One ring to bind them all:
SERS in the dark side of SPR

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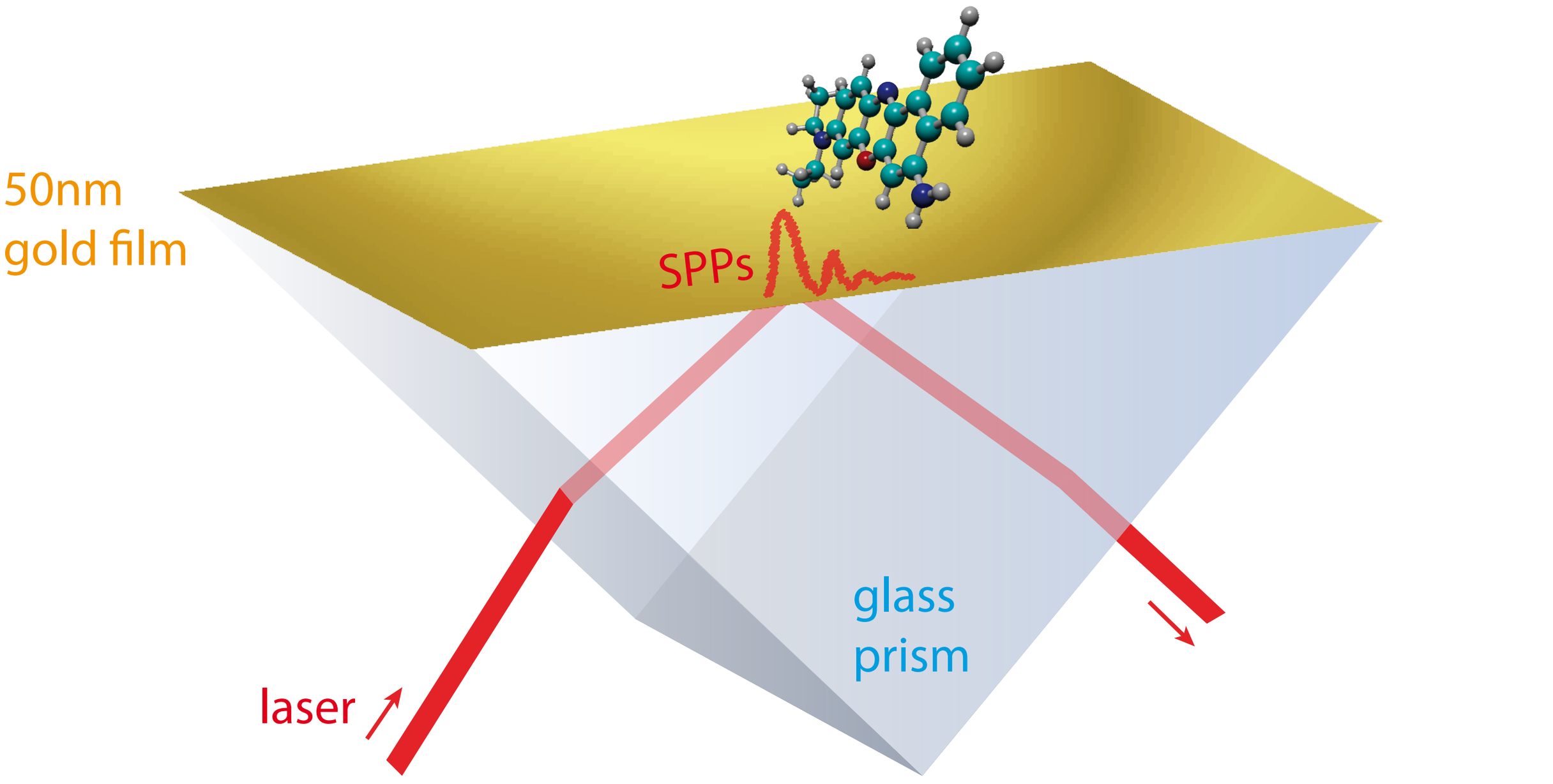
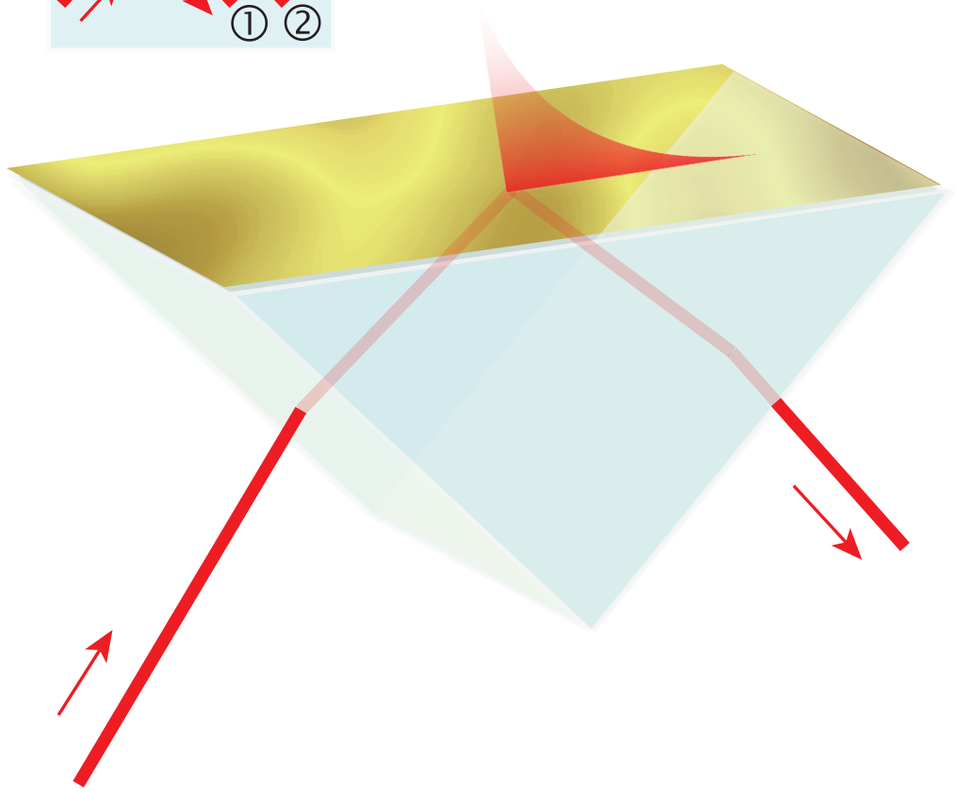
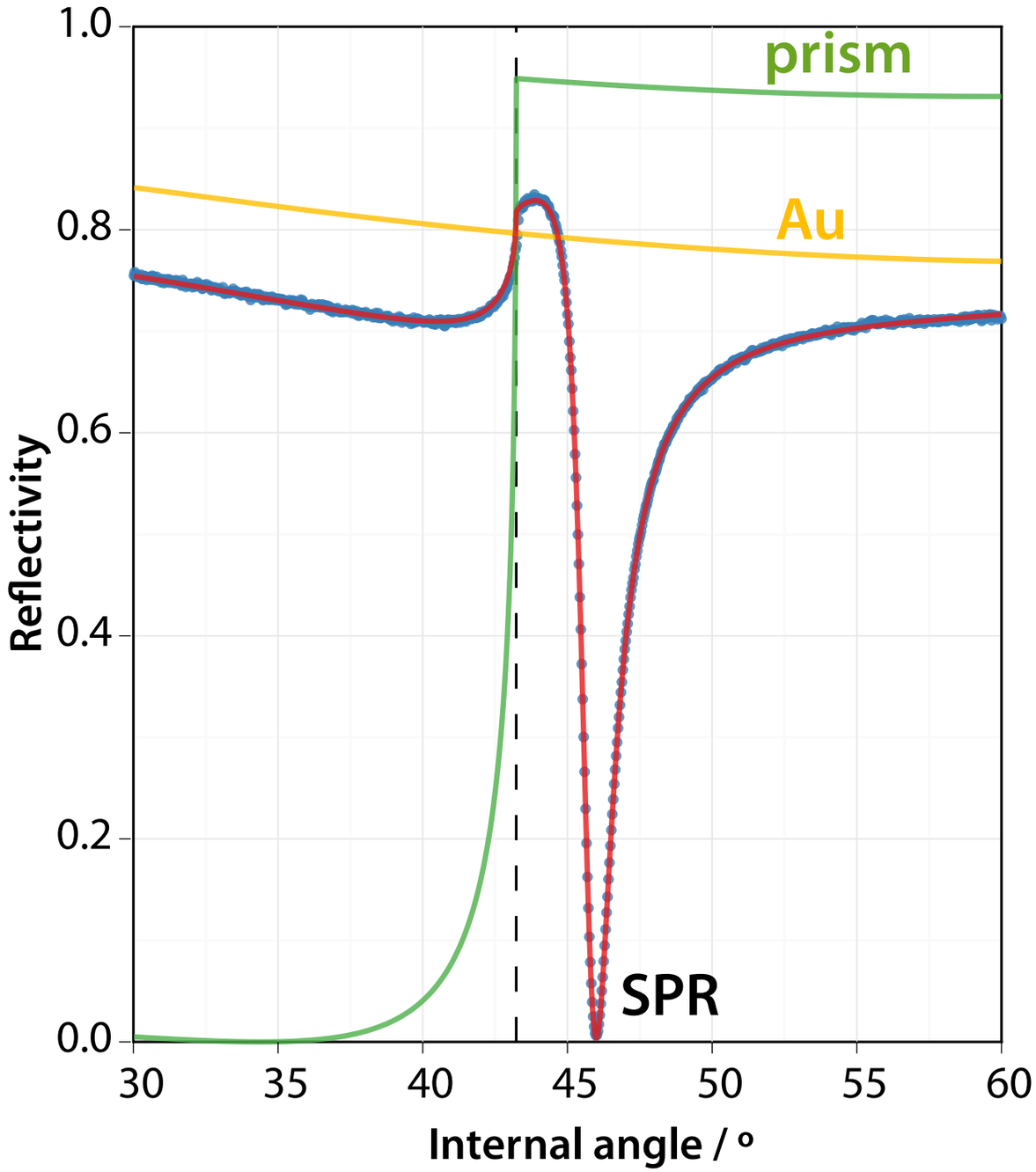
▽

