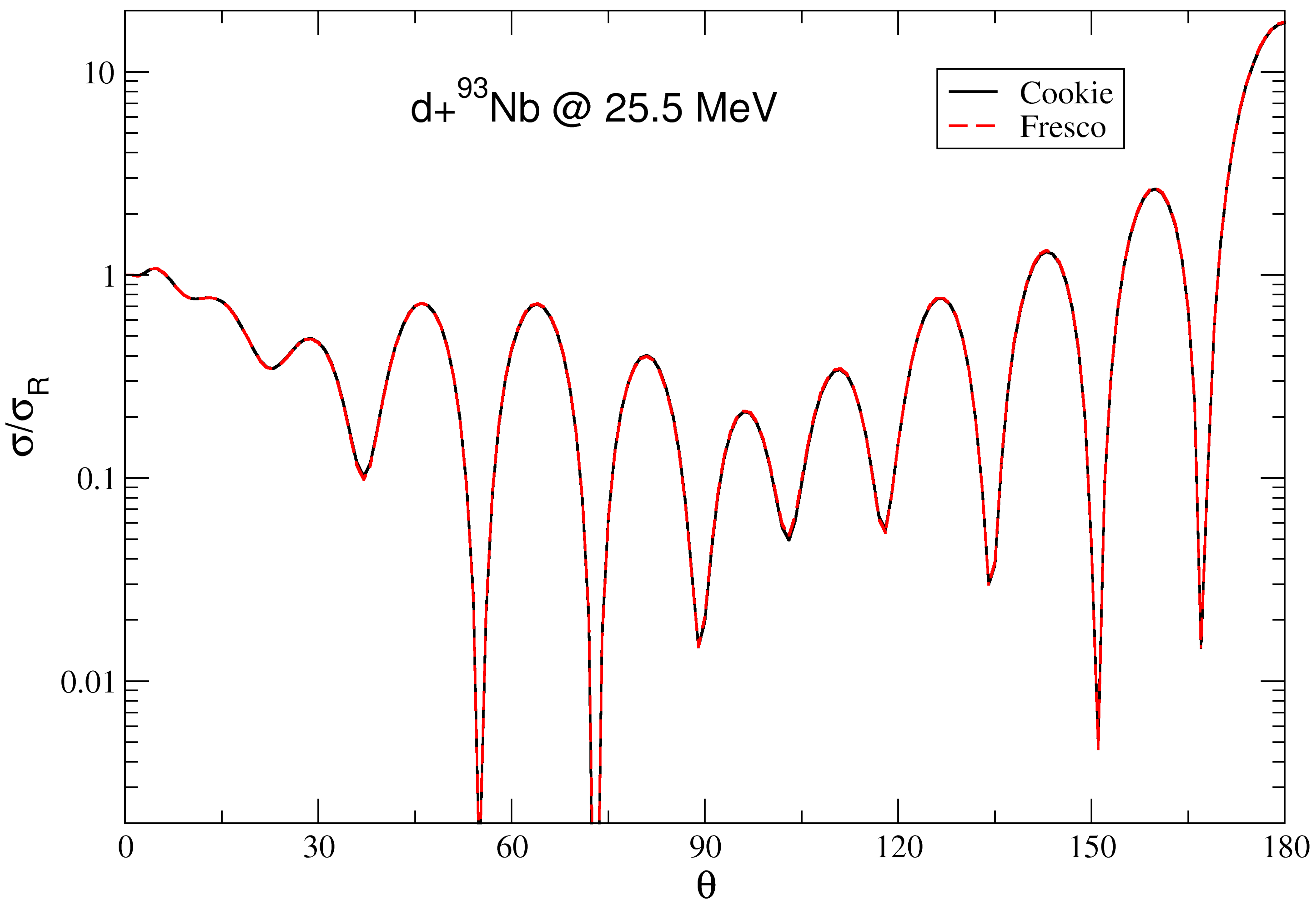
