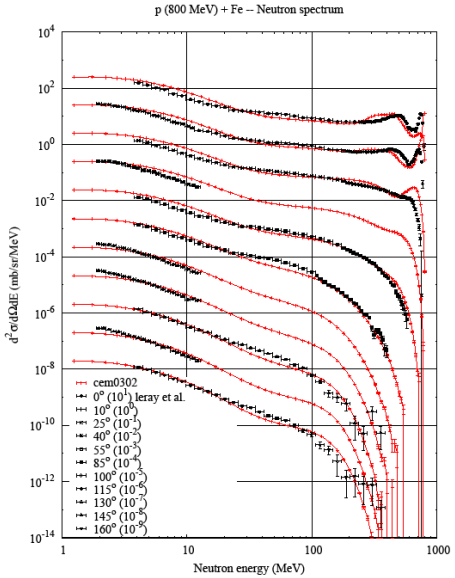
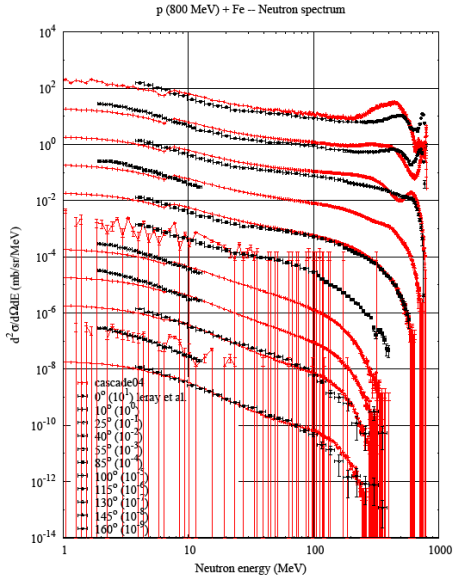
Spallation reactions consultants meeting
IAEA, Oct. 6-7, 2009 Vienna

Detlef Filges

General Trends on

- **Neutrons**
- **LCP'S**
- **Residue Production**
- **Pions**
- **Residue Production**
- **Excitation functions**


p (800 MeV) + Fe -- Neutron spectrum
d²σ/dΩdE (mb/sr/MeV)
Neutron energy (MeV)
cem0302
0° (10¹) leray et al.
10° (10⁰)
25° (10⁻¹)
40° (10⁻²)
55° (10⁻³)
85° (10⁻⁴)
100° (10⁻⁵)
115° (10⁻⁶)
130° (10⁻⁷)
145° (10⁻⁸)
160° (10⁻⁹)


p (800 MeV) + Fe -- Neutron spectrum
d²σ/dΩdE (mb/sr/MeV)
Neutron energy (MeV)
cascade04
0° (10¹) leray et al.
10° (10⁰)
25° (10⁻¹)
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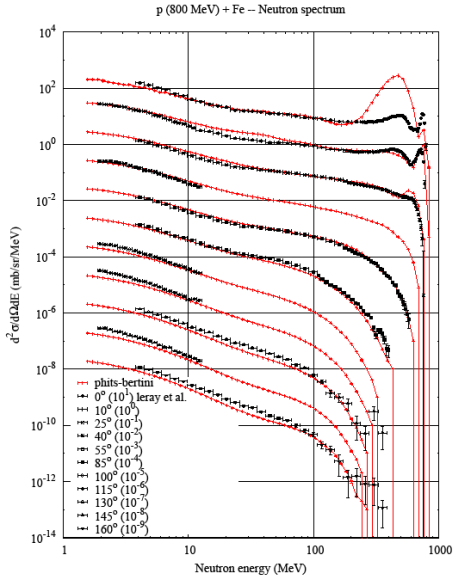
p (800 MeV) + Fe -- Neutron spectrum
d²σ/dΩdE (mb/sr/MeV)
Neutron energy (MeV)
phits-bertini
0° (10¹) leray et al.
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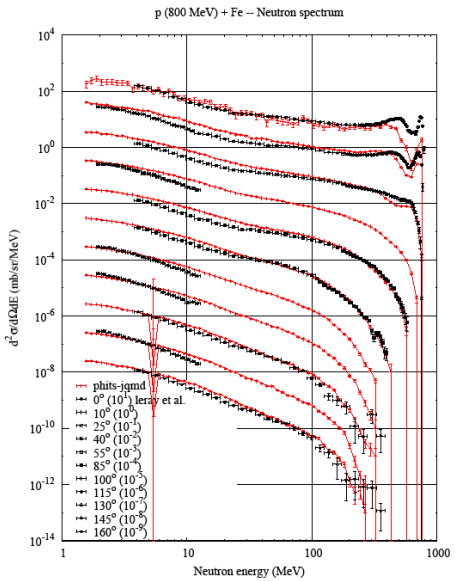
p (800 MeV) + Fe -- Neutron spectrum
d²σ/dΩdE (mb/sr/MeV)
Neutron energy (MeV)
phits-jqmd
0° (10¹) leray et al.
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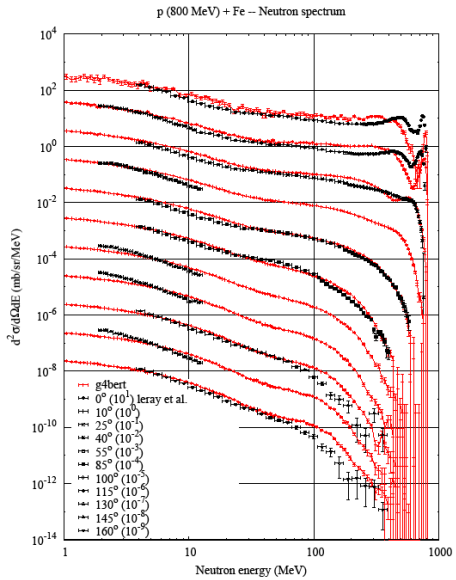
p (800 MeV) + Fe -- Neutron spectrum
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Neutron energy (MeV)
g4bert
0° (10¹) leray et al.
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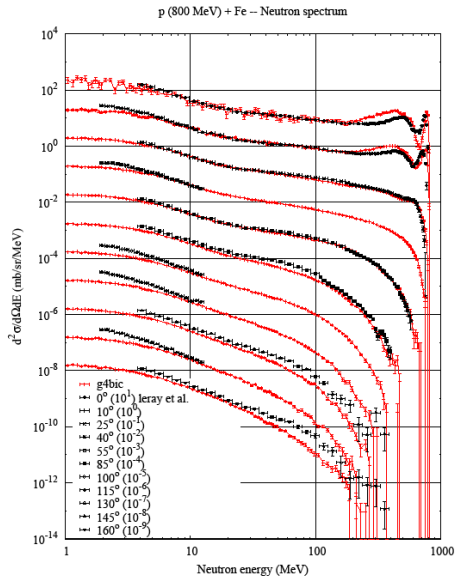
p (800 MeV) + Fe -- Neutron spectrum
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Neutron energy (MeV)
g4bic
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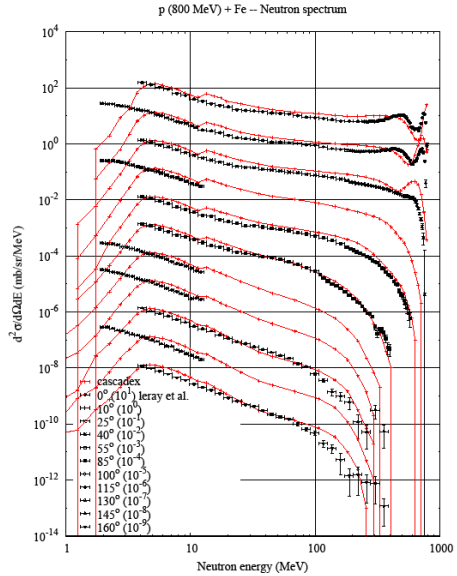
p (800 MeV) + Fe -- Neutron spectrum
d²σ/dΩdE (mb/sr/MeV)
Neutron energy (MeV)
cascadex
0° (10⁻¹) leray et al.
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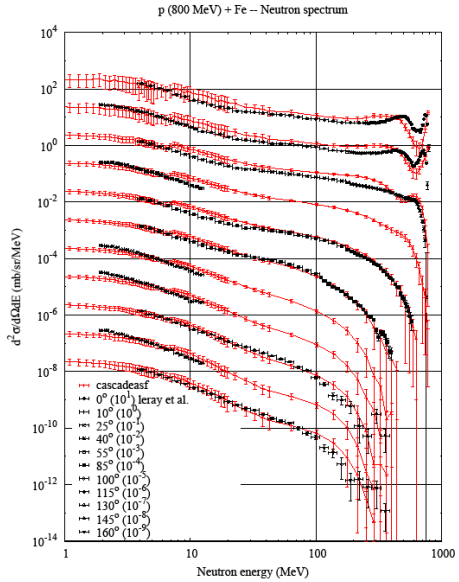
p (800 MeV) + Fe -- Neutron spectrum
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Neutron energy (MeV)
cascadeasf
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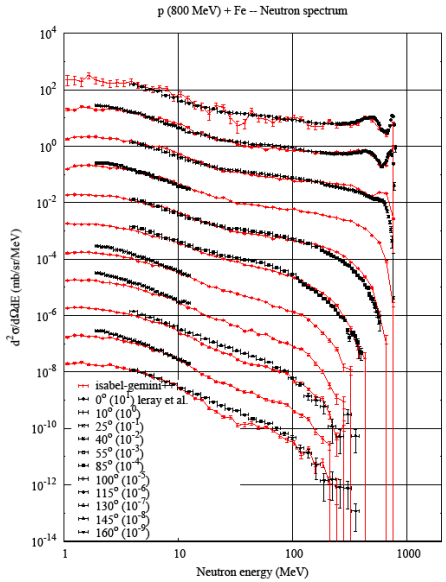
p (800 MeV) + Fe -- Neutron spectrum
d²σ/dΩdE (mb/sr/MeV)
Neutron energy (MeV)
isabel-gemini
0° (10⁻¹) leray et al.
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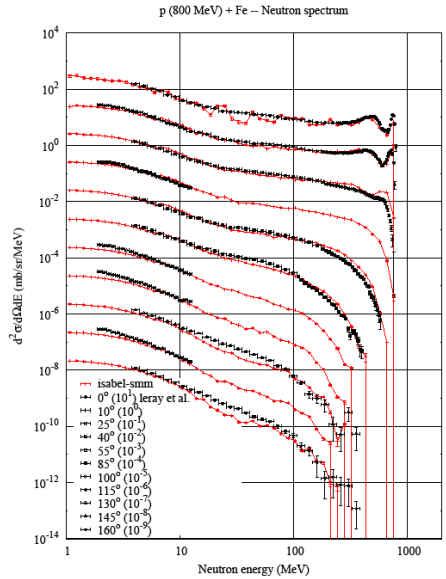
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d²σ/dΩdE (mb/sr/MeV)
Neutron energy (MeV)
isabel-smm
0° (10⁻¹) leray et al.
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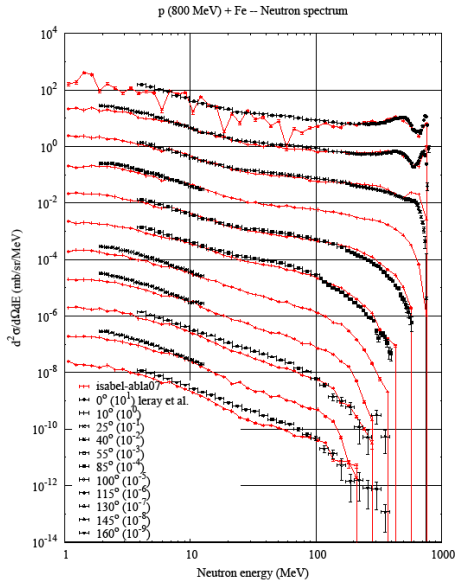
p (800 MeV) + Fe -- Neutron spectrum
d²σ/dΩdE (mb/sr/MeV)
Neutron energy (MeV)
isabel-abla07
0° (10⁻¹) leray et al.
10° (10⁰)
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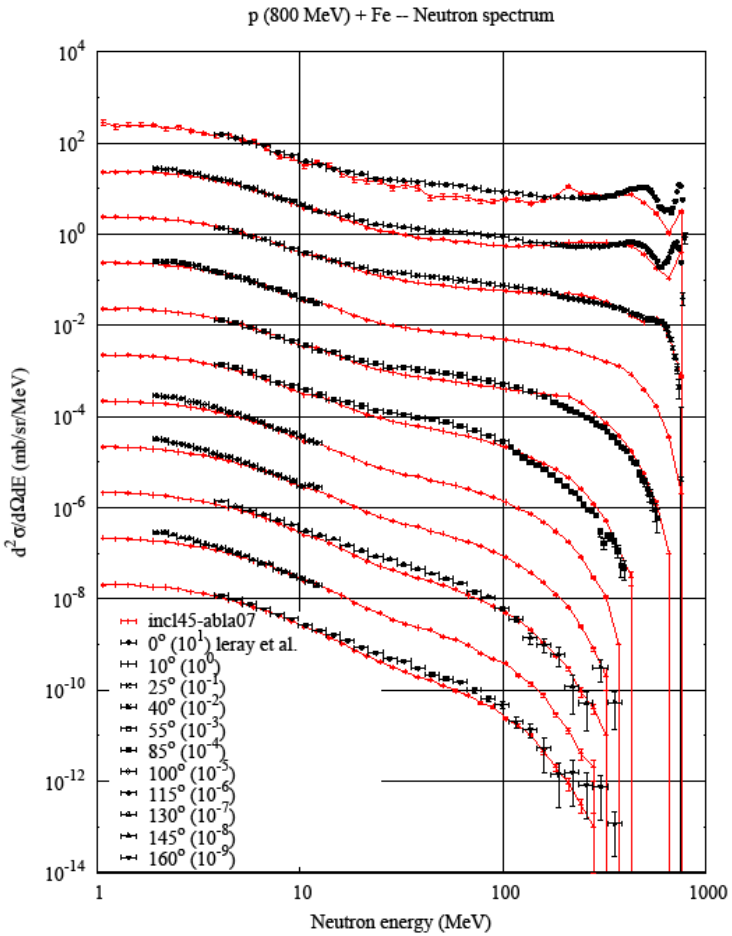
p (800 MeV) + Fe -- Neutron spectrum
d²σ/dΩdE (mb/sr/MeV)
Neutron energy (MeV)
incl45-abla07
0° (10¹) leray et al.
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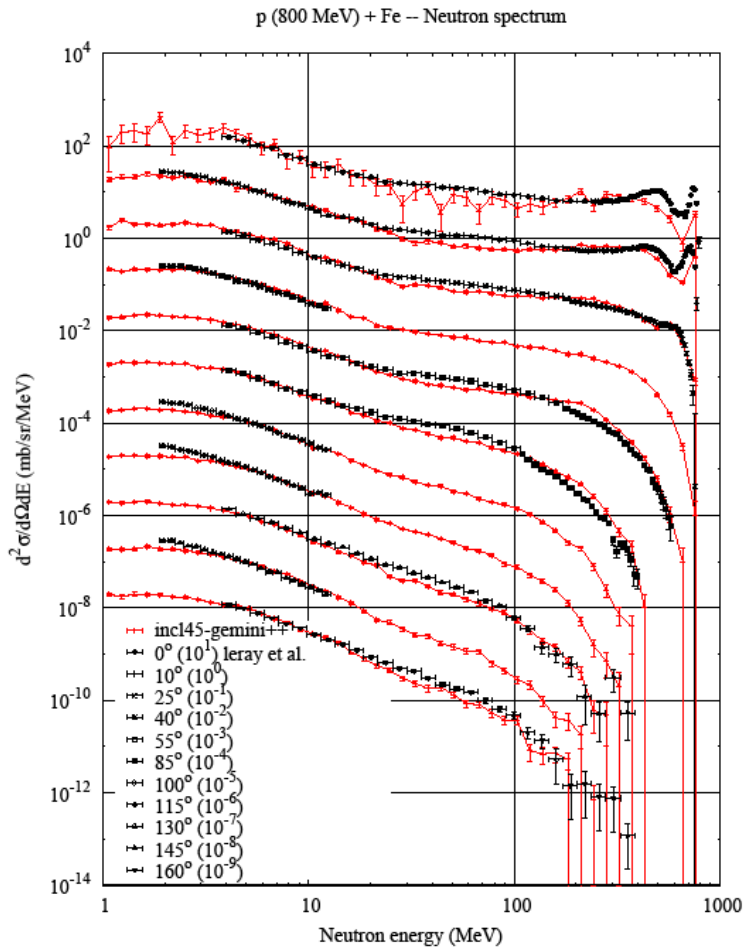
p (800 MeV) + Fe -- Neutron spectrum
d²σ/dΩdE (mb/sr/MeV)
Neutron energy (MeV)
incl45-gemini++
0° (10¹) leray et al.
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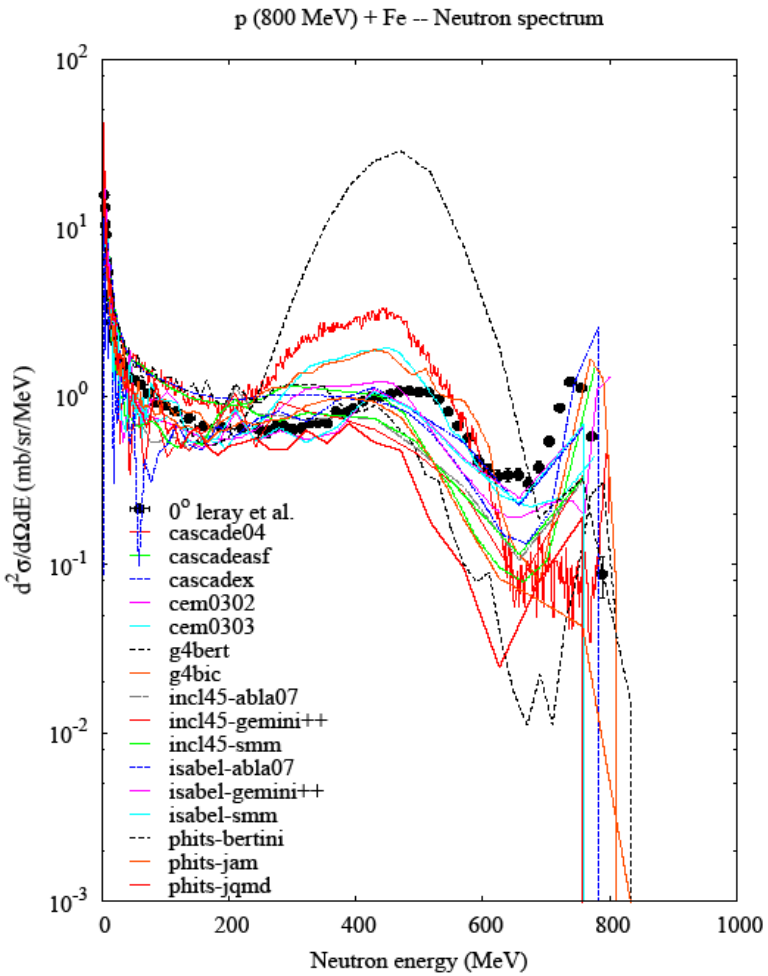
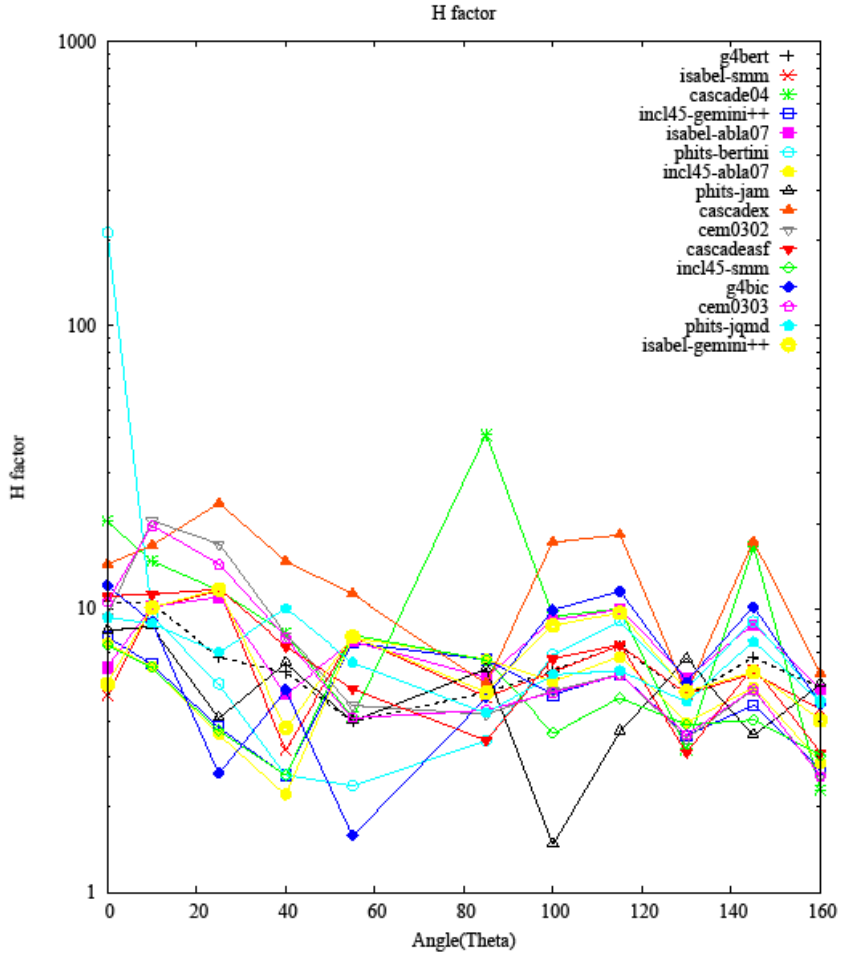

p (800 MeV) + Fe -- Neutron spectrum
d²σ/dΩdE (mb/sr/MeV)
Neutron energy (MeV)
0° leray et al.
cascade04
cascadeasf
cascadex
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
phits-bertini
phits-jam
phits-jqmd


