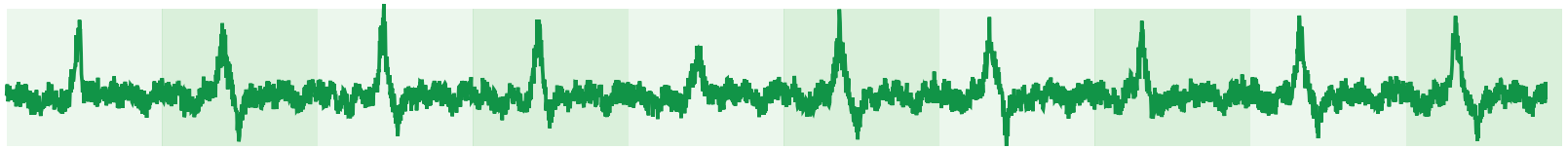
Resonance Raman Spectroscopy with Conventional Raman Systems



Baptiste Auguié

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Motivation

“

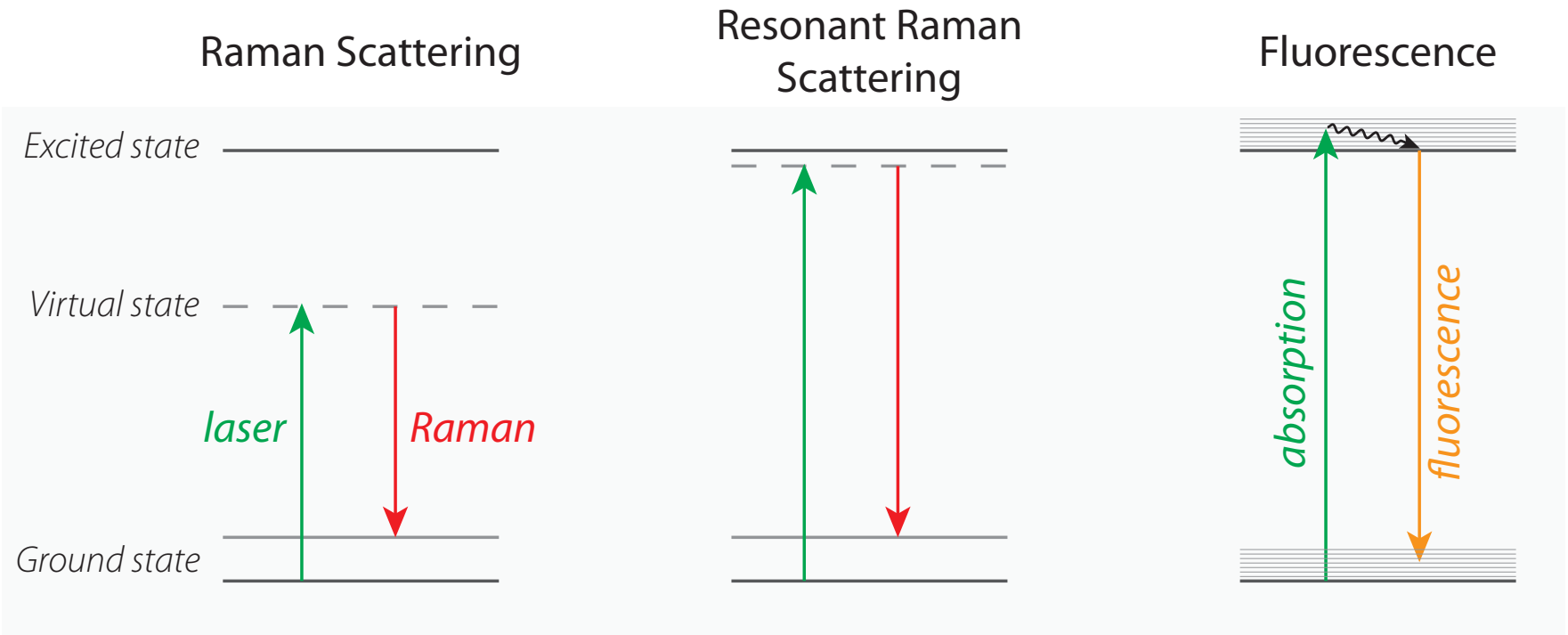
The first major impediment to using Raman spectroscopy is the ***weakness*** *of the effect.*

A second problem with Raman spectroscopy is another competitive effect, ***fluorescence****.*

