^{23}Al+^{12}C 反応から生成した ^{22}Mg の運動量分布の CDCC 解析

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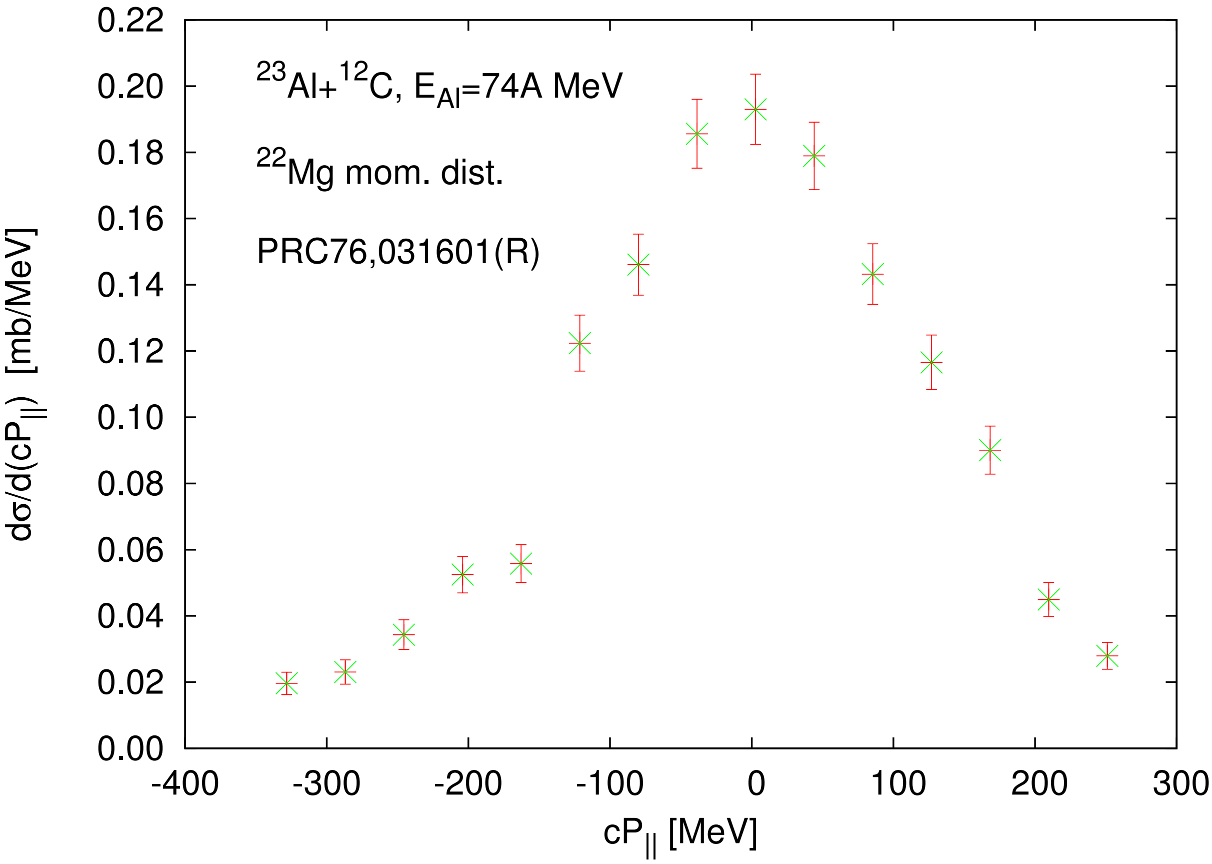
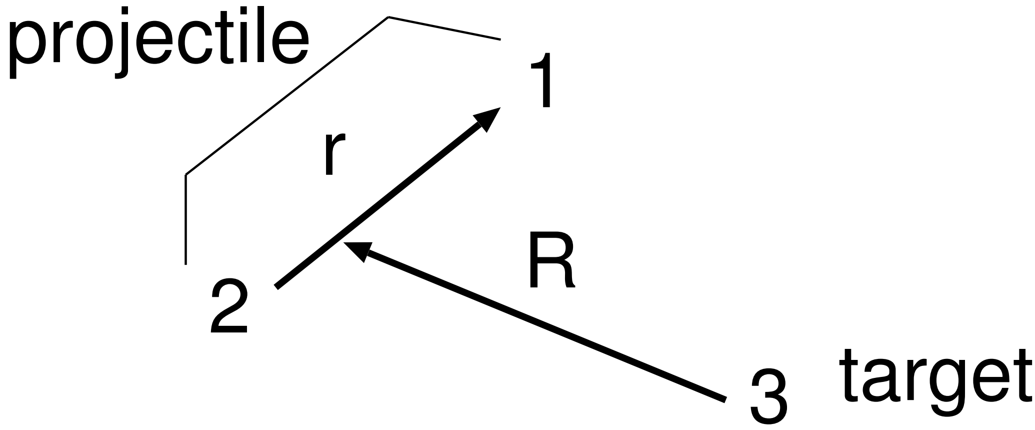


