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Dear Award Committee,

I would like to nominate myself for the 2019 LIGO Laboratory Award for Excellence in Detector Characterization and Calibration, for the project of studying ***LIGO detector calibration systematic errors and uncertainties*** in the third observing run (O3). My well-defined and delivered contributions include: (1) made important contributions to build the pyDARM calibration models of the two Advanced LIGO detectors for the O3 run, (2) extended the studies of calibration systematic errors and their contributions to the detector's response, (3) estimated the O3 overall calibration uncertainty and delivered the final uncertainty products to the data analysis teams, and (4) leading a calibration paper describing the methods we use to minimize systematic errors in O3 calibration. A detailed description of my contributions is as follows.

Before O3 started and at the early stage of the run, I worked at both Livingston and Hanford sites, and made major contributions to construct the first O3 pyDARM calibration models in time at both sites. This project was conducted under supervision of calibration leaders Joe Betzwieser and Jeff Kissel, based on the existing pyDARM framework mainly developed by Evan Goetz, and in collaboration with all calibration team members. I conducted a significant amount of work in the full procedure of constructing a pyDARM calibration model, including taking and analyzing the measurements of the electronics and the DARM loop, estimating the model parameters, compensating for the known systematic errors, and understanding and quantifying the contribution of residual systematic errors from each component. At the mean time, I implemented a new feature to automatically estimate the overall calibration uncertainty, composed of residual systematic errors and statistical uncertainties, on an hourly basis, generating the answers of calibration uncertainty for C00 data in real time. I led the review of the early O3 calibration uncertainty during my stay at the detectors, and reported to the collaboration in the March LVC meeting on behalf of the O3 calibration team. I also helped with verifying and reviewing the GDS line cleaning features.

At later stages of the run, I kept working remotely on detector calibration from Caltech, monitoring and following up with the model updates, producing the calibration uncertainty estimates that are important to the CBC parameter estimation team to analyze the O3 events. When the C01 data sets were produced, I recalculated the calibration uncertainty budget on an hourly basis, and delivered the final uncertainty products for C01. In the end of Aug, interferometer changes were made in the signal recycling cavity and a new calibration model was installed at Hanford to reduce the systematic errors at low frequencies. I visited Hanford site again after this change, collaborated with Jeff Kissel to solve the remaining calibration issues related to the model change, and came up with reliable uncertainty estimates before and after the model change.

At last, I am leading a calibration paper, which focuses on the known and unknown systematic errors and the overall uncertainty budget of the detector's response in O3. The paper will describe the methods we have used to measure the observables, construct reference calibration models, monitor and correct the

time-independent and time-dependent systematic errors, and calculate the uncertainty budget. It is of importance to both the calibration team and the analysis groups. This work is underway. I have been drafting the paper skeleton, leading the discussions, and tracking the progress.

In summary, I believe that my contribution is of importance in the LIGO O3 calibration. It was challenging to get the calibration models ready when O3 was about to start and the detector was still changing. In order to construct a reliable reference model in time, I did not only follow the standard procedures to analyze the measurements, construct and verify the model, but also, for the first time, quantified the contribution of residual errors in each component. This study helped us to determine whether the models and corrections were accurate enough to achieve our goal of precise calibration. The real-time estimate of calibration uncertainty budget, that I newly implemented, provided a timely reference for the parameter estimations of O3 events using C00 data. The carefully reviewed uncertainty budget products were delivered to the data analysis teams in time, together with different versions of the calibrated strain data, which is crucial to the accuracy of measuring astrophysical parameters in O3. Hence I believe that my efforts and delivered contributions warrant the self nomination.

I would appreciate your consideration. Thank you very much.