Self-induced Transparency

S. L. McCall and E. L. Hahn, Phys. Rev. **183**, 457 (1969)

The Area Theorem

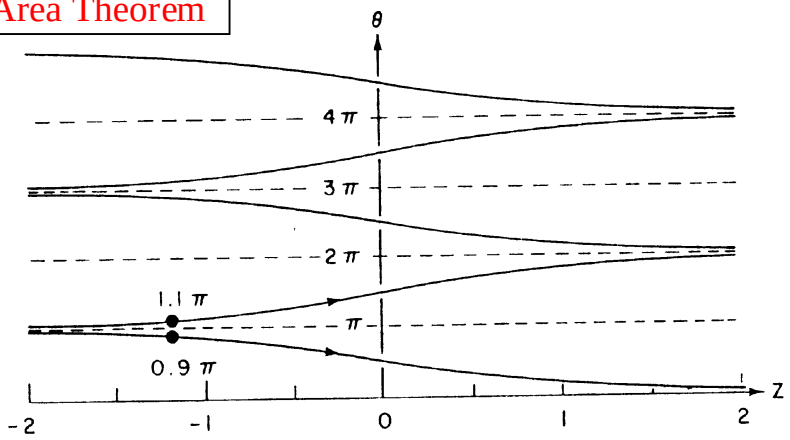

Fig. 2.1. Pulse area as a function of distance into the absorber (McCall and Hahn [1969]). Arrows denote the direction of evolution for the two input areas shown in the computer solutions in Fig. 2.2. The area is denoted by θ instead of A as in the text.

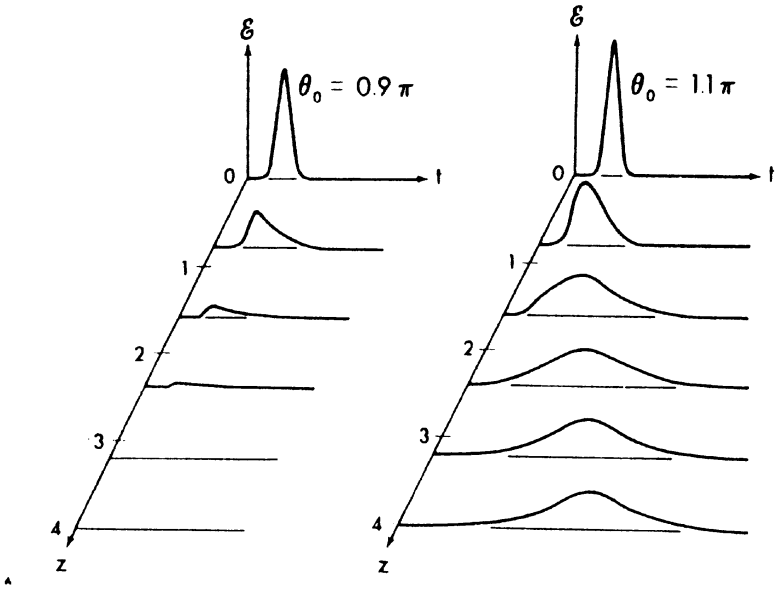

Fig. 2.2. Evolution of pulses with areas just above and below π as a function of z (McCall and Hahn [1969]). Distance is in units of $\pi\alpha^{-1}$ both in this figure and in Fig. 2.1. The time scale depends on the electric dipole moment of the excited transition.

