

Sonoluminescence



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sound $\Rightarrow$ light

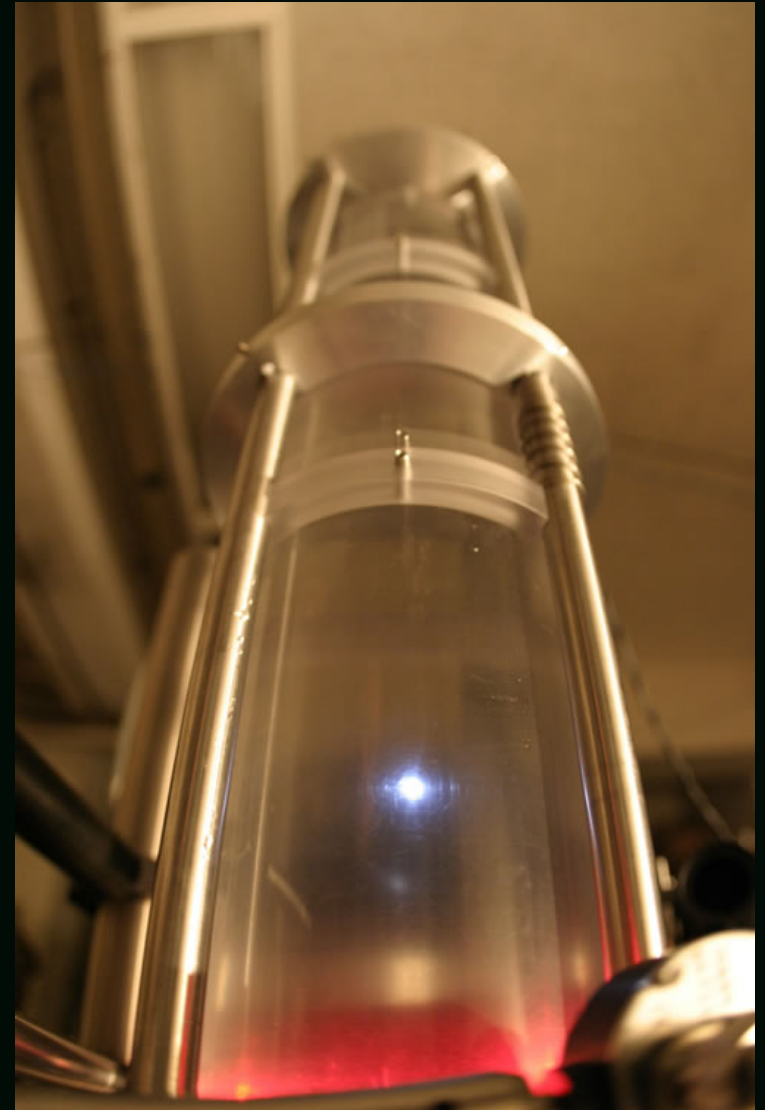
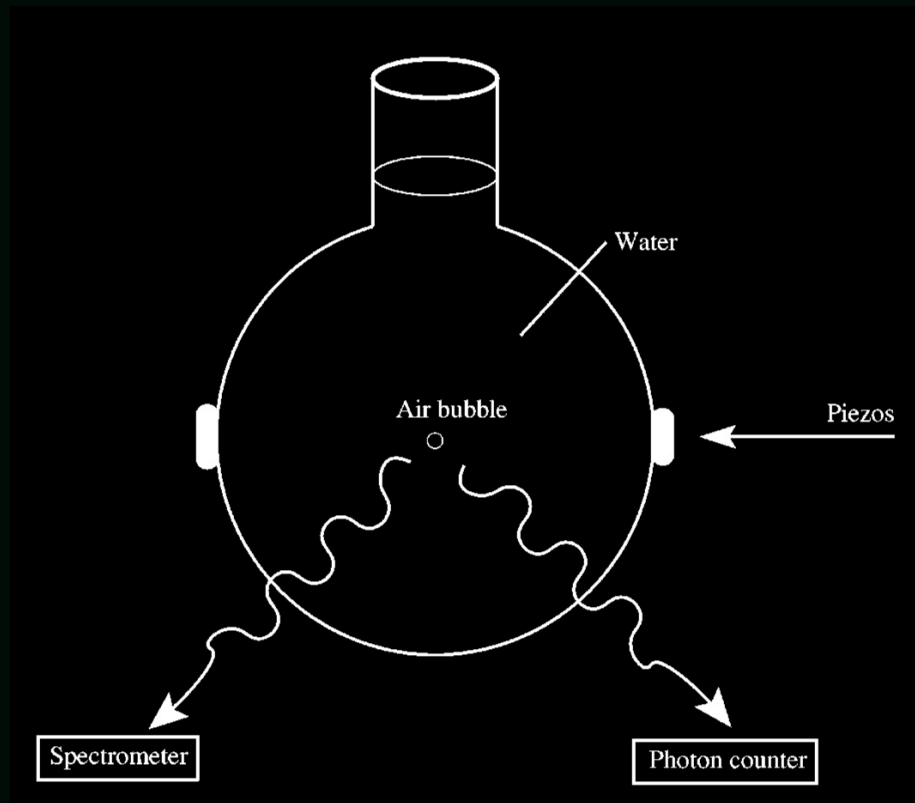