CDCC is a 3 body like approach to scatt. of loosely bound projectile off the hard nucleus



Hamiltonian H:

$$
\begin{aligned}
H &= T_r + V_{12}(r) \\
&\quad + T_R + V_{13}(r_{13}) + V_{23}(r_{23})
\end{aligned}
$$

$$\{T_r + V_{12}(\mathrm{r}) - E_c\}\,\phi_c(\mathrm{r}) = 0$$

scatt. state wf. at large r

$$\phi_c(k,\, r) \longrightarrow \sqrt{\frac{2}{\pi}}\,\sin(k\,r - l_c\pi/2 + \delta_{c\,k})/r$$

truncation	$\boldsymbol{k}$ **and spin space**
discretization	$\boldsymbol{k}$ **space**

$$\hat{\phi}_{c\,j} = \frac{1}{\sqrt{k_j - k_{j-1}}} \int_{k_{j-1}}^{k_j} \phi_c(k,\, r)\, dk$$

and is orthonormalized as

$$\langle \hat{\phi}_{c\,j} \,|\, \hat{\phi}_{c'\,j'} \rangle_{\mathrm{r}} = \delta_{c\,c'} \delta_{j\,j'}$$

$V_{13} + V_{23}$ **:**

consists of nucl. and Coul. pots.

$$\Psi_{J\,M} = \frac{1}{R} \sum_{c,\,j} \; \chi^{J}_{L_{c\,j}}(R)$$

$$\times \, [\hat{\phi}_{c\,j}(r) \; i^{l_c}\, Y_{l_c}(\hat{\mathrm{r}}) \; i^{L_{c\,j}} \; Y_{L_{c\,j}}(\hat{\mathrm{R}})]_{J\,M}$$

$$\chi^J_{L_{c\,j}}(R) \rightarrow I_{L_{c_0}}\;\delta_{c,c_0}\;\delta_{L_{c\,j},L_{c_0}} - \sqrt{\frac{K_{c_0}}{K_{c\,j}}}\;S^J_{c\,j,\,c_0\,L_{c_0}}\;O_{c\,j}$$

<u>**Elastic cross sec**</u>

$$\sigma_{el} \propto |f_c + \sum (\text{geom. factor})\, e^{i(\sigma_{L_0}+\sigma_L)} \times \left(S^J_{L,L_0} - \delta_{L\,L_0}\right)\; Y_{LM}(\hat{\mathrm{R}})|^2$$

<u>**triple diff. cross sec.**</u>

$$\frac{d^3\sigma}{d\Omega_1\, d\Omega_2\, dE_1} \propto (\text{final state dens.}) \times |T|^2$$

<u>double differential cross sec.</u>

$$\frac{d^2\sigma}{d\Omega_1\, dE_1} = \sum_{m_2} \int d\Omega_2 \frac{d^3\sigma}{d\Omega_1\, d\Omega_2\, dE_1}$$

<u>momentum. dist. in elast. BU.</u>

$$\frac{d^2\sigma}{d\Omega_1\, dp_1} = \frac{d^2\sigma}{d\Omega_1\, dE_1} \times \frac{dE_1}{dp_1}$$

<u>excahnge of part. 1 and 2</u>

$$T(1 <-> 2) = (-1)^l\, T(original)$$

<u>parameters, etc</u>

reaction:

^{23}**Al**+^{12}**C**

$\mathbf{E}_{Al} = \mathbf{80}$ **A [MeV]**

int. with ^{12}**C**

Watson et al., for p

Beunerd et al., for ^{22}**Mg**

int. of p-^{22}**Mg**

Woods-Saxon pot+ Coul.

states in 1-2 sys.:

