Gas Chromatography Infrared Spectrometry (GC/IR)

Instrumentation/Interface

- **Infrared Spectrophotometer determines the relative strengths and positions of the infrared region and plots the information on calibrated paper**
- **Gas Chromatograph partitions the sample as it passes through the column**
- **The two can be linked through glass column or vacuum tubes and other devices on more expensive equipment**

Gas Chromatography / Infrared Spectrometry

- **Capillary GC with IR specs can enable the separation and identifying the compounds**

- **The interface between the column and the detector is the main detail**

- **Small pipe (length 10-40 cm, diameter 1-3 mm) connected to column by narrow tubing**

- **Transmission of radiation occurs by multiple reflection off the wall**

GC/ IR

- **Light pipe is heated in order to rid condensation and maximize path length for enhanced sensitivity**

- **This also minimizes the dead volume to lessen band broadening**

- **Detector - highly sensitivity, liquid nitrogen cooled**

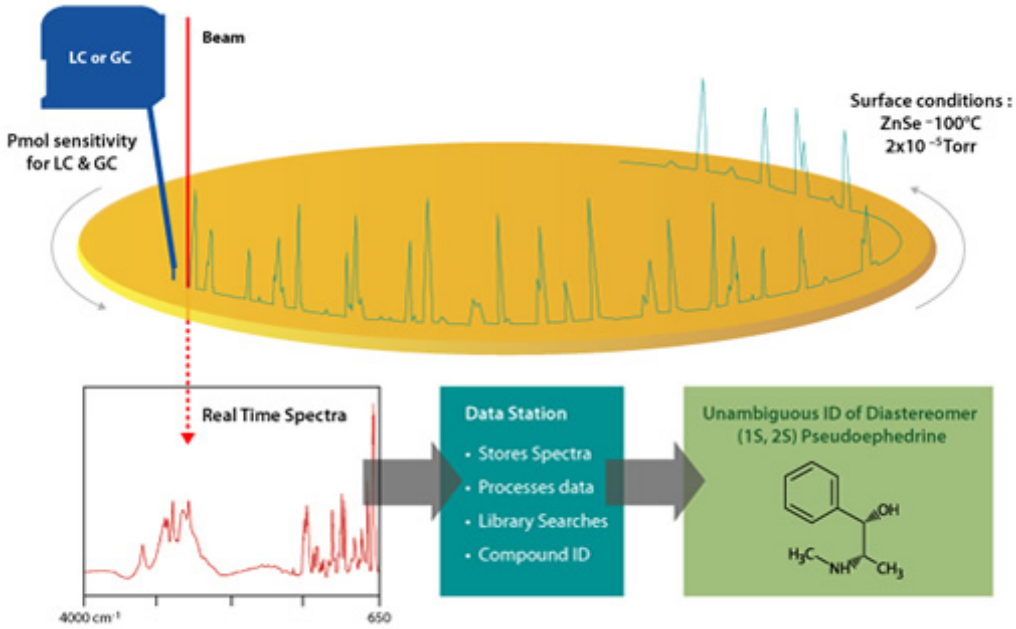
- **Scanning is started and a brief delay is needed for compound to travel form the detector region to the IR cell**

