1. Can a laser beam penetrate an optically thick medium with the help of another light source? Does the other light source have to be strong, or can you also realize transmission with a weak light source?

A: Yes, it can through EIT. There will be some probe absorption initially to prepare the dark state. The stronger the coupling laser, the fewer photons are needed to prepare the dark state.

2. For a lambda type level-diagram system, |g> is weakly coupled to |e> with detuning delta, while |f> is strongly coupled with detuning Delta and Rabi frequency Omega. |e> has a natural linewidth Gamma. What's the condition to observe transparency around delta=0? How wide is the transparency window when you detune delta away from zero?

A: Condition is delta=Delta, i.e. the two-photon resonance.

The width of the EIT feature (for Delta=0) is Omega when Omega> Gamma, or Omega^2/Gamma for small Omega.

3. Assume you have EIT in a lambda configuration. If the strong coupling light induces AC Stark shifts, how do they affect the laser detunings necessary to obtain EIT?

A: The AC Stark shifts does not affect the EIT condition, but could shift the absorption position of single-photon and 2-photon process.

4. What does EIT provide for nonlinear optics? What is the feature of the real and imaginary part of the index of refraction in an EIT system?

A: EIT generates a large slope for the real part of n as a function of omega, where n is the index of refraction), and at the same time the imaginary part is close to zero (transparency). These features can be used for nonlinear optics.