

Considerations in Choosing an ISC

Sensing & Control Configuration

☆ Compatibility

- ❑ LSC/ASC schemes are coupled. Should be developed synchronously
- ❑ Baseline: RF PDH length sensing, WFS+Oplevs for ASC

☆ LSC

- ❑ DC Readout at the AS port (w/ OMC $f_{\text{pole}} \sim 1$ MHz)
- ❑ Frontal RF Modulation
- ❑ Baseline uses ~ 200 MHz RF. Let's change to $(f_1+f_2) < 100$ MHz as a soft requirement to ease electronics (detectors, demods, oscillators)
- ❑ Assume **100 mW** detected per PD (REFL (all), PO (1000 ppm), AS/100)
- ❑ Finite dynamic range RFPDs: 100 mVpk, 1 nV/rHz

☆ ASC

- ❑ Same readout ports as in iLIGO. Exploring DD, 3f, NRSB, etc.
- ❑ Optical Torsion Spring @ 6 Hz with 1 MW in arms. WFS bandwidth becomes ~ 15 Hz. iLIGO has ~ 5 Hz BW and 40 Hz GW frequency.
- ❑ Need very, very low noise WFS system. No more crappy iLIGO WFS.

LSC Considerations

★ Evaluate Sensing Schemes

- ❑ Use Finesse (or equivalent), develop SNR matrix using previous pages constraints on f_{mod} and PD range and detected power.
- ❑ Make a LSC 'Noise Budget' of couplings (L+, I+, I-, Is).
- ❑ First evaluate for baseline of 125 W; NS/NS tune. Later do 10 W, BH Tune

★ The Matrix

- ❑ Let's try to ignore having a 'diagonal' matrix; (we have digital controls)
- ❑ Γ budget: Less than 1% of carrier power robbed for each SB
- ❑ Explore all intermodulations: DiffDemod, DoubleDemod, 3f, SSB, NRSB, 1f, 2f, etc.

★ Controls

- ❑ Conservative assumption of factor of 30 subtraction via off-diag correction paths. iLIGO gets $\sim 100x$ for MICH & $\sim 10x$ for PRC.
- ❑ 50 Hz UGF for all the short DOFs, $1/f$ loops. CM Servo has 10 kHz BW.
- ❑ Pay no attention to Lock Acquisition. Will be developed by 40m team.

★ Evaluate Sensing Schemes

- ❑ Use Finesse (or equivalent), develop SNR matrix using previous pages constraints on f_{mod} and PD range and detected power.
- ❑ Make a ASC 'Noise Budget' of couplings.
- ❑ First evaluate for baseline of 125 W; NS/NS tune. Later do 10 W, BH Tune
- ❑ Will probably need to develop WFS w/ 10^{-16} rad/rHz sensitivities.

★ The Matrix

- ❑ Let's try to ignore having a 'diagonal' matrix; (we have digital controls)
- ❑ Γ budget: Less than 1% of carrier power robbed for each SB
- ❑ Explore all intermodulations: DiffDemod, DoubleDemod, 3f, SSB, NRSB, 1f, 2f, etc.
- ❑ Explore stable v. unstable recycling cavities (long & short).

★ Controls

- ❑ Conservative assumption of angle \rightarrow length coupling of 1 meter/radian.
- ❑ 15 Hz UGF to handle the optical stiffness. *Might* be relaxed for some DOF.