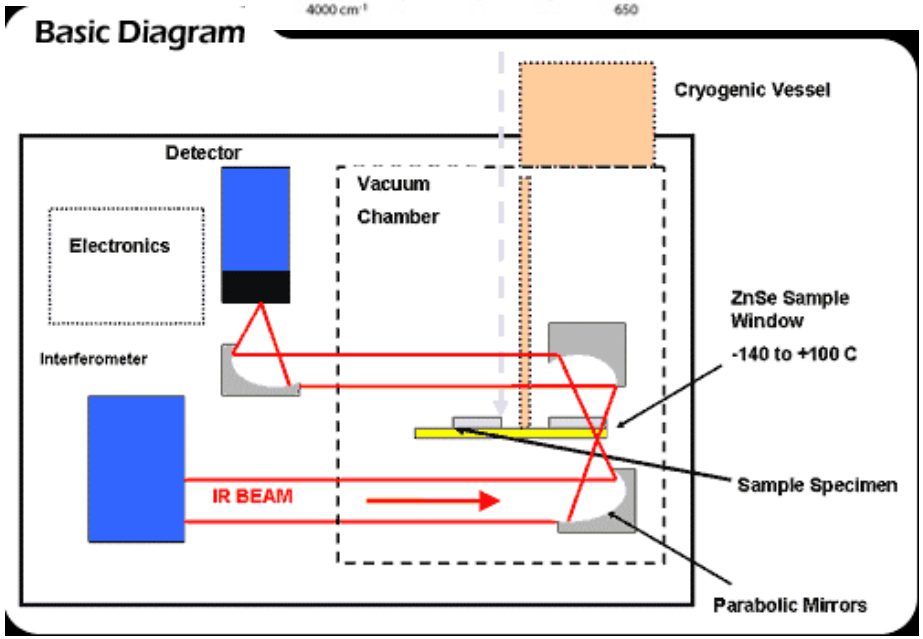
More on General GCIR

- **Very sensitive**
- **very expensive**
- **sample recovery**

Practical Uses

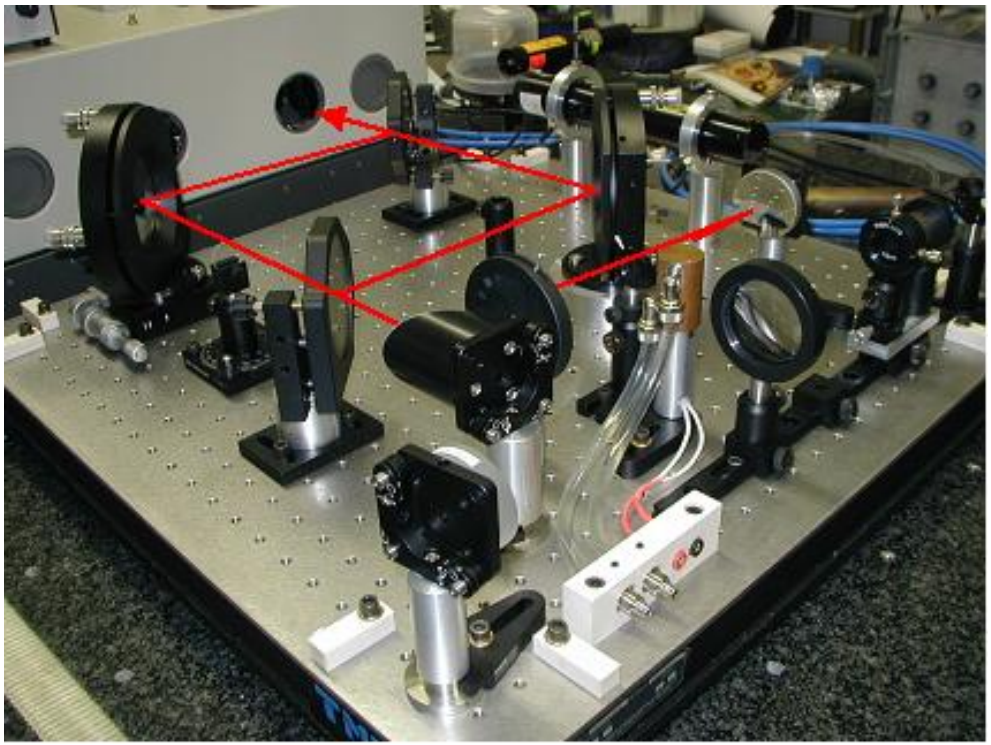
- **Pharmaceutical**
- **Industrial**
- **DNA Analysis of blood samples, other fluids**
- **many others**


LC or GC
Beam
Pmol sensitivity
for LC & GC
Surface conditions :
ZnSe -100°C
2x10 -5Torr
Real Time Spectra
4000 cm-1
650
Data Station
• Stores Spectra
• Processes data
• Library Searches
• Compound ID
Unambiguous ID of Diastereomer
(1S, 2S) Pseudoephedrine
OH
H3C
NH
CH3


Basic Diagram
Cryogenic Vessel
Detector
Vacuum
Chamber
Electronics
Interferometer
ZnSe Sample
Window
-140 to +100 C
IR BEAM
Sample Specimen
Parabolic Mirrors

