Automatic renormalization in X4Pro

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EXFOR data correction system (2009+)

(re-normalization system)

Goal:

To create tools for re-calculation absolute values from EXFOR according to

a) today's knowledge (new standards, decay data, abundances)

b) evaluators' experience based on additional information about experiments

Main tasks:

1) to re-normalize data using old monitors and new standards
2) to re-normalize data using decay data
3) to create a tool for data modifications: multiply data to a factor, correct wrong units, set up uncertainties, delete part of a data set, recalculate data using isotope abundances, etc.
4) to develop software to generate automatic corrections using EXFOR information
5) to collect experts' corrections to a database

"Automatic" corrections are based on the information given in EXFOR file: keywords MONITOR and MONIT-REF, monitor data in the DATA and COMMON sections. This method is objective.

"Manual" corrections are based user's knowledge and experience – theu include subjective judgment. NDS is collecting database of experts' corrections since 2011.

"Flagging" system. There are files provided from experts and programs detecting whether or not some data were accepted/rejected from by evaluators or programs. This information is stored in the database and used in the Web retrieval system (since 2019).

Automatic renormalization of EXFOR data

(part of EXFOR data correction system, 2010-2022)

1. Renormalization using old and new monitor cross sections

m0, dm0: "old monitor" – monitor-reaction cross sections used by authors

Source of data:

1) DATA, COMMON sections: MONIT, MONIN-ERR (EN, EN-NRM)
2) MONIT-REF pointing to another EXFOR data
3) MONIT-REF pointing to ENDF library (e.g., ENDF/B-5 Standards sub-library)
4) MONIT-REF pointing to "a publication" //--> Archive of old Monitors

m1, dm1: "new monitor" – monitor-reaction cross sections "recommended" now

Source of data:

1) IAEA Standards-2017
2) IRDFF-II (2019)

2. Renormalization of EXFOR data using newer Decay data

- Data source: EXFOR keywords DECAY-DATA and DECAY-MON
  1) "AR" annihilation radiation (511 keV, intensity)
  2) "DG" decay gamma (gamma line energy, intensity)
- Data renormalized to the current ENSDF data - thanks to M.Verpelli (IAEA-NDS)

3. Data types available for automatic renormalization

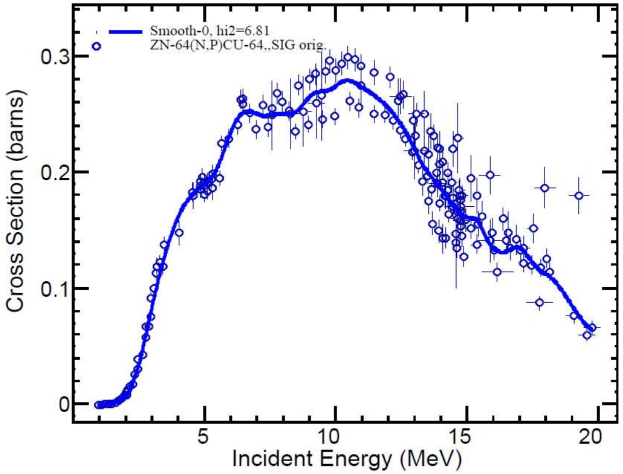
"SIG", "DA", "DE", "DAE", "FY".

Total number of Datasets having auto-renormalization: 17,395 (~10% of whole EXFOR)

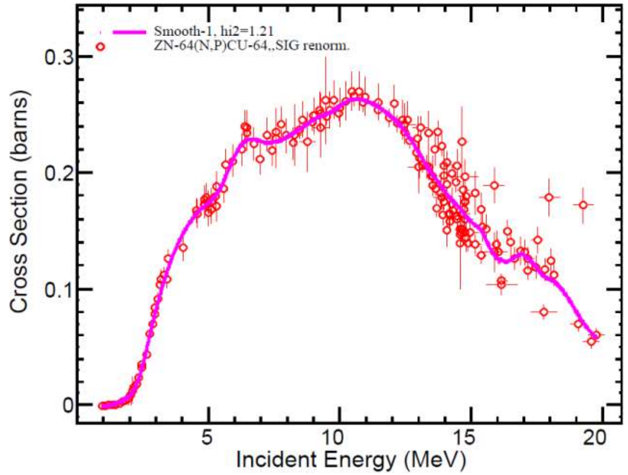
Trying automatically achieve corrections done by experts

