

Measuring Solar Temporal Photon Bunching

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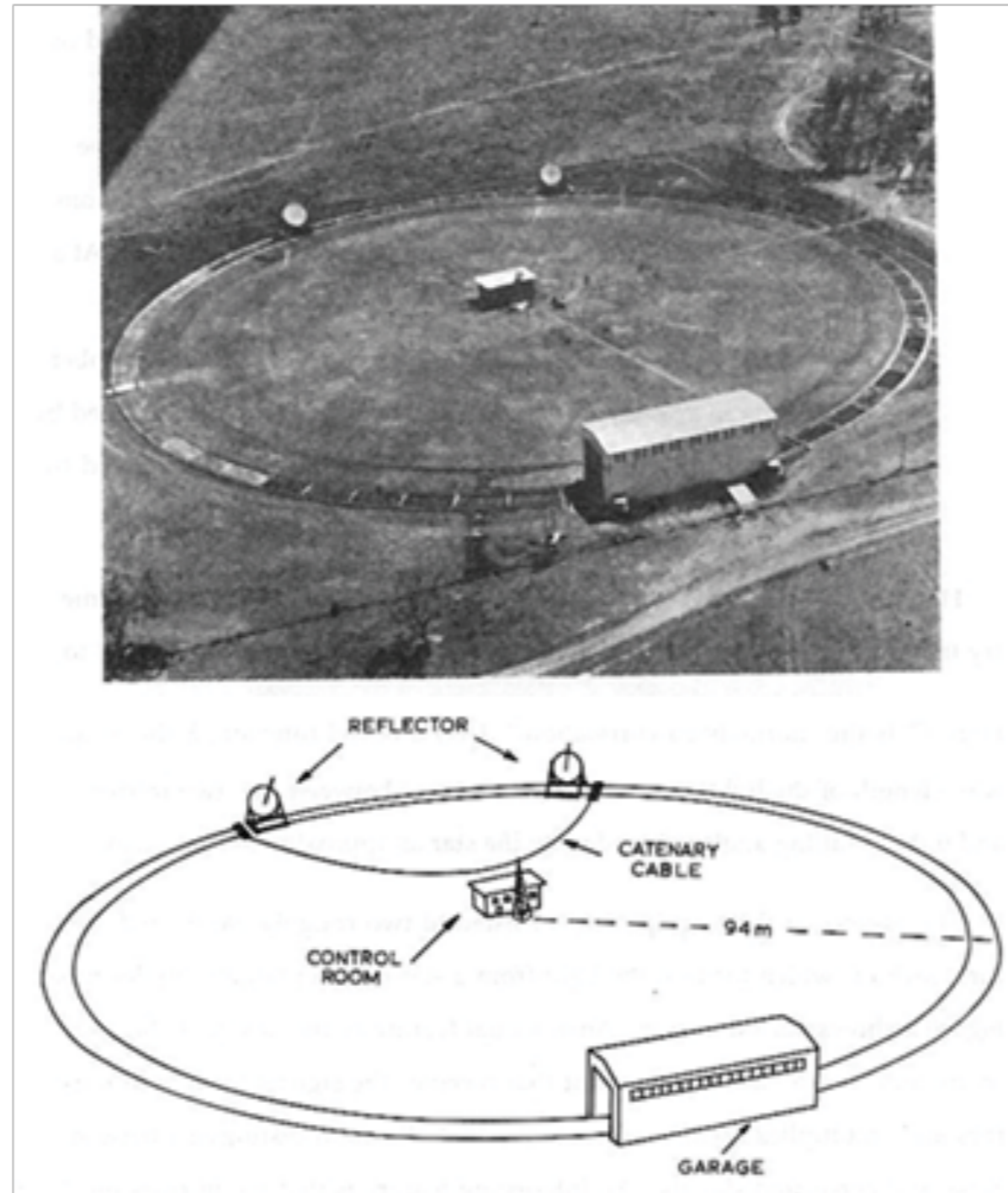


Narrabri Stellar Intensity Interferometer

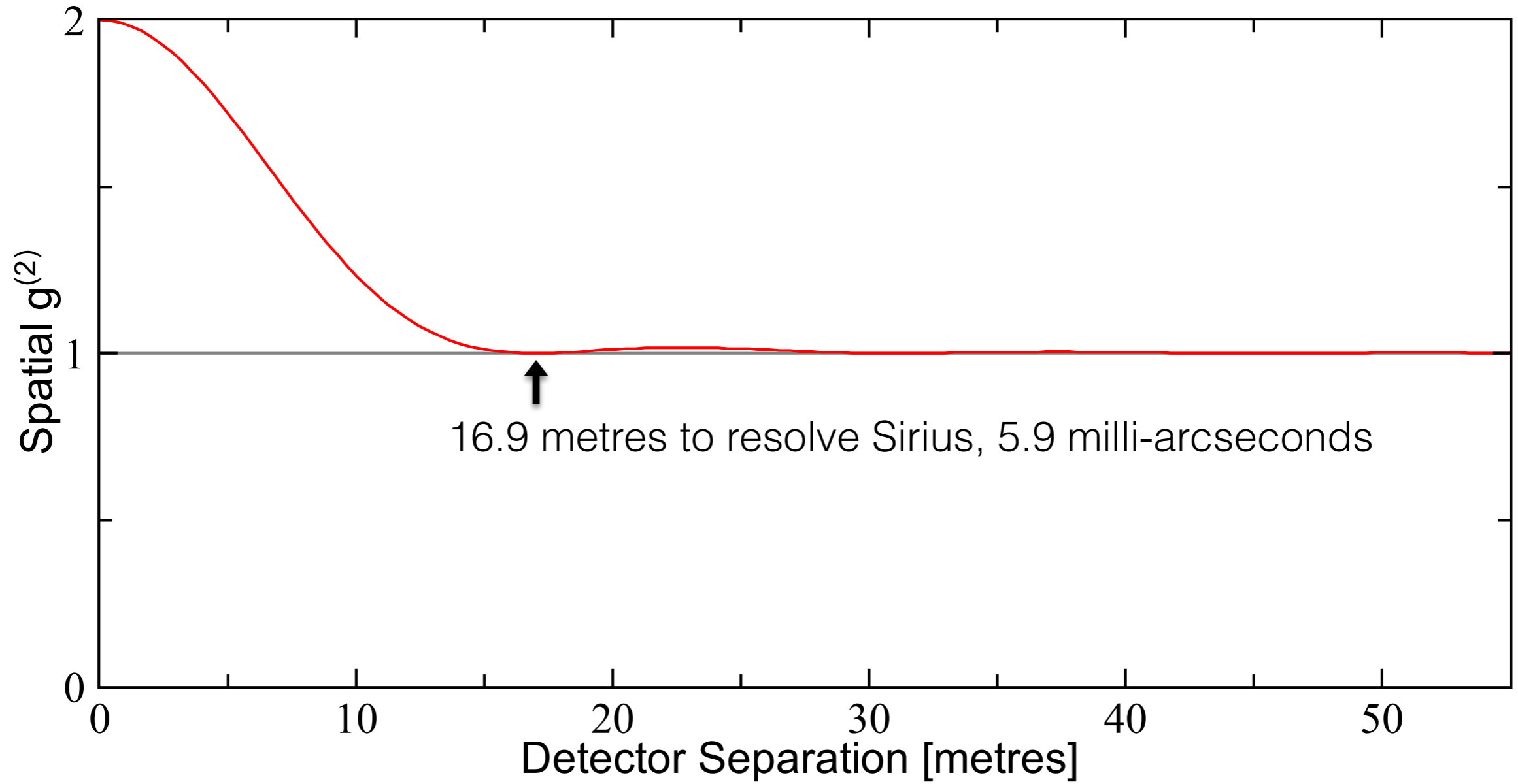


Source: Sydney University Stellar Interferometer group.