White-light interferometry

Fourier-transform Spectrometer + Mach-Zehnder Interferometer



$$\phi(\omega) = k(\omega)D$$

Photonic band dispersion

$$\omega = \omega(k)$$

$$v_g = \frac{d\omega}{dk} = \frac{D}{d\varphi / d\omega}$$

Group velocity

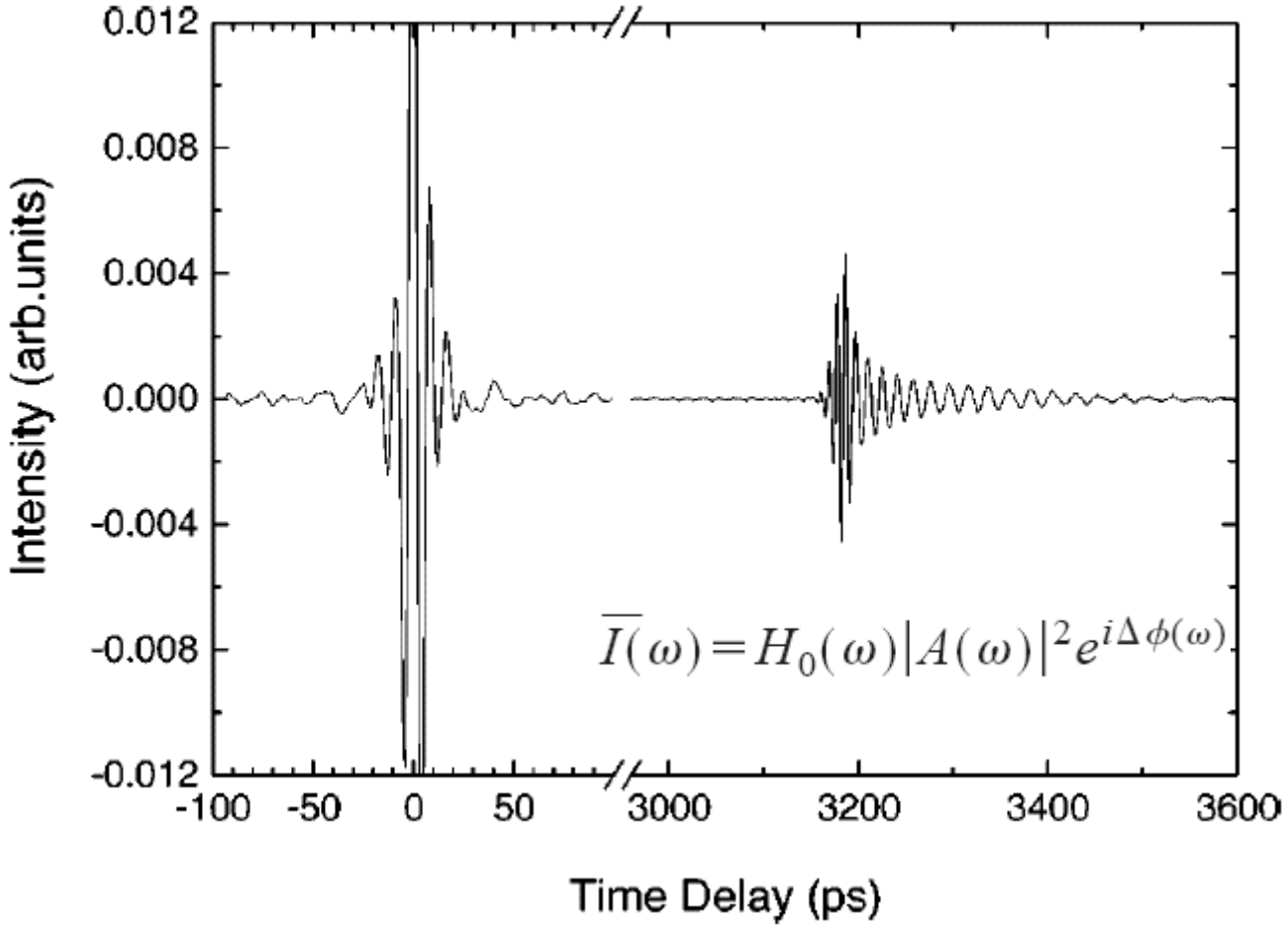
$$E(t)=\int_{-\infty}^{+\infty}[A(\omega)e^{i\omega t}+H(\omega)A(\omega)e^{i\omega(t+\Delta L/c)}]d\omega$$

