

Pulse Shaping Continued

1) VIPAs

- Direct Space to time mapping

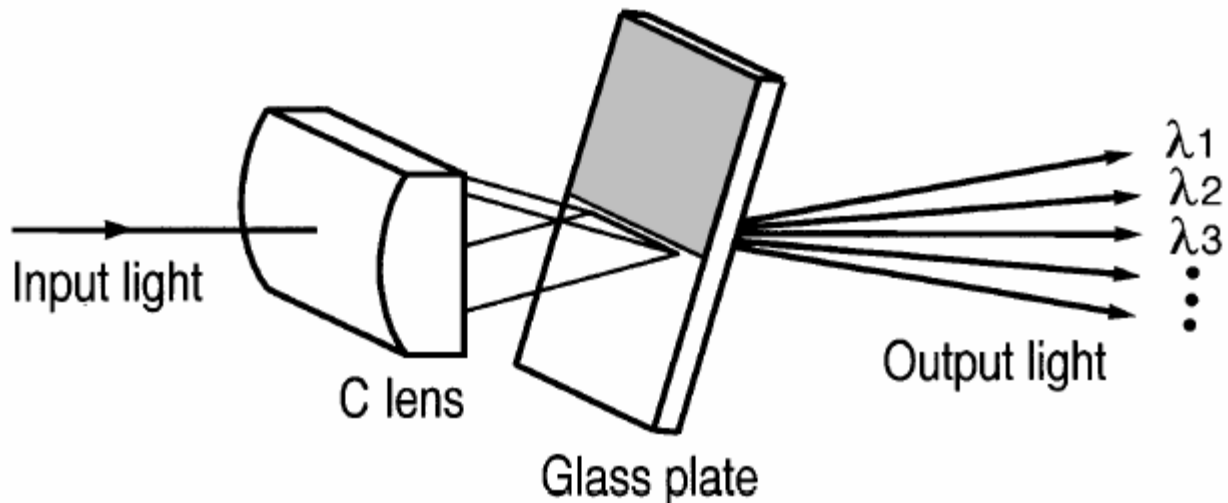
Virtually Imaged Phased Array (VIPA)

There are practical limits to the resolution achievable with gratings

→ Replace the grating with a VIPA

VIPA: basically a side-entrance etalon

Interference produces angular dispersion



VIPA Dispersion Equation

Constructive interference occurs for

$$\overline{ABC} - \overline{AD} = 2m\pi$$

for integer m

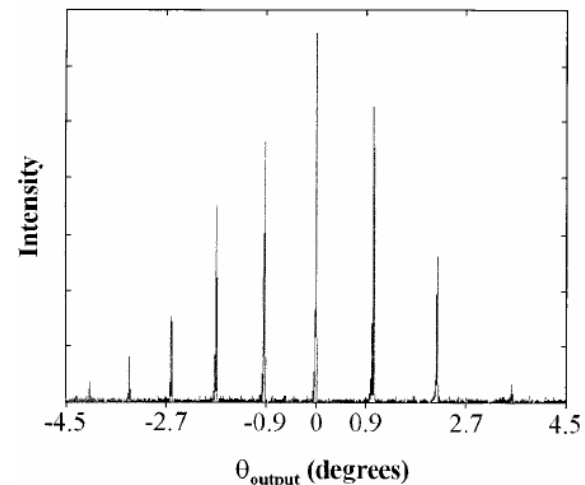
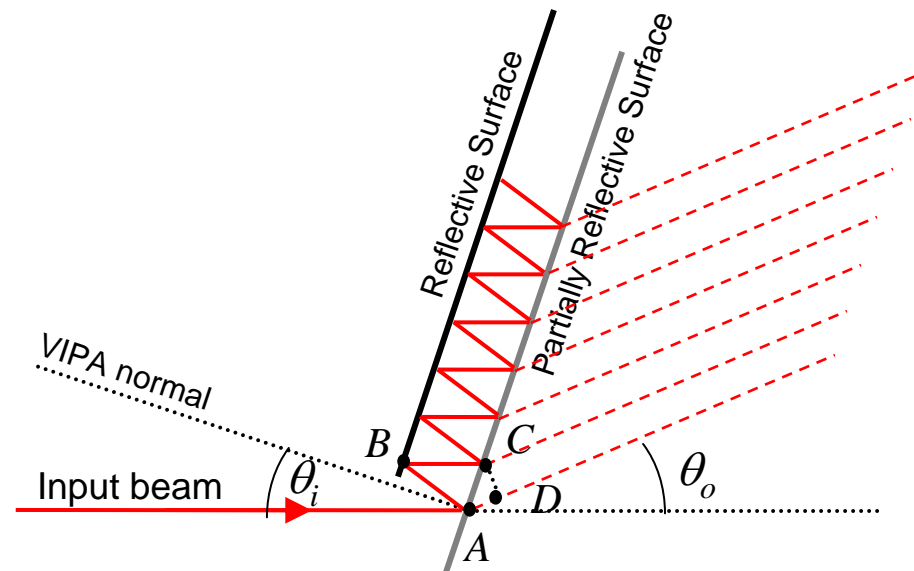
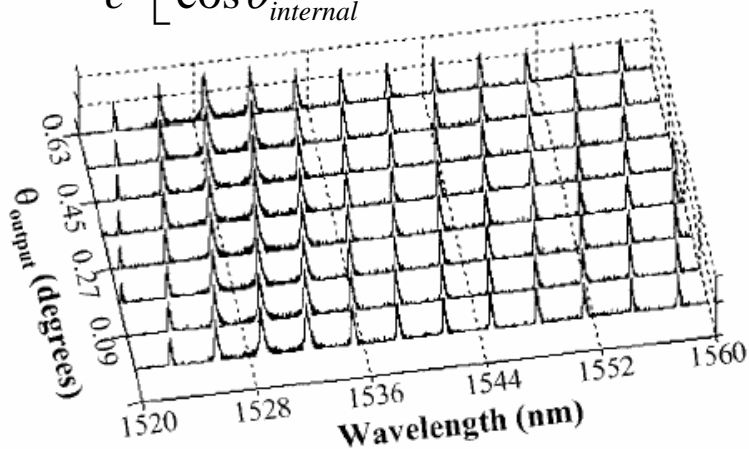
For an air-spaced etalon, this gives