Basic configuration

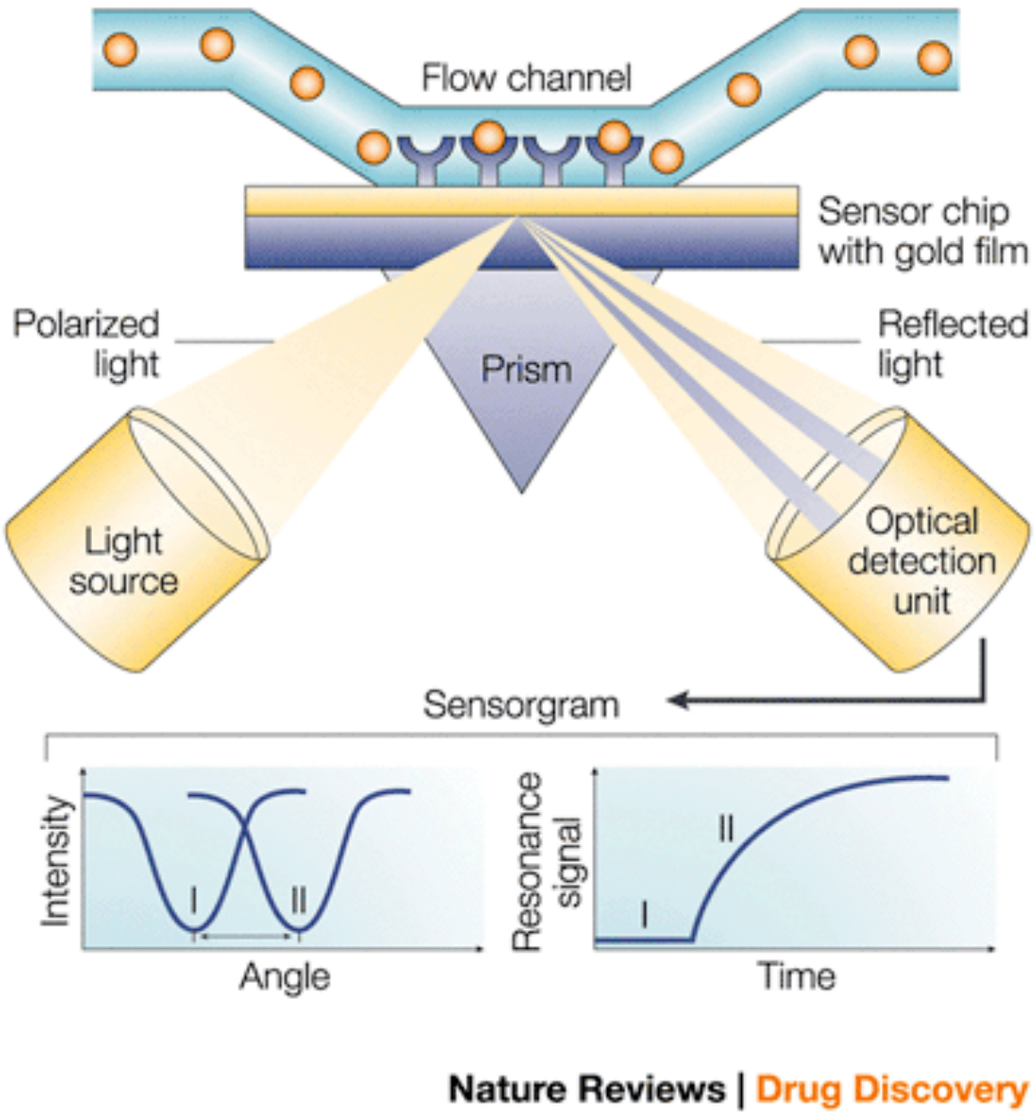


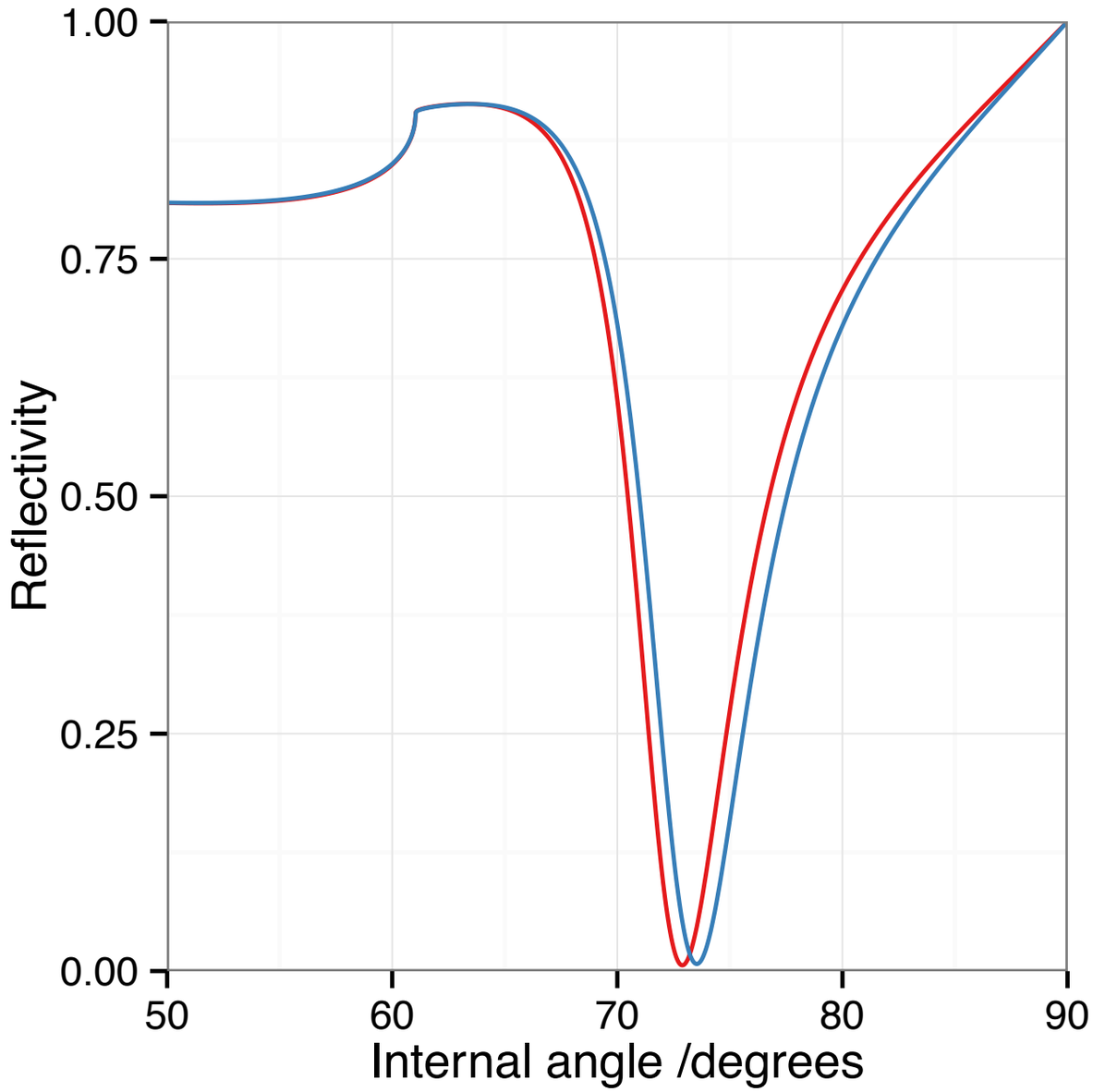
Surface Plasmon-Polaritons





Surface Plasmon Resonance sensing





Nature Reviews Drug Discovery 1, 515-528 (July 2002)

doi:10.1038/nrd838

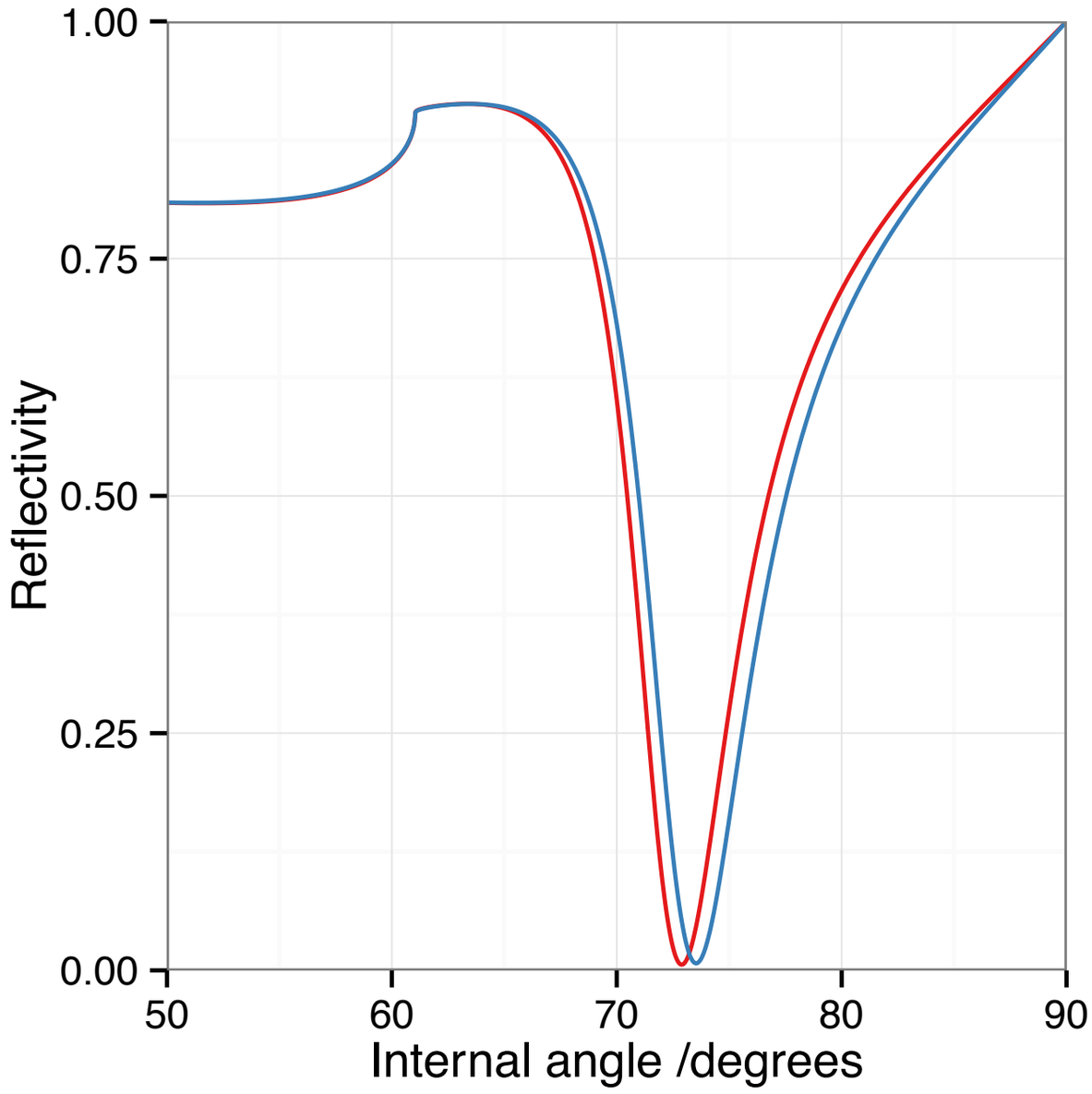
Surface Plasmon Resonance sensing

$$k_{\text{spp}} = k_0 \sqrt{\frac{\varepsilon_d \varepsilon_m}{\varepsilon_d + \varepsilon_m}} = k_0 n \sin(\theta)$$

