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Internet Access to Data for Scintillation Compounds

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INTERNET ACCESS TO DATA FOR SCINTILLATION COMPOUNDS†

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INTRODUCTION

The LBL Pulsed X-Ray Facility has scintillation data on a large variety of inorganic scintillators. We offer this information on *all* compounds that we have tested. The only restrictions / favors that we ask users of this data are:

1) The data is intended for research use and may not be sold.

2) If any portion of the data is used in a publication, that the following text appear somewhere in the publication:

> "This work was supported in part by the Director, Office of Energy Research, Office of Health and Environmental Research, Medical Applications and Biophysical Research Division of the U.S. Department of Energy under contract No. DE-AC03-76SF00098, and in part by Public Health Service Grant No. R01 CA48002 awarded by the National Cancer Institutes, Department of Health and Human Services."

Please note that the University of California and the U.S. Department of Energy make no warranty as to the accuracy of this data. If you have questions, comments, suggestions, etc., please send email to wwmoses@lbl.gov.

HOW TO CONNECT

(1) Establish an FTP connection to "**scint.lbl.gov**" .
(2) Log in using the user name "**anonymous**" .
(3) Give your email address as the password.

GENERAL ORGANIZATION

There are two general types of files — summary files and data files. Summary files are found in the top level directory, while data files are located in subdirectories. Files are ASCII text with a TAB character delimiting columns and a <CR> (carriage return) delimiting rows.

Compound Summary

The first summary file is "compounds.dat", which contains a list of the chemical formula and / or name of each measured compound. Note that each sample is identified by a unique number that identifies it. This files also list some of the pertinent physical properties, such as the color, the density, and the attenuation length for 511 keV photons. Unless otherwise noted, all of these samples are in powdered form and are contained in quartz cuvettes with 5 mm outer diameter, 0.3 mm wall thickness, and 50 mm length.

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Luminosity Summary

The summary files "luminosity.dat" record the apparent luminosity of these compounds. Two "luminosity.dat" files exist, one for data taken at a synchrotron light source with monochromatic x-rays (NSLS) and one for data taken at LBL with the pulsed x-ray source. The data is kept separate due to the different nature of the experiments. For both experiments, the sample is exposed to an x-ray source and the resulting scintillation photon rate determined with a photomultiplier tube (PMT). The "true" luminosity cannot be determined with powdered samples unless the optical attenuation length of the powder is known and corrected for. As we do not know this attenuation length, we merely assume that it is the same for all samples, and thus make no correction. A more complete discussion of this issue is given in [1] and [2]. In addition, more accurate estimates of the luminosity are obtained if a correction is made for the differing x-ray attenuation length in the sample. This is straightforward when monochromatic x-rays are used, as at the synchrotron source, and so the NSLS data has this correction made. It is complex when polychromatic x-rays are used, as with the pulsed x-ray source, so this correction is not made for the LBL data. The following discussion pertains to the LBL data - see [1] and [2] for a complete discussion of the NSLS data.

The Luminosity (defined as scintillation photon count rate per unit x-ray flux) protocol is as follows. The background count rate in the photomultiplier tube (PMT_Dark_Rate) is measured with the x-ray source turned on but no sample (or cuvette) in the x-ray beam. There is a weak background luminosity due to scintillation from the quartz cuvettes (Cuvette_Luminosity) — this is determined by placing an empty cuvette in the x-ray beam and measuring both the photomultiplier tube count rate (Raw_Cuvette_Rate) and the anode current in the x-ray tube (Current) in microamperes. Thus,

Cuvette_Luminosity = (Raw_Cuvette_Rate – PMT_Dark_Rate) / Current .

A sample is placed in the x-ray beam and the photomultiplier tube count rate (Raw_Rate) and the anode current in the x-ray tube (Current) measured. The apparent luminosity of the compound is then computed by correcting for the dark rate and the cuvette luminosity, or

Luminosity = [(Raw_Rate – PMT_Dark_Rate) / Current] – Cuvette_Luminosity .

No individual data files are kept for the Luminosity measurements — all relevant data is kept in the "luminosity.dat" files. For reference, with the pulsed x-ray source the luminosity of BGO is typically 1,600 counts/second/microampere and the background luminosity from dark current and the cuvette is typically 50 counts/second/microampere.

Decay Time Summary

The summary file "lifetime.dat" file contains an entry for each fit that has been performed on the decay time data. The function that is used to is usually a sum of n exponential decay components plus a constant background. More explicitly, the form of the fit is:

$$Fit(t) = Background + \sum_{i=1}^{n} \frac{Fraction_i}{\tau_i} \cdot \exp(-\frac{t}{\tau_i}) \quad .$$

The impulse response of the system (typically about 120 ps fwhm) is deconvolved from the data, and in some cases an exponential rise time is included in the fit. A goodness of fit (chi squared per degree of freedom) is included to help evaluate the fit. Decay times that are much longer than the repetition period of the x-ray source (typically 10 microseconds) are difficult to separate from the background due to PMT dark current, as neither has any apparent time structure. In many cases though, the background due to dark current is subtracted. There is another component of the Background that is due to excitation by "background" x-rays that are uncorrelated in time to the main pulse of x-rays (for details, see [3]). In most cases, no effort is made to differentiate this background from very long decay components.

Decay Time Data

Individual data files are kept for each decay time measurement. They are located in the "lifetime" subdirectory, or in subdirectories therein (arranged by compound number). The file name consists of the sample number, the date the data was taken, and the type of TDC used to take the data with, all separated by periods. Thus, the file name for BGO (sample #5) data taken on 6/15/95 with the Highland M-690 TDC is 0005.061595.M690 . Each file contains a header that describes in detail the run conditions under which the data was accumulated. The data is accumulated in fixed width bins (typically 20 ps), but has undergone a logarithmic compression so the width of the time bin divided by the difference the time bin is from time zero is approximately a constant (roughly 1%), which reduces the size of the data set considerably. Each data file consists of three columns - the time (in ns), the Count_Rate (listed in terms of counts per original bin), and a Weight factor (the number of original bins that have been merged to obtain this compressed bin). The total number of counts that went into this bin is then Count_Rate * Weight. More details on this compression are given in [4].

Emission Spectrum Data

Individual data files are kept for each emission spectrum measurement. They are located in the "spectrum" subdirectory or in subdirectories therein (arranged by compound number). The file name consists of the sample number, the date the data was taken, and the blaze of the monochromator grating used to acquire data, all separated by periods. Thus, the file name for BGO (sample #5) data taken on 6/15/95 with a grating blazed for 300 nm is 0005.061595.300 . Each file contains a header that describes the detailed run conditions under which the data was accumulated. The relative quantum efficiency of the monochromator / photomultiplier tube combination has been calibrated; these correction factors are included in each data file.

Wavelength Resolved Decay Time Data

For a few of the samples with multiple emission peaks, the wavelength resolved decay time is collected. These data are located in the "wr_lifetime" subdirectory. The file name consists of the sample number, the date the data was taken, and the designator WRDT, all separated by periods. Thus, the file name for BGO (sample #5) data taken on 6/15/95 is 0005.061595.WRDT . Each file contains a header that describes in detail the run conditions under which the data was accumulated. As with the lifetime data, the data is accumulated in fixed width bins but has undergone a logarithmic compression so the width of the time bin divided by the difference the time bin is from time zero is approximately 1%. Each data file consists of two columns that contain the time (in ns) and a Weight factor (the number of original bins that have been merged to obtain this compressed bin), followed by a column containing the Count_Rate (defined the same way as data in the Decay Time section) for each emission wavelength, selected using a monochromator.

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