Digging deeper: finding sub-threshold compact binary merger events in LIGO data

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The LIGO and Virgo detectors have collected gravitational wave (GW) data from three separate observation runs since 2015, with the third run presently collecting data. There have been 10 signals from binary black hole mergers and one binary neutron star merger detected from the first two observation runs and many more from the third run. These detections were all confirmed due to high confidence in their signal-to-noise ratio (SNR); however, there are likely many more unconfirmed signals in the data due to lower SNRs. A limitation in the SNR criteria arises when accidental coincidence of "loud" glitches or other rare noise fluctuations in the LIGO detectors can result in high SNRs but are not the product of real GWs. We hope to improve the detection or rejection of sub-threshold events with lower SNRs by computing the Bayesian coherence ratio (BCR): the odds between the hypothesis that the data comprise either a coherent compact-binary-coalescence signal in Gaussian noise or incoherent instrumental features, using parameter estimation. BCR analysis was done on Observation Run 3 (O3) events and background data. Initial results provide confidence that the BCR can distinguish between signal and incoherent noise given appropriate parameters, indicating potential to improve sub-threshold event detections.