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A New vSANS at NIST - challenges and opportunities

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Building next generation instruments on existing sources is limited by the fact the source brilliance is more or less fixed. Thus the design of these new instruments requires thinking of how to better take advantage of existing untapped potential (for example increasing the number of detectors). One way to approach the problem is to take a fresh look at the old design issue of choosing the "right" trade-off (e.g. between intensity and resolution). First and second generation instrumentation built-in many of those trade-offs based on best guesses at the time. With the new vSANS being built at NIST we are trying to take advantage of the many technological advances in the past few decades that allow us to now build a much more flexible (and technically complex) instrument that can give scientists many more choices of trade-offs to match their particular scientific problem at the time of the experiment.

The new NIST vSANS instrument will be 45 meters in total length. A high resolution (1.2 mm fwhm) 2D detector along with a longer flight path (45 m) will allow a factor of four smaller q to be measured, qmin = 0.002 nm-1, compared to the 30 m instruments. To enhance count rate at the smaller q-range, larger samples or relaxed resolution is employed. Converging beam collimation allows utilization of larger samples with a gain of a factor of 200 over standard pinhole collimation. Relaxed resolution using slit collimation with small samples produces a gain of 25,000 over pinhole collimation. The instrument will have three separate detectors that can be placed independently at different distances from the sample allowing the full q-range, 0.002 nm-1 $\leq$ q $\leq$ 7 nm^{-1} to be measured in one setting. The incident wavelength, and wavelength resolution, are controlled over a wide range with either a standard resolution mechanical velocity selector ($\Delta\lambda/\lambda$= 12%), high resolution graphite monochromator ($\Delta\lambda/\lambda$= 2%), or low resolution filtered beam covering 0.4 nm $\leq \lambda \leq$ 0.8 nm with Be filter and guide deflector. The instrument is being designed with a large 2 m sample area to allow for larger ancillary sample environments to be used while also providing a means to reduce the air path for smaller sample environments. Full beam polarization using a 3He analyzer will also available. Design choices and challenges will be discussed.