$$I(\tau)=\int_{-\infty}^{+\infty}E(t)E^{\star}(t-\tau)dt$$

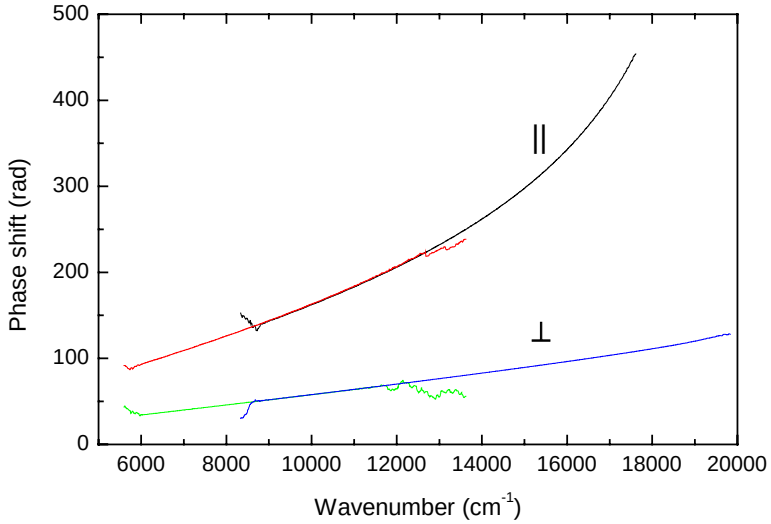
$$=\int_{-\infty}^{+\infty}H(\omega)^{\star}|A(\omega)|^{2}e^{i\omega(\tau-\Delta L/c)}d\omega$$

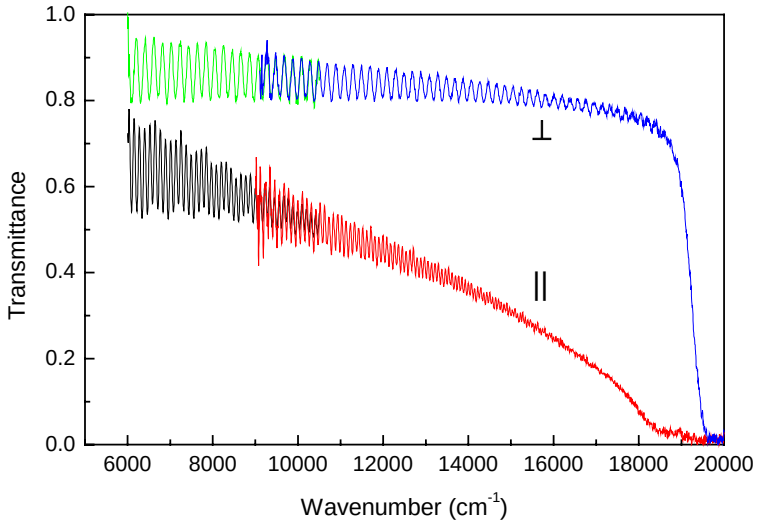
$$+\int_{-\infty}^{+\infty}(|A(\omega)|^{2}+|H(\omega)A(\omega)|^{2})e^{i\omega\tau}d\omega$$

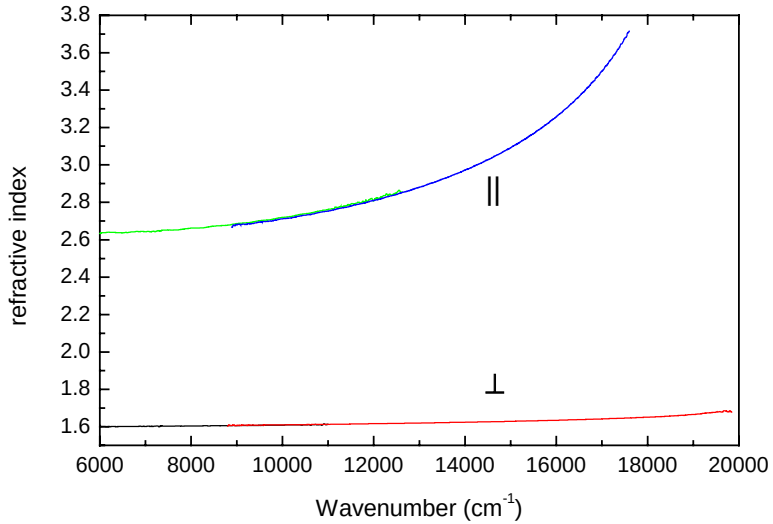
$$+\int_{-\infty}^{+\infty}H(\omega)|A(\omega)|^{2}e^{i\omega(\tau+\Delta L/c)}d\omega.$$