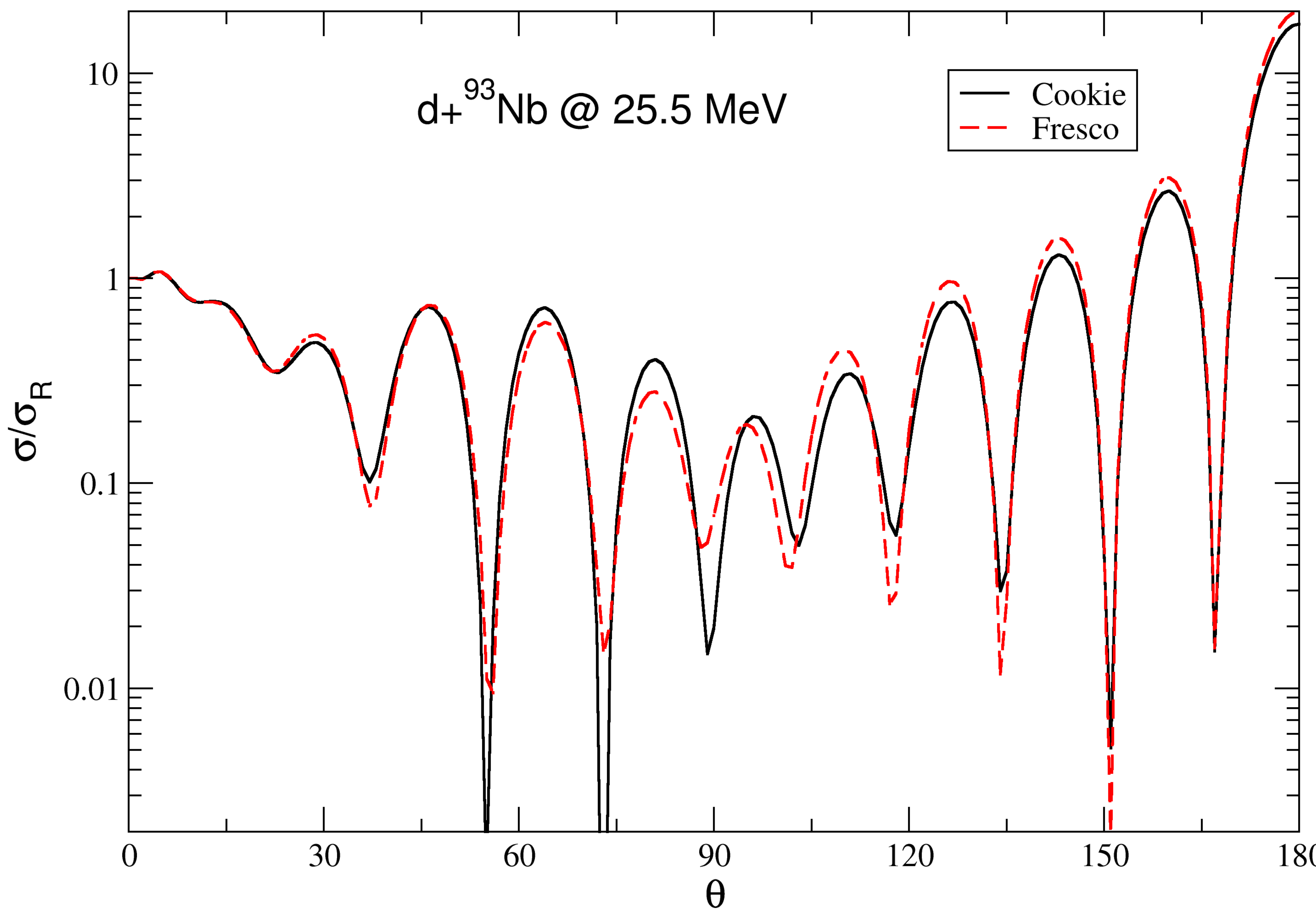
计算可观测量

