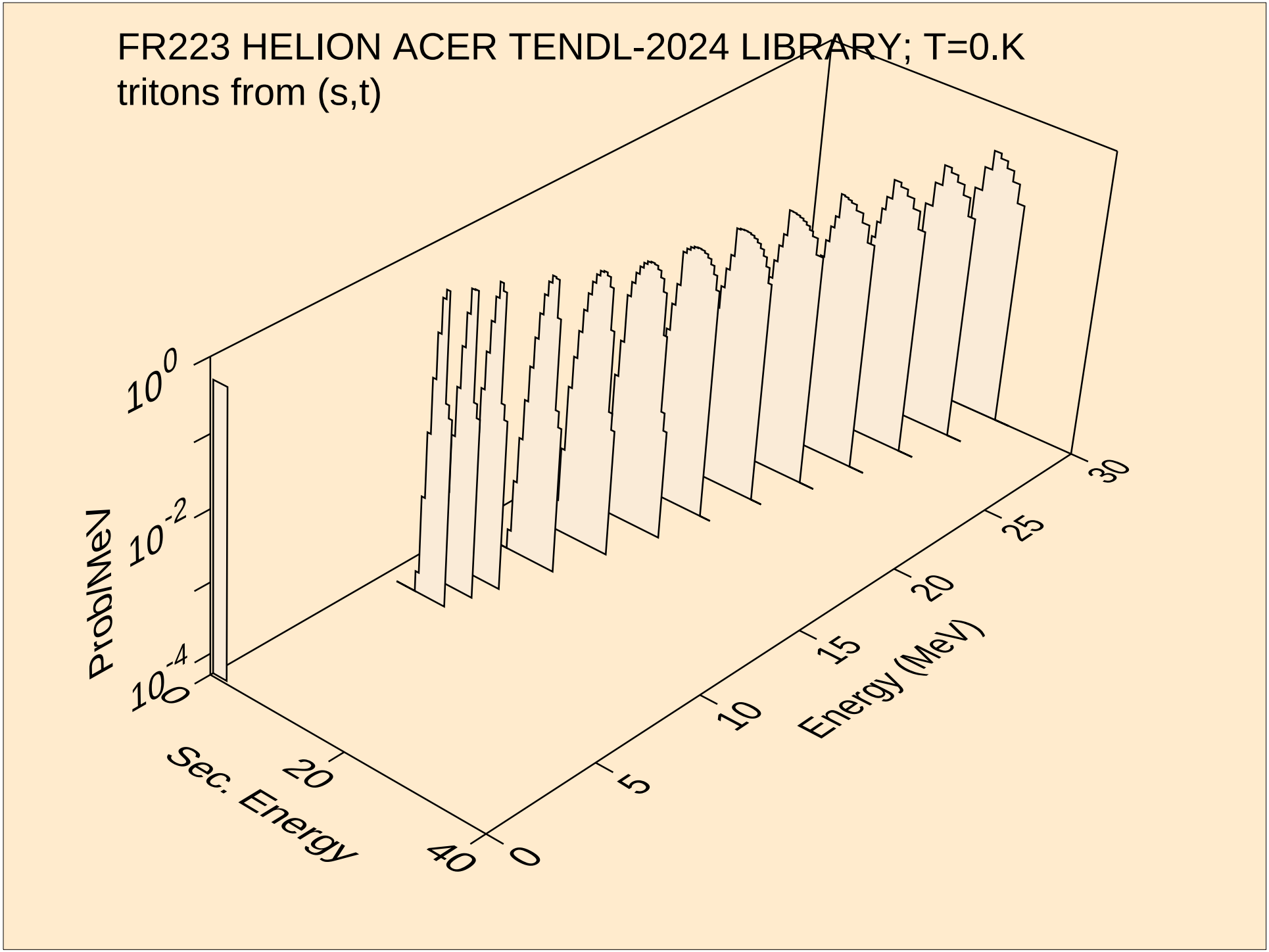

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
deuterons from (s,d)
Prob/MeV
10-2
10-4
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)

