

# DR4: Microwave Satellite Radio

## Ultra-High Frequency, High-Fidelity AM Receiver

- (Conventional AM/FM radio: 530-1700 kHz, 2.3-26 MHz)
- (“UHF”: 300 MHz-3GHz → TV, mobile phone communications)
  
- Constraints
  - 20 X 20 mm Chip, <100 Photonic Devices, <1000 Electrical Devices
  - Optical Coupler, Bends, Splitter, Modulator, Splitter, Filter Bank, Detector, TIA
  
- Performance
  - Frequency response  $\gg$  10 kHz
  - SNR > 50 dB



# Waveguide Design

# Waveguide Design

- Materials and dimensions
- Cladding
- Mode
- Performance: loss, dispersion, coupling



# Filter Design

# Filter Design

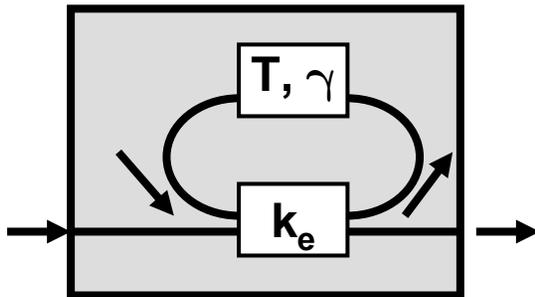
- Waveguide: materials and dimensions
- Radius
- Order
- Q
- Tuning
- Coupling
- Performance: center frequency, channel width, channel separation



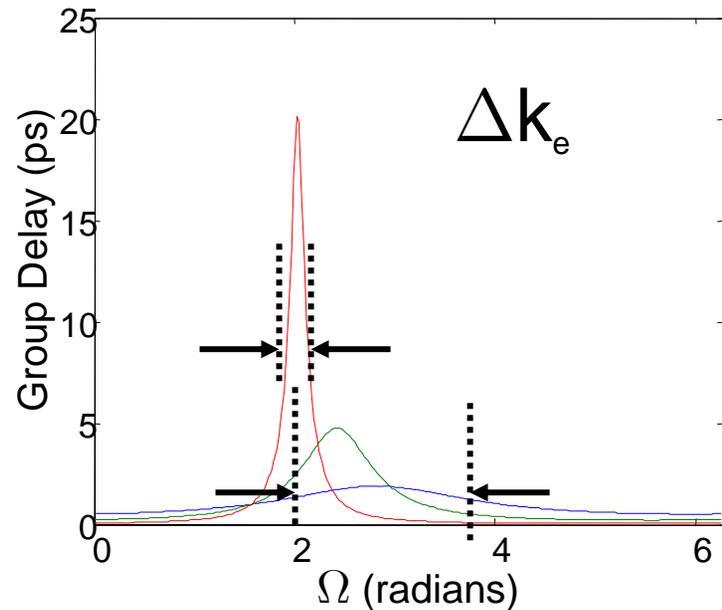
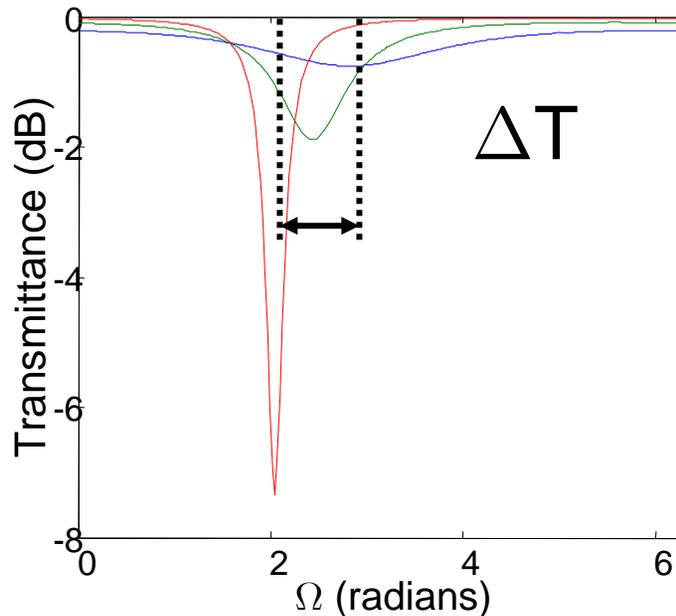
# Ring Resonator