The "Hg-Rb" Experiment

R. E. Slusher and H. M. Gibbs, Phys. Rev. **A5**, 1634 and **A6**, 1255E (1972)

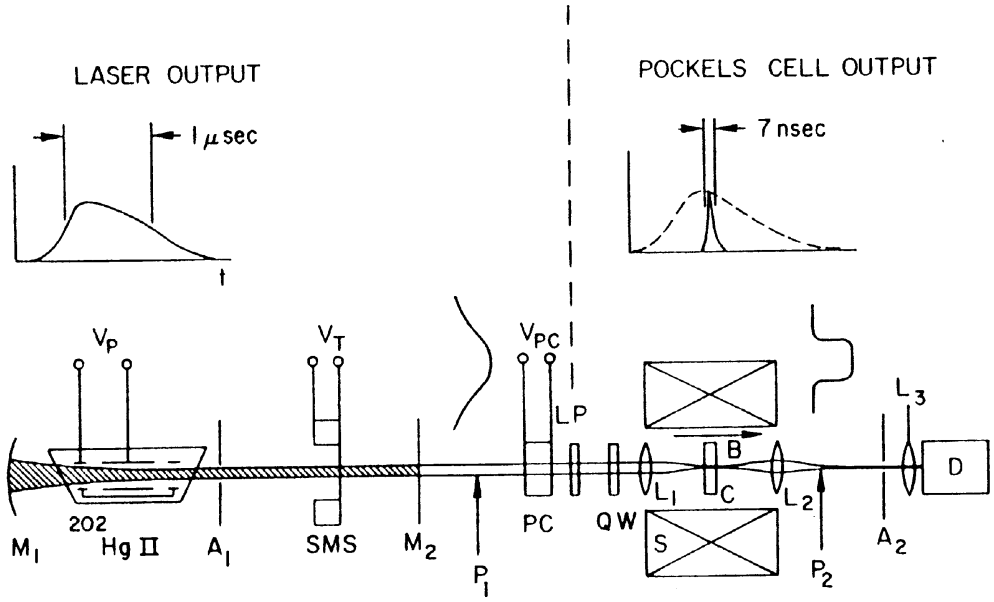

Fig. 3.1. Schematic diagram of Hg–Rb SIT apparatus (see SLUSHER and GIBBS [1972]). M_1 is a 3-m totally reflecting mirror; V_p is a 1-μsec voltage pulse causing 1-μsec single-mode laser pulse; A_1 is the aperture to select TEM_{00} mode; SMS is single-longitudinal-mode selector; V_T is the modetuning voltage across the piezoelectric transducer; M_2 is a 4 % transmission flat output mirror; P_1 is the Gaussian transverse intensity profile; PC is the Pockels-cell gating 5–10 nsec portion of the laser pulse; LP and QW are linear and circular polarizers; S is a superconducting solenoid; L_1, L_2 and L_3 are imaging lenses; B is the magnetic field ($\approx$ 74.5 kG); C is the Rb vapor cell; P_2 is the stripped Gaussian profile after SIT interactions in the Rb cell; A_2 is the limiting aperture used to observe a uniform transverse intensity; and D is an avalanche photodiode or cross-field photomultiplier detector.

The "Hg-Rb" Experiment (cnt'd)

