

Fabry-Perot Michelson Model

- Find the optimum demodulation phases
 - Maximize BS DoF at AS Q (both f_1 , f_2)
 - Maximize DARM DoF at AS Q (both f_1 , f_2)
 - Maximize CARM DoF at REFL I (both f_1 , f_2)
- How the optimum phase is determined?
- Do they agree with the analytical calculations?

For f1,
 $\sin(\alpha) \sim 0.92, \cos(\alpha) \sim 0.38$
 $\alpha = l_- \omega_m / c,$
 $\beta = l_+ \omega_m / c$

	DARM	MI	CARM
V1 (AS Q)	$-J_0 J_1 E_1 ^2 r'_{\text{reso}} r_{\text{anti}}$ $\times \cos\beta \sin\alpha$	$-J_0 J_1 E_1 ^2 r_{\text{reso}} r_{\text{anti}}$ $\times \cos\beta \sin\alpha$	0
V2 (REFL I)	$-J_0 J_1 E_1 ^2 r_{\text{reso}} r'_{\text{anti}} $ $\times \cos\beta \sin\alpha$	$J_0 J_1 E_1 ^2 r_{\text{reso}} r_{\text{anti}}$ $\times \cos\beta \sin\alpha$	$-J_0 J_1 E_1 ^2 r'_{\text{reso}} r_{\text{anti}}$ $\times \sin\beta \cos\alpha$
V3 (REFL Q)	$J_0 J_1 E_1 ^2 r_{\text{reso}} r'_{\text{anti}} $ $\times \sin\beta \sin\alpha$	$-J_0 J_1 E_1 ^2 r_{\text{reso}} r_{\text{anti}}$ $\times \sin\beta \sin\alpha$	$-J_0 J_1 E_1 ^2 r'_{\text{reso}} r_{\text{anti}}$ $\times \cos\beta \cos\alpha$

Table made by Koyama-kun,
 Analytical calculation by Ando's master thesis

FPMI Sensing Matrix (f1, 16.88MHz)

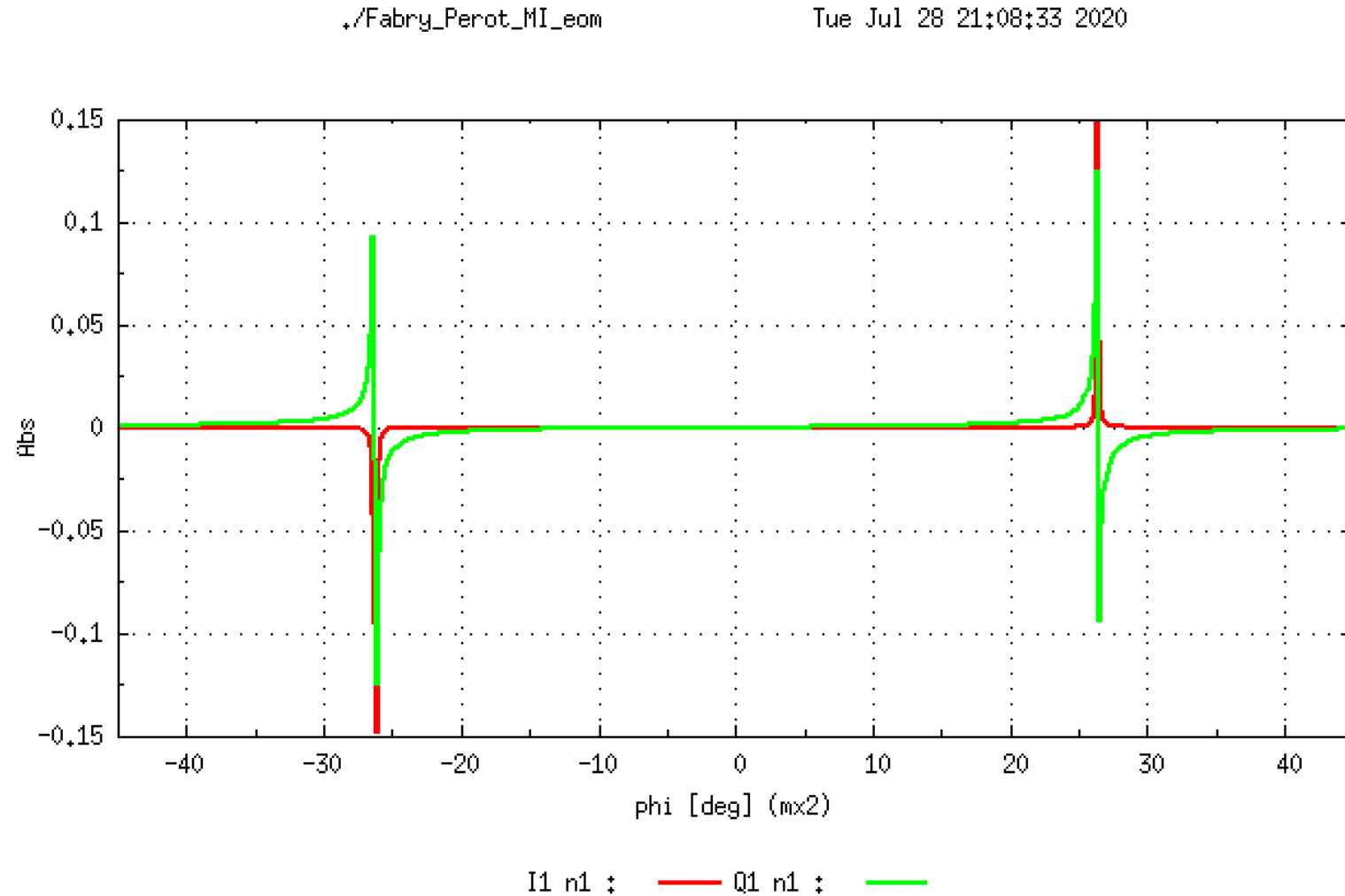
	DARM	MI	CARM
V1 (AS Q1)	4.35	0.0044	0
V2 (REFL I1)	0	0	-3.6
V3 (REFL Q1)	4.5e-5	-0.0045	0