$$\omega \frac{2L}{c} \left[\frac{1}{\cos \theta_i} - \tan \theta_i \sin(\theta_i + \theta_o) \right] = 2m\pi$$

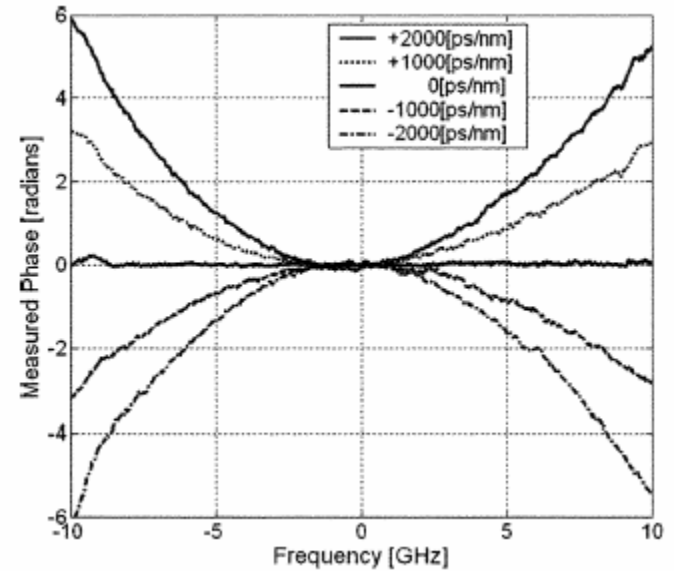
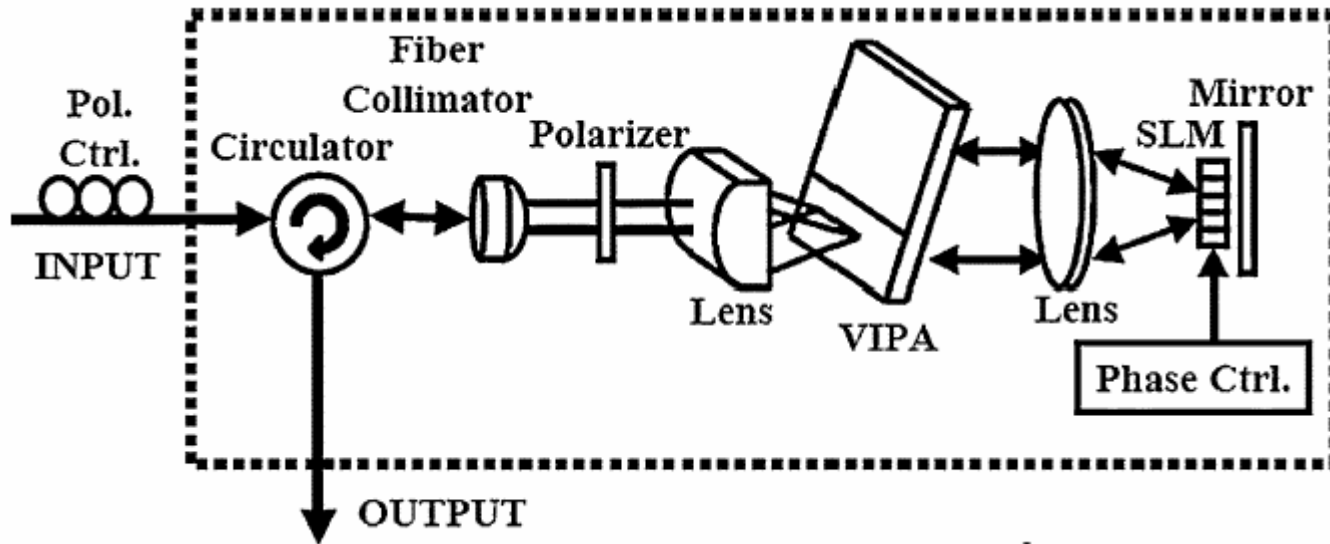
$$FSR = \frac{2L}{c} \left[\frac{1}{\cos \theta_i} - \tan \theta_i \sin(\theta_i + \theta_o) \right]^{-1}$$