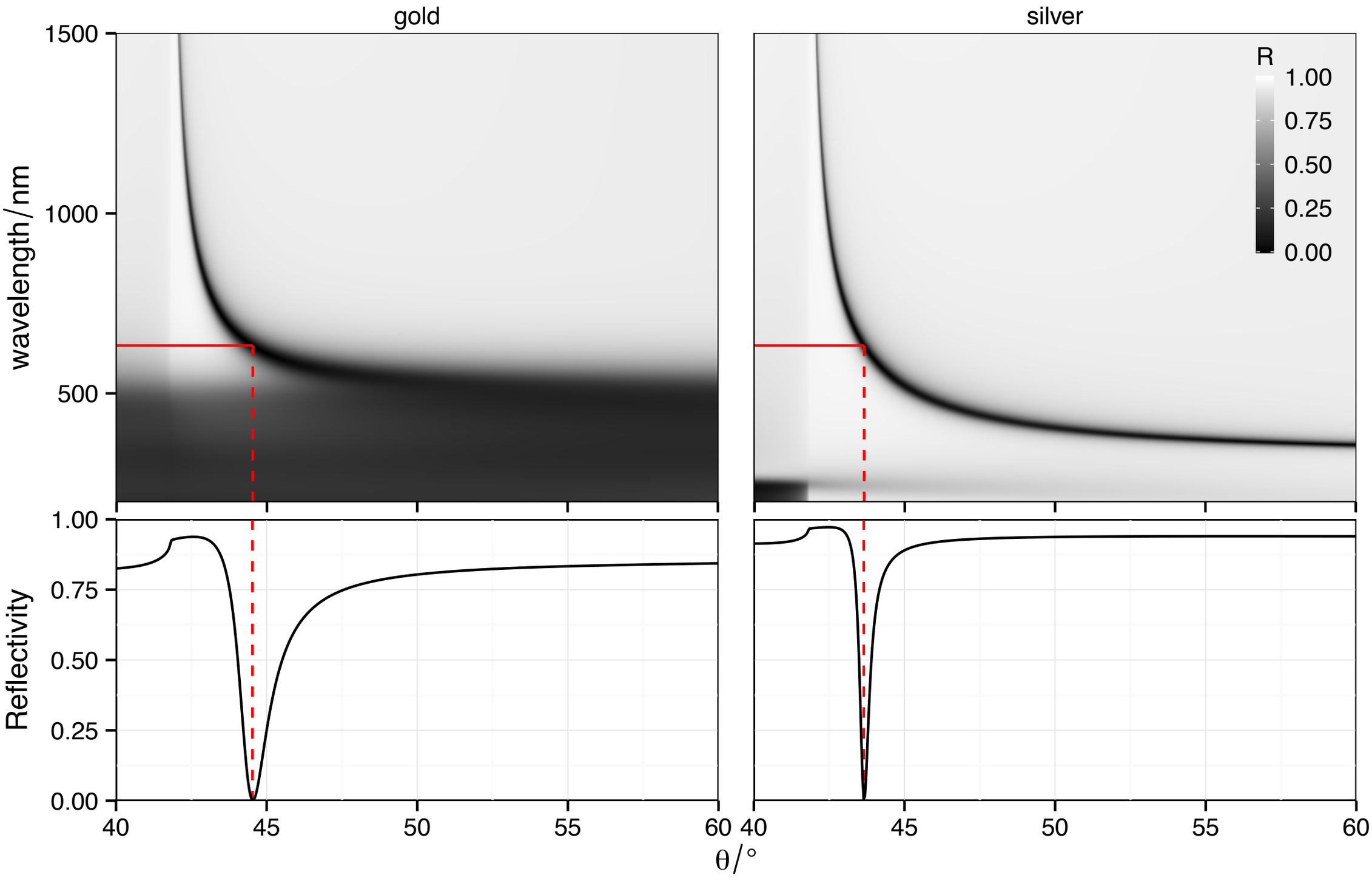
State-of-the-art:

$\sim 10^{-7}\,\text{RIU}^{-1}$

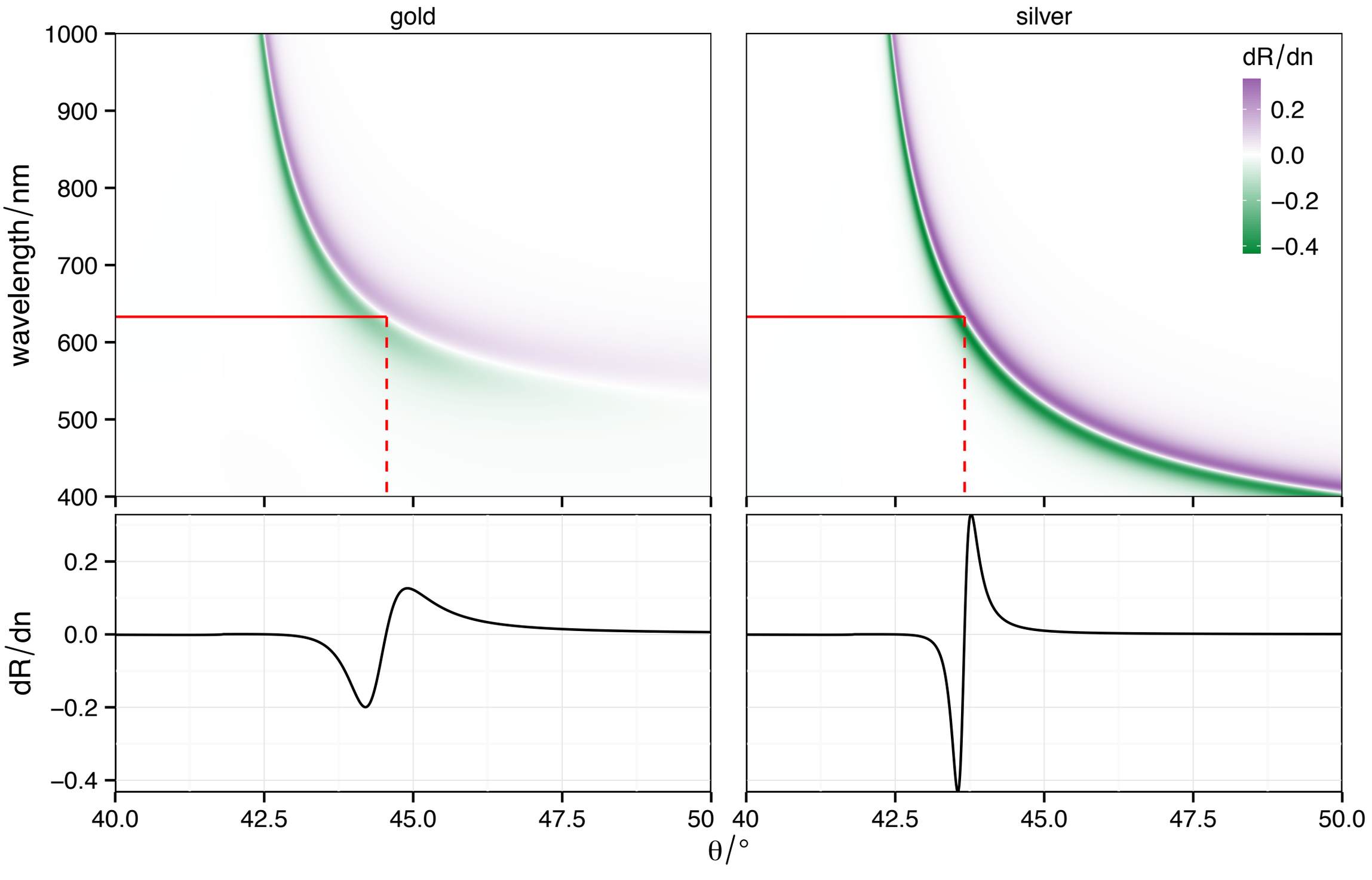
~ 0.1 ng / ml



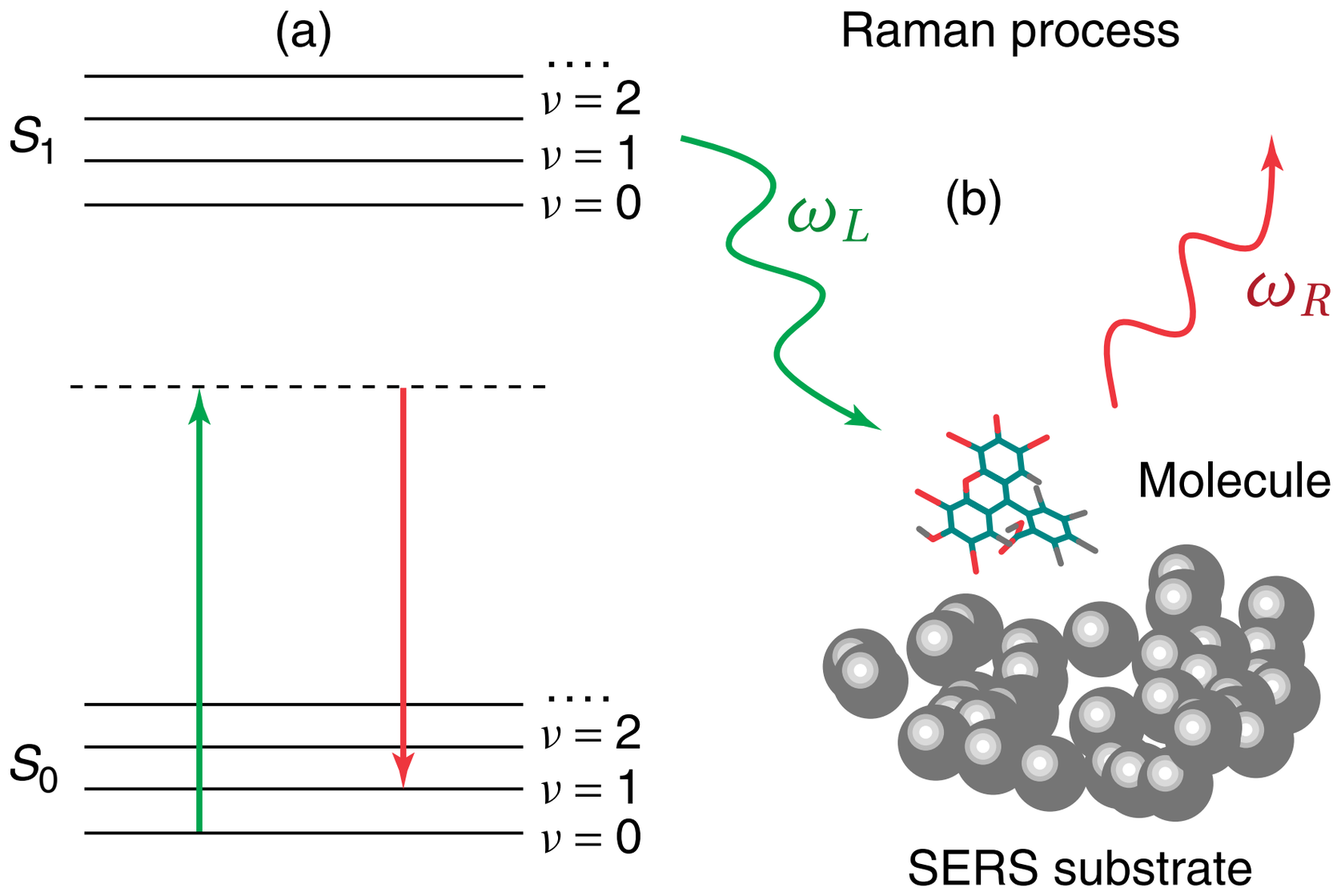
SPP dispersion



Sensitivity to refractive index change



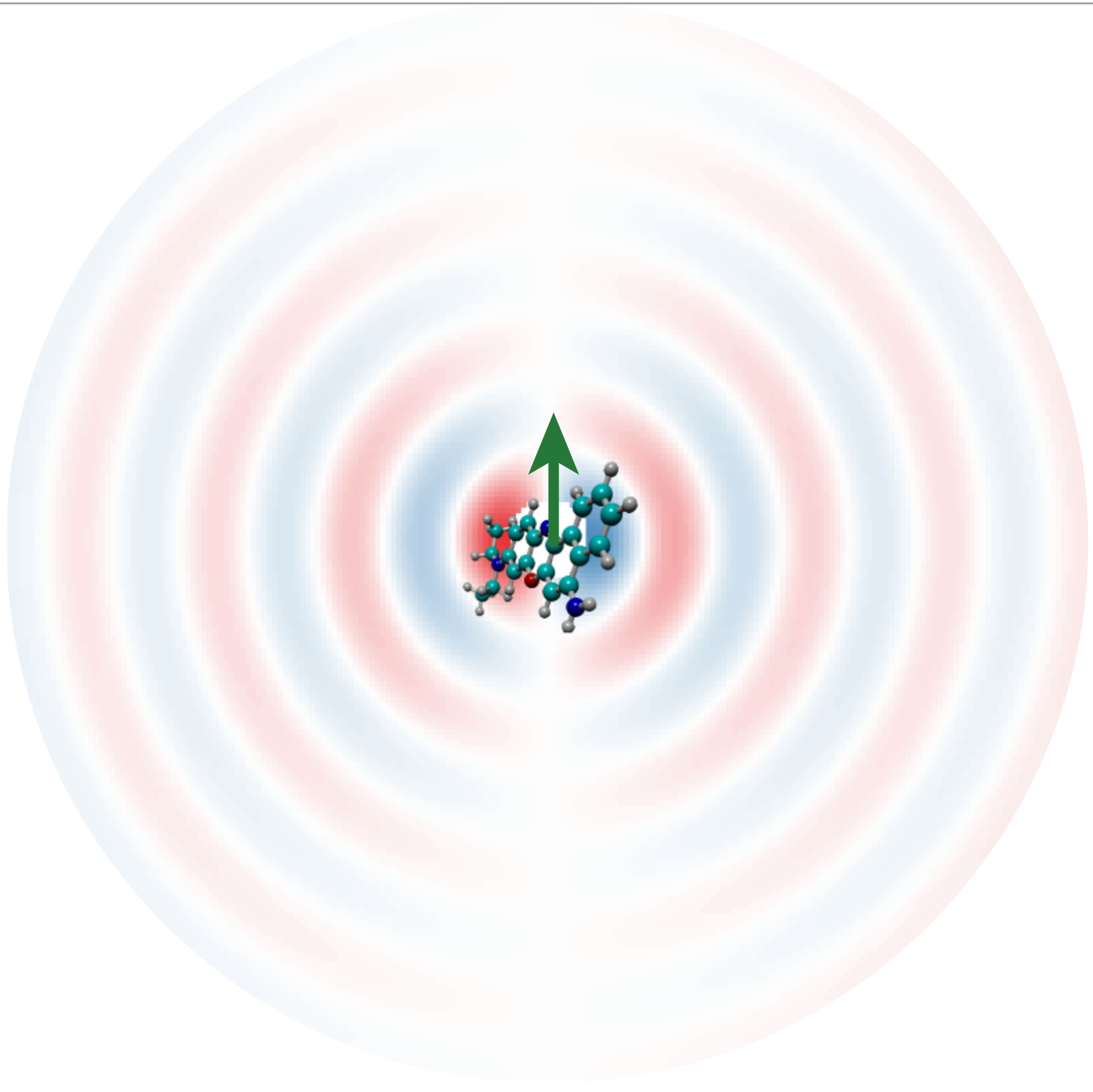
(Surface-Enhanced) Raman Scattering



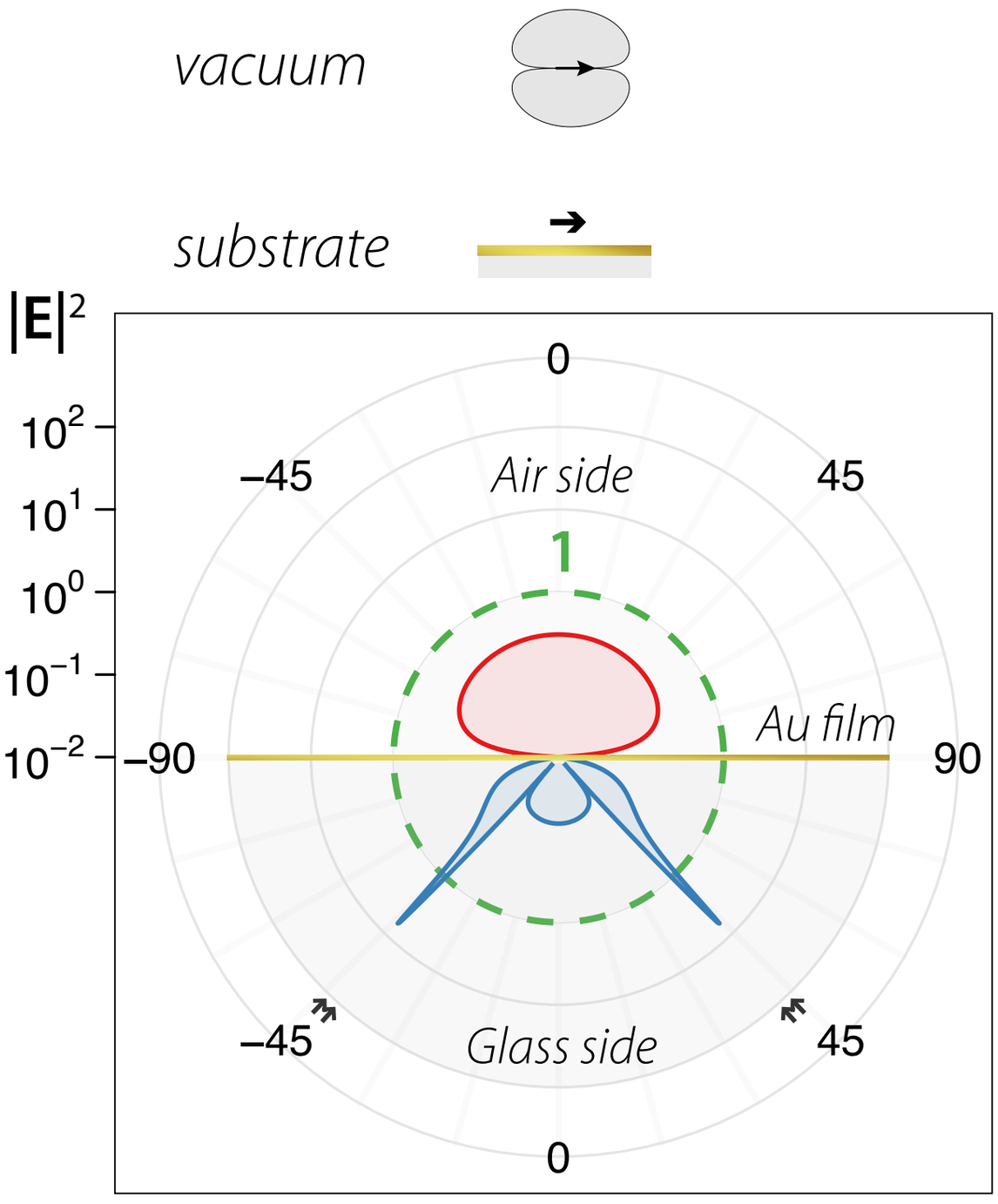
$$\text{Enhancement} \propto |E(\omega_L)|^2 \, |E(\omega_R)|^2$$