H factor
H factor
Angle(Theta)
g4bert
isabel-smm
cascade04
incl45-gemini++
isabel-abla07
phits-bertini
incl45-abla07
phits-jam
cascadex
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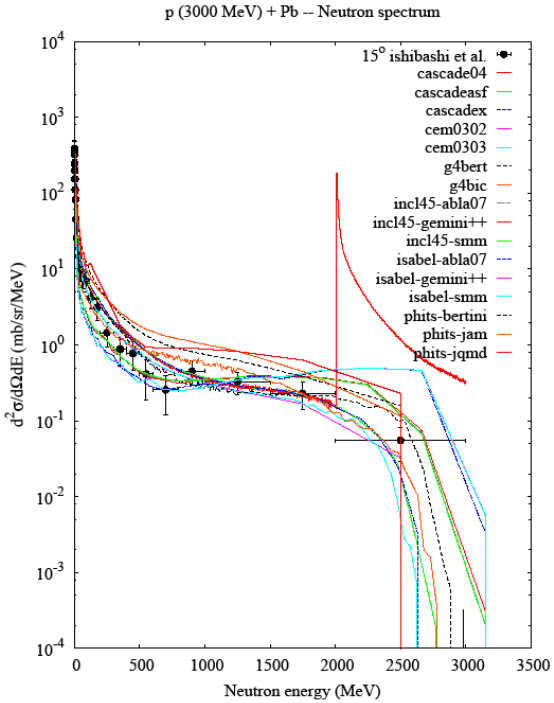
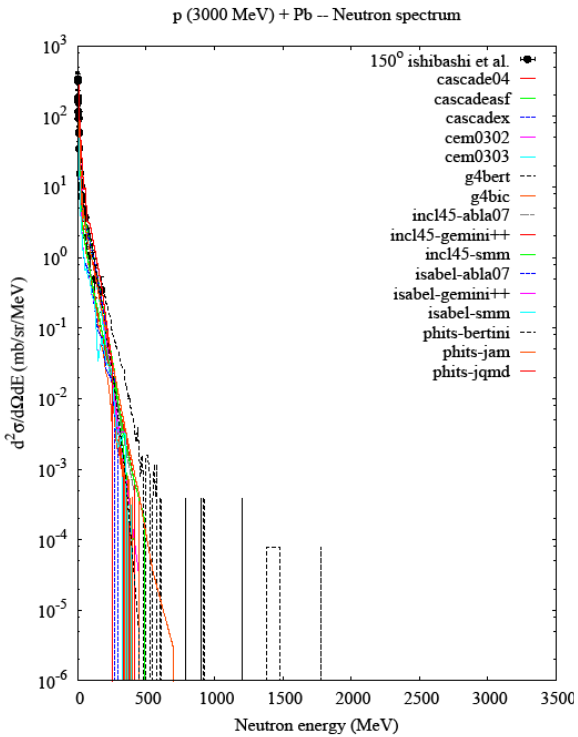
cem0303
phits-jqmd
isabel-gemini++


p (3000 MeV) + Pb -- Neutron spectrum
15° ishibashi et al.
cascade04
cascadeasf
cascadex
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
phits-bertini
phits-jam
phits-jqmd
d²σ/dΩdE (mb/sr/MeV)
Neutron energy (MeV)


p (3000 MeV) + Pb -- Neutron spectrum
150° ishibashi et al.
cascade04
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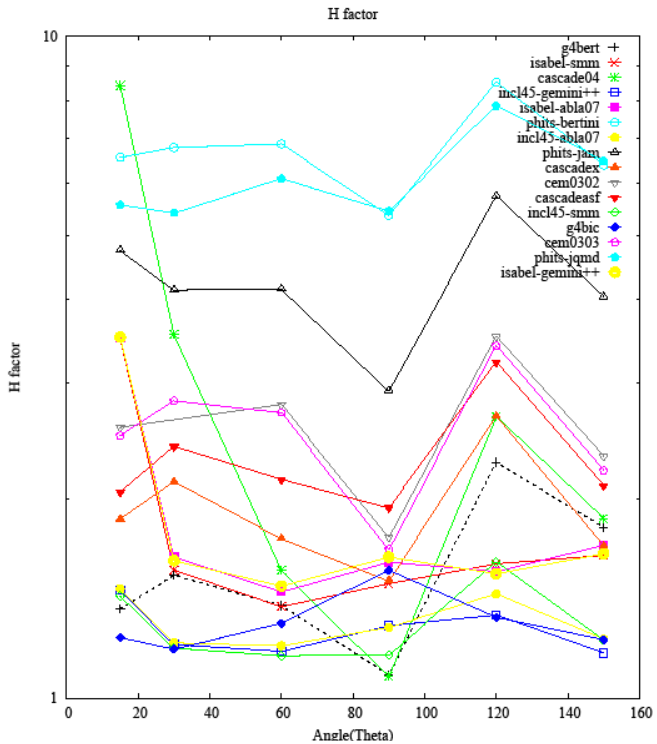
cascadex
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
phits-bertini
phits-jam
phits-jqmd
d²σ/dΩdE (mb/sr/MeV)
Neutron energy (MeV)


H factor
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cascade04
incl45-gemini++
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incl45-abla07
phits-jam
cascadex
cem0302
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g4bic
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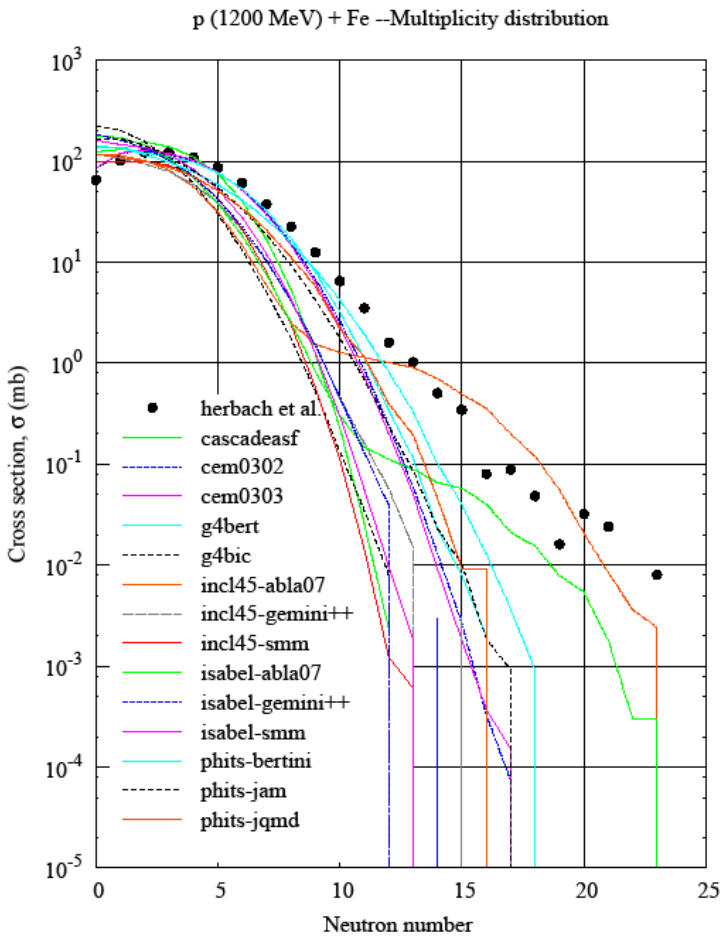
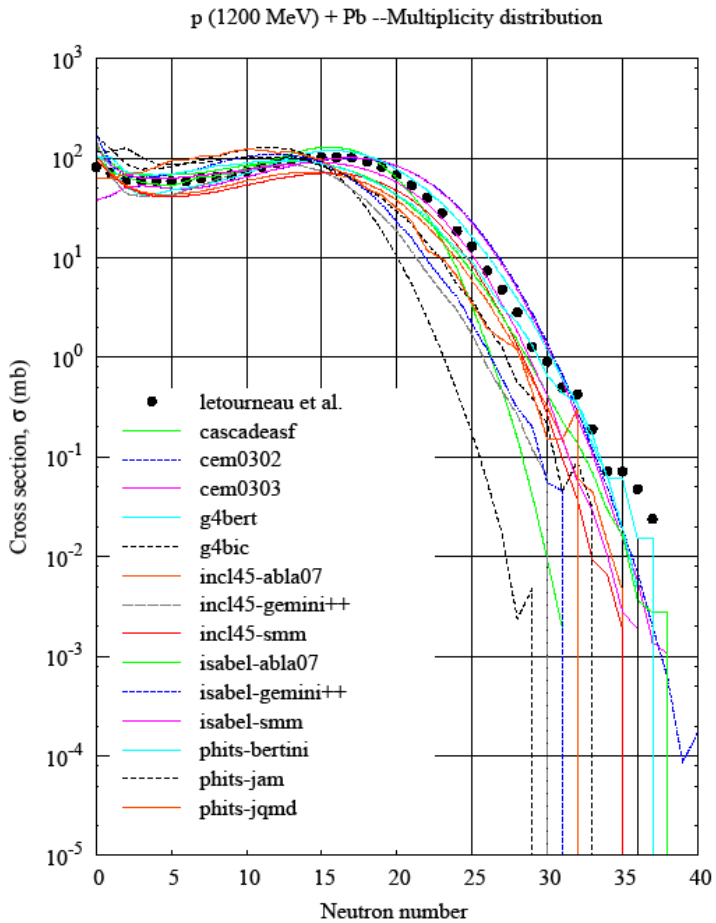
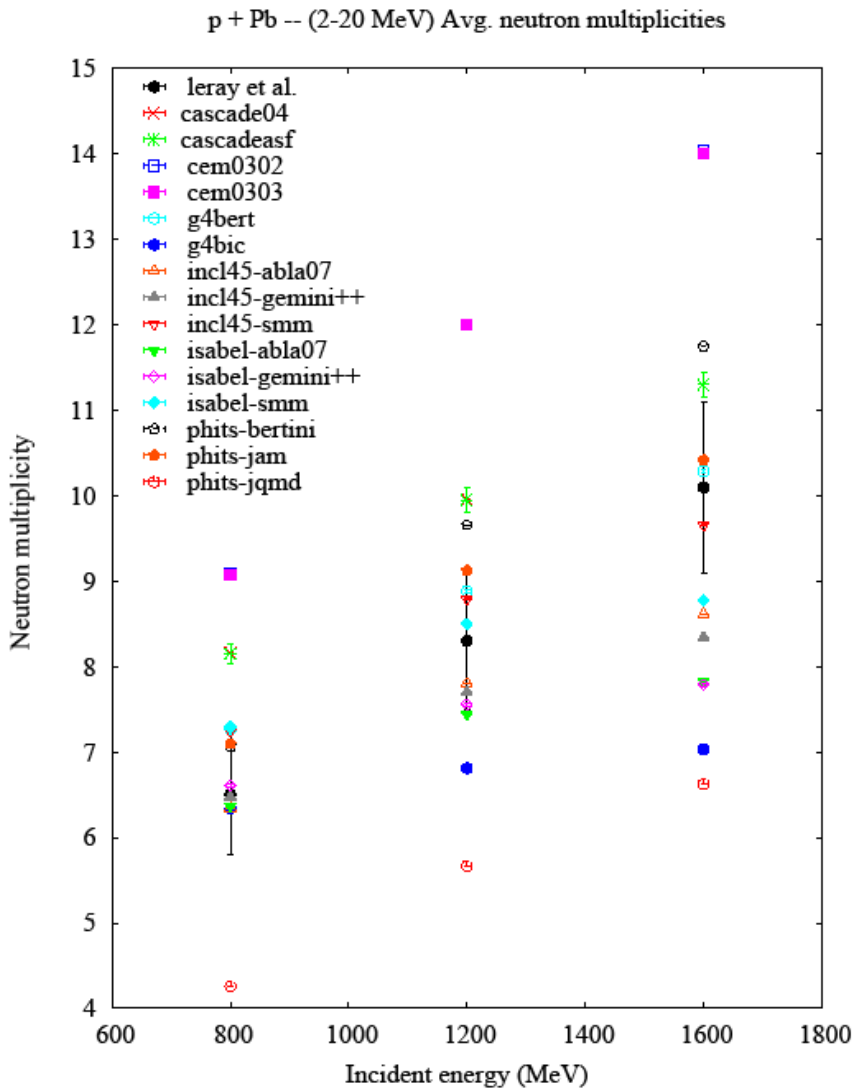
phits-jqmd
isabel-gemini++
H factor
Angle(Theta)

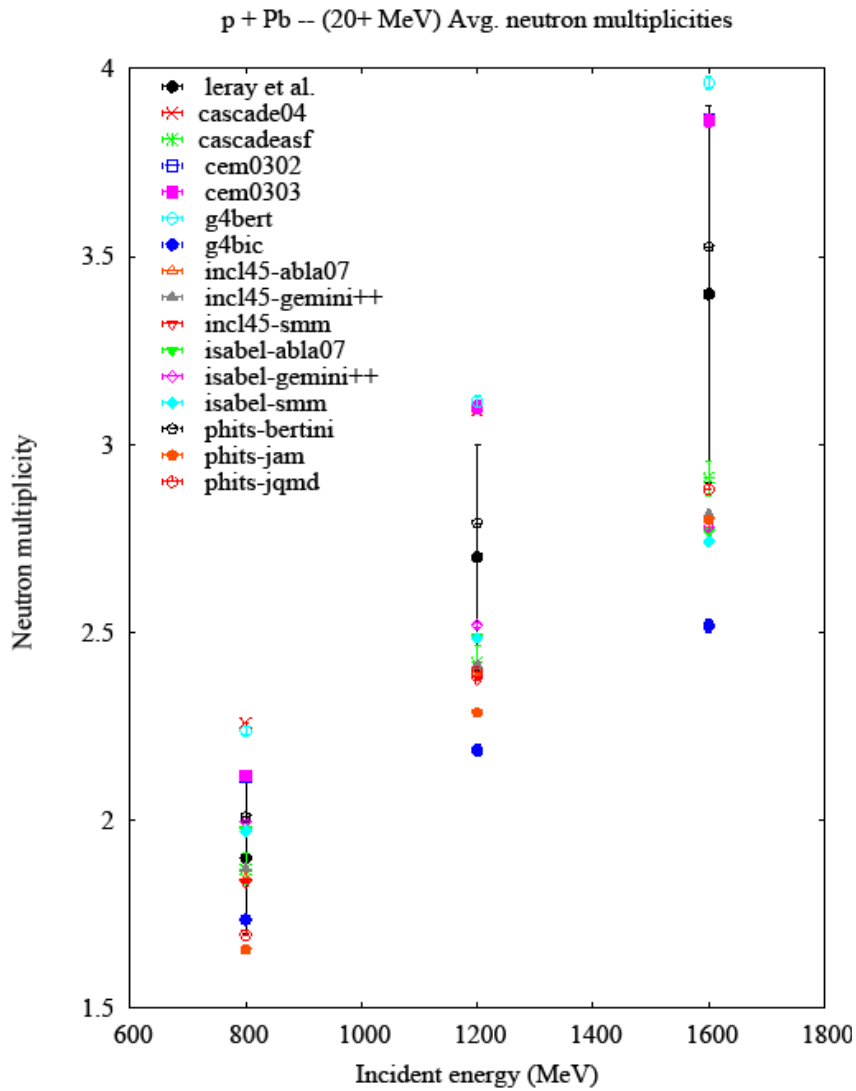
Multiplicity Distributions



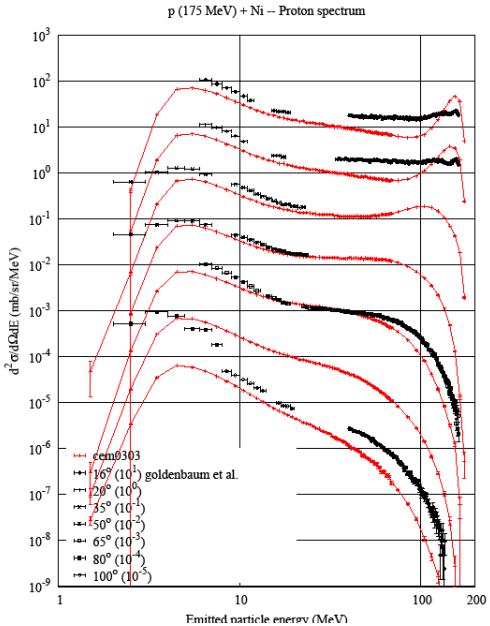


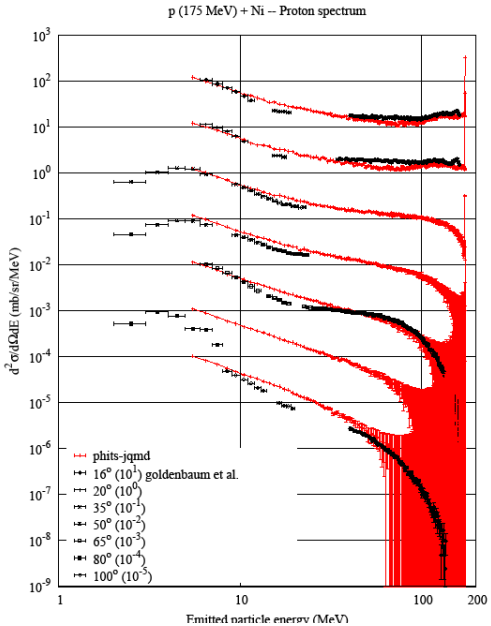
Average multiplicity





LCP‘s


p (175 MeV) + Ni -- Proton spectrum
d²σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)
cem03.03
16° (10¹) goldenbaum et al.
20° (10⁰)
35° (10⁻¹)
50° (10⁻²)
65° (10⁻³)
80° (10⁻⁴)
100° (10⁻⁵)