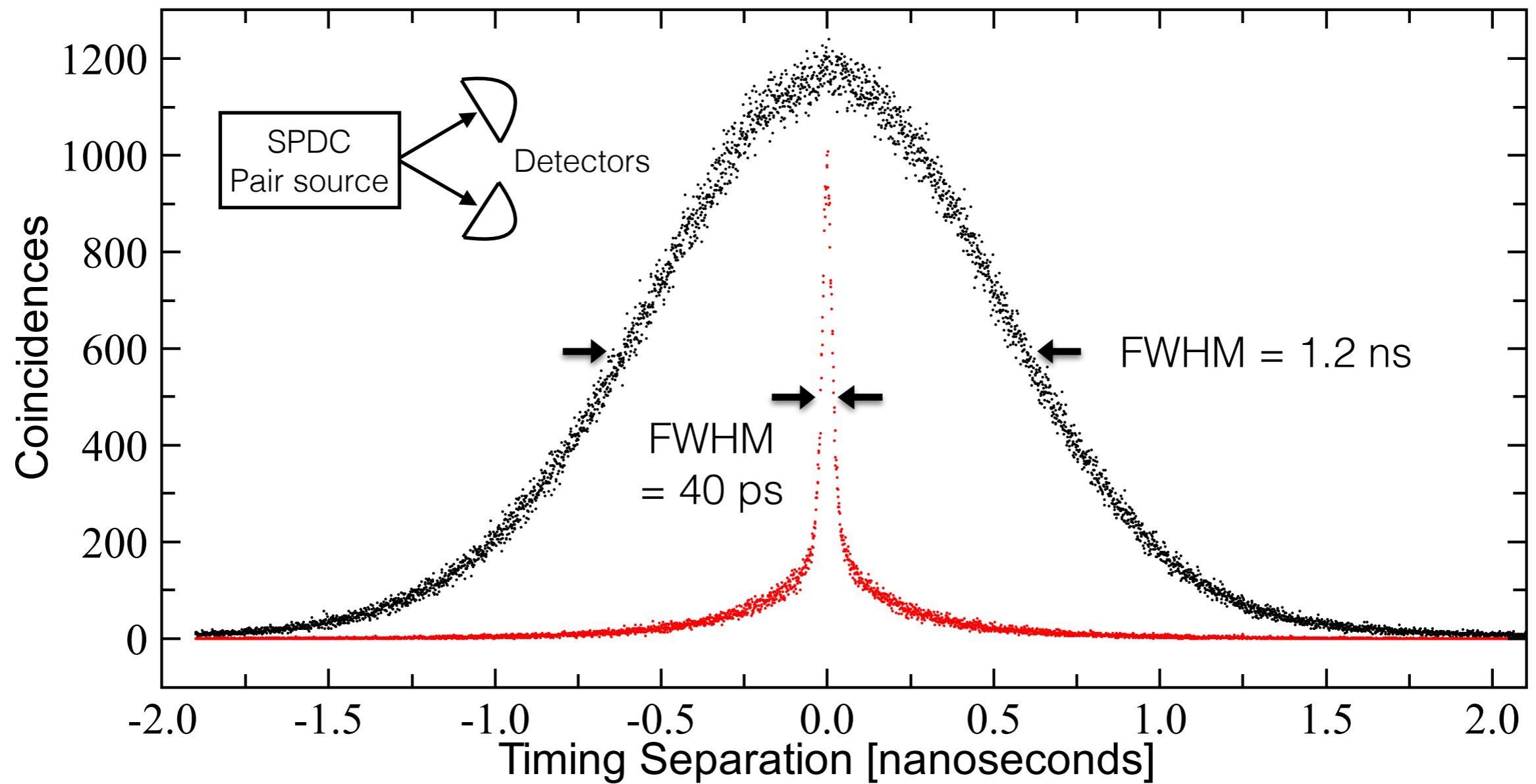
Spatial $g^{(2)}$: Layout



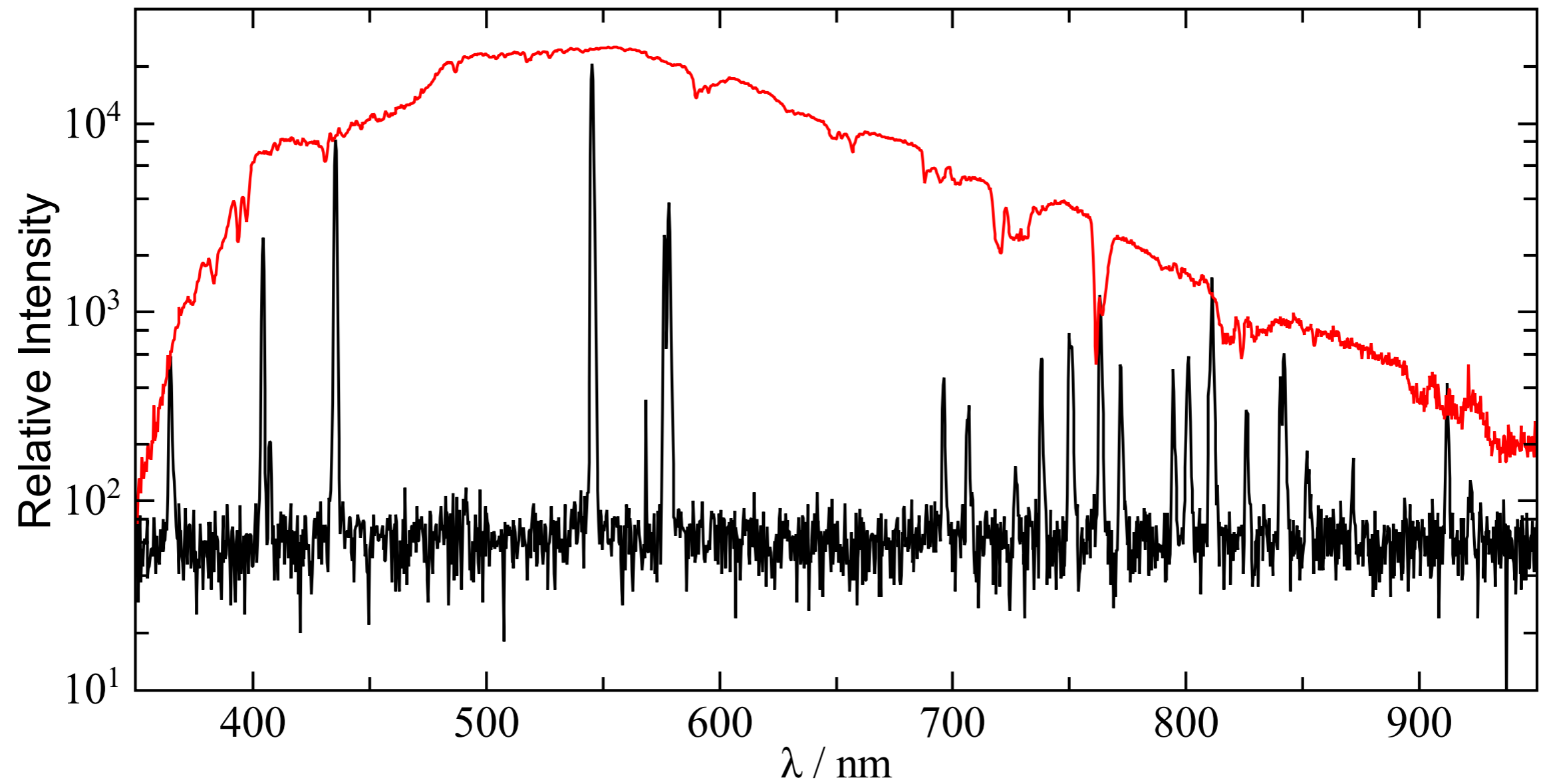
Spatial $g^{(2)}(b)$



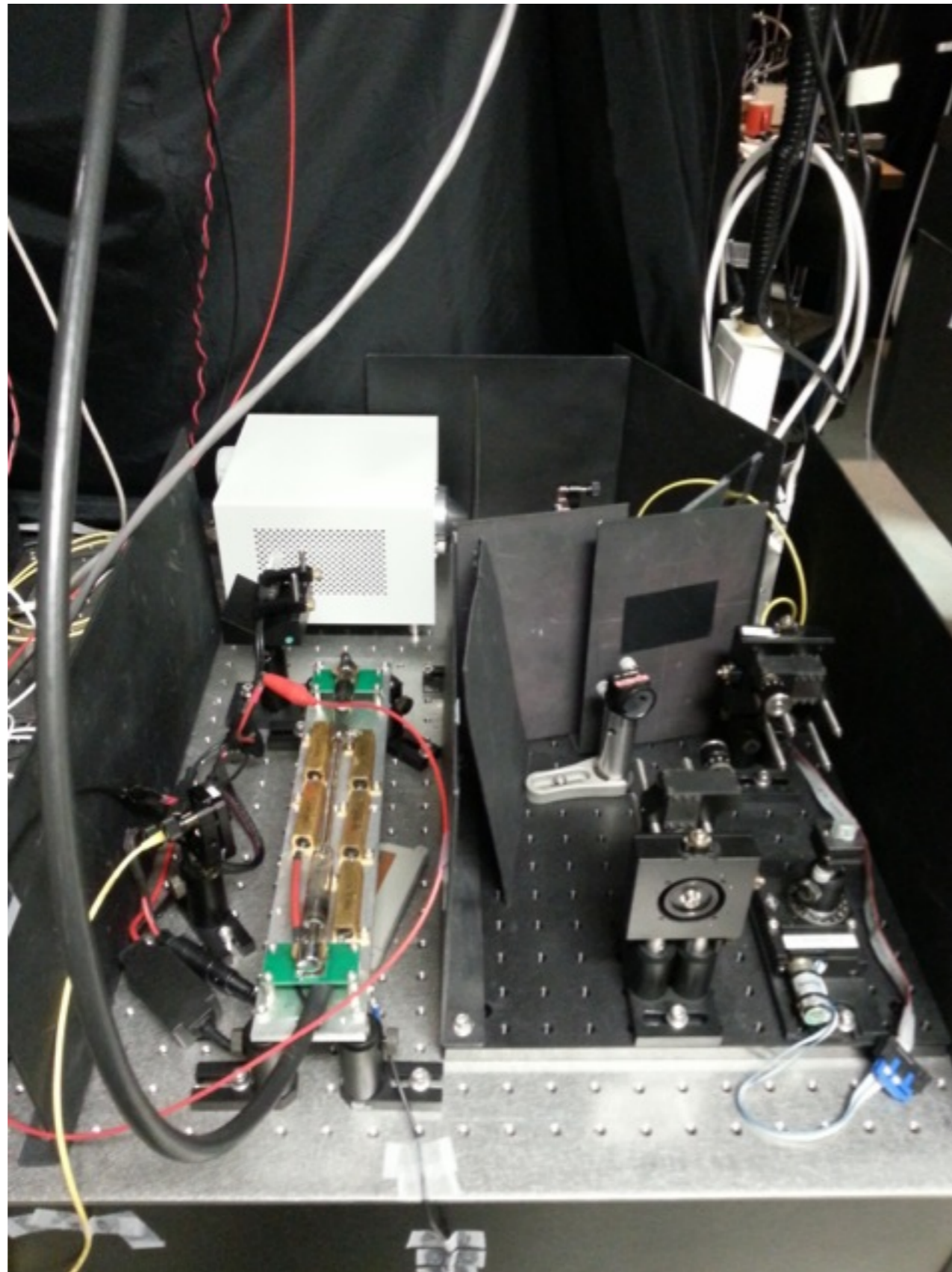
Photon Detector Resolution



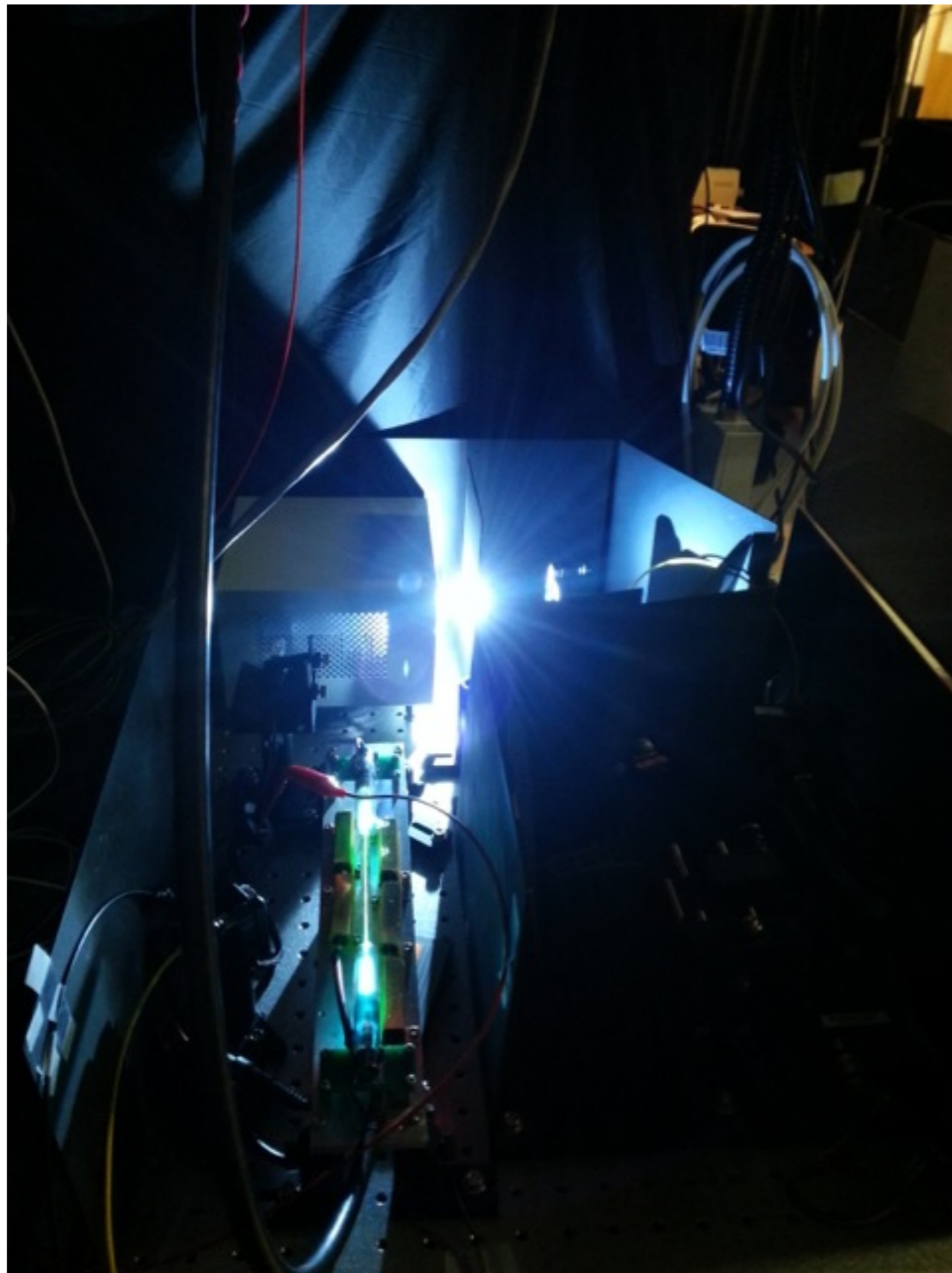
Spectrum: Mercury Lamp, The Sun



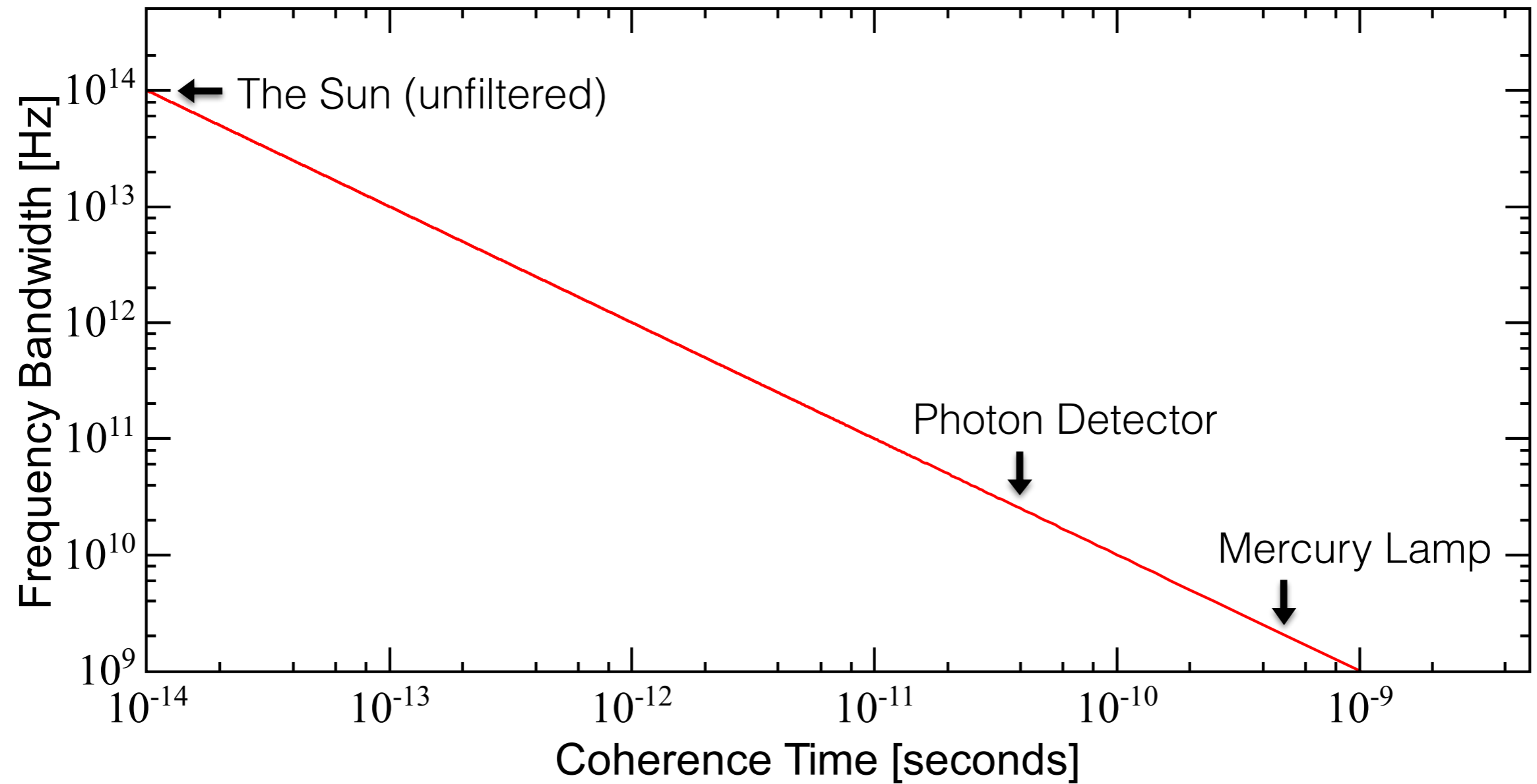
Temporal $g^{(2)}$: Mercury Lamp