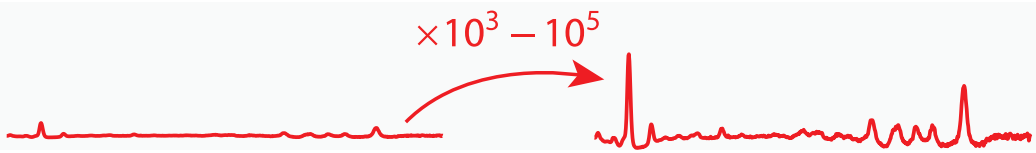
Richard McCreery

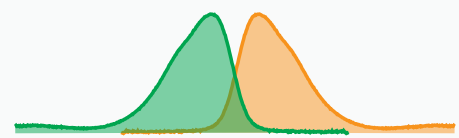
Raman Spectroscopy for Chemical Analysis

Light preamble

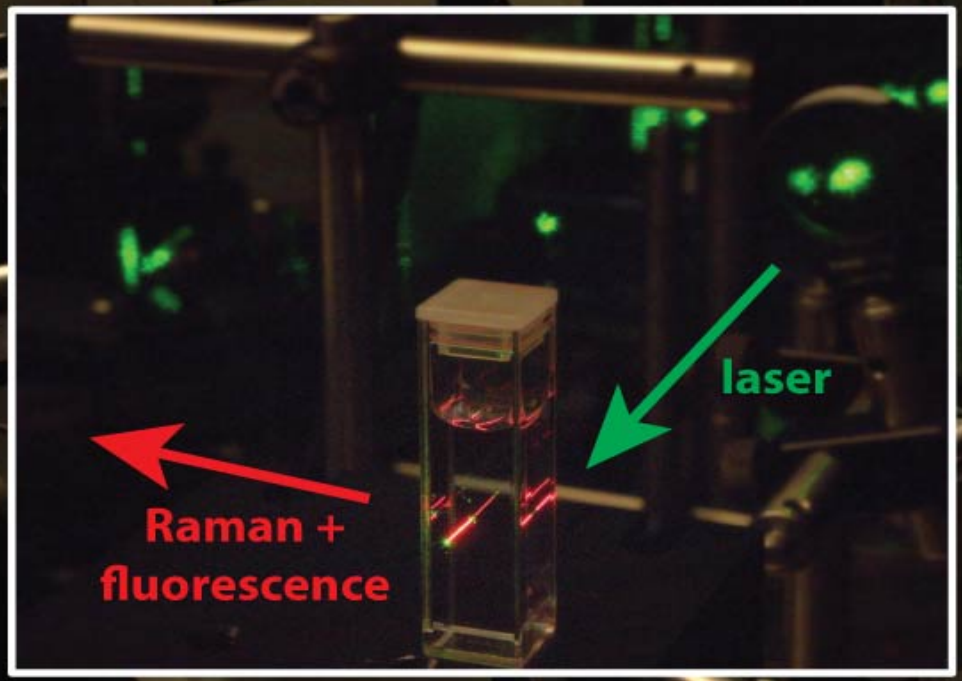


instantaneous	*instantaneous*	*delayed (~ns)*
polarised	*polarised*	*almost unpolarised*
$\sim 10^{-28} - 10^{-31}\ \mathrm{cm^2/sr}$	$\sim 10^{-23} - 10^{-25}\ \mathrm{cm^2/sr}$	$\sim 10^{-16} - 10^{-18}\ \mathrm{cm^2/sr}$





