Memo January 10, 2003

To: John D'Auria cc: DRAGON Group

From: Joel Rogers

Re: DRAGON Target-Position and Resonant-Energy Measurement

This memo proposes an alternative way to measure resonant-energies with DRAGON, which offers some advantages over the method used in our recent PRL paper. In the paper we scanned the beam energy to find the low-energy edge of the thick target yield curve, which method has the possible drawback that it requires many beam energy changes to locate the leading edge.

The new method would use the target position of the resonance, measured in a single run, to correct the beam energy for target energy loss. Only the one position is needed, since the target density and dE/dx are already known or knowable.

The Midas Z-position spectrum was calibrated using point sources of 6.1 and 4.4 MeV gamma rays mounted inside the target box. Spectra were acquired with a source at -4, -2, 0, 1, 2, 3, 4, and 6 cm along the beam line. Fig. 1 shows 6.1 MeV position-spectra with (solid)Gaussian fits of the peaks and (dashed) Gaussian fits "constrained" to ignore the flanks of the peaks. Fig. 2 shows the fitted Gaussian-"Mean" parameters and arithmetic-"Mean" values from Fig. 1 vs the actual source positions. Results similar to Figs. 1-2 were also obtained with the 4.4 MeV source.

The measurements deviate from straight lines by about +-1mm, which is to be expected from the imprecision of placing the 6 and 10mm diameter sources in the box. This data and analysis indicate that +-1mm is the upper limit of the systematic error, however statistical errors must also be considered.

To investigate statistical errors, fewer events from the same data files were analyzed to produce spectra and fits similar to Fig. 1. Fig. 3 shows the root-mean-square deviation of 24 separate data-runs with the source positions distributed uniformly over target positions 0-6cm. Also shown as a solid curve is the theoretical minimum deviation for the Gaussian fit, equal to the average Gaussian-sigma(c.f. Fig. 1) divided by root-N. In comparing Gaussian- with the arithmetic-mean estimator, it is necessary to divide the rms values by the slopes of the appropriate response curves in Fig. 1. Even with this adjustment, the arithmetic estimator is superior to the Gaussian-fit estimator at all count levels, at least up to N=160 events.

If the new method were applied to the 21Na data in the PRL paper, we would use only the central (E=220keV/u) run, which had N=44. The statistical standard deviation at N=44 is, with Sigma-x read from the solid curve in Fig. 3,

Sigma-E = (0.9cm/0.77slope) * dE/dx = 1.3keV/u,

which is worse than the 0.5keV/u uncertainty quoted in the paper. However, the central point was acquired with only 32h of beam time. If all the time spent on 21Na had been concentrated at the central point, including the time spent changing energies, a much better error would have been obtained with the new method.

We have touted DRAGON as a facility which can measure resonant-strengths with only a rough knowledge beforehand of the resonant-energy. The method described herein produces a measure of the resonant-energy as a by-product of the standard resonant-strength measurement.