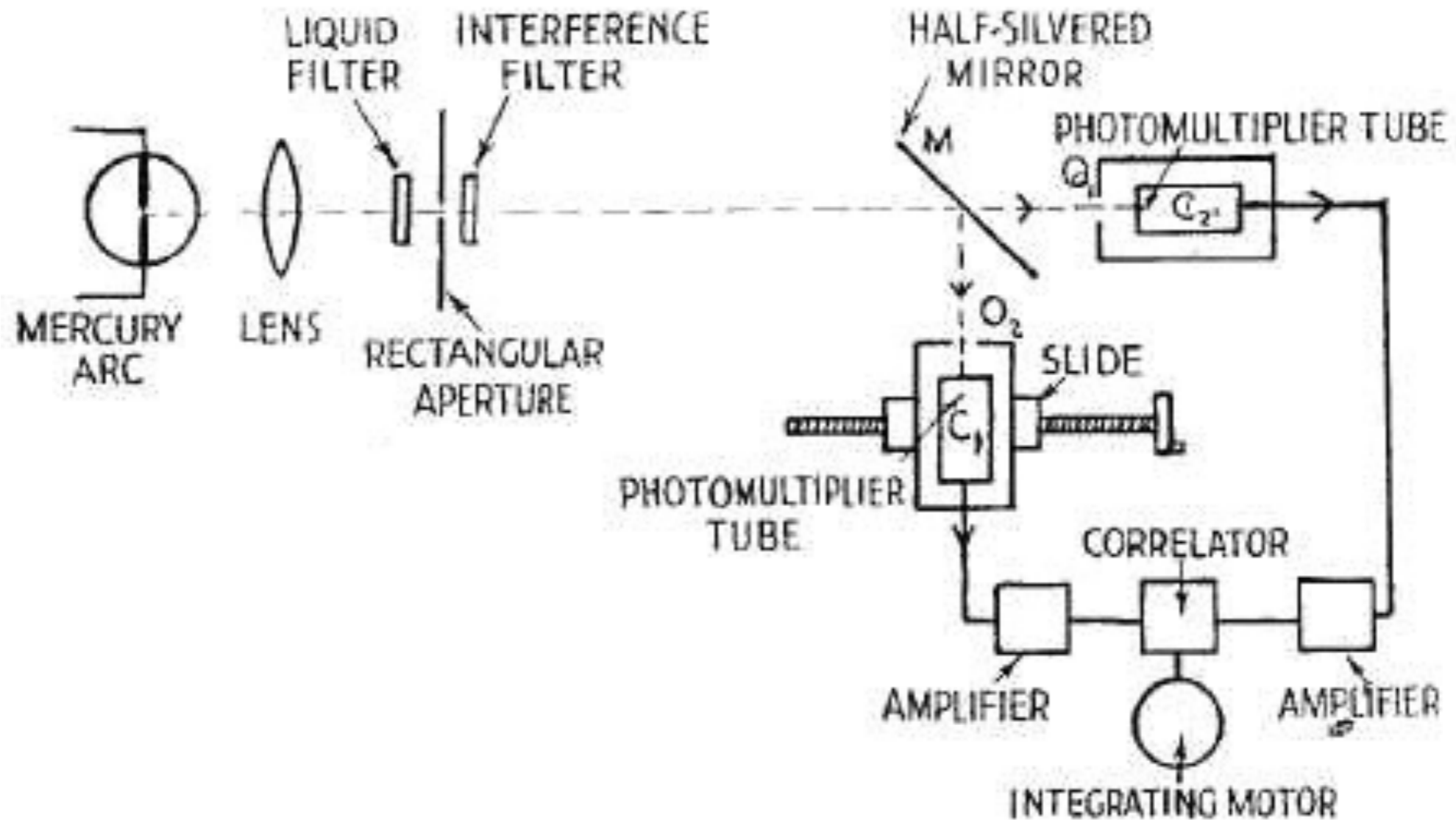
Temporal $g^{(2)}$: Arc Lamp



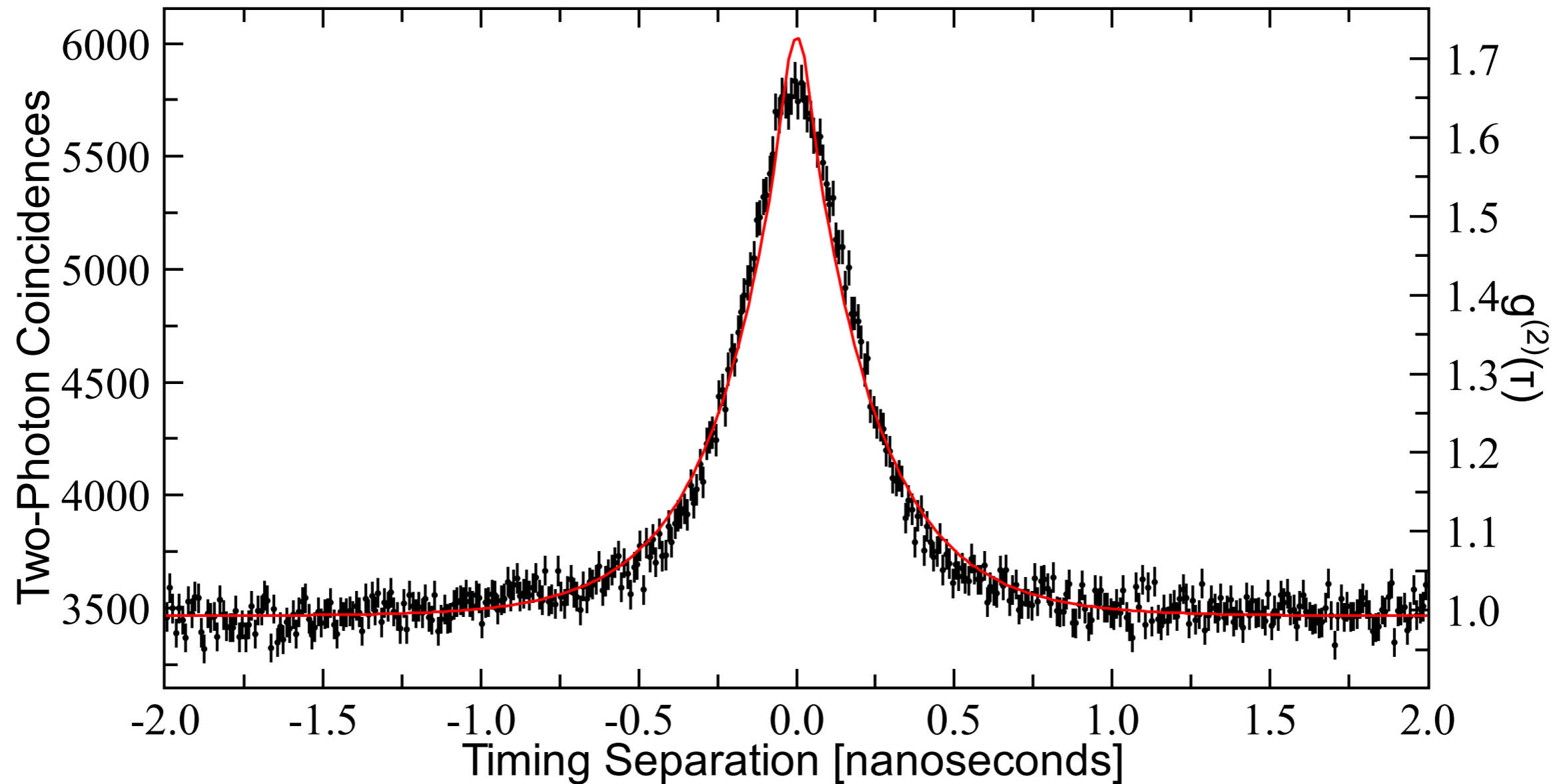
Coherence Time vs Detector Bandwidth



Temporal $g^{(2)}$: Setup



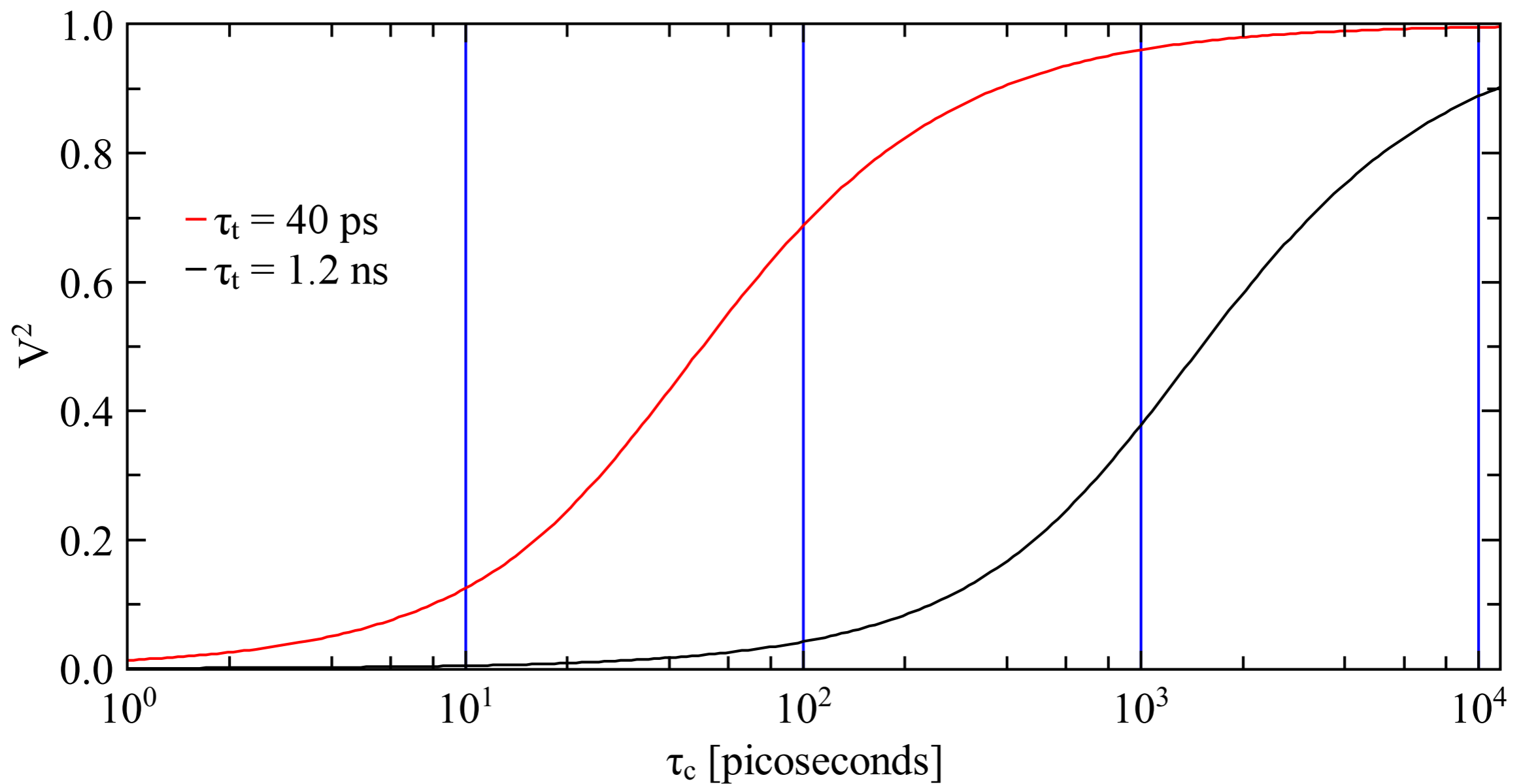
Temporal $g^{(2)}(\tau)$ of Mercury Lamp



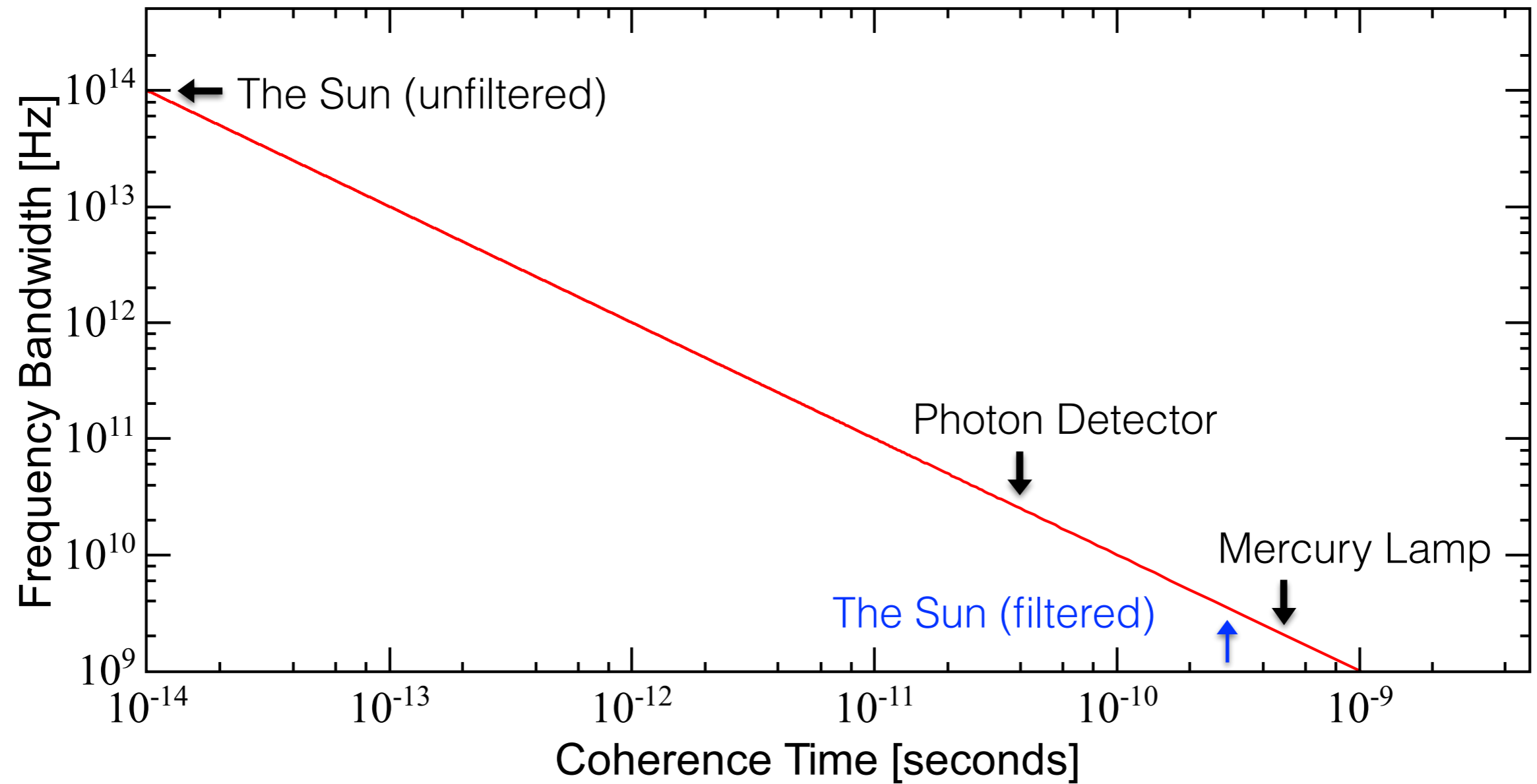