A naive experiment…



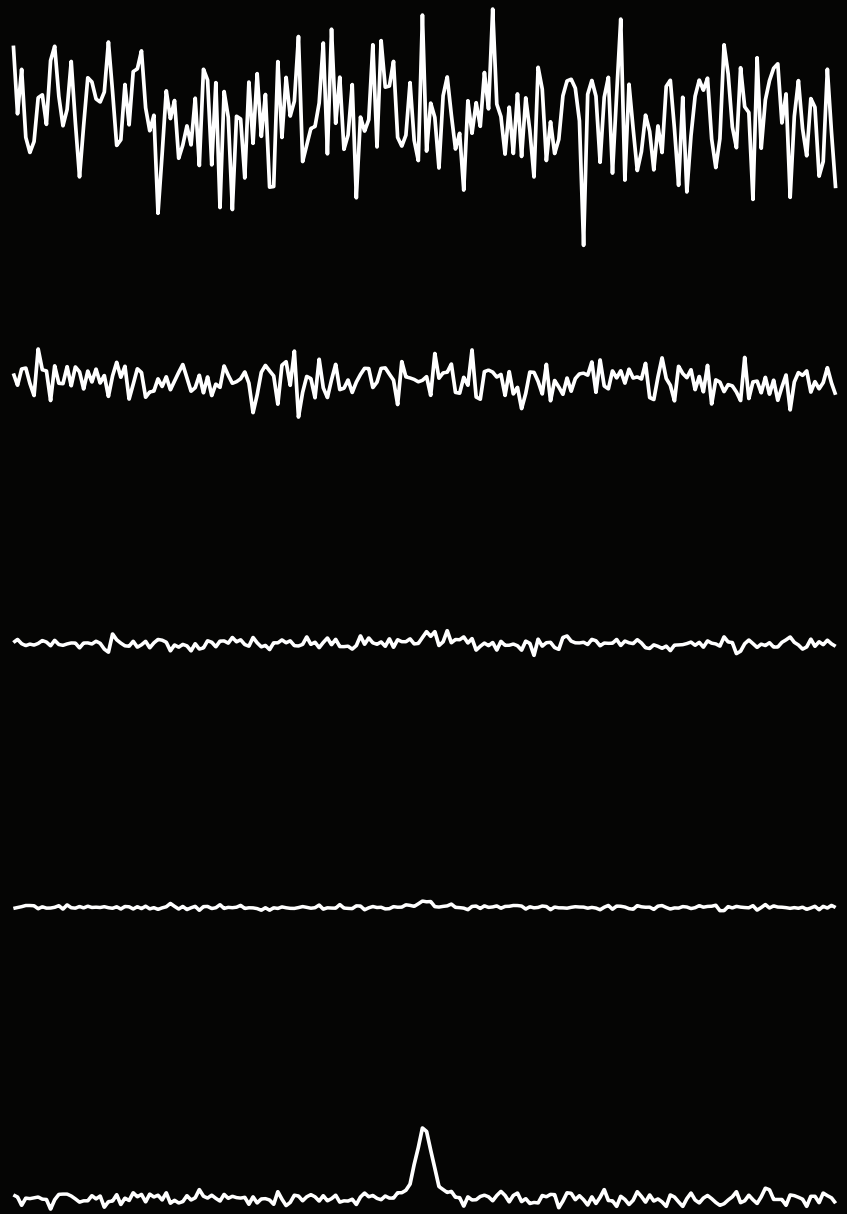
1 spectrum

10 spectra

10^2 spectra

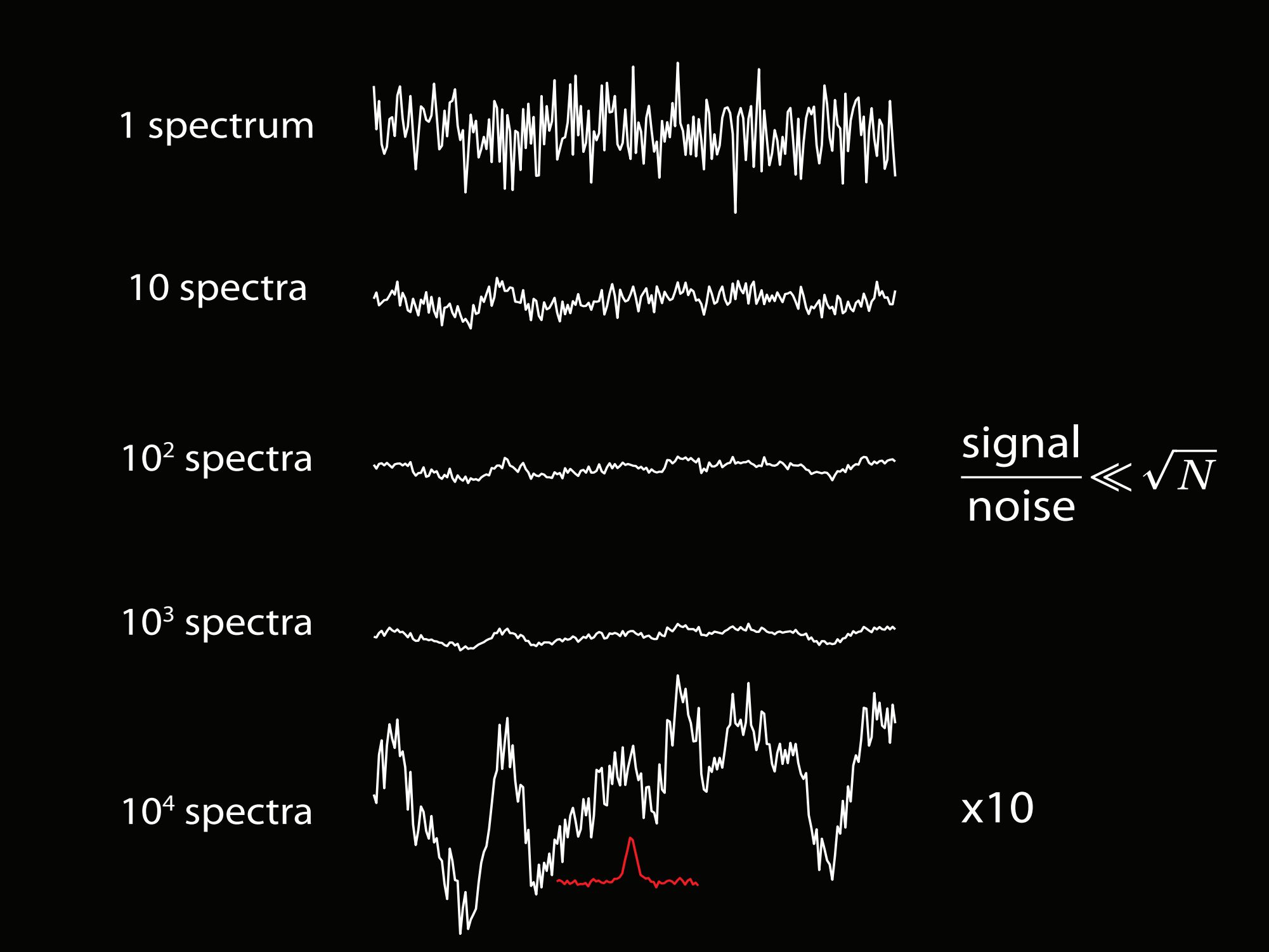
10^3 spectra

10^4 spectra