p (175 MeV) + Ni -- Proton spectrum
d²σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)
phits-jqmd
16° (10¹) goldenbaum et al.
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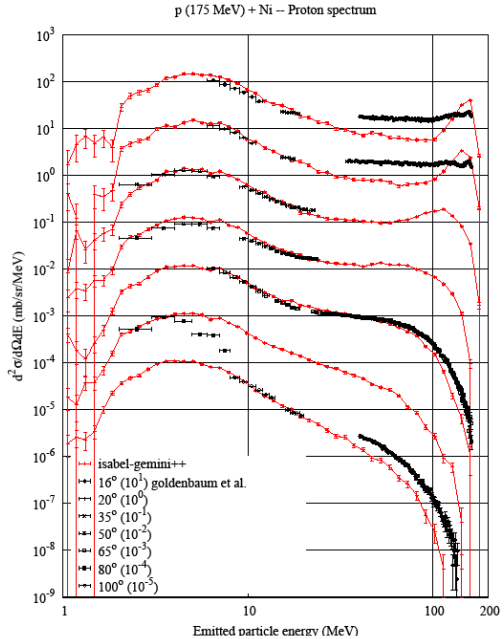
p (175 MeV) + Ni -- Proton spectrum
d²σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)
isabel-gemini++
16° (10¹) goldenbaum et al.
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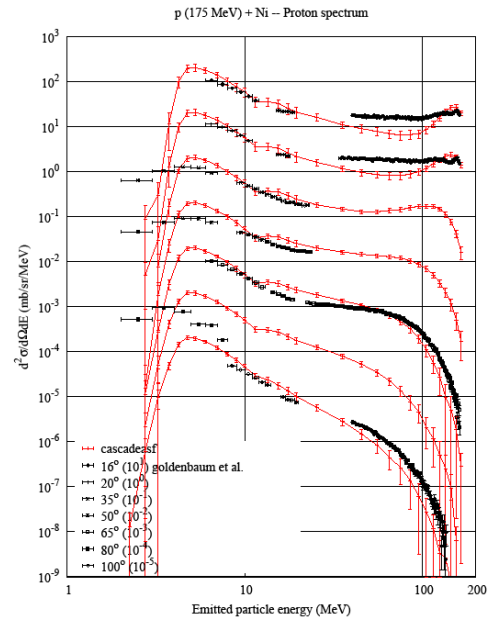
p (175 MeV) + Ni -- Proton spectrum
d²σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)
cascadeasf
16° (10¹) goldenbaum et al.
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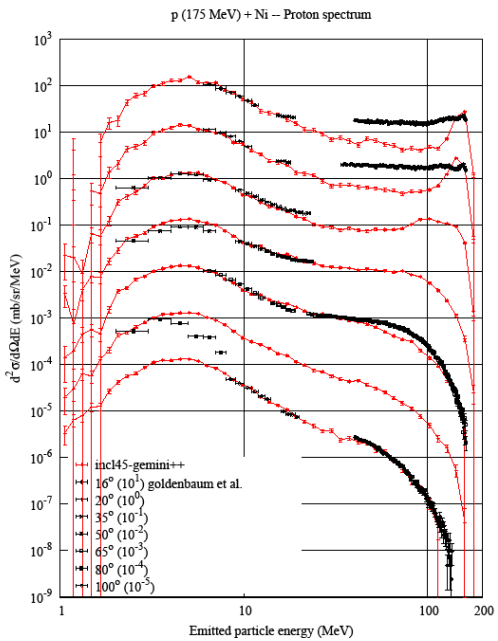
p (175 MeV) + Ni -- Proton spectrum
d²σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)
incl45-gemini++
16° (10¹) goldenbaum et al.
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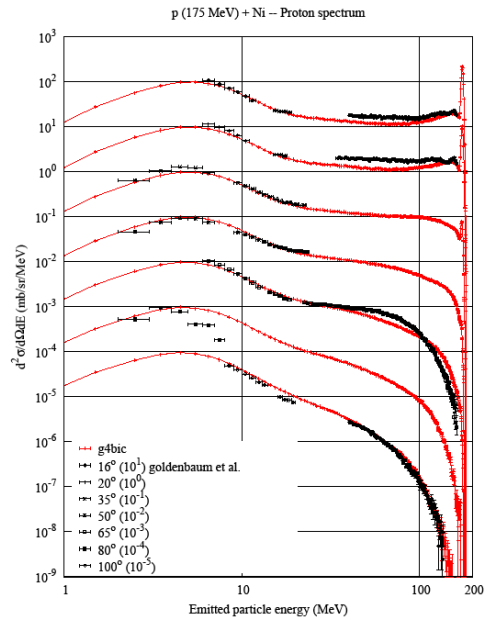
p (175 MeV) + Ni -- Proton spectrum
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Emitted particle energy (MeV)
g4bic
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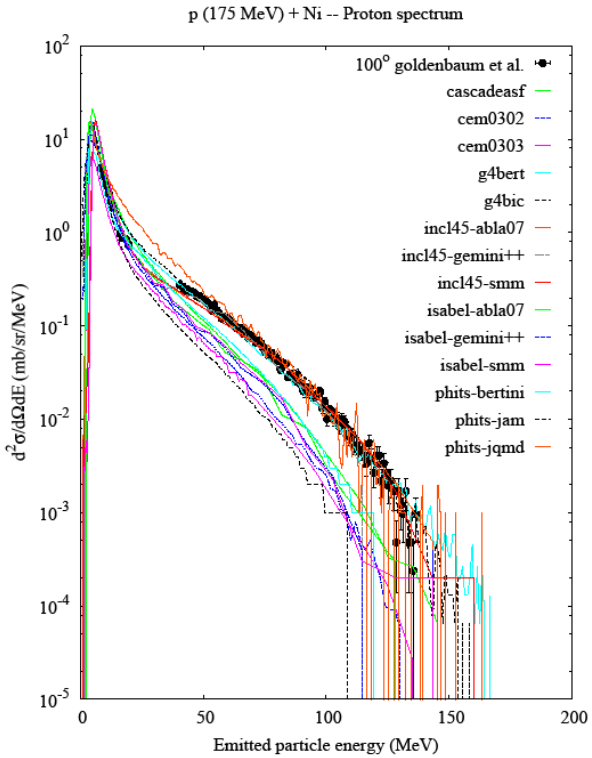
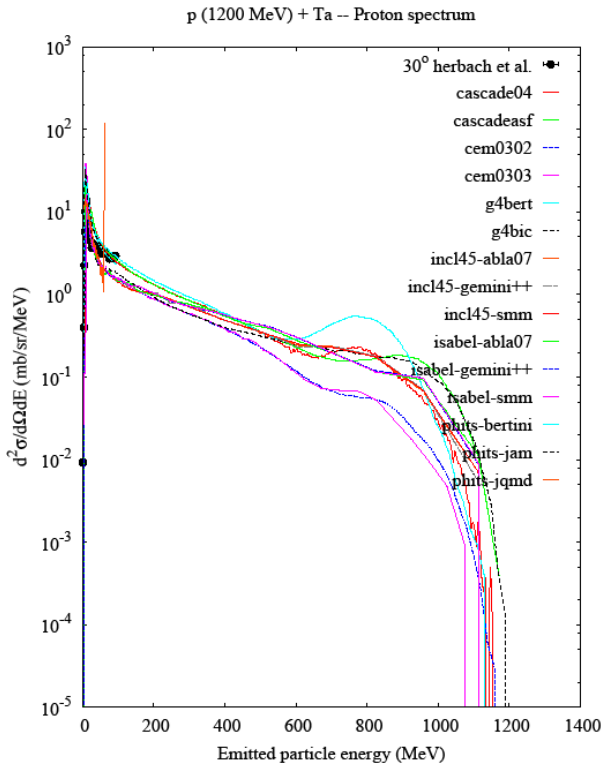
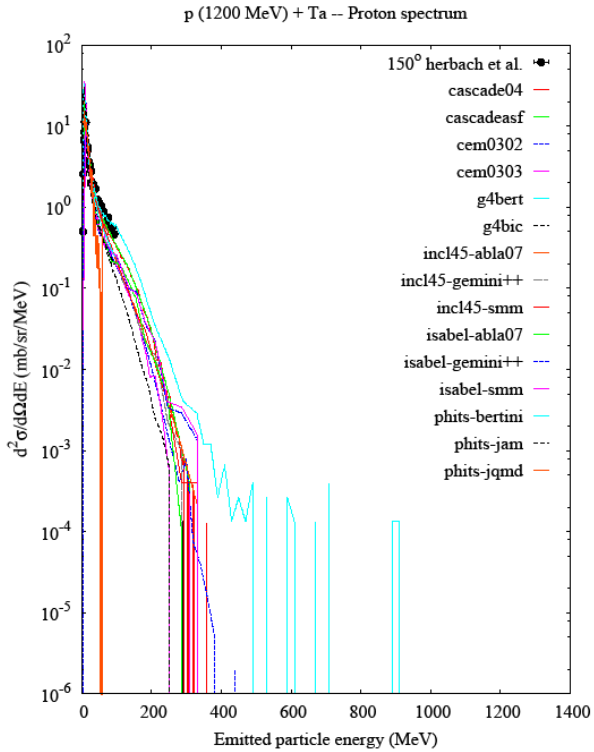
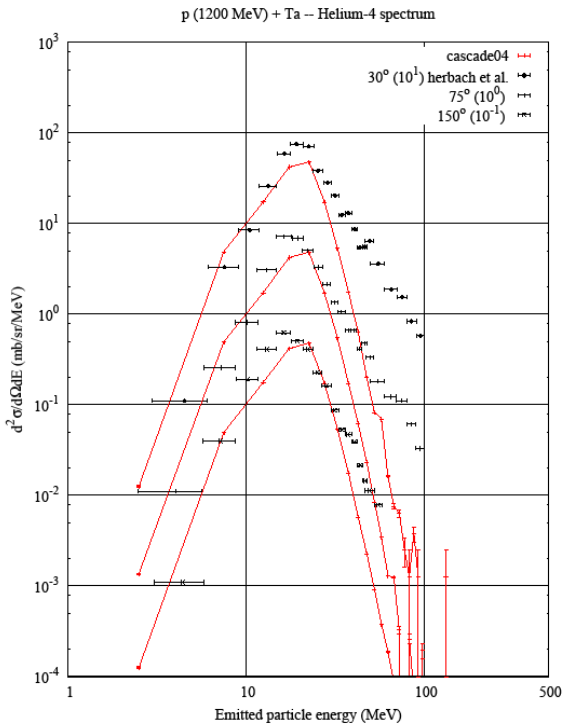
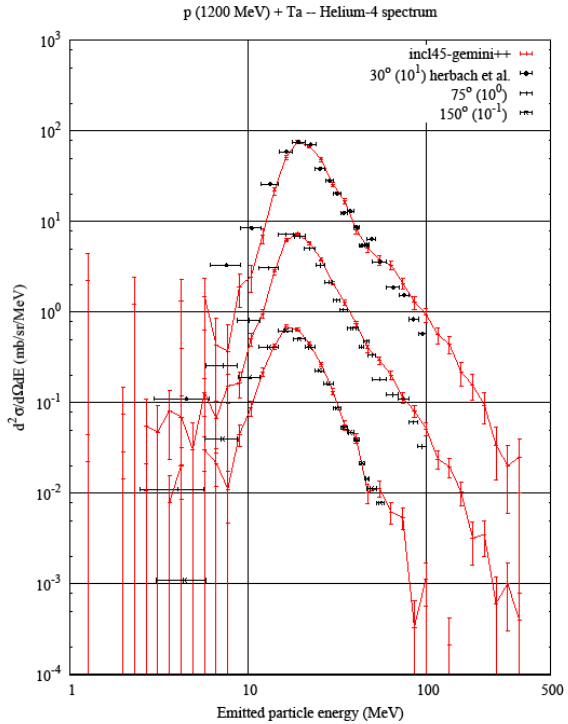
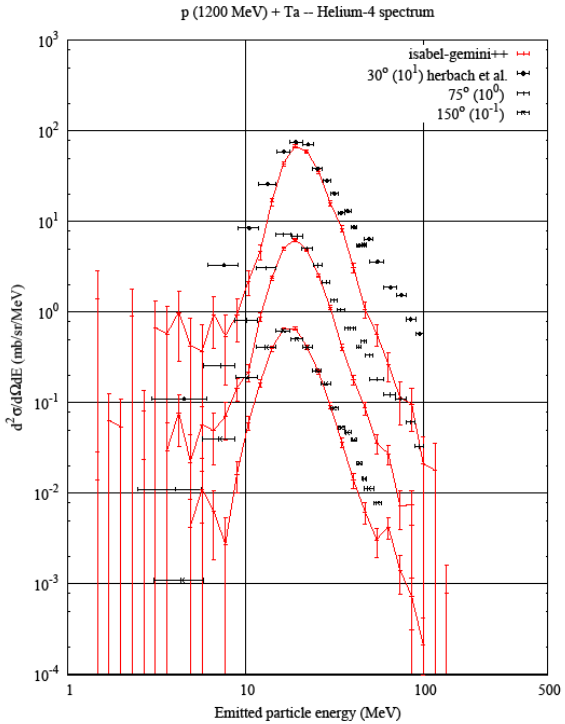

p (175 MeV) + Ni -- Proton spectrum
100° goldenbaum et al.
cascadeasf
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
phits-bertini
phits-jam
phits-jqmd
d²σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)

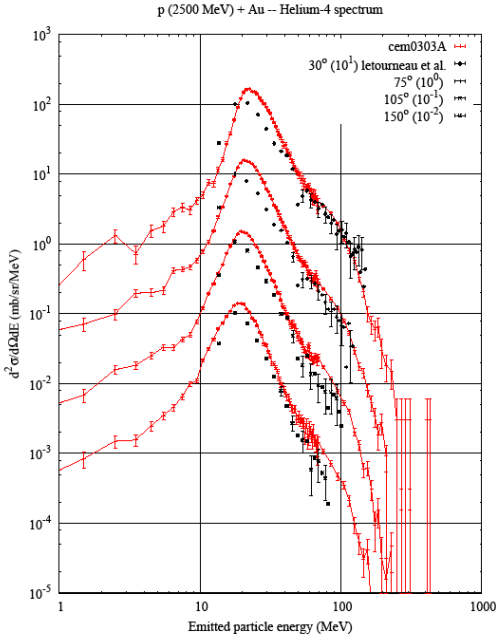

p (1200 MeV) + Ta -- Proton spectrum
30° herbach et al.
cascade04
cascadeasf
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
phits-bertini
phits-jam
phits-jqmd
d²σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)

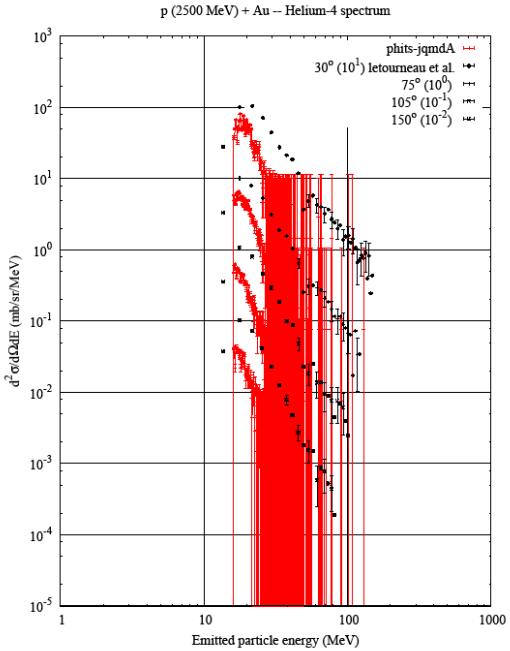

p (1200 MeV) + Ta -- Proton spectrum
150° herbach et al.
cascade04
cascadeasf
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
phits-bertini
phits-jam
phits-jqmd
d²σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)

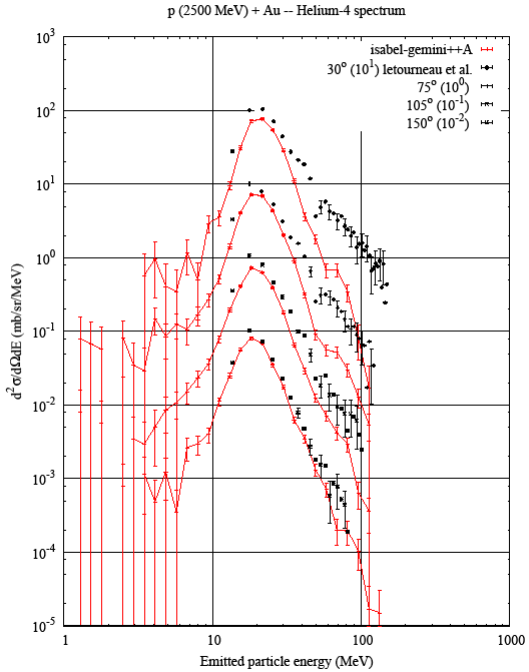

p (1200 MeV) + Ta -- Helium-4 spectrum
cascade04
30° (10^1) herbach et al.
75° (10^0)
150° (10^-1)
d^2σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)

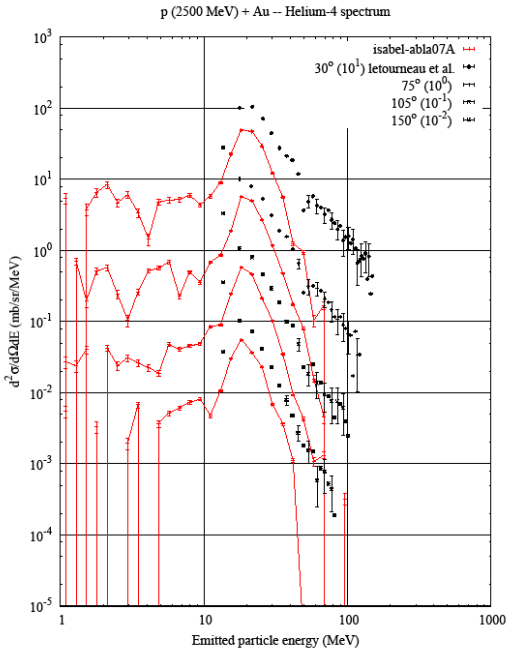

p (1200 MeV) + Ta -- Helium-4 spectrum
incl45-gemini++
30° (10^1) herbach et al.
75° (10^0)
150° (10^-1)
d^2σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)

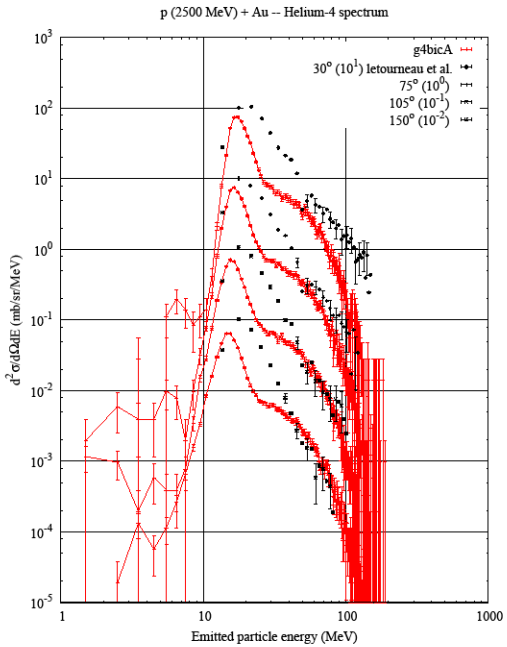

p (1200 MeV) + Ta -- Helium-4 spectrum
isabel-gemini++
30° (10^1) herbach et al.
75° (10^0)
150° (10^-1)
d^2σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)

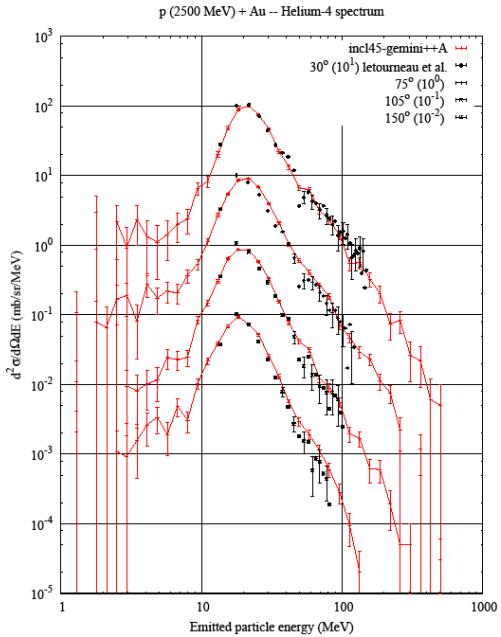

p (2500 MeV) + Au -- Helium-4 spectrum
cem0303A
30° (10^1) letourneau et al.
75° (10^0)
105° (10^-1)
150° (10^-2)
d^2σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)

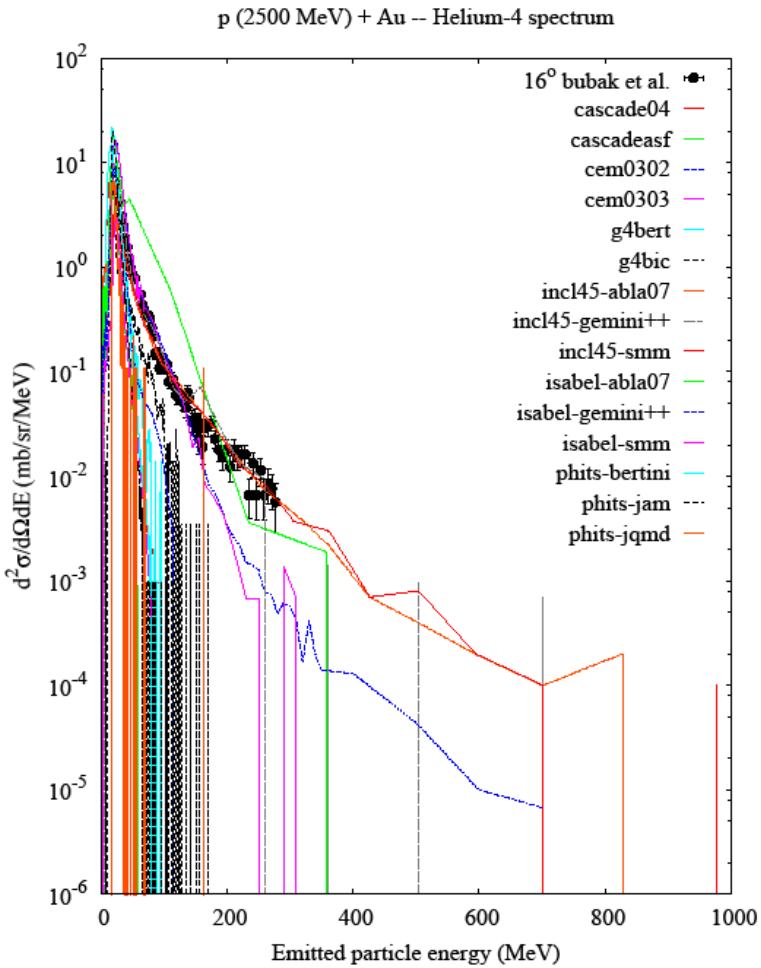

p (2500 MeV) + Au -- Helium-4 spectrum
phits-jqmdA
30° (10^1) letourneau et al.
75° (10^0)
105° (10^-1)
150° (10^-2)
d^2σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)

