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Loosely coherent search in LIGO O1 data for continuous gravitational waves from Terzan 5 and the galactic center

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We report results of a search for continuous gravitational waves from a region covering the globular cluster Terzan 5 and the galactic center. Continuous gravitational waves are expected from fast-spinning, slightly non-axisymmetric isolated neutron stars as well as more exotic objects. The regions that we target are believed to be unusually abundant in neutron stars. We use a new loosely coherent search method that allows to reach unprecedented levels of sensitivity for this type of search. The search covers the frequency band 475–1500 Hz and frequency time derivatives in the range of $[-3.0, +0.1] \times 10^{-8}$ Hz/s, which is a parameter range not explored before with the depth reached by this search. As to be expected with only a few months of data from the same observing run, it is very difficult to make a confident detection of a continuous signal over such a large parameter space. A list of parameter space points that passed all the thresholds of this search is provided. We follow-up the most significant outlier on the newly released O2 data and cannot confirm it. We provide upper limits on the gravitational wave strength of signals as a function of signal frequency.

I. INTRODUCTION

Continuous gravitational waves (CWs) are expected from fast-spinning neutron stars in a variety of circumstances, for example if they present a slight nonaxisymmetry (ellipticity). Many CW searches have been carried out on LIGO data [1], including several all-sky searches [2–5] and broadband directed searches [6]. No signals have been detected yet.

Directed searches are searches for signals from interesting targets – both specific objects or/and regions. The search presented here, targeting emission from the globular cluster Terzan 5 and the galactic center, falls into this category.

We use data collected during the first Advanced LIGO observing run, O1, [7–10] and employ a new mediumscale loosely coherent algorithm [11–13]. We probe a broad class of signals with frequencies between 475 and 1500 Hz, with unprecedented sensitivity. For sources at 8.5 kpc this search is sensitive to signals from neutron star deformations well within the range allowed by conventional neutron star equations of state [14].

Additionally this search was used as a pilot study of the new loosely-coherent search method. The search uses a substantially longer coherence length than used before and hence presents most of the challenges and difficulties of an all-sky search, but without the substantial load of searching the whole sky. This search has exposed performance bottlenecks in the algorithms implementation and has paved the way for the first all-sky loosely coherent search [5]. The paper is organized as follows: sections II and III briefly introduce the LIGO detectors, the data that is used and the signal waveform that we target with this search. Section IV describes the features of the main building block of the search, the enhanced loosely coherent method, and section V illustrates the pipeline, including the way the upper limits are established and the ranking of the outliers. The results are presented and discussed in section VI. The appendix A contains the outlier tables.

II. LIGO INTERFEROMETERS AND THE 01 OBSERVING RUN

The LIGO gravitational wave detector consists of two 4 km dual-recycling Michelson interferometers, one in Hanford, Washington and the other in Livingston, Louisiana, separated by a 3000-km baseline. The interferometer mirrors act as test masses, and the passage of a gravitational wave induces a differential arm length change that is proportional to the gravitationalwave strain amplitude. The Advanced LIGO [9, 10] interferometers came online in September 2015 after a major upgrade.

The O1 run occurred between September 12, 2015 and January 19, 2016, from which approximately 77 days and 66 days of analyzable data were produced by the Hanford (H1) and Livingston (L1) interferometers, respectively.

Notable instrumental contaminants affecting the searches described here include spectral combs of narrow lines in both interferometers, many of which were identified after the run had ended and were mitigated for future runs [3, 4, 15]. For instance an 8-Hz comb in H1 with the even harmonics (16-Hz comb) being especially strong, was ascribed to digitization roundoff error in a high-frequency excitation applied in order to servo-control the cavity length of the Output Mode Cleaner

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FIG. 1. Upper limits on gravitational wave strain. The dimensionless strain h_0 (vertical axis) is plotted against signal frequency. The upper (blue) curve shows worst-case (linearly polarized) 95% confidence level (CL) upper limits as a function of frequency. The upper limits are maximized over sky and all intrinsic signal parameters for each frequency band. The lower (red) curve shows upper limits assuming a circularly polarized source. The data for this plot can be found in [16]. (color online)

(OMC). Similarly, a set of lines found to be linear combinations of 22.7 Hz and 25.6 Hz in the L1 data was tracked down to digitization error in an OMC excitation at a still higher frequency.

Although most of these strong and narrow lines are stationary in frequency and hence do not exhibit the Doppler modulations due to the Earth's motion expected for a CW signal from most sky locations, they do degrade the sensitivity to astrophysical signals at the frequencies where they occur.

III. SIGNAL WAVEFORM

In this paper we assume a standard model of a spinning non-axisymmetric neutron star. Such a neutron star radiates circularly-polarized gravitational radiation along the rotation axis and linearly-polarized radiation in the directions perpendicular to the rotation axis. For the purposes of detection and establishing upper limits the linear polarization is the worst case, as such signals contribute the smallest amount of power to the detector. The strain signal measured by a detector is

$$h(t) = h_0 \left(F_+(t, \alpha_0, \delta_0, \psi) \frac{1 + \cos^2(\iota)}{2} \cos(\Phi(t)) + F_\times(t, \alpha_0, \delta_0, \psi) \cos(\iota) \sin(\Phi(t)) \right) ,$$
(1)

where F_+ and F_{\times} are the detector responses to signals with "+" and " \times " quadrupolar polarizations [17–19], the sky location of the source is described by right ascension α_0 and declination δ_0 , the inclination of the source rotation axis to the line of sight is ι , and we use ψ to denote the polarization angle (i.e. the projected source rotation axis in the sky plane).

The phase evolution of the signal is given by

$$\Phi(t) = 2\pi \left(f_0 \cdot (t - t_0) + f_0^{(1)} \cdot (t - t_0)^2 / 2 \right) + \phi , \quad (2)$$

with f_0 being the source frequency and $f_0^{(1)}$ denoting the first frequency derivative (which, when negative, is termed the *spindown*). We use t to denote the time in the Solar System barycenter frame. The initial phase ϕ is computed relative to reference time t_0 . When expressed as a function of local time of ground-based detectors, Equation 2 acquires sky-position-dependent Doppler shift terms.

Most natural "isolated" sources are expected to have negative first frequency derivative, due to the energy lost to emission of gravitational or electromagnetic radiation. The frequency derivative can be positive because of residual motions due to, for instance, a long-period orbit.

IV. THE MEDIUM SCALE LOOSELY COHERENT SEARCH

The medium scale loosely coherent search is the basic building-block of this search. It is described in [13] and follows earlier loosely coherent implementations [11, 12]. Here we highlight features that are useful to understand search output, in particular upper limits and outliers.

The input to the search are Hann-windowed 3600s short Fourier transforms (SFTs) for each of the LIGO interferometers : $\{a_{tfi}\}$, indexed by time t, discrete frequencies f and interferometer index i. A value of the weighted power sum $P(f_0, \vec{p})$ is computed for every searched wave shape, parametrized by the frequency of the source f_0 and a set of values for its spindown, sky position and source orientation $\vec{p} = (\alpha, \delta, f_0^{(1)}, \iota)$.

The loosely coherent weighted power sum is a bilinear function of the SFT data:

$$P(f_0, \vec{p}) = \frac{\sum_{t_1, t_2, i_1, i_2} K(t_1, t_2, \vec{p}, f_0) a_{t_1 f_1' i_1} \bar{a}_{t_2 f_2' i_2}}{\sum_{t_1, t_2} W(t_1, t_2, \vec{p})}.$$
 (3)

Here f'_1 and f'_2 are the interferometer-frame signal frequencies at the detector-time t_1 and t_2 . The kernel $K(t_1, t_2, \vec{p}, f_0)$ is equivalent to a narrow band filter on the input data that includes phase corrections to account for the signals' Doppler shifts and relativistic effects. The weight term $W(t_1, t_2, \vec{p})$ folds-in the noise level of the individual SFTs and the detectors' response to the specific source as a function of time (it is fourth order in the antenna response).

Because the polarization coefficients are factored out of power sums (Eq. 3), which involve thousands of SFTs, it is easy to produce separate power sums for any polarization of interest. For instance, we will provide upper limits for a population of circularly polarized signals which corresponds to the star's rotation axis pointing towards us $(\iota = 0 \text{ or } \pi \text{ in Eq. 1}).$

The fact that we compute power sums makes it possible to set upper limits on the signal strain amplitude by estimating the power excess that we would measure from the target signals at a given strain amplitude. This estimate is computed using the universal statistics algorithm which produces statistically valid results without assumptions on the probability distribution function of the noise – a rigorous derivation of the algorithm is given in [20]. An intuitive explanation of why this is possible is that if the expected power of the noise is bounded, then the expectation of any continuous function of the noise is also bounded over the space of all probability distributions (in mathematical terminology the space of probability distributions is compact in weak topology). If the noise is Gaussian, the implementation of the *Univer*sal statistic used in this search provides close-to-optimal values.

In order to bracket the range of upper limit strain values, depending on the orientation of the source, we consider the so called "worst-" and "best-" case polarization upper limits. The upper limits are given as a function of frequency and apply to 0.125 Hz signal-frequency intervals, i.e. there is a single upper limit number for every 0.125 Hz band. The "worst-case" upper limits are based on the maximum universal statistic value over the frequencies in any given band and all spindowns, sky positions and polarizations, further increased (by 7%) to account for losses due to signal-template mismatch. This maximization tends to select increased universal statistic values due to disturbances in the data, when present. For this reason the worst-case upper limit curve has larger outliers than the circular polarization ("best-case" one). The "best-case" upper limits are based on the maximum universal statistic value over the frequencies in any given the band and all spindowns and sky positions, while circular polarization is assumed.

The computation of universal statistic [20] also computes SNR as a byproduct, this is used as a detection statistic for identifying outliers.

V. SEARCH PIPELINE

We search a disk on the sky of radius $0.06 \text{ rad} (3.43^\circ)$ centered on right ascension $4.65 \text{ rad} (266.42^\circ)$ and declination $-0.46 \text{ rad} (-26.35^\circ)$. This search area is chosen to cover both the globular cluster Terzan 5 and Sagittarius A^{*}, galactic regions expected to contain many neutron stars. Terzan 5, in particular, has many known radio pulsars [21–23].

Stage	Coherence length (hours)	Minimum SNR
0	8	6
1	12	6.5
2	16	7
3	24	8
4	36	9
5	48	11
6	72	13

TABLE I. Search pipeline

Parameters of search pipeline. As explained in the text stage 6 also features an additional consistency check between the single-detector statistics.

The search pipeline iteratively uses the medium scale loosely coherent algorithm in a cascade of 6 different stages. The first stage employs an 8 hour coherence length. Outliers identified at this stage are followedup with more sensitive searches that utilise increasingly longer coherence lengths, as detailed in Table I. For all stages the detection statistic combines coherently over the coherent length the data from both detectors. At the last stage, the detection statistic from each detector separately is also computed and the additional requirement is set on surviving candidates that the parameters be consistent across the multi-detector and single-detector statistics.

The pipeline is validated using extensive Monte Carlos that simulate signals in the real data and test the recovery efficiency of the whole pipeline. This approach is completely standard for this type of search, where the expected signals are weak and in many frequency bands it is impossible to model the noise reliably. This procedure also validates the correctness of the upper limit values given here.

A. Outlier ranking

The likelihood of a search outlier to have astrophysical origin is commonly described by the false alarm rate an estimate of probability that this outlier is produced by pure chance. The most obvious method of computing this rate is to repeat the search many times with different realizations of the noise and count how many similar outliers are produced. This is impractical for broad parameter searches which usually take weeks to months to complete.

