

## High Speed Detection of Narcotics using Novel X-ray Diffraction Methods

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Worldwide, postal systems have become efficient transport networks for multiple illicit materials such as narcotics and pharmaceuticals. Between 80-95% of drug trafficking websites prescribe the use of postal systems for transportation and in 2017, US postal inspectors seized ~20,000 kg of illegal drugs from packages. The success of such trafficking is due to the high volume of postal items shipped daily coupled with the limited, high speed technology options capable of non-invasive detection for specific materials.

New, automated technologies are increasingly demanded by governments to assist local enforcement agencies in the interdiction of drug trafficking. As the majority of postal transported narcotics are in solid, polycrystalline form, X-ray diffraction is potentially a good candidate detection technology. Unfortunately, as diffraction signal intensities are several orders of magnitude less than those required for X-ray absorption imaging, data acquisition speeds have been traditionally incompatible with the demands of high throughput screening. This issue may be mitigated by high intensity X-ray sources and/or sensitive area detectors but this is at a cost that is commercially unacceptable. As an alternative, we have been developing an approach to increase diffraction signal intensity through manipulation of primary beam topology.

*Focal construct geometry* (FCG), employs a hollow incident cone beam and thus samples produce pseudo-focussed diffraction signals of relatively high intensity (see Fig 1). Recently, the method has been adopted commercially to address the detection of explosives within aviation screening systems. The presentation will discuss the advantages and disadvantages of this technique for postal screening and will also present initial results from illegal drugs concealed within a number of envelopes and small packages. We will also illustrate relationships between key performance indicators of the detection method (e.g. sensitivity, specificity) and speed of data acquisition.

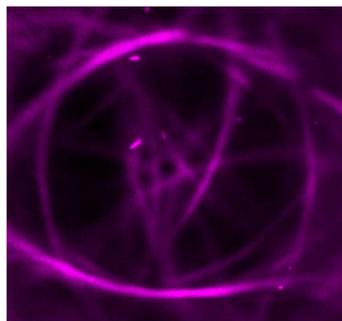


Figure 2. FCG data from a sample with preferred orientation

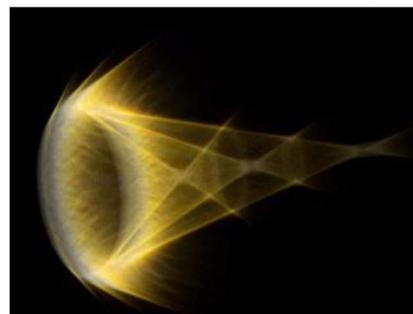


Figure 1. Simulation of FCG pseudo-focusing producing high intensity maxima from a planar sample