Be careful of fake signal
weak (see, next page)

Demod phases I = 66.2 , Q = 156.2
 $I_{\text{sym}} * 16.881\text{e}+6 * 2 * \pi / c * 180 / \pi - 360 * 3 = -66.5$

This column might be x2
Depending on definitions

DARM error signals REFL I2 and Q1 (v2 and v3)



For f2,
 $\sin(\alpha) \sim 0$, $\cos(\alpha) \sim 1$,

	Φ- アーム差動	Φ- マイケルソン	Φ+ アーム同相
V1 (AS Q)	$-J_0 J_1 E_1 ^2 r'_{\text{reso}} r_{\text{anti}}$ $\times \cos\beta \sin\alpha$	$-J_0 J_1 E_1 ^2 r_{\text{reso}} r_{\text{anti}}$ $\times \cos\beta \sin\alpha$	0
V2 (REFL I)	$-J_0 J_1 E_1 ^2 r_{\text{reso}} r'_{\text{anti}} $ $\times \cos\beta \sin\alpha$	$J_0 J_1 E_1 ^2 r_{\text{reso}} r_{\text{anti}}$ $\times \cos\beta \sin\alpha$	$-J_0 J_1 E_1 ^2 r'_{\text{reso}} r_{\text{anti}}$ $\times \sin\beta \cos\alpha$
V3 (REFL Q)	$J_0 J_1 E_1 ^2 r_{\text{reso}} r'_{\text{anti}} $ $\times \sin\beta \sin\alpha$	$-J_0 J_1 E_1 ^2 r_{\text{reso}} r_{\text{anti}}$ $\times \sin\beta \sin\alpha$	$-J_0 J_1 E_1 ^2 r'_{\text{reso}} r_{\text{anti}}$ $\times \cos\beta \cos\alpha$

Table by Koyama-kun

For f2,
 $\sin(\alpha) \sim 0$, $\cos(\alpha) \sim 1$,

	Φ- アーム差動	Φ- マイケルソン	Φ+ アーム同相
V1 (AS Q)	0	0	0
V2 (REFL I)	0	0	$-J_0 J_1 E_i ^2 r_{\text{res}} r_{\text{anti}}$ $\times \sin \beta \cos \alpha$
V3 (REFL Q)	0	0	$-J_0 J_1 E_i ^2 r_{\text{res}} r_{\text{anti}}$ $\times \cos \beta \cos \alpha$

Table by Koyama-kun

FPMI Sensing Matrix (f2, 45MHz)

	Φ- アーム差動 DARM	Φ- マイケルソン MI	Φ+ アーム同相 CARM
V1 (AS Q2)	0	~0	0
V2 (REFL I2)	0	~0	9.4
V3 (REFL Q2)	0	~0	0