Calculation

得到弹性散射截面，并与fresco的结果进行比较，形状符合的很好，但是依然存在一些差别，还在寻找原因。





Calculation

但是如果考虑连续态的影响S矩阵并不一致，但是没有发现这是为什么。这时的弹性截面也是显然不一致的。

```
   -> re-orthogonalizing at i,r= 102      5.1
  S-matrix     1 =    0.09688  -0.06655 for L=    0, J=     0.0
Elastic phase shift   1 =  -17.243  61.336 deg. for the L =
  S-matrix     2 =   -0.01710   0.00278 for L=    0, J=     0.0
  S-matrix     3 =   -0.04163   0.00282 for L=    0, J=     0.0
  S-matrix     4 =   -0.03292  -0.01873 for L=    0, J=     0.0
  S-matrix     5 =    0.01793  -0.03618 for L=    0, J=     0.0
  S-matrix     6 =    0.02383   0.01420 for L=    0, J=     0.0
  S-matrix     7 =    0.03134  -0.04554 for L=    0, J=     0.0
```

```
For Jtot=      0.0+ there are    7 channels to solve
Ch.    1  alpha3b=   1  n=   1  gs=T
Ch.    2  alpha3b=   1  n=   2  gs=F
Ch.    3  alpha3b=   1  n=   3  gs=F
Ch.    4  alpha3b=   1  n=   4  gs=F
Ch.    5  alpha3b=   1  n=   5  gs=F
Ch.    6  alpha3b=   1  n=   6  gs=F
Ch.    7  alpha3b=   1  n=   7  gs=F
For Ch.=  1 g.s.
    Chan. #  1     S=( 0.07193, 0.13351)      |S|= 0.151652
    Chan. #  2     S=(-0.06622,-0.00907)      |S|= 0.066838
    Chan. #  3     S=(-0.03272,-0.00789)      |S|= 0.033662
    Chan. #  4     S=( 0.01300,-0.02565)      |S|= 0.028757
    Chan. #  5     S=( 0.06863,-0.02622)      |S|= 0.073471
    Chan. #  6     S=( 0.00100,-0.04236)      |S|= 0.042376
    Chan. #  7     S=(-0.02924, 0.02412)      |S|= 0.037900
```