A commonly used shortcut is to reuse the data from the original search but combine it differently, for instance with non-astrophysical offsets for coincidence parameters (such as time or frequency) – for a notable example see [24]. The idea is to simulate different noise realisations of the search results, by constructing "off-source" combinations of the actual search results. Unfortunately, producing an "off-source" noise realization by combining the single-detector outliers from the last stage of this pipeline is not viable because the preceding stages are based on multi-detector statistics. This means that the candidates at the last stage generally present correlations between detection statistic values from the different detectors at nearby frequencies. On the other hand, the off-source sample constructed with a non-physical combination of single-detector candidates, would not, and hence would not be a good representation of the noise of the actual search.

We take here a different approach and derive an approximate analytical expression, under the assumption that underlying noise is Gaussian. This is a strong assumption that is known not to hold in many frequency bands. Thus this expression should not be used as criterion for detection. Rather it is meant as a figure of merit to evaluate relative significance of outliers.

As the entire hierarchical 6-stage pipeline is difficult to model, we derive the false alarm rate for a hypothetical search that used the last stage of followup to analyze rameter space; the distribution of the detection statistic for the stage 6 search, $P_{\chi^2,k}$; the "coincidence probability" associated with the multi-detector/single-detector consistency check, p_{coinc} . We derive these below.

We (over)-estimate the total number of templates N necessary to perform such search to be 1.6×10^{27} . We arrive at this number as follows: The total number of sky, polarization, spindown and frequency templates N is 9.3×10^{21} . A dynamic programming algorithm allowed frequency to vary by up to one frequency step in any of 11 times equally spaced through the run. To account for this we increase N by a factor of 3^{11} . This overcounts the number of independent templates. For example, two templates different by one jump in the middle of the run would be correlated.

Because we consider the last stage as a separate search the frequencies of outliers in individual interferometers are independent. The frequency coincidence criterion can be falsely triggered in pure noise with probability $p_{coinc} = 3.59 \times 10^{-5}$.

The last stage of the analysis uses a 3-day coherence time. As the fluctuations due to amplitude modulations average out over this time the power sums can be modelled as a χ^2 variable with at most k = 80 degrees of freedom, with k expected to be smaller for frequency regions with highly contaminated (and deweighted) data. k = 80 because there are 40 3-day chunks in a 4-month run and each chunk contributes two degrees of freedom

We take the Gaussian false alarm figure of merit for a candidate at signal-to-noise ratio value SNR, at the end of the last follow-up stage, to be

$$\log_{10} (\text{GFA}) = \log_{10} \left(P_{\chi^2, k} \left(k + \sqrt{2k} \cdot \text{SNR} \right) \right) + \log_{10} (N) + \log_{10} (p_{\text{coinc}}),$$
(4)

where SNR is defined as the ratio of the deviation of the detection statistic from its expected value to the standard deviation.

We emphasize again that the formula 4 was derived under the assumption of stationary Gaussian noise that is independent between the H1 and L1 interferometers. Since this assumption is violated in many frequency bands, this figure is not meant as a criteria for detection. For example, large negative values for outliers 1 through 8 are an indication of a presence of a signal, but these signals is known to be instrumental in origin.

VI. RESULTS

The search produces a number of outliers, the strongest of which are traced to clear instrumental artifacts. A number of unclassified outliers with smaller signal-tonoise ratios passes the follow-up pipeline. While the pipeline has been demonstrated to recover injected signals successfully even in the most heavily contaminated regions [13], the presence of noise does increase the false alarm rate. As the O1 data is highly contaminated with both stationary and non-stationary instrumental lines, classification of weak outliers is particularly difficult. This problem is made more challenging by the presence of instrumental artifacts coherent between both interferometers.

We further extend the coherent baseline of the search with ad-hoc semi-coherent follow-up searches like the ones used in [2, 3], on 352 outliers. We use three stages with coherent baselines of 210 hrs (12 segments), 500 hrs (6 segments) and 1260 hrs (2 segments), respectively. We denote the stages by FU0, FU1 and FU2. Since FU1 is rather computationally intensive we do not follow-up any outlier that can be associated with a disturbance (see comment field in the tables of Appendix A. 21 outliers survive all thresholds from these follow-up searches. The outlier with id 68 appears to be the most significant. On it we perform a dedicated search using the FU1 search on 480 hrs of the newly released data from the O2 run [8]. The search could not recover the candidate with detection statistic values consistent with what would have been expected if outlier 68 had been a continuous wave described by Eq. 1. Appendix A details all the outliers and indicates at what stage of these follow-ups the candidate was rejected.

The simulations described in [13] have shown that an astrophysical source adhering to expected signal model will be recovered within $15 \,\mu$ Hz of true frequency and within 1.5×10^{-11} Hz/s of true spindown. The sky position mismatch depends on frequency and, for outliers with frequency f is no more than $6.5 \times 10^{-4} \cdot (1 \,\text{kHz}/f)$ in ecliptic distance, defined as the distance between outlier location and true injection location after projection onto the ecliptic plane.

The universal statistic algorithm allows to set valid upper limits even in the most heavily contaminated bands. Figure 1 shows the best-case and worst-case 95% confidence upper limits on the signal strain in 0.125 Hz frequency intervals. At the highest frequency (1500 Hz) the worst-case upper limit on gravitational wave strain is 6.2×10^{-25} , which translates in a source with an ellipticity of 2.5×10^{-6} at 8.5 kpc. Because of maximization procedure the confidence level of the worst-case upper limits remains 95% or higher for any subset of parameters. For example, if one picks a sky location of the Terzan 5 globular cluster, spin-down of 5×10^{-9} Hz/s and a frequency of 550 Hz the worst case upper limit is 2.89×10^{-25} Hz, with a confidence level which is guaranteed to be at least 95%. The actual confidence level is likely to be larger than 95% for the specific point, because the quoted upper limit is the highest over all sampled spin-downs and the wider sky area.

Figure 2 shows the astrophysical reach of the search, i.e. the maximum distance at which this search could have detected a signal of a given frequency and spin-



FIG. 2. Range of the search for neutron stars spinning down solely due to gravitational radiation. This is a superposition of two contour plots. The green and purple solid lines are contours of the maximum distance at which a neutron star could be detected as a function of gravitational-wave frequency fand its derivative \dot{f} . The dashed lines are contours of the corresponding ellipticity $\epsilon(f, \dot{f})$. The fine dotted line marks the maximum spindown searched. Together these quantities tell us the maximum range of the search in terms of various populations (see text for details) (color online).

down, under the assumption that all the lost rotational energy is emitted in gravitational waves. The search presented here is sensitive to an optimally oriented neutron star at the galactic center (circularly polarized signal) with ellipticity of 10^{-6} and emitting gravitational waves at a frequency of 1200 Hz. In Terzan 5 a signal at 1200 Hz from an optimally oriented source having ellipticity of $\leq 7 \times 10^{-7}$ could have been detected.

The search presented is the most sensitive to date, aimed at this interesting region of our galaxy. This is reflected in the sensitivity depth of the search which is defined as the ratio of the upper limit value and the noise floor at nearby frequencies $\mathcal{D}(f) := \sqrt{\frac{S_h(f)}{h_0^{UL}}}$ [25]. Following [26], we estimate the noise taking the harmonic mean across the different detectors and obtain the following values of the sensitivity depth across the entire frequency range searched:

$$\begin{cases} \mathcal{D}_{\text{circ-pol}}(f) = 116 \ [\sqrt{\text{Hz}}]^{-1/2} \\ \mathcal{D}_{\text{worst-pol}}(f) = 42 \ [\sqrt{\text{Hz}}]^{-1/2}. \end{cases}$$
(5)

The radiometer search [27] targeting the galactic center is 4 times less sensitive than our most conservative upper limit (the worst case one), achieving, on the same data, a sensitivity depth smaller than 10. This search covers a larger spindown range than any previously published all-sky search, hence probing younger sources from our search area. Furthermore even our worst-case upper limits are more constraining than any all-sky search result to date, including the state of the art paper [28] that uses the more sensitive and longer duration data set from the O2 run.

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Appendix A: Outlier tables

Outliers passing all stages of automated followup from 475-1500 Hz band are separated into five tables. Table VI shows outliers inside the contaminated regions 495-520 Hz and 990-1033 Hz. The rest of the outliers is split into four regions 475-900 Hz, 900-1200 Hz, 1200-1400 Hz and 1400-1500 Hz (Tables II, III, IV, V).