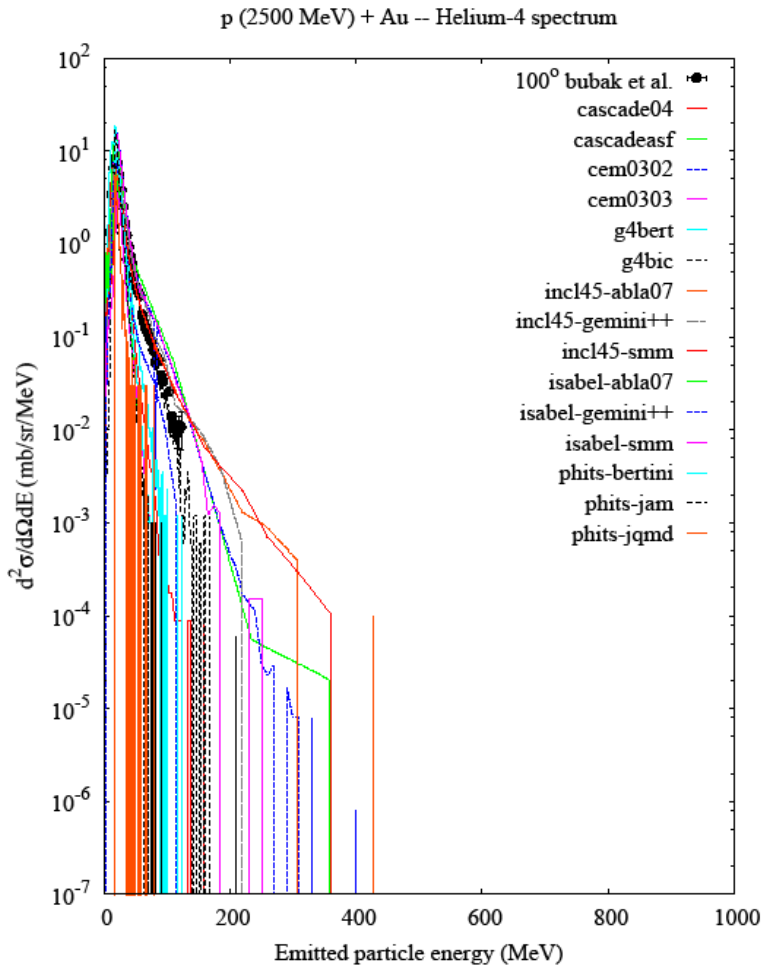

p (2500 MeV) + Au -- Helium-4 spectrum
isabel-gemini++A
30° (10^1) letourneau et al.
75° (10^0)
105° (10^-1)
150° (10^-2)
d^2σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)


p (2500 MeV) + Au -- Helium-4 spectrum
isabel-abla07A
30° (10^1) letourneau et al.
75° (10^0)
105° (10^-1)
150° (10^-2)
d^2σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)

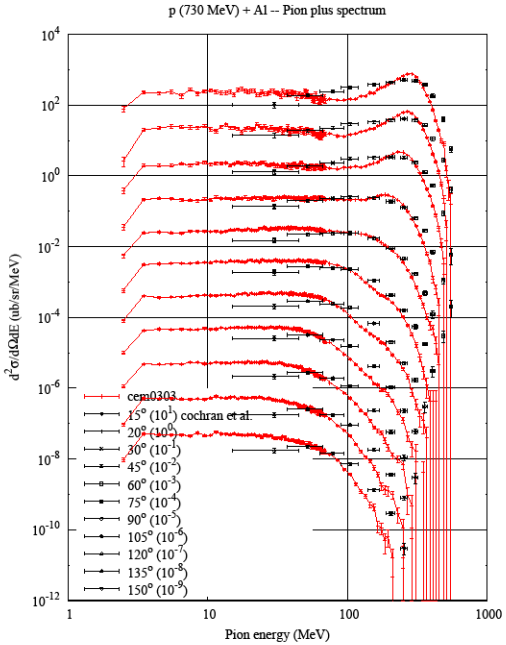

p (2500 MeV) + Au -- Helium-4 spectrum
g4bicA
30° (10^1) letourneau et al.
75° (10^0)
105° (10^-1)
150° (10^-2)
d^2σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)

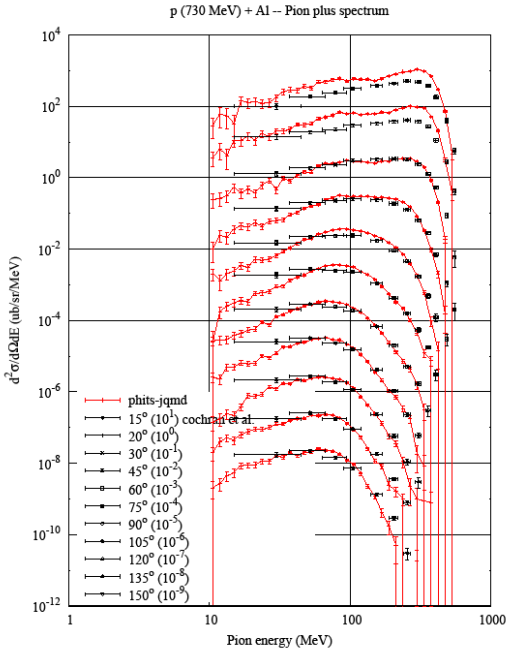

p (2500 MeV) + Au -- Helium-4 spectrum
incl45-gemini++A
30° (10^1) letourneau et al.
75° (10^0)
105° (10^-1)
150° (10^-2)
d^2σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)

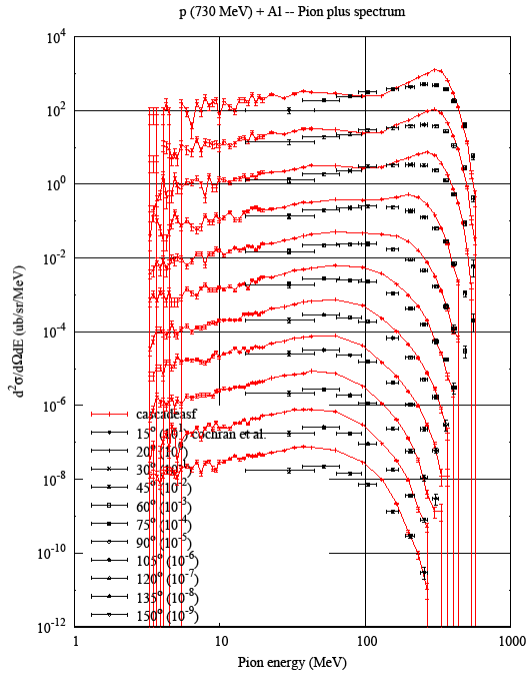

p (2500 MeV) + Au -- Helium-4 spectrum
16° bubak et al.
cascade04
cascadeasf
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
phits-bertini
phits-jam
phits-jqmd
d²σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)

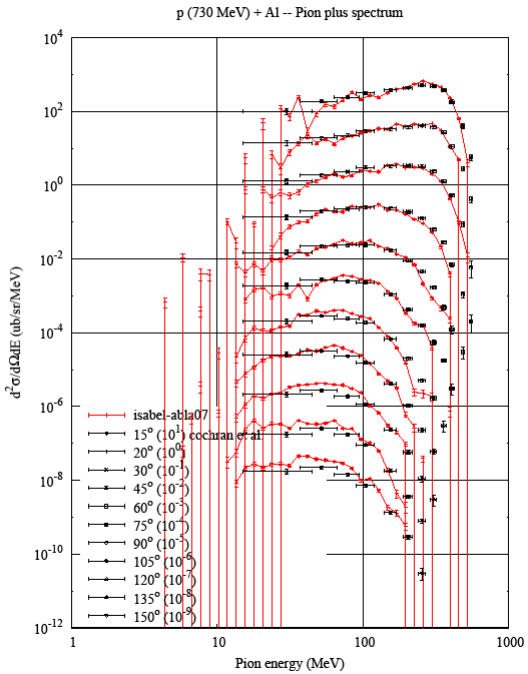

p (2500 MeV) + Au -- Helium-4 spectrum
100° bubak et al.
cascade04
cascadeasf
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
phits-bertini
phits-jam
phits-jqmd
d²σ/dΩdE (mb/sr/MeV)
Emitted particle energy (MeV)

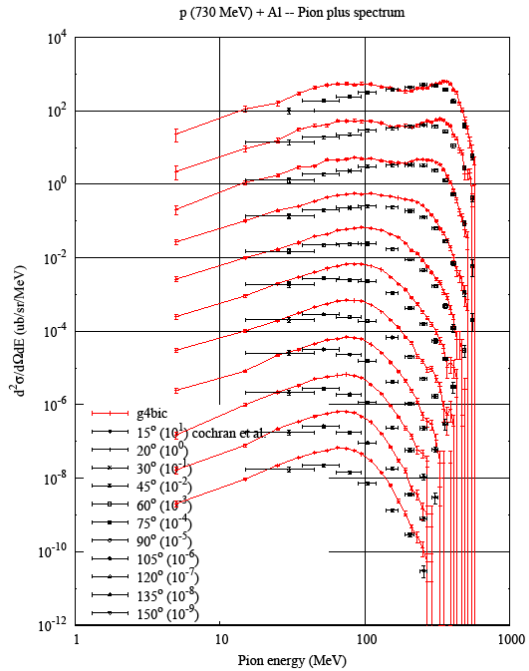
Double differential pion cross sections

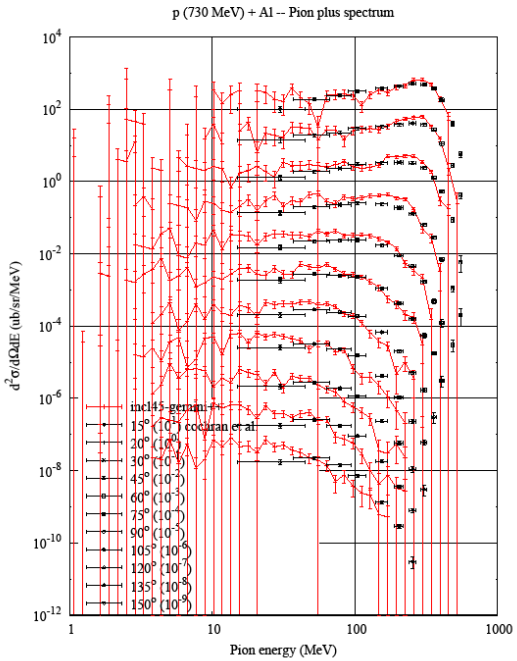

p (730 MeV) + Al -- Pion plus spectrum
d²σ/dΩdE (ub/sr/MeV)
Pion energy (MeV)
cem03.03
15° (10⁻¹) cochran et al.
20° (10⁰)
30° (10⁻¹)
45° (10⁻²)
60° (10⁻³)
75° (10⁻⁴)
90° (10⁻⁵)
105° (10⁻⁶)
120° (10⁻⁷)
135° (10⁻⁸)
150° (10⁻⁹)

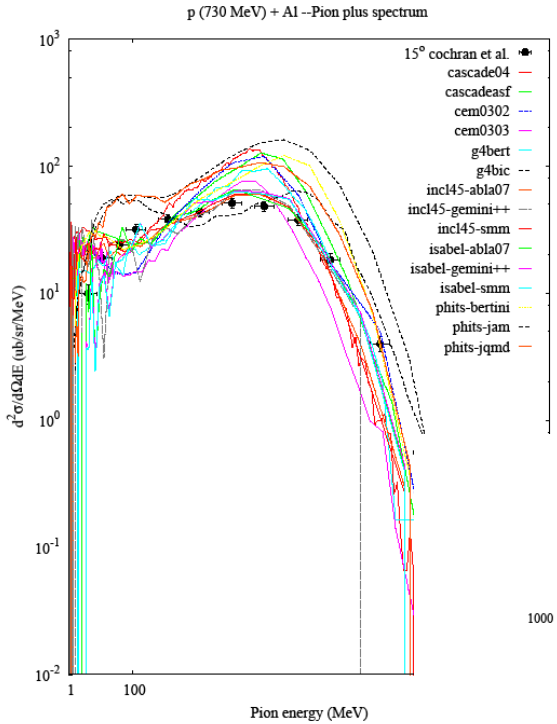

p (730 MeV) + Al -- Pion plus spectrum
d²σ/dΩdE (ub/sr/MeV)
Pion energy (MeV)
phits-jqmd
15° (10⁻¹) cochran et al.
20° (10⁰)
30° (10⁻¹)
45° (10⁻²)
60° (10⁻³)
75° (10⁻⁴)
90° (10⁻⁵)
105° (10⁻⁶)
120° (10⁻⁷)
135° (10⁻⁸)
150° (10⁻⁹)

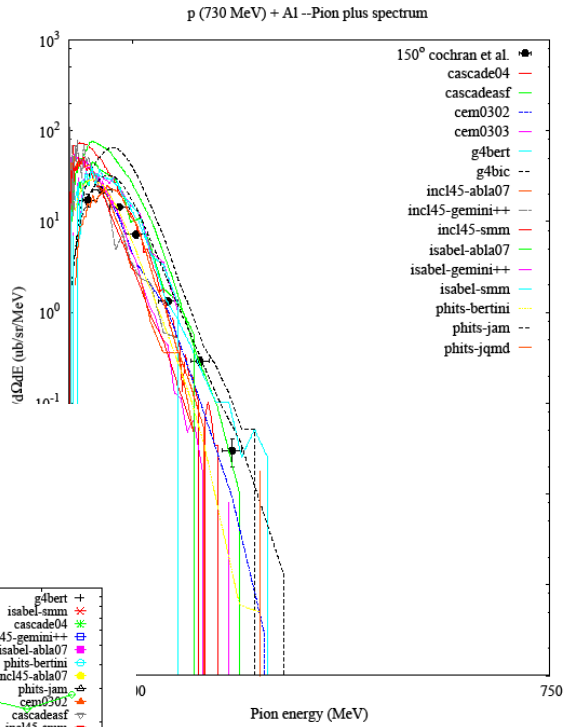

p (730 MeV) + Al -- Pion plus spectrum
d²σ/dΩdE (ub/sr/MeV)
Pion energy (MeV)
cascadeasf
15° (10⁻¹) cochran et al.
20° (10⁰)
30° (10⁻¹)
45° (10⁻²)
60° (10⁻³)
75° (10⁻⁴)
90° (10⁻⁵)
105° (10⁻⁶)
120° (10⁻⁷)
135° (10⁻⁸)
150° (10⁻⁹)

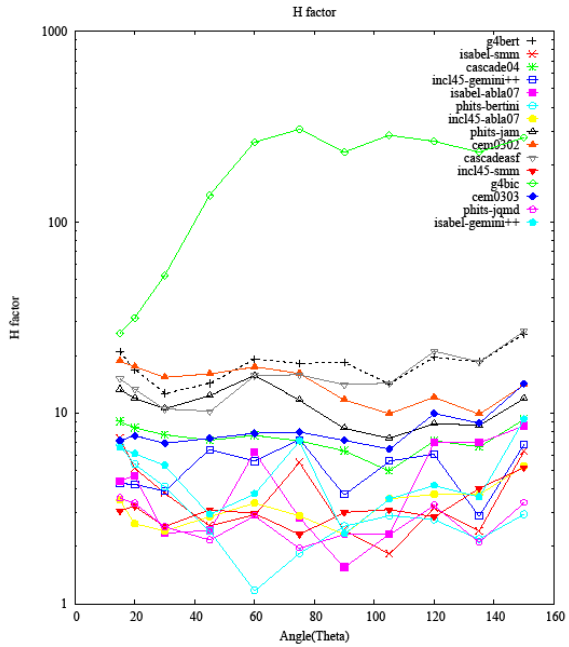

p (730 MeV) + Al -- Pion plus spectrum
d²σ/dΩdE (ub/sr/MeV)
Pion energy (MeV)
isabel-abla07
15° (10⁻¹) cochran et al.
20° (10⁰)
30° (10⁻¹)
45° (10⁻²)
60° (10⁻³)
75° (10⁻⁴)
90° (10⁻⁵)
105° (10⁻⁶)
120° (10⁻⁷)
135° (10⁻⁸)
150° (10⁻⁹)

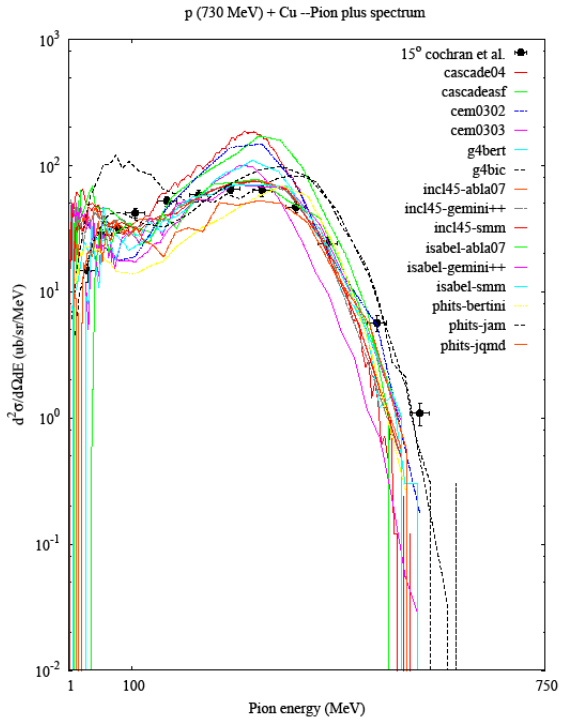

p (730 MeV) + Al -- Pion plus spectrum
d²σ/dΩdE (ub/sr/MeV)
Pion energy (MeV)
g4bic
15° (10⁻¹) cochran et al.
20° (10⁰)
30° (10⁻¹)
45° (10⁻²)
60° (10⁻³)
75° (10⁻⁴)
90° (10⁻⁵)
105° (10⁻⁶)
120° (10⁻⁷)
135° (10⁻⁸)
150° (10⁻⁹)

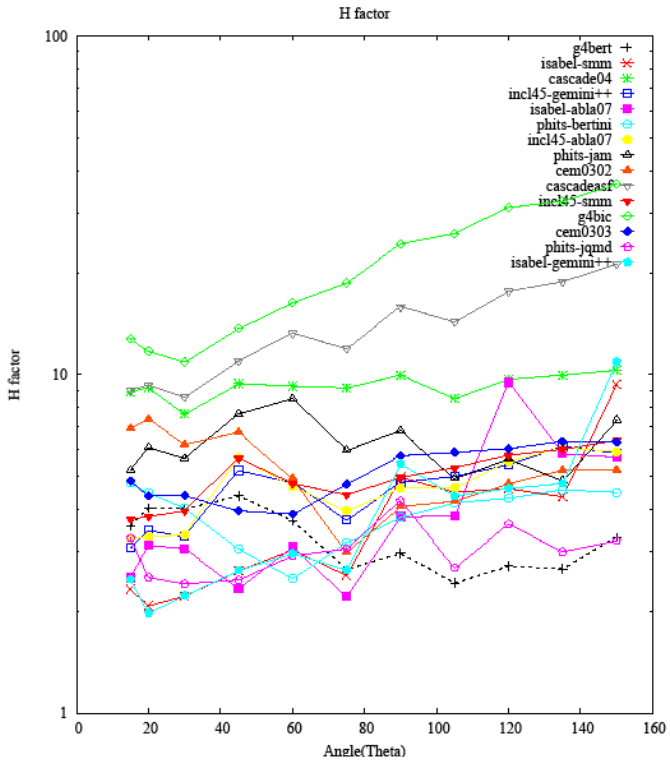

p (730 MeV) + Al -- Pion plus spectrum
d²σ/dΩdE (ub/sr/MeV)
Pion energy (MeV)
incl45-geman
15° (10⁻¹) cochran et al.
20° (10⁰)
30° (10⁻¹)
45° (10⁻²)
60° (10⁻³)
75° (10⁻⁴)
90° (10⁻⁵)
105° (10⁻⁶)
120° (10⁻⁷)
135° (10⁻⁸)
150° (10⁻⁹)

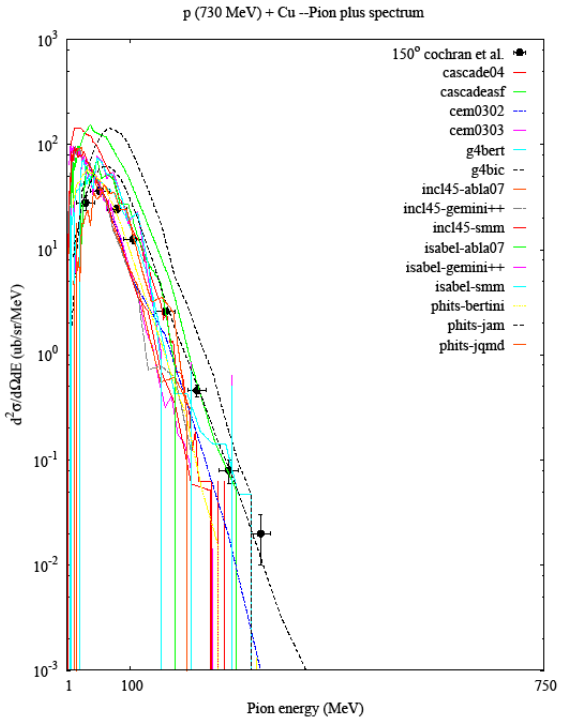

p (730 MeV) + Al --Pion plus spectrum
15° cochran et al.
cascade04
cascadeasf
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
phits-bertini
phits-jam
phits-jqmd
d²σ/dΩdE (ub/sr/MeV)
Pion energy (MeV)