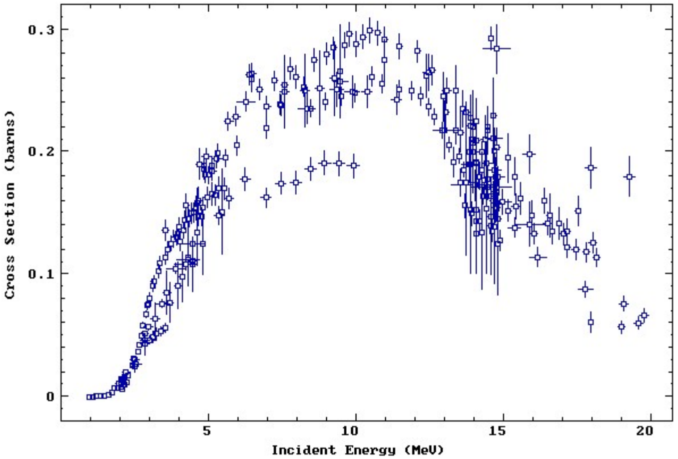
by K.Zolotarev, 2011

Data selected

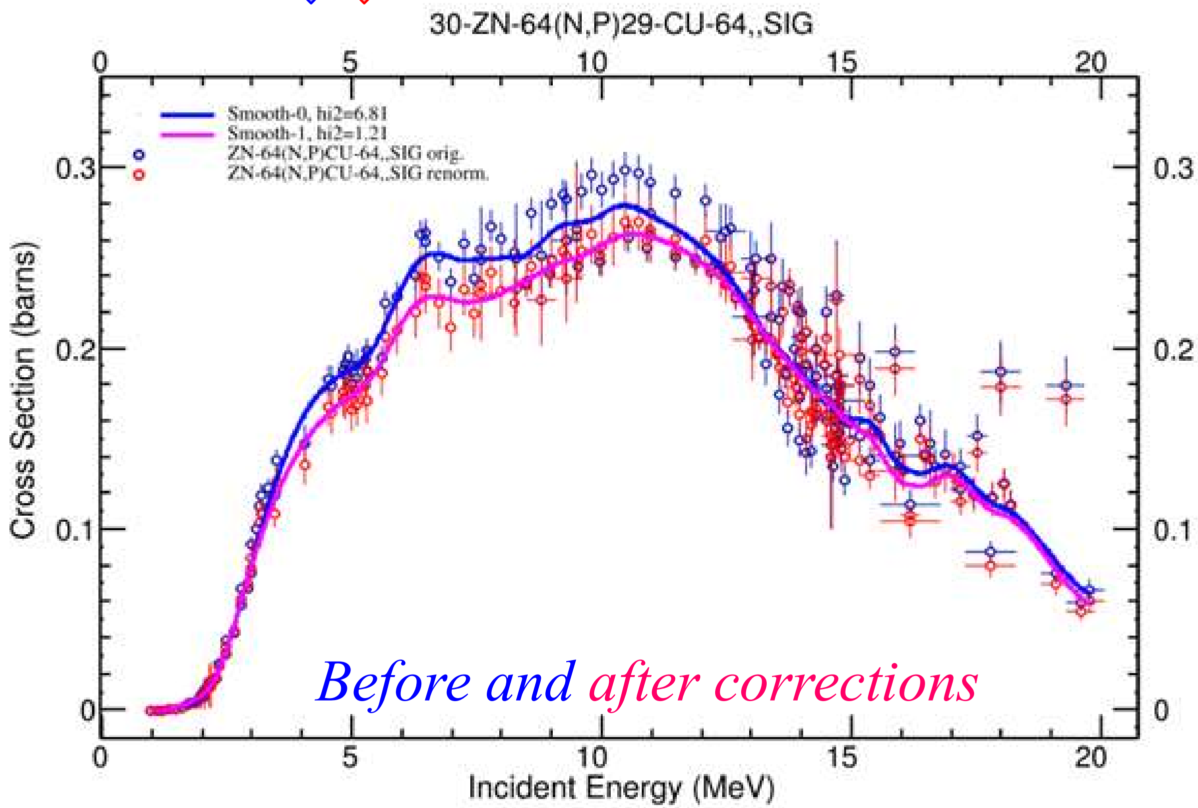


Data corrected





Original EXFOR data



Automatic vs. expert's correction

x4auto-corr.java, 2021

```
$A 2021-09-21 10:01:17, x4auto, V.Zerkin
13597002  x4u:19950217  #1995,Ghorai #Pts:4
 #[0]#---Monitor xs-data
 #[0]#Reaction: 30-ZN-64(N,P)29-CU-64,,SIG
 #[0]#Monitor:  13-AL-27(N,A)11-NA-24,,SIG
 m0: [EN,MONIT,MONIT-ERR]; #[0]#old monitor(energy)
 m1: recom$al27na;         #[0]#new monitor(energy)
 dy=dy/y;                  #to rel. uncertainties
 y=y/m0*m1;                #[0]#renormalizing CS
 dy=(dy**2-dm0**2+dm1**2)**0.5; #[0]#replace monitor uncertainties
 #[1]#---Reaction decay-data
 #[1]#REACTION   (30-ZN-64(N,P)29-CU-64,,SIG)
 #[1]#DECAY-DATA (29-CU-64,12.7HR,AR,511.,0.386) #Ix_old=0.386
 a1=0.386/0.352;           #[1]#DECAY-DATA: correction to new 511 keV gamma-yield per decay Cu-64 Ix_new=0.352
 y=y*a1;                   #[1]#Renorm.factor: a1=1.0965909
 #[2]#---Monitor decay-data
 #[2]#MONITOR    (13-AL-27(N,A)11-NA-24,,SIG)
 #[2]#DECAY-MON  (11-NA-24,15.02HR,DG,1369.,1.00) #Im_old=1.0
 a2=0.999936/1.0;          #[2]#DECAY-MON: correction to new 1368.626 keV gamma-yield per decay Na-24 Im_new=0.999936
 y=y*a2;                   #[2]#Renorm.factor: a2=0.999936
 dy=dy*y;                  #to abs. uncertainties
```

K.Zolotarev, 2011

```
$C 2011-05-16, K.Zolotarev 2011, Zn64(n,p)Cu64
13597002           #1994 S.K.Ghorai+
a0=0.386/0.348;    #correction to new  511 keV gamma-yield per decay Cu-64
a1=0.999936/1.0;   #correction to new 1368 keV gamma-yield per decay Na24
a2=0.84351;        #renorm.factor to the preliminary evaluated integral of cs
                   #in the neutron energy interval 14.2-16.2 MeV.
a3=a0*a1*a2;       #total energy independent correction factor
c2=0.0115          #added error in 511keV gamma-yield per decay Cu-64 - 1.15%
c3=0.02            #added error in remorm. factor - 2%
m0: [en, monit];   #old cs for Al27(n,a)Na24 monitor reaction
m2: [en, monit-err];#abs. error in old cs for Al27(n,a) monitor reaction
c0=m2/m0;          #rel. error in old cs for Al27(n,a) monitor reaction
m1: rrdf10 $ al27na;#new cs for Al27(n,a)Na24 monitor reaction
c1=dm1/m1;         #relative error in new cs for Al27(n,a) monitor reaction
dy=dy/y;           #relative error in original cs for Zn64(n,p)Cu64 reaction
fc=m1/m0*a3;       #total correction factor
y=y*fc;            #correction exp. cs
dy=dy^2-c0^2+c1^2+c2^2+c3^2; #determination the quadrature of new total error
dy=dy^0.5*y;       #determination the absolute value of new total error
```

EXFOR

```
ENTRY             13597   20140415
AUTHOR       (S.K.Ghorai,...)
MONITOR      (13-AL-27(N,A)11-NA-24,,SIG)
DECAY-MON  (11-NA-24,15.02HR,DG,1369.,1.00)
SUBENT          13597002       950217
REACTION     (30-ZN-64(N,P)29-CU-64,,SIG)
DECAY-DATA (29-CU-64,12.7HR,AR,511.,0.386)
DATA
EN        DATA     DATA-ERR    MONIT     MONIT-ERR
MEV       MB       MB          MB        MB
14.2      180.     10.         122.0     0.65
15.2      152.     9.          108.0     1.96
16.2      116.     6.          90.0      1.75
17.2      122.     8.          72.0      1.41
ENDDATA
```