# Ring Resonator

Transmittance and group delay give resonator coupling and loss



$T$  = delay  
 $\gamma$  = resonator loss  
 $k_e$  = coupling



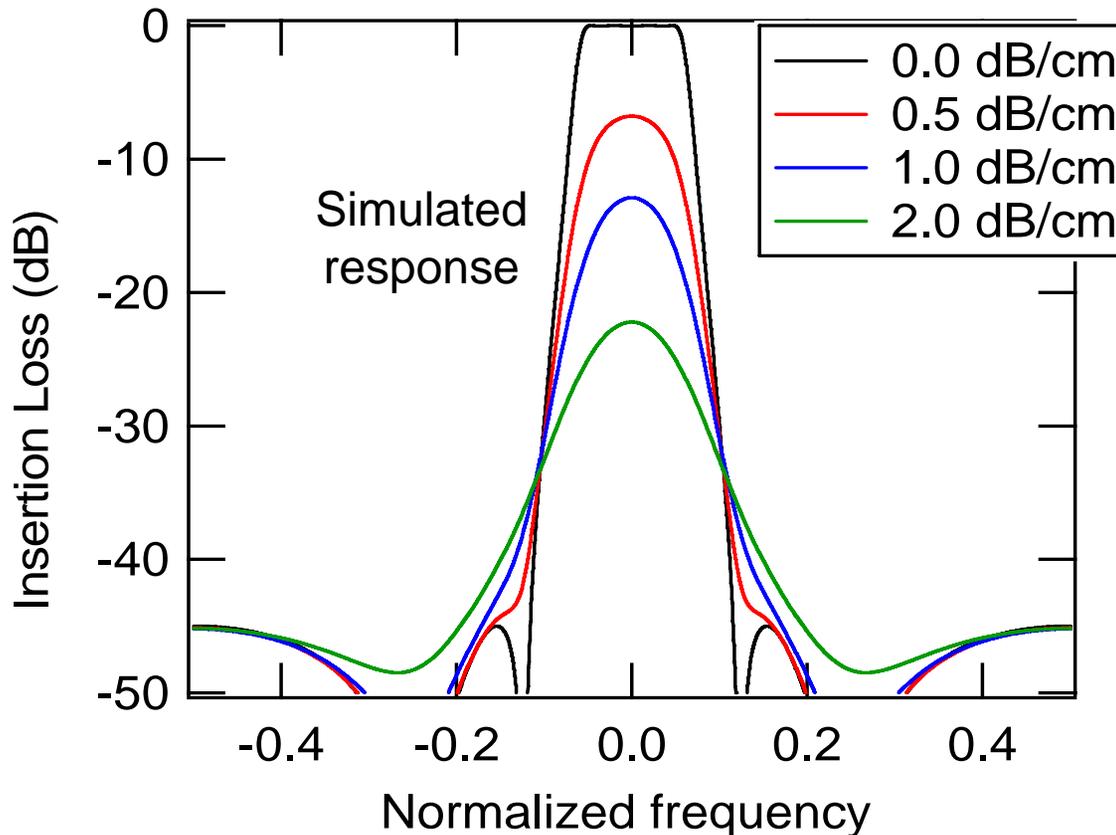


# Filter Performance

# Filter Performance

Required Performance:

- Low loss and Tunable



## Waveguide loss

- Dramatic increase in the filter insertion loss
- Rounding of passband
- Reduction in stopband



# Splitter Design

# Splitter Design

- Materials and dimensions
- Device
- Waveguide coupling
- Performance: insertion loss, power distribution



# Detector Design

# Detector Design

- Materials and dimensions
- Device
- Waveguide coupling
- Electronics
- Performance: bandwidth, quantum efficiency, linearity, dynamic range



# Modulator Design

# Modulator Design

- Materials and dimensions
- Device
- Waveguide coupling
- Electronics
- Performance: linearity, extinction ratio,  $V_{\pi}$

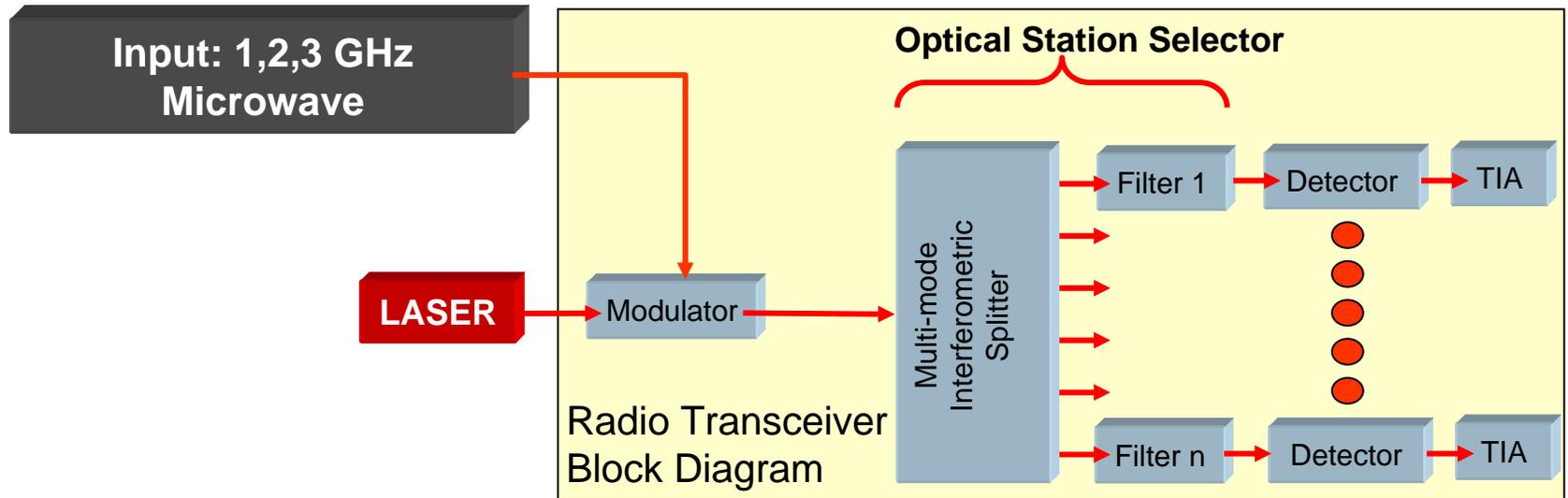


# Ultra-High Frequency AM Radio

Building a High-Fidelity AM Receiver

# Ultra-High Frequency AM Radio

## Building a High-Fidelity AM Receiver



(Conventional AM/FM radio: 153-279 kHz, 0.530-1.7 MHz, 2.3-26 MHz)  
("UHF": 300 MHz - 3 GHz → TV, mobile phone communications)

- 20 X 20 mm Chip, <100 Photonic Devices, <1000 Electrical Devices
- Optical Coupler, Bends, Splitter, Modulator, Splitter, Filter Bank, Detector, TIA
- Goal
  - Frequency response  $\gg 10$  kHz
  - SNR  $> 50$  dB