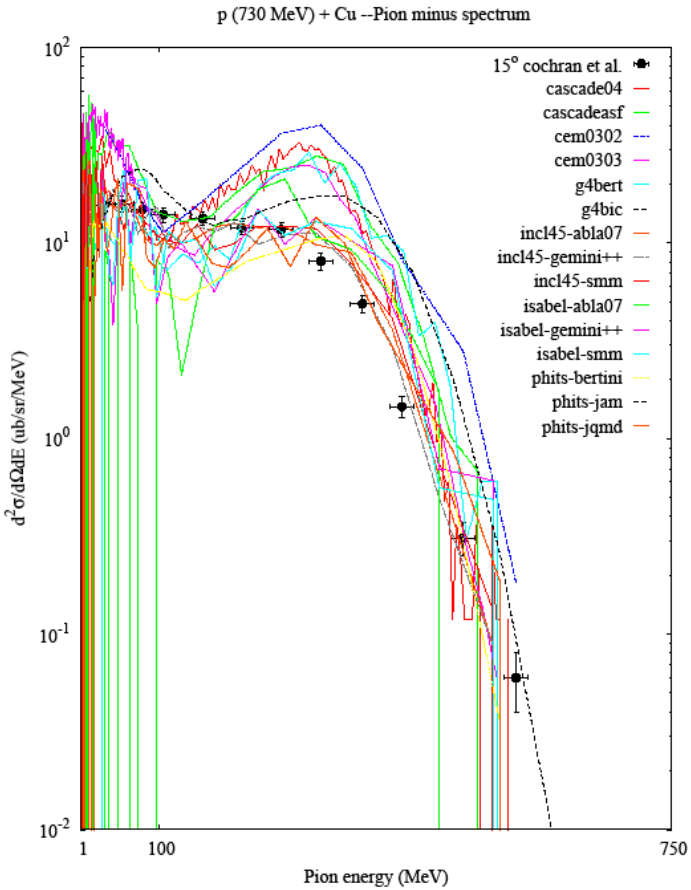

p (730 MeV) + Al --Pion plus spectrum
150° cochran et al.
cascade04
cascadeasf
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
phits-bertini
phits-jam
phits-jqmd
Pion energy (MeV)

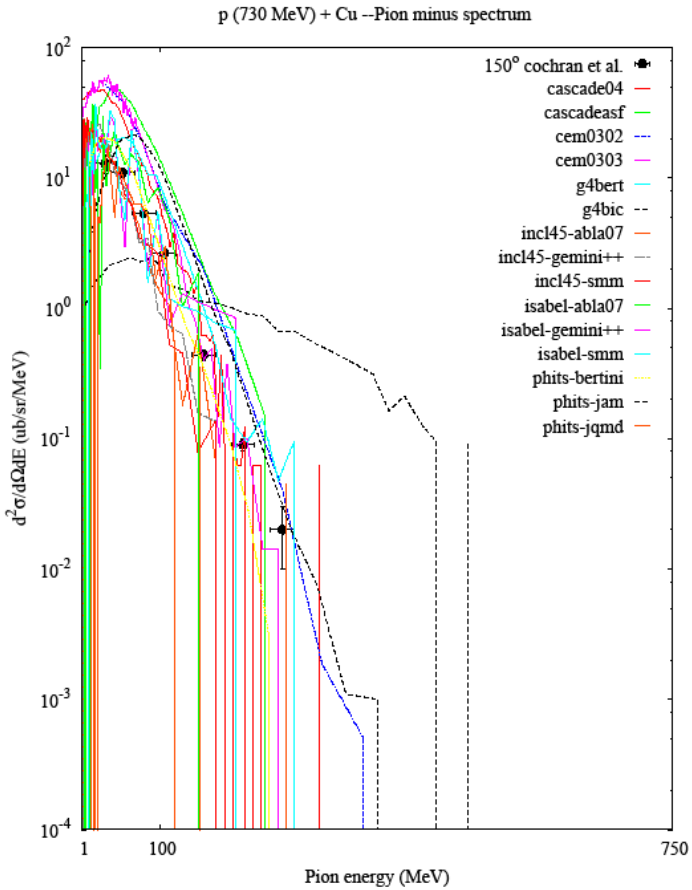

H factor
g4bert
isabel-smm
cascade04
incl45-gemini++
isabel-abla07
phits-bertini
incl45-abla07
phits-jam
cem0302
cascadeasf
incl45-smm
g4bic
cem0303
phits-jqmd
isabel-gemini++
H factor
Angle(Theta)


p (730 MeV) + Cu --Pion plus spectrum
15° cochran et al.
cascade04
cascadeasf
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
phits-bertini
phits-jam
phits-jqmd
d²σ/dΩdE (ub/sr/MeV)
Pion energy (MeV)


H factor
g4bert
isabel-smm
cascade04
incl45-gemini++
isabel-abla07
phits-bertini
incl45-abla07
phits-jam
cem0302
cascadeasf
incl45-smm
g4bic
cem0303
phits-jqmd
isabel-gemini++
H factor
Angle(Theta)


p (730 MeV) + Cu --Pion plus spectrum
150° cochran et al.
cascade04
cascadeasf
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
phits-bertini
phits-jam
phits-jqmd
d²σ/dΩdE (ub/sr/MeV)
Pion energy (MeV)

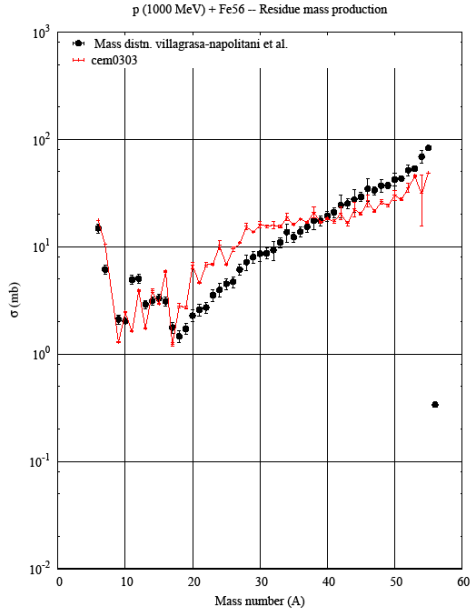

p (730 MeV) + Cu --Pion minus spectrum
15° cochran et al.
cascade04
cascadeasf
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
phits-bertini
phits-jam
phits-jqmd
d²σ/dΩdE (ub/sr/MeV)
Pion energy (MeV)
1
100
750

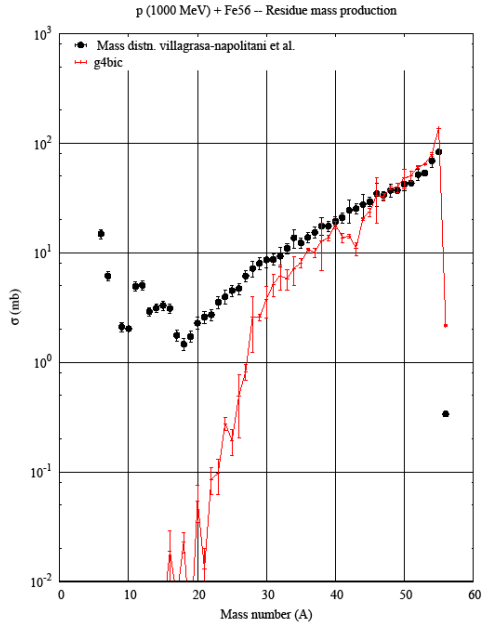

p (730 MeV) + Cu --Pion minus spectrum
150° cochran et al.
cascade04
cascadeasf
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
phits-bertini
phits-jam
phits-jqmd
d²σ/dΩdE (ub/sr/MeV)
Pion energy (MeV)
1
100
750

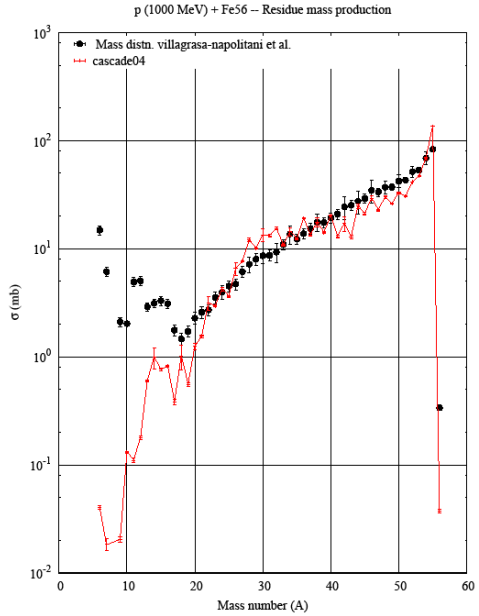
Residue Production

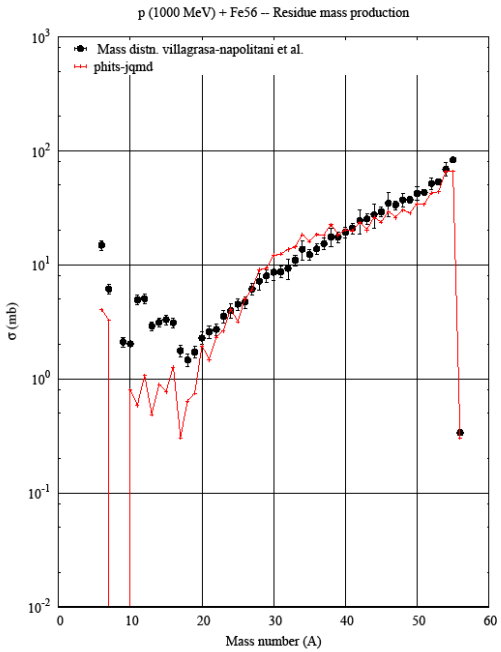
(Reaction with inverse kinematics)

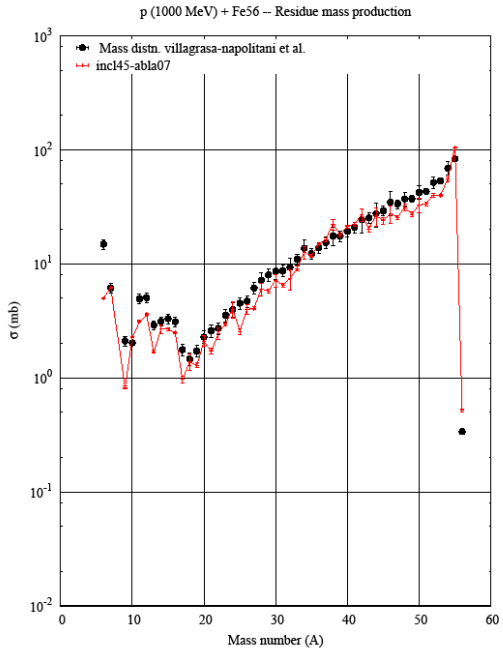
Residue mass / charge production

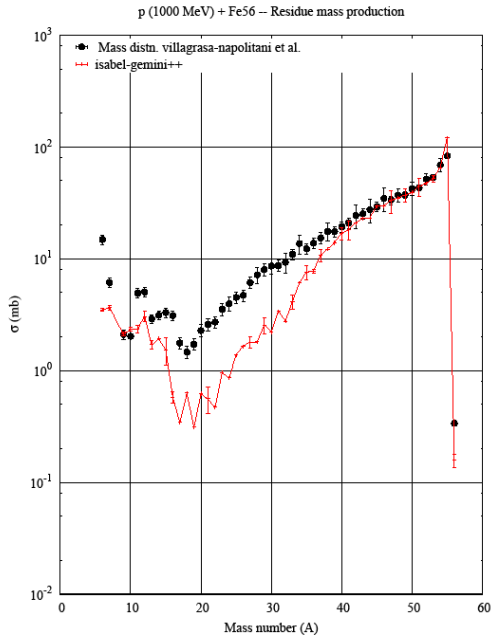

p (1000 MeV) + Fe56 -- Residue mass production
Mass distn. villagrasa-napolitani et al.
cem0303
σ (mb)
Mass number (A)

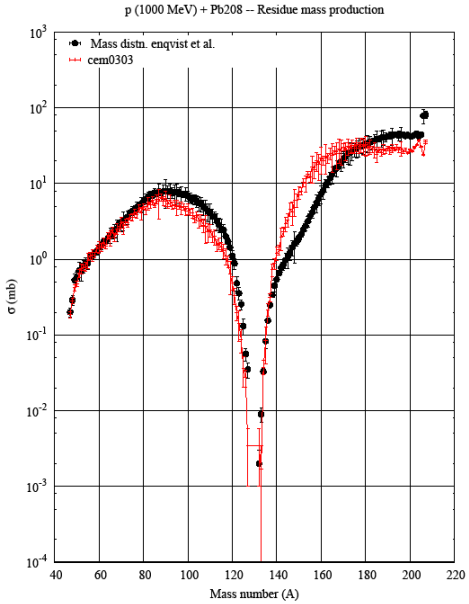

p (1000 MeV) + Fe56 -- Residue mass production
Mass distn. villagrasa-napolitani et al.
g4bic
σ (mb)
Mass number (A)

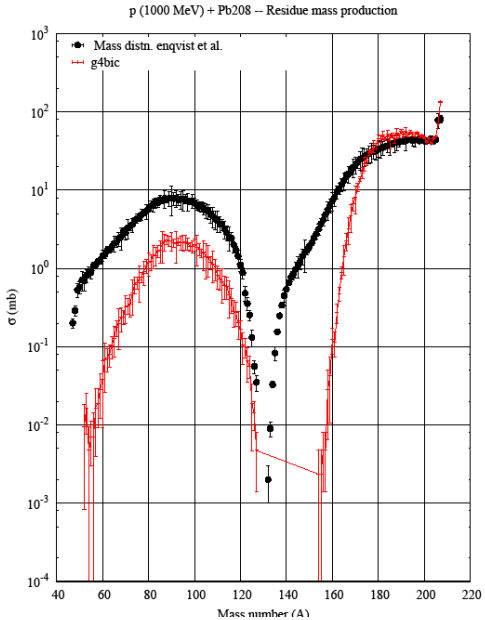

p (1000 MeV) + Fe56 -- Residue mass production
Mass distn. villagrasa-napolitani et al.
cascade04
σ (mb)
Mass number (A)

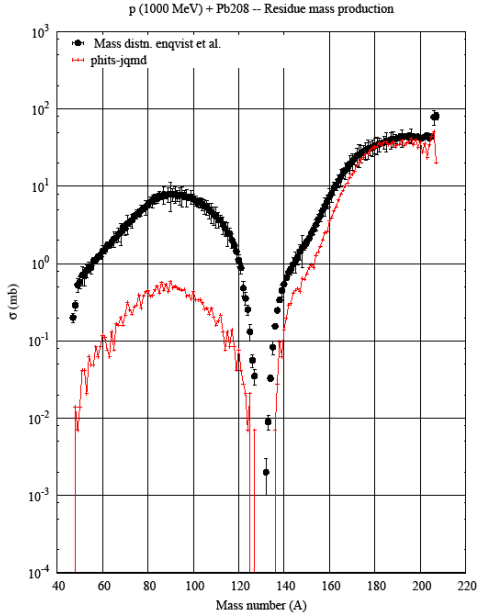

p (1000 MeV) + Fe56 -- Residue mass production
Mass distn. villagrasa-napolitani et al.
phits-jqmd
σ (mb)
Mass number (A)

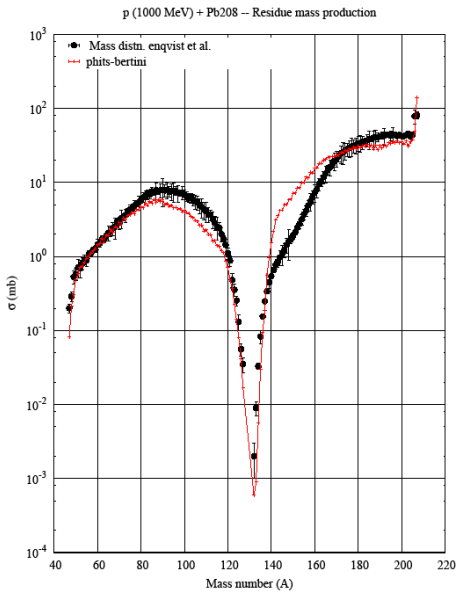

p (1000 MeV) + Fe56 -- Residue mass production
Mass distn. villagrasa-napolitani et al.
incl45-abla07
σ (mb)
Mass number (A)

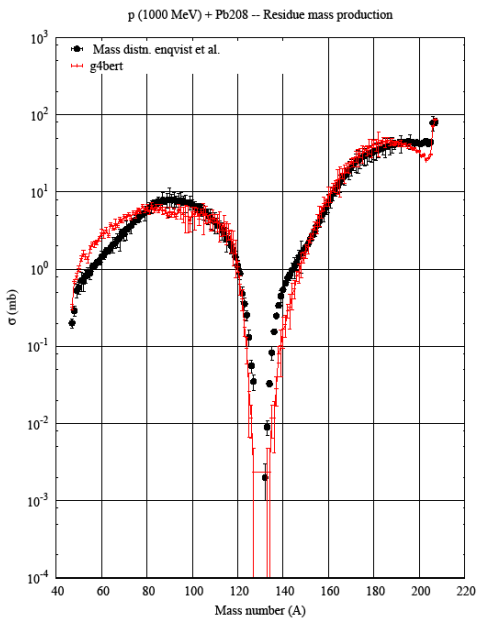

p (1000 MeV) + Fe56 -- Residue mass production
Mass distn. villagrasa-napolitani et al.
isabel-gemini++
σ (mb)
Mass number (A)

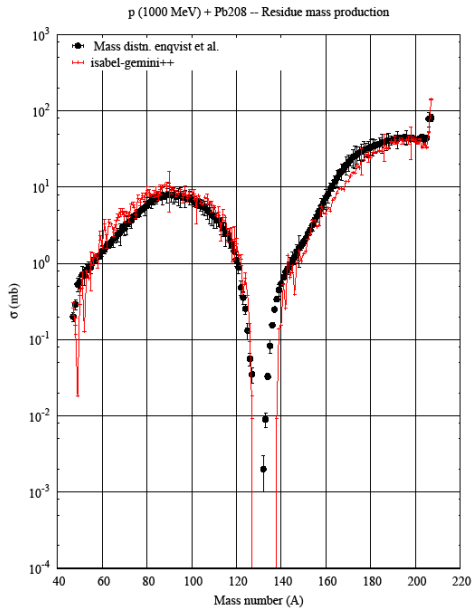

p (1000 MeV) + Pb208 -- Residue mass production
Mass distn. enqvist et al.
cem0303
σ (mb)
Mass number (A)

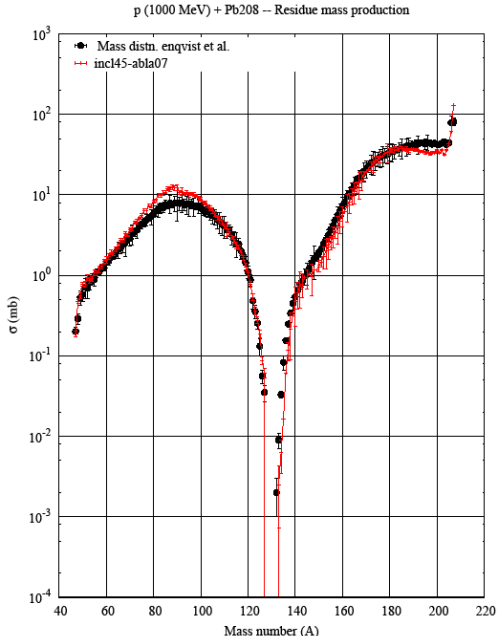

p (1000 MeV) + Pb208 -- Residue mass production
Mass distn. enqvist et al.
g4bic
σ (mb)
Mass number (A)

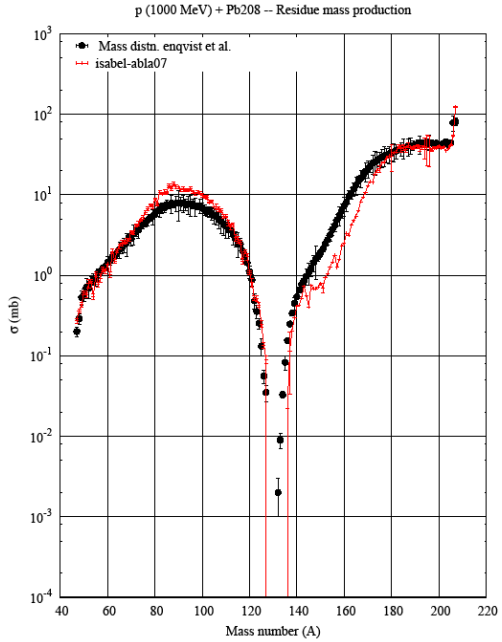

p (1000 MeV) + Pb208 -- Residue mass production
Mass distn. enqvist et al.
phits-jqmd
σ (mb)
Mass number (A)