Example: Energy dependent monitor given in DATA section

```
SUBENT        10421001   20030221
REFERENCE   (J,NSE,57,300,197508)
AUTHOR      (W.P.Poenitz)
TITLE       Measurements of the Neutron Capture Cross Sections of
            Gold-197 and Uranium-238 Between 20 and 3500 keV
SUBENT        10421003   20030221
REACTION    (92-U-238(N,G)92-U-239,,SIG)
MONITOR     (79-AU-197(N,G)79-AU-198,,SIG) Relative standard
DATA                   6          44
EN          EN-RSL     DATA       DATA-ERR   MONIT      MONIT-ERR
KEV         KEV        MB         MB         MB         PER-CENT
 20.           4.       631.        54.       720.        2.
 24.                    550.        47.       655.        2.
 28.                    490.        42.       600.        2.
 32.                    459.        39.       552.        2.
 36.                    434.        37.       518.        2.
 40.                    425.        37.       488.        2.
 44.                    389.        33.       464.        2.
 48.                    353.        30.       446.        2.
 52.                    315.        27.       430.        2.
 56.                    305.        26.       412.        2.
```

Automatically generated by x4getcorr.java

```
10421003  x4u:20030221  #1975 Poenitz
#Reaction:  92-U-238(N,G)92-U-239,,SIG
#Monitor:   79-AU-197(N,G)79-AU-198,,SIG
m0: [EN,MONIT,MONIT-ERR];           #old monitor(energy)
m1: recom$au197ng;                  #new monitor(energy)
dy=dy/y;                            #to rel. uncertainties
y=y/m0*m1;                          #renormalized CS
dy=(dy**2-dm0**2+dm1**2)**0.5;#replace monitor uncertaintie
dy=dy*y;                            #to abs. uncertainties
```

```
-1   En(MeV)=0.02   Y(mb)=631       dY(mb)=54       (8.56%) 10421003  W.P.Poenitz (75)
+1                  Y(mb)=614.184   dY(mb)=52.107   (8.48%) 10421003  *Fc=0.973351
-2   En(MeV)=0.024  Y(mb)=550       dY(mb)=47       (8.55%) 10421003  W.P.Poenitz (75)
+2                  Y(mb)=540.62    dY(mb)=45.7459  (8.46%) 10421003  *Fc=0.982946
-3   En(MeV)=0.028  Y(mb)=490       dY(mb)=42       (8.57%) 10421003  W.P.Poenitz (75)
+3                  Y(mb)=497.788   dY(mb)=42.3081  (8.50%) 10421003  *Fc=1.01589
-4   En(MeV)=0.032  Y(mb)=459       dY(mb)=39       (8.50%) 10421003  W.P.Poenitz (75)
+4                  Y(mb)=478.342   dY(mb)=40.3473  (8.43%) 10421003  *Fc=1.04214
-5   En(MeV)=0.036  Y(mb)=434       dY(mb)=37       (8.53%) 10421003  W.P.Poenitz (75)
+5                  Y(mb)=453.274   dY(mb)=38.4025  (8.47%) 10421003  *Fc=1.04441
-6   En(MeV)=0.04   Y(mb)=425       dY(mb)=37       (8.71%) 10421003  W.P.Poenitz (75)
+6                  Y(mb)=441.328   dY(mb)=38.2229  (8.66%) 10421003  *Fc=1.03842
-7   En(MeV)=0.044  Y(mb)=389       dY(mb)=33       (8.48%) 10421003  W.P.Poenitz (75)
+7                  Y(mb)=396.12    dY(mb)=33.4425  (8.44%) 10421003  *Fc=1.0183
-8   En(MeV)=0.048  Y(mb)=353       dY(mb)=30       (8.50%) 10421003  W.P.Poenitz (75)
+8                  Y(mb)=357.414   dY(mb)=30.2427  (8.46%) 10421003  *Fc=1.0125
-9   En(MeV)=0.052  Y(mb)=315       dY(mb)=27       (8.57%) 10421003  W.P.Poenitz (75)
+9                  Y(mb)=318.742   dY(mb)=27.2133  (8.54%) 10421003  *Fc=1.01188
-10  En(MeV)=0.056  Y(mb)=305       dY(mb)=26       (8.52%) 10421003  W.P.Poenitz (75)
+10                 Y(mb)=310.399   dY(mb)=26.3649  (8.49%) 10421003  *Fc=1.0177
```

Generated by x4-correction system on Web

Example: monitor given in MONIT-REF pointing to ENDF/B-V

```
SUBENT        22325001   20190205   20190424   20190420       2274
BIB                 17         70
TITLE       Activation cross section measurement of reactions
            producing short-lived nuclei at neutron energy
            between 13.4 MeV and 14.9 MeV
AUTHOR     (Y.Kasugai, H.Yamamoto, K.Kawade, Y.Ikeda, Y.Uno,
            H.Maekawa)
REFERENCE  (C,94GATLIN,2,935,1994) Main ref.
MONITOR    (13-AL-27(N,P)12-MG-27,,SIG) Based on the standard
            Al-27(n,a) reaction in ENDF/B-V.
MONIT-REF  (,,3,ENDF/B-V,,1978)
. . . . . . . .
SUBENT        22325004   20190205   20190424   20190420
REACTION   (26-FE-57(N,P)25-MN-57,,SIG)
DATA                 3          6
EN          DATA       ERR-T
MEV         MB         MB
      13.38       63.        7.
      13.70       60.        4.
      14.03       59.        4.
      14.36       59.        4.
      14.66       55.        4.
      14.95       53.        4.
ENDDATA              8
ENDSUBENT           17
```

