

# FST-51200.50.19.13 (FY 2019-2021): Integrating Nuclear Techniques to Enhance Detection of Opioids

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## Objective:

Develop and integrate complementary nuclear techniques to enhance detection of opioids in packages passing through mail rooms, airports and other sensitive areas.

## Results/Achievements Thus Far:

- Built and commissioned Nuclear Quadrupole Resonance Spectrometer (NQR) (Figure 1).
- Built and commissioned first-generation photoacoustic system, with 3D-printed acoustic horn detection (Figure 2).
- Completed preliminary round-robin testing of surrogate packages using non-nuclear and nuclear (neutron and x-ray) techniques. Limitations of non-nuclear techniques (non-penetrating) confirmed.
- Initial chemometric model shows excellent ability to distinguish various classes of narcotics from each other and cutting agents (Figure 3).

## Collaborations/Leveraging:

Stakeholders: CBSA, RCMP, DRDC, CSC, AECL

This work follows from a preliminary study investigating the use of nuclear techniques for the detection of opioids and explosives (FST-51200.50.18.14) and current Canadian Safety and Security Program project CSSP-2018-CP-2338 “Advanced Nuclear Techniques for Toxic and Explosive Chemical Detection”

## Future Work:

1. Continue developing NQR, photoacoustic, x-ray and neutron-based detection.
2. Further testing of multiple narcotic surrogates in different packaging (paper, foil, mixed).
3. Further development of chemometric models (individual and collective detection).
4. Test real substances with support from RCMP and CBSA.

## Expected Outcomes:

- Demonstrated effectiveness of nuclear techniques for detection of opioids, showing need for these techniques in the real world.
- Chemometric model integrating multiple techniques to enhance detection and classification.