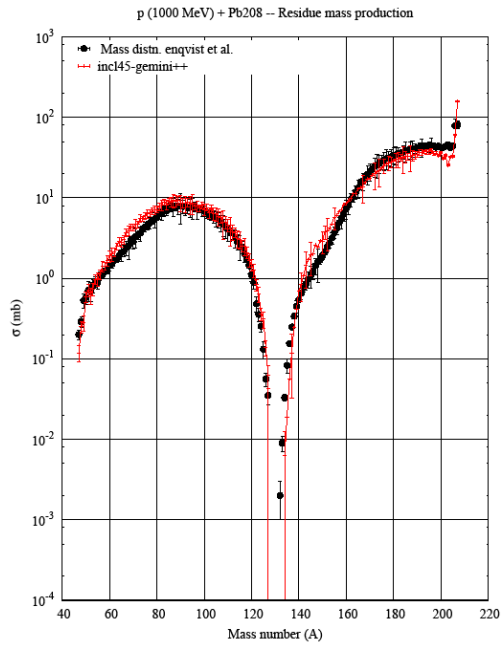

p (1000 MeV) + Pb208 -- Residue mass production
Mass distn. enqvist et al.
phits-bertini
σ (mb)
Mass number (A)

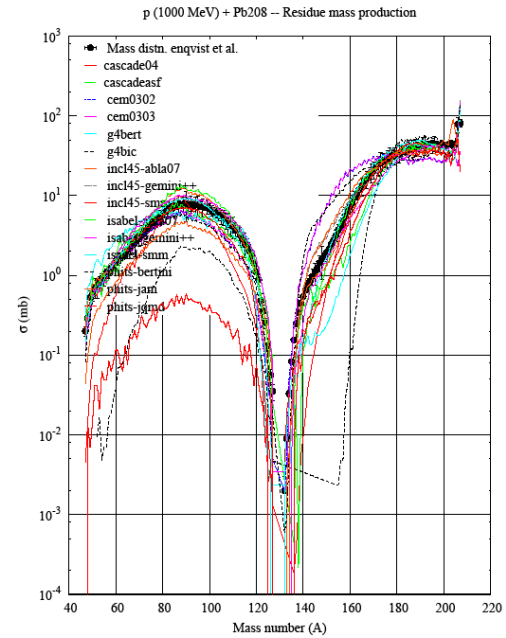

p (1000 MeV) + Pb208 -- Residue mass production
Mass distn. enqvist et al.
g4bert
σ (mb)
Mass number (A)

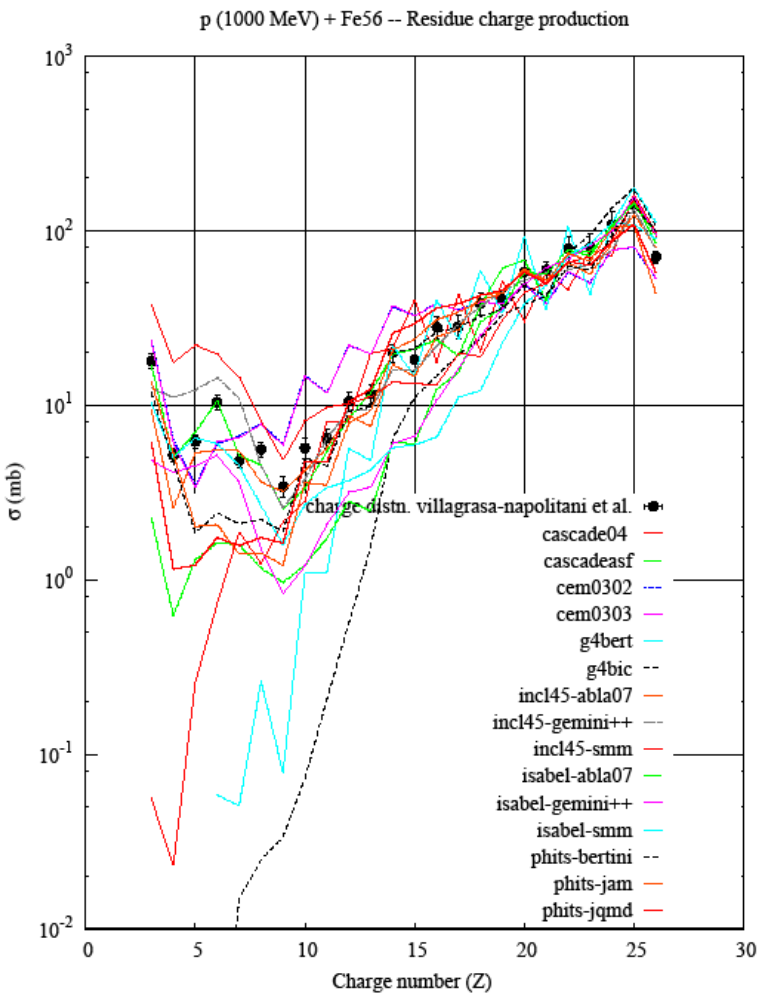

p (1000 MeV) + Pb208 -- Residue mass production
Mass distn. enqvist et al.
isabel-gemini++
σ (mb)
Mass number (A)

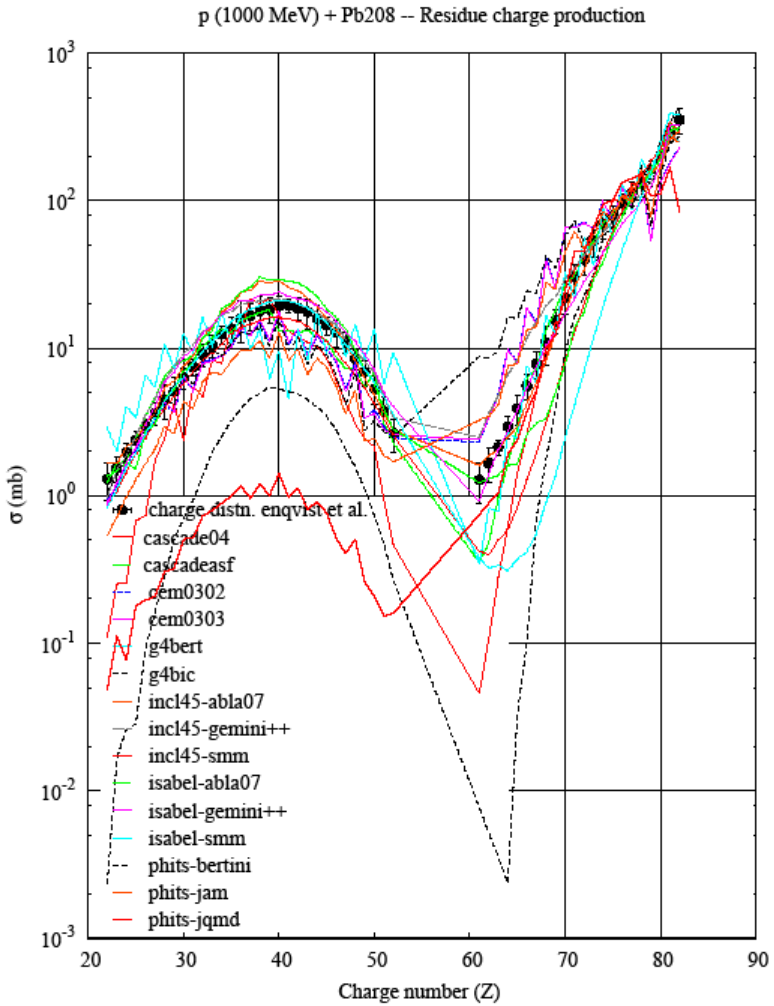

p (1000 MeV) + Pb208 -- Residue mass production
Mass distn. enqvist et al.
incl45-abla07
σ (mb)
Mass number (A)


p (1000 MeV) + Pb208 -- Residue mass production
Mass distn. enqvist et al.
isabel-abla07
σ (mb)
Mass number (A)


p (1000 MeV) + Pb208 -- Residue mass production
Mass distn. enqvist et al.
incl45-gemini++
σ (mb)
Mass number (A)


p (1000 MeV) + Pb208 -- Residue mass production
Mass distn. enqvist et al.
cascade04
cascadeasf
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
pluto-bertini
pluto-jam
pluto-jqmd
σ (mb)
Mass number (A)

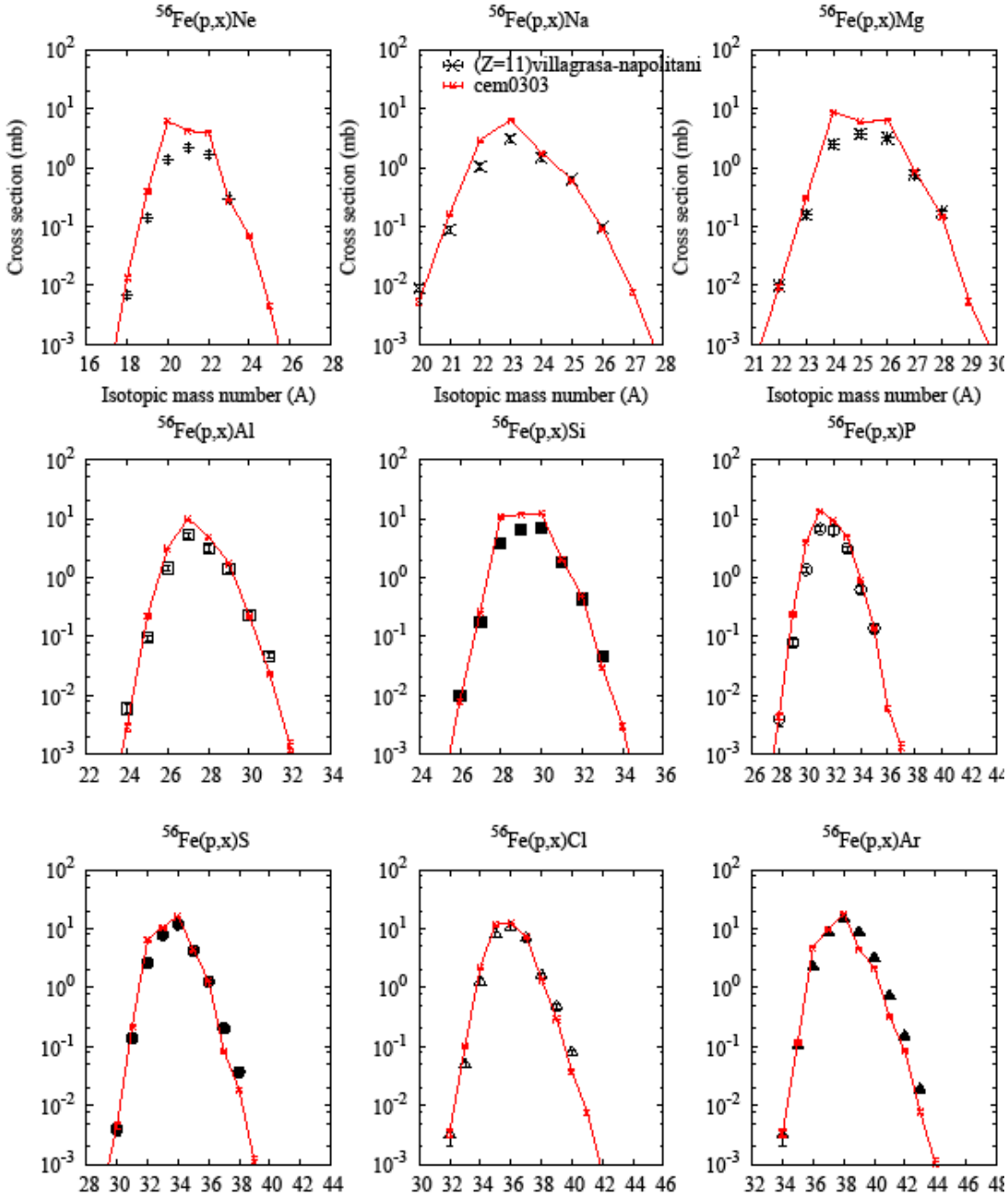

p (1000 MeV) + Fe56 -- Residue charge production
σ (mb)
Charge number (Z)
charge distn. villagrasa-napolitani et al.
cascade04
cascadeasf
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
phits-bertini
phits-jam
phits-jqmd

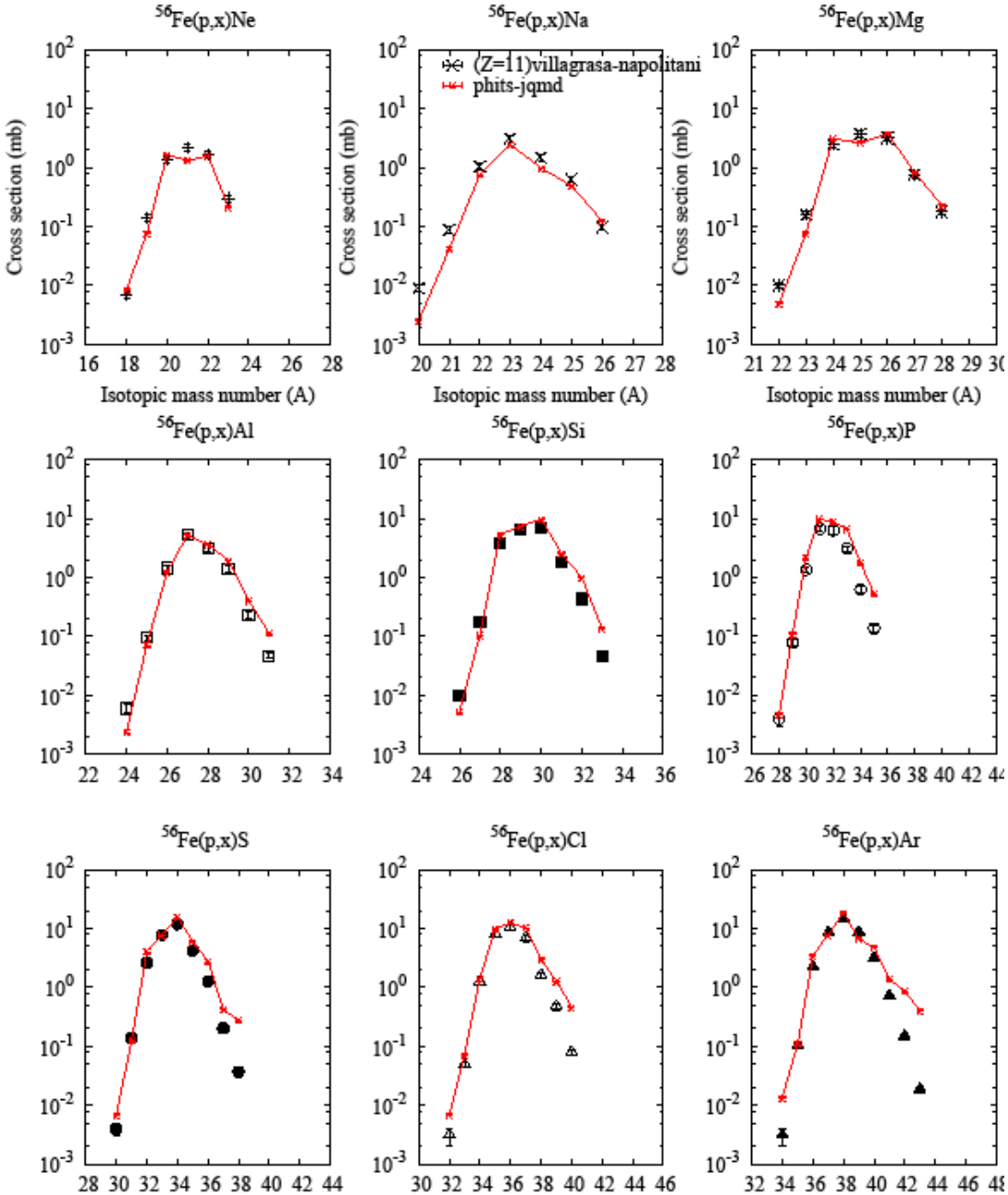

p (1000 MeV) + Pb208 -- Residue charge production
σ (mb)
Charge number (Z)
charge distn. enqvist et al.
cascade04
cascadeasf
cem0302
cem0303
g4bert
g4bic
incl45-abla07
incl45-gemini++
incl45-smm
isabel-abla07
isabel-gemini++
isabel-smm
phits-bertini
phits-jam
phits-jqmd

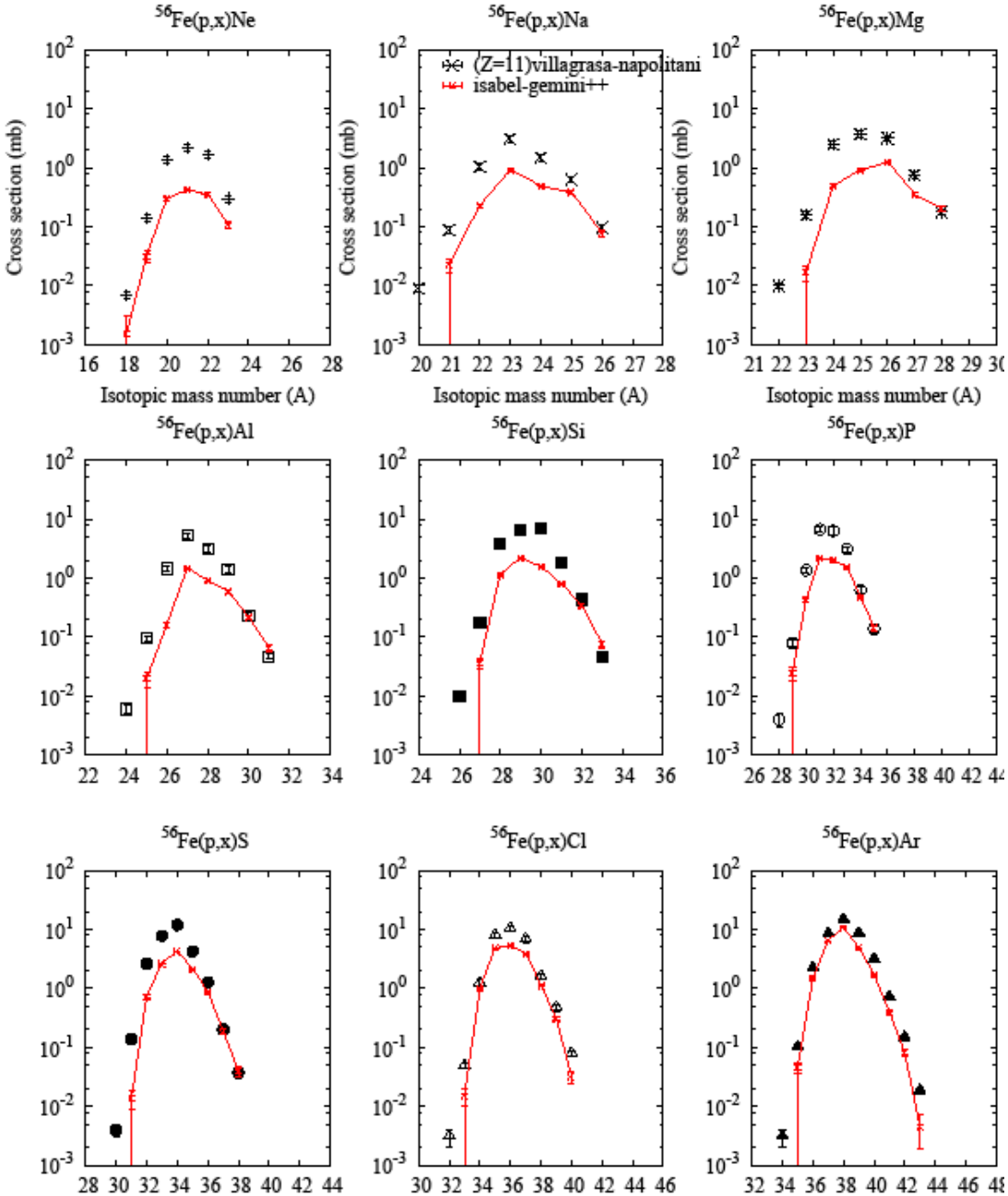
Residue Production

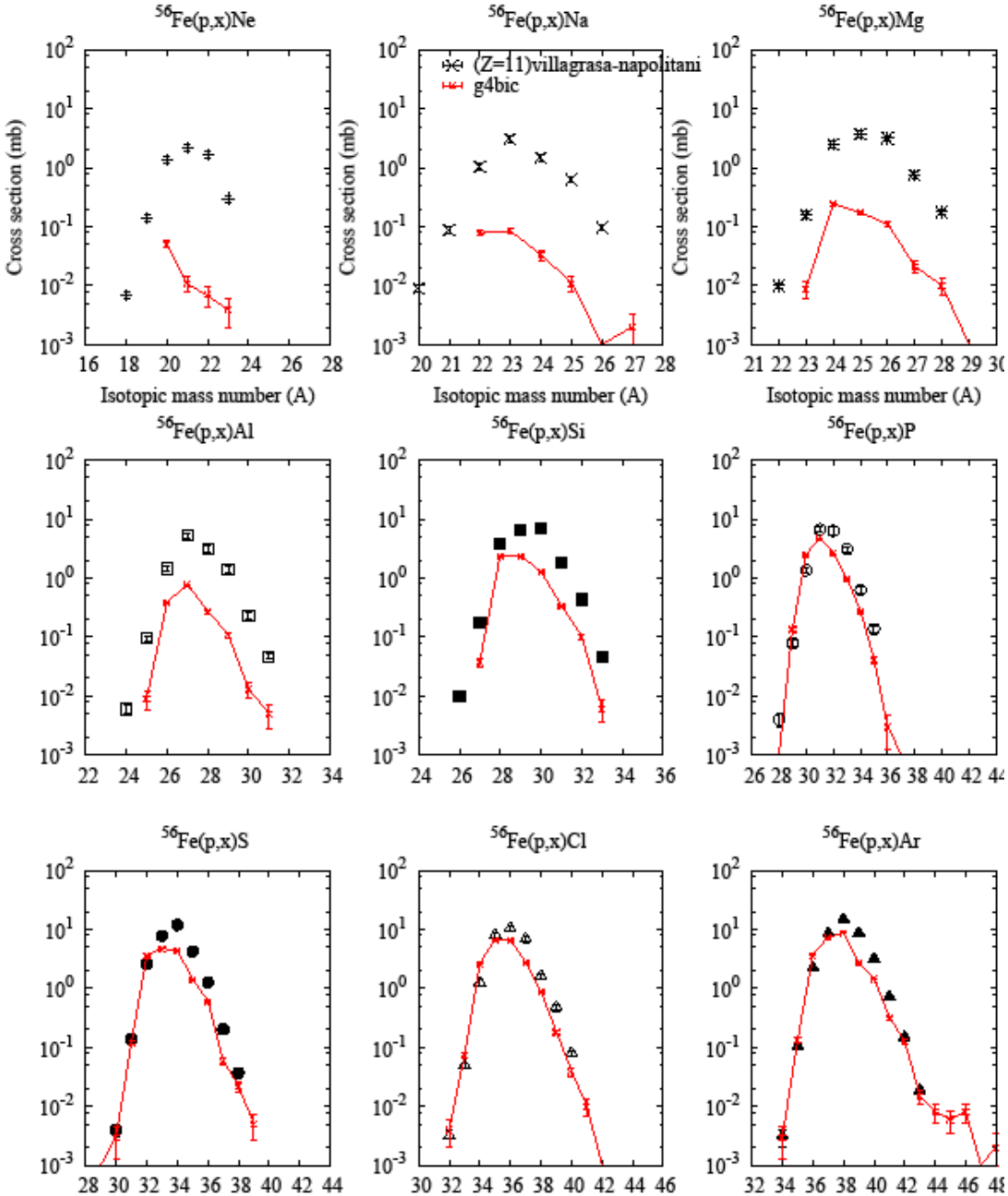
(Reaction with inverse kinematics)