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Idx	SNR	$\log_{10} (\text{GFA})$	Frequency	Spindown	RA_{J2000}	DEC_{J2000}	Description
			Hz	nHz/s	degrees	degrees	
6	23.9	-17.5	612,48610	-9.197	267.037	-29.754	Broad large line in L1 at 612 45 Hz
8	23.5	-16.6	736 09475	-22 991	267 808	-28,287	Sharp bin-centered lines at 736 Hz (H1) and 736 1 (L1)
13	$\frac{20.0}{21.2}$	-11 7	736 09791	-21.997	266 439	-29.165	Sharp bin-centered lines at 736 Hz (H1) and 736.1 (L1)
17	20.3	9.6	684 06515	-17.607	265 576	-22.160	Sharp bin centered lines at 100 Hz (HI) and 100.1 (HI)
20	20.5	-3.0	662 18256	-17.007	262.549	25.691	Strong bin contored line in L1 at 662 20 Hz
20	19.4	-1.5	710 54465	-24.021	203.348	-23.081	Strong bin-centered line in L1 at 710 50 Hz
24	17.9	-4.0	710.34403	-21.820	204.017	-21.341	Lenge brood lines in U1 neer 500 14 Up and 500 16 Up
32	17.0	-4.0	599.19367	-15.234	266.039	-28.005	Large broad lines in H1 near 599.14 Hz and 599.16 Hz
34	17.5	-3.8	761.75580	-13.218	265.953	-25.889	Strong bin-centered line in L1 at 761.70 Hz (FU0)
43	16.8	-2.4	707.65162	-10.129	266.799	-24.227	Strong bin-centered line in L1 at 707.6 Hz
44	16.6	-2.1	575.23174	-5.519	266.534	-29.341	Hardware injected pulsar 2
45	16.6	-2.0	898.86970	-0.491	269.397	-28.914	Large broad lines in H1
47	16.5	-1.9	898.84667	-15.157	266.790	-26.909	Large broad lines in H1
70	15.2	0.8	659.35418	-12.386	269.229	-26.124	Strong bin-centered line in L1 at 659.3 Hz
72	15.1	0.9	629.86431	-29.241	267.817	-25.916	Large broad lines in L1
75	15.0	1.1	787.35687	-8.004	265.084	-29.806	Sharp bin-centered line in L1 at 787.3 Hz
80	14.8	1.4	660.51361	-20.472	268.538	-22.492	*
84	14.8	1.5	829 85946	-8 609	264 856	-25.815	Strong bin-centered line in L1 at 829.8 Hz
85	1/ 8	1.5	520 84815	-3 204	267 198	-29.179	Large broad line in H1 near 520.82 Hz
80	14.0	1.0	520.84814	-3.204	267 202	-20.350	Large broad line in H1 near 520.82 Hz
00	14.7	1.7	762.04206	-0.201	201.202	-29.335	Hange broad line in 111 flear 520.62 flz
100	14.0	2.1	703.94300	-20.331	202.900	-20.415	(EUO)
102	14.5	2.1	8/3.20/13	-29.286	264.627	-28.210	
103	14.5	2.1	606.63606	-27.504	263.085	-27.581	Large broad line in H1 at 606.67 Hz
104	14.4	2.3	730.35349	-8.153	266.654	-26.898	Sharp bin-centered line in L1 at 730.3 Hz
119	14.2	2.7	787.35542	-8.931	264.431	-28.451	Sharp bin-centered line in L1 at 787.3 Hz
120	14.1	2.8	608.06595	-19.469	268.412	-28.434	Sharp bin-centered line in H1 at 608 Hz
121	14.1	2.8	899.25624	-27.714	263.423	-28.511	Strong broad lines in H1
135	14.0	3.1	599.49600	-17.127	267.287	-28.898	Strong broad lines in H1
137	14.0	3.1	771.05117	-8.789	265.082	-22.538	(FU1)
139	13.9	3.1	587.37228	-0.374	265.864	-29.281	(FU1)
145	13.9	3.2	864.06026	-9.286	262.769	-25.668	Sharp bin-centered line in H1 at 864 Hz
146	13.9	3.3	575.23399	-5.628	268.609	-27.074	Hardware injected pulsar 2
149	13.9	3.3	764 65686	-8 411	267 769	-27209	Sharp hin-centered line in L1 at 764.6 Hz
151	13.9	3.3	817 31637	-23.376	267 491	-28.124	(FU1)
156	13.8	3.4	773 67502	-4.093	265 308	-23 202	$(1 \circ 1)$
161	13.8	35	618 06167	-13.840	268,606	-25.285	Slope in H1 spectrum
166	19.0	3.5	728 02255	-13.849	263.000	-25.265	(EUO)
100	13.0	3.0	738.02233	-0.388	205.204	-27.112	
169	13.7	3.0	629.86433	-29.236	207.845	-20.110	Large broad line in L1
170	13.7	3.6	769.35342	-26.944	267.449	-22.402	$(F \cup I)$
172	13.7	3.6	686.75565	-11.731	264.065	-29.473	$(F \cup 0)$
176	13.7	3.7	764.65687	-8.411	267.773	-27.188	Sharp bin-centered line in L1 at 764.6 Hz
180	13.6	3.7	683.40267	-12.421	265.532	-28.007	Slight slope in L1 (FU0)
186	13.6	3.8	799.26703	-5.724	266.255	-28.143	(FU0)
190	13.6	3.8	824.59028	-2.196	268.212	-27.435	(FU0)
192	13.6	3.8	645.94631	-15.366	266.741	-26.423	
202	13.5	3.9	727.32568	-17.438	267.008	-27.029	(FU1)
203	13.5	3.9	539.85863	-8.429	267.373	-29.396	Near 60 Hz line
215	13.5	4.1	851.68971	-18.266	266.383	-22.291	(FU1)
219	13.4	4.1	489.11959	-5.482	265.242	-25.347	Nearby lines
227	13.4	4.2	694,42637	-26.409	267.828	-27.898	(FU0)
229	13.4	4.2	581,71075	-9.491	263.276	-28.388	(FU1)
232	13.4	4.3	713 46388	-2 209	266 696	-26.761	Strong bin-centered line in L1 at 713.4 Hz
2/3	13.3	13	575 25658	-18 581	265 147	-29.940	Hardware injected pulsar 2
240	13.3	4.0	583 35870	-8 304	260.147	-20.052	Strong broad line in H1 at 583 317 (FU0)
244	13.3	4.0	763 05114	-21.211	266 312	-24.681	Hardware injected pulsar 0
240	12.0	4.4	680 97269	-21.211	200.312	-24.081	(EUO)
249 051	10.0	4.4	608 00180	-14.039	200.404	-20.491	(FOU) Show his contered line in U1 of COS U
201	13.3	4.4	608.00120	-10.840	263.648	-28.505	Sharp bin-centered line in H1 at 608 Hz
254	13.3	4.4	770.00605	-19.542	264.245	-27.578	$(F \cup I)$
260	13.3	4.4	172.83474	-27.344	267.338	-26.027	Snarp bin-centered line in L1 at 772.8 Hz
261	13.3	4.4	809.98476	-27.979	263.634	-25.694	Sharp bin-centered line in L1 at 810 Hz
264	13.3	4.4	694.42638	-26.413	267.818	-27.711	(FU0)
270	13.3	4.5	878.16583	-14.756	267.454	-26.247	Strong bin-centered line in L1 at 878.1 Hz
282	13.2	4.5	547.67510	-9.729	263.964	-27.205	(FU0)
287	13.2	4.6	829.86026	-8.384	265.709	-27.241	Strong bin-centered line in L1 at 829.8 Hz
290	13.2	4.6	792.70263	-16.328	266.224	-29.232	(FU0)
291	13.2	4.6	655.43480	-2.403	263.896	-25.645	(FU0)
297	13.2	4.6	848.06291	-16.696	264.046	-26.114	Strong bin-centered line in H1 at 848 Hz
299	13.2	4.6	725.52768	-5.731	263.854	-25.707	(FU0)
303	13.2	4.6	782.79214	-20.134	265.043	-26.320	(FU1)
309	13.1	4.7	599.20398	-18.747	269.644	-26.805	Big broad lines in H1 near 599.14 and 599.16 Hz
310	13.1	4.7	698.22224	-22.943	263.921	-25.129	(FU0)
311	13.1	4 7	763 95114	-21 208	266 313	-24 999	Hardware injected pulsar 9
312	19.1	17	597 19774	_7 911	266.075	_95 556	(FU0)
316	12.1	4.1	752 07590	0.940	200.070	-25.000	(FU0)
317	19.1	4.0	811 15041	0.049	200.000 969.94E	-20.200	(FU1)
01/ 910	10.1	4.0	700 62051	-9.201	202.000	-24.008	
313	13.1	4.8	718 00050	-3.359	200.959 266 124	-29.050	
323	13.1	4.8	(18.02858	-22.968	200.134	-27.019	
325	13.1	4.8	527.64148	-23.659	268.915	-24.650	
335	13.0	4.9	621.85099	-11.539	266.052	-27.996	Sloping H1 spectrum
337	13.0	4.9	676.37758	-0.769	268.788	-24.882	(FU0)
340	13.0	4.9	678.39254	-3.871	263.974	-28.642	

TABLE II. Outliers below 900 Hz that passed the automated detection pipeline excluding regions heavily contaminated with violin modes. Outliers marked with "line" had strong narrowband disturbances identified near the outlier location. We have marked outliers not consistent with the target signals at one of the semi-coherent \mathcal{F} -statistic follow-ups with "(FU0/1/2)", depending on the stage at which they did not pass the detection thresholds. Frequencies are converted to epoch GPS 1130529362.

Idx	SNR	log ₁₀ (GFA)	Frequency	Spindown	RA,12000	DEC,12000	Description
		1010(Hz	nHz/s	degrees	degrees	<u>I</u>
5	25.2	-20.4	1176 69799	-26.024	26/ 288	-23 567	Strong hin-centered line in L1 at 1176.6 Hz
16	20.2	-20.4	955 00851	-26.744	269 405	-24.278	Sharp line in L1
19	19.3	-7.6	910.17153	-8.556	264.028	-24.077	Large broad line in H1 at 910.1 Hz
33	17.5	-4.0	1176.58614	-3.254	263.501	-25.977	Strong bin-centered line in L1 at 1176.6 Hz
39	17.0	-2.9	1120.09915	-25.758	264.594	-27.448	Strong bin-centered line in H1 at 1120 Hz
40	16.9	-2.6	910.18376	-22.563	268.269	-25.989	Large broad line in H1 at 910.1 Hz
58	15.5	0.1	1173.80211	-28.189	264.045	-27.467	Strong bin-centered line in L1 at 1173.7 Hz
59	15.5	0.1	1128.38343	-12.747	267.927	-27.526	Strong bin-centered line in L1 at 1128.3 Hz
63	15.3	0.4	906.63379	-17.648	264.077	-23.762	Strong bin-centered line in L1 at 906.6 Hz
68	15.2	0.6	1105.15733	-26.774	263.713	-26.330	(FU1 w. O2 data)
76	15.0	1.2	1128.39396	-25.644	263.670	-27.537	Strong bin-centered line in L1 1128.3 Hz
77	14.9	1.3	946.92321	-20.521	266.068	-27.668	(FU0)
81	14.8	1.4	977.67244	-18.241	264.215	-26.981	Strong bin-centered line in L1 at 977.6 Hz
86	14.7	1.6	1130.32268	-1.751	267.651	-29.016	(FU0)
101	14.5	2.1	983.46951	-11.611	264.204	-23.932	Strong bin-centered line in L1 at 983.4 Hz
106	14.4	2.3	976.01956	-26.851	265.826	-29.672	Line in H1 at 976 Hz
113	14.3	2.5	957.88553	-2.921	266.766	-24.376	Sharp bin-centered line in L1 at 957.8 Hz
114	14.3	2.0	932.28870	-0.777	200.303	-20.123	(FUO)
110	14.2	2.0	1117 02710	-19.421 20.271	200.328	-24.080	(F00)
125	14.2	2.1	1102 54700	-29.371	267 676	-24.014 -26.744	(FUO)
120	14.1 14.1	2.9	1132.34799	-12.261	265 508	-28.590	(FU0)
130	14.0	3.0	1146.01080	-14.459	264.505	-26.227	(FU1)
133	14.0	3.1	1056.49144	-6.807	263.080	-25.072	(FU1)
143	13.9	3.2	916.79125	-21.067	266.033	-24.889	(FU0)
147	13.9	3.3	1055.06400	-21.219	267.870	-25.985	(FU0)
148	13.9	3.3	1148.12864	-9.921	268.460	-28.864	Strong bin-centered line in L1 at 1148.1 Hz
158	13.8	3.4	1193.00546	-15.631	266.493	-25.264	(FU0)
159	13.8	3.5	911.76958	-9.399	266.039	-25.180	(FU0)
160	13.8	3.5	1130.73154	-3.169	263.000	-26.335	(FU0)
162	13.8	3.5	953.40039	-10.813	266.270	-27.596	
174	13.7	3.6	1087.75530	-28.077	269.614	-26.525	(FU2)
181	13.6	3.7	969.52238	-8.313	265.371	-29.459	(FU0)
206	13.5	4.0	1159.91542	-24.221	264.096	-25.279	(FU0)
208	13.5	4.0	1142.86654	-6.054	263.246	-24.169	(FUU) (FUU)
210	13.5	4.0	934.78201	-2.273	268.362	-25.152	(FUU) Strong scientident his contened lines in U1 and U1 at 1080 Un
211 213	13.5	4.0	1127 80227	-27.759 -10.557	200.170	-23.283	(FU1)
213	13.0	4.1	970 66243	-29.248	266 863	-25.561 -25.559	(FUI)
228	13.4	4.2	931 29979	-10.836	266 227	-29.987	(100)
233	13.4	4.3	1151.53614	-8.588	265.597	-23.441	
237	13.3	4.3	1145.63773	-5.498	268.460	-29.377	(FU0)
242	13.3	4.3	983.47659	-7.236	265.003	-27.225	Strong bin-centered line in L1 at 983.4 Hz
245	13.3	4.3	1197.77064	-27.963	269.015	-27.561	5
253	13.3	4.4	903.29002	-15.369	266.450	-25.044	(FU0)
258	13.3	4.4	938.88434	-9.556	264.187	-28.599	(FU0)
265	13.3	4.4	953.40039	-10.816	266.269	-27.442	
266	13.3	4.5	906.90104	-20.814	263.359	-26.506	Broad line in H1 near 906.82 Hz
267	13.3	4.5	1069.13874	-2.926	263.432	-27.102	
272	13.2	4.5	1033.96710	-20.787	262.779	-25.972	(FUU)
213	13.2	4.0	1101 71065	0.882	201.920	-24.097	
270	13.2	4.5	1121.71800	-15.150	205.124	-21.100	(FUU) (FUI)
219	13.2	4.5	1055 06111	-20.201	200.982	-27.473 -28.653	(FUI)
285	13.2	4.5	1081 91076	-20.100 -29.388	264 805	-28.055 -29.647	(FU0)
295	13.2	4.6	1143 15676	-5,409	269.119	-26.704	(FU1)
300	13.2	4.6	951.01213	-4.077	266.334	-28.538	(FU0)
305	13.2	4.7	1070.50637	-4.409	264.544	-27.297	
307	13.1	4.7	1123.01894	-10.841	268.163	-24.666	(FU0)
314	13.1	4.7	945.03386	-24.222	267.786	-26.393	Bump in L1
318	13.1	4.8	989.77830	-4.182	269.861	-25.516	Disturbed H1 spectrum
330	13.1	4.8	1176.33662	-22.274	264.698	-27.271	(FU1)
336	13.0	4.9	985.14327	-23.229	265.622	-26.558	Many strong nearby lines in H1
338	13.0	4.9	1090.81873	-0.502	264.444	-29.353	(FU0)
339	13.0	4.9	1196.00279	-2.451	267.251	-24.656	(FU0)
342	13.0	4.9	1037.60585	-26.743	263.801	-28.995	Strong bin-centered line in L1 at 1037.5 Hz
350	13.0	4.9	1197.48407	-23.759	269.911	-25.523	