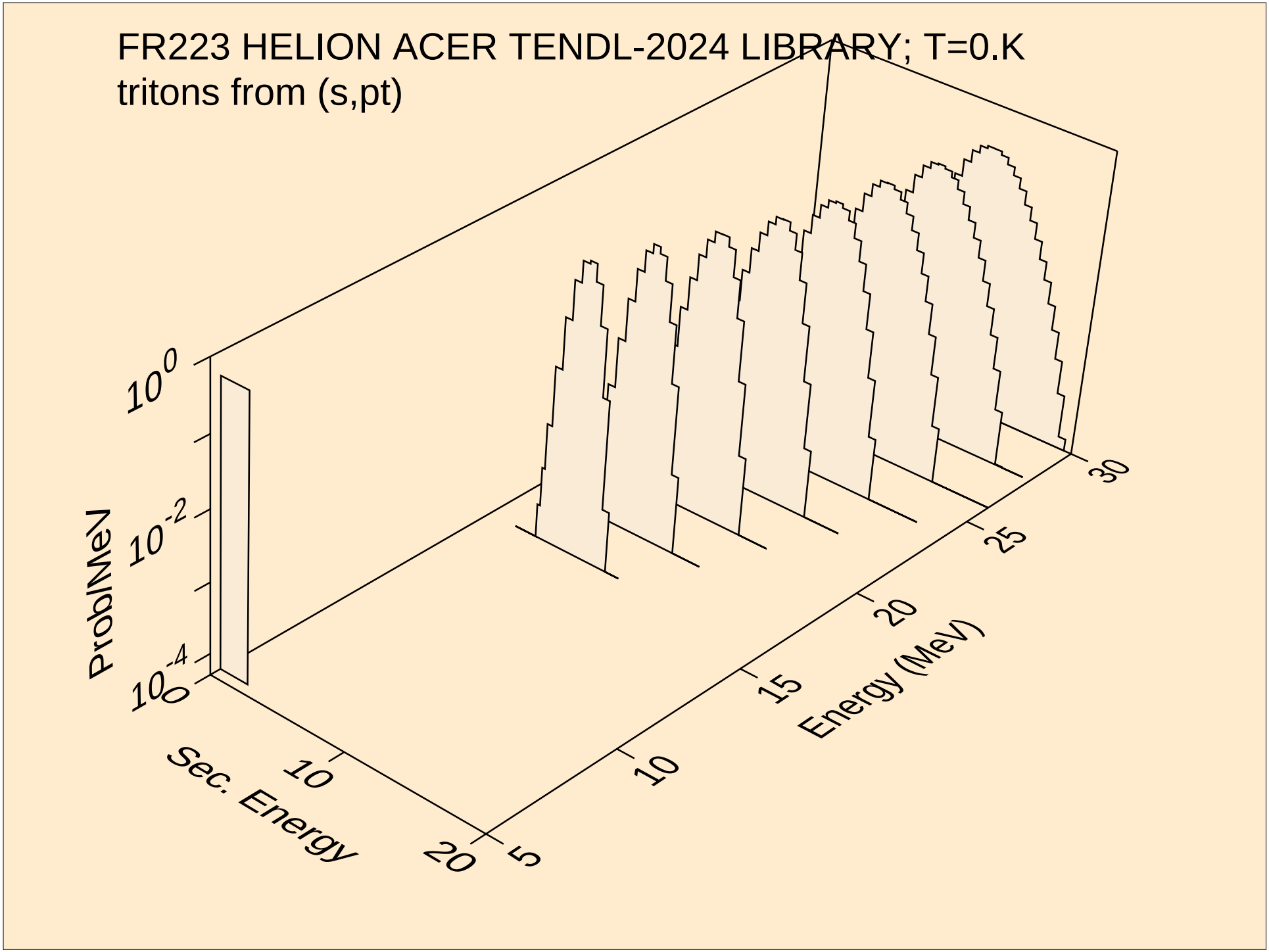

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
deuterons from (s,pd)
Prob/MeV
10^0
10^-2
10^-4
0
Sec. Energy
10
20
5
10
15
20
25
30
Energy (MeV)

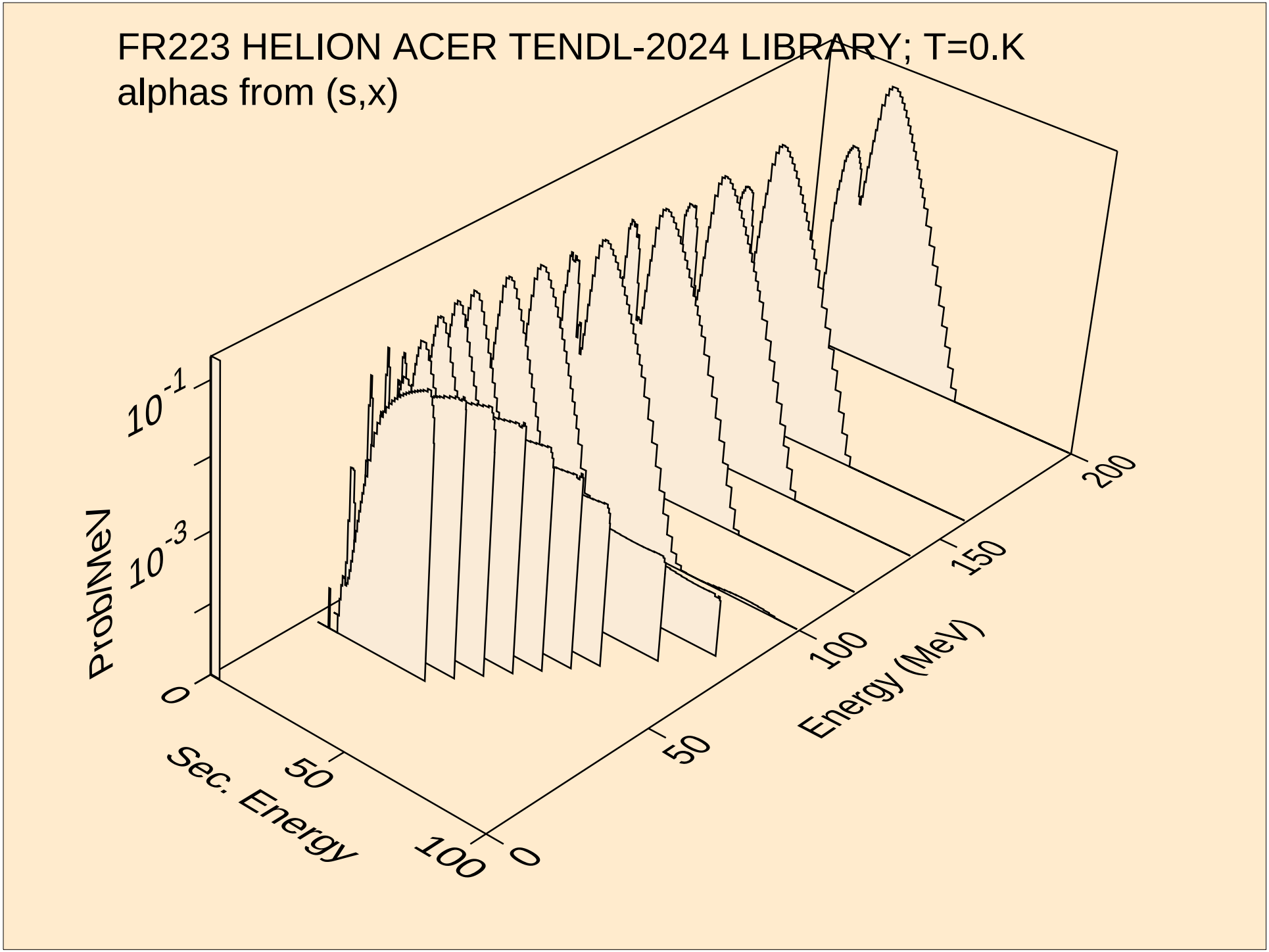

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
deuterons from (s,da)
Prob/MeV
10^0
10^-2
10^-4
0
20
40
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)