Automatically generated by x4getcorr.java

```
22325004  x4u:20190205  #1994 Kasugai
#Reaction: 26-FE-57(N,P)25-MN-57,,SIG
#Monitor:  13-AL-27(N,P)12-MG-27,,SIG
#m0: {,,3,ENDF/B-V,,1978} $ al27np;#old monit-ref
m0: endfb5$al27np;          #old monitor(energy) in ENDF
m1: recom$al27np;           #new monitor(energy)
dy=dy/y;                    #to rel. uncertainties----
y=y/m0*m1;                  #renormalized CS
dy=(dy**2-dm0**2+dm1**2)**0.5;#replace monitor uncertaintie
dy=dy*y;                    #to abs. uncertainties
```

```
-1 En(MeV)=13.38  Y(mb)=63       dY(mb)=7        (11.11%)22325004  Y.Kasugai+ (94)
+1                Y(mb)=64.8167  dY(mb)=7.17063  (11.06%)22325004  *Fc=1.02884
-2 En(MeV)=13.7   Y(mb)=60       dY(mb)=4        (6.67%) 22325004  Y.Kasugai+ (94)
+2                Y(mb)=60.1809  dY(mb)=3.96481  (6.59%) 22325004  *Fc=1.00302
-3 En(MeV)=14.03  Y(mb)=59       dY(mb)=4        (6.78%) 22325004  Y.Kasugai+ (94)
+3                Y(mb)=57.7125  dY(mb)=3.86958  (6.70%) 22325004  *Fc=0.978177
-4 En(MeV)=14.36  Y(mb)=59       dY(mb)=4        (6.78%) 22325004  Y.Kasugai+ (94)
+4                Y(mb)=56.1903  dY(mb)=3.76892  (6.71%) 22325004  *Fc=0.952378
-5 En(MeV)=14.66  Y(mb)=55       dY(mb)=4        (7.27%) 22325004  Y.Kasugai+ (94)
+5                Y(mb)=51.193   dY(mb)=3.68991  (7.21%) 22325004  *Fc=0.930782
-6 En(MeV)=14.95  Y(mb)=53       dY(mb)=4        (7.55%) 22325004  Y.Kasugai+ (94)
+6                Y(mb)=48.3388  dY(mb)=3.6192   (7.49%) 22325004  *Fc=0.912052
```

Generated by x4-correction system on Web

Correction protocol

Applied corrections. Datasets: 1

1) EXFOR:#22325004 Ref:Y.Kasugai,ET.AL. (94) Corrected_Points:6 yFactor_Ave:0.96754 yFactor_Min:0.912052 yFactor_Max:1.02884

22325004 X4U:20190205; M0:endfb5$al27np; M1:recom$al27np; dY=dY/Y; Y=Y/M0*M1; tmp0=dY^2-dM0^2+dM1^2; dY=tmp0^0.5; dY=dY*Y;

Example: monitor given in MONIT-REF pointing to EXFOR

```
ENTRY              30581    20090506
REFERENCE    (J,APP/B,11,853,198011) Final
AUTHOR       (E.Zupranska,K.Rusek,J.Turkiewicz,P.Zupranski)
TITLE        Excitation functions for (n,a) reactions in the neutron
             energy range from 13 to 18 MeV.
MONITOR      (26-FE-56(N,P)25-MN-56,,SIG)
MONIT-REF    (20377002,H.LISKIEN+,J,JNE/AB,19,73,196502)
STATUS       (APRVD) Approved with corrections, by M.Herman,81/06/15
SUBENT          30581004    20090506
REACTION     (25-MN-55(N,A)23-V-52,,SIG)
DATA                    4           10
EN           EN-RSL      DATA        ERR-T
MEV          MEV         MB          MB
 1.3000E+01 1.0000E-01 2.1900E+01 2.1000E+00
 1.3300E+01 1.0000E-01 2.1800E+01 1.4000E+00
 1.3900E+01 2.0000E-01 2.4100E+01 1.5000E+00
 1.4500E+01 2.0000E-01 2.7700E+01 1.6000E+00
 1.5100E+01 2.0000E-01 2.9200E+01 1.9000E+00
 1.5500E+01 2.0000E-01 2.4900E+01 1.8000E+00
 1.5900E+01 2.0000E-01 2.3700E+01 2.2000E+00
 1.6600E+01 1.0000E-01 2.3900E+01 2.6000E+00
 1.7400E+01 2.0000E-01 2.1300E+01 2.6000E+00
 1.7800E+01 1.0000E-01 1.8100E+01 2.4000E+00
ENDDATA                12
```

Automatically generated by x4getcorr.java

```
30581004 x4u:20090506  #1980 Zupranska
#Reaction: 25-MN-55(N,A)23-V-52,,SIG
#Monitor:  26-FE-56(N,P)25-MN-56,,SIG
#m0:{20377002,H.LISKIEN+,J,JNE/AB,19,73,196502}$fe56np;#old monit-ref
m0: exfor$20377002_fe56np;     #old monitor(energy)
m1: recom$fe56np;              #new monitor(energy)
dy=dy/y;                       #to rel. uncertainties
y=y/m0*m1;                     #renormalized CS
dy=(dy**2-dm0**2+dm1**2)**0.5;#replace monitor uncertainties
dy=dy*y;                       #to abs. uncertainties
```

```
-1  En(MeV)=13   Y(mb)=21.9     dY(mb)=2.1      (9.59%)  30581004  E.Zupranska,ET.AL.(80)
+1               Y(mb)=22.258   dY(mb)=2.12897  (9.56%)  30581004  *Fc=1.01635
-2  En(MeV)=13.3 Y(mb)=21.8     dY(mb)=1.4      (6.42%)  30581004  E.Zupranska,ET.AL.(80)
+2               Y(mb)=22.3688  dY(mb)=1.42838  (6.39%)  30581004  *Fc=1.02609
-3  En(MeV)=13.9 Y(mb)=24.1     dY(mb)=1.5      (6.22%)  30581004  E.Zupranska,ET.AL.(80)
+3               Y(mb)=25.8839  dY(mb)=1.60114  (6.19%)  30581004  *Fc=1.07402
-4  En(MeV)=14.5 Y(mb)=27.7     dY(mb)=1.6      (5.78%)  30581004  E.Zupranska,ET.AL.(80)
+4               Y(mb)=30.6262  dY(mb)=1.75976  (5.75%)  30581004  *Fc=1.10564
-5  En(MeV)=15.1 Y(mb)=29.2     dY(mb)=1.9      (6.51%)  30581004  E.Zupranska,ET.AL.(80)
+5               Y(mb)=32.8526  dY(mb)=2.12995  (6.48%)  30581004  *Fc=1.12509
-6  En(MeV)=15.5 Y(mb)=24.9     dY(mb)=1.8      (7.23%)  30581004  E.Zupranska,ET.AL.(80)
+6               Y(mb)=27.1053  dY(mb)=1.95423  (7.21%)  30581004  *Fc=1.08857
-7  En(MeV)=15.9 Y(mb)=23.7     dY(mb)=2.2      (9.28%)  30581004  E.Zupranska,ET.AL.(80)
+7               Y(mb)=25.9568  dY(mb)=2.40631  (9.27%)  30581004  *Fc=1.09522
-8  En(MeV)=16.6 Y(mb)=23.9     dY(mb)=2.6      (10.88%) 30581004  E.Zupranska,ET.AL.(80)
+8               Y(mb)=25.9387  dY(mb)=2.82001  (10.87%) 30581004  *Fc=1.0853
-9  En(MeV)=17.4 Y(mb)=21.3     dY(mb)=2.6      (12.21%) 30581004  E.Zupranska,ET.AL.(80)
+9               Y(mb)=22.7836  dY(mb)=2.77977  (12.20%) 30581004  *Fc=1.06965
-10 En(MeV)=17.8 Y(mb)=18.1     dY(mb)=2.4      (13.26%) 30581004  E.Zupranska,ET.AL.(80)
+10              Y(mb)=19.3299  dY(mb)=2.56225  (13.26%) 30581004  *Fc=1.06795
```

