# AbstractID: 10954 Title: An energy-dispersive technique to measure tissue x-ray coherent scattering form factors

**Purpose:** Data for the x-ray scattering properties of tissues are needed for the development of x-ray scatter imaging systems. Published amorphous material form factors from x-ray diffractometer measurements vary significantly. An energy-dispersive technique was developed to provide more accurate measurements.

**Method and Materials:** The form factor is measured as a function of the momentum transfer argument $x=\lambda^{-1}\sin(\theta/2)$ where $\lambda$ is the photon wavelength and $\theta$ is the scattering angle. Crystallographic diffractometers measure scattering versus $\theta$ at one wavelength (energy). Our method fixes $\theta$ and measures versus energy, using a high purity germanium spectrometer to measure the scattered polychromatic spectrum from a tungsten anode x-ray tube. The target is moved laterally to measure the transmitted and scattered spectra without adjusting the x-ray tube and detector. By taking the scatter to transmitted ratio bin-to-bin, the coherent scattering form factor is determined without adjustable parameters. Repeating with four $\theta$ values, the range $0.5\ \text{nm}^{-1} < x < 12\ \text{nm}^{-1}$ is obtained.

**Results:** Measurements of the coherent scattering form factor of water and several plastics with our prototype system give good agreement for $x > 7\ \text{nm}^{-1}$ with the Independent Atom Model. This, together with general agreement at smaller $x$ with published diffractometer data, is strong evidence that our measurement is accurate. The precision of our measurement has been thoroughly characterized and is approximately 10%.

**Conclusion:** The energy-dispersive technique measures over a wider $x$ range than do diffractometers and does not require the use of arbitrary scaling constants. Our measurements are limited to 5 – 10% in $x$ resolution at small $\theta$ but this is acceptable for tissue measurements. Resolution and precision will be improved by using rectangular apertures. Due to the advantages of the technique and to its thorough characterization, we expect the energy-dispersive technique to provide definitive form factor results.