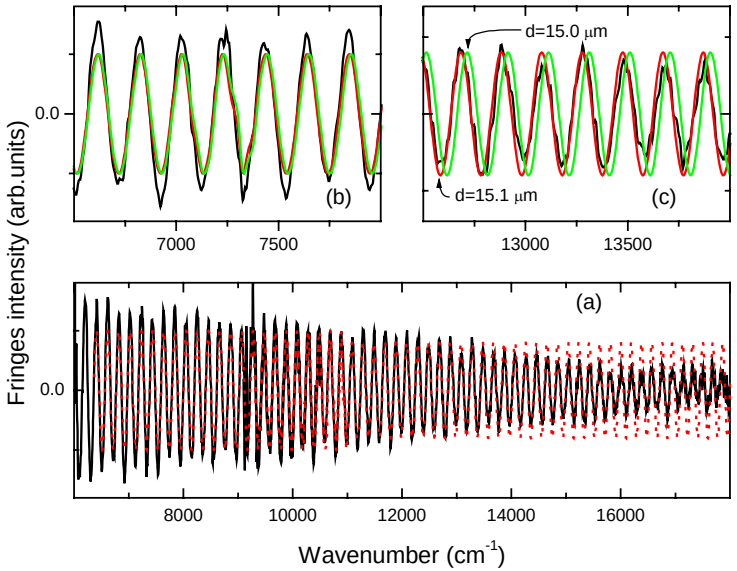

0.012
0.008
0.004
0.000
-0.004
-0.008
-0.012
Intensity (arb.units)
-100
-50
0
50
3000
3200
3400
3600
Time Delay (ps)
$\overline{I}(\omega) = H_0(\omega)|A(\omega)|^2 e^{i\Delta\phi(\omega)}$

Interferometric determination of the anisotropic refractive index dispersion of poly-(p-phenylene-vinylene)