Generated by x4-correction system on Web

All data needed for automatic corrections are coming with the database.

They can be optionally applied by user’s program.

Table x4pro_c5dat

```
create table x4pro_c5dat (
     DatasetID              varchar(9) not null
    ,idat                   integer    null
    ,y                      real null -- measured data
    ,dy                     real null
    ,x1                     real null -- ind. variable 1
    ,dx1                    real null
    ,x2                     real null -- ind. variable 2
    ,dx2                    real null
    ,x3                     real null -- ind. variable 3
    ,dx3                    real null
    ,x4                     real null -- ind. variable 4
    ,dx4                    real null
    ,x5                     real null -- ind. variable 5
    ,dx5                    real null
    ,dyerr                  real null -- given data error
    ,dysys                  real null -- total systematic error
    ,dystat                 real null -- total uncorrelated error
    ,dyprt                  real null -- total part.corr.error
    ,Em0                    real null -- energy of monitor point
    ,m0                     real null -- old monitor CS
    ,dm0                    real null
    ,m1                     real null -- new monitor CS
    ,dm1                    real null
    ,Fcm0                   real null -- correction factor
    ,cdat                   json null -- additional: ilevel, product,..
    ,PRIMARY KEY            (DatasetID,idat)
)
```

measured data (y, dy)

independent variables (x1–dx5)

generalized partial uncertainties (dyerr, dysys, dystat, dyprt)

data for renormalization (Em0, m0, dm0, m1, dm1, Fcm0)

extra info (cdat)

Table x4pro_autocorr

```
create table x4pro_autocorr (
    DatasetID          varchar(9)    not null
   ,ndat               integer       null -- number of data points in the Dataset
   ,reatyp             varchar(12)   null -- reaction type (Dict.213)
   ,quant1             varchar(16)   null -- quantity
   ,reacode            varchar(511)  null -- reaction code
   ,monitor            varchar(255)  null -- monitor reaction code
   ,monType            varchar(32)   null -- monitor type (X4DATA, X4POINT)
   ,FcDecayData        real          null -- correction factor from DECAY-DATA
   ,ddNucl             varchar(24)   null -- DECAY-DATA:Nuclide
   ,ddT12              varchar(24)   null -- DECAY-DATA:t1/2
   ,ddT12New           varchar(24)   null -- DECAY-DATA:new t1/2 (ENSDF)
   ,ddRad              varchar(16)   null -- DECAY-DATA:Radiation (AR,DG)
   ,ddEne              real          null -- DECAY-DATA:Energy
   ,ddEneNew           real          null -- DECAY-DATA:found near Energy (ENSDF)
   ,ddAbu              real          null -- DECAY-DATA:Intensity
   ,ddAbuNew           real          null -- DECAY-DATA:new Intensity/ENSDF
   ,FcDecayMon         real          null -- correction factor from DECAY-MON
   ,dmNucl             varchar(24)   null -- DECAY-MON:Nuclide
   ,dmT12              varchar(24)   null -- DECAY-MON:t1/2
   ,dmT12New           varchar(24)   null -- DECAY-MON:new t1/2 (ENSDF)
   ,dmRad              varchar(16)   null -- DECAY-MON:Radiation (AR,DG)
   ,dmEne              real          null -- DECAY-MON:Energy
   ,dmEneNew           real          null -- DECAY-MON:found near Energy (ENSDF)
   ,dmAbu              real          null -- DECAY-MON:Intensity
   ,dmAbuNew           real          null -- DECAY-MON:new Intensity/ENSDF
   ,autoCorr           varchar(8192) null -- correction text (for human control)
   ,PRIMARY KEY        (DatasetID)
)
```

Now on EXFOR-Web:

```
30581004  x4u:20090506  #1980,Zupranska #Pts:10
 #[0]#---Monitor xs-data
 #[0]#Reaction: 25-MN-55(N,A)23-V-52,,SIG
 #[0]#Monitor:  26-FE-56(N,P)25-MN-56,,SIG
 #m0: {20377002,H.LISKIEN+,J,JNE/AB,19,73,196502} $ fe56np;#[0]#old monit-ref
 m0: exfor$20377002_fe56np;      #[0]#old monitor(energy) in EXFOR
 m1: recom$fe56np;               #[0]#new monitor(energy)
 dy=dy/y;                        #[0]#to rel. uncertainties----
 y=y/m0*m1;                      #[0]#renormalizing CS
 dy=(dy**2-dm0**2+dm1**2)**0.5;  #[0]#replace monitor uncertainties
 dy=dy*y;                        #[0]#to abs. uncertainties
```