Calculation

形式上已经输出了该fort.57的形式的结果，并且Bin states内部的nuclear phase是可信的。

```
d+ 150Sm at Ed=15.0 CDCC (no spins)
     15.0000  2.2250 20.9008  1.4400  0.0000 0  0.0000
  2.0141150.0000  1.0078  1.0063
     1.0    62.0     1.0     0.0
d       150Sm    p       Neutron
     0.0     0.0     0.0     0.0
      1       1       1       1
  42 100  42   5
 181  0.0000  1.0000
 0 0.0  0.0445  0.0049  0.0460 100    2    2
  3.1416  3.1416  3.1416  3.1416  3.1416  3.1040  3.1018  3.0995  3.0972  3.0951
  3.0927  3.0906  3.0883  3.0861  3.0839  3.0816  3.0794  3.0771  3.0749  3.0727
  3.0705  3.0682  3.0660  3.0638  3.0615  3.0593  3.0571  3.0549  3.0526  3.0504
  3.0482  3.0459  3.0437  3.0415  3.0392  3.0370  3.0348  3.0326  3.0303  3.0281
  3.0259  3.0237  3.0215  3.0192  3.0170  3.0148  3.0126  3.0104  3.0081  3.0059
  3.0037  3.0015  2.9993  2.9971  2.9948  2.9926  2.9904  2.9882  2.9860  2.9838
  2.9816  2.9794  2.9772  2.9750  2.9728  2.9706  2.9684  2.9662  2.9640  2.9618
  2.9596  2.9573  2.9552  2.9529  2.9508  2.9486  2.9464  2.9442  2.9420  2.9398
  2.9376  2.9354  2.9332  2.9310  2.9289  2.9267  2.9245  2.9223  2.9201  2.9179
  2.9158  2.9136  2.9114  2.9092  2.9071  2.9049  2.9027  2.9005  2.8984  2.8962
 0 0.0  0.2017  0.0460  0.0872 100    3    2
  2.8963  2.8941  2.8919  2.8898  2.8876  2.8854  2.8833  2.8811  2.8789  2.8768
  2.8746  2.8725  2.8703  2.8682  2.8660  2.8639  2.8617  2.8596  2.8574  2.8553
  2.8531  2.8510  2.8489  2.8467  2.8446  2.8424  2.8403  2.8382  2.8360  2.8339
  2.8318  2.8296  2.8275  2.8254  2.8233  2.8212  2.8190  2.8169  2.8148  2.8127
  2.8106  2.8085  2.8063  2.8042  2.8021  2.8000  2.7979  2.7958  2.7937  2.7916
  2.7895  2.7874  2.7853  2.7832  2.7811  2.7790  2.7770  2.7749  2.7728  2.7707
  2.7686  2.7665  2.7645  2.7624  2.7603  2.7582  2.7562  2.7541  2.7520  2.7500
  2.7479  2.7458  2.7438  2.7417  2.7396  2.7376  2.7355  2.7335  2.7314  2.7294
  2.7273  2.7253  2.7233  2.7212  2.7192  2.7171  2.7151  2.7131  2.7110  2.7090
  2.7070  2.7049  2.7029  2.7009  2.6989  2.6969  2.6948  2.6928  2.6908  2.6888
```

CDCC = 1

: Print out the $f(m'M' : mM;\theta)$ for each angle θ on file 57 for partition PEL, after the following information for *uncoupled* bin states:

```
line Y:(i2)  1    (indicating CDCC=1 format below)
line Z: (A120)   HEADNG from Fresco input.
line A: (F10.4,3F8.4)   ENLAB,Bproj,H2SM,e^2,Btarg,inp, (Qval if inp=1)
              lab energy,projectile binding energy, hbar^2/2.m, e^2,
              target binding energy,inp, Qval if inp=1

line B: (7f8.4)         massp,masst,massc,massv,massr
                                 masses: projectile,target,core,valence,residual
line C: (7f8.4)         Zp,Zt,Zc,Zv,Zr                  charges
line D: (7A8)           namep,namet,namec,namev,namer names
line E: (7f8.1)         Jp,Jt,Jc,Jv,Jr                  g.s. spins
line F: (7i8)           Pp,Pt,Pc,Pv,Pr                  g.s. parities
   If inp=1, cards B-F (incl) have further #6 and #7 values
                 for 'initial projectile' and 'initial target' too.

line G: (4I4)           NBINS,NKMAX,NEXB,NNJMAX no. CDCC bins, max NK,
                                                no. excited states, max(2*Jex+1)
line H: (I4,2f8.4)      NANGL,THMIN,THINC       (cm angular range from \&FRESCO)
for each of the NBINS bins:
 line I:(i2,2f4.1,3f8.4,2i4)
         l,j,Emid,kmin,kmax,NK,KN,ISC
            l,j: quantum numbers  (s==Jv)
            Emid:  centre of bin with respect to continuum threshold
            kmin,kmax,NK: Min,max and number of k values in bin integral
            KN:  original KN index for bin state
            ISC:  normalisation used for bin
     for each IK=1,NK
         line J: (10f8.4) delta(IK): nuclear phase shift used in bin integral (radians)

for each excited state pair in the entrance partition: IA=1,NEXB::
    line K: (f4.1,i4,f8.4,i4) Jex,Parity,Eex,IBIN:
            Jex :           spin of this projectile excited state  (not including core spin)
            Parity:         parity of this projectile state
            Eex:            excitation energy of this state above g.s.
            IBIN:           (first) bin defined for this excited state
    for each IANG=1,NANGL: read complex numbers:
    line L: (6E12.4): ((FAM(MEX,MP,IANG,IA),MEX=1,2*Jex(IA)+1),MP=1,2*Jp+1)
```