For a solid etalon, this gives

$$\omega \frac{2L}{c} \left[\frac{n}{\cos \theta_{internal}} - \tan \theta_{internal} \sin(\theta_i + \theta_o) \right] = 2m\pi$$



VIPA Pulse Shaping



Direct Space-to-Time (DST) Pulse shaping

The standard pulse shaping technique maps space to frequency

→ A pixel on the SLM corresponds to a frequency in the output

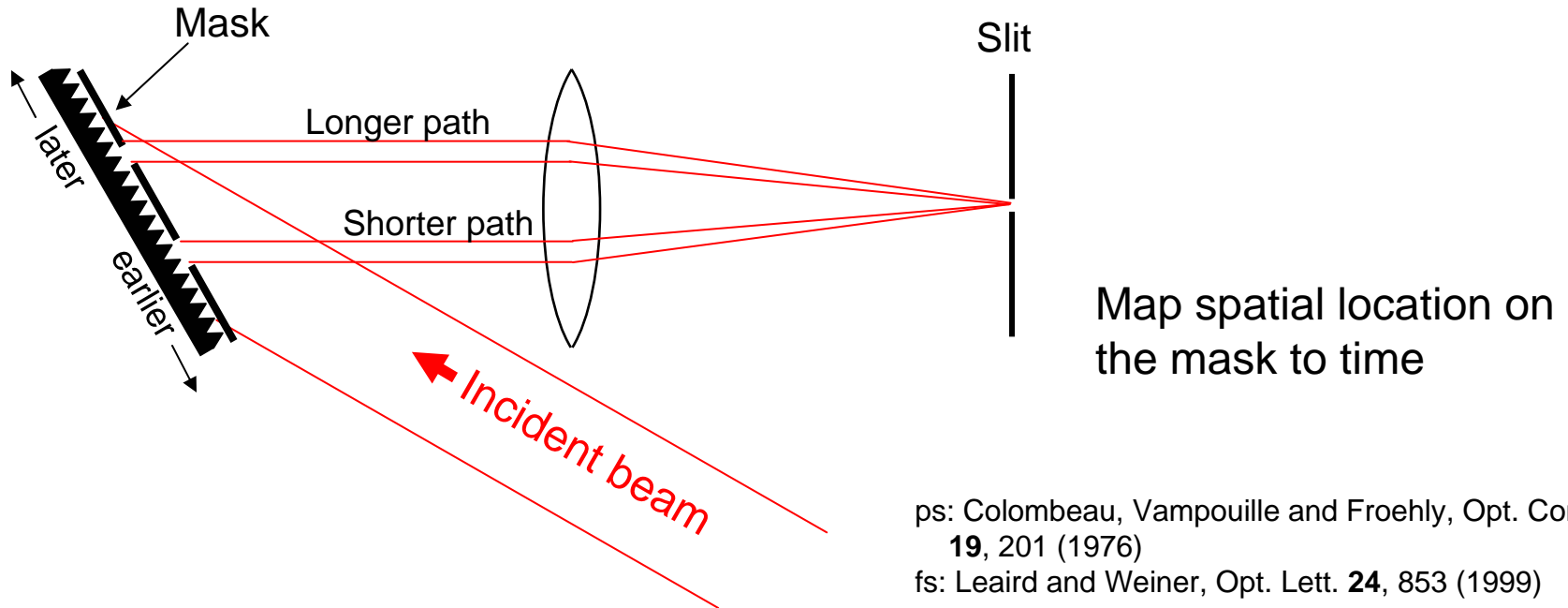
It is sometimes more convenient to map space to time

Avoid taking Fourier transform

example: serial to parallel conversion of data

How can we implement such direct space-to-time pulse shaping?