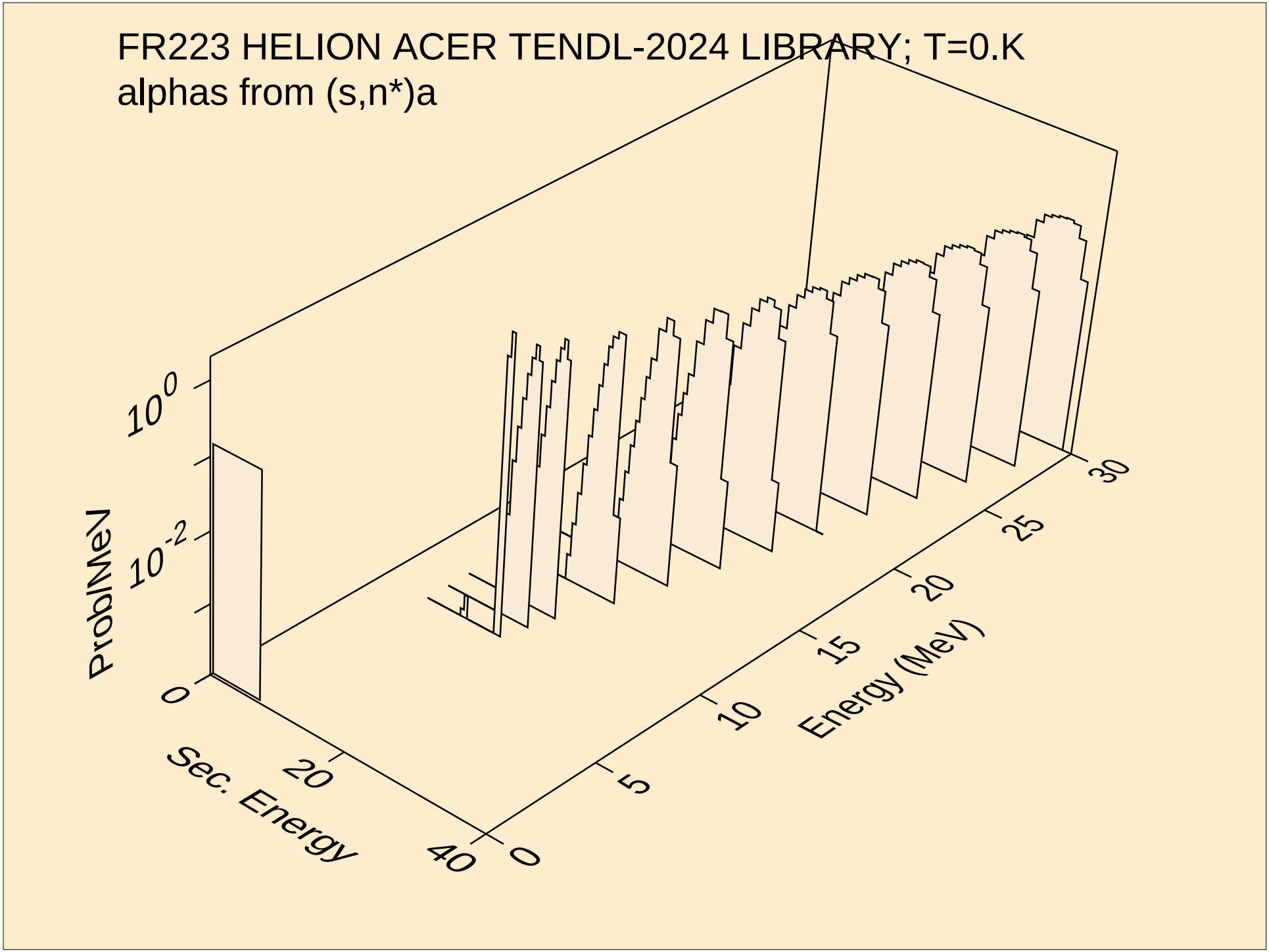

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
tritons from (s,x)
Prob/MeV
10-1
10-3
10-5
0
100
200
Sec. Energy
0
50
100
150
200
Energy (MeV)

