BERKELEY LAB
LAWRENCE BERKELEY NATIONAL LABORATORY

U.S. DEPARTMENT OF ENERGY

Beta feeding upper limits using GTOL

Shamsuzzoha Basunia

USNDP virtual meeting, Oct 28-31, 2025

GTOL and GLSC

GTOL (FORTRAN):

- ❑ Excited level energies from least-square fitting of the gamma-ray energies
    - useful to identify poorly fitted gamma-rays
- ❑ Transition intensity balance at each level
    - calculated net feeding to levels

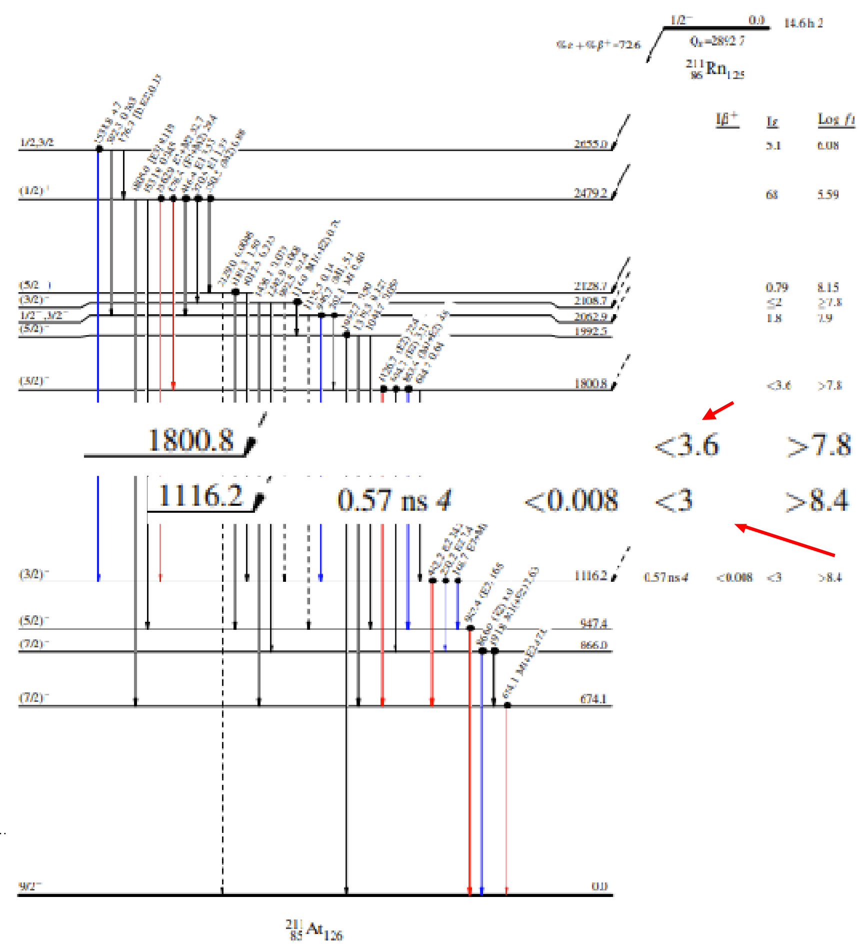
GLSC (JAVA) by Jun Chen

- ❑ Same as GTOL – more features including to handle problematic gamma-rays
- ❑ Additionally, it can be used for decay data normalization

BERKELEY LAB

^{211}Rn ε decay (14.6 h) 1972As11,1972As12

Parent: ^{211}Rn: E=0.0; J^{π}=1/2$^-$; $T_{1/2}$=14.6 h *2*; Q(ε)=2892 *7*; %ε+%β^+ decay=72.6 *17*




```
                         RI                 RI           NET FEEDING
   LEVEL               (OUT)               (IN)          (CALC)         (INPUT)

1116.21  8           79   4            95   6             3   3         3          LT
       Upper limit (90% C.L.) estimates:
         Method 1:       6.65
         Method 2:       6.30
1800.80  8           69   3            64   3            1.6 20         3.6        LT
       Upper limit (90% C.L.) estimates:
         Method 1:       4.38
         Method 2:       4.12
```

In GTOL Readme file

GTOL report:

c. Comparison of calculated net feedings to each level with values input on B, E, or A records. Note: if the calculated net feeding overlaps zero within three standard deviations, the program will calculate estimated upper limits (90% confidence level) using two methods suggested by Louis Lyons in Statistics for nuclear and particle physicists (Cambridge University Press) and report these estimates if they differ by more than 0.01. The two methods are:

- i (Integral of gdB from 0 to Bl)/(Integral of gdB from 0 to infinity)=0.9 where g is the normal (Gaussian) distribution.
- ii Bl<Bm+1.28sigma.

Where ‘Bl’ and ‘Bm’ are true and measured values, respectively

Assumption: follows Gaussian distribution

Source:

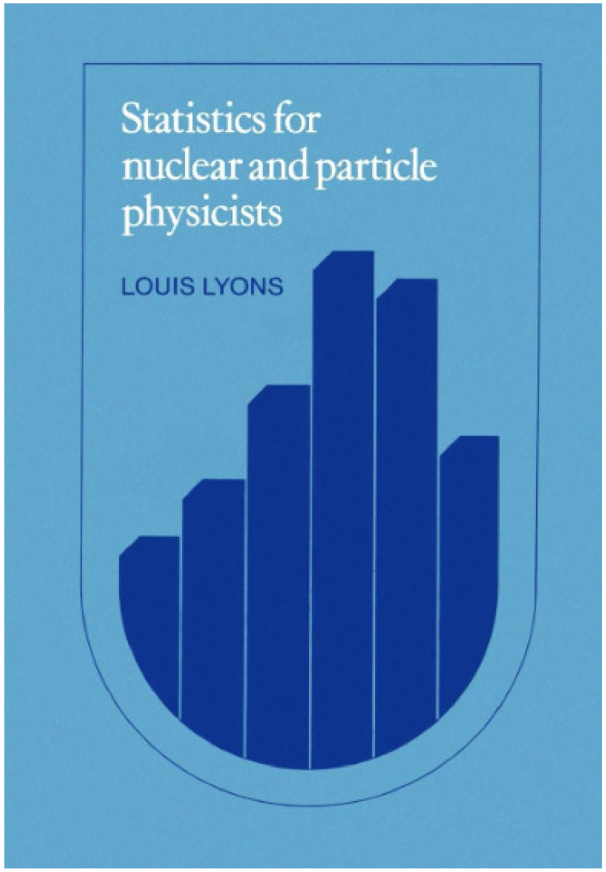
Statistics for nuclear and particle physicists

by

Louis Lyons

Cambridge University Press 1986

(A book, written be a non-statistician for non-statisticians)



On page 78:

Discussed on the experimental results for rare or ‘forbidden’ processes, where only a few events may have been observed, and yielded something like $(3 \pm 5)\times10^{-9}$, i.e. consistent with zero.