isdaq03:/isdaq/data42/dragon/joel4/point.doc Joel

FIGURE 1

6.13 MeV γ POINT SOURCE GAUSSIAN FITS

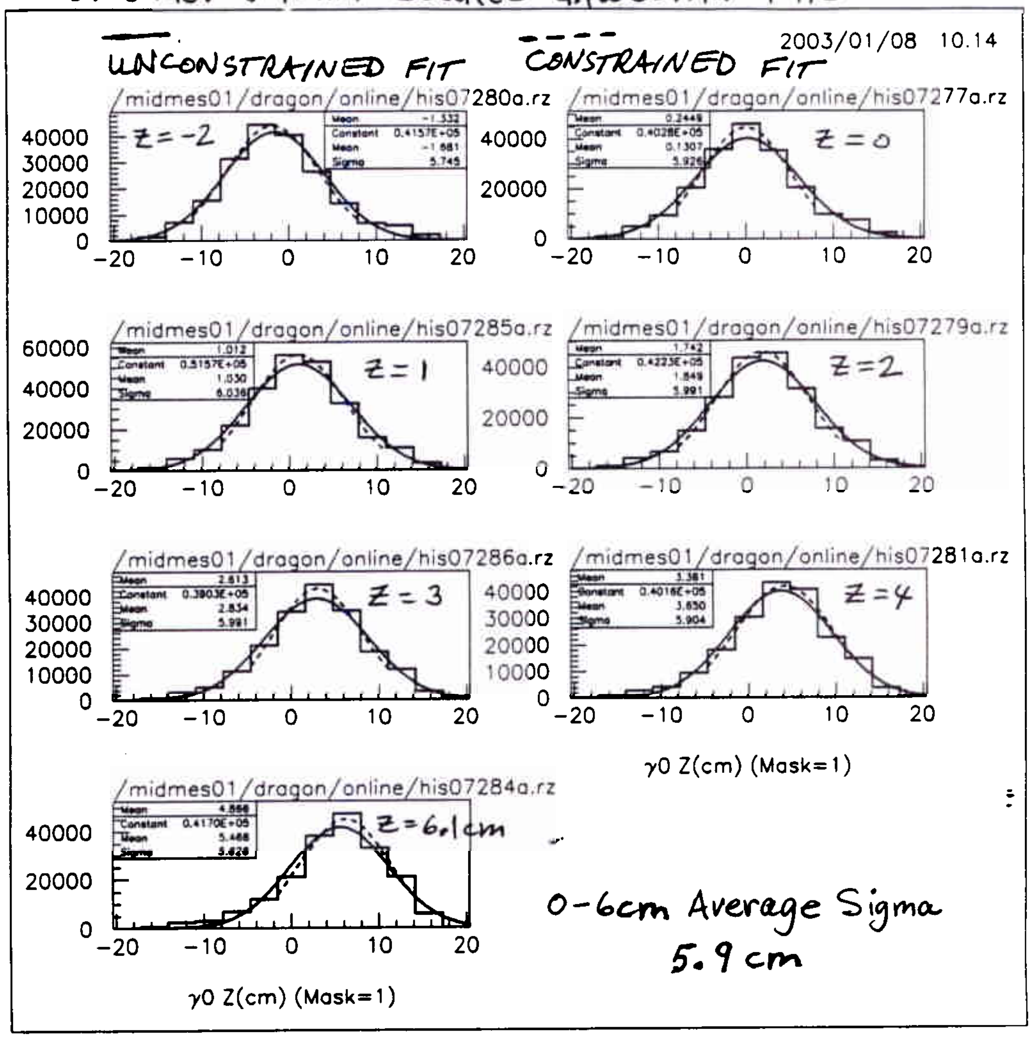


FIGURE 2

6.13 MeV γ POINT SOURCE POSITION SCAN

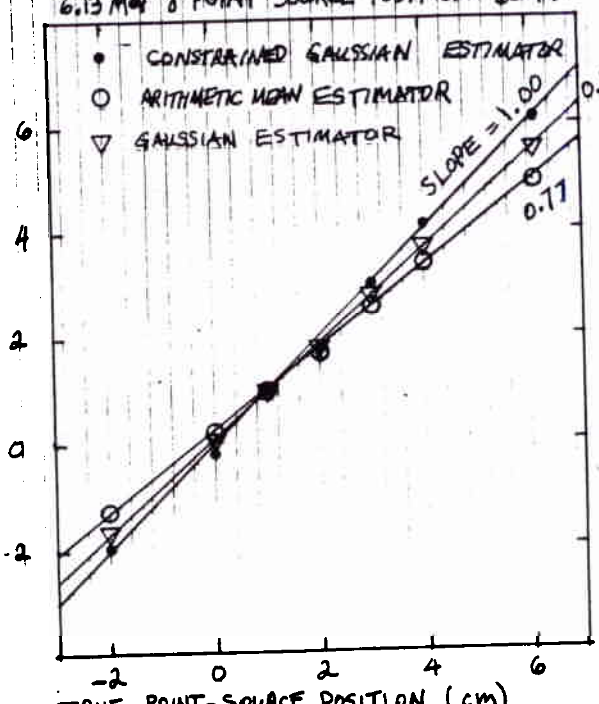
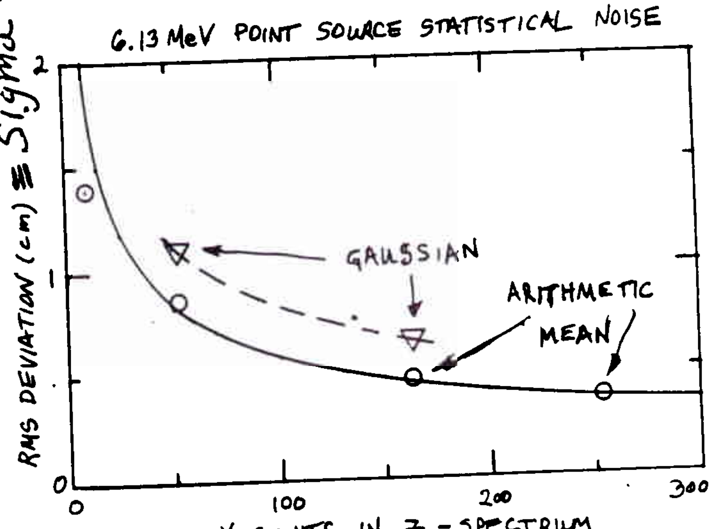


FIGURE 3

6.13 MeV POINT SOURCE STATISTICAL NOISE



SCALING PROGRAM mods

Replace *fix momentum* with *scale mass* having the following functionality:

- Only the mass can be changed.
- If the current ED values do not correspond to the scaled tune values a popup asks if you want to scale from current ED values.
- Only the ED's are changed by *apply scaled tune* in this mode.

Saving tune as reference will have changed functionality:

- *Modify reference parameters* page will come up automatically with the scaled tune energy, mass, charge and comments.
- If the current ED values are different by > .2% from the scaled ED values a popup advises that *the ED's do not correspond to the reference parameters. Are you sure you want to save?*
- If the energy calculated from the MD1 NMR differs from the scaled tune value a popup warning also occurs. The NMR may not be locked or the energy might be incorrect from hysteresis.

A new button calculates a scaled energy from the mass, charge, and NMR.

There is an advanced page implemented. *scale* 1^{st} *half, scale* 2^{nd} *half, modify energy calibration constant* are done here.

A real help file is installed.

Dec 2002 Accel. Beam Proposals to EEC

Number	Reaction	Rating	Comments
E870	^{18}Ne(α,p)		Good progress, run whe
E900	^{15}O(^{6}Li,d)	Med-High	"useful" vs KVI expt.
E927	^{19,20}Na via (^{3}He,p)	12 shifts ^{20}Na (+ 12 shifts $^{17 or 18}$Ne if it works	impt at ISAC-2 energies
E946	^{17}F(p,γ)	49 shifts High	subm. runplan for 10^{8}
E947	^{12}C(^{12}C,γ)	42 shifts Med	moderate interest
E952	^{12}C(α,γ)	High; 30 shifts to test accept /eff'cy/ang.res.	will require gas strip or ECR devel
E964	^{8}Li(α,n)	"some shifts" for det. dev.	EEC wants detailed for detector dev.
LIXXXIV	C+C astro-phys	important	submit full proposal
LIXXXV	^{14}C(α,γ)	Med-High	^{14}C beam not priority