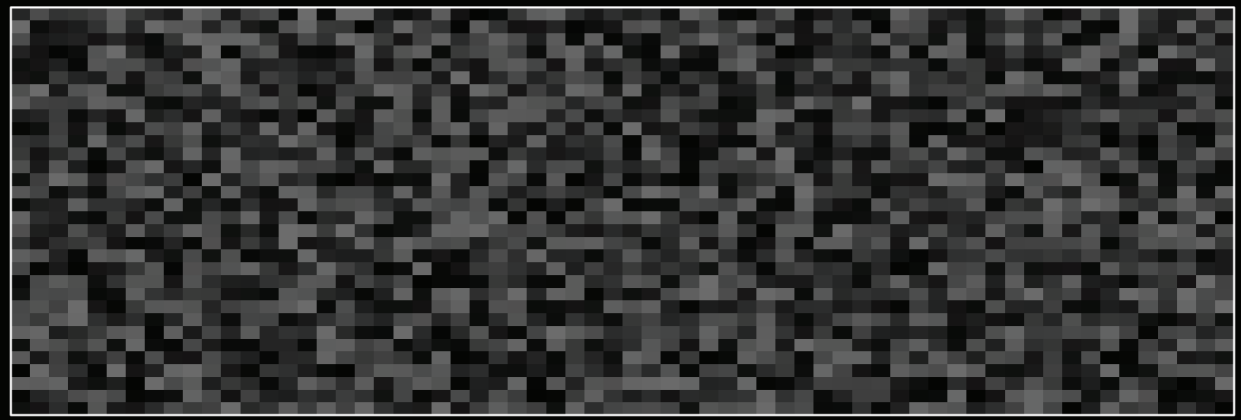
$$\frac{\text{signal}}{\text{noise}} = \sqrt{N}$$

x10


1 spectrum
10 spectra
10² spectra
10³ spectra
10⁴ spectra
signal / noise ≪ √N
x10