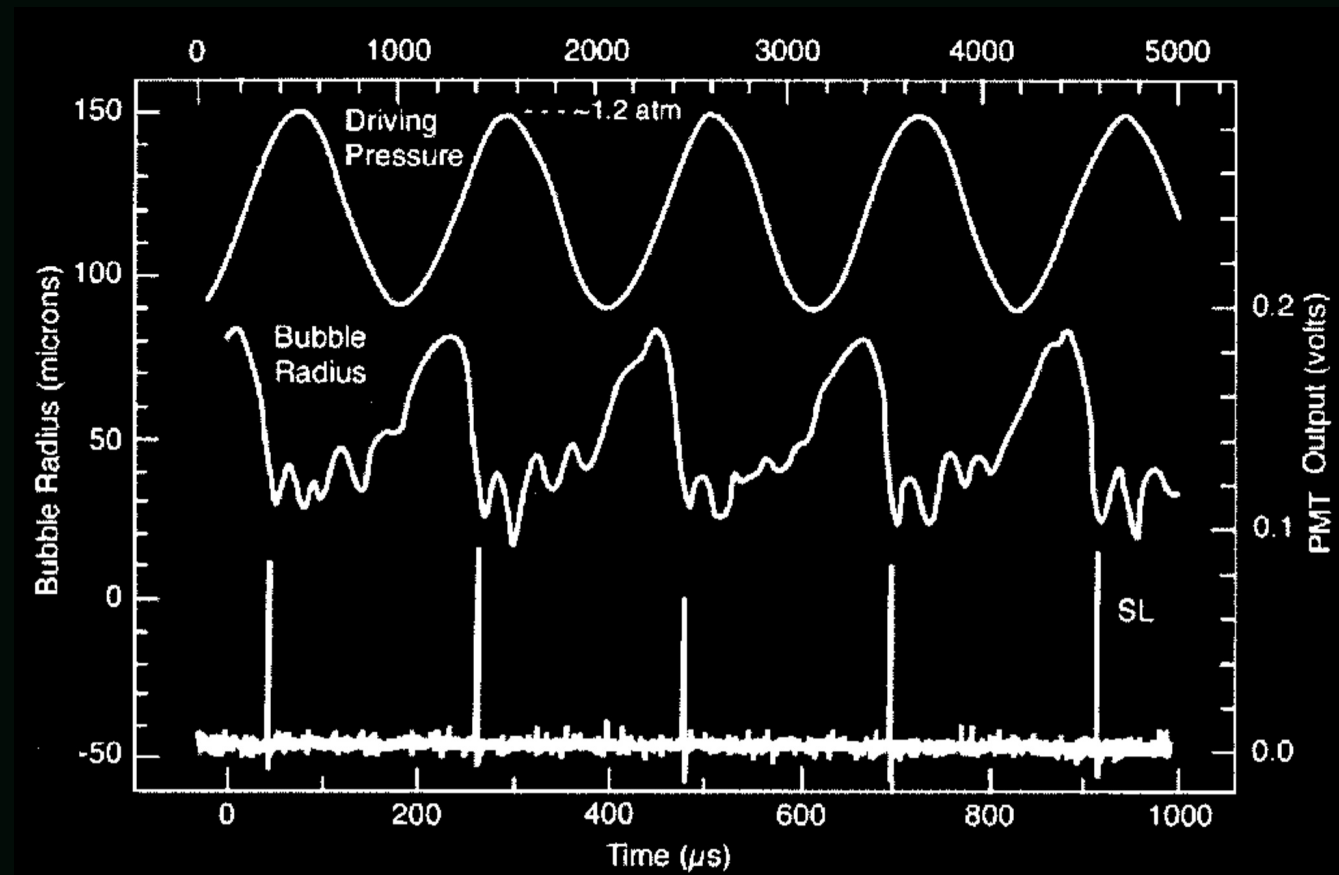
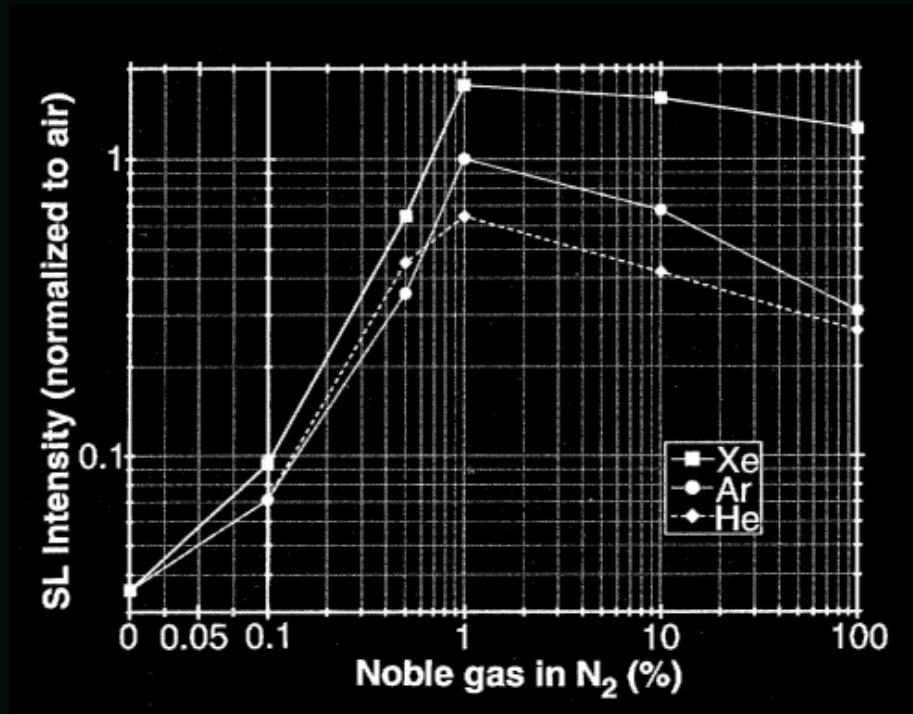