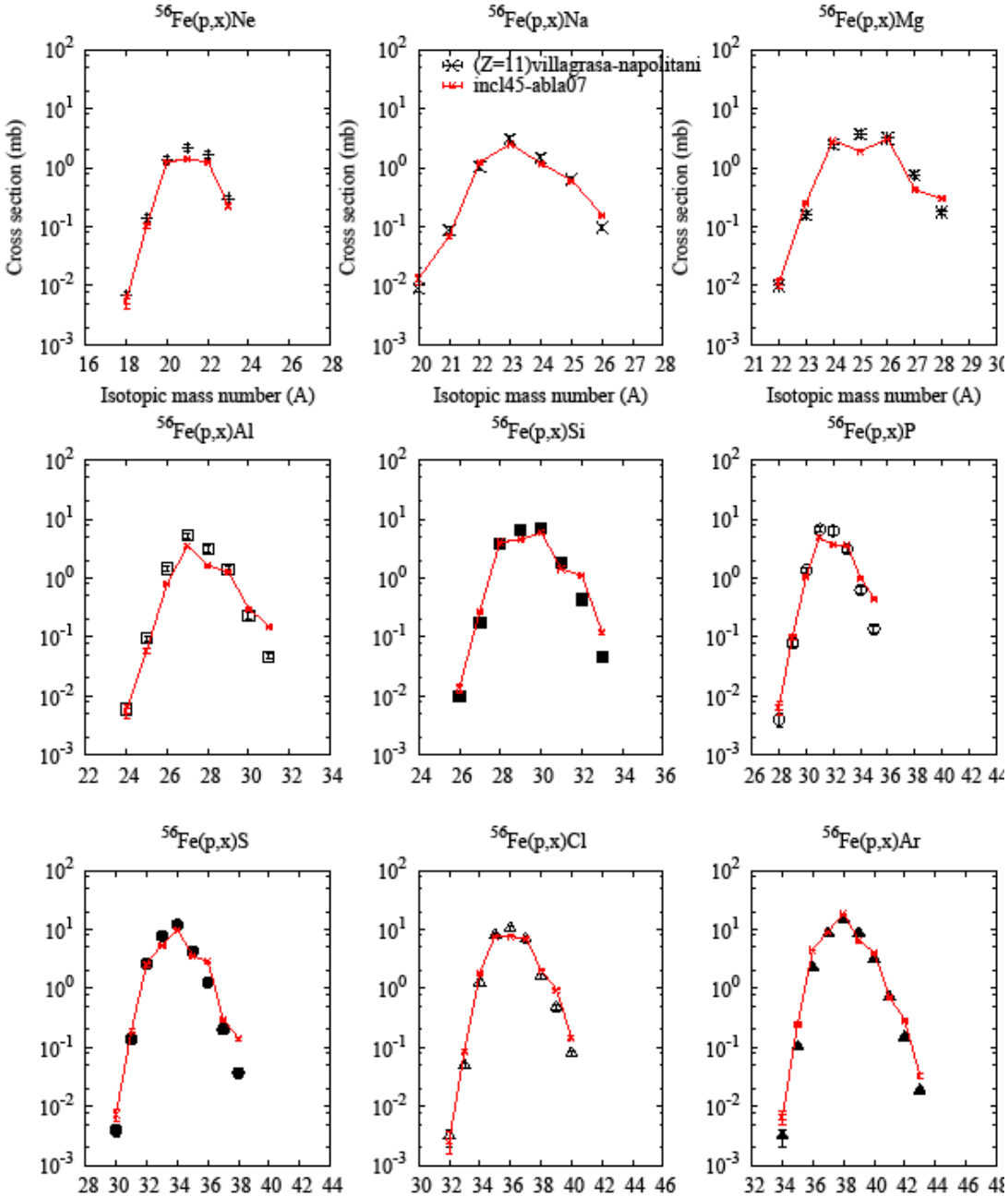
Isotopic distribution (residue mass production w.r.t. isotope number)

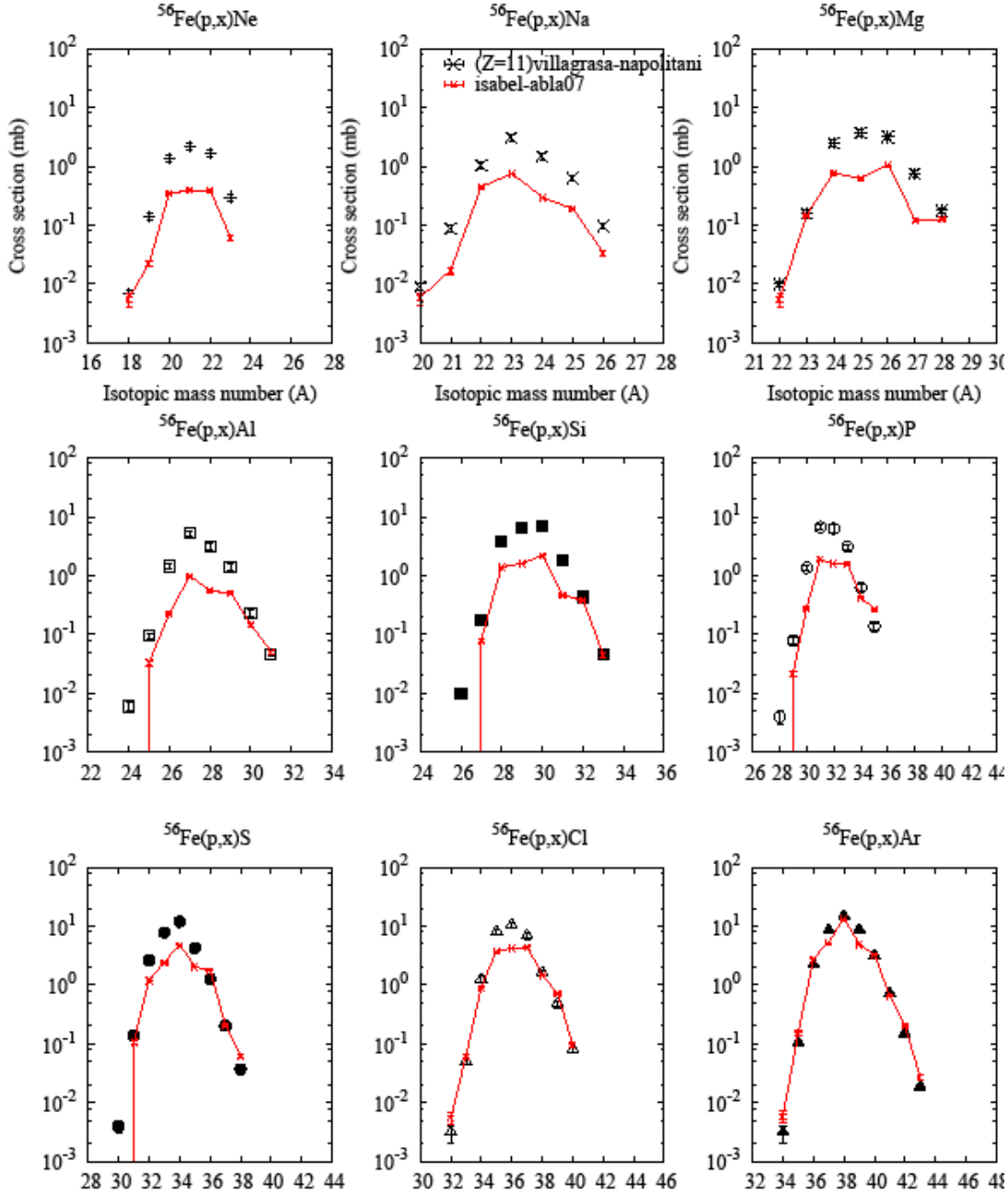

56Fe(p,x)Ne
56Fe(p,x)Na
56Fe(p,x)Mg
(Z=11)villagrasa-napolitani
cem0303
Cross section (mb)
Isotopic mass number (A)
56Fe(p,x)Al
56Fe(p,x)Si
56Fe(p,x)P
56Fe(p,x)S
56Fe(p,x)Cl
56Fe(p,x)Ar

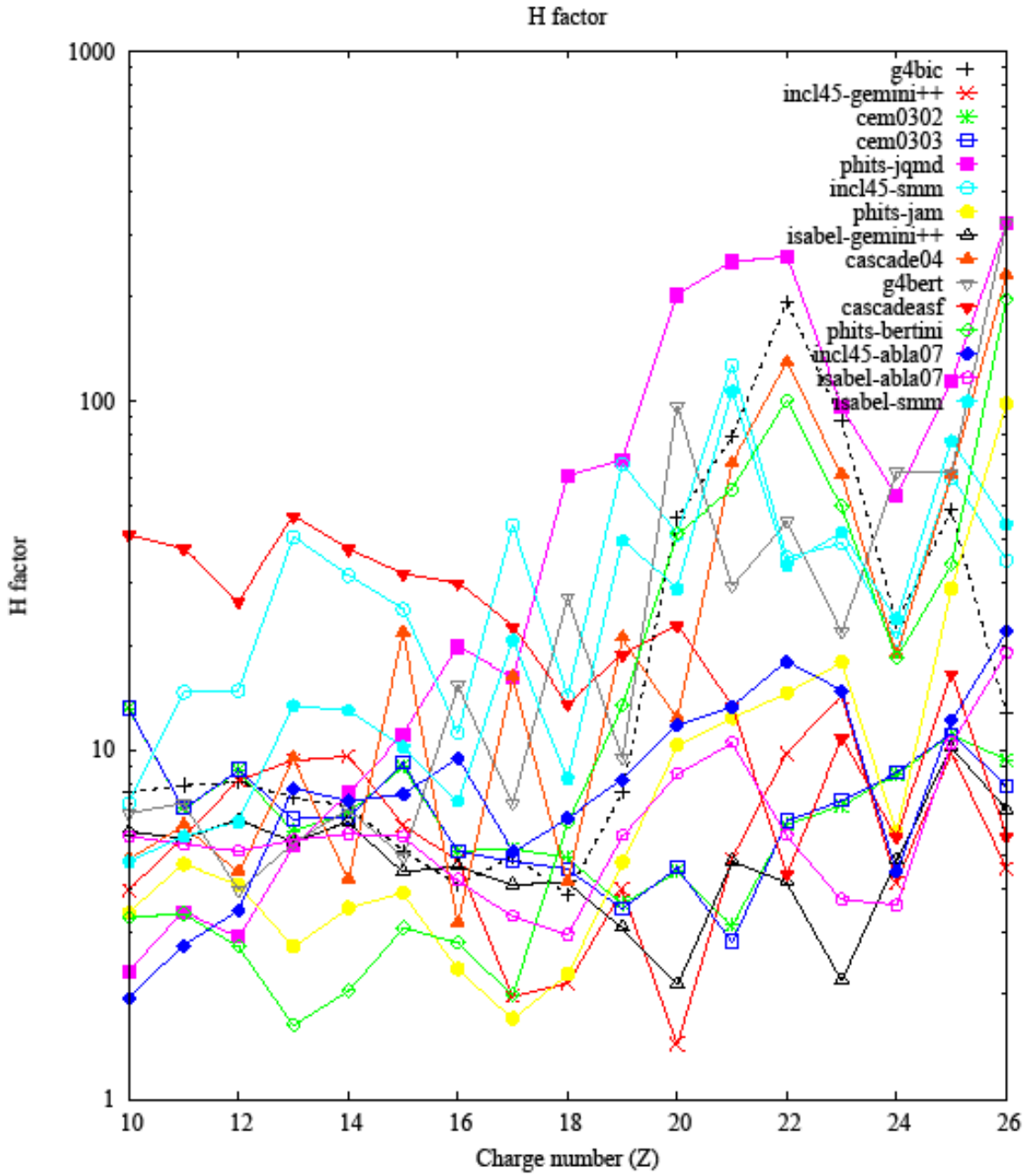

^{56}Fe(p,x)Ne
^{56}Fe(p,x)Na
^{56}Fe(p,x)Mg
(Z=11)villagrasa-napolitani
phits-jqmd
Cross section (mb)
Isotopic mass number (A)
^{56}Fe(p,x)Al
^{56}Fe(p,x)Si
^{56}Fe(p,x)P
^{56}Fe(p,x)S
^{56}Fe(p,x)Cl
^{56}Fe(p,x)Ar

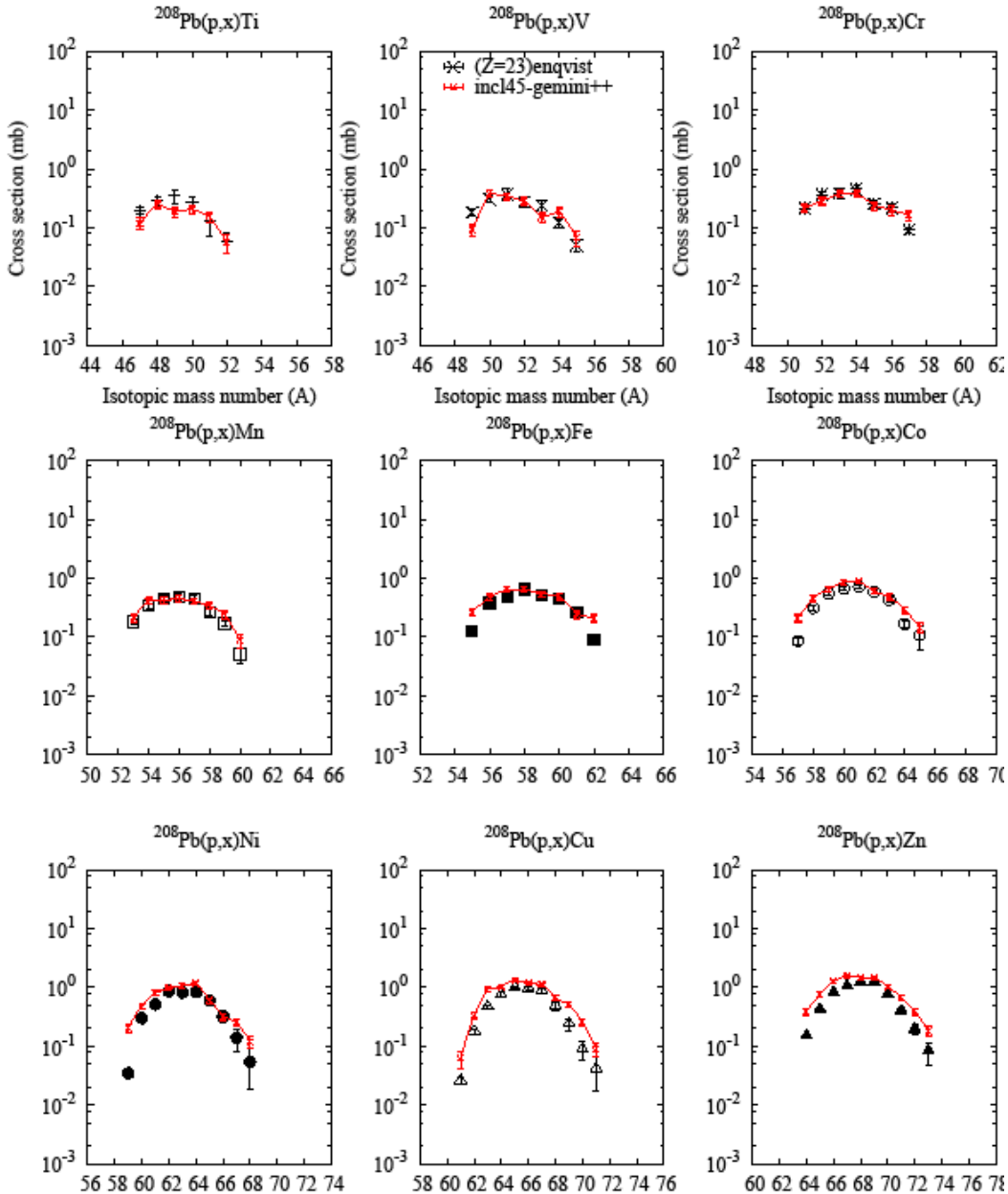

56Fe(p,x)Ne
56Fe(p,x)Na
56Fe(p,x)Mg
(Z=11)villagrasa-napolitani
isabel-gemini++
Cross section (mb)
Isotopic mass number (A)
56Fe(p,x)Al
56Fe(p,x)Si
56Fe(p,x)P
56Fe(p,x)S
56Fe(p,x)Cl
56Fe(p,x)Ar

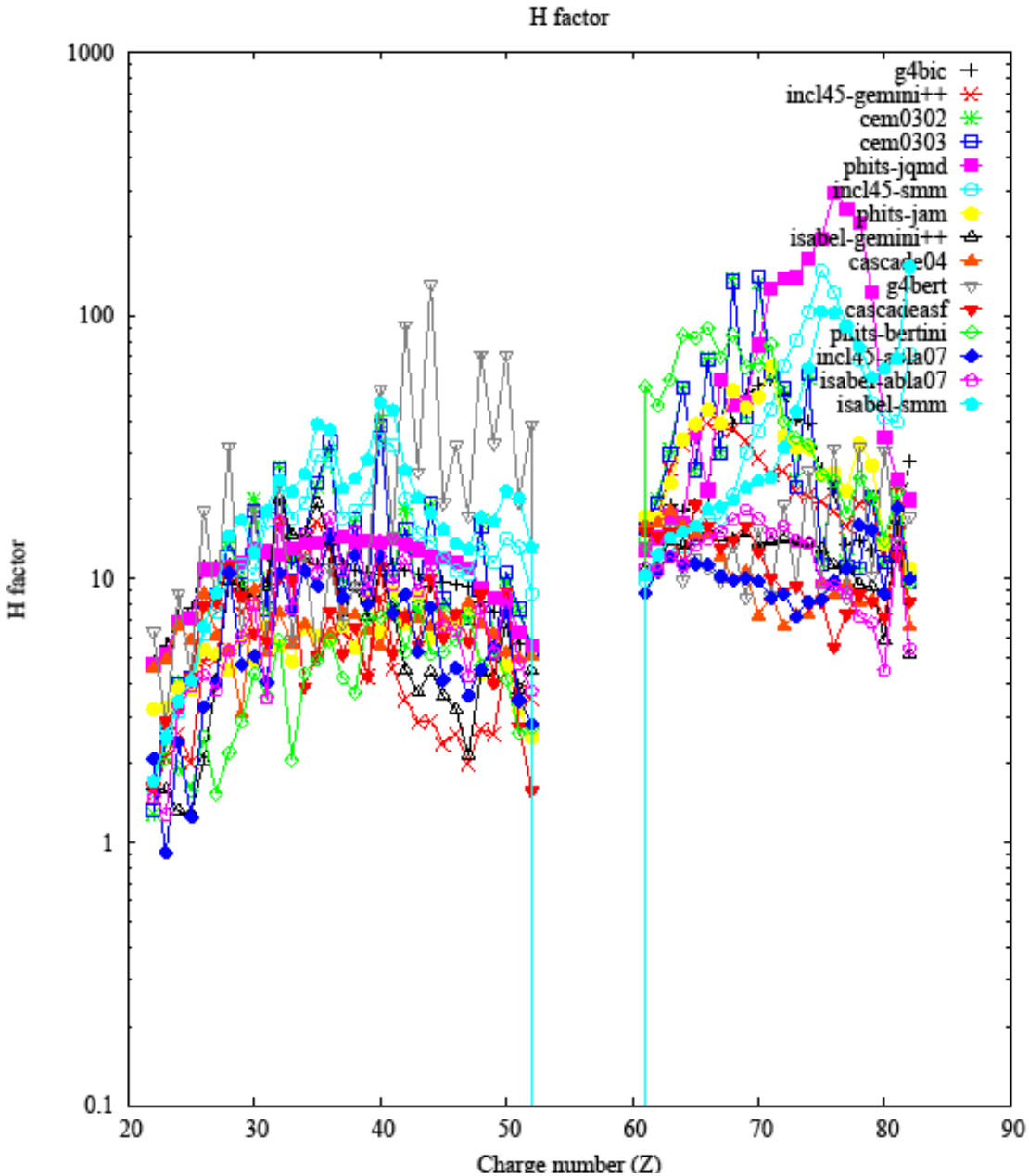

56Fe(p,x)Ne
56Fe(p,x)Na
56Fe(p,x)Mg
(Z=11)villagrasa-napolitani
g4bic
Cross section (mb)
Isotopic mass number (A)
56Fe(p,x)Al
56Fe(p,x)Si
56Fe(p,x)P
56Fe(p,x)S
56Fe(p,x)Cl
56Fe(p,x)Ar