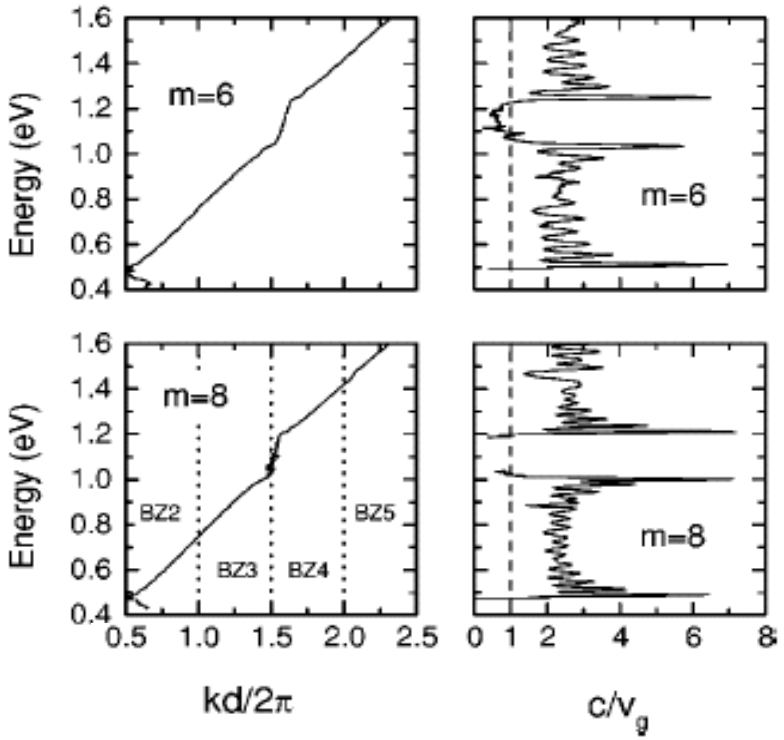


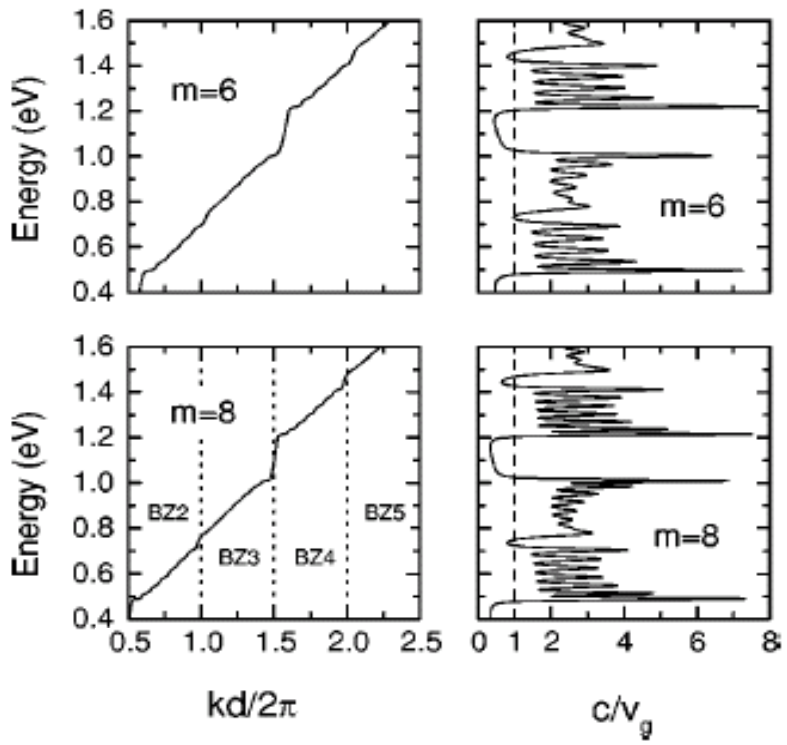






Misura del ritardo di fase con Interferometro di Mach-Zehnder

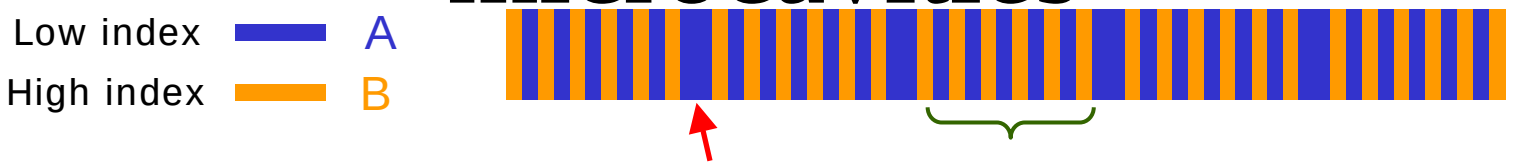




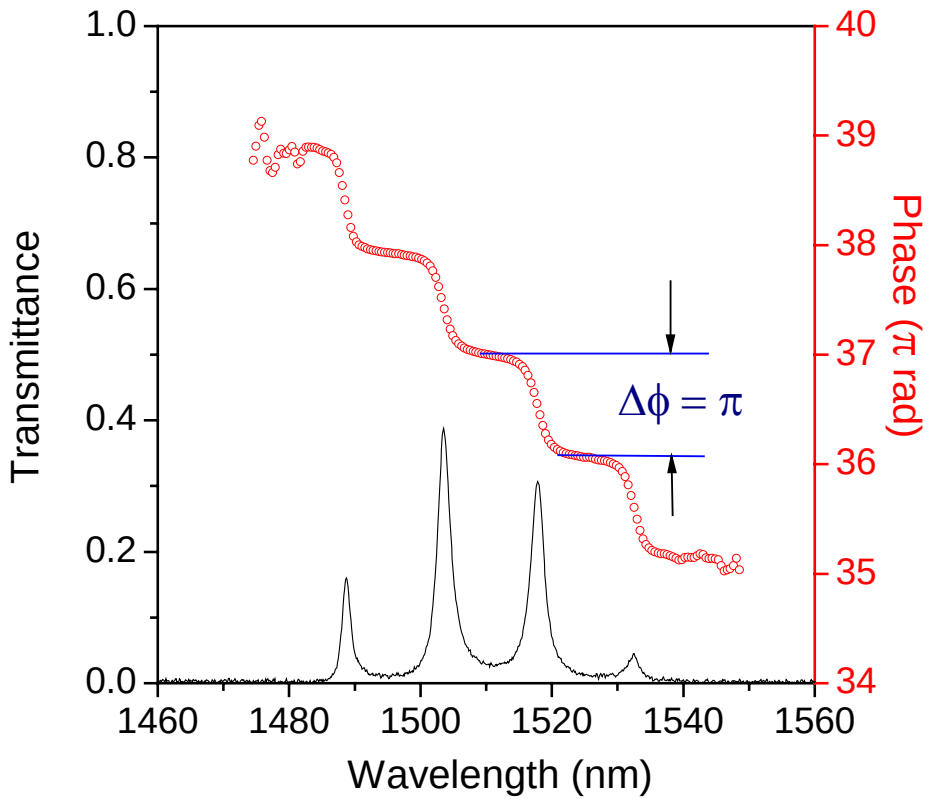
Esperimento e Teoria (Andreani)