Image credit: Brenner et al. 2002;
Seth Putterman's Lab (UCLA)

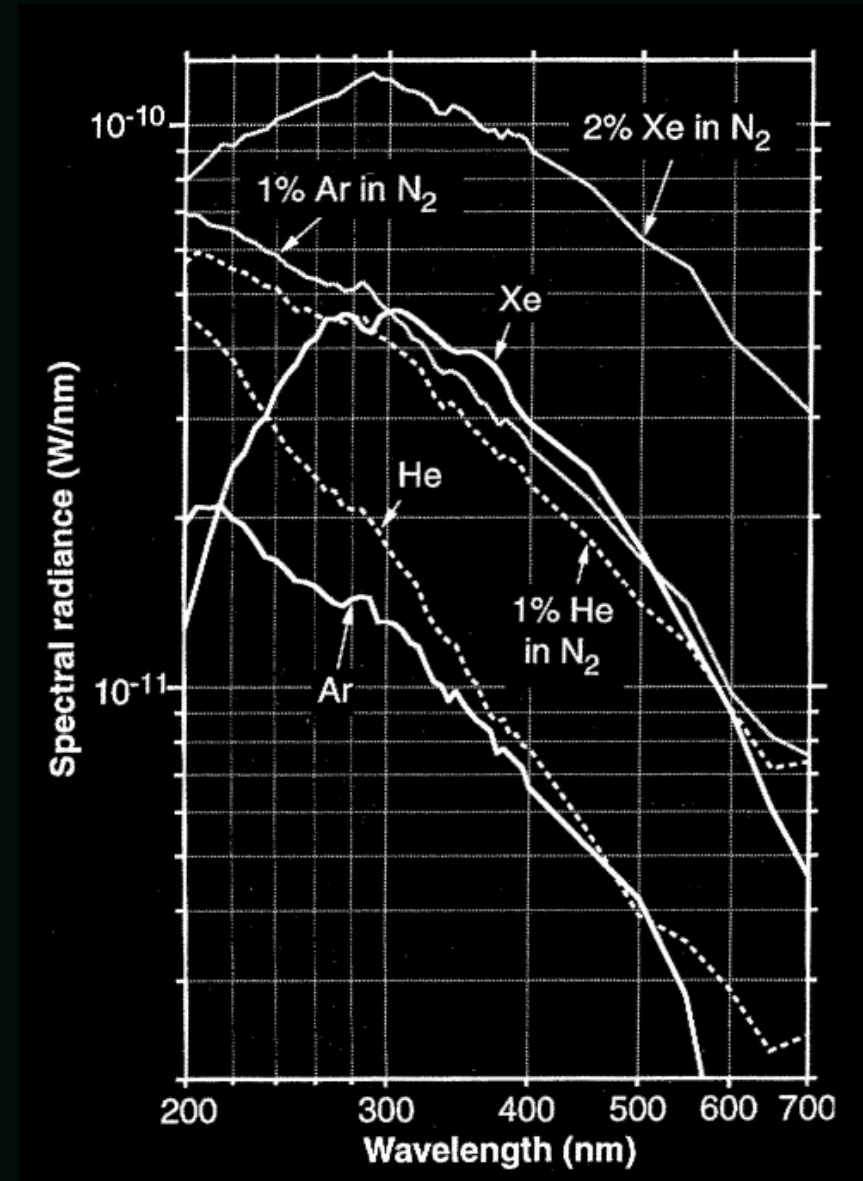


Brenner et al. 2002

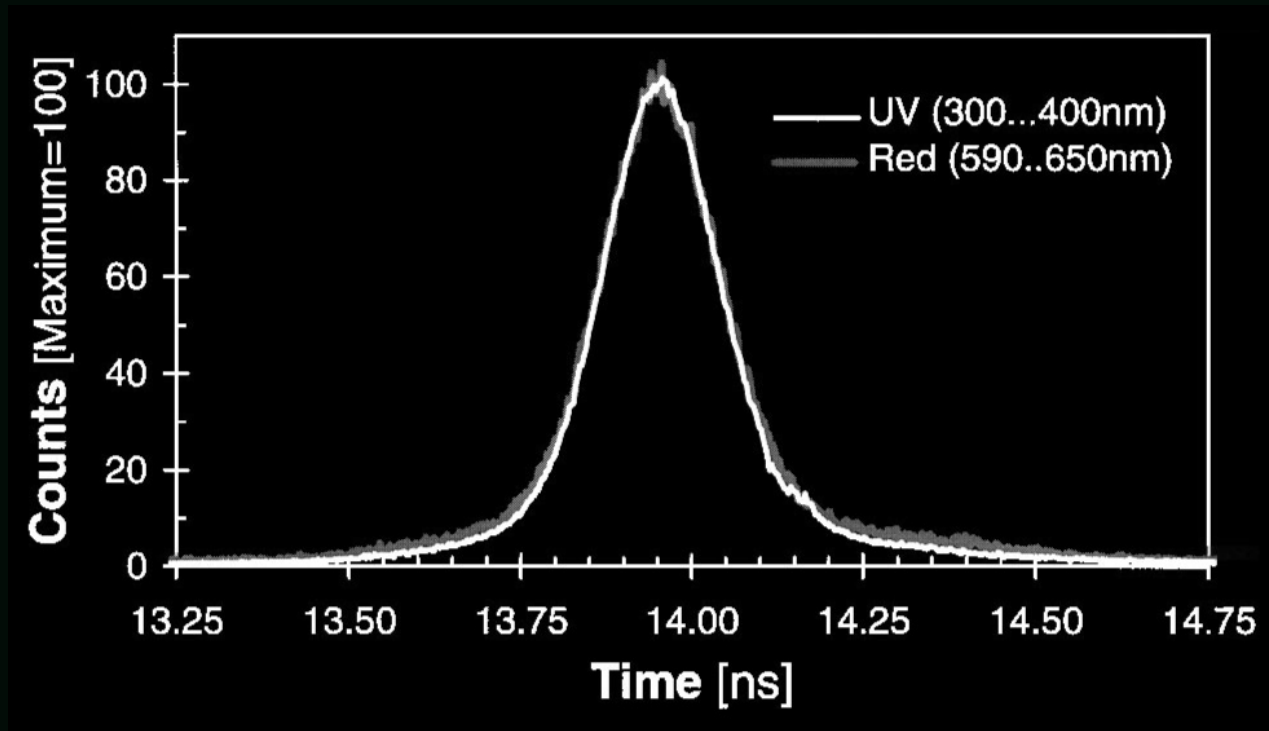
Hints of composition dependence



