Evaluation of ^{56}Co Decay Data

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^{56}Co Decay Data

- ^{56}Co decays by positron emission (19.58%) and by electron capture (80.42%) to excited states of ^{56}Fe.
- 46 gamma rays with energies up to 3.6 MeV de-exciting 15 excited states in ^{56}Fe have been reported.
- This energy range makes ^{56}Co useful as a calibration source in gamma ray spectrometry.

^{56}Co Decay Data

- The Q value for the decay is given by Audi *et al*. as
  - **4566 (20) keV**
- The half-life of ^{56}Co has been evaluated by Woods *et al.* as
  - **77.236 (26) days**

^{56}Co Gamma Ray Emission Probabilities

- Relative gamma ray emission probabilities for the 46 gamma rays reported by 31 authors between 1965 and 2002 were tabulated.
- A problem arose when considering the high energy data.
- In many cases detector efficiency curves used measured data up to about 2.5 MeV and were then extrapolated to 3.6 MeV.

^{56}Co Gamma Ray Emission Probabilities

- It was clear from experimentally determined efficiency curves above 3 MeV that the extrapolated curves introduced errors of up to 6%.
- Therefore, of the 31 papers cited, only 8 which had used experimentally determined efficiency curves up to 3.6 MeV were included in the evaluation of data above 3 MeV.

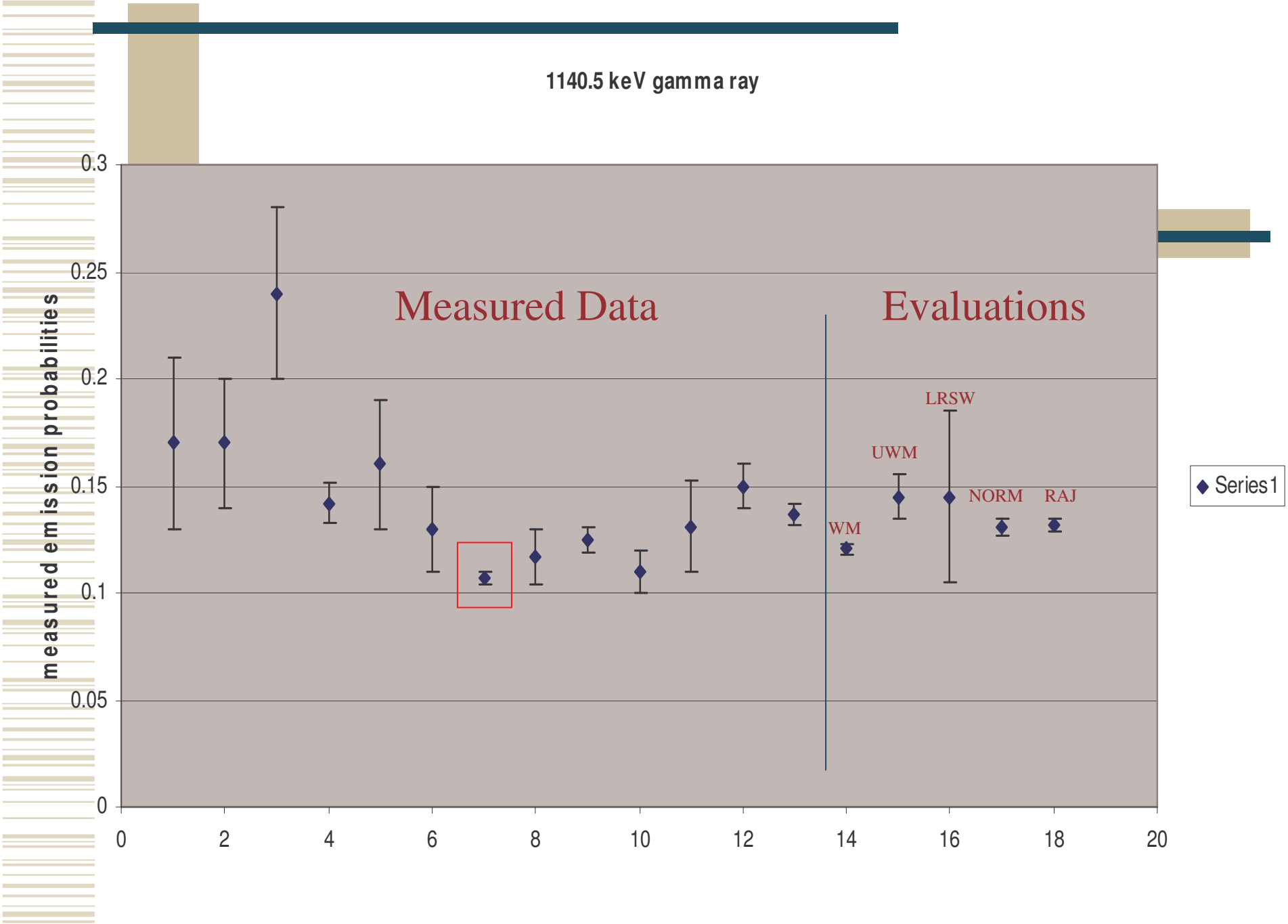
^{56}Co Gamma Ray Emission Probabilities

- The second problem was the significant number of discrepant data in the data set.
- Of the 46 gamma rays considered, 18 had data sets with a reduced chi-squared ranging from 2.0 to 7.8, indicating significant discrepancies.

