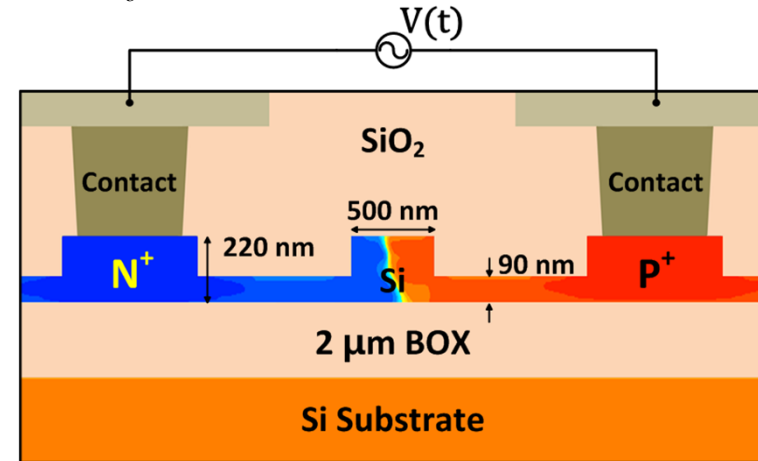
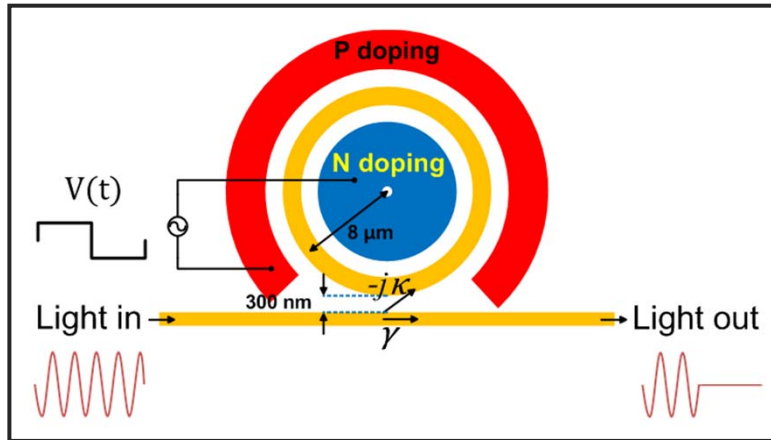
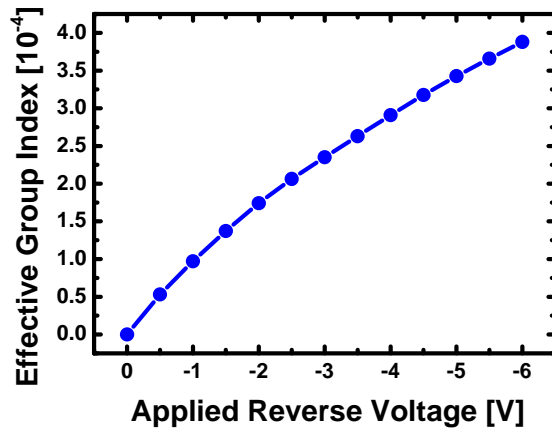


Dynamics Modeling of MRM

- Input optical signal $E_i = E_0 \exp(j\omega t) \longrightarrow E_o$



- Input electrical signal $V(t) \longrightarrow \eta(t)$

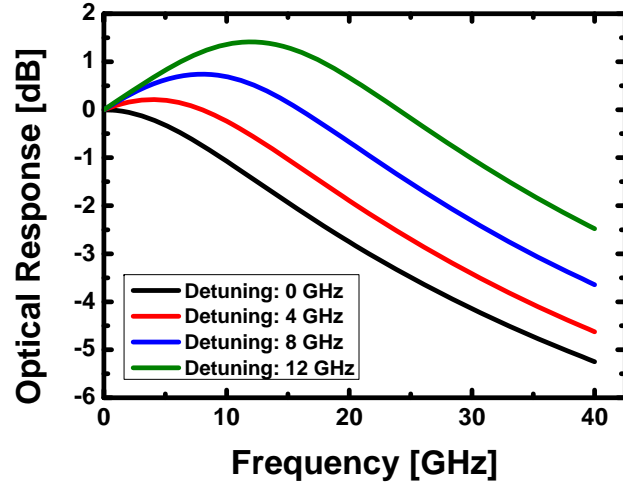


Plasma Dispersion Effect

Voltage Change \rightarrow Refractive Index Change

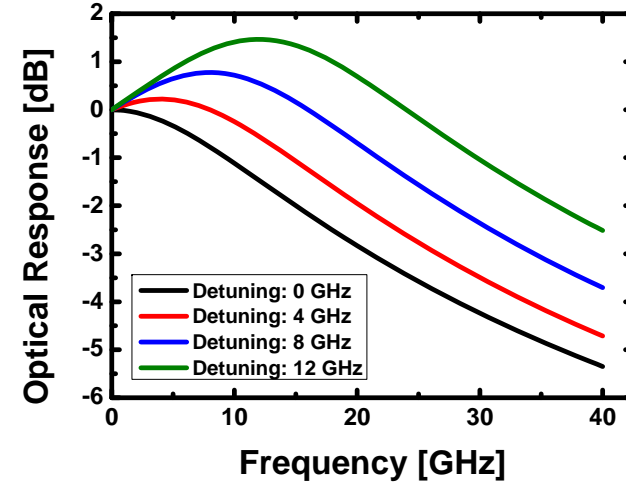
Dynamics Modeling of MRM

ROUND-TRIP APPROACH



$$\begin{aligned}
 E^t &= \left[\gamma - \kappa^2 \alpha \exp(-j\theta_1) - \kappa^2 \alpha^2 \gamma \exp(-j\theta_2) - \dots \right] E^i \\
 &= \left[\gamma - \kappa^2 \sum_{n=1}^{\infty} \alpha^n \gamma^{n-1} \exp(-j\theta_n) \right] E^i(t) \\
 \theta_n &= n\eta_m k_0 L + \sum_{k=1}^n \int_{z=0}^{z=L} k_0 \eta(t - kT + z/v_g) dz \\
 &= n\eta_m k_0 L + \sum_{k=1}^n k_0 v_g \left[N(t - (k-1)T) - N(t - kT) \right] \\
 &= n\eta_m k_0 L + k_0 v_g \left[N(t) - N(t - nT) \right]
 \end{aligned}$$

COUPLED-MODE APPROACH



$$\begin{aligned}
 \frac{d}{dt} a_n &= \left(j\omega_{0n} - \frac{1}{\tau_n} \right) a_n - j\mu_n E^i, \quad E^t = E^i - j\mu a \\
 b_n(t) &= \left(j\omega_{0n} - \frac{1}{\tau_n} \right) t \\
 a_n(t) &= \exp(b(t)) \int_c^t \exp(-b(v)) (-j\mu(v)) E_0 \exp(j\omega v) dv \\
 a_n(t) &= A_n \exp\left(j\omega_{0n} t - \frac{1}{\tau_n} t \right) - \frac{j\mu_n E_0}{j(\omega_n - \omega_{0n}) + \frac{1}{\tau_n}} \exp(j\omega t)
 \end{aligned}$$