Time-averaged maximal $V^2(\tau \approx 0, \tau_t, \tau_c)$

$$\begin{aligned} V^2(\tau \approx 0, \tau_t, \tau_c) &= \frac{1}{\tau_t} \int_{\tau=0}^{\tau=\tau_t} e^{-2\tau/\tau_c} d\tau \\ &= \frac{\tau_c}{2\tau_t} \left(1 - e^{-2\tau_t/\tau_c} \right) \end{aligned}$$

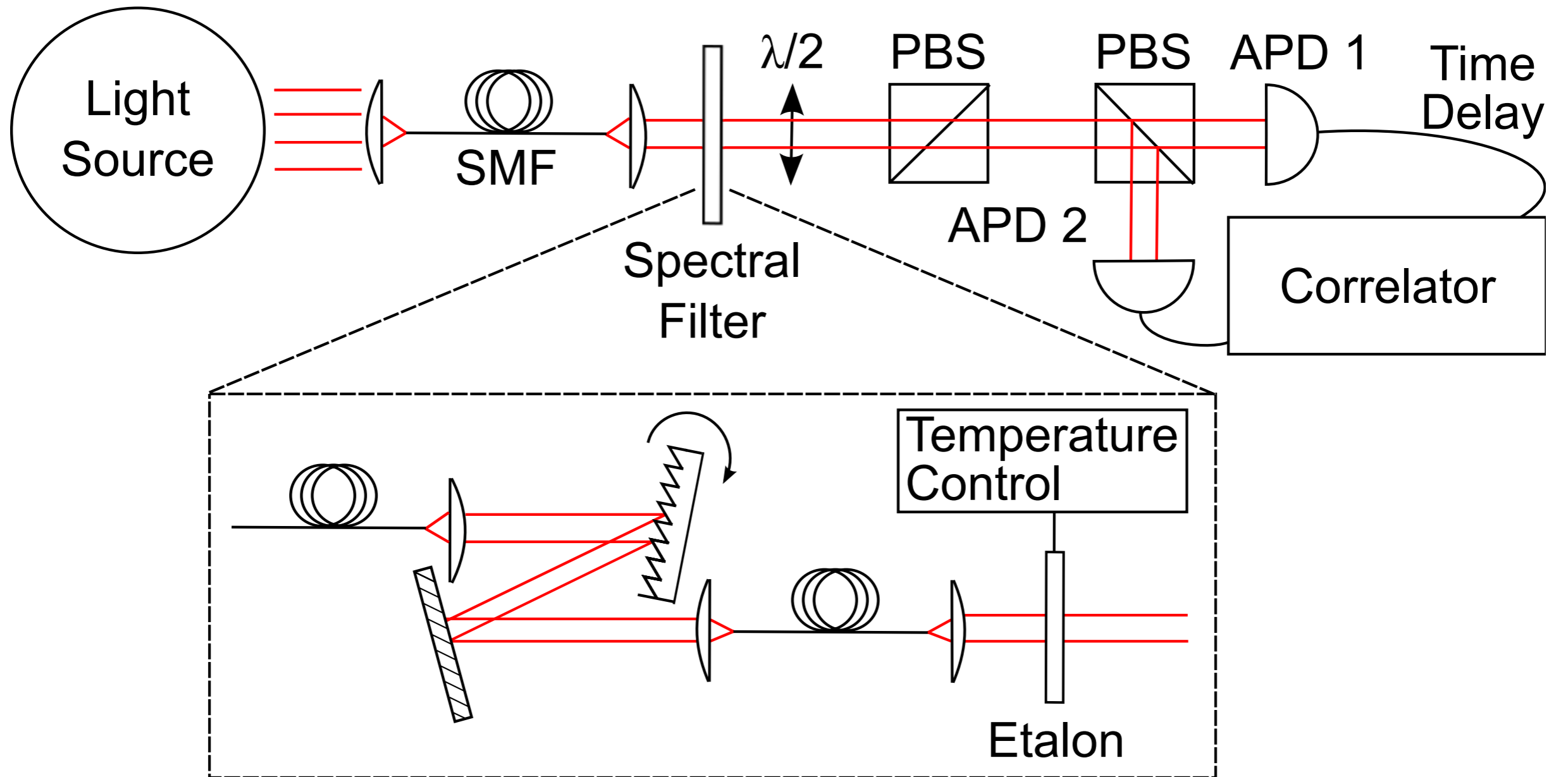
Time-averaged maximal $V^2(\tau \sim 0, \tau_t, \tau_c)$