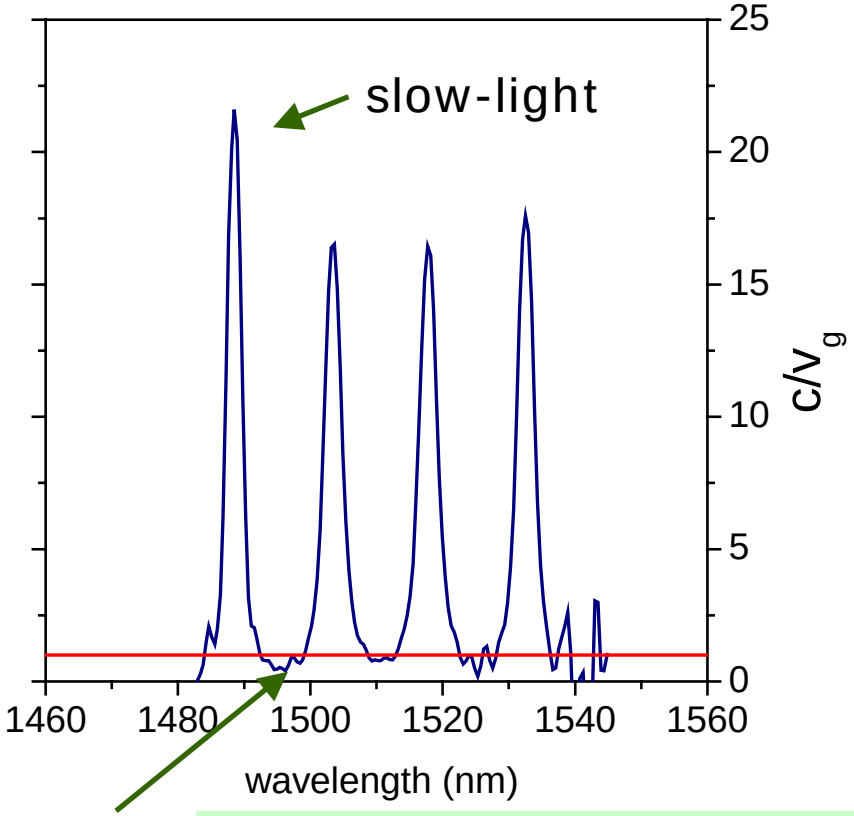
Curve di dispersione dei modi di propagazione della luce in strutture fotoniche

Porous Silicon coupled microcavities



Layer sequence: 6.5AB-AA-6.5AB-AA -6.5AB-AA -6.5AB-AA -6.5AB





Superluminal group velocity!

Ghulinyan *et al.* Appl. Phys. Lett. 88, 241103 2006