Currently implemented using:
1. EXFOR Parser (C)
2. Interpreter (C)
3. Archive of monitors
4. Database of new standards

X4Pro: table x4pro_c5dat

MySQL Query Browser - Connection: / x4mysql5nds

File Edit View Query Script Tools Window MySQL Enterprise Help

Go back Next Refresh

```
SELECT DatasetID, idat, y, dy, x1, dx1, dyerr,
Em0, m0, dm0, m1, dm1, Fcm0
FROM x4pro_c5dat
where DatasetID='30581004'
```

Execute Stop

Resultset 1

New: data for renormalization are coming together with the database

DatasetID	idat	y	dy	x1	dx1	dyerr	Em0	m0	dm0	m1	dm1	Fcm0
30581004	0	0.0219	0.0021	13000000	50000	0.0021	13000000	0.112833	0.007	0.114678	0.00169076	1.01635
30581004	1	0.0218	0.0014	13300000	50000	0.0014	13300000	0.112909	0.007	0.115855	0.00152817	1.02609
30581004	2	0.0241	0.0015	13900000	100000	0.0015	13900000	0.106857	0.007	0.114767	0.00125861	1.07402
30581004	3	0.0277	0.0016	14500000	100000	0.0016	14500000	0.0990947	0.00602105	0.109563	0.00118709	1.10564
30581004	4	0.0292	0.0019	15100000	100000	0.0019	15100000	0.0902632	0.00566842	0.101554	0.00126434	1.12509
30581004	5	0.0249	0.0018	15500000	100000	0.0018	15500000	0.0876595	0.00541351	0.0954231	0.00130102	1.08857
30581004	6	0.0237	0.0022	15900000	100000	0.0022	15900000	0.0813719	0.00494375	0.0891203	0.00130266	1.09522
30581004	7	0.0239	0.0026	16600000	50000	0.0026	16600000	0.0723261	0.00406087	0.0784956	0.00127819	1.0853
30581004	8	0.0213	0.0026	17400000	100000	0.0026	17400000	0.0634344	0.00397812	0.0678528	0.00126376	1.06965
30581004	9	0.0181	0.0024	17800000	50000	0.0024	17800000	0.0592387	0.00359677	0.0632639	0.00125757	1.06795

10 rows fetched in 0.0072s (0.1015s)

Edit Apply Changes Discard Changes First Last Search

1: 1

X4Pro: data renormalization with SQL SELECT

(example: using SQLite DB Browser)

DB Browser for SQLite - x4sqlite1.db

File Edit View Tools Help

New Database | Open Database | Write Changes | Revert Changes | Open Project | Save Project | Attach Database

Database Structure | Browse Data | Edit Pragmas | Execute SQL

SQL 1

```sql
select x1,dx1,y,dy,
Fcm0,(y*Fcm0) as ynew,(dy*Fcm0) as dynew
from x4pro_c5dat
where DatasetID='30581004'
```

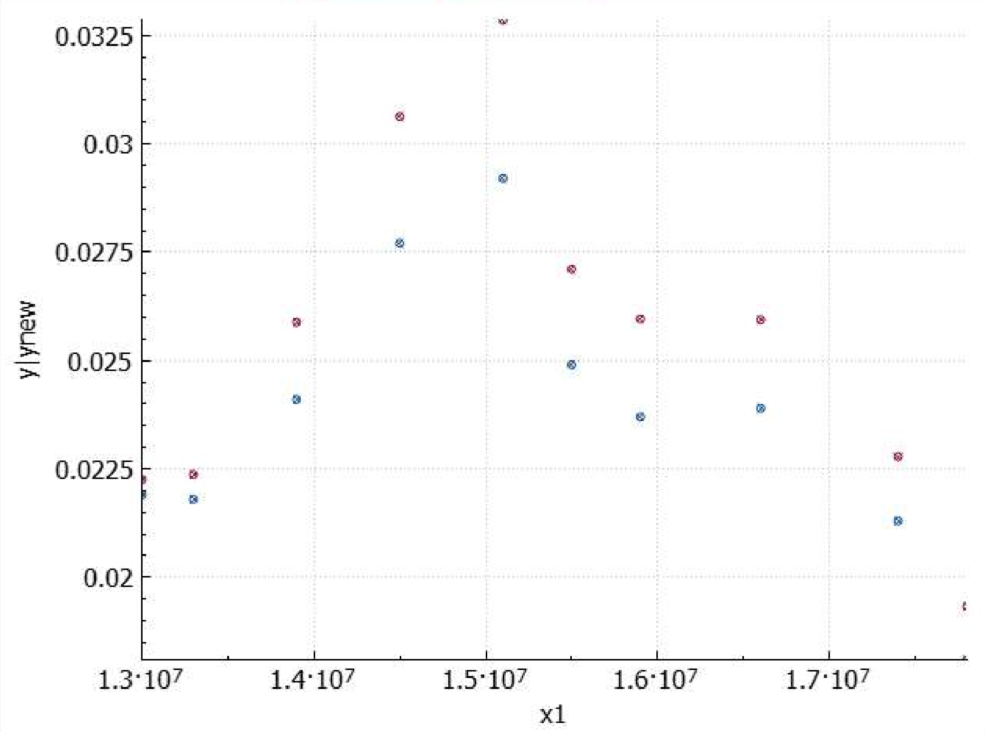
	x1	dx1	y	dy	Fcm0	ynew	dynew
1	13000000.0	50000.0	0.0219	0.0021	1.01635	0.022258065	0.002134335
2	13300000.0	50000.0	0.0218	0.0014	1.02609	0.022368762	0.001436526
3	13900000.0	100000.0	0.0241	0.0015	1.07402	0.025883882	0.00161103
4	14500000.0	100000.0	0.0277	0.0016	1.10564	0.030626228	0.001769024
5	15100000.0	100000.0	0.0292	0.0019	1.12509	0.032852628	0.002137671
6	15500000.0	100000.0	0.0249	0.0018	1.08857	0.027105393	0.001959426
7	15900000.0	100000.0	0.0237	0.0022	1.09522	0.025956714	0.002409484
8	16600000.0	50000.0	0.0239	0.0026	1.0853	0.02593867	0.00282178
9	17400000.0	100000.0	0.0213	0.0026	1.06965	0.022783545	0.00278109
10	17800000.0	50000.0	0.0181	0.0024	1.06795	0.019329895	0.00256308

```
Execution finished without errors.
Result: 10 rows returned in 9ms
At line 1:
select x1,dx1,y,dy,Fcm0,(y*Fcm0) as ynew,(dy*Fcm0) as dynew from x4pro_c
where DatasetID='30581004'
```