The phase convention for all CDCC values is that there is no Coulomb phase shift for $L=0$ in the Coulomb scattering amplitude : factors such as $\exp i(\sigma_L - \sigma_0))$ appear in the A's.t

Calculation

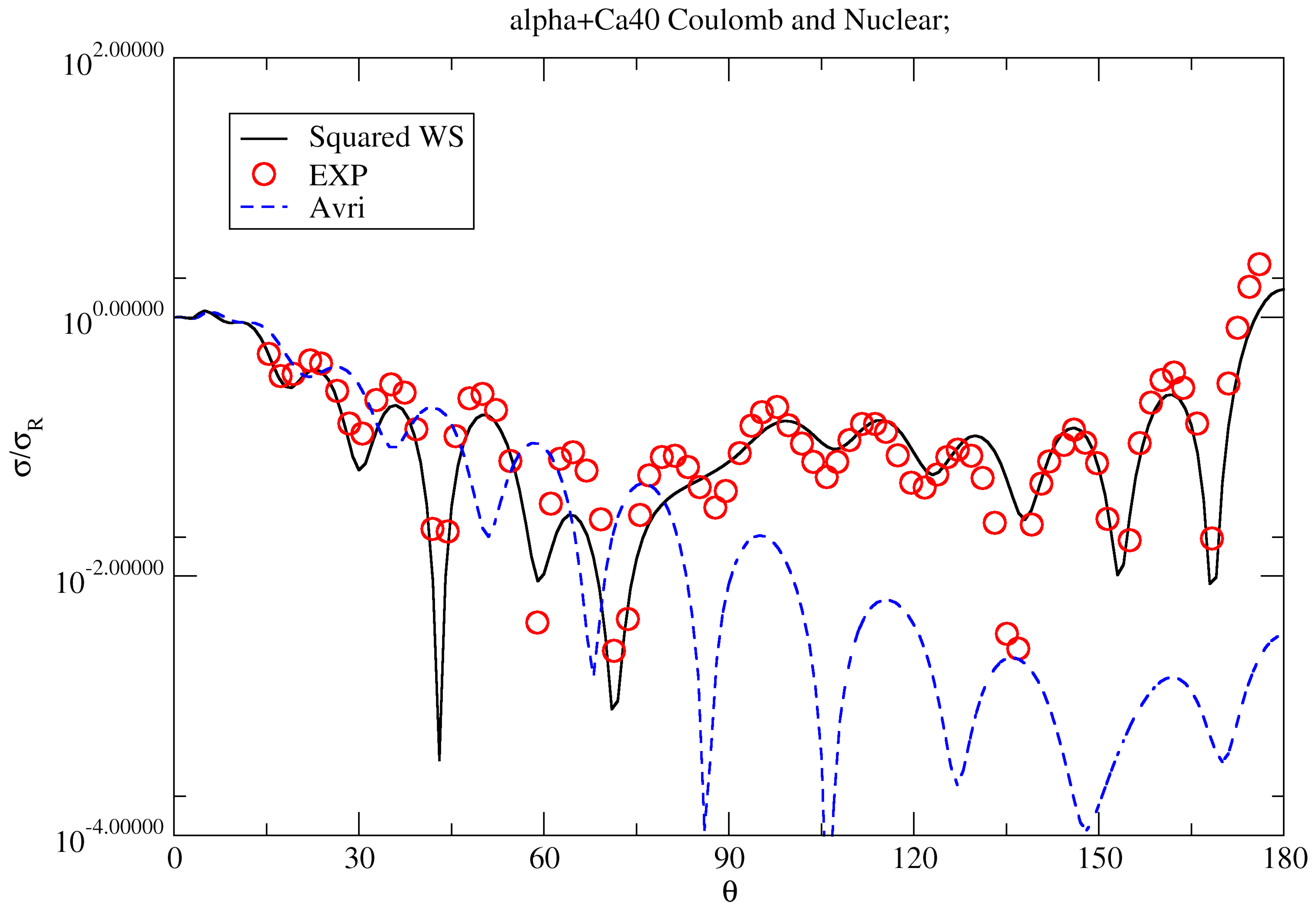
形式上已经输出了该fort.57的形式的结果，并且Bin states内部的nuclear phase是可信的。Fresco使用等间隔的动量划分bins，cookie使用等间隔能量划分。

```
d+   93Nb at Ed=25.5 CDCC (no spins)
     25.5000  2.2240 20.9008  1.4400  0.0000 0  0.0000
  2.0000 93.0000  1.0078  0.9922
     1.0     41.0      1.0      0.0
d        93Nb     p        Neutron
     0.0      0.0      0.0      0.0
       1        1        1        1
   6 100    6    1
 181  0.0000  1.0000
 0 0.0  0.5230  0.0489  0.1504 100    2   2
  2.8776  2.8722  2.8668  2.8614  2.8560  2.8507  2.8453  2.8400  2.8346  2.8293
  2.8240  2.8187  2.8134  2.8081  2.8028  2.7976  2.7923  2.7870  2.7818  2.7766
  2.7714  2.7662  2.7610  2.7558  2.7506  2.7454  2.7403  2.7352  2.7300  2.7249
  2.7198  2.7147  2.7096  2.7046  2.6995  2.6945  2.6894  2.6844  2.6794  2.6744
  2.6694  2.6644  2.6595  2.6545  2.6496  2.6446  2.6397  2.6348  2.6299  2.6251
  2.6202  2.6154  2.6105  2.6057  2.6009  2.5961  2.5913  2.5865  2.5818  2.5770
  2.5723  2.5676  2.5629  2.5582  2.5535  2.5488  2.5442  2.5396  2.5349  2.5303
  2.5257  2.5211  2.5166  2.5120  2.5075  2.5029  2.4984  2.4939  2.4894  2.4849
  2.4805  2.4760  2.4716  2.4672  2.4628  2.4584  2.4540  2.4496  2.4452  2.4409