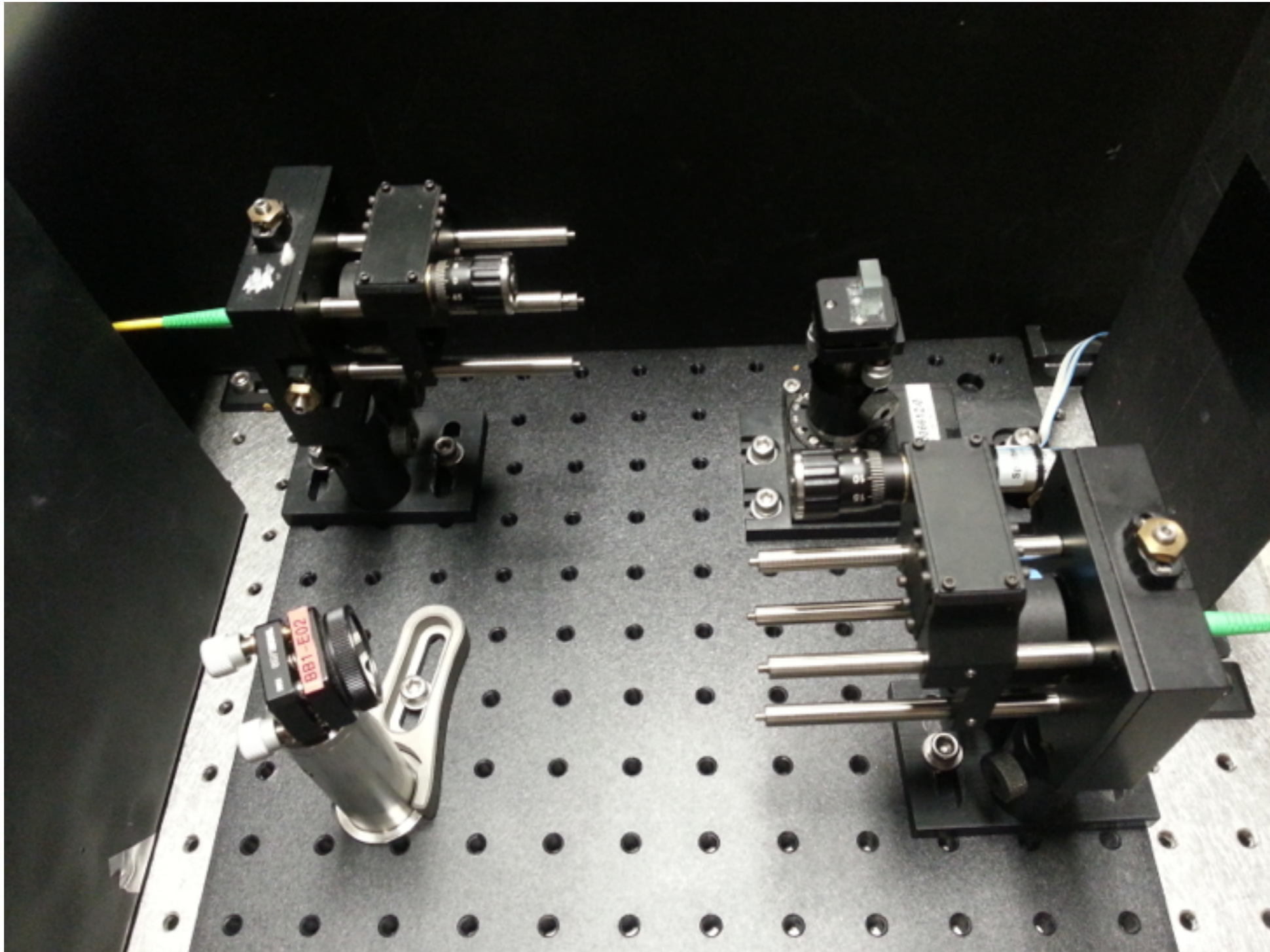
Coherence Time vs Detector Bandwidth



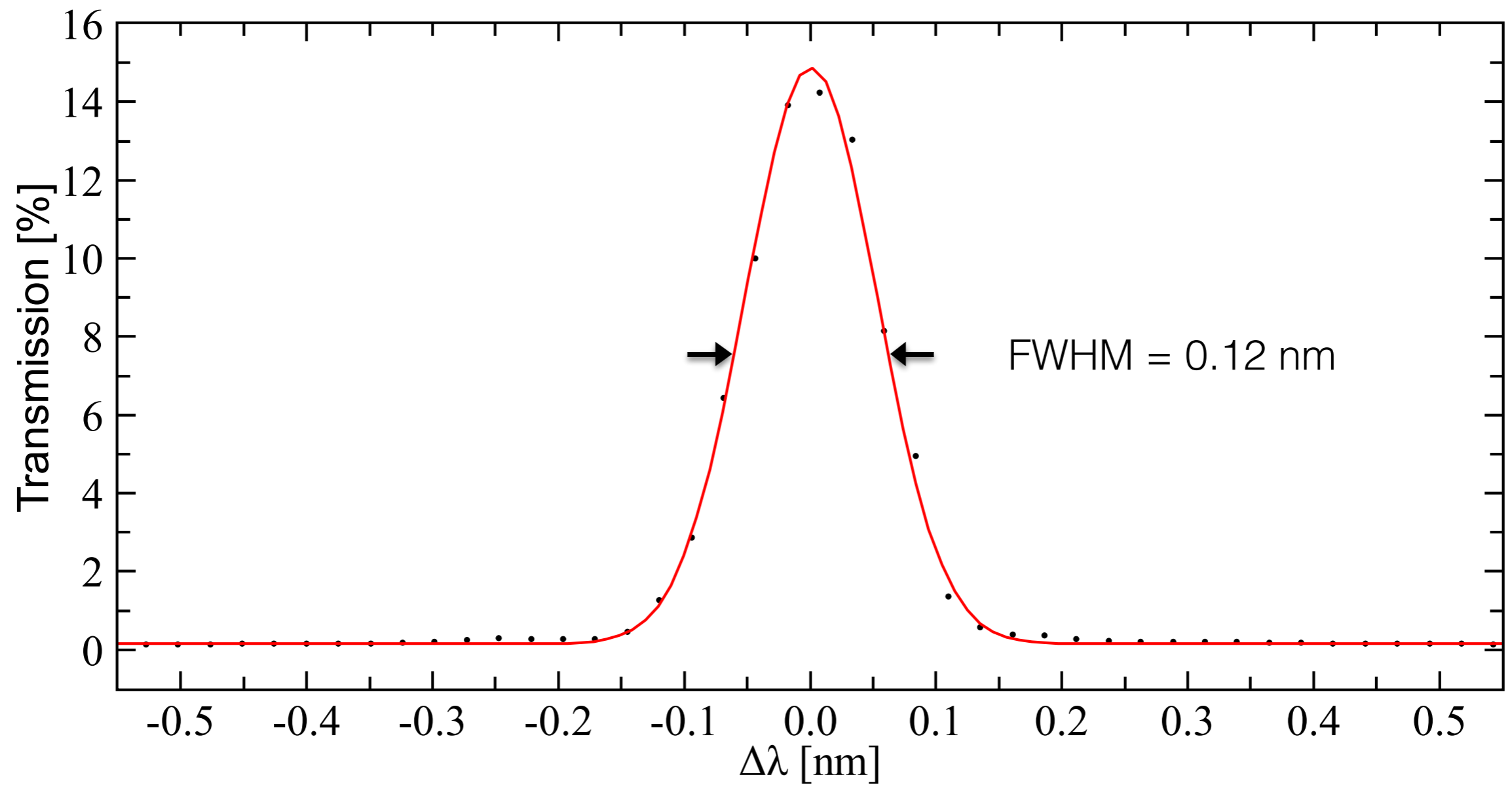
Experimental Setup



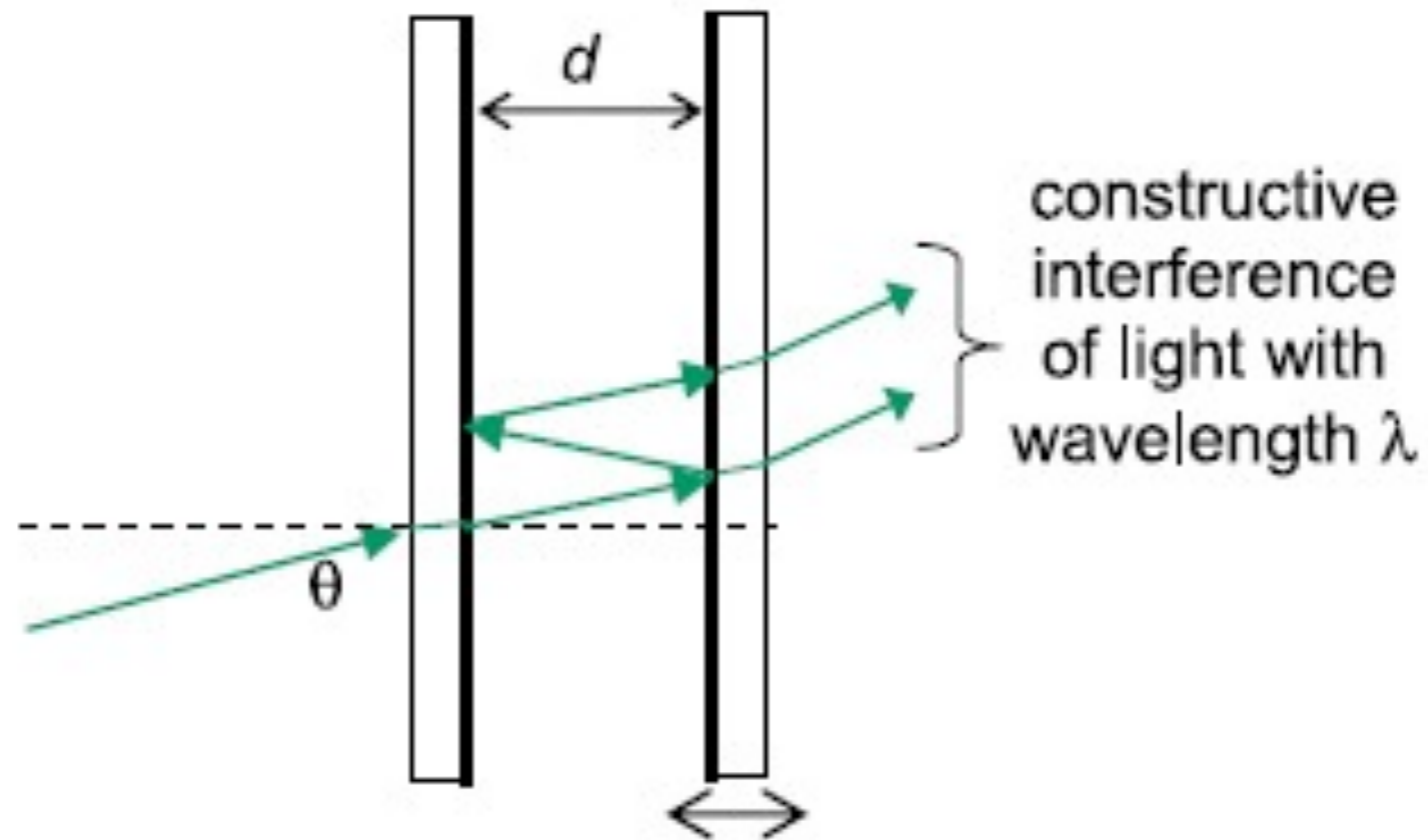
Grating Spectrometer



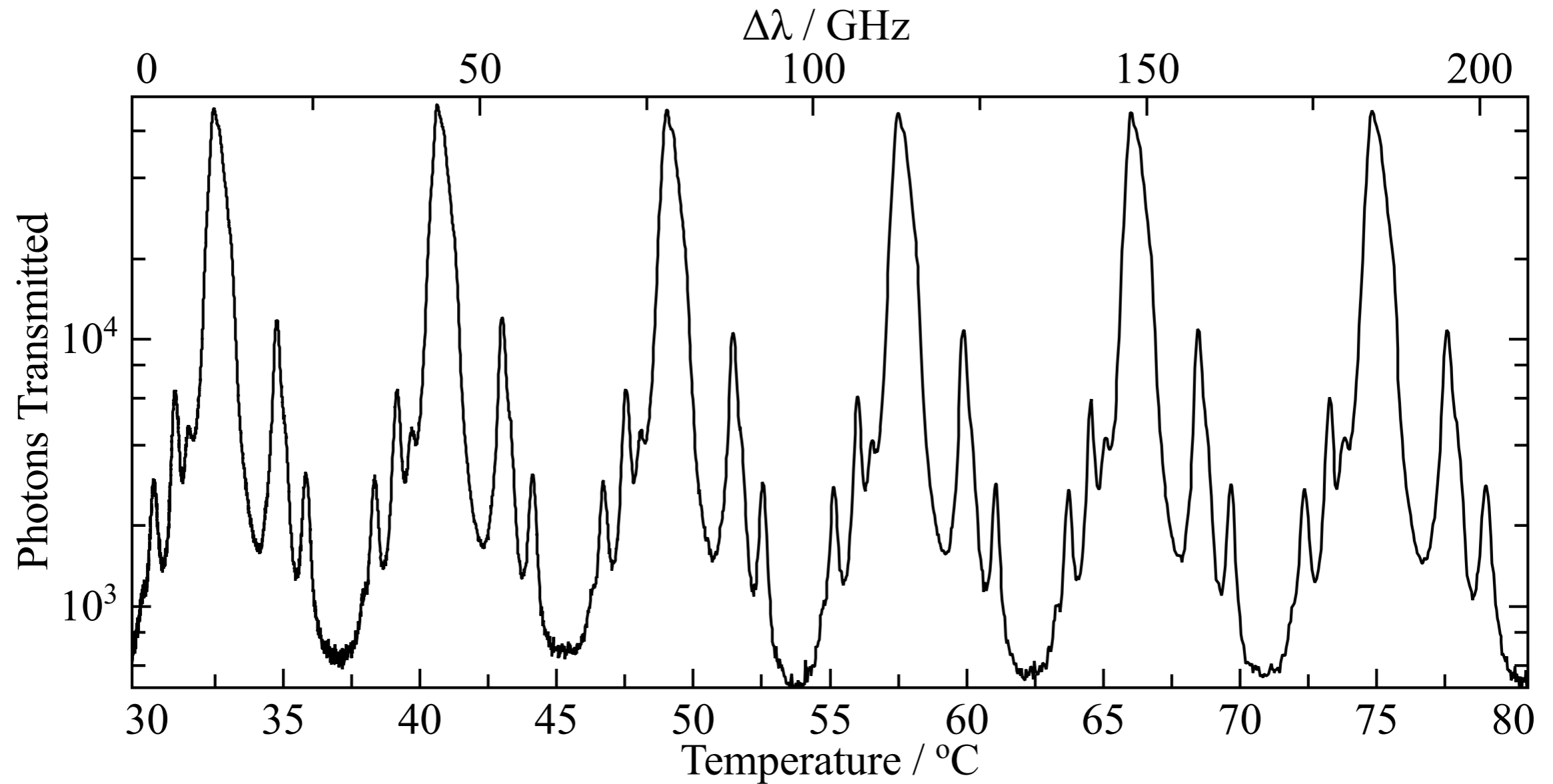
Grating: Transmission