R. E. Slusher and H. M. Gibbs, Phys. Rev. **A5**, 1634 and **A6**, 1255E (1972)

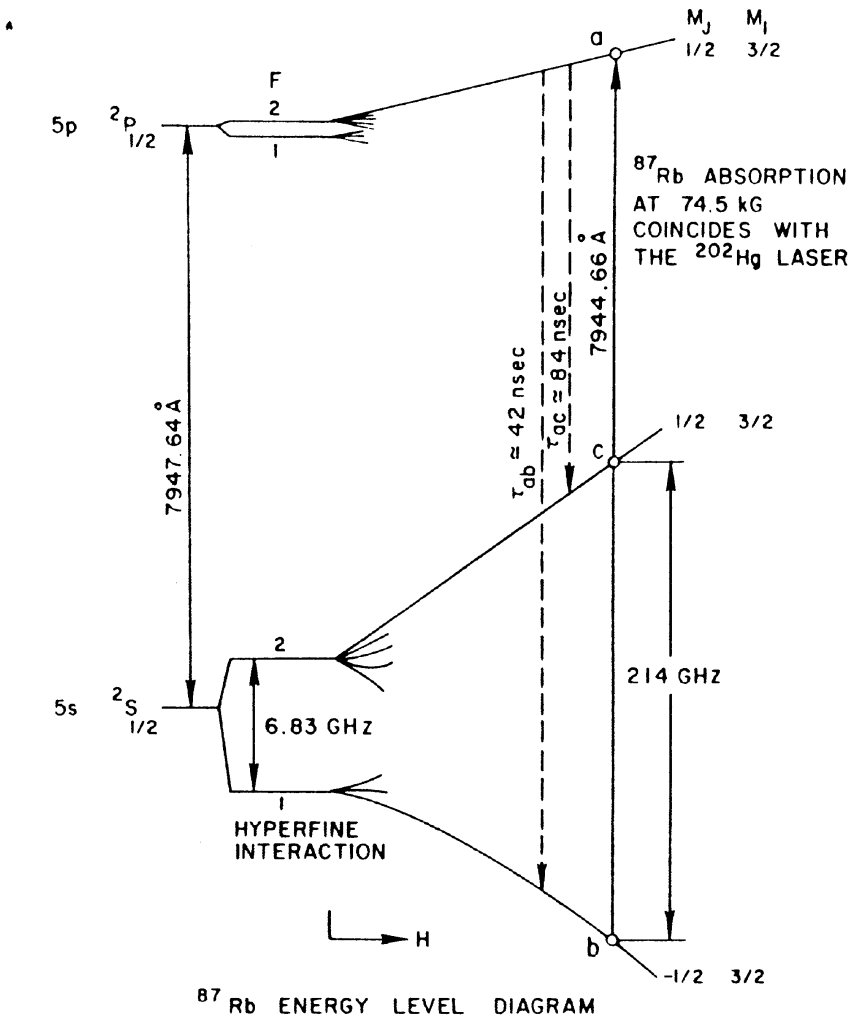

Fig. 3.2. Diagram of the relevant energy levels of ^{87}Rb as a function of magnetic field strength. The Zeeman interaction at 74.5 kOe lifts the low-field degeneracy and increases the absorption frequency to coincide with the Hg laser emission frequency.

The "Hg-Rb" Experiment

R. E. Slusher and H. M. Gibbs, Phys. Rev. **A5**, 1634 and **A6**, 1255E (1972)

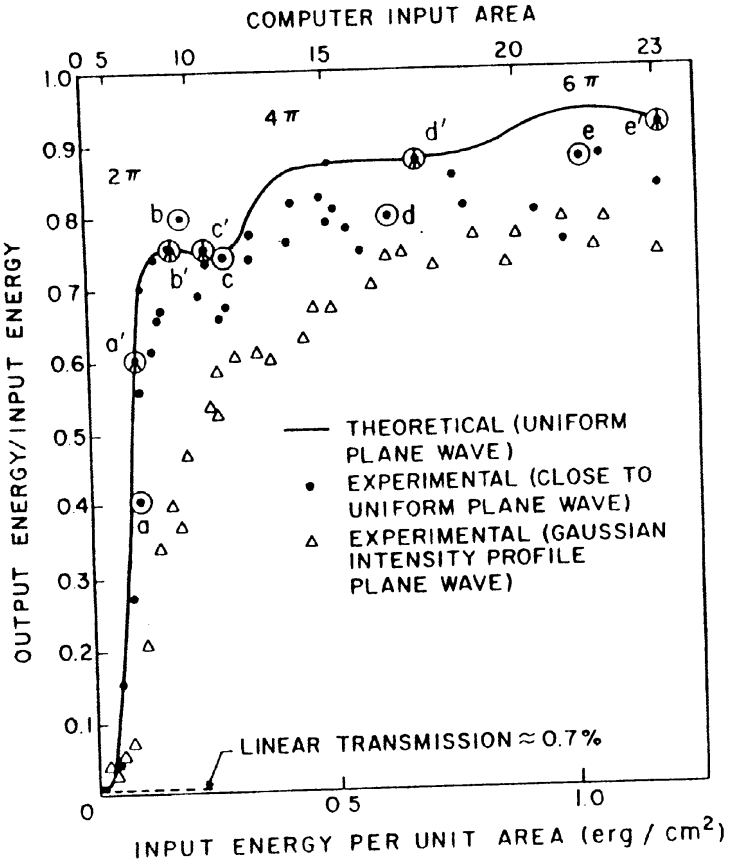

Fig. 3.3. SIT nonlinear transmission in Rb vapor with $\alpha L = 5$. Solid curve is a uniform plane-wave computer solution. Solid dots are data taken with 200-μm output aperture to approximate uniform plane wave. Triangles are data with no aperture corresponding to a plane-wave with Gaussian intensity profile. The pulse shapes for the circled points are shown in Fig. 3.4.

Additional References:

- R. E. Slusher, in Progress in Optics XII, E. Wolf, ed., 1974.
- M. Sargent III, M. O. Scully, and W. E. Lamb, *Laser Physics*, Addison-Wesley, 1974-1993.