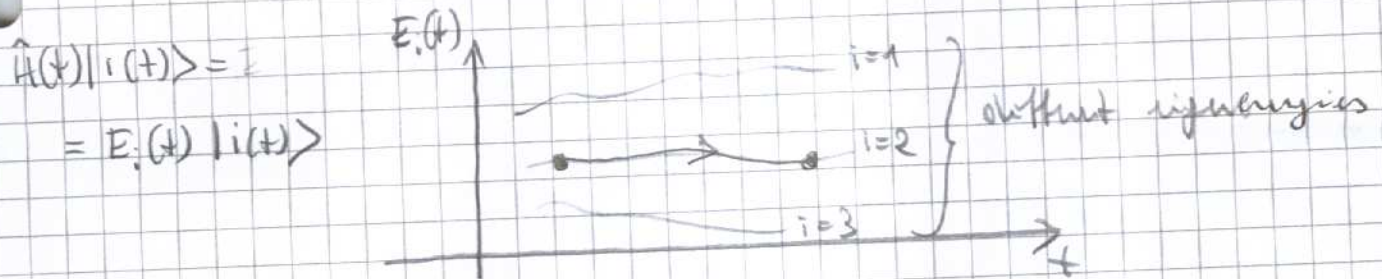


Address: light stopping and dynamic photonic structures

spatially homogeneous system: \hbar is conserved whatever
The evolution and time-dependence of H

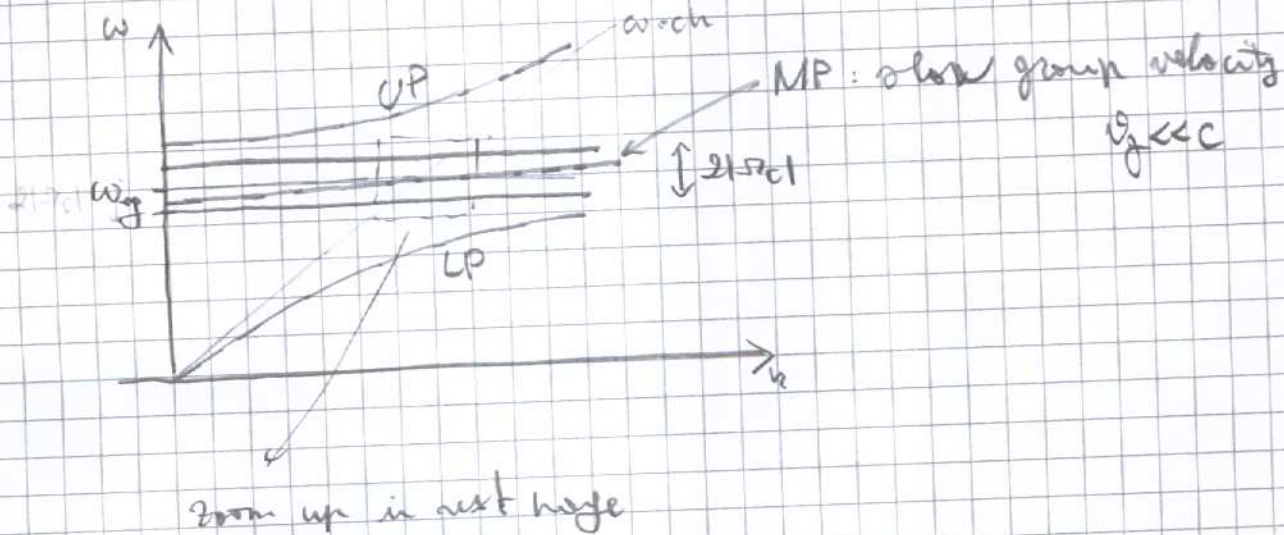
adiabatic regime: system follows eigenstate of $\hat{H}(t)$
varies slowly in time, $\tau \gg \frac{1}{\Delta\omega}$,
with $\Delta\omega =$ distance to neighboring state