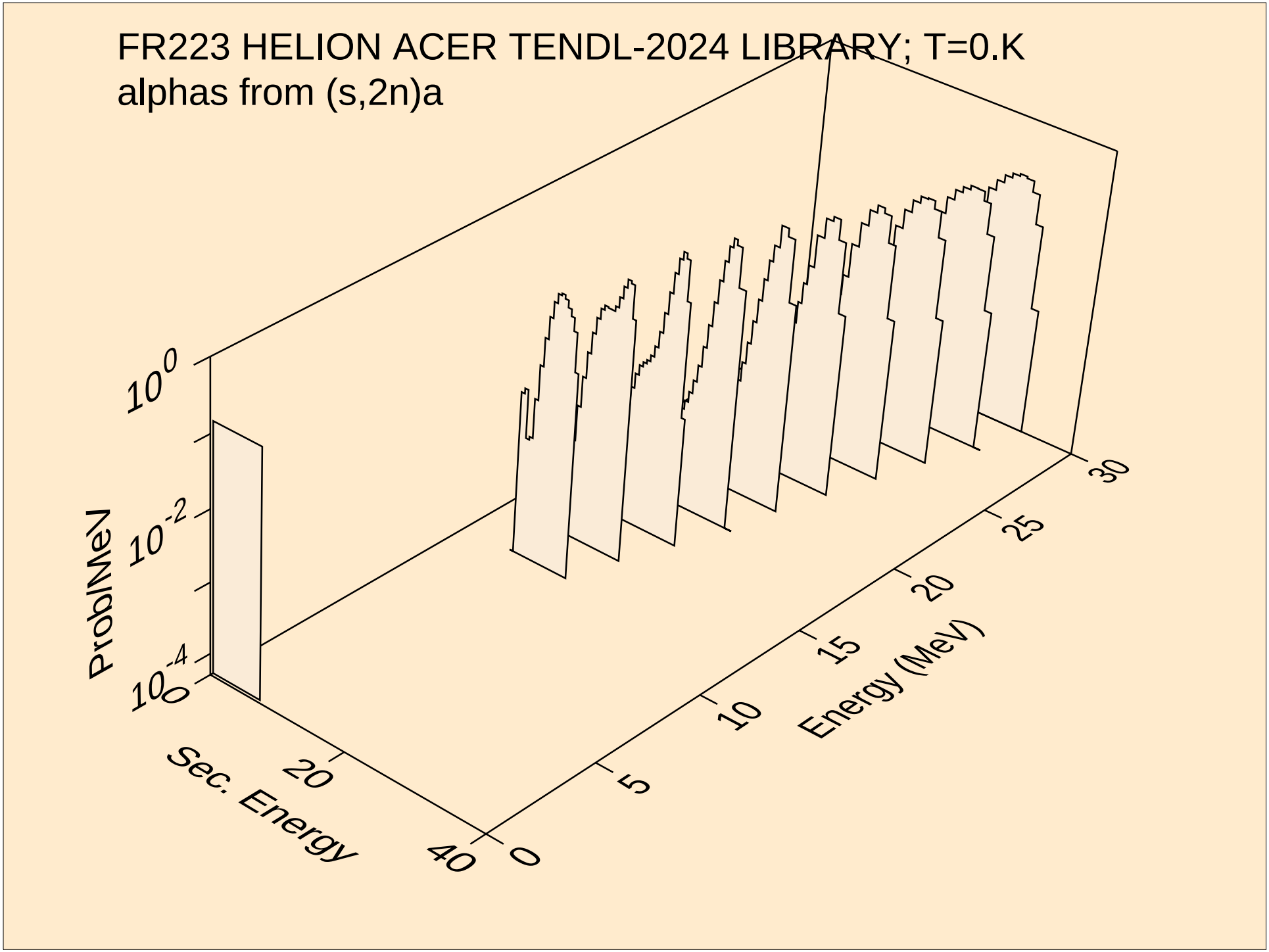

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
tritons from (s,n*)t
Prob/MeV
10^0
10^-2
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)