^{56}Fe(p,x)Ne
^{56}Fe(p,x)Na
^{56}Fe(p,x)Mg
(Z=11)villagrasa-napolitani
incl45-abla07
Cross section (mb)
Isotopic mass number (A)
^{56}Fe(p,x)Al
^{56}Fe(p,x)Si
^{56}Fe(p,x)P
^{56}Fe(p,x)S
^{56}Fe(p,x)Cl
^{56}Fe(p,x)Ar

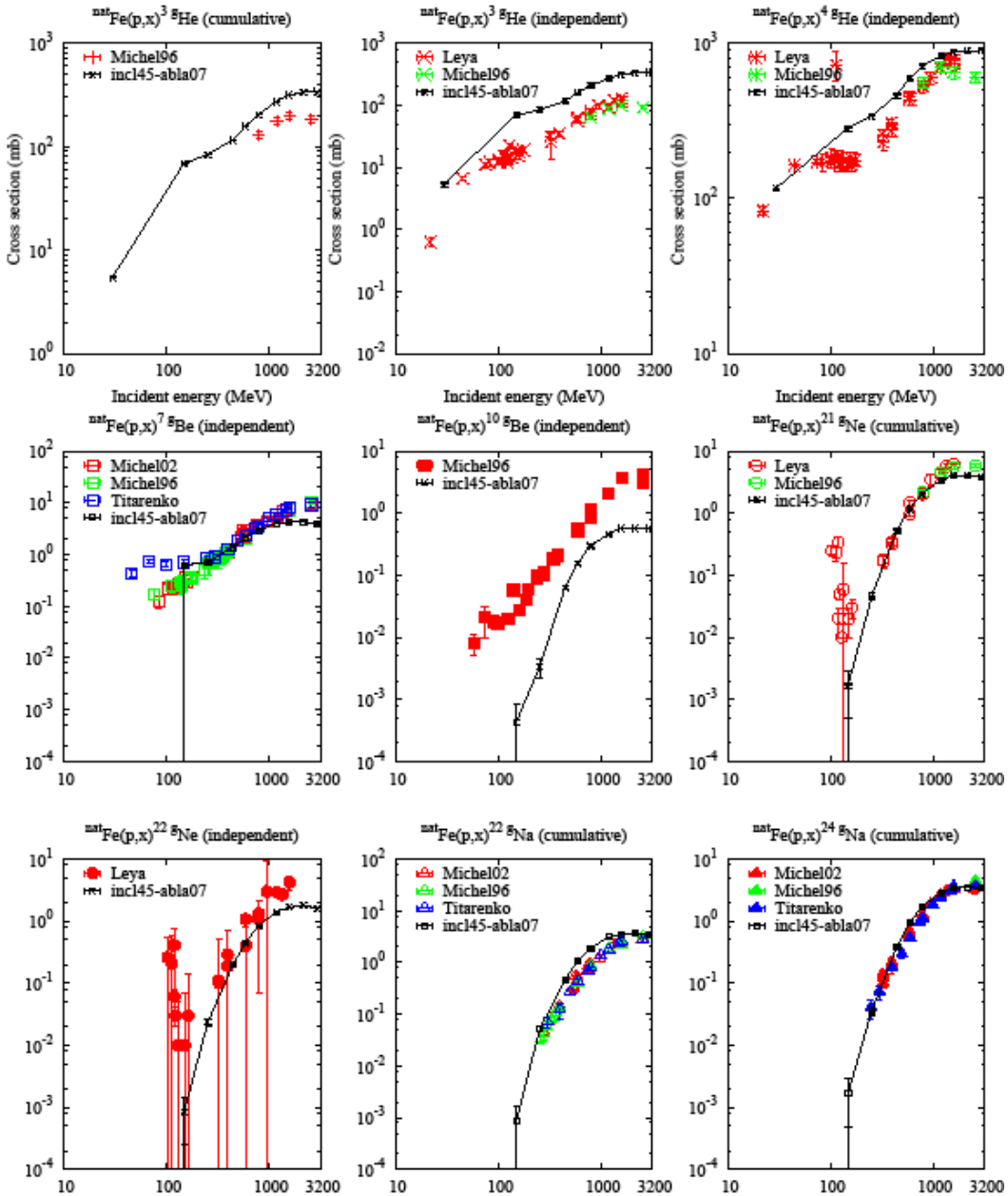

^{56}Fe(p,x)Ne
^{56}Fe(p,x)Na
^{56}Fe(p,x)Mg
(Z=11)villagrasa-napolitani
isabel-abla07
Cross section (mb)
Isotopic mass number (A)
^{56}Fe(p,x)Al
^{56}Fe(p,x)Si
^{56}Fe(p,x)P
^{56}Fe(p,x)S
^{56}Fe(p,x)Cl
^{56}Fe(p,x)Ar

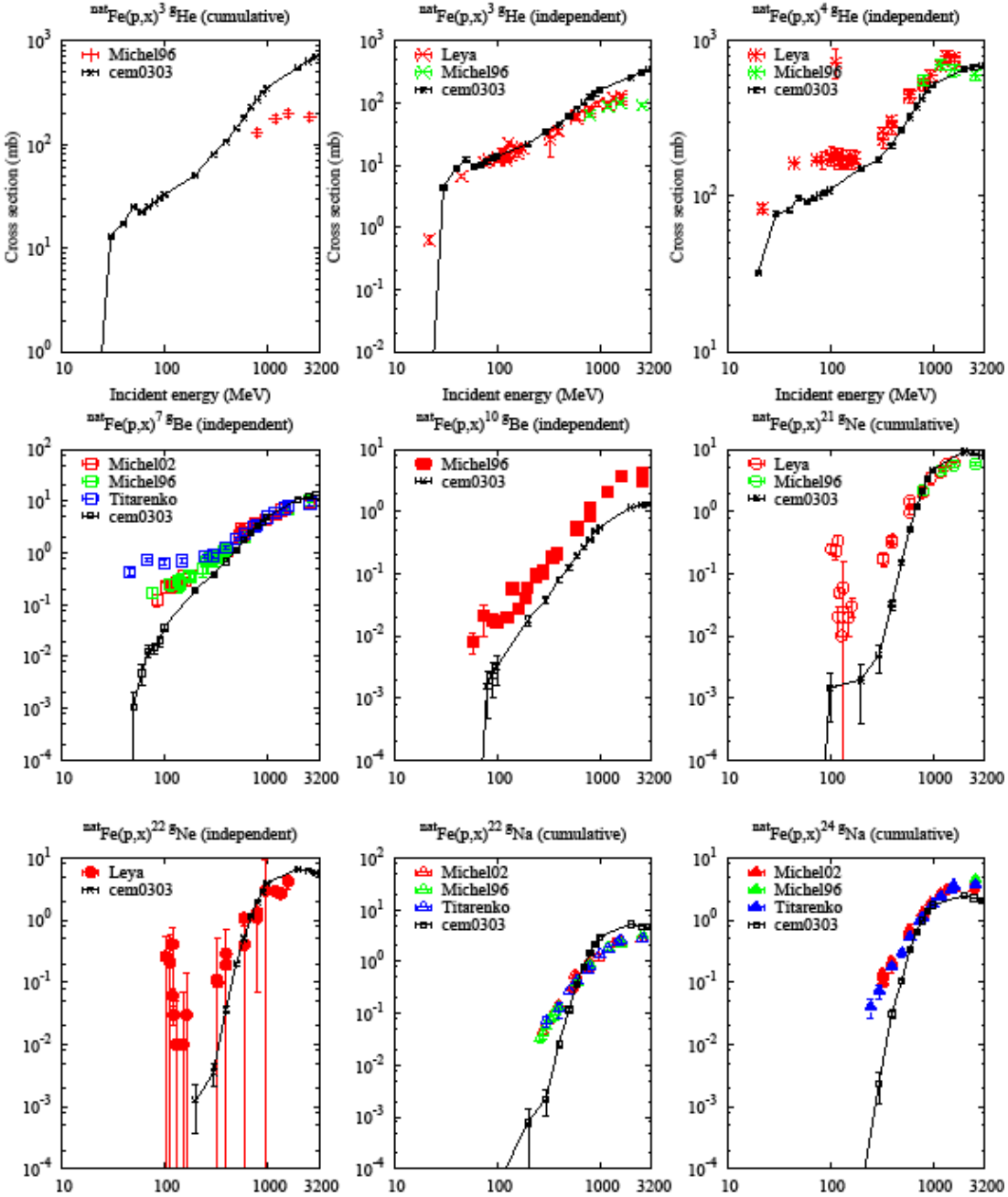

H factor
1000
100
10
1
H factor
10
12
14
16
18
20
22
24
26
Charge number (Z)
g4bic
incl45-gemini++
cem0302
cem0303
phits-jqmd
incl45-smm
phits-jam
isabel-gemini++
cascade04
g4bert
cascadeasf
phits-bertini
incl45-abla07
isabel-abla07
isabel-smm

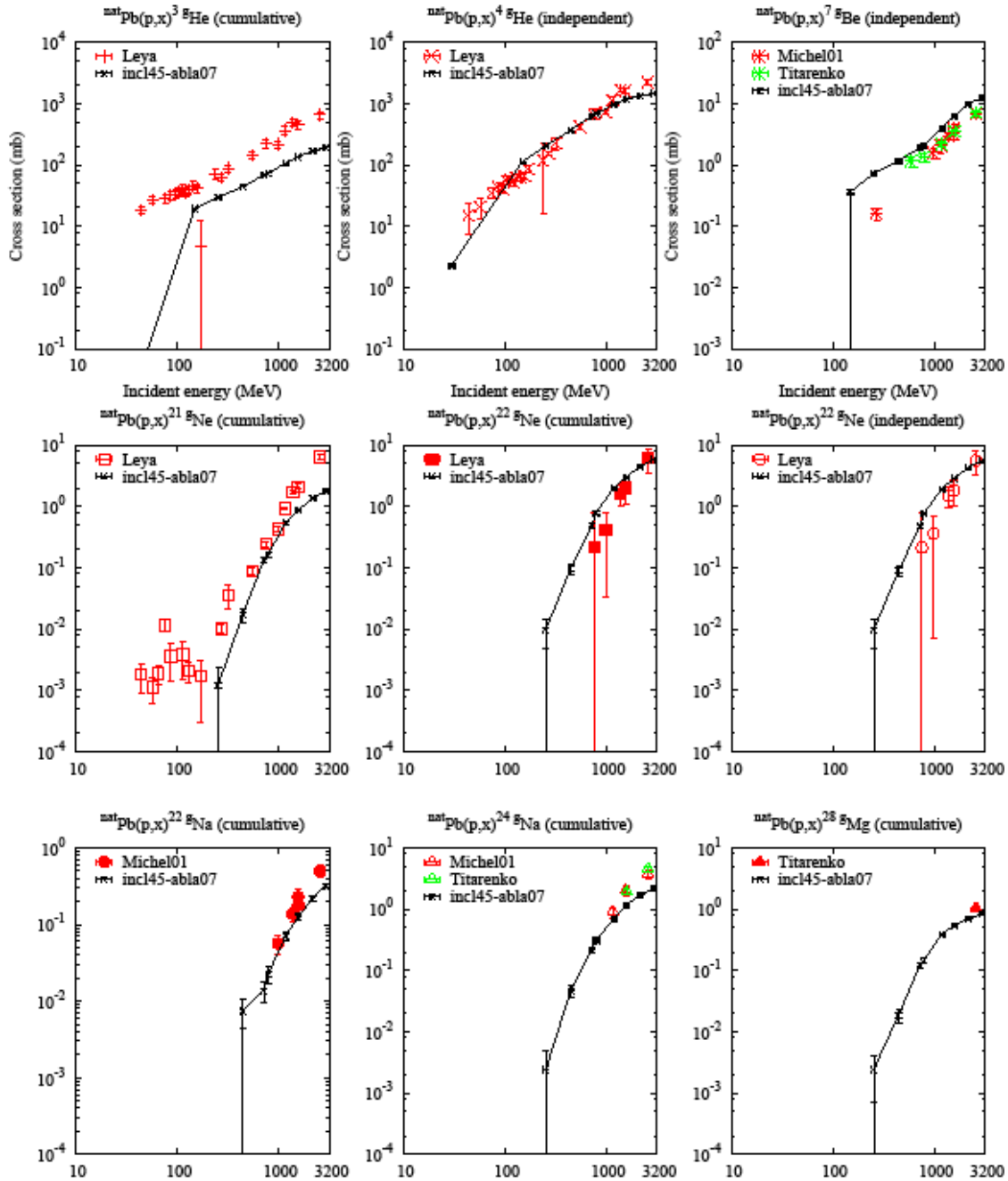

208Pb(p,x)Ti
208Pb(p,x)V
208Pb(p,x)Cr
(Z=23)enqvist
incl45-gemini++
Cross section (mb)
Isotopic mass number (A)
208Pb(p,x)Mn
208Pb(p,x)Fe
208Pb(p,x)Co
208Pb(p,x)Ni
208Pb(p,x)Cu
208Pb(p,x)Zn

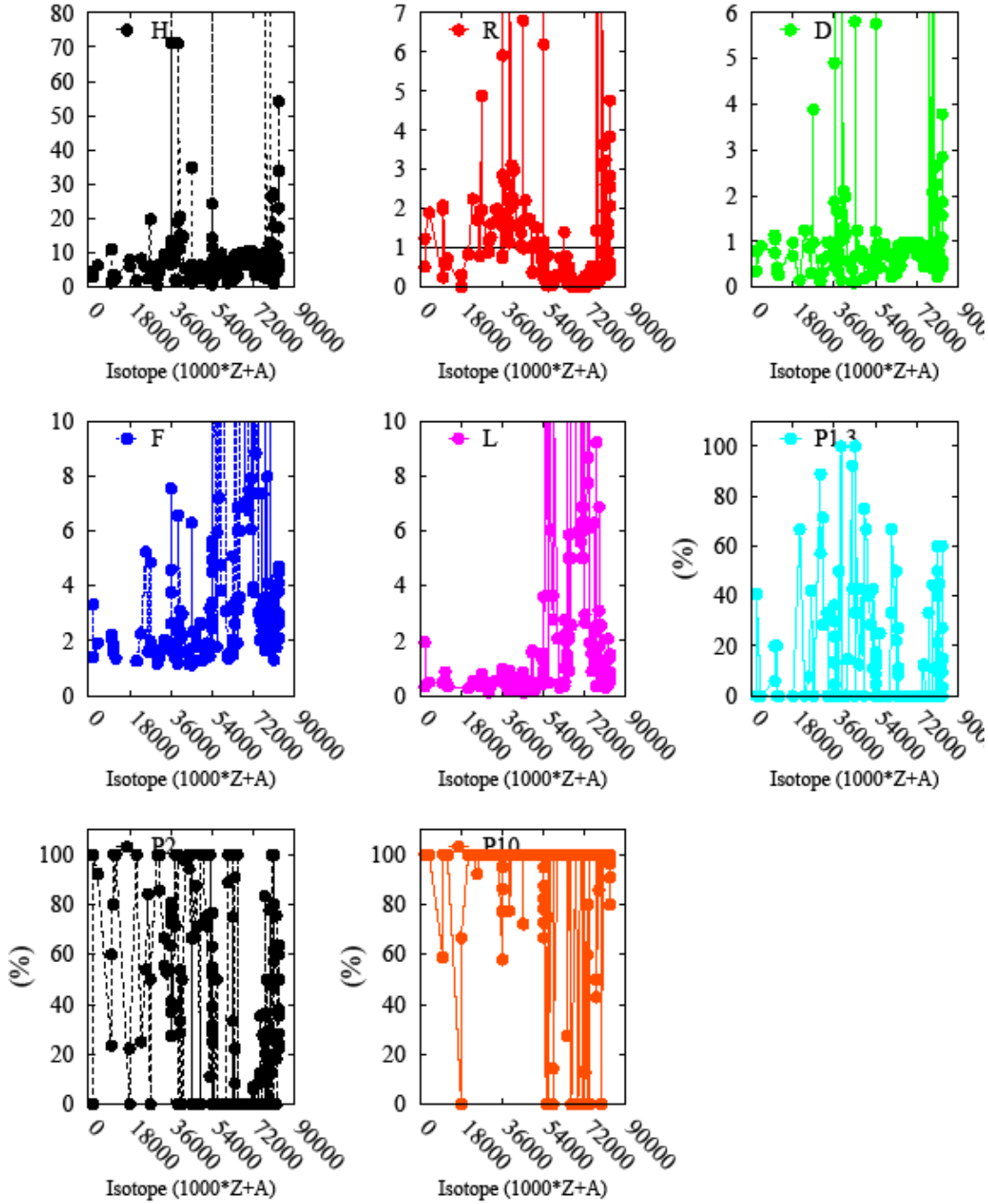

H factor
1000
100
10
1
0.1
H factor
20
30
40
50
60
70
80
90
Charge number (Z)
g4bic
incl45-gemini++
cem0302
cem0303
phits-jqmd
incl45-smm
phits-jam
isabel-gemini++
cascade04
g4bert
cascadeasf
phits-bertini
isabel-smm

Excitation functions


natFe(p,x)3 8He (cumulative)
Michel96
incl45-abla07
Cross section (mb)
Incident energy (MeV)
natFe(p,x)3 8He (independent)
Leya
Michel96
incl45-abla07
natFe(p,x)4 8He (independent)
Leya
Michel96
incl45-abla07
natFe(p,x)7 8Be (independent)
Michel02
Michel96
Titarenko
incl45-abla07
natFe(p,x)10 8Be (independent)
Michel96
incl45-abla07
natFe(p,x)21 8Ne (cumulative)
Leya
Michel96
incl45-abla07
natFe(p,x)22 8Ne (independent)
Leya
incl45-abla07
natFe(p,x)22 8Na (cumulative)
Michel02
Michel96
Titarenko
incl45-abla07
natFe(p,x)24 8Na (cumulative)
Michel02
Michel96
Titarenko
incl45-abla07


natFe(p,x)3 8He (cumulative)
Michel96
cem0303
natFe(p,x)3 8He (independent)
Leya
Michel96
cem0303
natFe(p,x)4 8He (independent)
Leya
Michel96
cem0303
Cross section (mb)
Incident energy (MeV)
natFe(p,x)7 8Be (independent)
Michel02
Michel96
Titarenko
cem0303
natFe(p,x)10 8Be (independent)
Michel96
cem0303
natFe(p,x)21 8Ne (cumulative)
Leya
Michel96
cem0303
natFe(p,x)22 8Ne (independent)
Leya
cem0303
natFe(p,x)22 8Na (cumulative)
Michel02
Michel96
Titarenko
cem0303
natFe(p,x)24 8Na (cumulative)
Michel02
Michel96
Titarenko
cem0303


natPb(p,x)3 gHe (cumulative)
natPb(p,x)4 gHe (independent)
natPb(p,x)7 gBe (independent)
natPb(p,x)21 gNe (cumulative)
natPb(p,x)22 gNe (cumulative)
natPb(p,x)22 gNe (independent)
natPb(p,x)22 gNa (cumulative)
natPb(p,x)24 gNa (cumulative)
natPb(p,x)28 gMg (cumulative)
Leya
Michel01
Titarenko
incl45-abla07
Cross section (mb)
Incident energy (MeV)


H
R
D
F
L
P13
P2
P10
(%)
Isotope (1000*Z+A)
0
18000
36000
54000
72000
90000