Hiller et al. 1994



TC-SPC

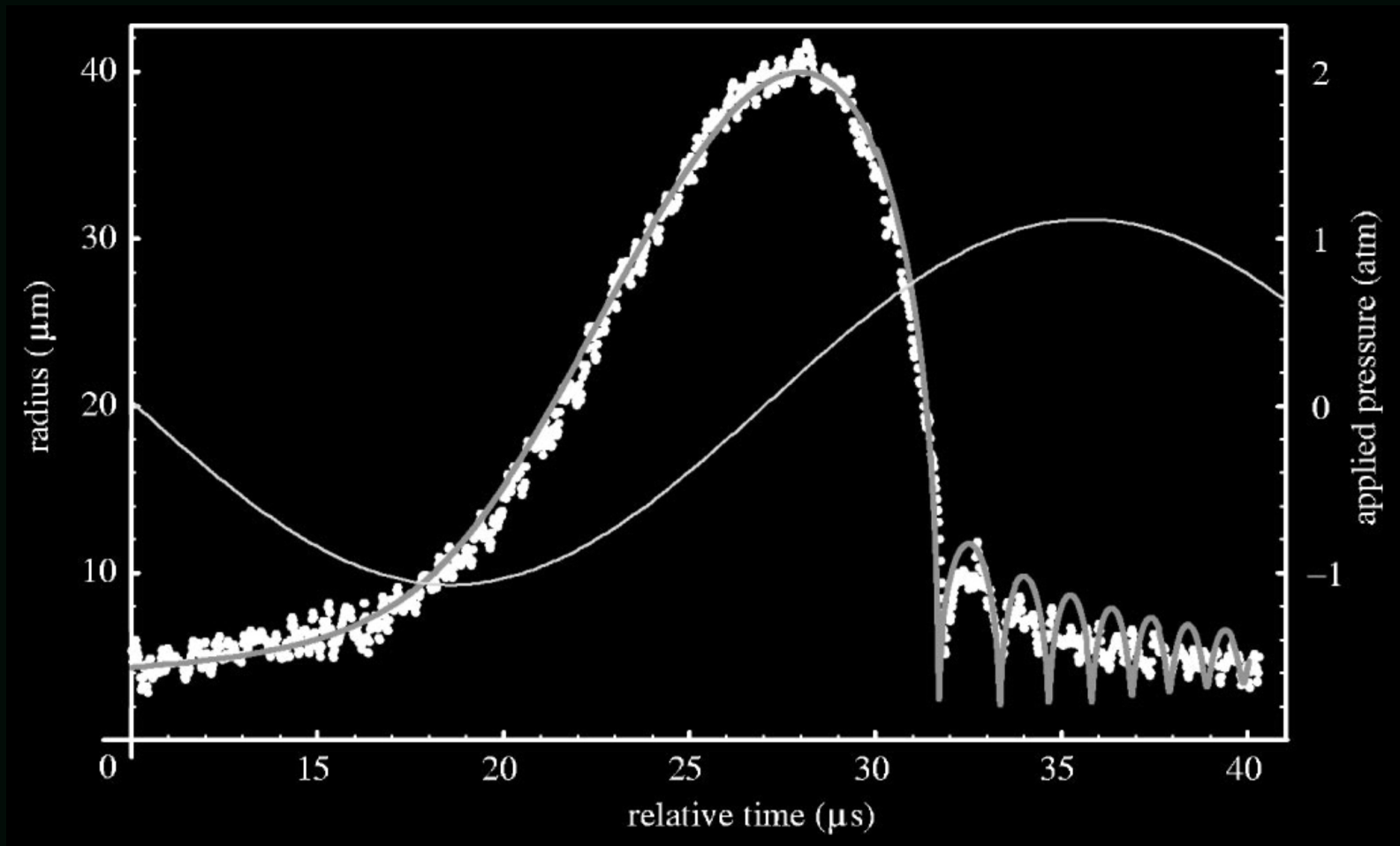


Gompf et al. 1997

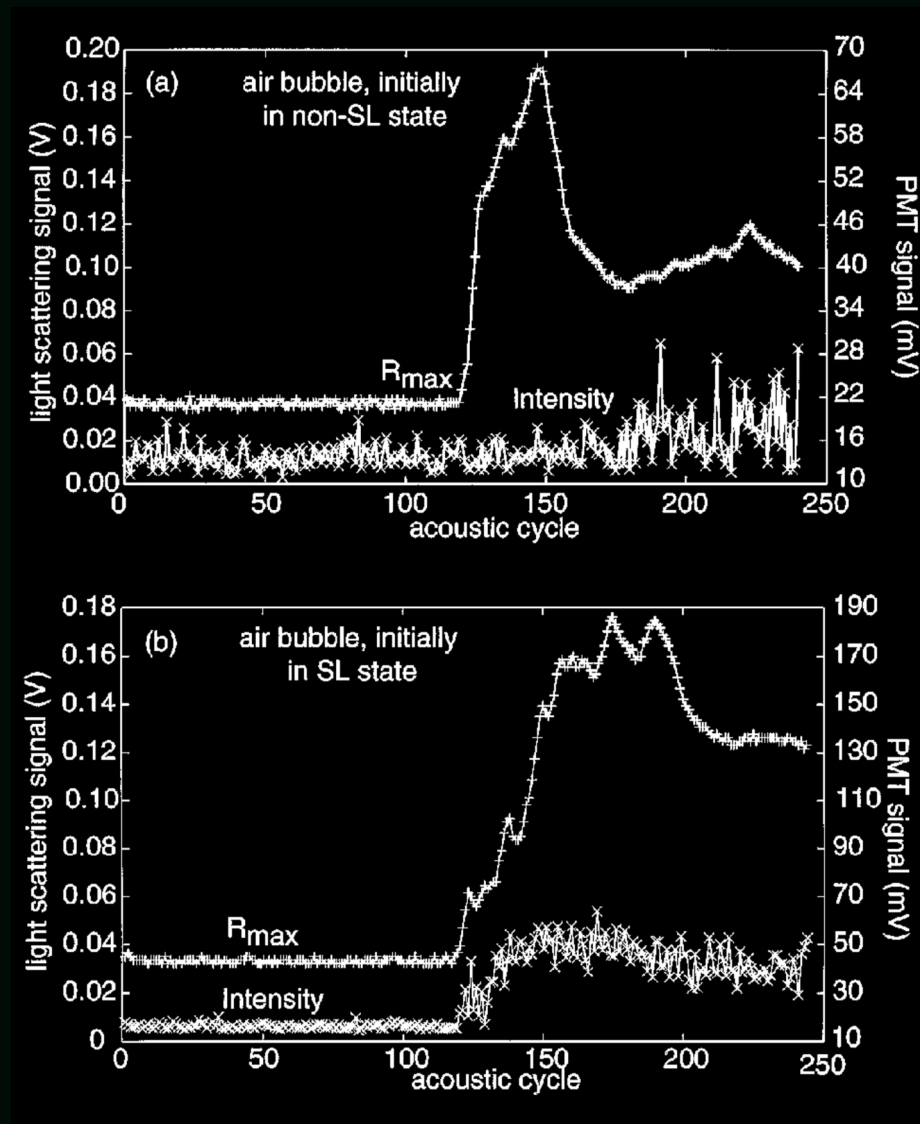
$$\rho(\delta_t u + u \cdot \nabla u) = -\nabla p + \eta \nabla^2 u + \zeta \nabla(\nabla \cdot u)$$

$$\delta_t \rho + \nabla \cdot (\rho u) = 0$$

$$R\ddot{R} + \frac{3}{2}\dot{R}^2 = \frac{1}{\rho} \left(p_g - P_0 - P(t) - 4\eta \frac{\dot{R}}{R} - \frac{2\sigma}{R} \right)$$