Be careful of fake signals

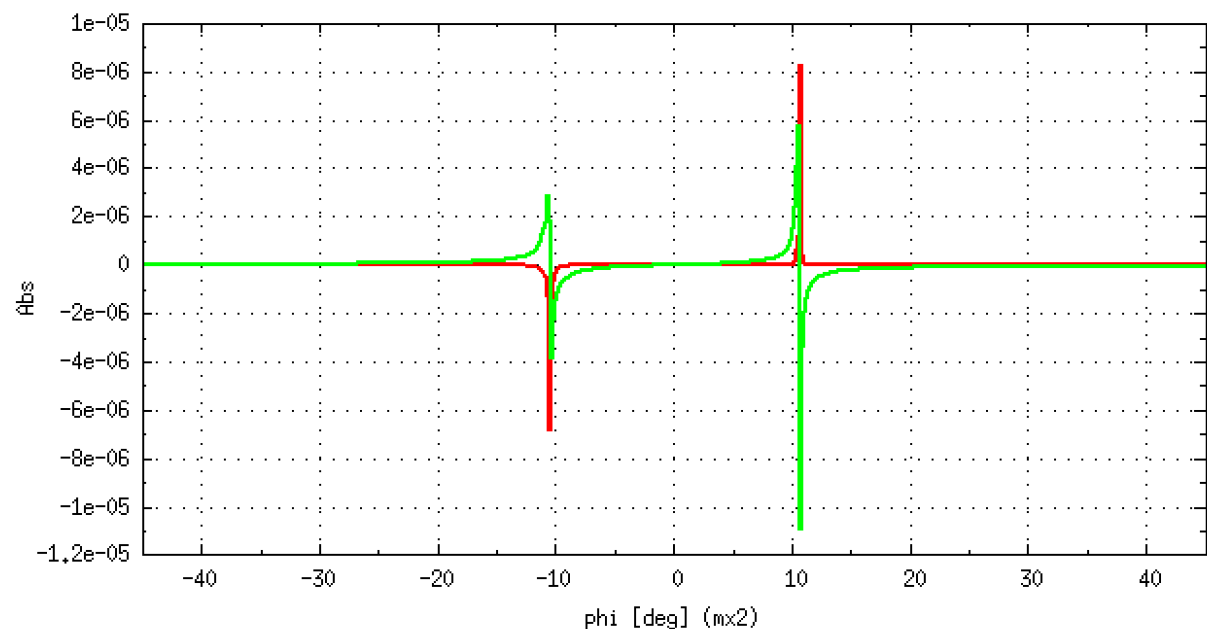
Demodulation phases I = 176.56 , Q = 266.56
$$I_{\text{sym}} * 45.0159 \text{e}+6 * 2 * \pi / c * 180 / \pi - 360 * 8 = -177.18$$

DARM error signals at AS and REFL

REFL

./Fabry_Perot_MI_eom

Tue Jul 28 21:14:00 2020



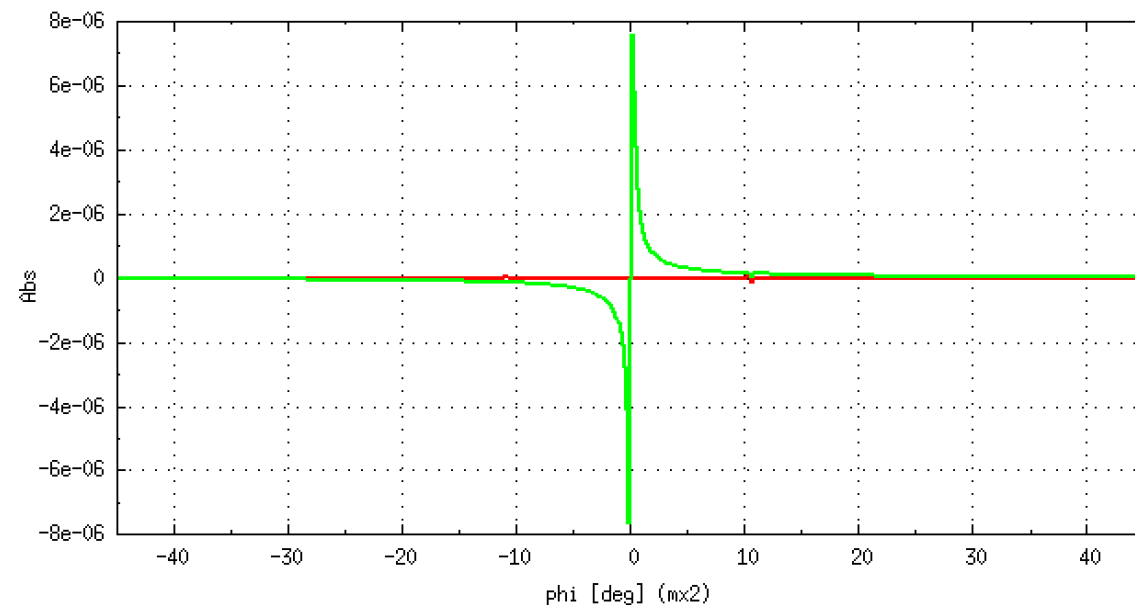
I2 n1 : — Q2 n1 : —

REFL: 0 まわりの傾きほぼなし

AS

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I2 n4 : — Q2 n4 : —

AS: 信号がありそうだが絶対値がものすごく小さい

Fabry-Perot Michelson Model

Parameter Summary

Parameter	Design values (lossless case)
Arm finesse	1550
Arm FSR	50 kHz
Arm cutoff frequency	16 Hz
Complex arm reflectivity (carrier resonant)	-0.996
Transmission at MI for f1	0.9239 (amplitude)
Transmission at MI for f2	0.000048 (amplitude)