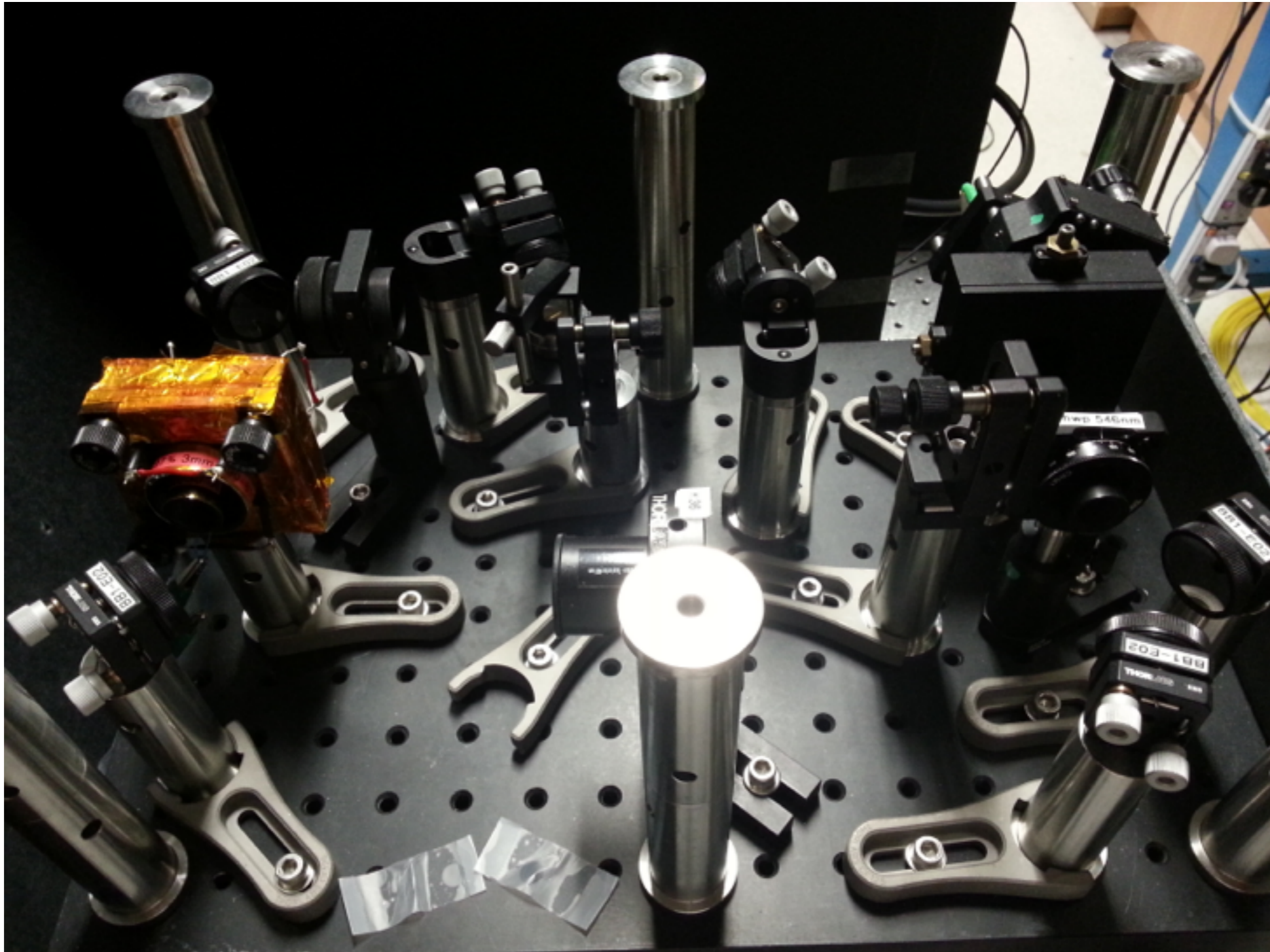
Etalon



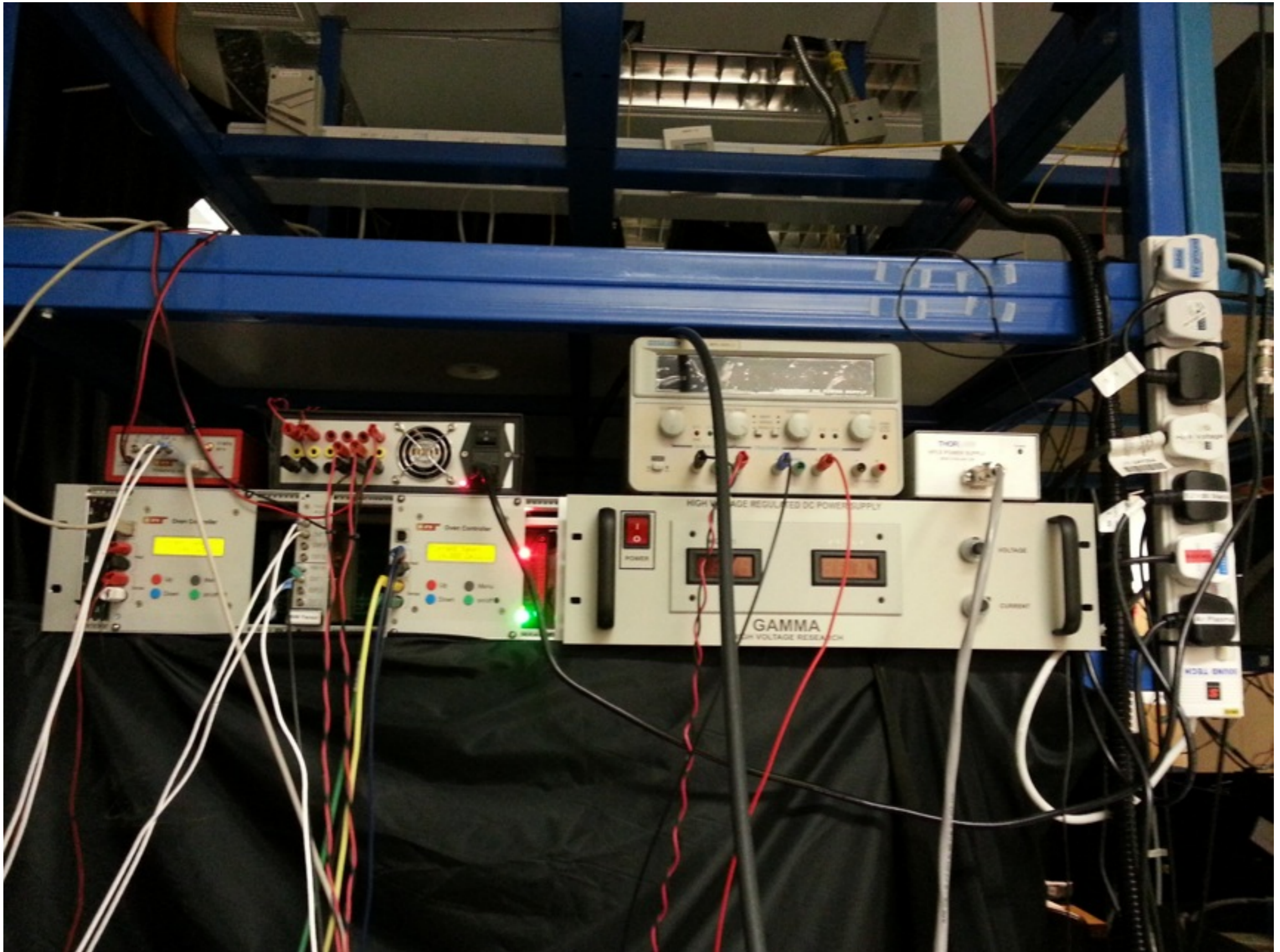
3mm Etalon: Transmission of Hg Lamp



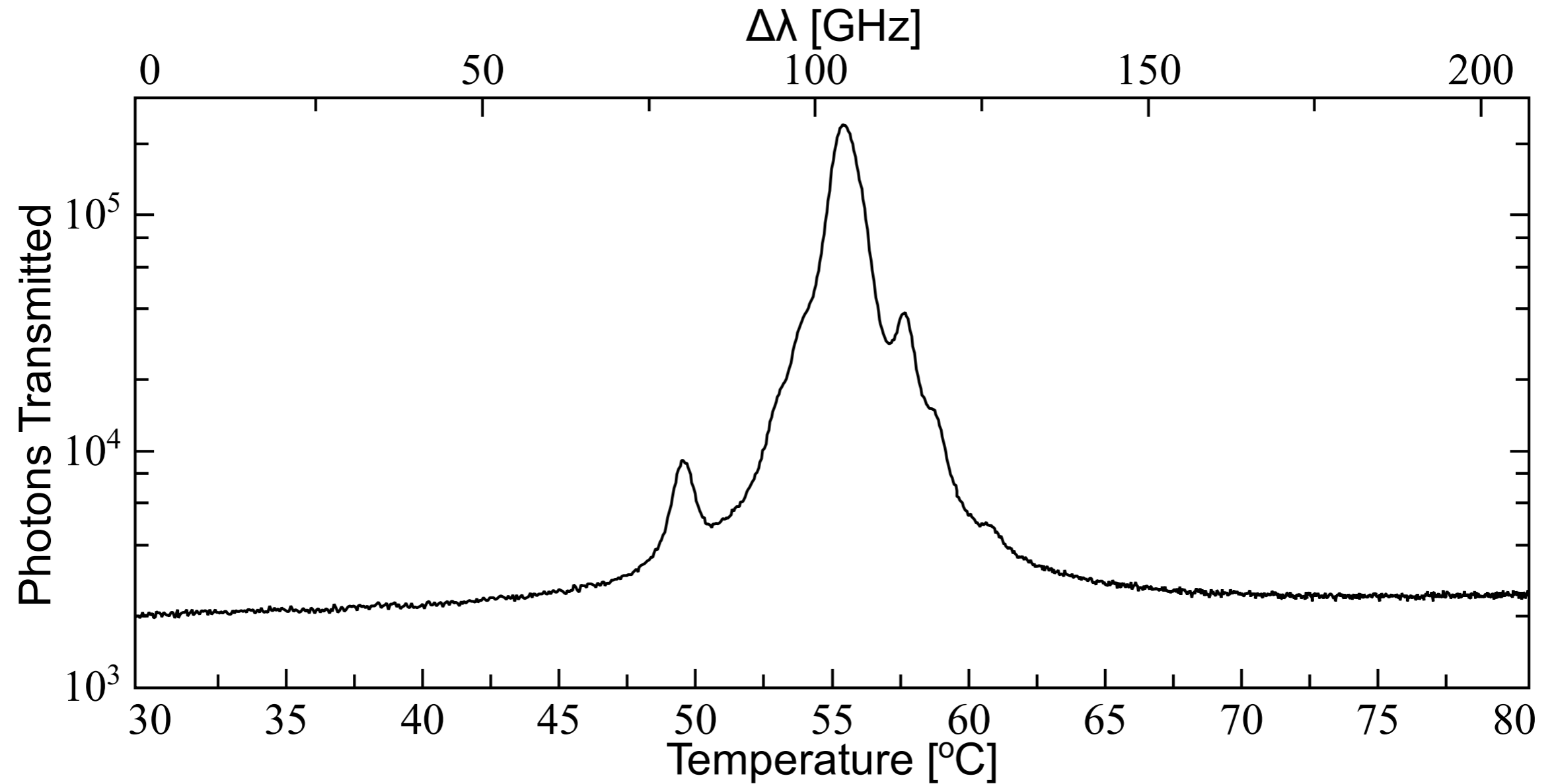
Etalon: Setup



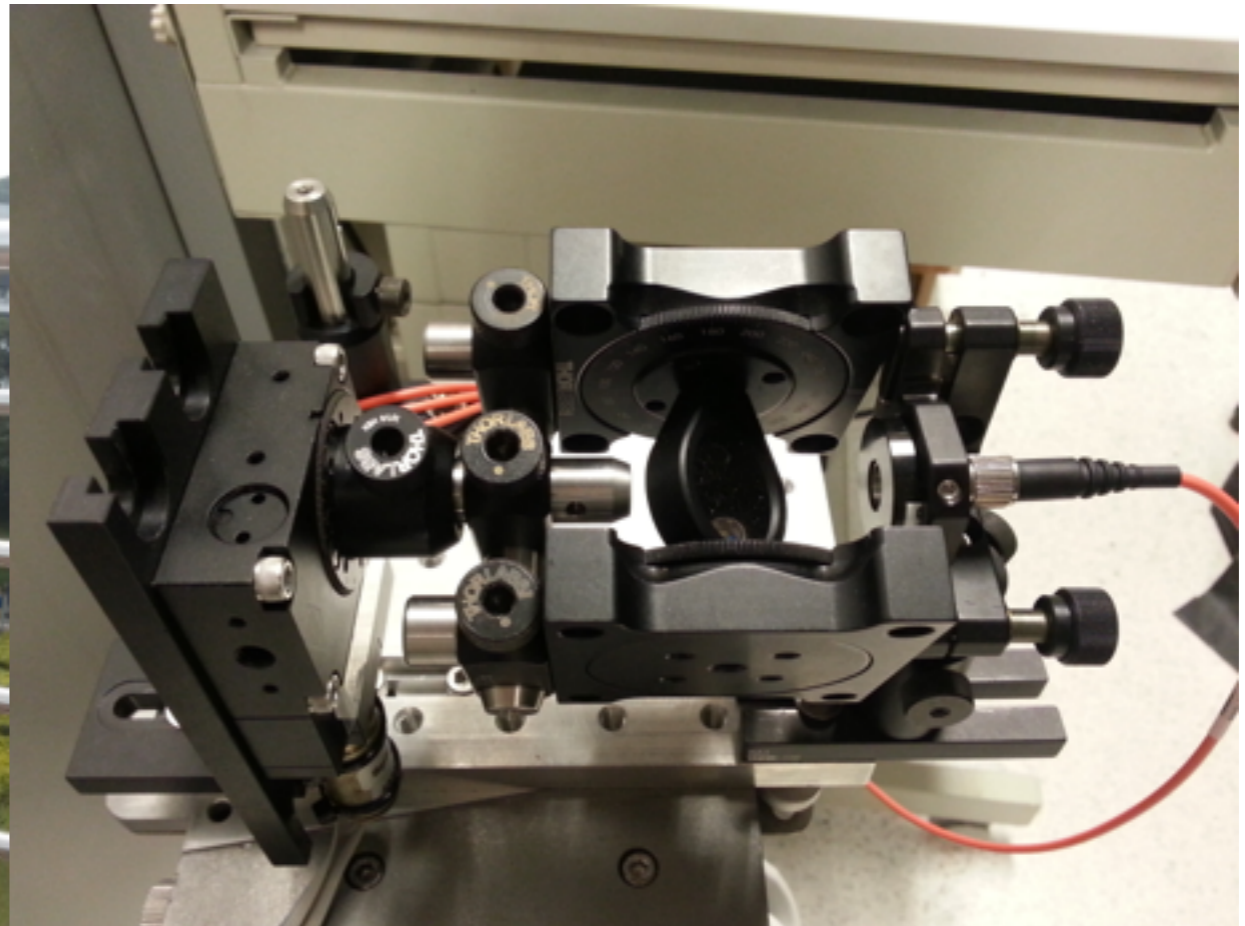
Electronics



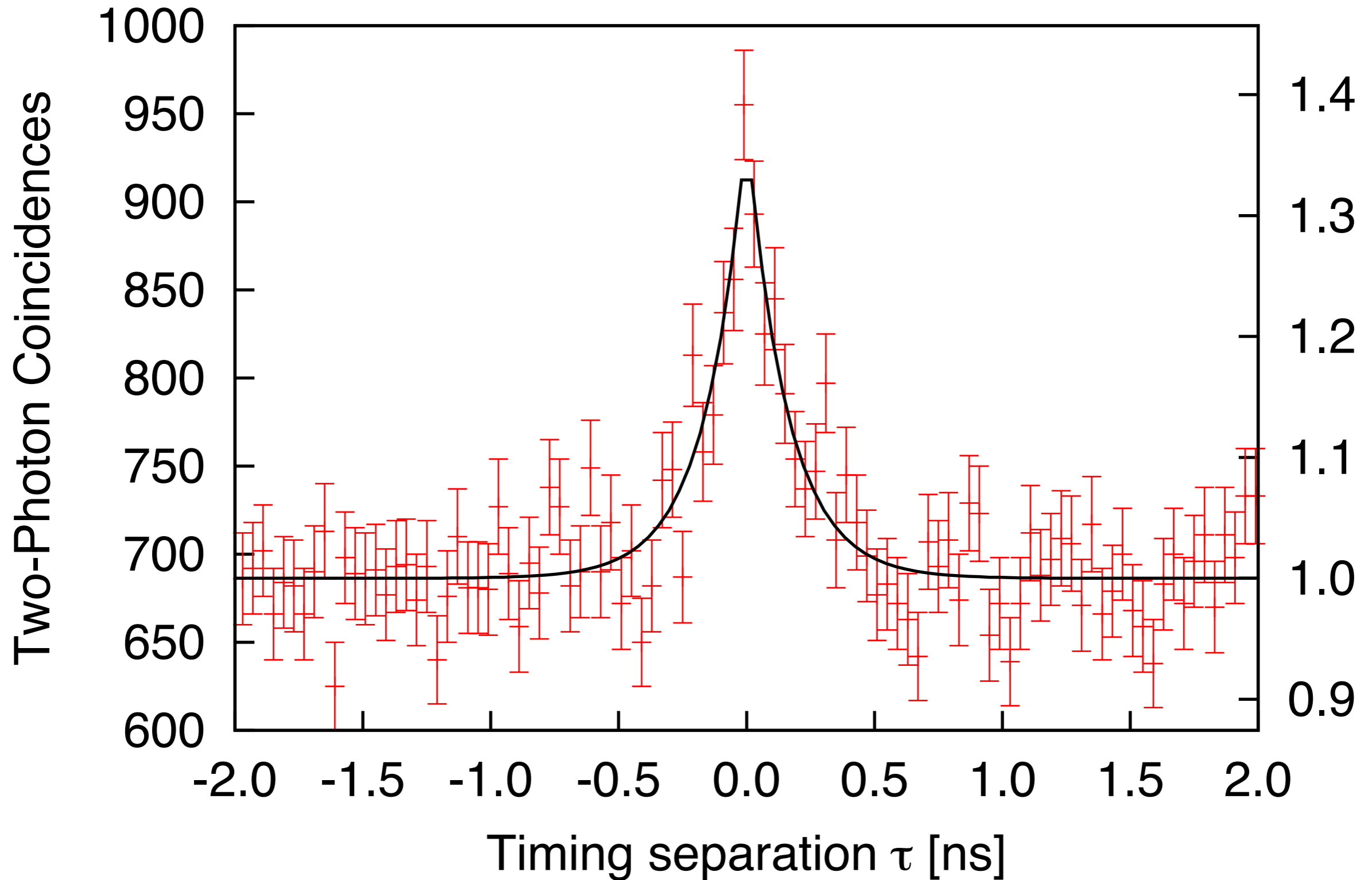
0.5mm Etalon: Transmission of Hg Lamp



Coelostat: Setup



Temporal $g^{(2)}(\tau)$ of The Sun



?

$$SNR = A\eta RI_0 \sqrt{\frac{T}{\tau_t}} \cdot V^2(b, \tau)$$

A = Aperture area of collection optics

η = Quantum efficiency of detectors

R = Mirror reflectivity (optical losses)

