

Towards safer spirits: Non-invasive detection of methanol in sealed spirit bottles

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Fake alcohol warning after 100 die from poisoning in popular tourist spot
THE INDEPENDENT
Feb 2025

Six people are dead after a suspected mass methanol poisoning at a backpacker party town. What went wrong in Laos?
THE GUARDIAN
Nov 2024

Eleven countries added to methanol poisoning warning list
BBC
Nov 2025

Tainted alcohol leaves 13 dead and 21 blinded in Kuwait, health ministry says
REUTERS
Aug 2025

Methanol poisoning remains a global threat, with 61 incidents and **488 fatalities** reported across **21 countries** in 2025 alone.

The Reality

The Problem

Current gold-standard methanol detection methods still rely on off-site laboratory-based analysis, which is **time consuming**, **costly**, and inherently **destructive**.

The non-contact nature of **Raman spectroscopy** allows quick, on-site **molecular analysis through containers**.

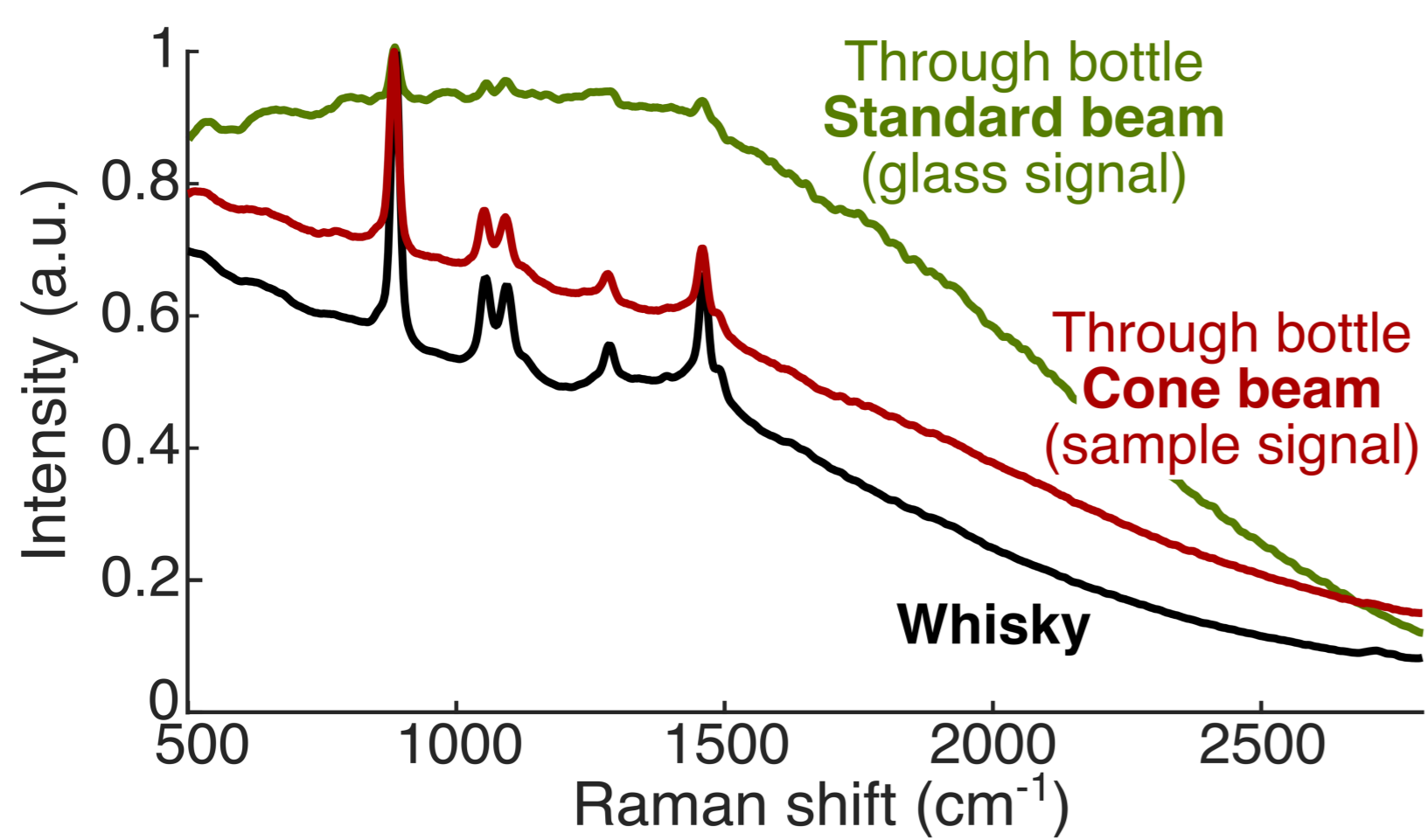
The Solution

Challenges

1. Signal from the container \gg Raman signal of the contents.
2. Weak Raman signals due to absorbance of the container.

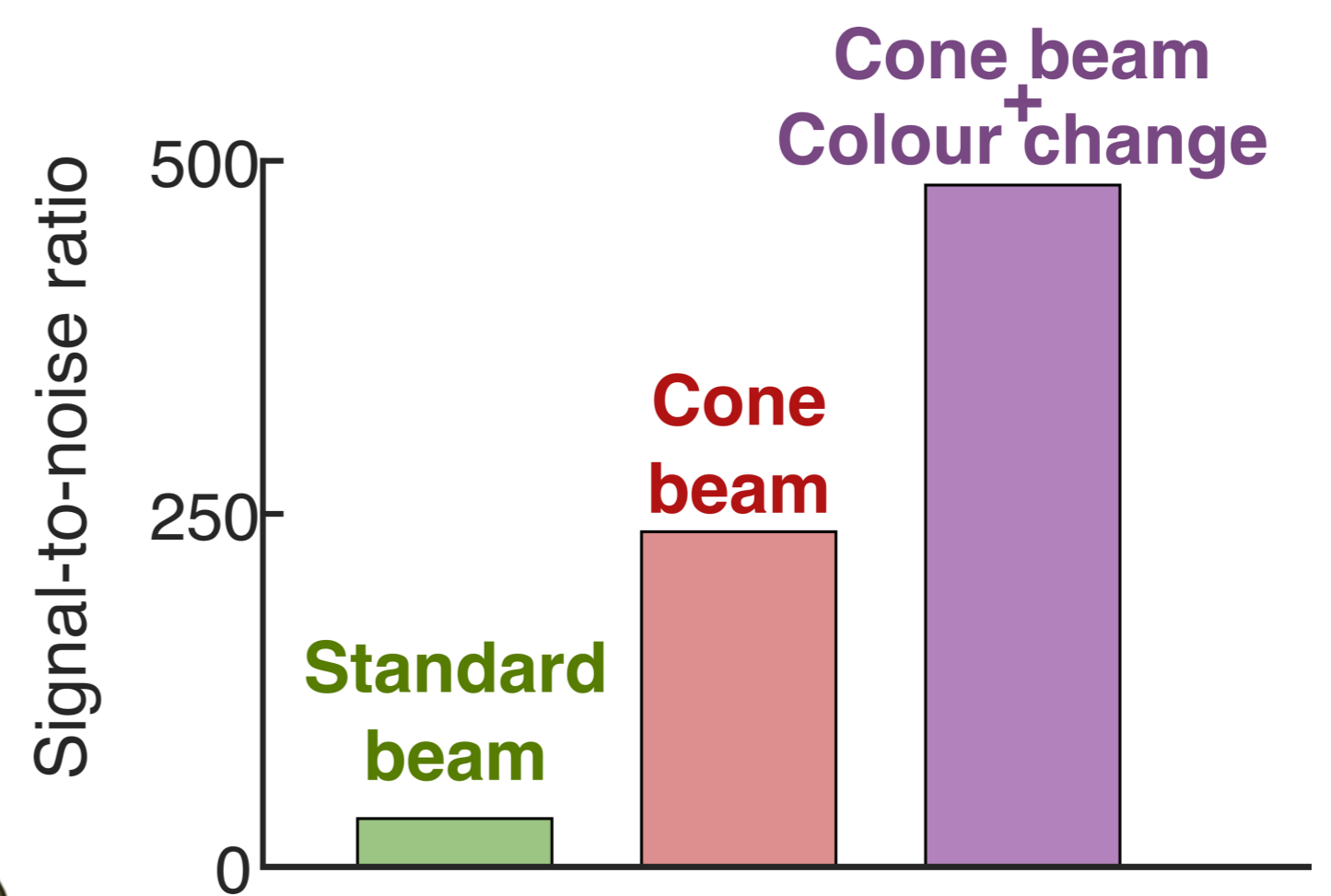
Changing the *shape* of the laser beam

We create a cone-shaped laser beam that forms a ring on the bottle surface before collapsing to a focus inside the liquid. This geometry allows the Raman signal to be collected, **avoiding the fluorescence signal from the glass**.