TABLE III. Outliers in frequency range 900-1200 Hz that passed the detection pipeline excluding regions heavily contaminated with violin modes. Outliers marked with "line" had strong narrowband disturbances identified near the outlier location. We have marked outliers not consistent with the target signals at one of the semi-coherent \mathcal{F} -statistic follow-ups with "(FU0/1/2)", depending on the stage at which they did not pass the detection thresholds. Frequencies are converted to epoch GPS 1130529362.

Idx	SNR	$\log_{10} (\text{GFA})$	Frequency Hz	Spindown nHz/s	RA _{J2000} degrees	DEC _{J2000} degrees	Description
1	30.5	-32.4	1220.62344	-16.068	265.994	-24.436	Induced by hardware injection 7 (FU0)
37	17.0	-2.9	1360.09284	-16.252	262.922	-27.103	Strong bin-centered line in H1 at 1360 Hz
42	16.8	-2.5	1276.22672	-0.304	268.176	-23.187	Strong bin-centered line in L1 at 1276.1 Hz
55	15.8	-0.4	1202.29927	-6.043	264.510	-24.894	Strong bin-centered line in L1 at 1202.2 Hz
56	15.7	-0.2	1376.12253	-4.253	269.645	-26.036	Strong bin-centered line in H1 at 1376 Hz
67	15.3	0.6	1280.12932	0.519	268.744	-23.550	Strong bin-centered line in H1 at 1280 Hz
69	15.2	0.8	1270.39556	-12.976	268.516	-24.920	Strong bin-centered line in L1 at 1270.3 Hz
78	14.9	1.3	1328.13275	0.159	269.294	-26.578	Strong bin-centered line in H1 at 1328 Hz
82	14.8	1.5	1202.29985	-5.880	264.920	-25.698	Strong bin-centered line in L1 at 1202.2 Hz
91	14.7	1.8	1370.09811	-20.913	201.292	-20.000	(FUI)
93	14.0	2.0	1303.19792	-22.717 -13.662	205.274	-21.341 -20.082	(FUI) (FU0)
107	14.0	2.0	1303.55001	-19.634	263 445	-25.032 -25.948	Strong bin-centered line in L1 at 1321 5 Hz
111	14.3 14.3	2.4	1352 11873	-15.034 -4.071	205.445 266 570	-25.940 -28.811	Bin-centered line in H1 at 1352 Hz
112	14.3	2.5	1254.44064	-15.222	265.991	-25.692	(FU1)
115	14.2	2.6	1301.62221	-15.454	265.848	-28.031	()
117	14.2	2.6	1202.30356	-26.059	267.238	-23.480	Strong bin-centered line in L1 at 1202.2 Hz
123	14.1	2.9	1270.39317	-17.622	268.335	-25.117	Strong bin-centered line in L1 at 1270.3 Hz
127	14.0	3.0	1386.49465	-13.231	267.856	-23.177	(FU0)
128	14.0	3.0	1380.26131	-19.417	263.195	-24.722	(FU0)
129	14.0	3.0	1264.07644	-19.604	265.130	-29.366	Line in at 1264 Hz in H1
138	13.9	3.1	1249.43252	-2.559	265.309	-23.949	(FU0)
140	13.9	3.2	1373.86300	-7.084	263.597	-27.357	(FU0)
141	13.9	3.2	1205.72493	-26.927	264.610	-28.241	(FU0)
142	13.9	3.2	1271.07364	-17.608	266.148	-28.676	(FU0)
144	13.9	3.2	1366.55954	-0.596	262.870	-26.589	(FUU) (FUI)
150	13.9	3.3 2.4	1351.30890	-21.827	203.304	-26.464	(FUI) Strong his contored line in H1 at 1964 Hz
162	13.0	3.4	1204.10309	-0.094 -21.804	202.390	-20.001 -25.232	(FUO)
165	13.8	3.5	1310.28928	-21.034 -19.417	263 200	-25.252 -24.633	(FU0)
171	13.7	3.6	1269.91895	-21.536	267.428	-28.206	(FU0)
173	13.7	3.6	1276.99016	-0.241	265.645	-29.501	(FU1)
175	13.7	3.7	1332.83814	-16.049	265.781	-27.931	(FU0)
177	13.7	3.7	1372.18144	-19.329	264.461	-27.028	(FU1)
179	13.7	3.7	1267.04168	-8.514	268.806	-23.928	(FU0)
182	13.6	3.7	1232.09595	-8.929	266.351	-26.068	Strong bin-centered line in H1 at 1232 Hz
188	13.6	3.8	1254.44064	-15.229	265.990	-25.311	(FU1)
189	13.6	3.8	1394.57034	-8.916	269.267	-23.752	(FU1)
191	13.6	3.8	1270.38626	-19.122	263.603	-25.026	Strong bin-centered line in L1 at 1270.3 Hz
194	13.6	3.8	1318.61537	-2.694	263.896	-27.405	Line in L1 at 1318.6 Hz ???
195	13.6	3.9	1262.65832	-14.294	266.151	-27.129	(FU0)
199	13.5	3.9	1212.89700	-9.841	202.709	-25.319	(FUI) Strong his contored line in L1 at 1902 2 Hz
207	13.0	4.0	1202.29641	-27.100	203.130	-20.461	Strong bin-centered line in L1 at 1202.2 Hz
214 218	13.5	4.1	1232.09133	-10.200	208.914	-24.410 -25.347	Strong bin-centered line in L1 at 1252 Hz
220	13.0	4.1	1313 36532	0.507	266.019	-23.381	(FU0)
236	13.3	4.3	1242.80188	0.099	263.747	-28.690	(FU0)
238	13.3	4.3	1210.06445	-0.084	264.836	-26.046	(- •••)
241	13.3	4.3	1317.50608	-14.391	267.541	-28.868	(FU0)
246	13.3	4.3	1280.91794	-20.272	265.138	-29.732	(FU1)
247	13.3	4.4	1222.09162	-9.369	268.642	-26.238	Strong bin-centered line in L1 at 1222 Hz
255	13.3	4.4	1253.01107	-5.959	265.096	-25.776	
257	13.3	4.4	1323.77888	0.764	268.106	-29.354	(FU0)
262	13.3	4.4	1253.01107	-5.964	265.098	-25.512	(FU0)
263	13.3	4.4	1261.98690	-6.648	265.929	-24.334	(FU0)
269	13.3	4.5	1329.92157	-2.304	264.893	-25.113	(FU0)
271	13.2	4.5	1371.33276	-6.367	267.733	-27.949	(FU0)
274	13.2	4.5	1299.81900	-3.076	265.372	-26.913	(FU0)
218 282	13.2	4.0	1209.14048	-18.428	200.039 262.007	-21.429	
200	13.2	4.5	1292.03374	-16.191	203.987	-24.020	(FU0)
280 288	13.2 13.2	4.0	1321 820/7	-0.904 -26.062	209.208	-20.330 -26.380	(1.00)
280	13.2	4.0	1321.82947	-20.302 -29.214	264 793	-20.339 -29.091	
293	13.2	4.6	1247.68962	-21.128	265,493	-23.383	Strong bin-centered line in L1 at 1247.6 Hz (FU0)
294	13.2	4.6	1225.38754	-28.327	264.042	-25.595	(FU0)
298	13.2	4.6	1359.45910	-2.732	266.847	-26.802	(FU0)
308	13.1	4.7	1282.33163	-13.246	263.533	-26.441	(FU0)
322	13.1	4.8	1225.72267	-17.528	263.821	-25.398	(FU0)
327	13.1	4.8	1249.95109	-23.121	266.789	-27.051	(FU1)
331	13.1	4.8	1297.00050	-1.628	267.856	-26.736	(FU0)
332	13.1	4.8	1215.84097	-17.271	269.914	-27.022	(FU0)
333	13.0	4.9	1295.23973	-11.871	266.940	-28.091	(FU0)
334	13.0	4.9	1306.38413	-18.809	265.273	-22.916	(FU0)
341	13.0	4.9	1345.96737	-26.084	263.623	-26.514	(FU1)
343	13.0	4.9	1216.27144	-10.614	267.855	-25.711	(FU0)
344	13.0	4.9	1259.45564	-9.417	267.383	-28.047	(FU0) (FU1)
345 247	13.0	4.9	1208 05061	-0.544	203.100	-27.175	
341 310	12.0	4.9	1324 08025	-0.021	204.003 267 905	-20.118	
340 340	13.0 13.0	4.9	1979 99405	-21.003 -27.604	207.000 264 174	-26.108 -27.700	(1.00)
351	13.0	4.9	1334.41973	-22.024	262.929	-28.009	(FU0)

TABLE IV. Outliers in frequency range 1200-1400 Hz that passed the detection pipeline excluding regions heavily contaminated with violin modes. Outliers marked with "line" had strong narrowband disturbances identified near the outlier location. We have marked outliers not consistent with the target signals at one of the semi-coherent \mathcal{F} -statistic follow-ups with "(FU0/1/2)", depending on the stage at which they did not pass the detection thresholds. Frequencies are converted to epoch GPS 1130529362.