^{56}Co Gamma Ray Emission Probabilities

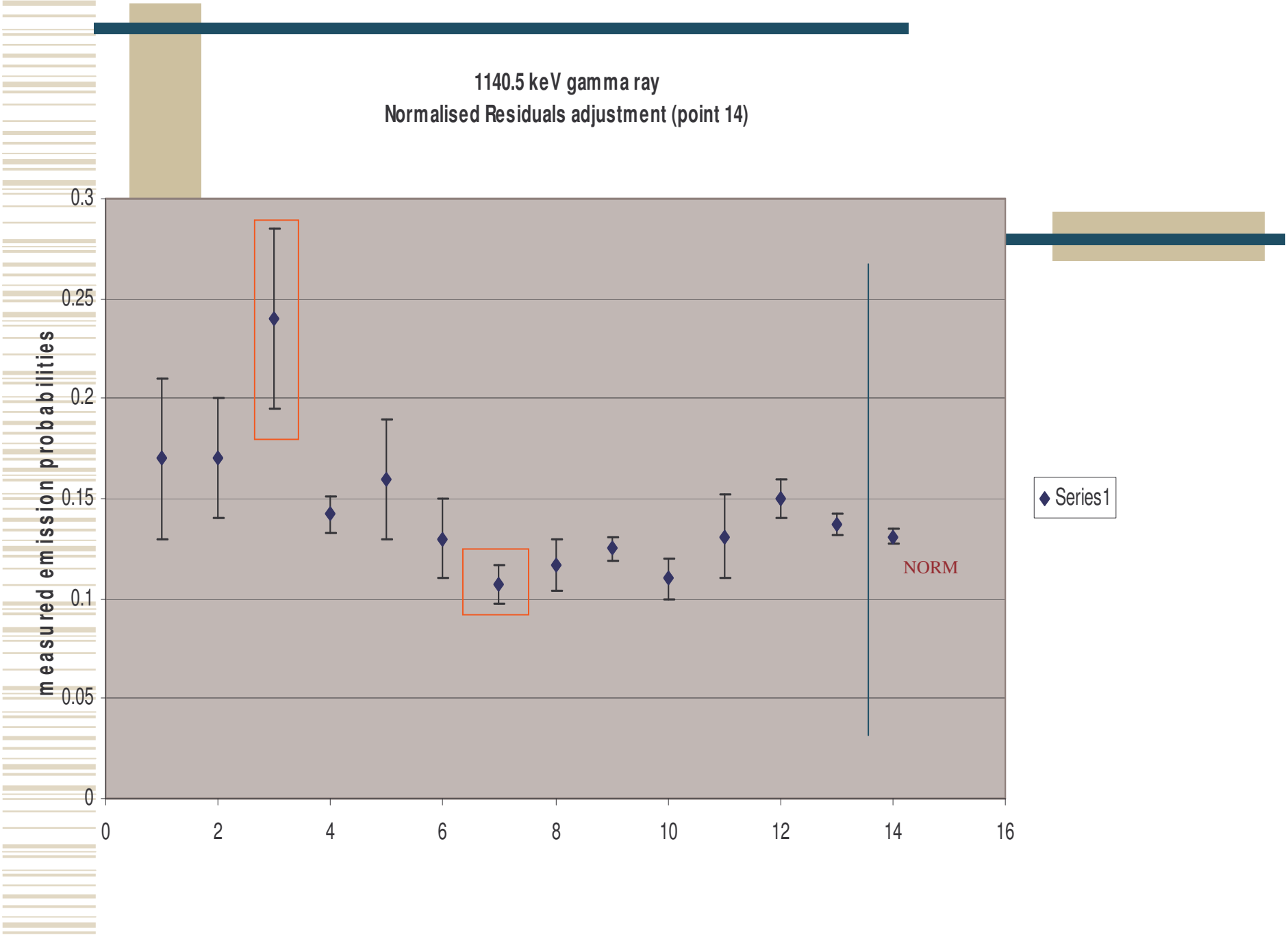
- The following graph shows the data for the 1140.5 keV gamma ray, for which the reduced chi-squared is 5.2.