→ Utilize tilted pulse fronts



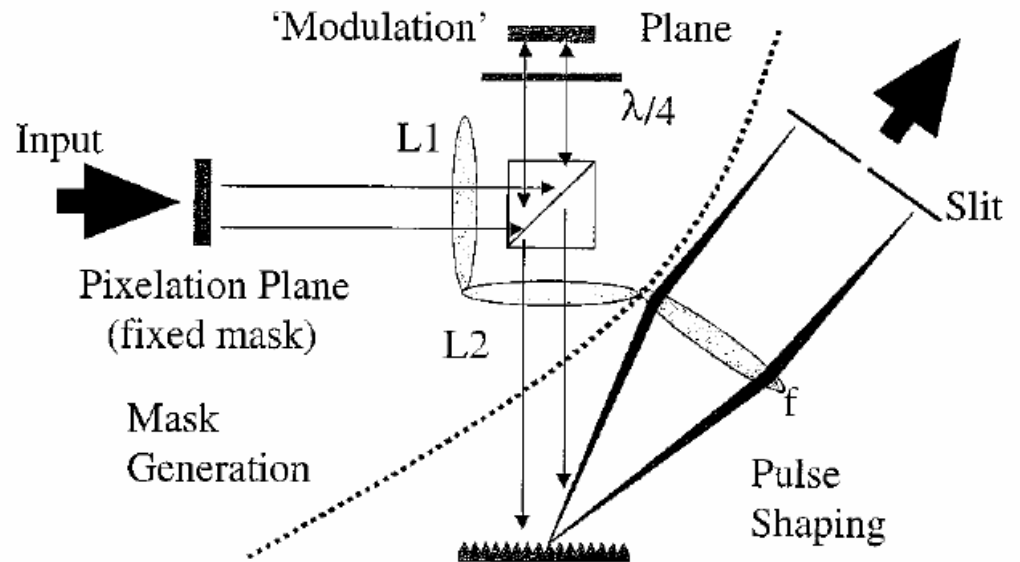
ps: Colombeau, Vampouille and Froehly, Opt. Commun. **19**, 201 (1976)

fs: Leaird and Weiner, Opt. Lett. **24**, 853 (1999)

DST pulse shaping apparatus

Physically putting the mask on the grating is difficult

→ Image mask plane onto grating



What about pulse duration?

Recall: spectral resolution is proportional to amount of grating illuminated

Narrower slit in mask → lower spectral resolution → shorter pulse through slit

Wider slit in mask → higher spectral resolution → longer pulse

Does position of slit matter?

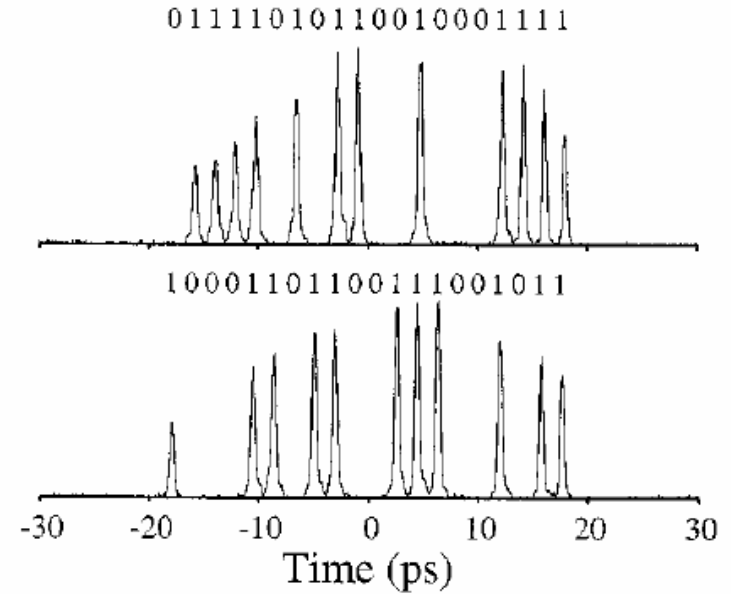
Determines center wavelength of output

Slit width?

→ Temporal window and efficiency (inverse of each other)

Examples of DST pulse shaping

Generation of “data packets”



Effect of moving output slit