  2.4366  2.4323  2.4280  2.4237  2.4194  2.4151  2.4109  2.4067  2.4024  2.3982
 0  0.0  1.7997  0.1504  0.2519 100    3   2
  2.3982  2.3940  2.3899  2.3857  2.3815  2.3774  2.3733  2.3692  2.3650  2.3610
  2.3569  2.3528  2.3488  2.3447  2.3407  2.3367  2.3327  2.3287  2.3247  2.3208
  2.3168  2.3129  2.3090  2.3051  2.3012  2.2973  2.2934  2.2896  2.2857  2.2819
  2.2781  2.2743  2.2705  2.2667  2.2629  2.2592  2.2554  2.2517  2.2480  2.2442
  2.2405  2.2369  2.2332  2.2295  2.2259  2.2222  2.2186  2.2150  2.2114  2.2078
  2.2042  2.2007  2.1971  2.1936  2.1900  2.1865  2.1830  2.1795  2.1760  2.1725
  2.1691  2.1656  2.1622  2.1588  2.1553  2.1519  2.1485  2.1451  2.1418  2.1384
  2.1351  2.1317  2.1284  2.1251  2.1217  2.1184  2.1152  2.1119  2.1086  2.1054
  2.1021  2.0989  2.0956  2.0924  2.0892  2.0860  2.0828  2.0797  2.0765  2.0733
  2.0702  2.0670  2.0639  2.0608  2.0577  2.0546  2.0515  2.0484  2.0454  2.0423
```

```
d     +93Nb at Ed=   25.500000000000000       CDCC
  25.5000  2.2240 20.9008  1.4400  0.0000 0  0.0000
 2.0000 93.0000  1.0078  1.0087
 1.0000 41.0000  1.0000  0.0000
  d        93Nb     p        n
    0.0      0.0      0.0      0.0
     1        1        1        1
  6 100    6    1
181  0.0000  1.0000
0 0.0  1.2523  0.0491  0.2734 100    2   2
 0.2714  0.2830  0.2944  0.3059  0.3173  0.3287  0.3400  0.3513  0.3625  0.3737
 0.3849  0.3960  0.4070  0.4180  0.4289  0.4398  0.4507  0.4614  0.4722  0.4828