a bound d-state

BE=−0.125 MeV

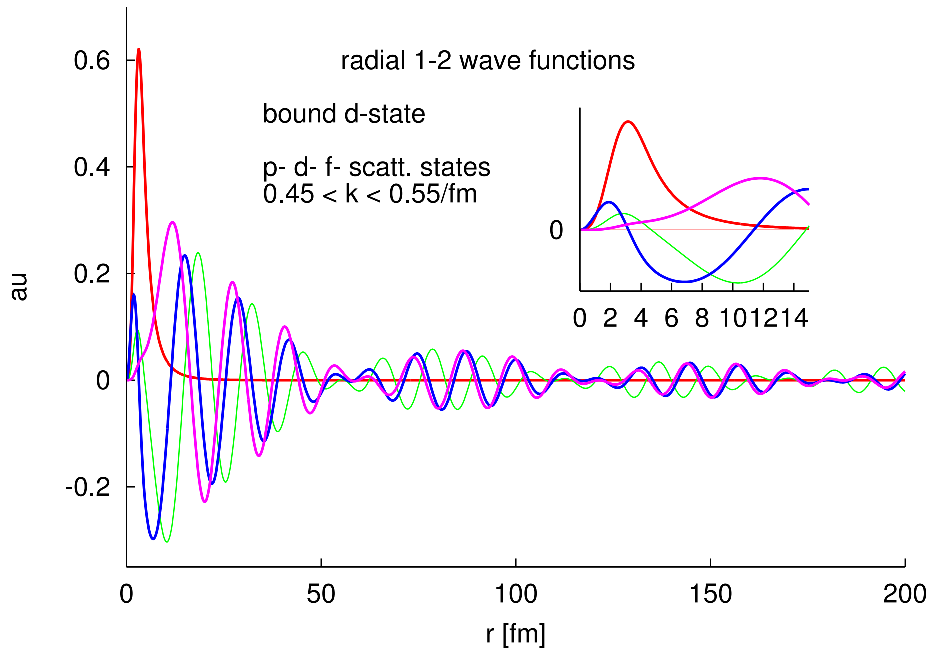
s, p, d, f, g states

$\mathbf{0 \leq k_{12} \leq 1.5}$ $\mathbf{fm^{-1}}$

$\hat{\phi}(r)$, the 1-2 base

real, even for scatt. states

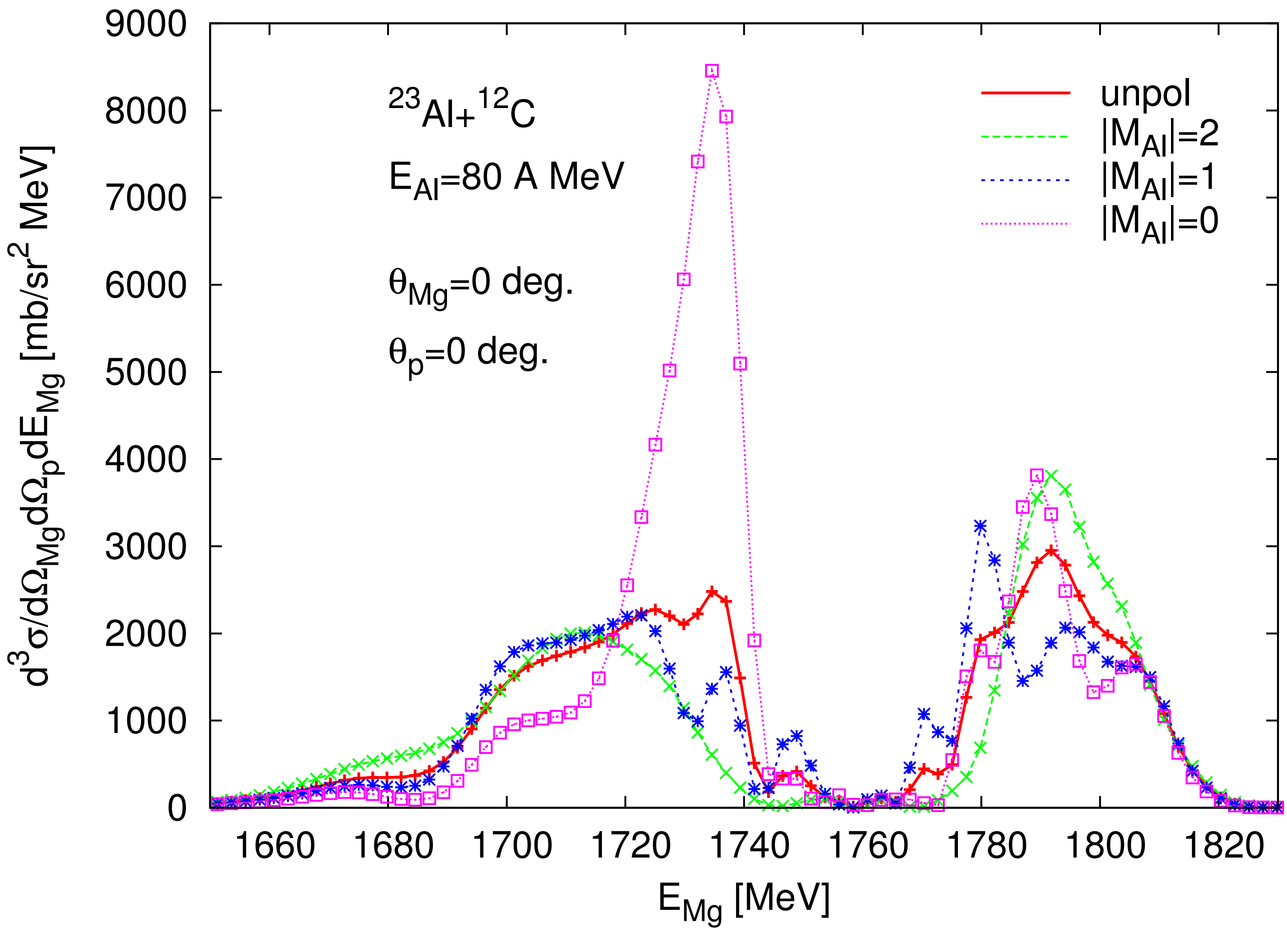
d-, p-, f-state (bound/ scatt.) wf.
$0.45 < k < 0.55\ fm^{-1}$