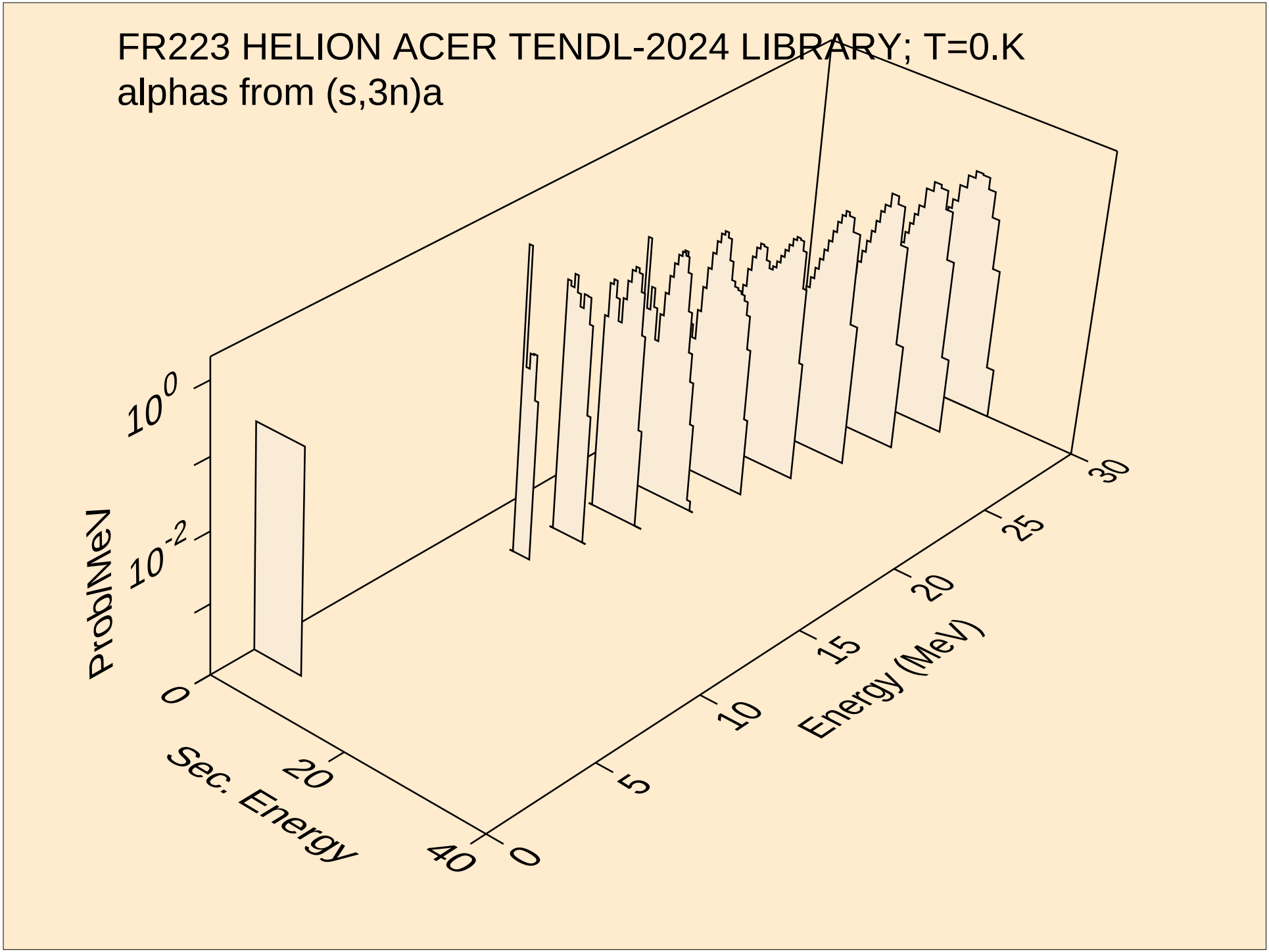

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
tritons from (s,t)
Prob/MeV
10^0
10^-2
10^-4
0
20
40
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)

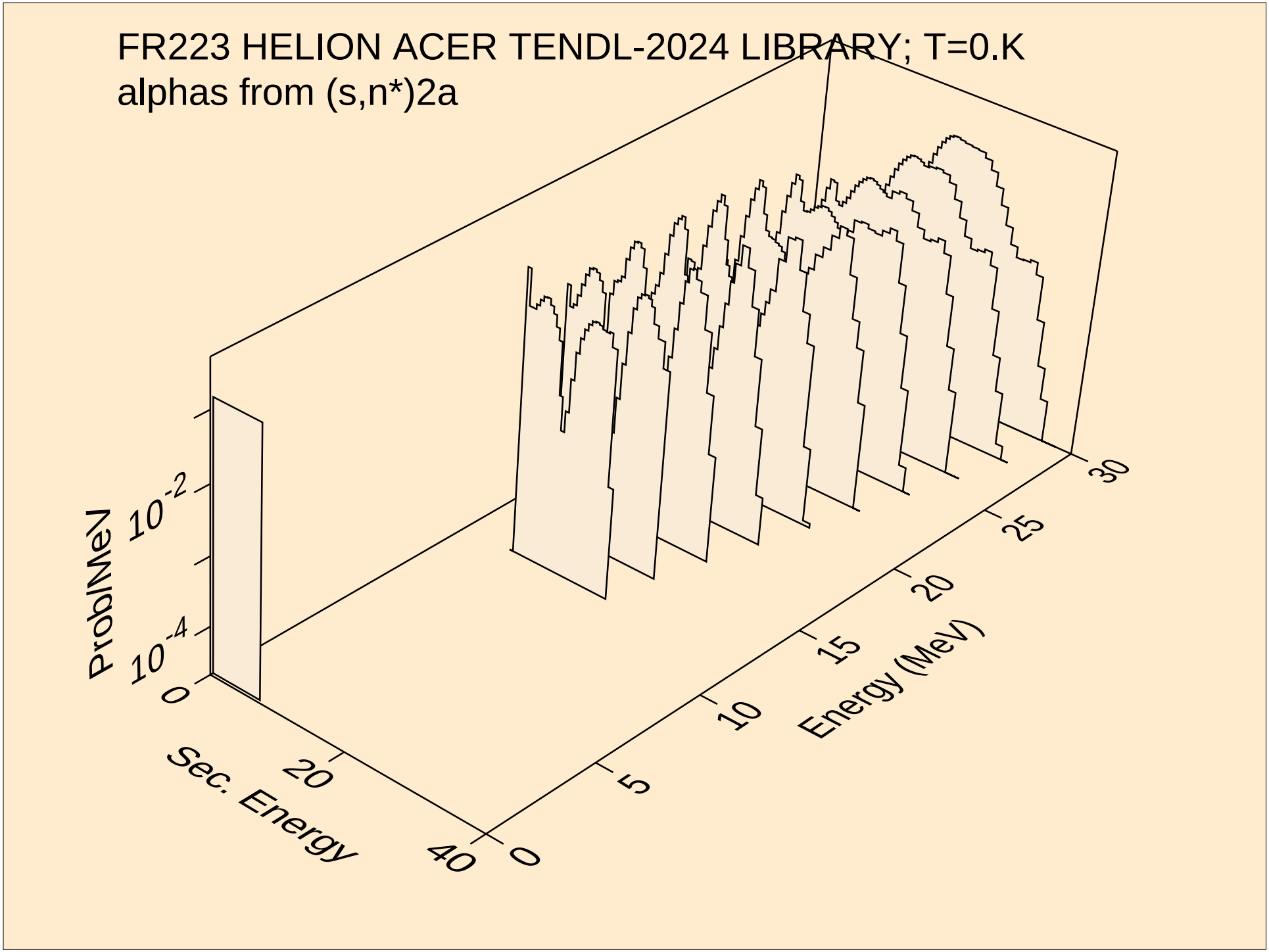

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
tritons from (s,pt)
Prob/MeV
10^0
10^-2
10^-4
0
Sec. Energy
10
20
5
10
15
20
25
30
Energy (MeV)