Hz mHz/s degrees degrees 2 27.8 26.2 14579711 -5.92 207.360 -23.336 Broad line in L1 2 21.6 1468.1440 -12.04 207.360 -23.439 Broad line in L1 116 15 20.9 -11.0 1467.55237 -19.920 205.501 -29.141 Broad disturbance in H1 (7) 18 -7.1 147.477.5305 -0.200 288.82 -20.681 Broad lines in L1 at 1409.3 Hz 29 17.7 -4.3 1420.1181.1 -6.437 204.313 -27.039 Broad lines in H1 14121 Hz 30 17.6 -4.2 140.6053 -1.440 243.13 -27.043 Broad lines in H1 14121 Hz 16 1.1 1.142.11841 -6.439 29.431.3 -27.043 Broad line in H1 1418.1 Hz 16 1.1 1.445.7642 29.205.709 29.41.1 -26.586 Froad line in H1 17.4 -3.1 1.421.1481 -22.01 24.747.864	Idx	SNR	$\log_{10} (\text{GFA})$	Frequency	Spindown	$\mathrm{RA}_{\mathrm{J2000}}$	$\mathrm{DEC}_{\mathrm{J2000}}$	Description
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			-	Hz	nHz/s	degrees	degrees	
$ \begin{array}{ccccccccccccccccccccccccccccccccccc$	2	27.8	-26.2	1457.98771	-5.923	267.265	-23.236	Broad line in L1
12 21.6 -12.6 1409.4104 -12.041 267.020 -24.39 Strong bin-centered line in L1 at 1409.3 Hz 18 20.2 -0.6 1409.44100 -1.792 269.546 -24.541 Strong bin-centered line in L1 at 142.1 Hz 21 19.1 -7.1 1421.1163 -6.019 260.448 Brong bin-centered line in L1 at 142.1 Hz 23 18.1 -5.1 1478.75359 -0.209 268.51 -26.084 Brong bin-centered line in L1 at 1421.1 Hz 23 17.6 -4.2 1408.10431 -25.129 266.189 -237.030 Strong bin-centered line in L1 at 1421.1 Hz 24 16.2 -1.2 1408.10431 -25.72 262.090 267.800 -26.238 Brond line in H1 25 17.4 -3.6 1449.418.6 265.21 -27.384 Broad line in H1 26 15.4 0.3 1449.4408 -7.311 263.883 -25.493 Nach line in H1 27 15.0 1.1 1445.7642 -2.8404 26.171 (FU1) 28 1.4 1.5 -2.841.28 -2.85.28 Food line in	3	27.5	-25.5	1495.87736	-19.359	263.979	-25.411	Broad line in L1
15 20.9 -11.0 1467.5527 -19.292 29.591 -29.741 Broad disturbance in H1 (?) 21 19.1 -7.1 1421.11633 -6.041 26.048 Strong bin-centered line in L1 at 142.1 Hz 21 19.1 -7.1 1421.11633 -6.041 26.048 Strong bin-centered line in L1 at 142.1 Hz 26 17.8 -4.4 1440.40683 -14.402 28.178 -28.641 Strong bin-centered line in L1 at 142.1 Hz 26 17.4 -3.6 1411.11841 -6.643 264.643 Strong bin-centered line in L1 at 142.1 Hz 27 -3.1 1421.11841 -6.645 264.317 27.743 Strong bin-centered line in L1 at 142.1 Hz 28 11.4 1444.5012 -6.777 20.925 -27.348 Broad line in H1 21.5 0.2 147.77364 -1.877 20.8225 -27.948 Broad line in L1 21.1 1444.5042 -2.914 25.252 -26.456 Broad line in H1 23.1 14.44.7047364 -1.877 20.826 22.438 Broad line in L1 23.1 1444.45704 -2.912 </td <td>12</td> <td>21.6</td> <td>-12.6</td> <td>1469.41404</td> <td>-12.041</td> <td>267.020</td> <td>-24.399</td> <td>Strong bin-centered line in L1 at 1469.3 Hz</td>	12	21.6	-12.6	1469.41404	-12.041	267.020	-24.399	Strong bin-centered line in L1 at 1469.3 Hz
18 20.2 -9.6 1469.44100 -1.79 290.546 -24.51 Strong bin-centered line in L at 1421 Hz 23 18.1 -5.1 1478.75396 -0.269 268.825 -26.648 Broad line in II at 1421 Hz 23 18.1 -5.1 1478.75396 -0.269 268.825 -26.648 Broad line in II at 1421 Hz 29 17.7 -4.3 1421.11841 -6.437 263.13 -27.030 Strong bin-centered line in L1 at 1421 Hz 30 17.6 -3.1 1421.11841 -6.437 264.313 -27.031 Strong bin-centered line in L1 at 1421 Hz 31 16.2 -1.2 1446.150512 -6.777 269.297 277.981 Broad line in H1 31 16.2 -1.2 1447.47364 -1.878 288.825 -27.438 Broad line in H1 32 15.0 1.1 1448.75642 -29.076 244.511 -26.457 Forad line in L1 34 14.7 1.8 140.073383 -8.001 285.406 -28.256 Forad line in L1 34 14.6 1.9 1447.44174 -4.232	15	20.9	-11.0	1467.55257	-19.926	265.951	-29.741	Broad disturbance in H1 (?)
21 19.1 -7.1 1421.11633 -6.941 263.048 -26.048 Brong bin-centered line in L1 at 1420 Hz 26 17.8 -4.4 1460.4088 -14.400 263.178 -26.341 Strong bin-centered line in L1 at 1420 Hz 36 17.6 -4.3 141.11841 -6.347 263.3178 -27.030 Strong bin-centered line in L1 at 1420 Hz 36 17.6 -4.3 141.11841 -6.347 263.3178 -27.030 Strong bin-centered line in L1 at 1421 Hz 36 17.1 -1.3 141.11841 -6.347 263.292 -27.038 Brond line in H1 37 36 0.5. 1.2 1477.47364 -1.577 269.295 -27.348 Brond lines in H1 38 1.4.1 1.444.57642 -2.9.162 26.5401 -26.171 FU1 39 1.4.7 1.7 148.536568 -1.9.02 26.840 -26.171 FU1 41.6 1.8 1402.34127 -8.2.162 26.338 -23.341 Broad line in L1 41.6 1.8 142.44710 -0.512 26.864 FU1 FU1<	18	20.2	-9.6	1469.44100	-1.796	269.546	-24.514	Strong bin-centered line in L1 at 1469.3 Hz
23 18.1 -5.1 1478.75395 -0.269 268.825 -26.084 Broad line in H1 29 17.7 -4.3 1421.11841 -6.437 264.313 -27.30 Strong bin-centreed line in L1 at 1420 Hz 20 17.6 -4.2 1408.10431 -25.10 266.180 -23.20 Strong bin-centreed line in L1 at 1420 Hz 30 17.6 -4.2 1408.10431 -25.10 266.180 -23.20 Strong bin-centreed line in L1 at 1420 Hz 31 17.4 -5.6 1418.2029 -20.366 207.609 -24.773 Strong bin-centreed line in L1 at 1420 Hz 32 17.4 -3.6 1418.2029 -20.366 207.609 -24.773 Strong bin-centreed line in L1 at 1421 Hz 33 16.2 -1.2 1467.47364 -4.77 290.2056 -27.298 Broad line in H1 40 15.5 -0.2 1477.875226 -0.090 267.825 -27.981 Broad line in H1 41 15.0 -1.1 1448.475642 -2.9816 255.225 -26.457 Broad line in H1 41 15.0 -1.1 1404.847564 -2.9816 255.225 -26.457 Broad line in H1 41 15.0 -1.1 1404.98454 -22.076 264.511 -26.586 (FU1) 41 17.1 -1.8 1400.73383 -8.001 265.040 -25.138 (FU1) 41 46 -1.9 1497.84101 -4.821 265.660 -28.526 Broad line in L1 41 46 -1.9 1497.84101 -4.821 265.660 -28.526 Broad line in L1 41 46 -1.9 1497.84101 -4.821 265.660 -28.526 Broad line in L1 41 46 -1.9 1497.84101 -4.821 265.660 -28.451 Broad line in L1 41 46 -1.9 1497.84101 -4.821 265.660 -28.451 Broad line in L1 41 46 -1.9 1497.84101 -4.821 265.660 -28.451 Broad line in L1 41 46 -1.9 1497.84101 -4.821 265.660 -28.451 Broad line in L1 41 416 -1.9 1497.84101 -4.821 265.660 -28.451 Broad line in L1 41 416 -1.9 1497.84101 -4.221 265.860 -27.360 Broad line in H1 42 14.6 -1.9 1497.84102 -4.221 $248.256.860$ -27.360 Broad line in H1 42 14.6 -1.9 1497.84102 -1.820 265.988 -27.568 (FU0) 42 13.5 -3.9 1442.61715 -1.6.942 265.988 -27.568 (FU0) 42 13.5 -3.9 1442.61715 -1.6.942 265.988 -27.568 (FU0) 42 13.5 -3.9 1442.61745 -1.0.942 265.988 -27.568 Broad line in H1 42 14.4 -1.96 176.832 -2.85.32 Broad line in H1 42 14.4 -4.2 1498.97625 -2.92.12 Broad 25.998 Broad line in H1 42 14.4	21	19.1	-7.1	1421.11633	-6.941	263.048	-26.468	Strong bin-centered line in L1 at 1421 Hz
26 17.8 -1.4 14069.4083 -14.406 263.178 -27.03 Strong bin-centered line in L1 at 1409. Hz 30 17.6 -4.2 1408.10431 -25.129 266.189 -23.09 Strong bin-centered line in L1 at 1408. Hz 31 17.1 -5.1 1418.1.161.2022 -20.86 267.09 -24.774 Strong bin-centered line in L1 at 1421. Hz 36 17.1 -5.1 142.1.11841 -6.436 264.313 -27.043 Strong bin-centered line in L1 at 1421. Hz 36 15.5 2 145.777 269.252 -27.981 Broad line in H1 36 15.5 2 145.777.2 267.252 -27.981 Broad line in H1 37 15.0 1.1 140.108854 -22.076 264.5171 -26.882 PC101 38 14.7 1.7 145.98808 -15.962 268.240 -28.528 Broad line in L1 39 14.6 1.8 1492.34125 -8.216 266.388 27.330 Broad line in L1 310 14.143.81841 -9.11 268.246 -28.5451 Broad line in L1	23	18.1	-5.1	1478.75395	-0.269	268.825	-26.084	Broad line in H1
29 17.7 -4.3 1421.11841 -6.447 264.313 -27.030 Strong bin-centered line in H1 at 1421 Hz 35 17.4 -3.6 1418.2022 -20.366 267.609 -23.702 Strong bin-centered line in H1 at 1421 Hz 41 16.8 -2.3 1434.50512 -6.777 260.205 -26.208 Broad line in H1 53 16.2 -1.2 1467.47304 -1.878 265.528 -27.648 Broad line in H1 60 15.5 0.2 1477.57226 -0.099 267.825 -27.648 Broad line in H1 61 1.4 0.3 1494.4086 -2.311 263.658 -25.498 Broad line in H1 61 1.4 1.416.92.4125 -2.6171 263.649 -25.138 (PU1) 91 1.6 1.8 1.407.7388 -1.68.21 Particle and line in L1 14.6 1.9 1.497.84101 -4.821 263.600 -28.548 Broad line in L1 1.4143.7 Hz 151 1.43 1.449.67420 -1.9.13 264.048 -23.533 Broad line in L1 1.4143.7 Hz <	26	17.8	-4.4	1469.40683	-14.406	263.178	-26.341	Strong bin-centered line in L1 at 1469.3 Hz
30 11.0 -4.2 1408.10431 -20.129 Strong bin-centered line in L1 at 1408 Hz 35 17.4 -5.6 1418.2222 -20.368 267.093 Strong bin-centered line in L1 at 1421 Hz 36 17.1 -3.1 1421.11841 -6.4366 264.313 -27.043 Strong bin-centered line in L1 at 1421 Hz 36 17.1 -3.1 1421.11841 -6.4366 264.313 -27.043 Strong bin-centered line in L1 at 1421 Hz 36 15.5 -1.2 1445.45512 -0.77 296.252 -27.981 Broad line in H1 37 15.0 1.1 1404.069454 -29.816 265.225 -26.447 Broad line in H1 38 14.7 1.7 145.598689 -50.92 268.240 -26.171 90 14.7 1.8 1409.73838 -80.1286.467 -28.528 Broad line in L1 12 14.6 1.8 1492.34125 -8.212 265.666 -28.526 Broad line in L1 1414.143.7 Hz 13 13.6 3.4 1494.81841 -0.11 27.248 Broad line in L1 141	29	17.7	-4.3	1421.11841	-6.437	264.313	-27.030	Strong bin-centered line in L1 at 1421 Hz
