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Guassuan Fit & Midterm Continuation

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1. Guassuan Fit

1.1. Introduction

Knight shifts are frequency shifts of the nuclear magnetic resonance in paramagnetic metals. The phenomenon was developed by physicist Walter D. Knight whom noted the effect of providing a magnetic field onto a crystal structure. The result shows that conduction electrons in metals provide an additional effective field at the nuclear site which are due to the spin orientations of the conduction electrons in the presence of an external field. Depending on the electronic structure of a metal, its Knight shift may be temperature dependent. In metals which normally “have a broad featureless electronic density of states, Knight shifts are temperature independent.” [3,4]

An organic compound, named HKUST-TCNQ (Tetracyanoquinodimethane), developed in the Hong Kong Technological University, is being claimed to have a Knight shift.[5] Provided the sample, CSULA masters student and Dr. Oscar Bernal gathered NMR data to observe Knight shift data.

After doing so the data is plotted and fitted under a best fitted line, either a Guassian fit, Lorentzian, or Pseudo-Voignt fit.

1.2. Equation

A single data set was imported and plotted to observe a double Gaussian fit from the Gaussian function

$$f(x) = aexp\frac{[x - x_0]^2}{2b^2}$$

where a is the amplitude of the Gaussian curve peak. The variable b is the center of the peak and c is thestandard deviation or the width of the bell curve. [7]

Meanwhile xo is our frequency data in Hertz.

1.3. Plot

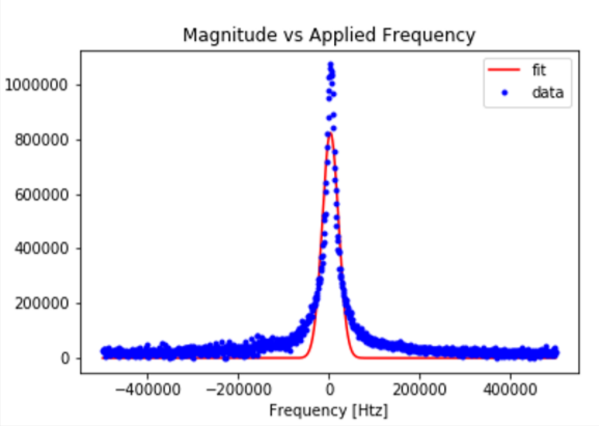

Figure 1: A Gaussian fitted curve was produced for a single data set.

See Figure 1.

1.4. Conclusion

A single Gaussian fitted curve was produced for a single NMR data set. The peak of the curve was reduced in from using the Gaussian function. This means that a different equation should be used to analyze this NMR dataset. A Lorenztian or Pseudo-Voignt function could be used instead of a Gaussian fitted curve to reduce the % error bars of the expected Knight shift plot.

2. Midterm Continuation

2.1. Introduction

The Xenon100 experiment at the Laboratory Nazionali del Gran Sasso is one of the first WIMP dark matter detector. The Xenon100 is designed after the Xenon10 experiment to detect nuclear recoils from WIMP-nucleus scattering. The improved detector operates with a liquid xenon target mass. A target of dual-phase time projection chamber is intended to capture two signals. The scintillation S2 and ionization signals S2 from particle interactions are detected and low-background photo multipliers catch the signals from the particle interactions. In studies by John Ellisa, Natsumi Nagatab and Keith A. Olivec, the theoretical representation for the calculation of spin-independent scattering matrix elements for the scattering of WIMP dark matter particles on nuclear matter. [6]

2.2. Equation

At zero momentum transfer, and neglecting nuclear structure effects, the spin independent cross-section for the elastic scattering of a generic WIMP on a nucleus with charge Z and atomic number A, mass m_r isospin transformation f_n

$$\sigma_S^Z = 4m_r^2/\pi\ [Z\ f_p + (\text{A-Z}) f_n]^2$$

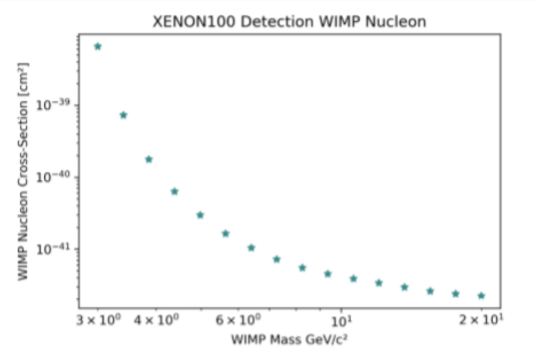

Figure 2: Detector Sensitivity of Cross section versus WIMP Mass

2.3. Plot

Figure 2 is a plot of the Xenon100 detector and its sensibility to detect a WIMP nucleon cross-section with respect to its mass. Detector sensibility decreases as the WIMP mass drops below 10 Gev.

2.4. Conclusion

Xenon100 analyses show that the recoil energy is determined using the size of the S1 signal and the relative scintillation efficiency for the nuclear recoils compared with a 122keV calibration gamma line of 57Co. In previous XENON100 analyses WIMPs masses below 10GeV/c2 create nuclear recoils up to a few keV. Nuclear recoils of this magnitude produce results in a lower S2 signal resulting in an S2 signal and an S1 signal that becomes undetectable. This puts huge importance in the sensitivity of WIMP detection. Although, without a comparable successful Dark Matter detection experiment, every event is analyzed as a probable Dark Matter interaction. Unlike the Xenon10, the Xenon100 has a minimum of 1000 events that undergo analysis.

References

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