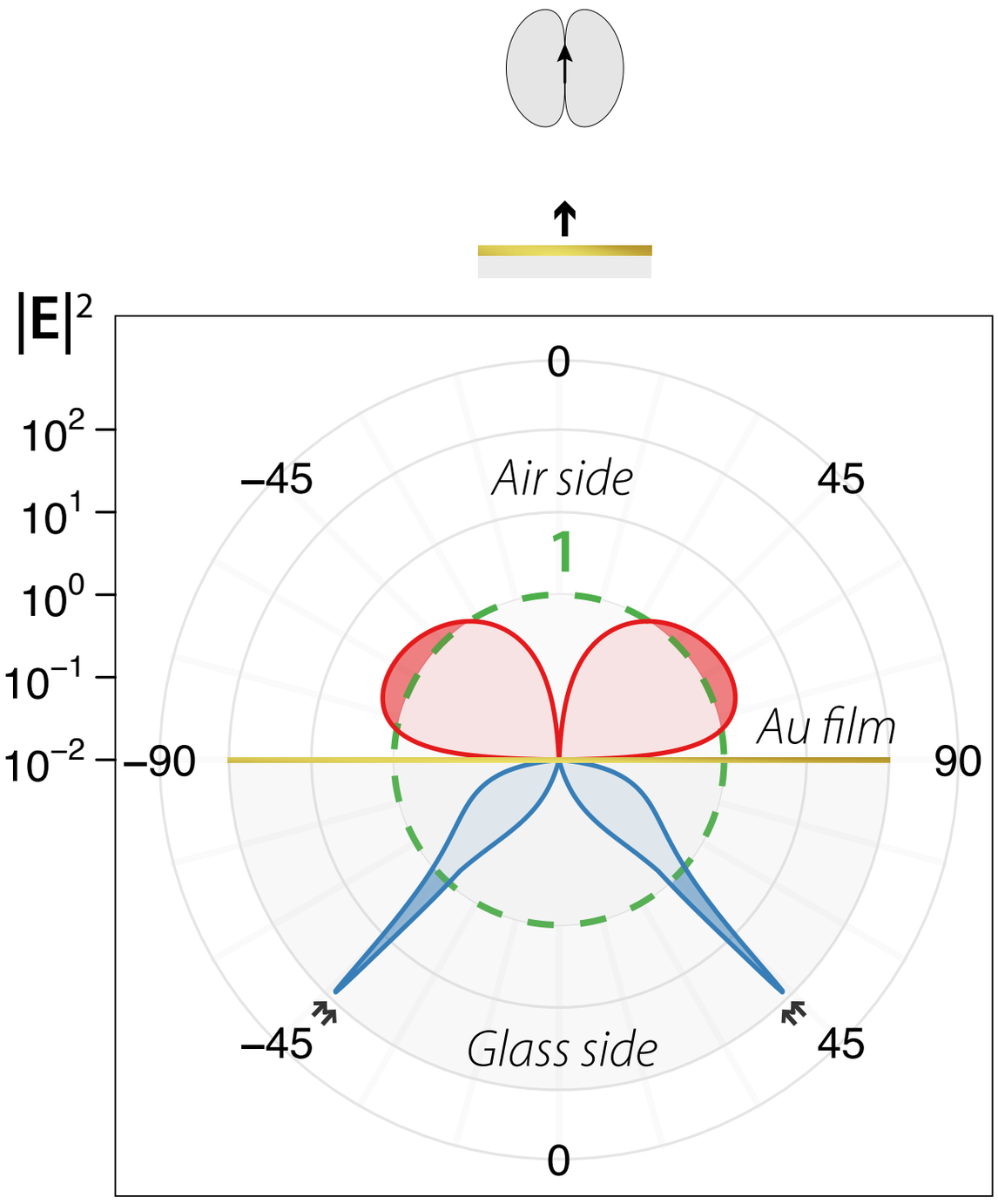
typically ~10^4 – 10^9

Dipole emission

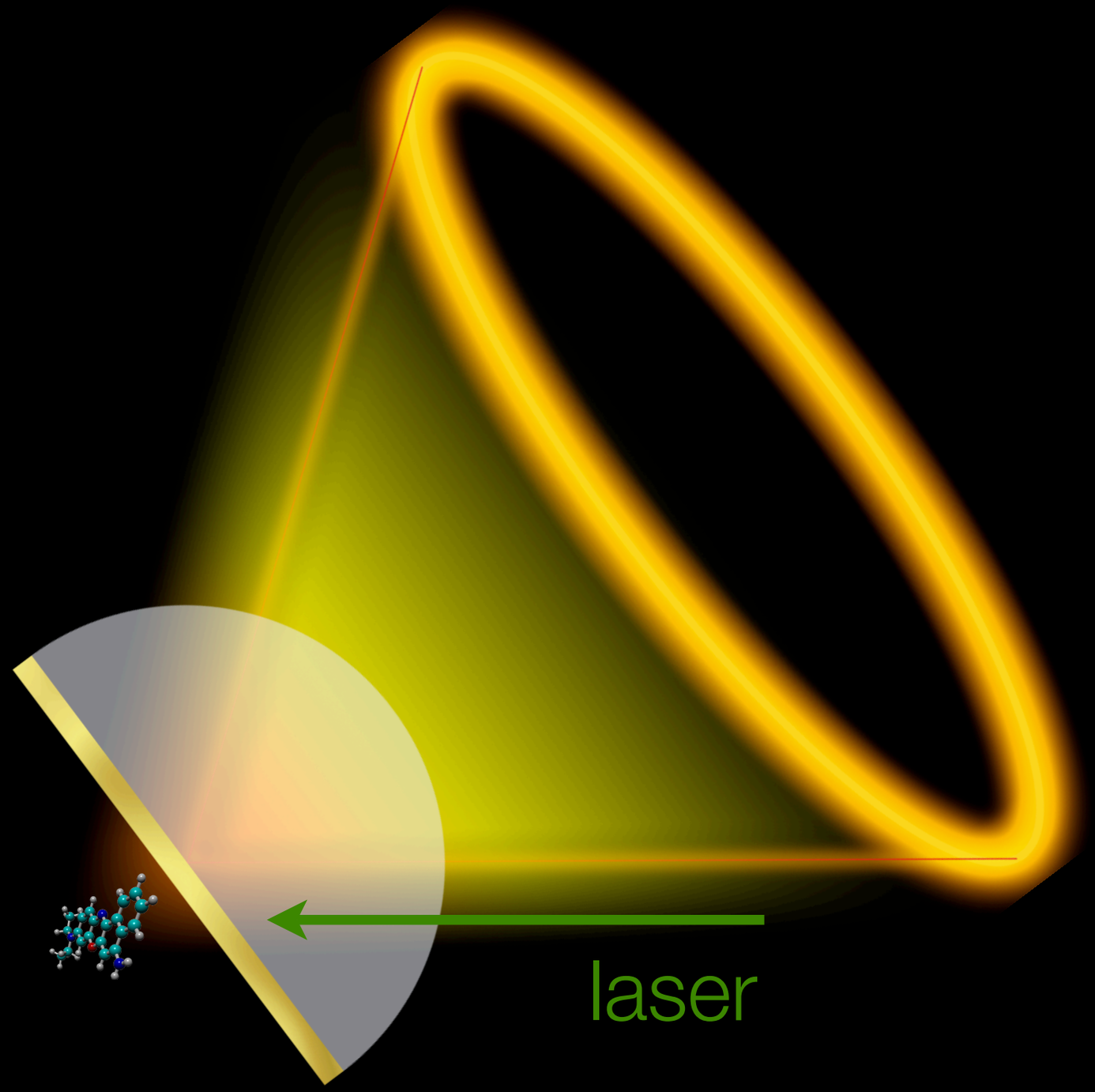


Dipole near a SPR substrate

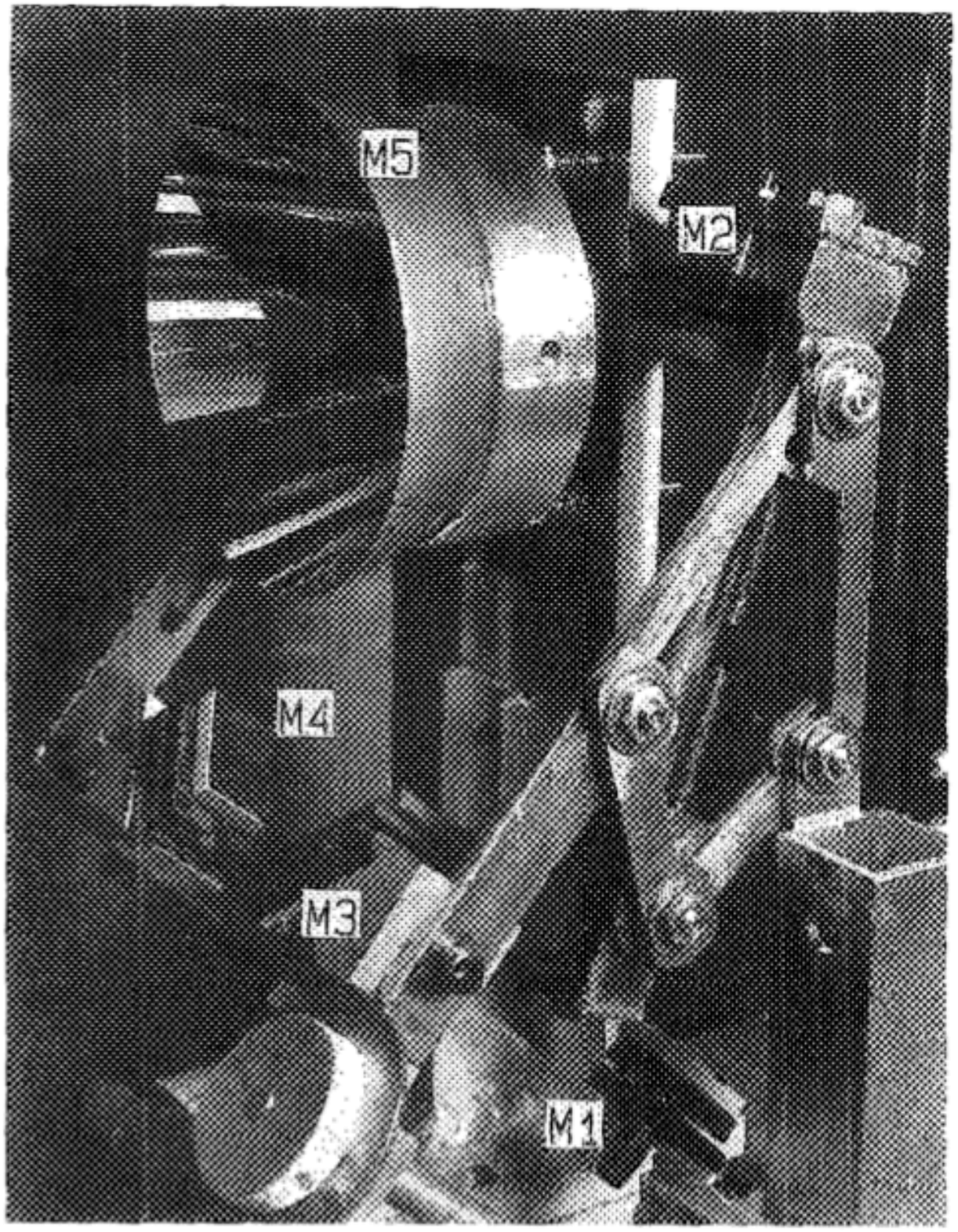


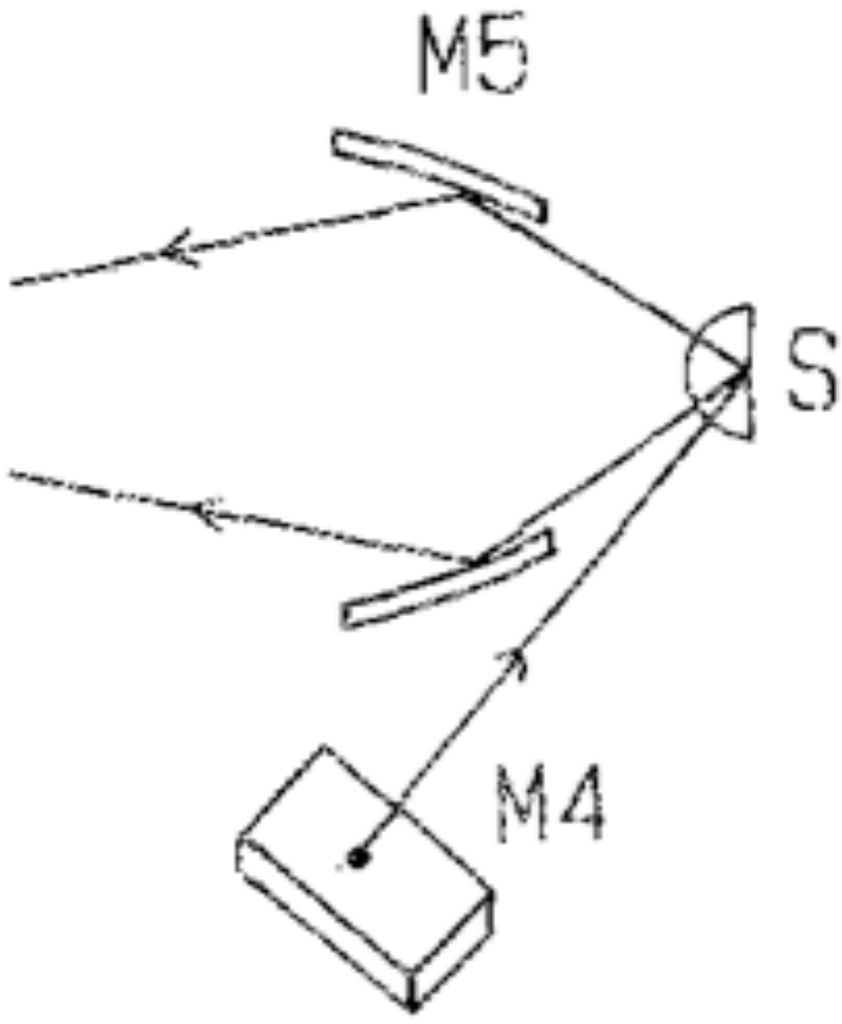


Collecting the cone

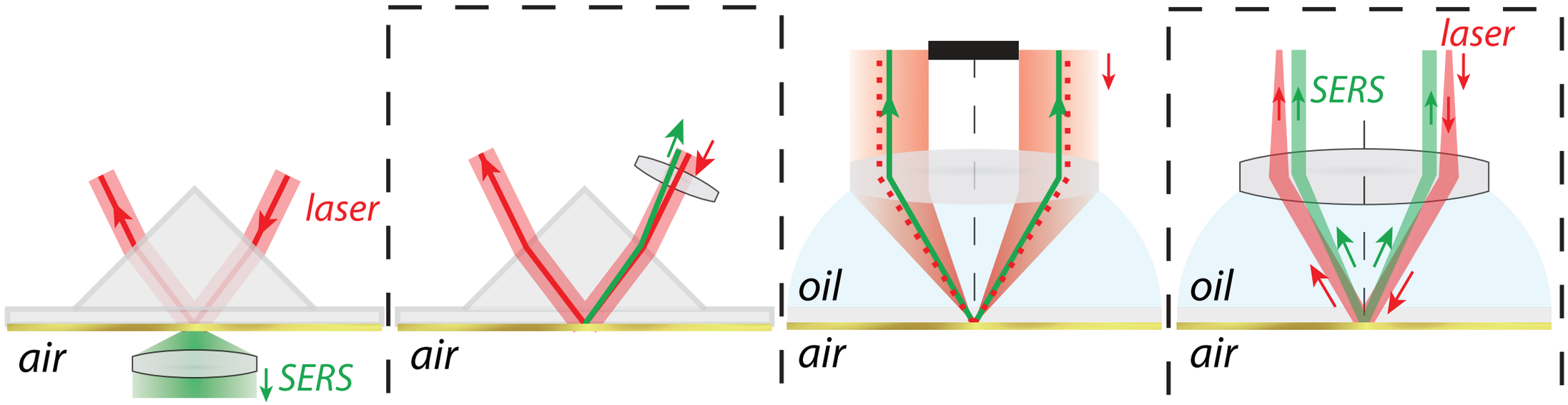


Early attempts (1984)