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	30	17.6	-4.2	1408.10431	-25.129	265.189	-23.920	Strong bin-centered line in H1 at 1408 Hz
	30	17.4	-3.0	1418.20292	-20.380	207.009	-24.774	Strong bin-centered line in L1 at 1418.1 Hz
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	30 41	16.9	-3.1	1421.11041	-0.430	204.313	-21.045	Prood line in U1
60 15.5 1.0 1475.75226 -0.000 267.825 -27.981 Broad line in H1 73 15.0 1.1 1499.44085 28.83 -25.408 Nearly broad lines in H1 and L1 73 15.0 1.1 1494.75642 -20.761 26.151 -26.566 (FU1) 84 1.7 1.7 1450.95808 -15.962 268.240 -26.171 90 14.7 1.8 1400.73383 -8.001 28.000 -25.138 (FU1) 91 14.6 1.8 1492.34125 -8.216 266.388 -23.361 Broad line in L1 100 14.5 2.1 1484.48710 -0.763 267.266 Broad line in L1 110 14.5 2.1 1484.8710 -0.763 267.266 Broad line in L1 121 14.0 3.1 1497.84102 -4.823 263.665 -28.451 Broad line in H1 137 3.5 1472.20303 -12.624 263.554 Broad line in H1 143.57 138 3.6 3.9 1445.63610 -4.96	41 53	16.2	-2.5	1467 47364	-0.777 -1.878	209.293	-20.208 -27.384	Broad line in H1
12 15.4 0.3 1499.44086 -7.31 263.883 -25.403 Nearly broad lines in H1 and L1 74 15.0 1.1 148.75642 -20.816 265.25 -26.467 Broad line in H1 74 15.0 1.1 148.75642 -22.086 265.25 -26.467 Broad line in L1 88 14.7 1.8 1407.5388 -5.062 282.52 -26.461 Broad line in L1 92 14.6 1.9 1497.84101 -45.22 266.688 -23.335 Broad lines in H1 100 14.5 2.1 1484.48710 -0.763 267.266 -28.451 Broad line in L1 114 3.1 1497.64102 -4.822 263.654 -22.475 Broad line in L1 157 13.6 3.7 1496.247014 -23.426 264.648 -23.475 Broad line in L1 167 13.7 3.5 1472.02303 -12.622 263.547 -25.625 183 13.6 3.7 1492.4162.0124 -23.426 Broad line in H1 11.1 196	60	15.5	0.2	1478 75226	-0.909	267 825	-27.981	Broad line in H1
73 15.0 1.1 1484.75642 -29.86 265.225 -26.457 Broad line in H1 74 15.0 1.1 140.6954 -22.076 264.511 -26.566 (FU1) 98 14.7 1.8 1400.73383 -8.001 266.388 -23.361 Broad line in L1 94 14.6 1.8 1402.34125 265.66 -28.526 Broad lines in H1 132 14.0 3.1 1443.48101 -0.652 267.286 -27.112 Broad line in L1 134 1.4 3.1 1443.8141 -9.152 257.286 -27.112 Broad line in L1 135 3.4 1497.84102 -4.822 23.654 -22.478 Broad line in L1 136 3.7 1402.87061 -20.621 22.625 Broad line in L1 138 3.6 3.7 1442.61715 -16.332 267.326 Broad line in L1 138 3.9 1454.89391 -20.218 28.541 -25.456 Broad line in L1 135 3.9 1442.61715 -16.392	62	15.4	0.3	1499 44086	-7.311	263 883	-25493	Nearby broad lines in H1 and L1
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	73	15.0	1.1	1484.75642	-29.816	265.225	-26.457	Broad line in H1
88 14.7 1.7 1458.95808 -15.962 268.240 -26.171 90 14.7 1.8 1400.7383 -8.001 268.040 -25.138 (FU1) 92 14.6 1.8 1402.34125 -8.216 266.388 -23.361 Broad line in L1 100 14.5 2.1 1444.48710 -0.763 267.286 -27.112 Broad lines in H1 132 14.0 3.1 1443.81841 -0.151 268.044 -22.8451 Broad lines in H1 134 13.8 3.4 1498.67420 -19.913 264.044 -23.412 Broad line in L1 137 3.5 1472.02303 -12.624 263.554 -25.278 Broad line in L1 138 13.6 3.7 1402.07061 -20.561 269.872 -26.485 11.1454 138 3.5 3.9 1442.61715 -16.934 265.988 -27.306 Broad line in H1 138 3.5 3.9 1442.61715 -16.934 264.598 -27.518 Groad line in H1 141 3.9 1443.61058	74	15.0	1.1	1401.69854	-22.076	264.511	-26.586	(FU1)
90 14.7 1.8 1400.73833 -8.010 268.040 -25.138 (FU1) 91 14.6 1.9 1492.34125 -8.210 266.638 -23.536 Broad line in L1 101 14.5 2.1 1484.48710 -0.763 267.286 -27.112 Broad lines in H1 132 14.0 3.1 1443.81841 -0.151 268.034 -25.533 Strong bin-centered line in L1 141.43.7 Hz 134 3.8 3.4 1498.67420 -19.913 264.048 -23.412 Broad line in H1 157 3.5 1472.02303 -12.054 268.54 -25.675 Broad line in L1 168 3.6 3.9 1442.61715 -16.934 267.499 -25.465 17.5 3.9 1442.61715 -16.934 267.499 -25.625 183 3.6 3.9 1442.61715 -16.948.69 -27.360 Broad line in H1 201 1.5.5 3.9 1442.01715 -16.83.99 -26.734 (FU0) </td <td>88</td> <td>14.7</td> <td>1.7</td> <td>1458.95808</td> <td>-15.962</td> <td>268.240</td> <td>-26.171</td> <td></td>	88	14.7	1.7	1458.95808	-15.962	268.240	-26.171	
92 14.6 1.8 1492.34125 -8.212 263.660 -23.361 Broad line in L1 100 14.5 2.1 1443.48710 -0.763 267.266 -27.112 Broad line in L1 132 14.0 3.1 1443.81841 -9.151 268.034 -25.533 Strong bin-centered line in L1 at 1443.7 Hz 136 13.1 1443.81841 -9.151 268.034 -22.543 Broad line in L1 137 3.4 1448.67420 -19.93 264.048 -23.412 Broad line in L1 138 3.6 3.7 1472.02303 -22.0561 269.577 272 264.85 138 13.5 3.9 1442.61715 -63.274 -25.425 Broad line in L1 138 13.5 3.9 1442.61753 -26.598 -27.058 FU00 201 13.5 3.9 1442.61753 -26.598 -27.058 FU00 201 13.5 3.9 1442.61734 -21.961 261.399 -25.456 202 13.5 4.0 1449.61532 -85.39	90	14.7	1.8	1400.73383	-8.001	268.040	-25.138	(FU1)
94 14.6 1.9 147.84101 -0.763 267.266 -28.526 Broad lines in L1 132 14.0 3.1 1434.81841 -9.151 268.034 -25.533 Strong bin-centered line in L1 at 1443.7 Hz 133 13.6 3.1 1470.20303 -12.624 263.655 -25.278 Broad line in H1 167 13.7 3.5 1472.02303 -12.624 263.524 -25.425 Broad line in L1 163 13.6 3.7 1442.87061 -20.612 263.54 -25.625 198 13.5 3.9 1442.61715 -16.934 267.360 Broad line in H1 201 13.5 3.9 1442.61715 -6.934 27.360 Broad line in L1 201 13.5 3.9 1442.61715 -8.632 264.346 -22.186 (FU0) 201 13.5 3.9 1442.01745 -46.450 -27.360 Broad line in L1 201 13.5 4.0 1496.13532 -8.633 264.346 -26.734 (FU0) 213 4.1 <t< td=""><td>92</td><td>14.6</td><td>1.8</td><td>1492.34125</td><td>-8.216</td><td>266.388</td><td>-23.361</td><td>Broad line in L1</td></t<>	92	14.6	1.8	1492.34125	-8.216	266.388	-23.361	Broad line in L1
	94	14.6	1.9	1497.84101	-4.821	263.660	-28.526	Broad line in L1
12214.03.11443.81841 -9.151 268.034 -25.533 Strong bin-centered line in L1 at 1443.7 Hz15413.83.41498.67420 -19.913 263.665 -28.451 Broad line in H116713.73.51472.02303 -12.624 263.554 -25.278 Broad line in L116813.63.71402.87061 -20.561 269.872 -26.485 17813.63.81457.63610 -4.906 263.216 -24.295 Broad line in L118113.63.91442.61715 -16.934 267.499 -25.456 19813.53.91442.61715 -16.934 267.396Broad line in H120113.53.91448.98202 -9.992 265.988 -27.568 FU0)20513.54.01496.13532 -8.503 264.346 -26.994 Broad line in L1 and L120913.54.01496.13532 -8.503 266.290 -25.146 Nearby broad lines in H1 and L121613.54.11498.67734 -21.961 286.022 -224.757 (FU0)23013.44.21499.92652.92.13266.388 -23.494 Strong bin-centered line in H1 at 1408 Hz22613.44.21499.94284 -16.246 265.682Disturbed spectrum in H123113.44.31408.10786 -17.896 270.286 Strong bin-centered line in H1 at 1408 Hz23513.34.31482.00682 -4.574 </td <td>100</td> <td>14.5</td> <td>2.1</td> <td>1484.48710</td> <td>-0.763</td> <td>267.286</td> <td>-27.112</td> <td>Broad lines in H1</td>	100	14.5	2.1	1484.48710	-0.763	267.286	-27.112	Broad lines in H1
13614.03.11497.84102 -4.823 263.665 -28.451 Broad line in L11373.51472.02303 -12.624 263.554 -23.412 Broad line in L113813.63.71402.87061 -20.561 269.872 -26.485 13913.63.81457.63610 -4.906 263.216 -24.295 Broad line in L113613.63.91442.61715 -16.302 265.988 -25.456 20013.53.91442.61715 -16.342 264.860 -27.360 Broad line in H120113.53.91443.50058 -8.113 268.399 -26.734 (FU0)20413.53.91443.50058 -8.113 264.390 -22.058 Broad line in L121613.54.01496.13532 -8.503 264.346 -22.050 Broad line in H121613.54.01499.4302 -15.954 264.590 -25.146 Nearby broad lines in H1 and L121613.54.11498.67734 -21.961 267.824 -29.502 Broad line in H121613.44.21489.97625 -29.213 260.022 -24.757 (FU0)23013.44.21489.97625 -29.212 269.022 -24.757 (FU0)23113.44.31408.1002 -10.656 270.286 -26.385 Strong bin-centered line in H1 at 1408 Hz25013.34.31482.00682 -4.574 263.893 -26.682 <	132	14.0	3.1	1443.81841	-9.151	268.034	-25.533	Strong bin-centered line in L1 at 1443.7 Hz
154 13.8 3.4 1498.67420 -19.13 264.048 -23.12 Broad line in H1 177 3.5 1472.02303 -12.0561 263.872 -26.485 Broad line in L1 183 13.6 3.7 1402.87061 -20.561 269.872 -26.485 196 13.6 3.9 1442.61715 -16.934 267.499 -25.466 198 13.5 3.9 1442.61715 -16.934 267.499 -26.736 Broad line in H1 201 13.5 3.9 1448.98202 -9.992 265.988 -27.058 (FU0) 205 13.5 4.0 1496.613532 -8.503 264.346 -26.994 Broad lines in H1 and L1 216 13.5 4.0 1496.6734 -21.961 267.824 -29.502 Broad lines in H1 and L1 224 13.4 4.2 1498.67734 -21.961 266.336 -23.421 (FU0) 231 13.4 4.2 1488.0766 -28.842 -25.082 Biroad lines in H1 and L1 224 148.206821 <	136	14.0	3.1	1497.84102	-4.823	263.665	-28.451	Broad line in L1