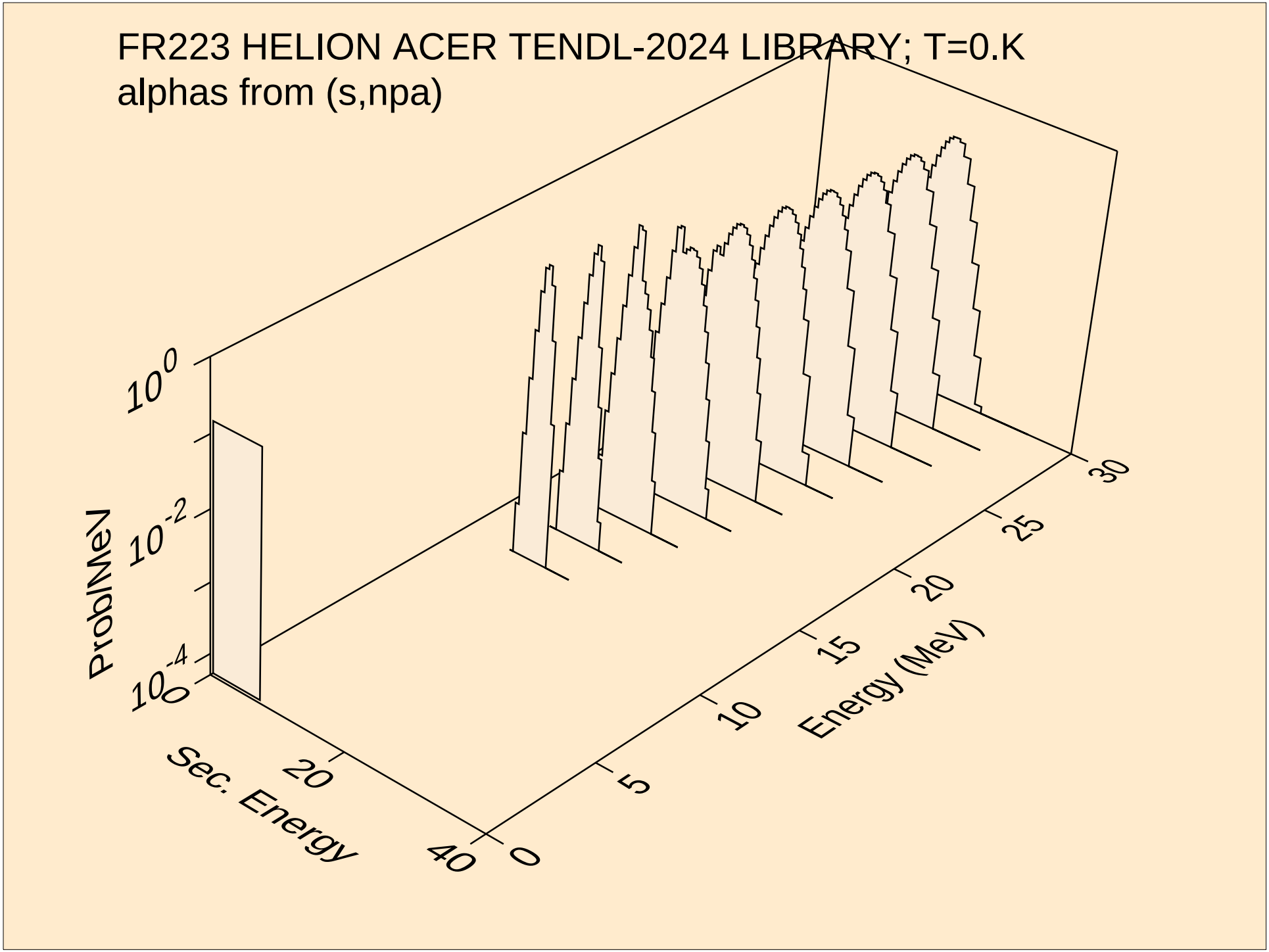

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
alphas from (s,x)
Prob/MeV
10-1
10-3
0
Sec. Energy
50
100
0
50
100
150
200
Energy (MeV)