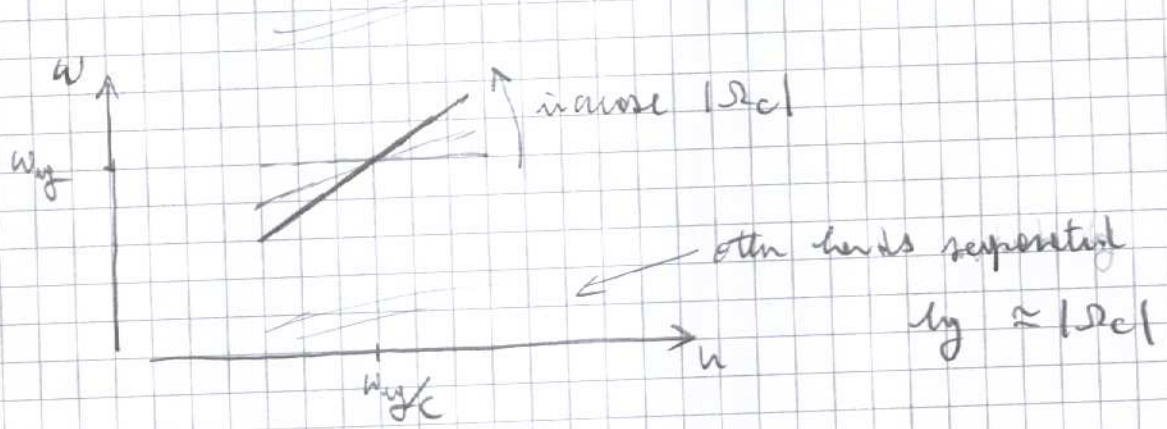
f.g.

$|a(t=0)\rangle = |2(t_0)\rangle \xrightarrow{\text{adiabatic}} |2(t_f)\rangle$ without mixing
to other states $|i(t_f)\rangle$
with $i \neq 2$

Polaritons in slow-light regime (resonant case $\omega_c = \omega_e - \omega_m$)



$$v_g = c \cdot \frac{16\pi^2}{3} \frac{|\Omega_c|^2}{\rho_c \omega_g} \frac{1}{n \frac{3}{\omega_g}} = \left. \frac{d\omega}{dn} \right|_{\omega = \omega_g/c}$$



Polariton $|MP, n\rangle_{\rho_c} \xrightarrow{\text{adiabatic}} |MP, n\rangle_{\rho_c^{-1}}$
 under a ramp of $\Omega_c(t)$ slow enough
 $\omega \approx \omega_{\text{pol}} \approx \Omega_c^{-1}$

Wavepacket → what superposition of $|MP, n\rangle$ with different n 's

propagates at v_g in space

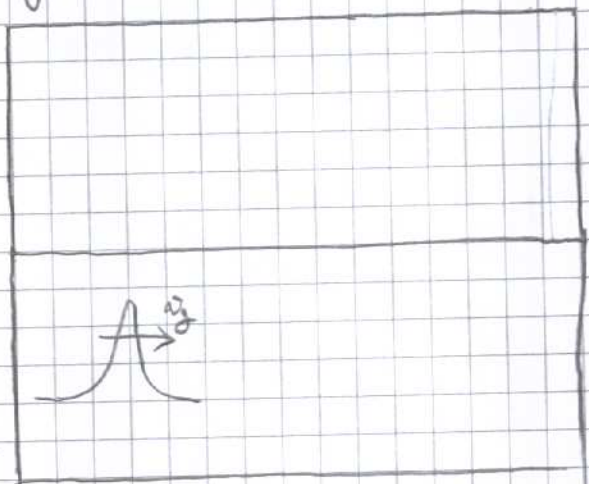
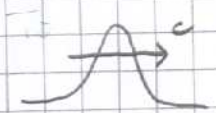
→ can be mixed with ρ_c