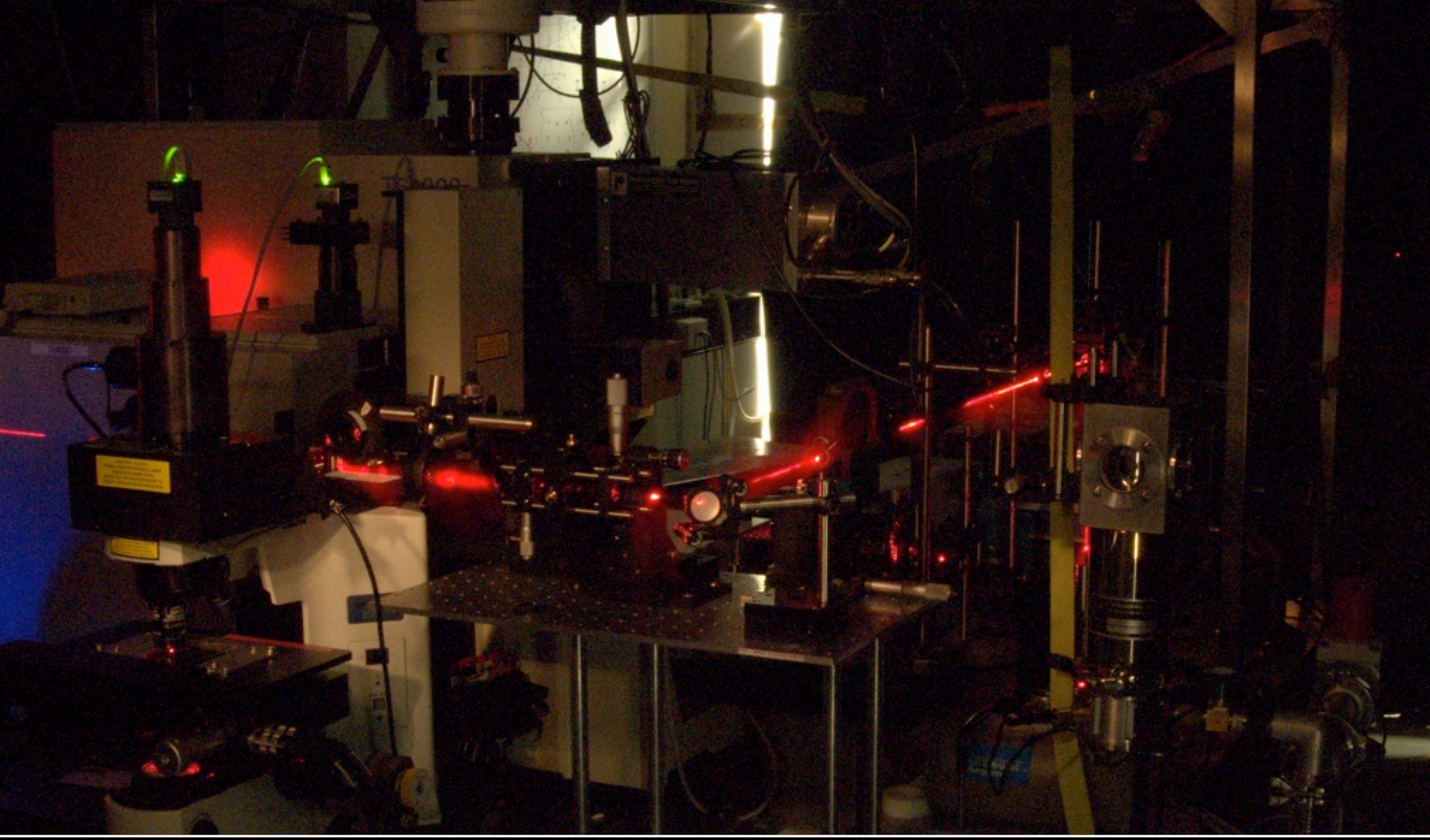




Current strategies

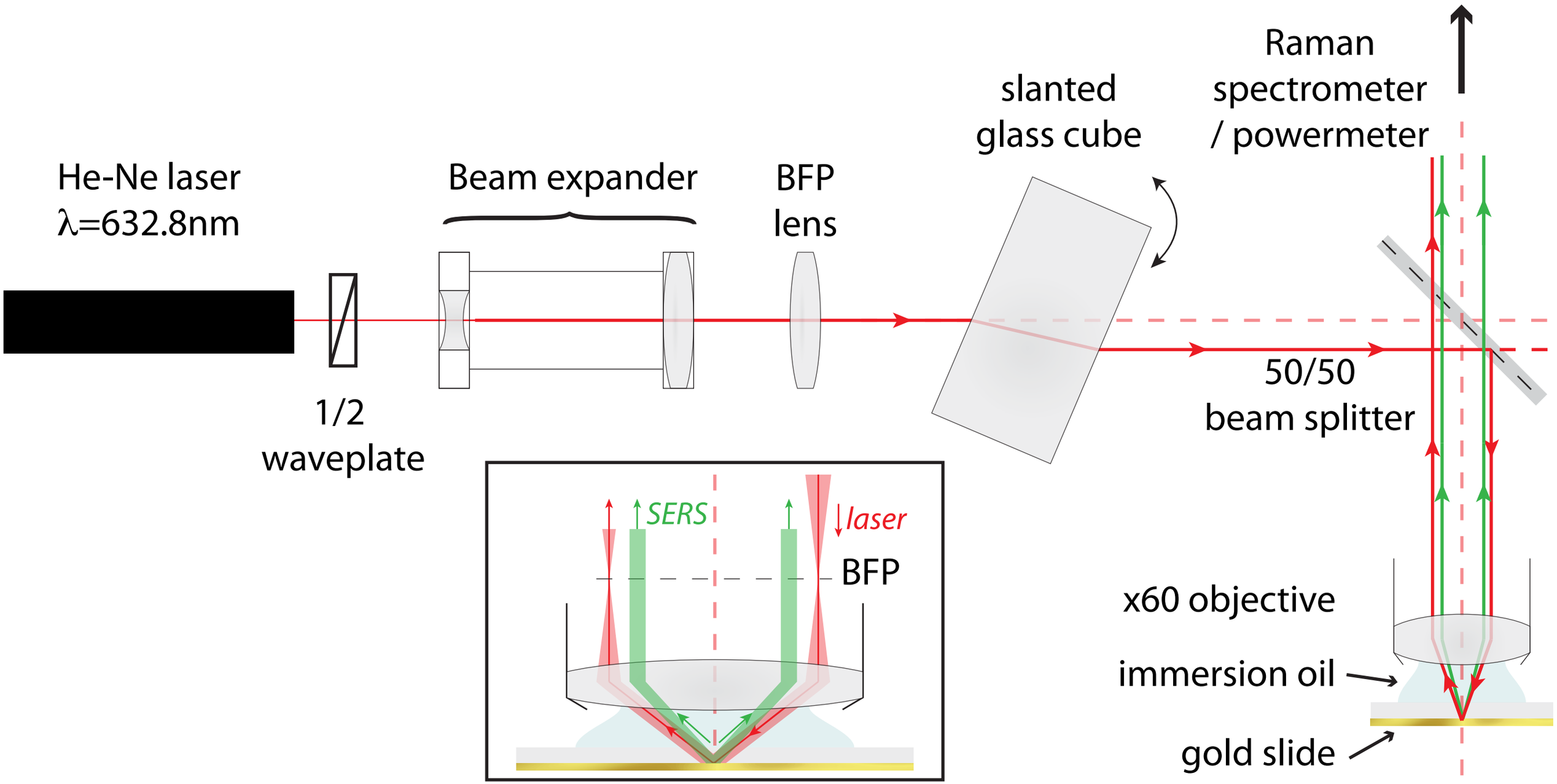


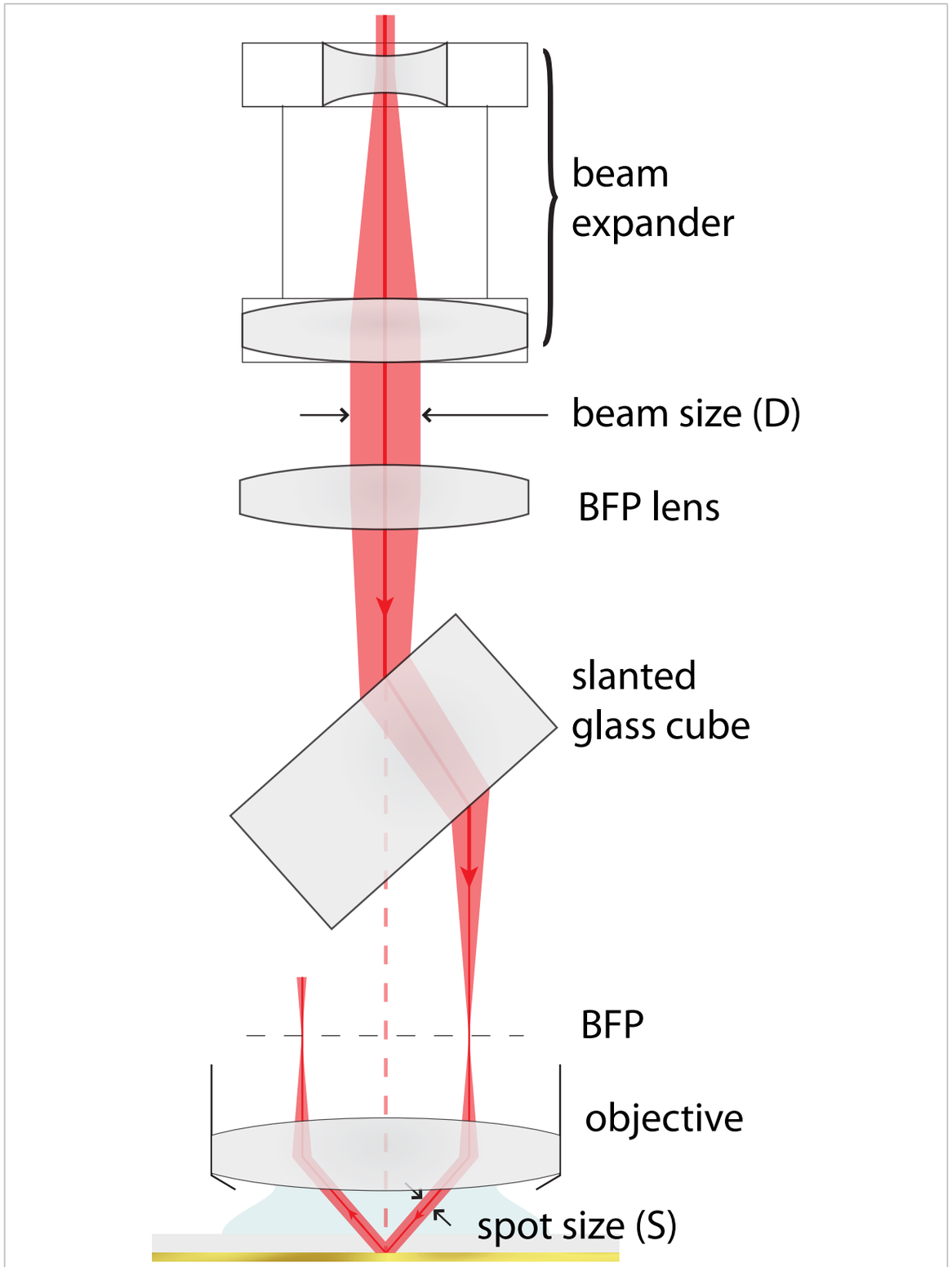
	Y. Liu *et al* *Rev. Sci. Instrum.* **81**, 036105 (2010)	S. A. Meyer *et al* *Anal. Chem.* **83**, 2337 (2011)	F. D. Stefani, et al *Phys. Rev. Lett.* **94**, 023005 (2005)	S. A. Meyer *et al* *J. Phys. Chem. A* **116**, 1000–1007 (2012)
SPR	✔	✔	✘	✔
coupling	✔	✔	✘	✔
microscopy	≈	✘	✔	✔
SERS signal	≈	≈	≈	✔