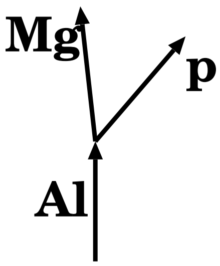
dumps at large r, which is a large merit of binning

s, p, d-states have a node $r < 4$ fm but not for f-state(No bond states)

triple diff. Xsec.

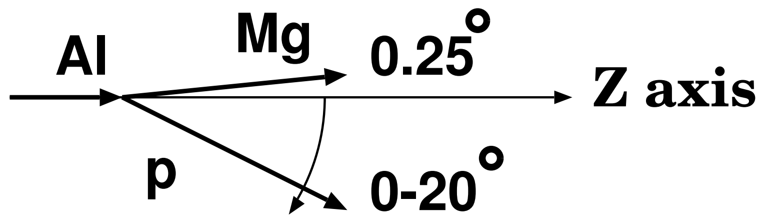


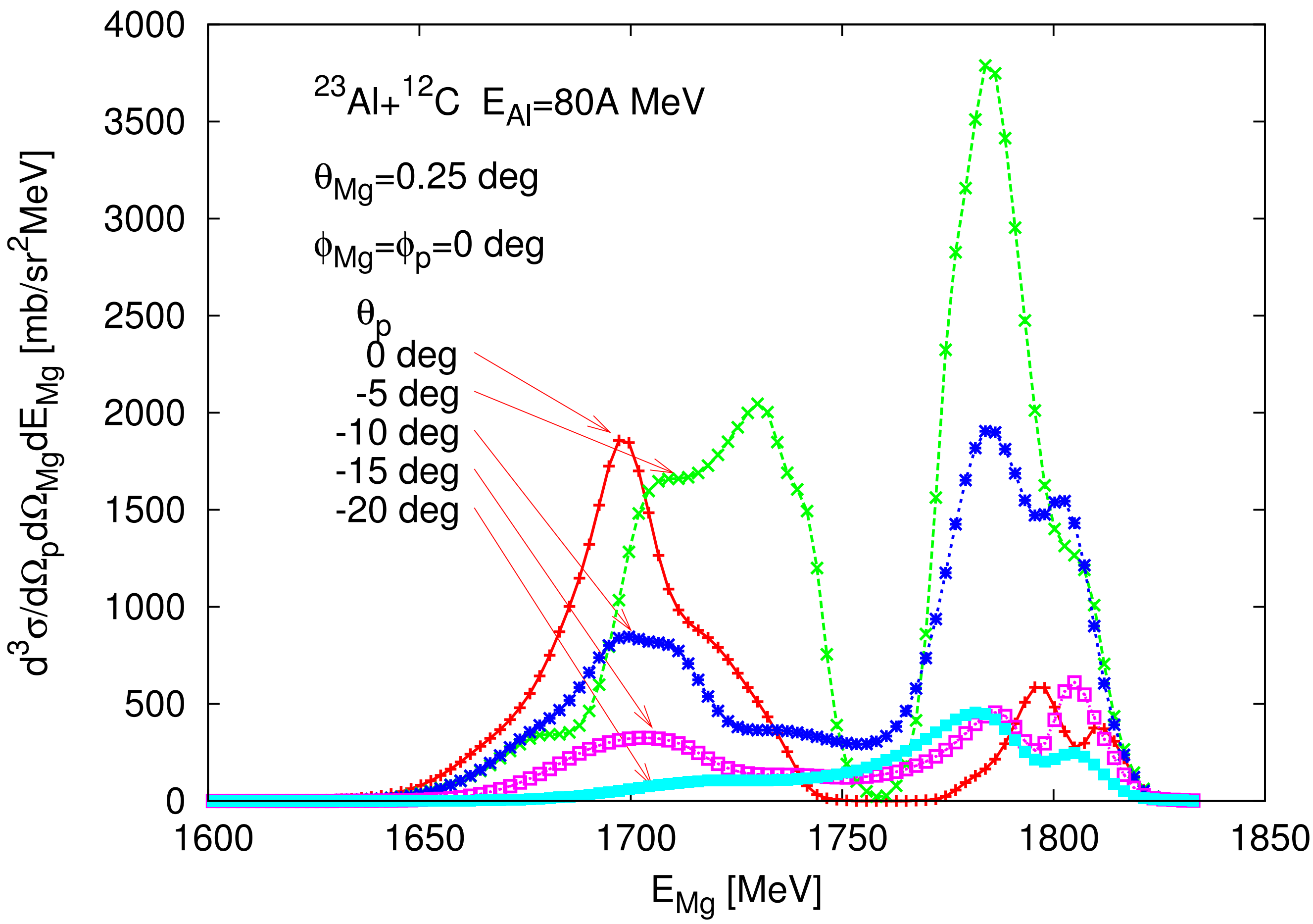
クーロン斥力



No Xsec. for $k_{12} = 0\,\mathrm{fm}^{-1}$

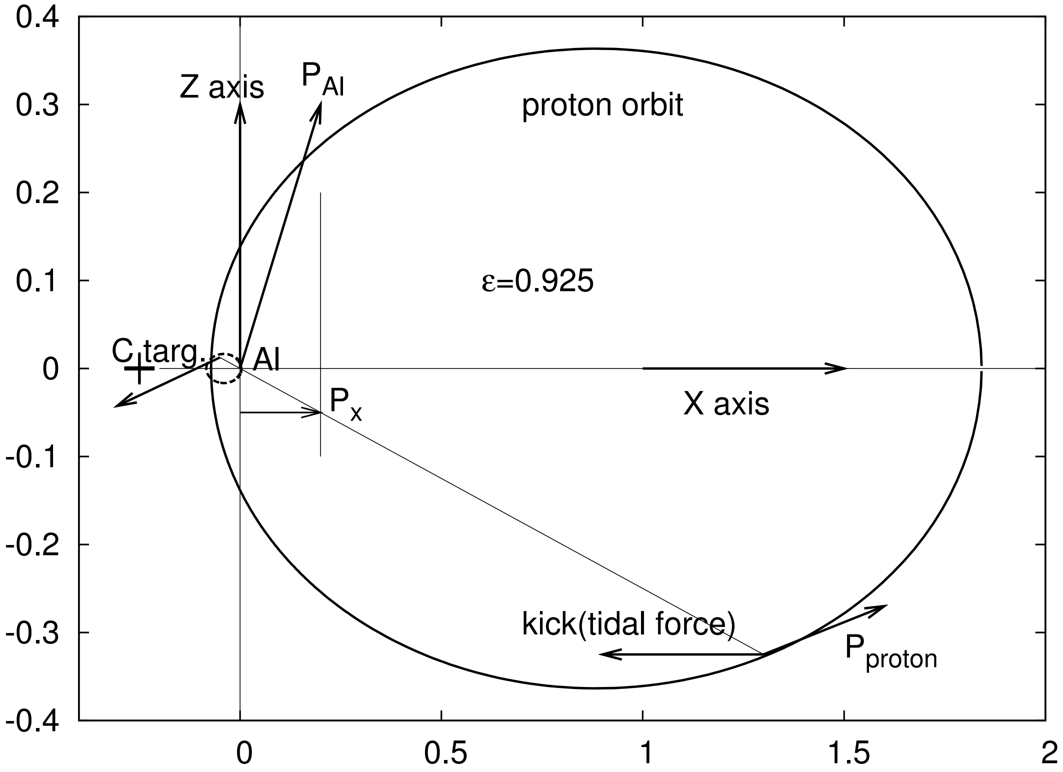
triple diff. Xsec.





Mg と p が入射粒子に関して、逆方向ならば $k_{12} = 0\ \mathrm{fm}^{-1}$ の谷は消える

peak for $m = 0$ trans.