 0.4934  0.5040  0.5145  0.5249  0.5353  0.5456  0.5559  0.5661  0.5762  0.5863
 0.5963  0.6063  0.6162  0.6260  0.6358  0.6455  0.6552  0.6648  0.6743  0.6838
 0.6932  0.7025  0.7118  0.7210  0.7302  0.7393  0.7483  0.7573  0.7662  0.7751
 0.7839  0.7926  0.8013  0.8099  0.8185  0.8270  0.8354  0.8438  0.8521  0.8604
 0.8686  0.8768  0.8849  0.8929  0.9009  0.9088  0.9167  0.9245  0.9323  0.9400
 0.9477  0.9553  0.9629  0.9704  0.9778  0.9852  0.9926  0.9999  1.0071  1.0143
 1.0215  1.0286  1.0357  1.0427  1.0496  1.0565  1.0634  1.0702  1.0770  1.0837
 1.0904  1.0971  1.1037  1.1102  1.1167  1.1232  1.1296  1.1360  1.1424  1.1487
0 0.0  4.5162  0.2734  0.3836 100    3   2
 1.1518  1.1548  1.1579  1.1609  1.1640  1.1670  1.1700  1.1730  1.1761  1.1790
 1.1820  1.1850  1.1880  1.1909  1.1939  1.1968  1.1998  1.2027  1.2056  1.2085
 1.2114  1.2143  1.2171  1.2200  1.2229  1.2257  1.2286  1.2314  1.2342  1.2370
 1.2399  1.2427  1.2455  1.2482  1.2510  1.2538  1.2565  1.2593  1.2620  1.2648
 1.2675  1.2702  1.2729  1.2756  1.2783  1.2810  1.2837  1.2864  1.2890  1.2917
 1.2943  1.2970  1.2996  1.3022  1.3049  1.3075  1.3101  1.3127  1.3153  1.3178
 1.3204  1.3230  1.3255  1.3281  1.3306  1.3332  1.3357  1.3382  1.3408  1.3433
 1.3458  1.3483  1.3508  1.3533  1.3557  1.3582  1.3607  1.3631  1.3656  1.3680
 1.3705  1.3729  1.3753  1.3777  1.3801  1.3826  1.3850  1.3873  1.3897  1.3921
 1.3945  1.3969  1.3992  1.4016  1.4039  1.4063  1.4086  1.4109  1.4133  1.4156
```