167 3.5 1472.02303 -12.624 263.554 -26.485 193 13.6 3.8 1457.63610 -4.906 263.216 -24.485 198 13.5 3.9 1442.61715 -16.934 267.499 -25.456 200 13.5 3.9 1442.61715 -16.934 267.499 -25.456 201 13.5 3.9 1442.60712 -26.483 -27.036 Broad line in H1 201 13.5 3.9 1443.50058 -8.113 268.399 -26.734 (FU0) 204 13.5 4.0 1499.43021 -15.954 264.590 -25.146 Nearby broad lines in H1 and L1 216 13.5 4.0 1499.43021 -15.954 263.688 -28.34 Nearby broad lines in H1 and L1 224 13.4 4.2 1489.67734 -21.912 260.022 -24.757 (FU0) 231 13.4 4.2 1489.1786 -27.156 (FU0) 231 13.4 4.3 1408.12849 -22.6825 Strong bin-centered line in H1 at 1408 Hz	154	13.8	3.4	1498.67420	-19.913	264.048	-23.412	Broad line in H1
18313.63.71402.87061 -20.561 299.872 -26.485 19613.63.91454.83301 -20.218 268.541 -25.625 19813.53.91442.61715 -16.934 267.499 -25.456 20013.53.91442.61715 -16.934 267.499 -25.456 20113.53.91448.98202 -9.992 255.988 -27.360 Broad line in H120113.53.91448.5065 -8.113 268.399 -26.734 (FU0)20513.54.01496.13532 -8.503 264.346 -226.994 Broad line in L120913.54.01499.43021 -15.954 264.590 -25.146 Nearby broad lines in H1 and L121613.54.11498.6774 -21.961 267.824 -29.502 Broad line in H122613.44.21499.42849 -16.246 23.688 -28.354 Nearby broad lines in H1 and L122613.44.21409.1265 -92.13 260.622 Disturbed spectrum in H123113.44.21405.36884 -1.351 266.383 -26.682 Disturbed spectrum in H123513.34.31408.10786 -17.896 277.102 27.156 (FU0)25213.34.41406.13953 -25.686 267.954 -26.385 Strong bin-centered line in H1 at 1408 Hz23613.34.41406.13953 -25.686 267.954 <td< td=""><td>167</td><td>13.7</td><td>3.5</td><td>1472.02303</td><td>-12.624</td><td>263.554</td><td>-25.278</td><td>Broad line in L1</td></td<>	167	13.7	3.5	1472.02303	-12.624	263.554	-25.278	Broad line in L1
13313.63.81457.63610 -4.906 203.216 -22.4295 Broad line in L119613.63.91454.89391 -20.218 285.841 -25.456 19813.53.91442.61715 -16.934 267.499 -22.4736 Broad line in H120113.53.91488.98202 -9.992 265.988 -27.360 Broad line in L120113.53.91488.98202 -9.992 265.988 -27.360 Broad line in L120513.54.01496.1352 -8.503 264.346 -26.994 Broad line in L120913.54.01499.43021 -15.954 264.590 -25.146 Nearby broad lines in H1 and L121613.44.21499.42849 -16.246 263.688 -28.354 Nearby broad lines in H1 and L122413.44.21499.42849 -16.246 263.688 -28.354 Nearby broad lines in H1 and L123013.44.21499.42849 -16.246 263.688 -23.737 (FU0)23113.44.31408.12849 -2.961 264.812 -24.757 (FU0)23313.34.31408.10786 -17.896 270.286 -26.385 Strong bin-centered line in H1 at 1408 Hz23513.34.41460.13933 -25.662 05.794 -26.966 (FU0)25613.34.41408.11002 -10.656 268.376 -27.919 Strong bin-centered line in H1 at 1408 Hz259 </td <td>183</td> <td>13.6</td> <td>3.7</td> <td>1402.87061</td> <td>-20.561</td> <td>269.872</td> <td>-26.485</td> <td></td>	183	13.6	3.7	1402.87061	-20.561	269.872	-26.485	
19613.63.91442.89391 -20.218 208.541 -22.625 19813.53.91442.01715 -16.34 267.499 -25.456 20013.53.91448.98202 -9.992 265.988 -27.058 (FU0)20413.53.91443.50058 -8.113 268.399 -26.734 (FU0)20513.54.01496.13532 -8.503 264.346 -26.994 Broad line in L120613.54.01499.42849 -16.246 265.488 -28.354 Nearby broad lines in H1 and L121613.54.11498.67734 -21.961 267.824 -29.502 Broad line in H122413.44.21499.42849 -16.246 263.688 -28.354 Nearby broad lines in H1 and L122613.44.21499.625 -29.213 266.032 -24.757 (FU0)23013.44.21485.0682 -4.574 263.839 -26.682 Disturbed spectrum in H123113.44.31408.10786 -17.896 270.286 -27.156 (FU0)25213.34.41408.1002 -10.566 287.924 -27.156 (FU0)25213.34.41482.62319 -22.633 264.730 -27.878 Nearby broad line in H1 at 1408 Hz25913.34.41482.62319 -22.633 264.730 -27.878 Nearby broad line in H126813.34.41482.62319 -22.632	193	13.6	3.8	1457.63610	-4.906	263.216	-24.295	Broad line in L1
13813.53.91442.01715 -10.394 20.489 -22.430 20013.53.91442.00124 -28.426 264.896 -27.366 Broad line in H120113.53.91443.50058 -8.113 268.399 -26.734 (FU0)20413.54.01496.13532 -8.503 264.346 -26.994 Broad line in L120913.54.01490.43021 -15.954 264.590 -25.146 Nearby broad lines in H1 and L121613.54.1 1498.6734 -21.961 267.824 -29.502 Broad line in H122413.44.2 1499.42849 -16.246 263.688 -28.354 Nearby broad lines in H1 and L122613.44.2 1489.97625 -29.133 269.022 -24.757 (FU0)23113.44.3 1408.12849 -2.961 264.812 -28.640 Strong bin-centered line in H1 at 1408 Hz23513.34.3 1482.00682 -4.574 263.836 -26.825 Strong bin-centered line in H1 at 1408 Hz25013.34.4 1460.13953 -25.666 277.919 Strong bin-centered line in H1 at 1408 Hz25113.34.4 1460.13953 -25.636 267.954 -26.966 (FU0)25213.34.4 1462.1362 -26.326 264.720 -27.156 $(FU0)$ 25613.34.4 1482.62319 -22.633 264.730 -27.88 Nearby broad line	196	13.6	3.9	1454.89391	-20.218	268.541	-25.625	
20013.53.91482.09124-28.420204.800-27.300Broad line in H120113.53.91483.50058-8.113268.399-26.734(FU0)20413.53.91443.50058-8.113268.399-26.734(FU0)20513.54.01499.43021-15.954264.590-25.146Nearby broad lines in H1 and L120913.54.01499.43021-15.954264.590-25.146Nearby broad lines in H1 and L121613.54.11498.67734-21.061267.824-29.502Broad line in H122613.44.21499.42849-16.242263.688-28.354Nearby broad lines in H1 and L122613.44.21465.36884-13.51266.38-23.042(FU0)23013.44.31408.12849-2.961264.812-28.640Strong bin-centered line in H1 at 1408 Hz23513.34.31482.00682-4.574263.839-26.682Disturbed spectrum in H123913.34.31408.10766-17.896270.266-27.156(FU0)25213.34.41459.40166-29.472269.924-27.156(FU0)25213.34.41445.1002-10.652268.8527.919Strong bin-centered line in H1 at 1408 Hz25013.34.41445.1002-10.652268.362-27.919Strong bin-centered line in H1 at 1408 Hz25313.34.4<	198	13.5	3.9	1442.01/10	-16.934	267.499	-25.450	Devel line in II1
20113.53.51435.30202 -9.392 205.368 -27.036 $(FU0)$ 20513.54.01496.13532 -8.503 264.346 -26.994 Broad line in L120913.54.01499.43021 -15.954 264.530 -25.146 Nearby broad lines in H1 and L121613.54.11498.67734 -21.961 267.824 -29.502 Broad line in H122413.44.21489.67734 -21.961 267.824 -29.502 Broad lines in H1 and L122613.44.21489.67734 -21.9213 269.022 -24.777 $(FU0)$ 23013.44.21465.36884 -1.351 266.338 -23.042 $(FU0)$ 23113.44.31408.10862 -4.574 263.39 -26.682 Disturbed spectrum in H123913.34.31408.10786 -17.896 270.286 -26.385 Strong bin-centered line in H1 at 1408 Hz25013.34.41409.10353 -25.686 267.946 $(FU0)$ 25613.34.41408.1002 -10.656 268.366 -27.919 Strong bin-centered line in H1 at 1408 Hz25913.34.41408.1002 -10.656 268.361 -27.919 Strong bin-centered line in H1 at 1408 Hz25913.34.41482.62319 -26.332 264.730 -27.878 Nearby broad line in H126813.34.51445.84829 -16.384 268.512 -28.667	200	13.0	3.9	1402.09124	-28.420	204.800	-27.500	
20415.33.51445.30038-5.113205.398-20.134(170)20513.54.01499.43021-15.954264.540-25.146Nearby broad lines in H1 and L121613.54.11498.67734-21.961267.824-29.502Broad line in H122413.44.21499.42849-16.246263.688-28.354Nearby broad lines in H1 and L122613.44.21449.67734-21.961266.382-24.757(FU0)23013.44.21465.36884-1.351266.338-23.042(FU0)23113.44.31408.1028-4.574263.839-26.682Disturbed spectrum in H123913.34.31408.00786-17.896270.286-26.385Strong bin-centered line in H1 at 1408 Hz25013.34.41460.13953-25.686267.954-26.966(FU0)25213.34.41408.1002-10.656268.386-27.919Strong bin-centered line in H1 at 1408 Hz25913.34.41408.2219-21.633264.730-27.878Nearby broad line in H126813.34.51445.84829-16.384265.515-26.05527513.24.51447.29669-28.242265.215-26.05527613.34.41408.11002-16.586-27.919Strong bin-centered line in H126813.34.51445.84829-16.384-28.617(FU0)<	201	13.5	3.9	1400.90202	-9.992 -8.113	205.988	-27.038 -26.734	(FU0) (FU0)
1001101	204	13.5 13.5	4 0	1496 13532	-8.503	264 346	-26.994	Broad line in L1
1051	200	13.5	4.0	1499 43021	-15,954	264 590	-25.146	Nearby broad lines in H1 and L1