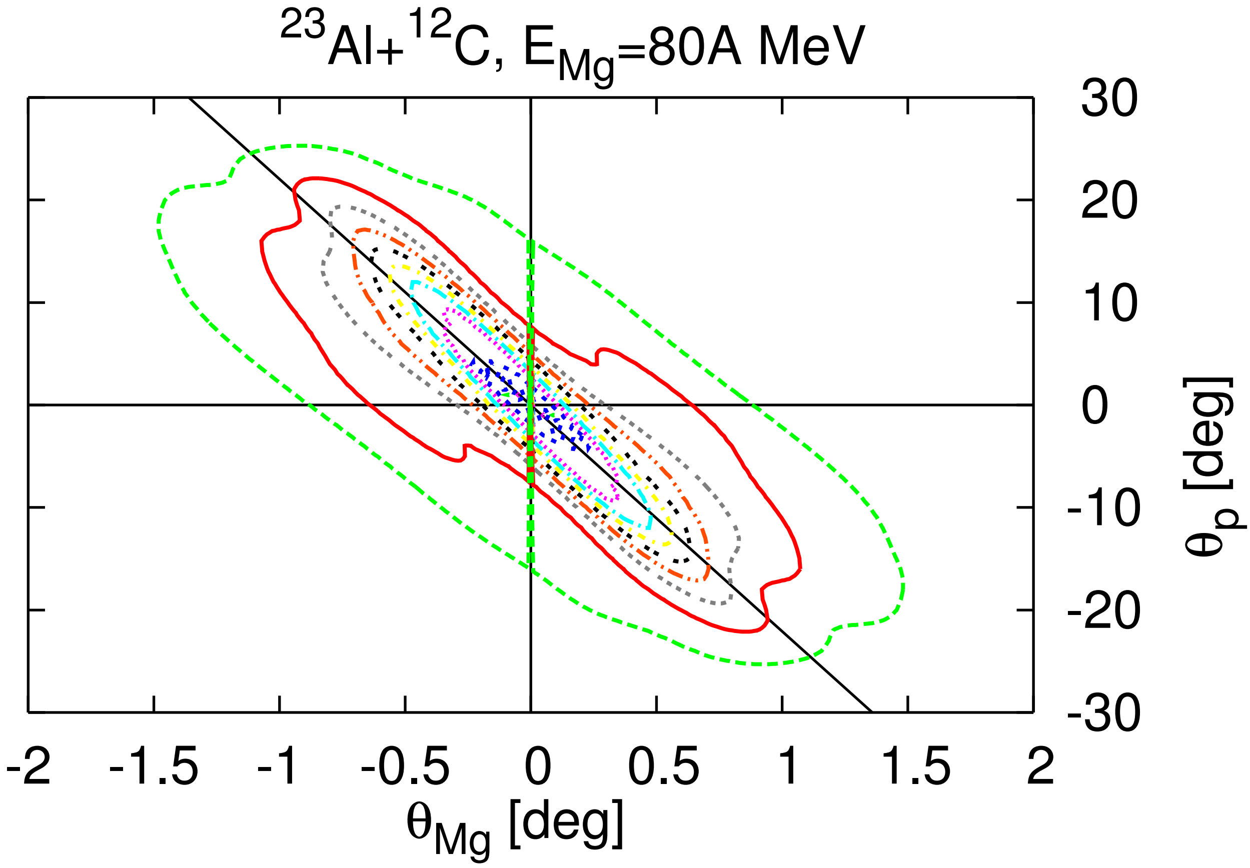
	Mg	proton	
$(P_{Mg/p})_x$	$-2.15\,P_x$	$+2.15\,P_x$	等大
潮汐力	$+1.2\,P_x$	$-2.2\,P_x$	6 : 11
和	$-0.95\,P_x$	$-0.05\,P_x$	22 : 1
$(P_{Mg/p})_z$	$-$	$+$	

y comp. in int. mom. for $|m| \neq 0$

Double diff. Xsec. 1

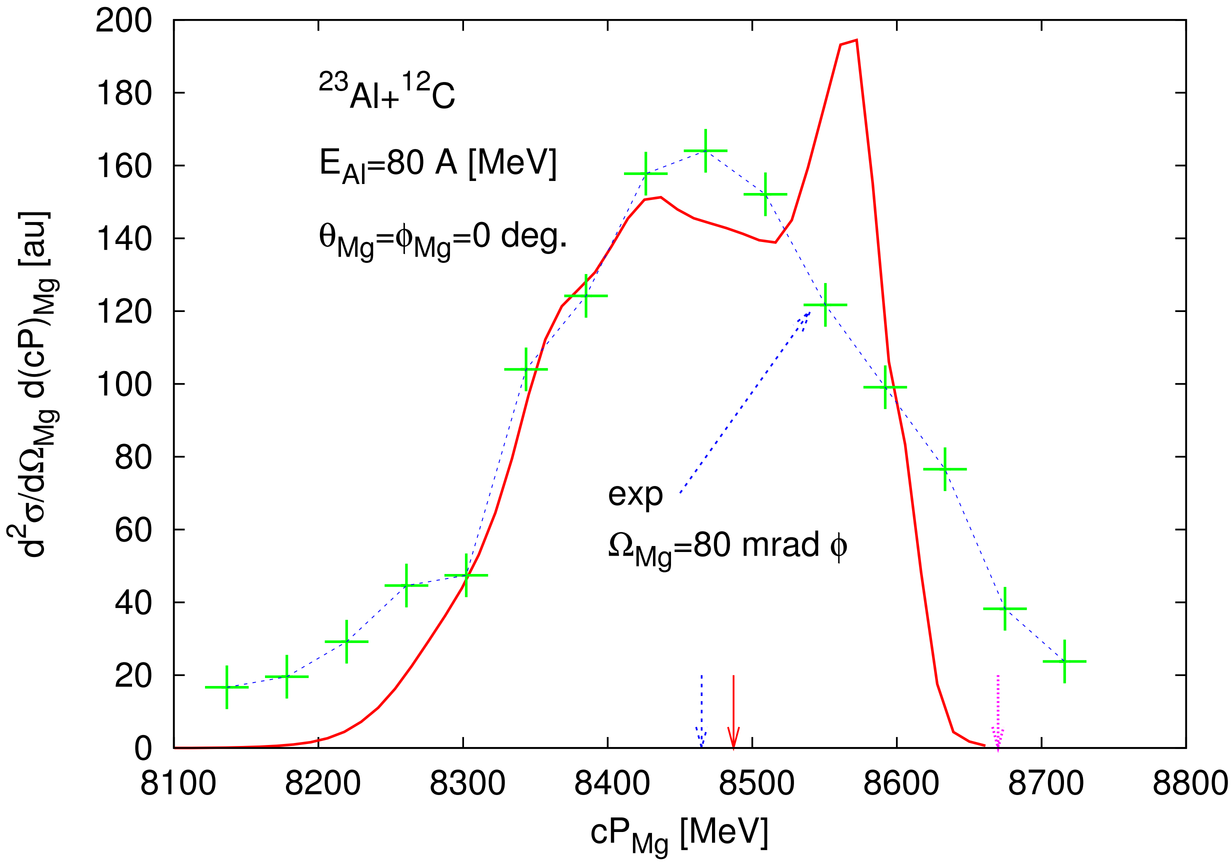
$$\sum_{E_1} \frac{d^3\sigma}{d\Omega_{Mg} d\Omega_p dE_1}$$