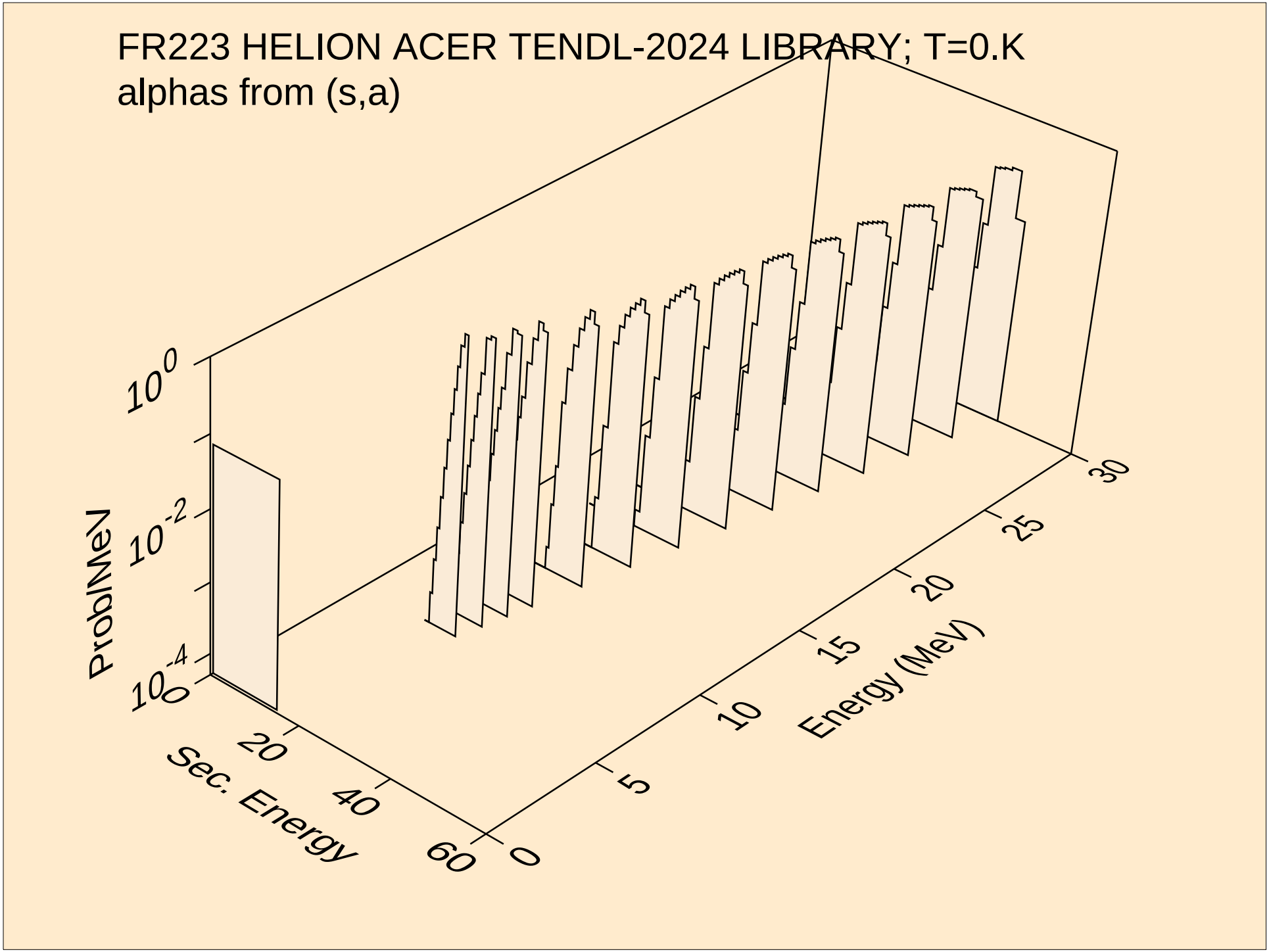

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
alphas from (s,n*)a
Prob/MeV
10^0
10^-2
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)