Calculation

另外考虑平方Wood-Saxon势，与α粒子的弹性散射的比较，我们可以看到平方Wood-Saxon的结果很好。



Calculation

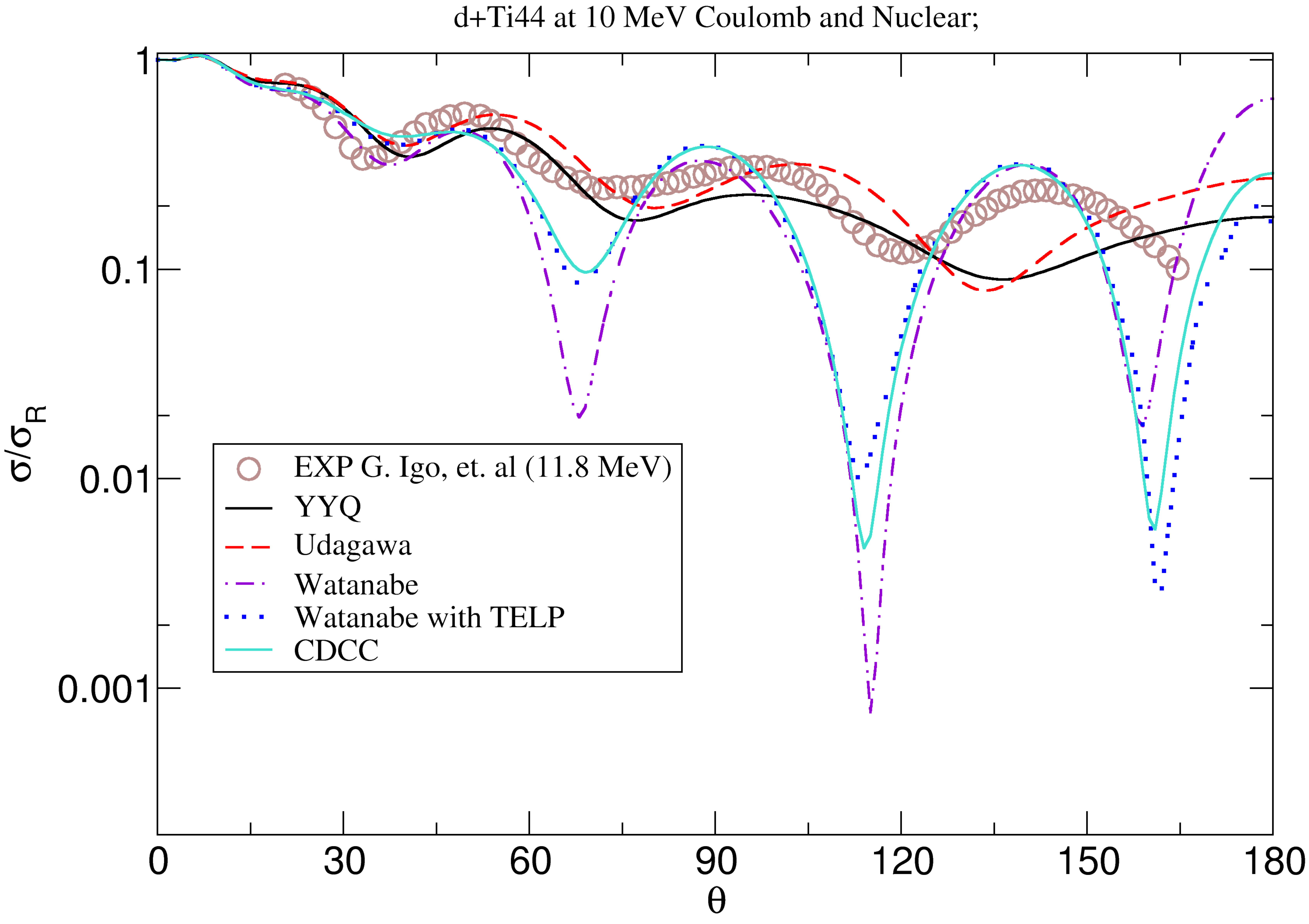
除此之外可以使用这样的形式，可以保证在弹性散射数据基本不变的情况下，调整内部势的深度。

$$V(r) = \frac{V_0}{1 + \exp\frac{r - r_0}{a_0}} \xrightarrow{r \to \infty} V(r) = V_0 \exp(\frac{r_0}{a_0})\ \exp(-\frac{r}{a_0})$$

通过保持$V_0 \exp(\frac{r_0}{a_0})$不变，调整$V_0, r_0$，进行操作。

暂时还没有对这个关系进行验证，可以通过这个方法调整Pauli forbidden。

Calculation



弹性散射数据对于两种势都有着一些相近的地方。