Edit Database Cell

Plot

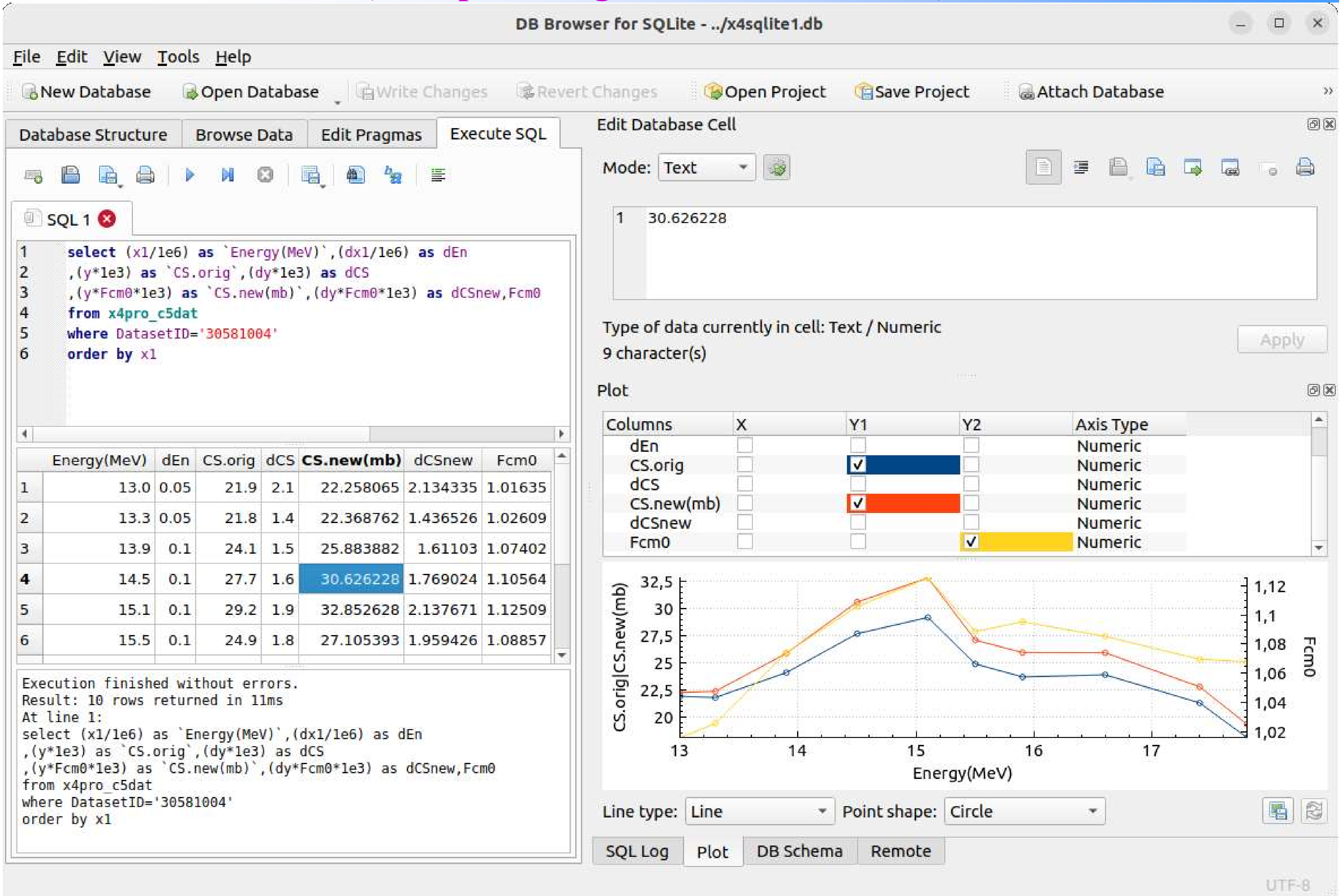
Columns	X	Y1	Y2	Axis Type
Row...	☐	☐	☐	Numeric
x1	☑	☐	☐	Numeric
dx1	☐	☐	☐	Numeric
y	☐	☑	☐	Numeric
dy	☐	☐	☐	Numeric
Fcm0	☐	☐	☐	Numeric
ynew	☐	☑	☐	Numeric