$$\text{where,} \quad \phi_{Mg} = \phi_p = 0^\circ$$



対角線の傾きは 陽子と ^{22}Mg の質量比

Double diff. Xsec. 2



exp. Fang et al., $E_{Al} = 74$ MeV

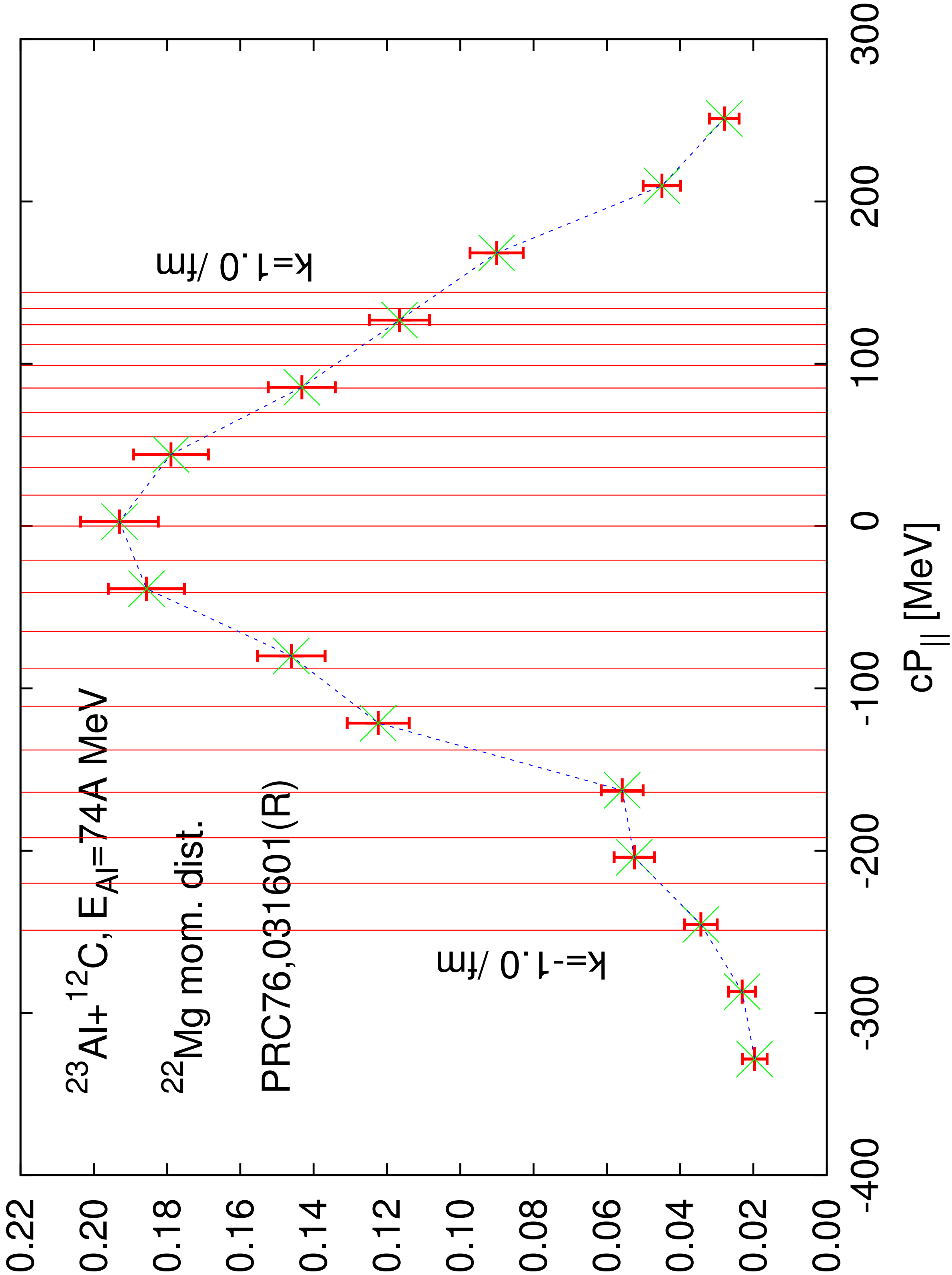
aperture 80 mrd$^{\phi}$

cal. $E_{Al} = 80$ **A MeV**

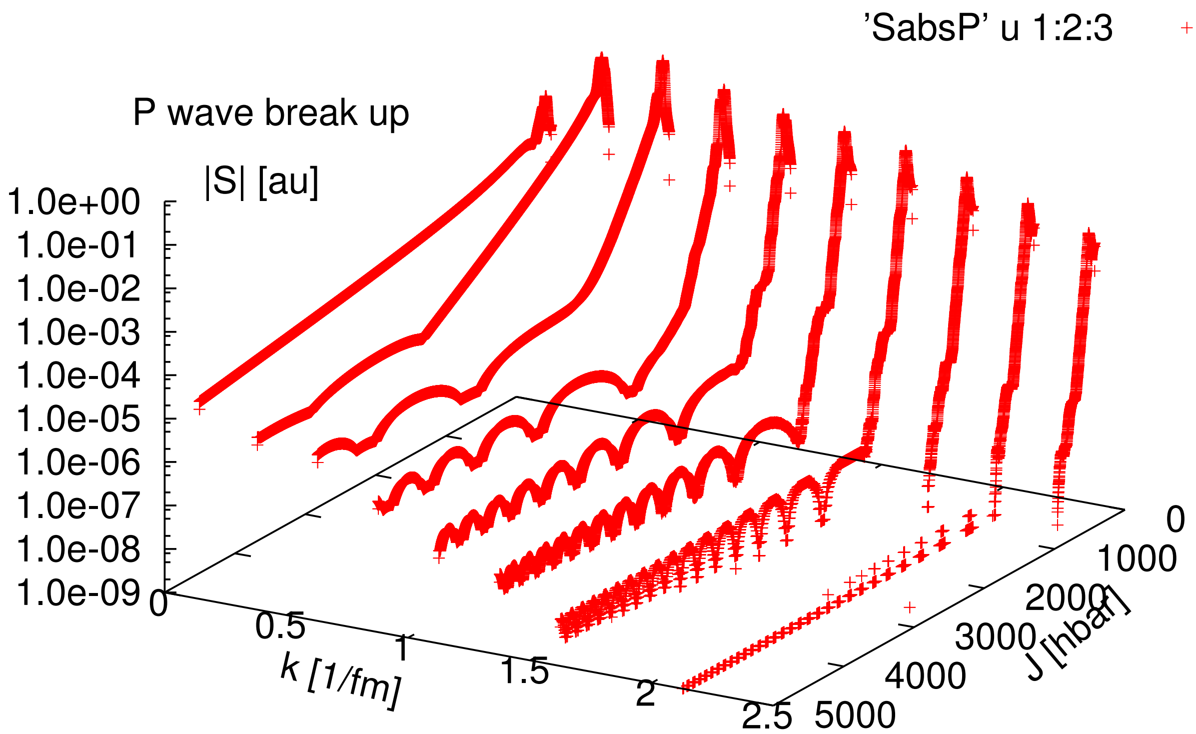
$$\theta_{Mg} = \phi_{Mg} = 0^\circ$$

$$0^\circ \le \theta_p \le 45^\circ \quad 0^\circ \le \phi_p \le 180^\circ$$

プログラム hctak は提供可です


^{23}Al+^{12}C, E$_{Al}$=74A MeV
^{22}Mg mom. dist.
PRC76,031601(R)
k=1.0 /fm
k=-1.0 /fm
cP$_{||}$ [MeV]
-400
-300
-200
-100
0
100
200
300
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
0.22

J and k dep. of p-wave absorption



just qualitative !