In particular: for $\rho_c \rightarrow 0$, $v_g \rightarrow 0$

LIGHT STOPPING

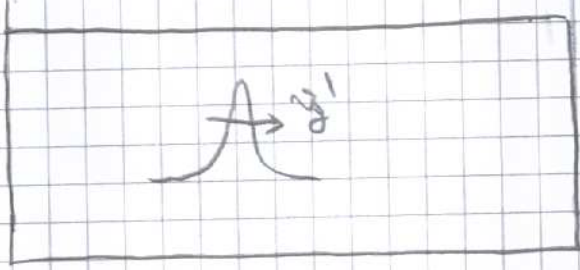
long slab of EIT medium

1) incident wavepacket for outside



2) enters in medium and propagates at v_g scaled length by $\frac{v_g}{c}$

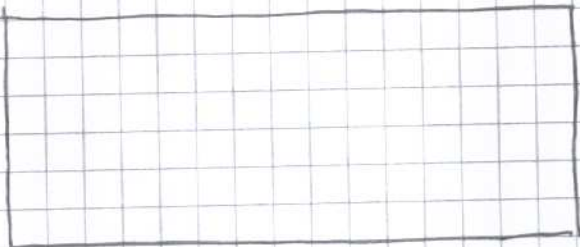
3) once up is fully in medium: resp of $\Omega_c \rightarrow \Omega_c'$



→ v_g becomes v_g' (possibly with $v_g' = 0 \rightarrow$ light stopping)
 → length unchanged

possible other ways of Ω_c

n) wavepacket exits the medium



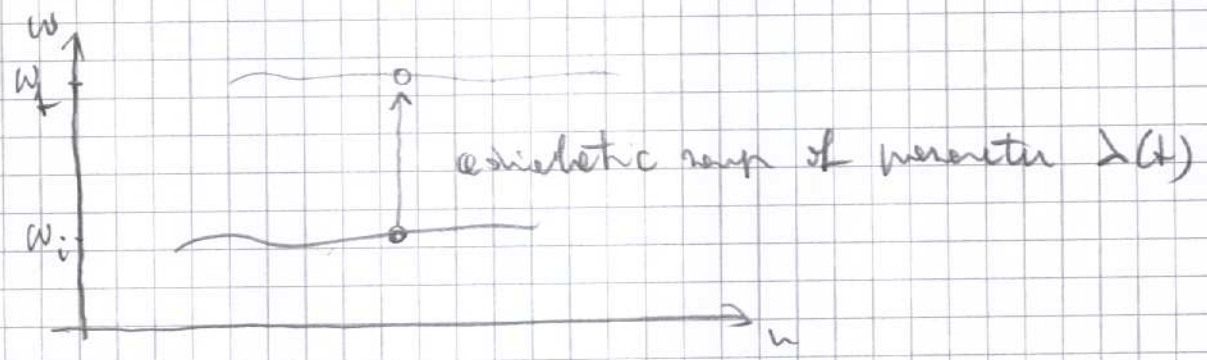
NOTE: properties of medium are modified while wavepacket is fully in medium →
 → behaves as effectively infinite system
 → wavepacket shape unchanged

DYNAMIC PHOTONIC STRUCTURE

DYNAMIC PHOTONIC STRUCTURE

Another example of dynamic photonic structure:

PHOTON ENERGY LIFTER



photon enters at $\omega_i \longrightarrow$ exits at ω_f

- carrier frequency changes (by arbitrary $\Delta\omega$)
- wavepacket shape preserved.

\longrightarrow process preserves coherence, so can be used in quantum devices

Bibliography:

- Yarnik-Fer, "Dynamic photonic structures", *Stud. Appl. Math.* 115, 233-253 (2005)
- Fleischhauer, Imamoglu, Marangos, "EIT: optics in coherent media", *Rev. Mod. Phys.* 77, 633 (2005)