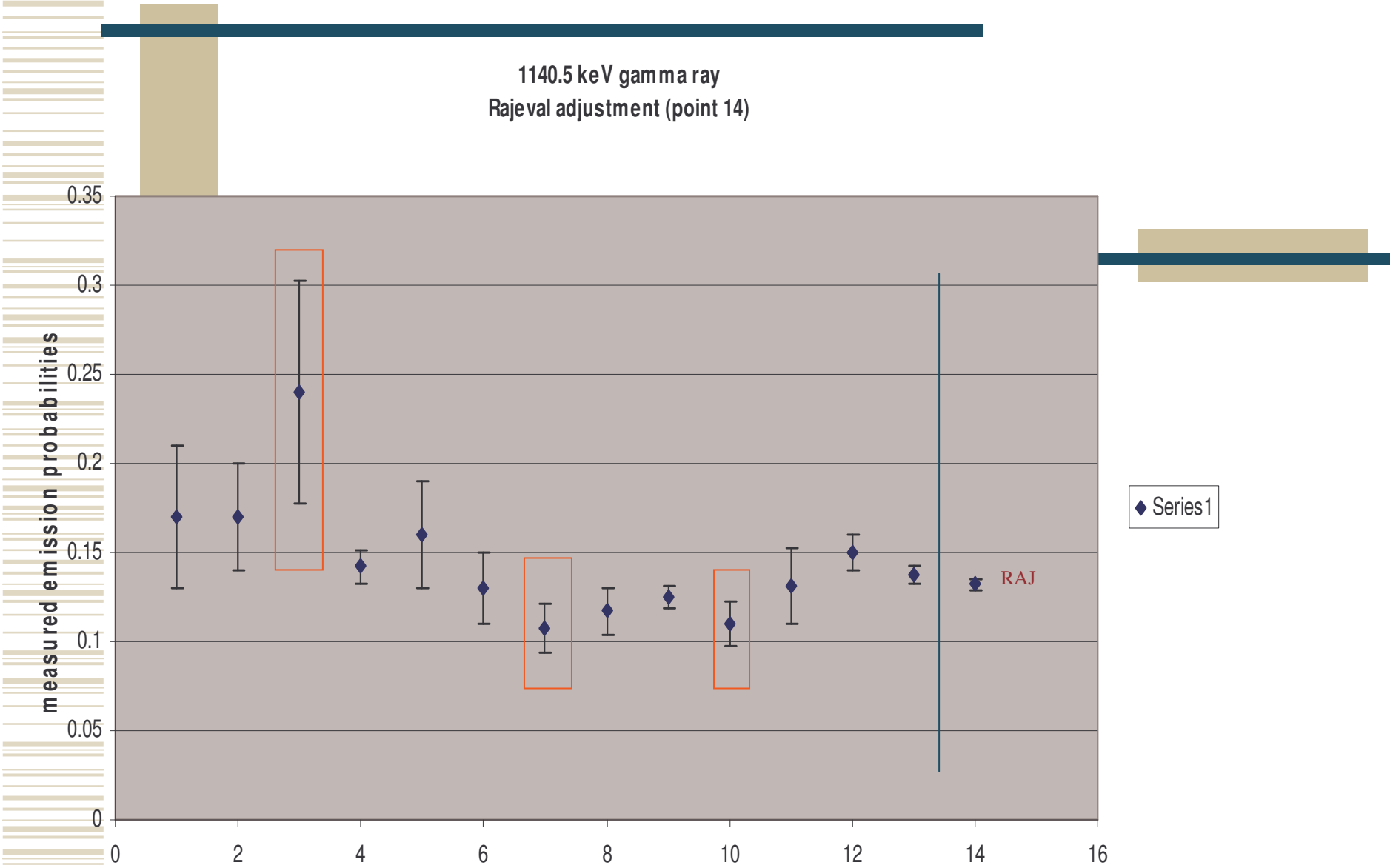
- The discrepancies are clear from the graph.


1140.5 keV gamma ray
measured emission probabilities
0.3
0.25
0.2
0.15
0.1
0.05
0
0
2
4
6
8
10
12
14
16
18
20
Measured Data
Evaluations
WM
UWM
LRSW
NORM
RAJ
Series1

^{56}Co Gamma Ray Emission Probabilities

- On the previous graph points 1 to 13 are the experimental data.
- Point 14 is the weighted mean 0.1204(21)
- Point 15 is the unweighted mean 0.145(10)
- Point 16 is the LRSW 0.145 (38)
- Point 17 is the norm. resid. 0.131(4)
- Point 18 is the Rajeval value 0.132(4)


1140.5 keV gamma ray
Normalised Residuals adjustment (point 14)
measured emission probabilities
0.3
0.25
0.2
0.15
0.1
0.05
0
0
2
4
6
8
10
12
14
16
NORM
Series1


1140.5 keV gamma ray
Rajeval adjustment (point 14)
measured emission probabilities
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
2
4
6
8
10
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16
RAJ
Series1