I_0 = Spectral density of source

T = Measurement duration

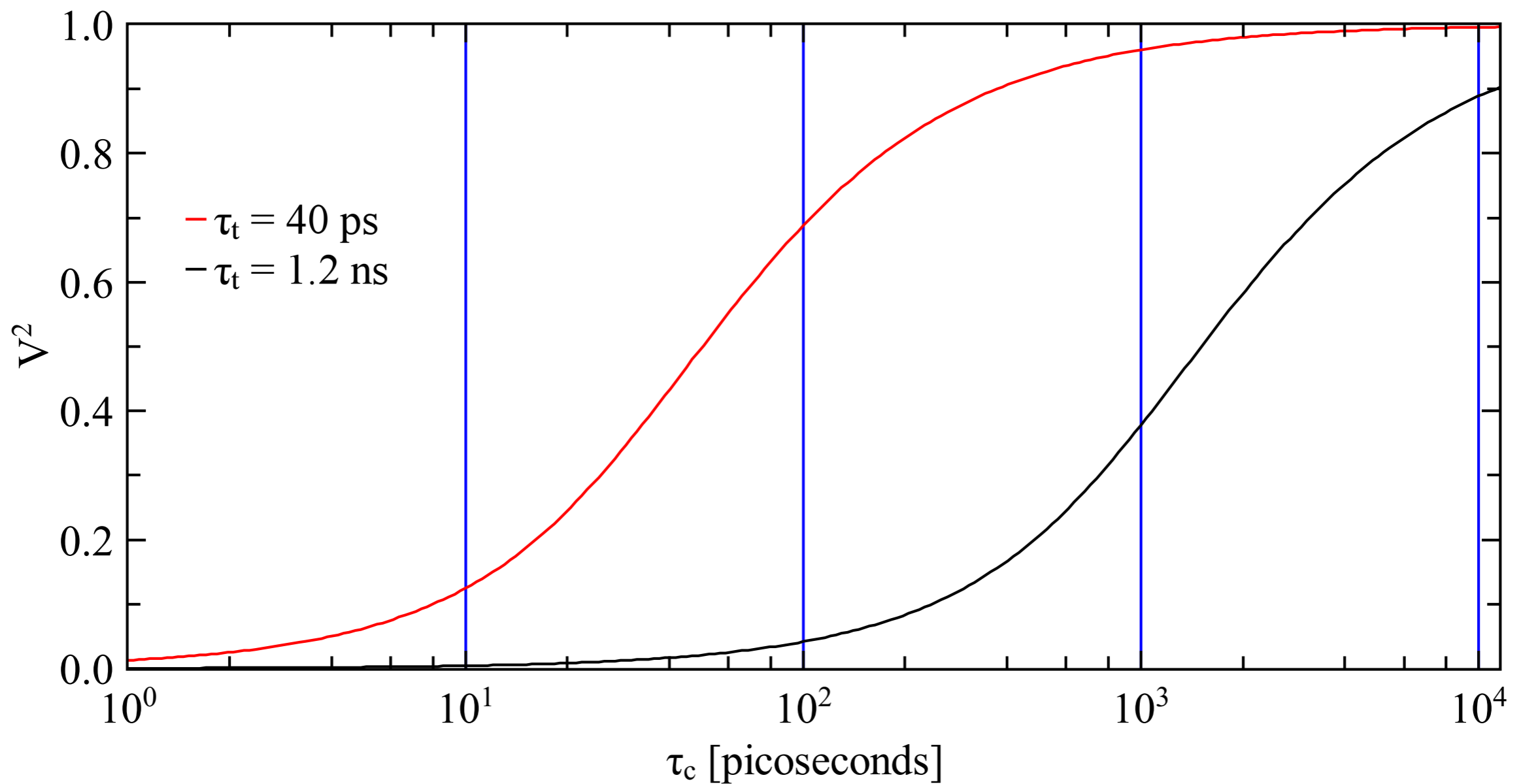
τ_t = Detector resolution

V = Visibility

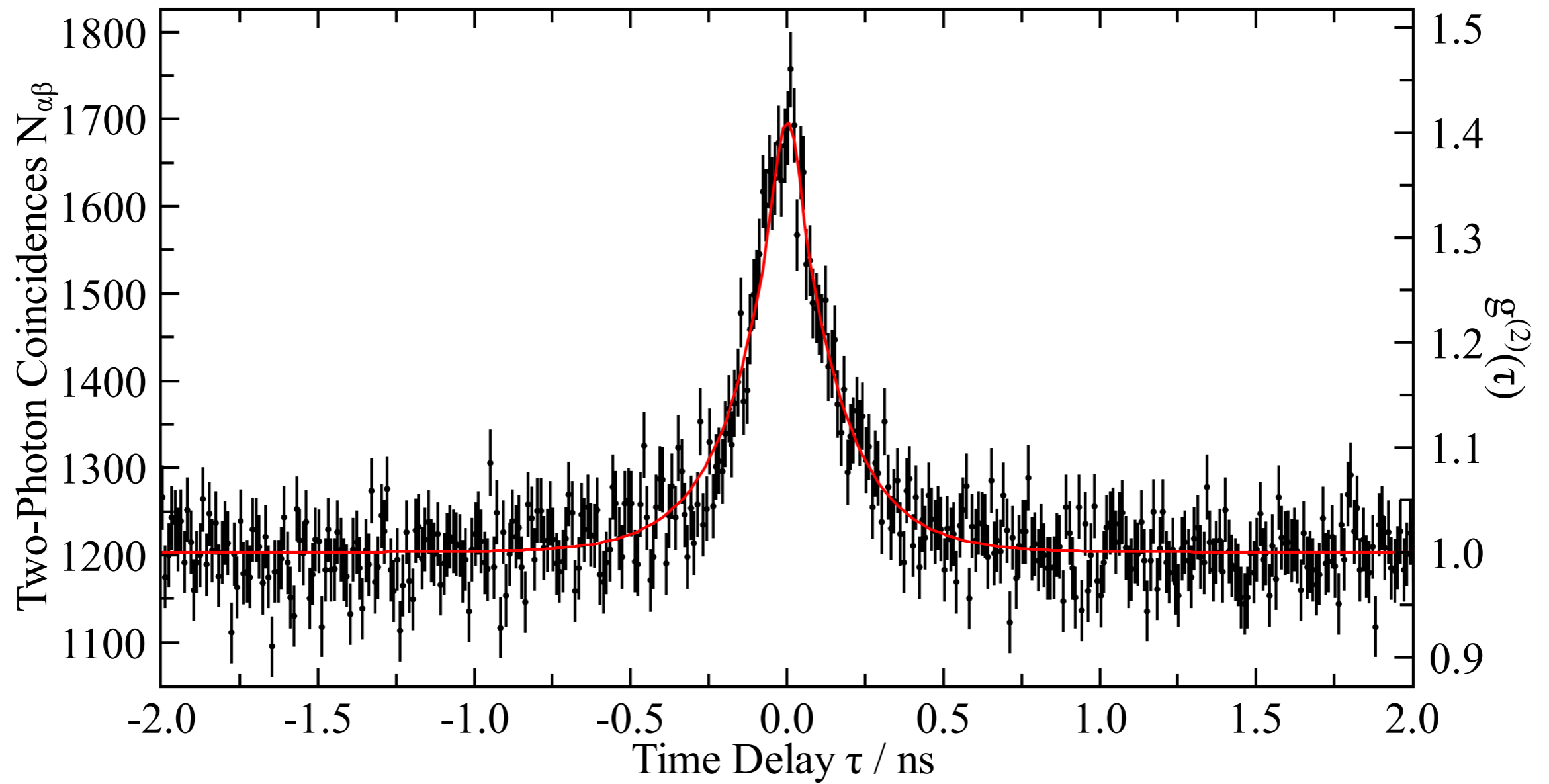
b = baseline (spatial separation) of detectors

τ = timing separation between photons

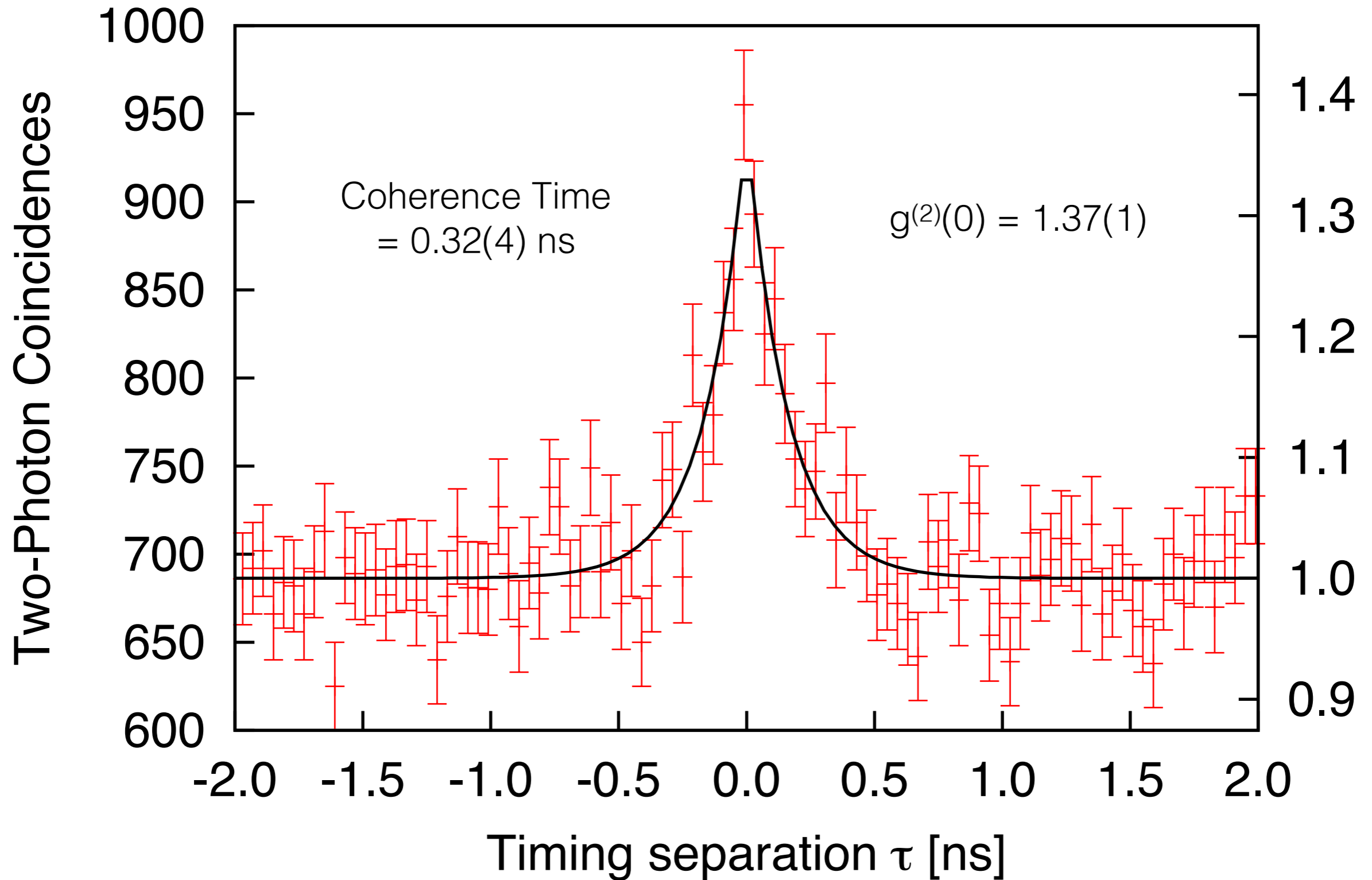
Time-averaged maximal $V^2(\tau \sim 0, \tau_t, \tau_c)$



$g^{(2)}(\tau)$ of Arc Lamp



Temporal $g^{(2)}(\tau)$ of The Sun



Temporal $g^{(2)}(\tau)$ of The Sun: 5 μ m to 6 μ m