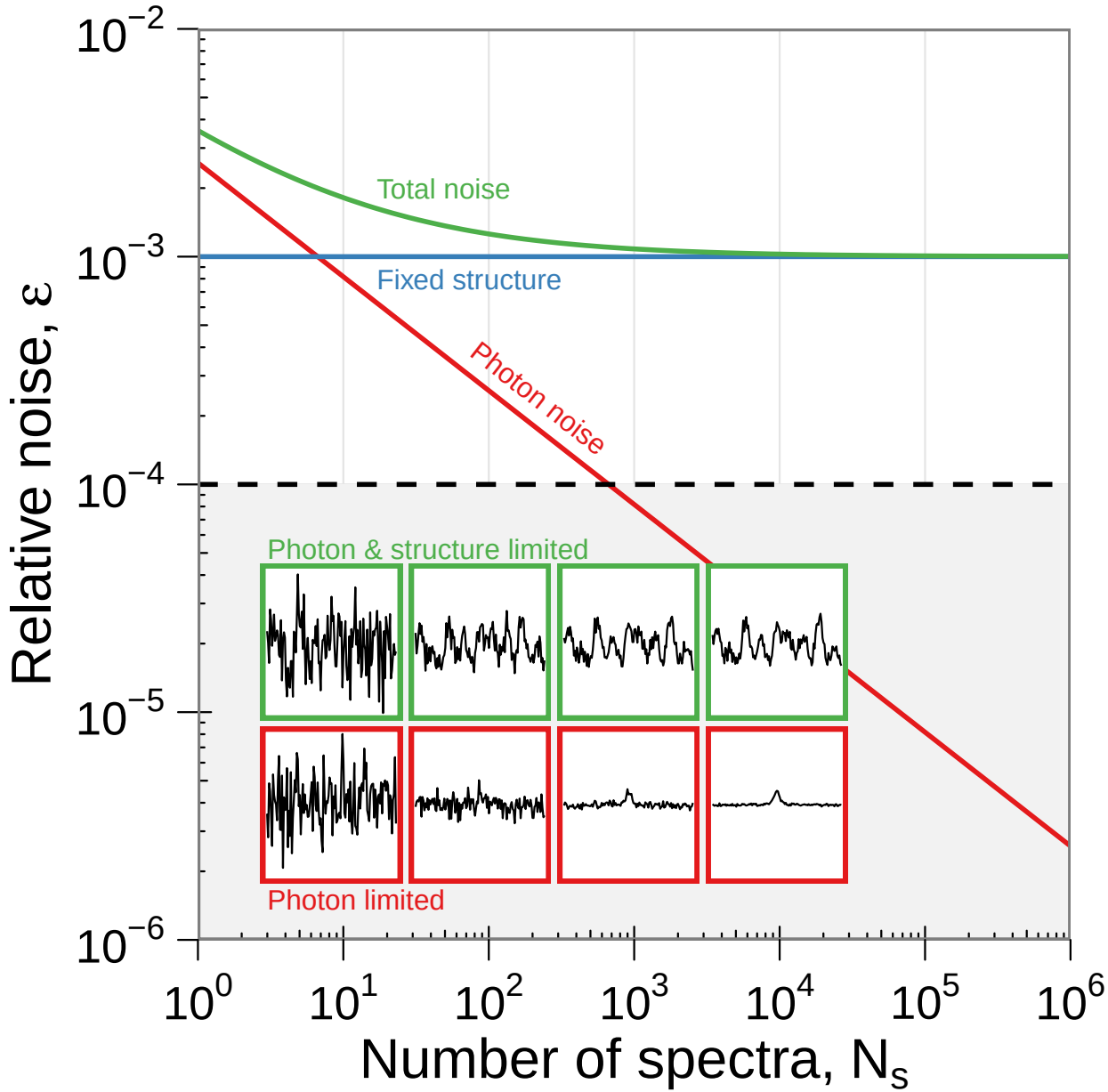
Flat (homogeneous) source

CCD flat field

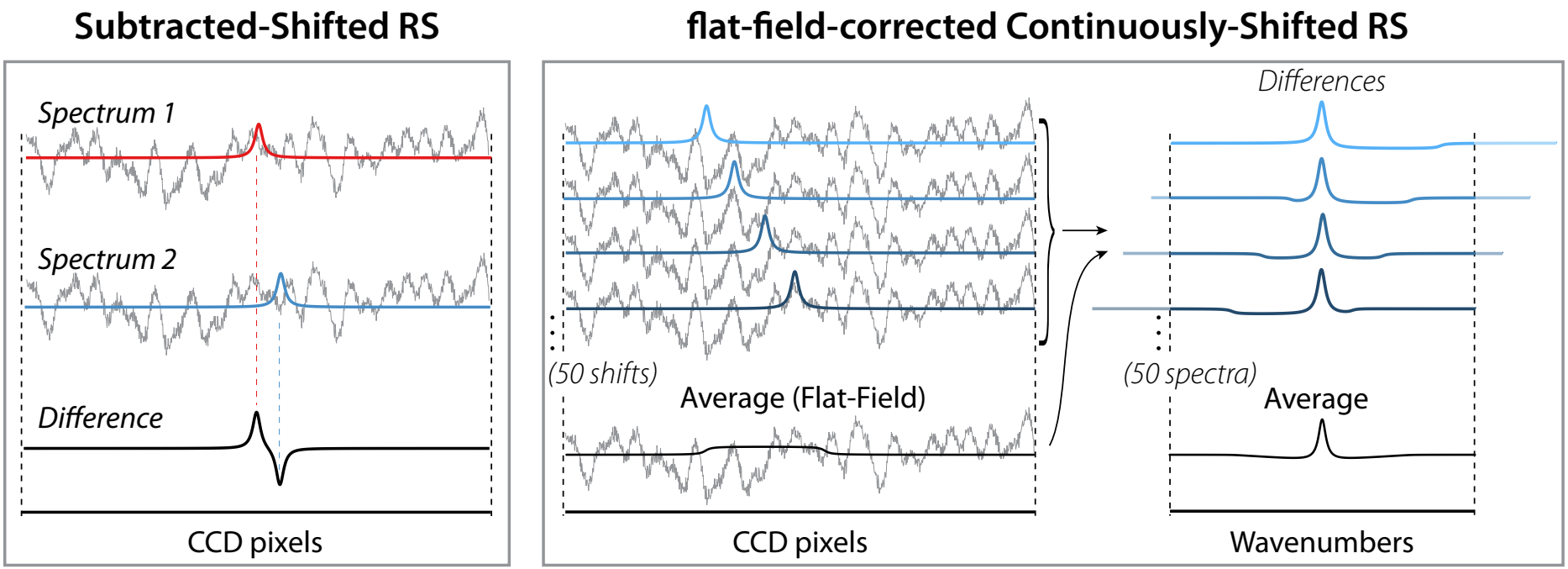


~1% response inhomogeneity

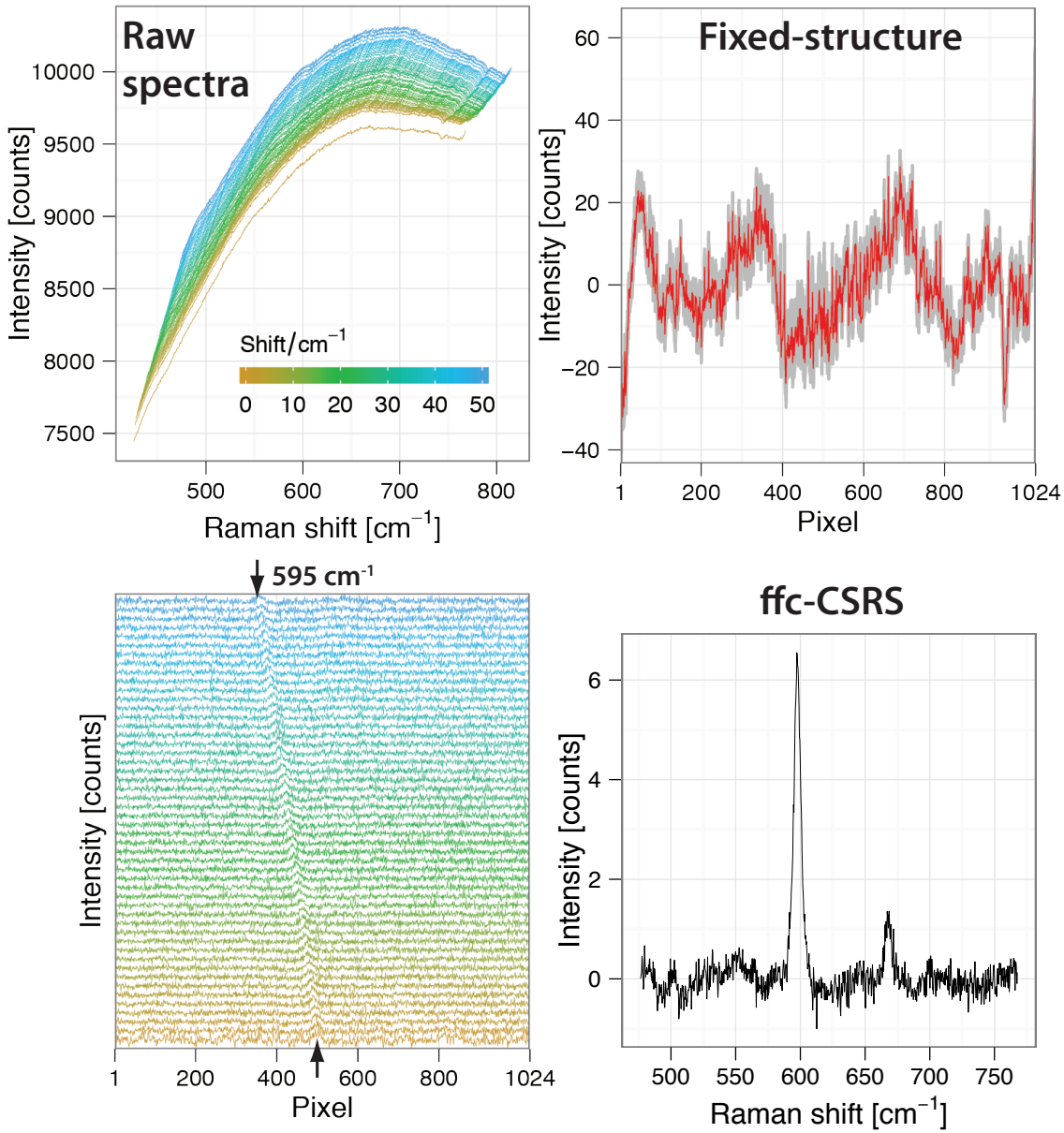
Sources of noise in CCD measurements



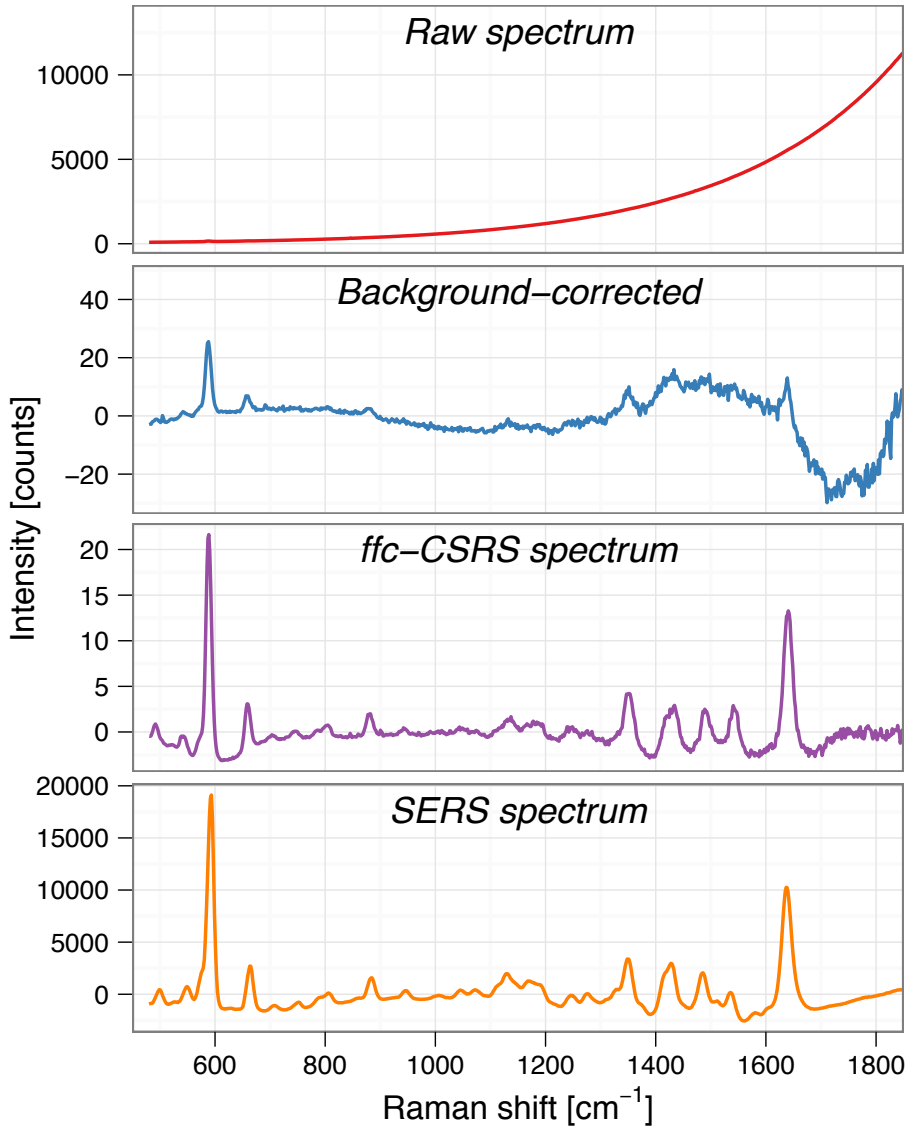