Line type: None Point shape: CrossCircle

X4Pro: data renormalization with SQL SELECT

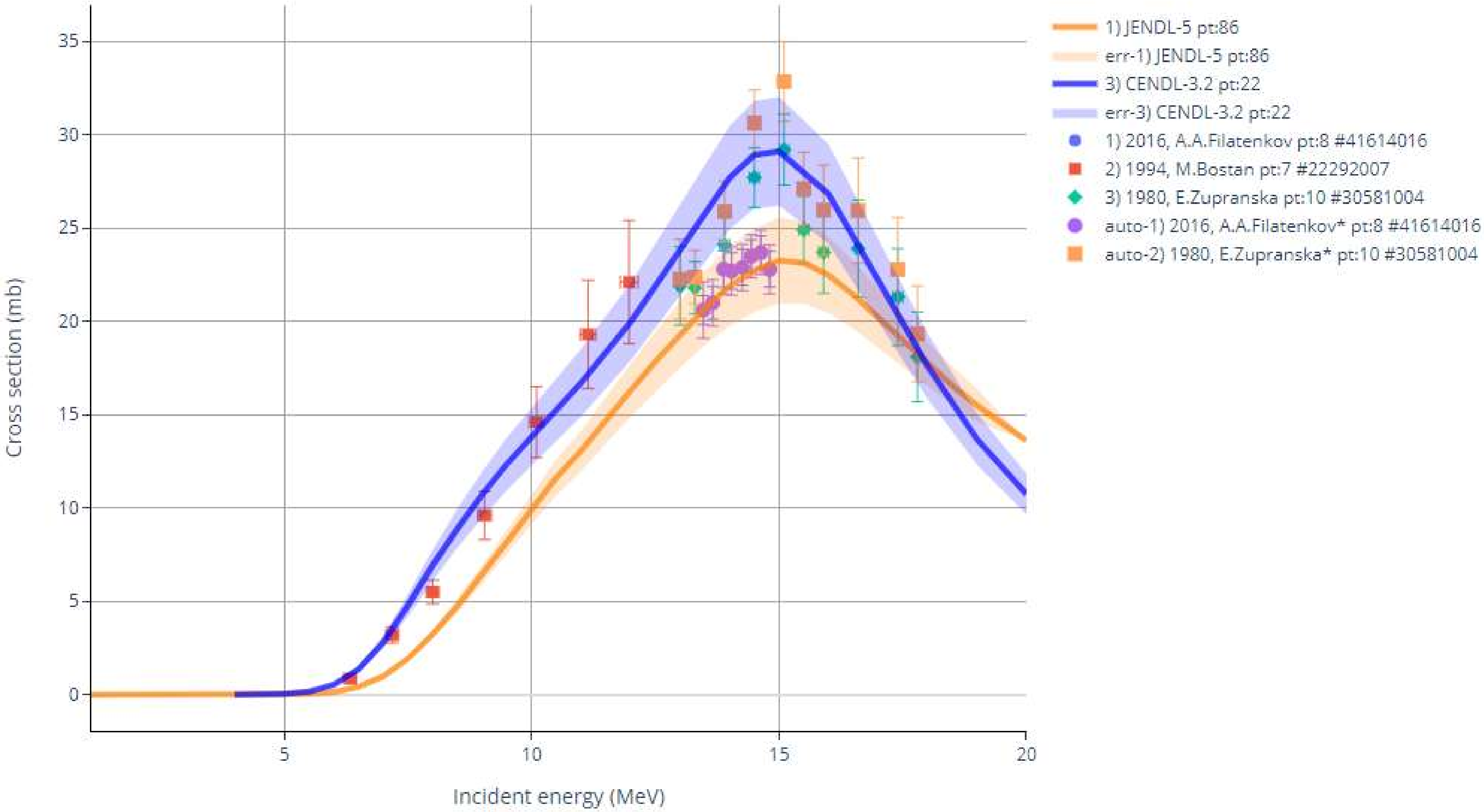
(example: using SQLite DB Browser)



Automatic renormalization in Python

Automatic correction of EXFOR cross sections: Mn-55(n,a),sig

X4Pro, by V.Zerkin, IAEA-NDS, 2021/12/07-2022/03/24



Automatic renormalization: SQL query

```sql
SELECT x4.DatasetID,ds.year1 as YearRef1
 ,ds.author1ini as Author1Ini,ds.author1 as Author1
 ,ds.reacode as fullCode, x4.idat as iPoint,x4.xdat
 ,round(c5.y*c5.Fcm0,10) as ynew0sql
 ,c5.y,c5.dy
 ,case
   when c5.Fcm0>0 and corr.FcDecayData>0 and corr.FcDecayMon>0
        then c5.Fcm0*corr.FcDecayData*corr.FcDecayMon
   when c5.Fcm0>0 and corr.FcDecayData>0 then c5.Fcm0*corr.FcDecayData
   when c5.Fcm0>0 and corr.FcDecayMon>0  then c5.Fcm0*corr.FcDecayMon
   when corr.FcDecayData>0 and corr.FcDecayMon>0 then corr.FcDecayData*corr.FcDecayMon
   when c5.Fcm0>0 then c5.Fcm0
   when corr.FcDecayData>0 then corr.FcDecayData
   when corr.FcDecayMon>0  then corr.FcDecayMon
   else null
 end as FcNew
 ,c5.x1 as En,c5.dx1 as dEn
 ,c5.dyerr,c5.dysys,c5.dystat
 ,c5.Fcm0,corr.FcDecayData,corr.FcDecayMon
 ,c5.m0,c5.dm0,c5.m1,c5.dm1
 FROM x4pro_x4data x4
  inner join x4pro_c5dat c5 on
  x4.DatasetID=c5.DatasetID and x4.idat=c5.idat
  inner join x4pro_ds ds on x4.DatasetID=ds.DatasetID
  left  join x4pro_autocorr corr on corr.DatasetID=ds.DatasetID
 WHERE (ds.Targ1 like 'Mn-55')
  and ds.reacode like '%(n,a)%'
  and ((Author1 like 'Zupranska' )
      or (ds.year1>2000 and Author1 like 'Filatenkov')
      or (Author1 like 'Bostan')
--    or (Author1 like 'Bormann’) or (Author1 like 'Fessler')
      )
 ORDER BY ds.reacode,ds.year1 desc,c5.DatasetID,c5.x1,x4.idat
```

Example: 3 types of renormalization factor on SQL level united to FcNew. Can be implemented in user’s program.

Automatic renormalization of data point

(will be called for every data point)

```
def auto_corr_point(row):
    y=row['y']                  #initial value
    y0=y
    fc=row.get('FcNew')         #factor: m1/m0
    if fc is None: return 0 #unchanged
    y=y*fc;                     #correction exp. cs
    row['y']=y                  #store new value
    dy=row.get('dy')
    if (dy is None): return 1 #updated
    if (y0!=0):
        m0=row.get('m0')        #monitor: old cs
        dm0=row.get('dm0')
        m1=row.get('m1')        #monitor: new cs
        dm1=row.get('dm1')
        if (m0 is not None) and (dm0 is not None)and(m1 is not None)and(dm1 is not None):
            dy=dy/y0             #to rel. uncertainties
            dm0=dm0/m0
            dm1=dm1/m1
            if (dy>dm0):
                dy=dy**2-dm0**2+dm1**2; #determination the quadrature of new total error
            else:
                dy=dy**2+dm1**2; #determination the quadrature of new total error
            dy=dy**0.5*y;        #determination the absolute value of new total error
            row['dy']=dy         #store new uncertainty
    return 1 #updated
```

Concluding remarks

1. X4Pro provides data for automatic renormalization using monitor and decay data

2. X4Pro allows to implement automatic data corrections programmatically even on the level of SQL commands

Thank you.