Brenner et al. 2002



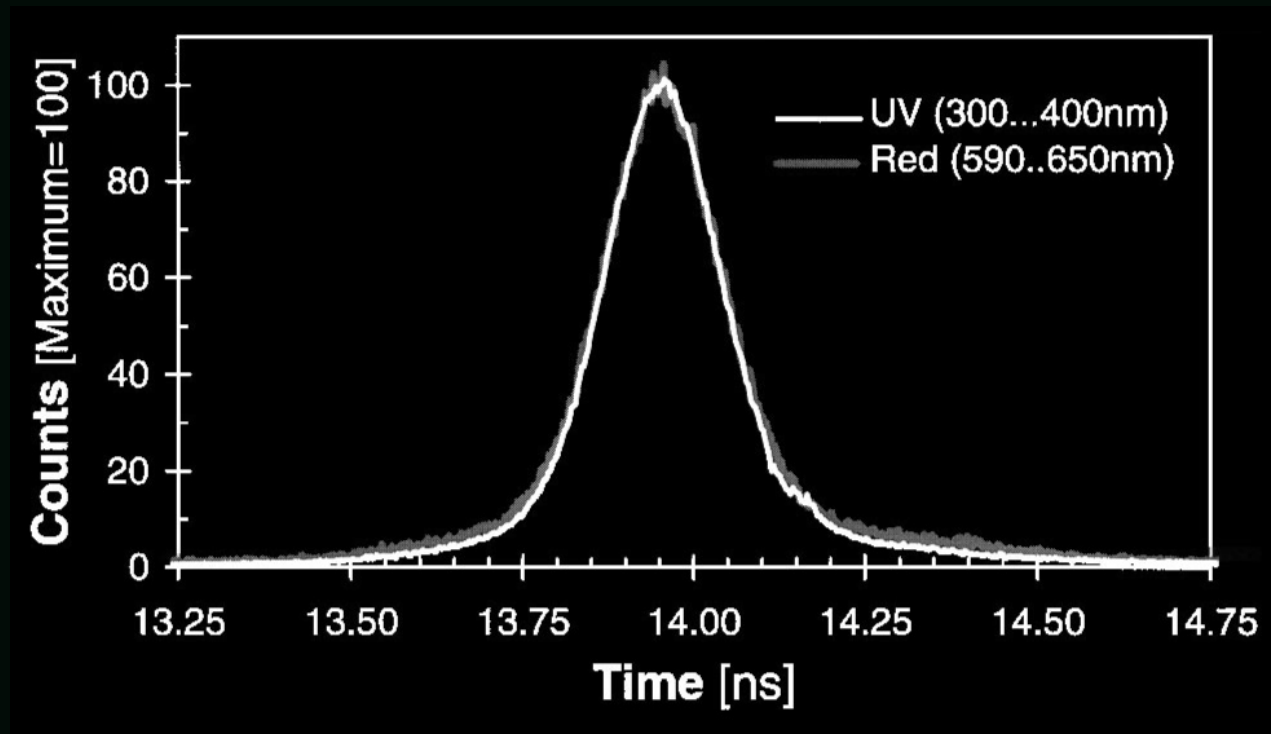
Brenner et al. 2002

**but where is the light
coming from?**

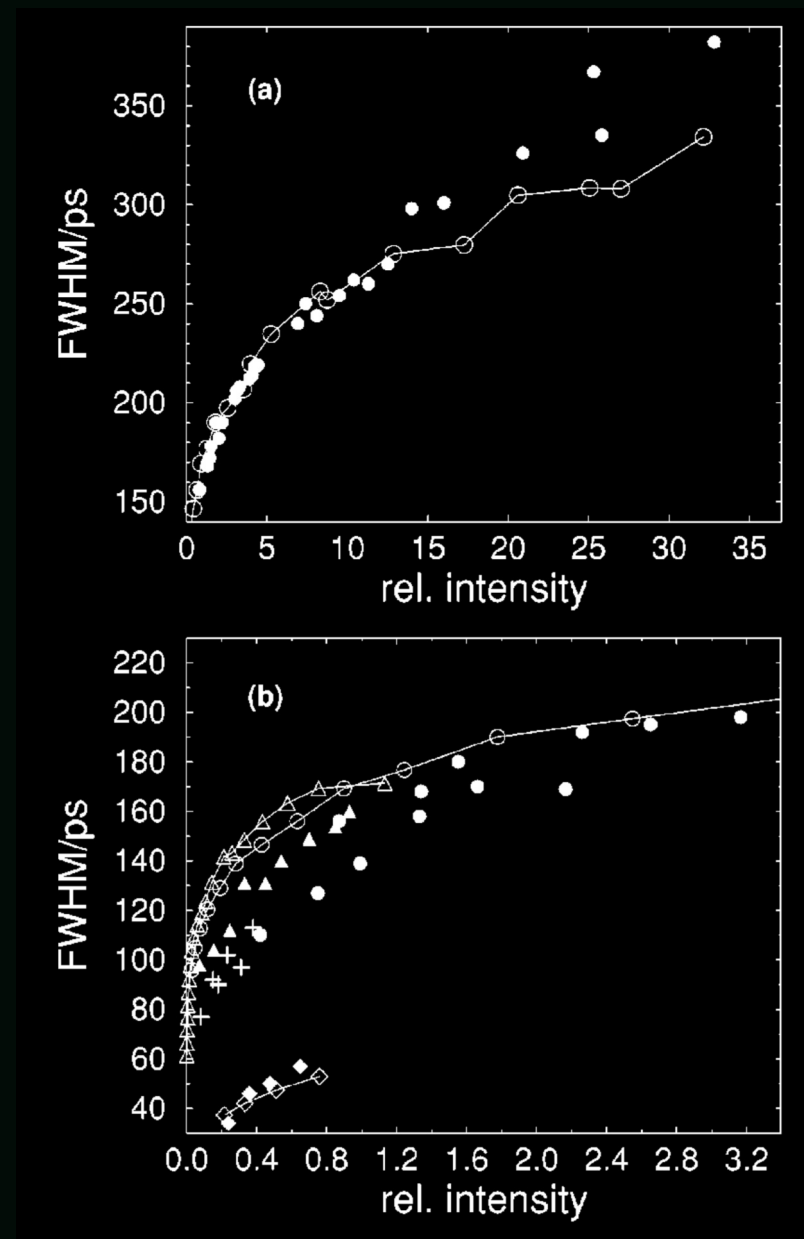
first, the wacky: Eberlein 1996

$$\mathcal{P}(\omega) = 1.16 \frac{(n^2 - 1)^2}{16\pi^2 n^2} \frac{\hbar}{c^4} \frac{(\Delta R^2)^2}{\gamma} \omega^3 e^{-2\gamma\omega}$$

but it's probably thermal



Gompf et al. 1997



thermal volume emitter

Brenner et al. 2002

what (probably) happens

expansion

turnaround

Rayleigh collapse

decoupling (vapor, thermal)

dissociation

light!

(Ar, O, H ionize; electrons emit)

References

- [1] Brenner, M. P., Hilgenfeldt, S., & Lohse, D. 2002, Reviews of Modern Physics, 74, 425
- [2] Eberlein, C. 1996, Physical Review Letters, 76, 3842
- [3] Gaitan, D. F., Crum, L. A., Church, C. C., & Roy, R. A. 1992, Acoustical Society of America Journal, 91, 3166
- [4] Gompf, B., Günther, R., Nick, G., Pecha, R., & Eisenmenger, W. 1997, Physical Review Letters, 79, 1405
- [5] Hiller, R., Weninger, K., Putterman, S. J., & Barber, B. P. 1994, Science, 266, 248
- [6] Lauterborn, W., & Kurz, T. 2010, Reports on Progress in Physics, 73, 106501