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LIGO Hanford Observatory Noise Investigations

There are three possible projects that can be focused on this summer, all of which will be noise investigation studies on the LIGO Hanford Interferometers. However, only one or two will be pursued. Such choices will be determined by the availability of access to the IFO complex. Some of these potential projects will involve researching a remediation to such sources of noise along with studies into the problem.

The first of such projects would be radio frequency (RF) studies which may include remediation. Currently, ISC RF source cabling of the approximately 13 dBm RF cables feature 20 μV to 100 mV (approximately 0.1 Vrms) cabling ground to ground level RF. This could possibly be the source of noise. It is believed that this should be less than 10 μVrms. It is proposed that we would spend time researching the problem. Then, different fixes would be tried and then evaluated on their success. If a fix is proven to work, it would be proposed that the fix be permanently installed into apparatus. The parts of the system that are suspected to be the root of the RF leakages are the DC ground isolations units and some RF or power connections of control modules. To investigate these items, there would need to be hands-on explorations in the LVEA ISC racks.

Another project that has been proposed is in the electronics lab. Subtle lines of combs (at about 1 Hz) have been observed in the GW CW data. This has particularly been seen at low frequencies. Study would be done on the test bench operation of the GPS Disciplined RF

Oscillators. From what has already been observed, the hardware elements do not seem to be the problem. However, the GPS 1 PPS control system seems to wander in phase. This can be as much as 20-30 ns over multi-second periods. This could have more of an effect than one might think.

The last of the proposed projects would be in the control room. This would involve a study of self and cross correlations in very low frequency noise of the interferometer. This noise has been seen to be approximately 0.1 to 10 Hz. The study would target the mysteries of the more than ten times actual noise to the GWINC predictions. The study would potentially be non-invasive and would use IFO control room monitoring systems or offline data. During Non-Science Observation periods, possible excitations would be led by Keita Kawabe. To aid in this study, a vertical mass oscillator of about 0.3 Hz could be created.

As previously stated, two of these three projects will be the subject of research throughout the summer. According to Dick Gustafson, access to the interferometer will only be allowed once per week. This will likely affect the choice of the projects and the rate of progress since my appointment is from June 11th to August 19th, 2017. This will allow for ten accesses in total. If a project turns out to be mostly analytical, there will potentially be an option for the continuation of the work after the program ends. Whichever projects are chosen, there will surely be an impact on the noise levels of the interferometer.