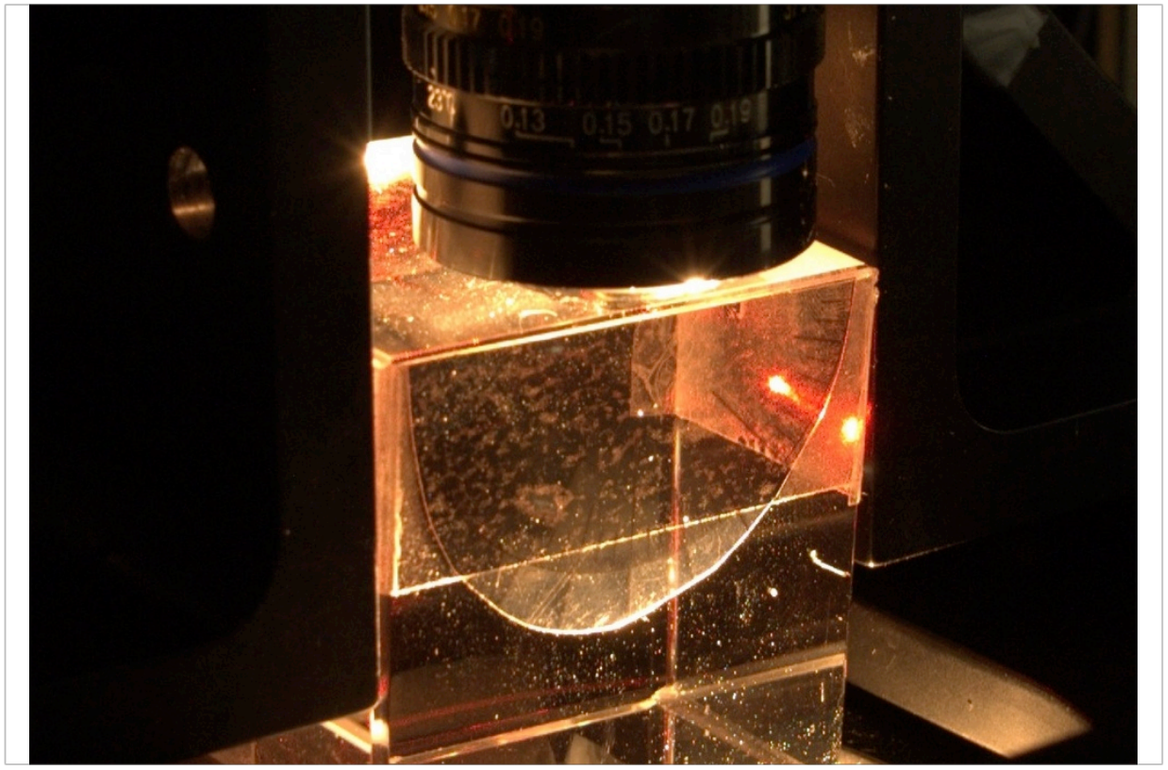


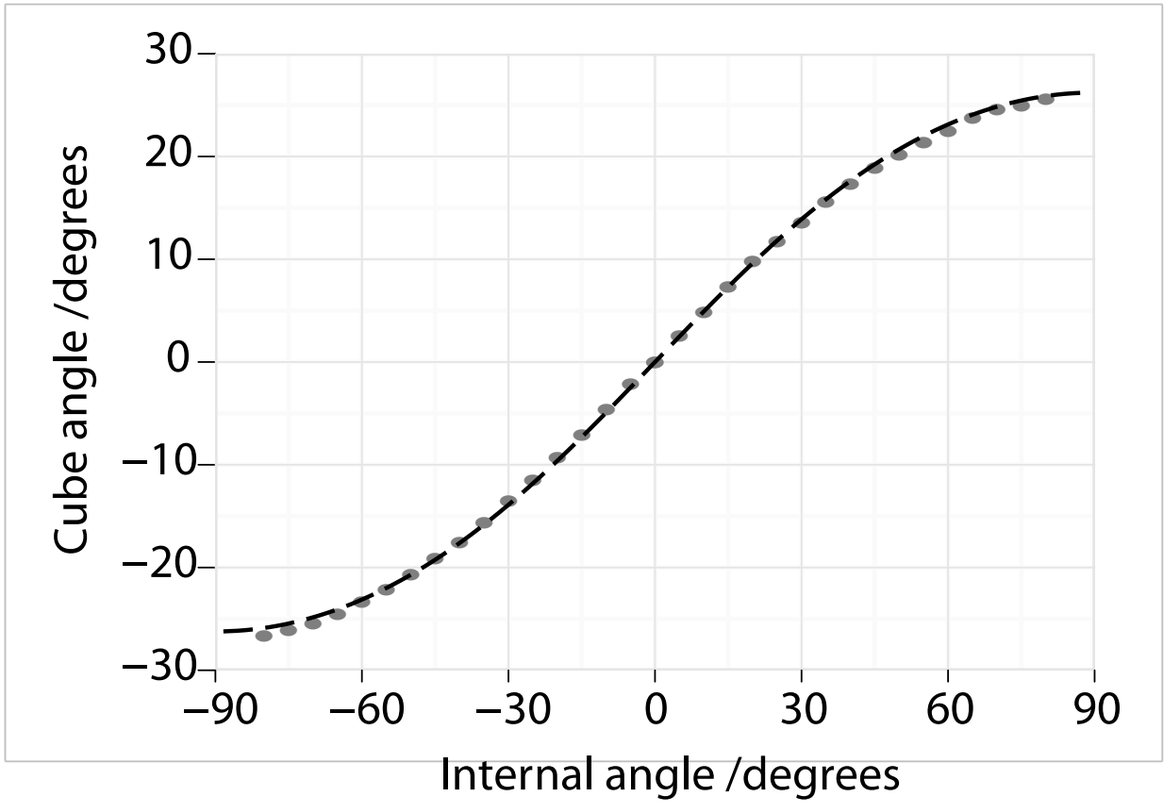
Experimental setup

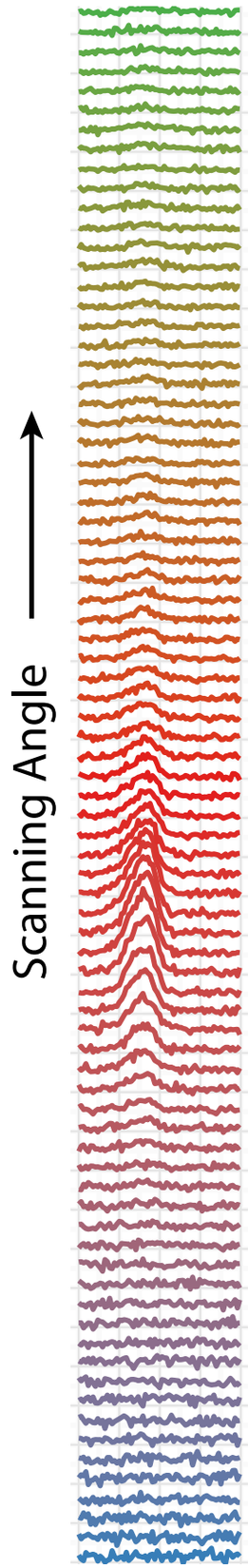
Setup

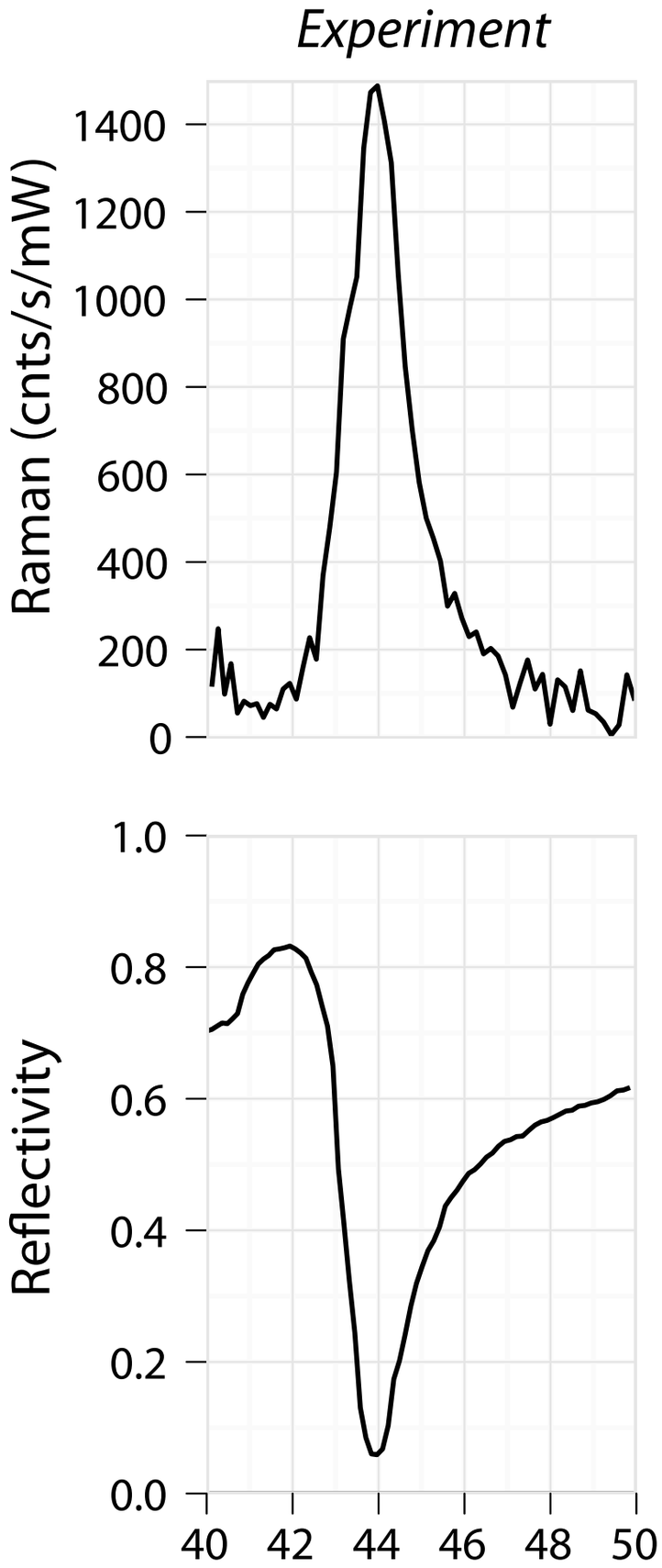

He-Ne laser
λ=632.8nm
1/2
waveplate
Beam expander
BFP
lens
slanted
glass cube
Raman
spectrometer
/ powermeter
50/50
beam splitter
x60 objective
immersion oil
gold slide
SERS
laser
BFP

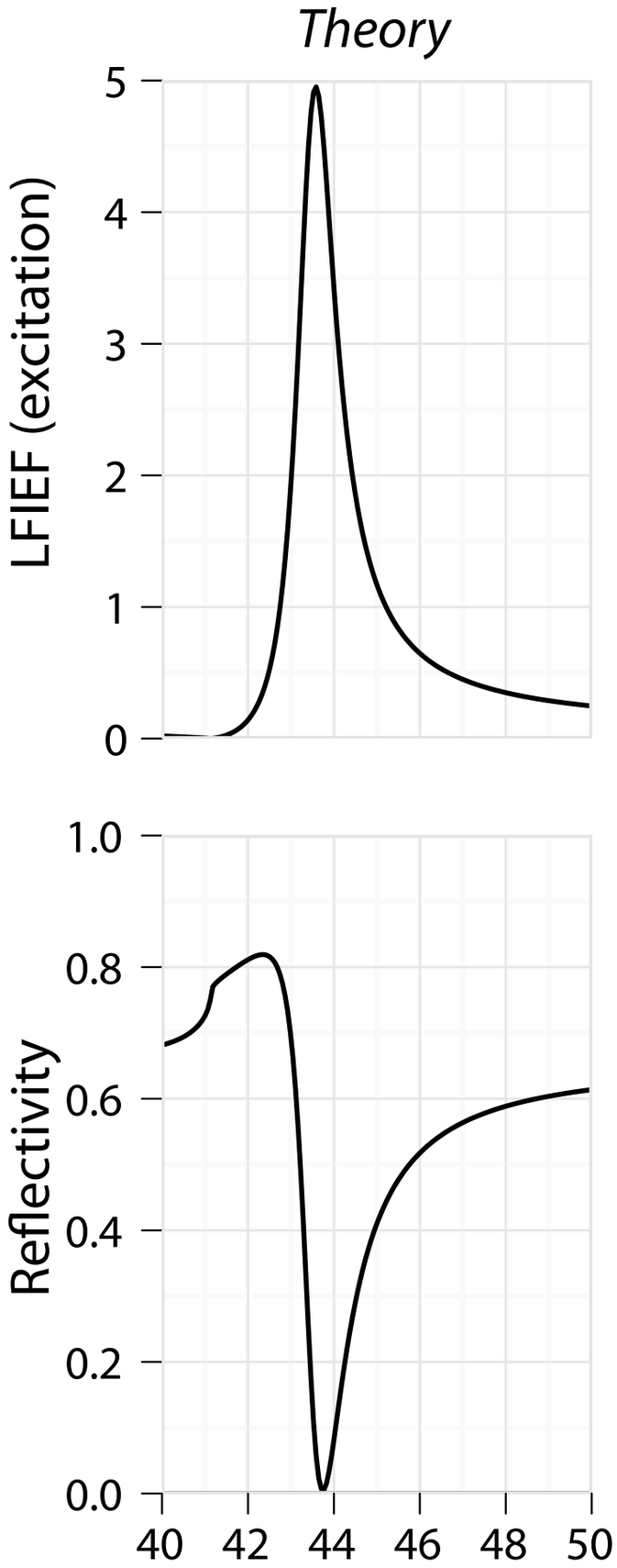

beam
expander
beam size (D)
BFP lens
slanted
glass cube
BFP