Changing the *colour* of the laser beam

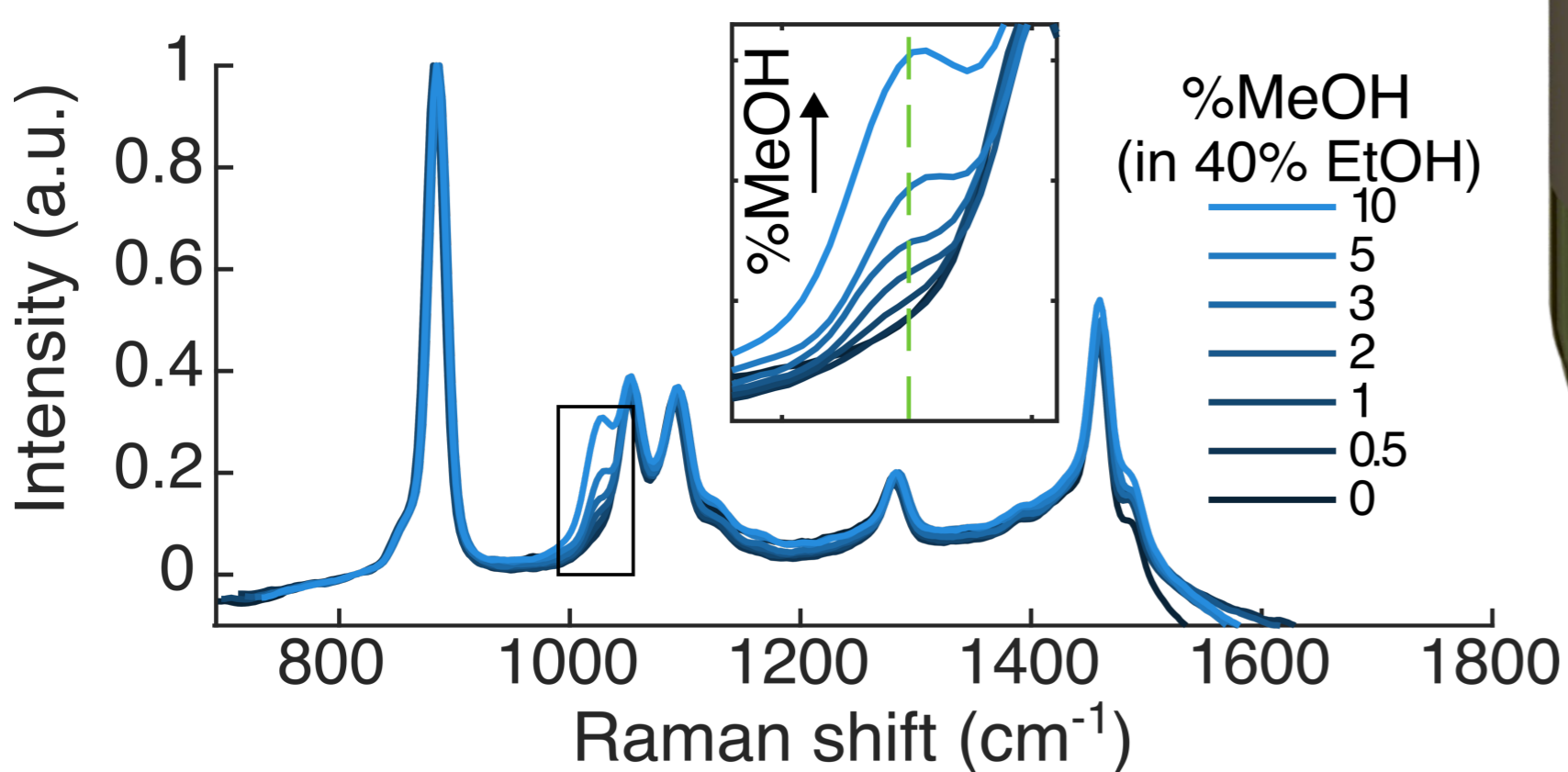
We change the wavelength of the laser beam to suppress fluorescence by exploiting the fact that the Raman signal shifts with wavelength while the fluorescence remains static. This allows the Raman peaks to be isolated, **improving the signal-to-noise ratio up to 12-fold**.



The Result

We can **detect methanol concentrations as low as 0.2%** without opening the bottle, which is well below the 2% harmful threshold.

- Non-invasive – no need to open the bottle
- Independent of bottle type or colour
- Independent of spirit inside the bottle



Laser beam in
Raman signal out

More applications

This research provides a versatile platform for sensing through packaging for **authentication**, **quality control**, and **consumer safety** across the **food**, **cosmetic**, **pharmaceutical**, and **security** industries.



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