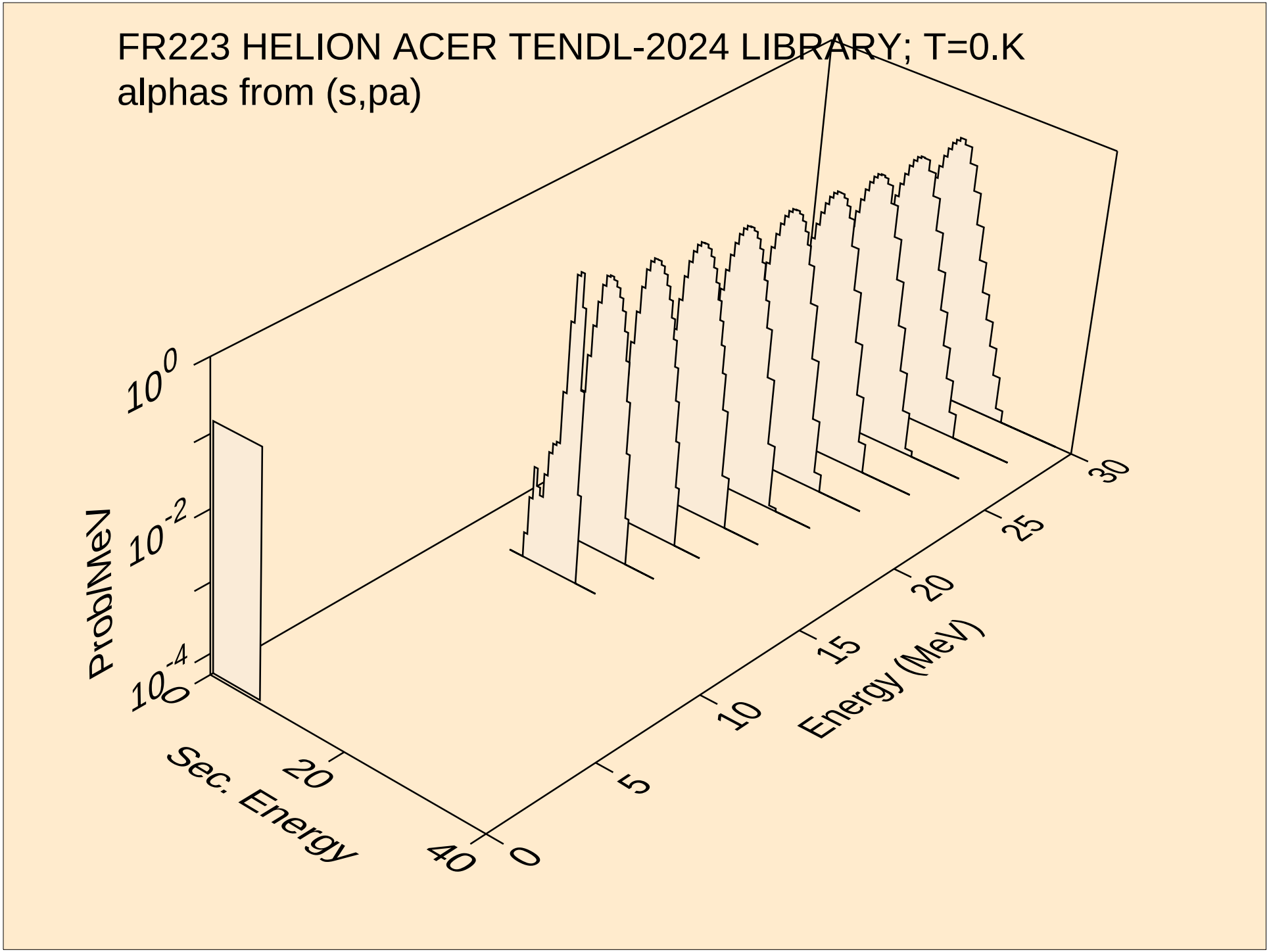

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
alphas from (s,2n)a
Prob/MeV
10^0
10^-2
10^-4
0
20
40
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)

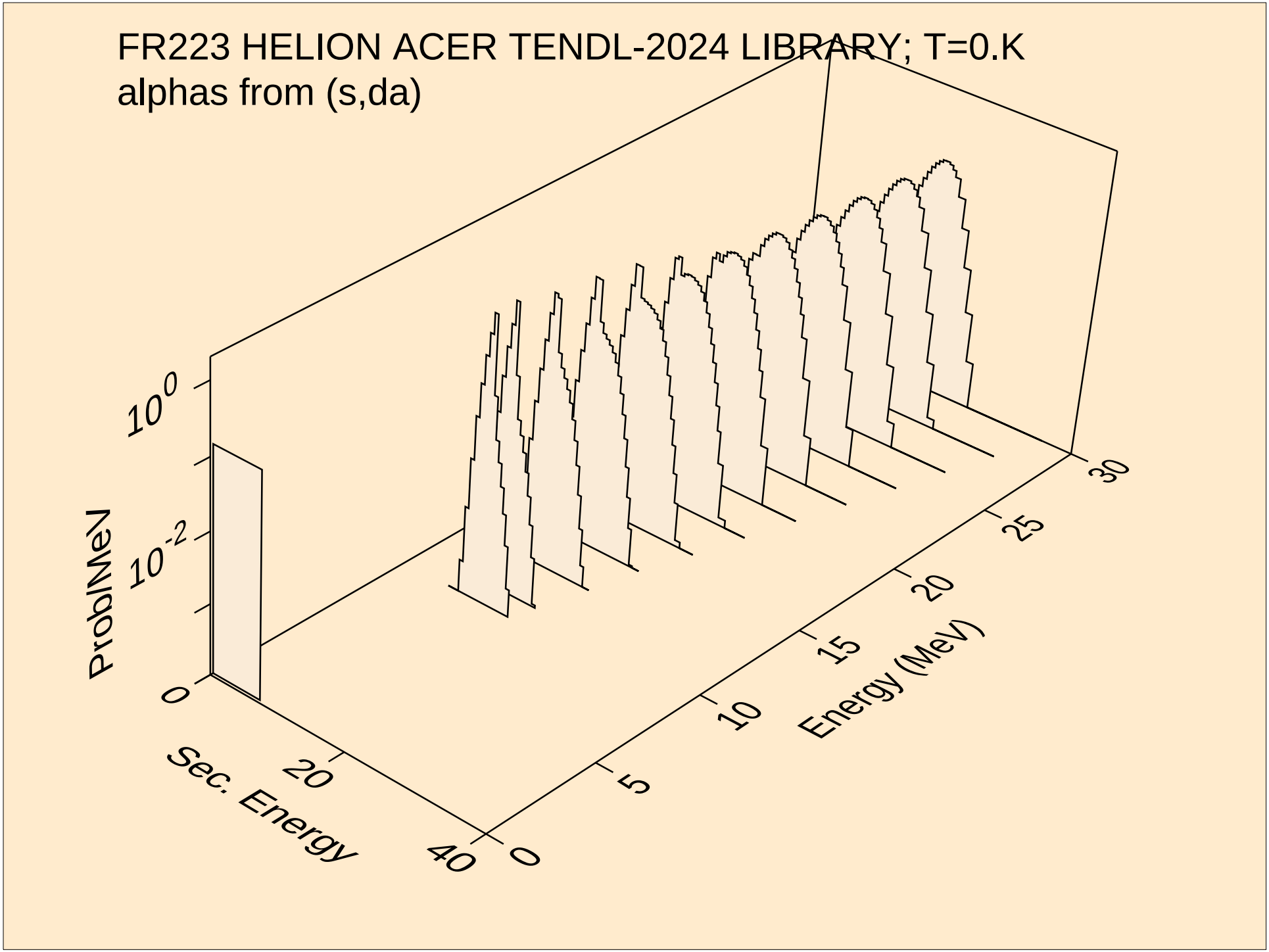

FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
alphas from (s,3n)a
Prob/MeV
10^0
10^-2
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)


FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
alphas from (s,n*)2a
Prob/MeV
10-2
10-4
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)


FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
alphas from (s,npa)
Prob/MeV
10^0
10^-2
10^-4
0
20
40
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)


FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
alphas from (s,a)
Prob/MeV
10^{0}
10^{-2}
10^{-4}
0
20
40
60
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)


FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
alphas from (s,pa)
Prob/MeV
10^{0}
10^{-2}
10^{-4}
0
20
40
Sec. Energy
0
5
10
15
20
25
30
Energy (MeV)


FR223 HELION ACER TENDL-2024 LIBRARY; T=0.K
alphas from (s,da)
Prob/MeV
10^0
10^-2
0
Sec. Energy
20
40
0
5
10
15
20
25
30
Energy (MeV)