objective
spot size (S)



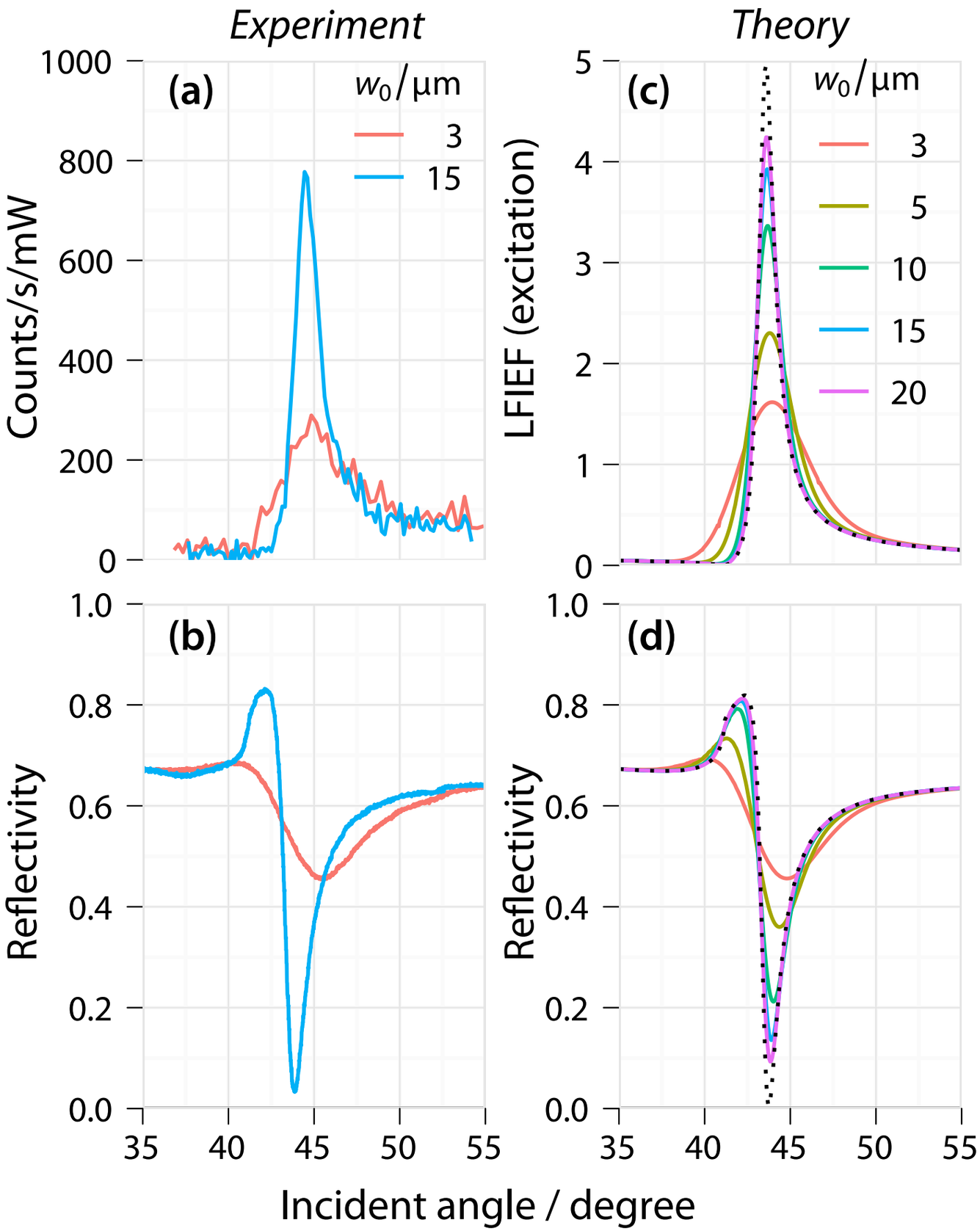

30
20
10
0
−10
−20
−30
Cube angle /degrees
−90
−60
−30
0
30
60
90
Internal angle /degrees


Scanning Angle
Raman shift
(595 cm⁻¹ Nile Blue)


Experiment
Raman (cnts/s/mW)
1400
1200
1000
800
600
400
200
0
Reflectivity
1.0
0.8
0.6
0.4
0.2
0.0
40
42
44
46
48
50
Incident angle / degree


Theory
LFIEF (excitation)
5
4
3
2
1
0
Reflectivity
1.0
0.8
0.6
0.4
0.2
0.0
40
42
44
46
48
50

Beam divergence, *étendue*



¿questions?