Removing the fixed-structure noise



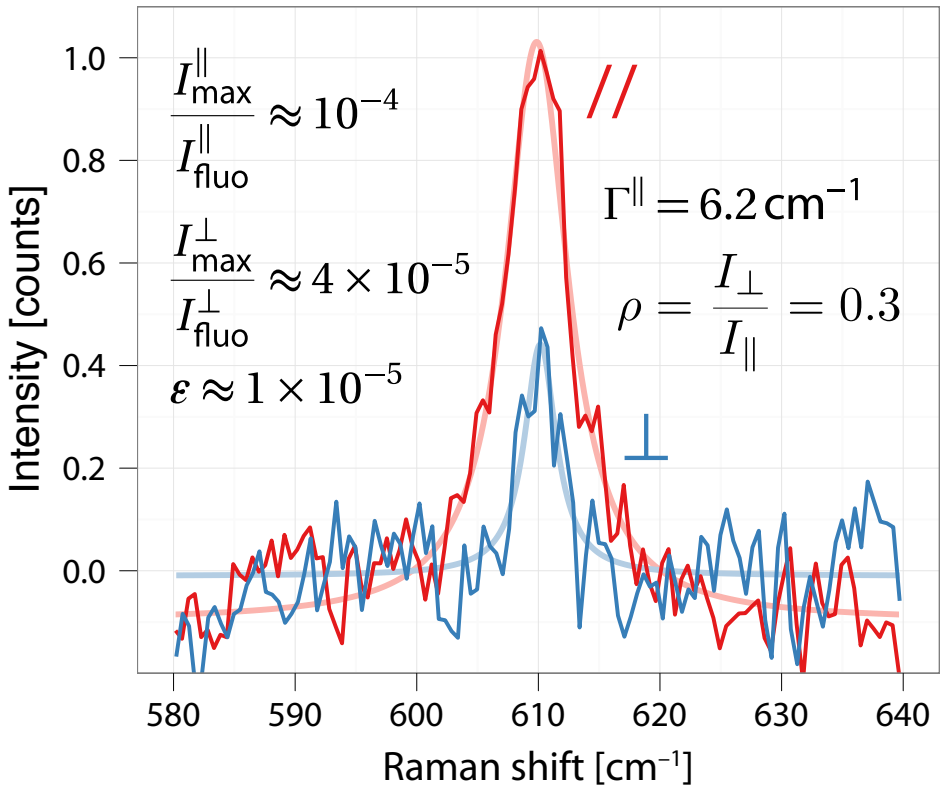
Example 1: Nile Blue, λ =647nm



Example 2: full Raman spectrum of Nile Blue, λ =568nm



Example 3: polarised resonant Raman cross-sections of Rhodamine 6G , $\lambda = 514\text{nm}$



Conclusions

- CSRS is a new, powerful tool that enables *routine* resonant Raman spectroscopy, with *conventional setups*
- new avenues of research: comparison with SERS, database of cross-sections …
- versatile method: can be applied to other challenging situations in spectroscopy (also *imaging*?)

Detailed references


E. C. Le Ru, L. C. Schroeter, P. G. Etchegoin. *Anal. Chem.* **84**, 5074 (2012).


B. Auguié, E. C. Le Ru, A. Reigue, P. G. Etchegoin. *Anal. Chem.* **84**, 7938 (2012).


A. Reigue, B. Auguié, P. G. Etchegoin, E. C. Le Ru. *J. Raman Spectrosc.* (2013) doi:10.1002/jrs.4233.