22413.44.21499.42849-16.246263.688-28.354Nearby broad lines in H1 and L122613.44.214489.97625-29.213269.022-24.757(FU0)23013.44.21465.36884-1.351266.338-23.042(FU0)23113.44.31408.12849-2.961264.812-28.640Strong bin-centered line in H1 at 1408 Hz23513.34.31408.10786-17.896270.286-26.682Disturbed spectrum in H123913.34.41460.13953-25.686267.954-26.682Strong bin-centered line in H1 at 1408 Hz25013.34.41460.13953-25.686267.954-26.966(FU0)25213.34.41408.11002-10.656268.386-27.919Strong bin-centered line in H1 at 1408 Hz25913.34.41408.11002-10.656268.386-27.919Strong bin-centered line in H126813.34.51445.84829-16.384268.512-28.667(FU0)27513.24.51474.29669-28.242265.215-26.055Nearby broad line in H1, disturbed H1 spectrum27713.24.51474.29669-28.242265.539-29.328(FU0)28413.14.61459.94553-3.364265.599-29.328(FU0)30113.24.61455.78804-1.216263.067-25.410(FU1)31213.14.8 <t< td=""><td>216</td><td>13.5</td><td>4.1</td><td>1498.67734</td><td>-21.961</td><td>267.824</td><td>-29.502</td><td>Broad line in H1</td></t<>	216	13.5	4.1	1498.67734	-21.961	267.824	-29.502	Broad line in H1
22613.44.21489.97625 -29.213 269.022 -24.757 $(FU0)$ 23013.44.21465.36884 -1.351 266.338 -22.042 $(FU0)$ 23113.44.31408.12849 -2.961 264.812 -28.640 Strong bin-centered line in H1 at 1408 Hz23513.34.31408.10786 -17.896 270.286 -26.385 Strong bin-centered line in H1 at 1408 Hz23913.34.41408.10786 -17.896 270.286 -26.385 Strong bin-centered line in H1 at 1408 Hz25013.34.41408.1006 -29.472 269.924 -27.156 $(FU0)$ 25113.34.41408.11002 -10.656 268.386 -27.919 Strong bin-centered line in H1 at 1408 Hz25913.34.41408.11002 -10.656 268.386 -27.919 Strong bin-centered line in H1 at 1408 Hz25813.34.41408.11002 -10.656 268.386 -27.919 Strong bin-centered line in H1 at 1408 Hz25913.34.41408.11002 -10.656 268.386 -27.919 Strong bin-dine in H1 at 1408 Hz25913.34.41482.62319 -22.633 264.173 -27.878 Nearby broad line in H126813.34.514478.634829 -68.963 -25.106 $(FU0)$ 27513.24.51474.29669 -28.422 265.215 -26.055 Nearby broad line in L1 at 1478 Hz, disturbed H1 spectrum <t< td=""><td>224</td><td>13.4</td><td>4.2</td><td>1499.42849</td><td>-16.246</td><td>263.688</td><td>-28.354</td><td>Nearby broad lines in H1 and L1</td></t<>	224	13.4	4.2	1499.42849	-16.246	263.688	-28.354	Nearby broad lines in H1 and L1
23013.44.21465.36884 -1.351 266.338 -23.042 (FU0)23113.44.31408.12849 -2.961 264.812 -28.640 Strong bin-centered line in H1 at 1408 Hz23513.34.31482.00682 -4.574 263.839 -26.682 Disturbed spectrum in H123913.34.31408.10786 -17.896 270.286 -26.385 Strong bin-centered line in H1 at 1408 Hz25013.34.41459.40166 -29.472 269.924 -27.156 (FU0)25213.34.41460.13953 -25.686 267.954 -20.966 (FU0)25613.34.41408.11002 -10.656 268.386 -27.919 Strong bin-centered line in H1 at 1408 Hz25913.34.41482.62319 -22.633 264.730 -27.878 Nearby broad line in H126813.34.51445.84829 -16.384 268.512 -28.667 (FU0)27513.24.51447.20669 -28.242 265.215 -22.655 Nearby broad line in H1, disturbed H1 spectrum27613.24.61478.10769 -26.661 265.99 -29.328 (FU0)29613.24.61459.9453 -3.364 265.99 -29.328 (FU0)30113.24.61459.78804 -1.216 263.403 -28.173 (FU1)31213.14.81430.424876 -23.659 267.769 -28.544 (FU0)32013	226	13.4	4.2	1489.97625	-29.213	269.022	-24.757	(FU0)
23113.44.31408.12849 -2.961 264.812 -28.640 Strong bin-centered line in H1 at 1408 Hz23513.34.31408.00682 -4.574 263.839 -26.682 Disturbed spectrum in H123913.34.31408.10786 -17.896 270.286 -26.385 Strong bin-centered line in H1 at 1408 Hz25013.34.41459.40166 -29.472 269.924 -27.156 (FU0)25213.34.41460.13953 -25.686 267.954 -26.966 (FU0)25613.34.41408.11002 -10.656 268.386 -27.919 Strong bin-centered line in H1 at 1408 Hz25913.34.41448.62319 -22.633 264.730 -27.878 Nearby broad line in H126813.34.51445.84829 -16.384 268.512 -28.667 (FU0)27513.24.51462.20888 -19.916 268.963 -25.106 (FU0)27613.24.61478.10769 -26.661 265.631 -22.822 Bin-centered line in L1 at 1478 Hz, disturbed H1 spectrum30113.24.61455.78804 -1.216 263.403 -28.173 (FU1)31213.14.71472.96626 -6.889 263.067 -25.410 (FU1)31213.14.81496.76907 -17.039 262.628 -26.112 (FU0)32413.14.81492.48786 -23.205 28.544(FU0)32413.1	230	13.4	4.2	1465.36884	-1.351	266.338	-23.042	(FU0)
23513.34.31482.00682 -4.574 263.839 -26.682 Disturbed spectrum in H123913.34.31408.10786 -17.896 270.286 -26.385 Strong bin-centered line in H1 at 1408 Hz25013.34.41459.40166 -29.472 269.924 -27.156 (FU0)25113.34.41460.13953 -25.686 267.954 -26.966 (FU0)25613.34.41408.11002 -10.656 268.386 -27.919 Strong bin-centered line in H1 at 1408 Hz25913.34.41482.62319 -22.633 264.730 -27.878 Nearby broad line in H126813.34.51445.84829 -16.384 268.512 -28.667 (FU0)27513.24.51445.084829 -16.384 268.512 -28.607 (FU0)27613.24.61474.29669 -28.242 265.215 -26.055 Nearby broad line in H1, disturbed H1 spectrum27713.24.61478.10769 -26.661 265.631 -22.822 Bin-centered line in L1 at 1478 Hz, disturbed H1 spectrum30113.24.61459.94553 -3.364 265.599 -29.328 (FU0)31213.14.71472.96626 -6.889 263.067 -25.410 (FU1)32013.14.81432.48786 -23.659 267.769 -28.544 (FU0)32113.14.81499.42798 -8.03 266.28 -26.112 (FU0) <td>231</td> <td>13.4</td> <td>4.3</td> <td>1408.12849</td> <td>-2.961</td> <td>264.812</td> <td>-28.640</td> <td>Strong bin-centered line in H1 at 1408 Hz</td>	231	13.4	4.3	1408.12849	-2.961	264.812	-28.640	Strong bin-centered line in H1 at 1408 Hz
23913.34.31408.10786 -17.896 270.286 -26.385 Strong bin-centered line in H1 at 1408 Hz25013.34.41459.40166 -29.472 269.924 -27.156 (FU0)25213.34.41460.13953 -25.686 267.954 -26.966 (FU0)25613.34.41482.62319 -22.633 264.730 -27.878 Nearby broad line in H1at 1408 Hz25913.34.41445.84829 -16.384 268.512 -28.667 (FU0)27513.24.51445.84829 -16.384 268.512 -28.667 (FU0)27513.24.51442.2069 -28.242 265.215 -26.055 Nearby broad line in H1, disturbed H1 spectrum27613.24.51462.2088 -19.916 268.963 -25.106 (FU0)29613.24.61478.10769 -26.661 265.599 -29.328 (FU0)30113.24.61455.78804 -1.216 263.403 -28.173 (FU1)31213.14.71472.96626 -6.889 263.067 -25.410 (FU1)32013.14.81492.4786 -23.659 267.769 -28.544 (FU0)32113.14.81499.42798 -18.013 268.803 -25.498 Nearby broad lines in H1 and L132613.14.81490.76907 -17.039 262.628 -26.112 (FU0)32413.14.81490.1240 $-23.$	235	13.3	4.3	1482.00682	-4.574	263.839	-26.682	Disturbed spectrum in H1
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	239	13.3	4.3	1408.10786	-17.896	270.286	-26.385	Strong bin-centered line in H1 at 1408 Hz
25213.34.41460.13953 -25.686 267.954 -26.966 (FU0)25613.34.41408.11002 -10.656 268.386 -27.919 Strong bin-centered line in H1 at 1408 Hz25913.34.41482.62319 -22.633 264.730 -27.878 Nearby broad line in H126813.34.51445.84829 -16.384 268.512 -28.667 (FU0)27513.24.51474.29669 -28.242 265.215 -26.055 Nearby broad line in H1, disturbed H1 spectrum27713.24.51478.10769 -26.661 268.963 -25.106 (FU0)29613.24.61478.10769 -26.661 265.599 -29.328 (FU0)30113.24.61459.94553 -3.364 265.599 -29.328 (FU1)31213.14.71472.96626 -6.889 263.067 -25.410 (FU1)32013.14.81496.76907 -17.039 262.628 -26.112 (FU0)32113.14.81492.48786 -23.206 268.803 -25.498 Nearby broad lines in H1 and L132613.14.81495.08910 -24.164 268.123 -29.057 Nearby broad lines in H1 and L132613.14.81430.12480 -23.206 266.342 -24.490 32913.14.81430.12480 -23.206 266.342 -24.490 32913.14.81430.12480 -23.206 26	250	13.3	4.4	1459.40166	-29.472	269.924	-27.156	(FU0)
25613.34.41408.11002 -10.656 268.386 -27.919 Strong bin-centered line in H1 at 1408 Hz25913.34.41482.62319 -22.633 264.730 -27.878 Nearby broad line in H126813.34.51445.84829 -16.384 268.512 -28.667 (FU0)27513.24.51447.429669 -28.242 265.215 -26.055 Nearby broad line in H1, disturbed H1 spectrum27713.24.51462.20888 -19.916 268.963 -22.106 (FU0)29613.24.61478.10769 -26.661 265.631 -22.822 Bin-centered line in L1 at 1478 Hz, disturbed H1 spectrum30113.24.61459.94553 -3.364 265.599 -29.328 (FU0)30213.24.61455.78804 -1.216 263.403 -28.173 (FU1)31213.14.71472.96626 -6.889 263.067 -25.410 (FU1)32013.14.81496.76907 -17.039 262.628 -26.112 (FU0)32113.14.81496.76907 -17.039 262.628 -26.112 (FU0)32413.14.8149.475.08910 -24.164 268.123 -29.057 Nearby broad lines in H1 and L132613.14.81430.12480 -23.206 266.342 -24.490 32813.14.81430.12480 -23.204 266.342 -24.490 32813.14.81430.12480 </td <td>252</td> <td>13.3</td> <td>4.4</td> <td>1460.13953</td> <td>-25.686</td> <td>267.954</td> <td>-26.966</td> <td>(FU0)</td>	252	13.3	4.4	1460.13953	-25.686	267.954	-26.966	(FU0)
25913.34.41482.62319 -22.633 264.730 -27.878 Nearby broad line in H126813.34.51445.84829 -16.384 268.512 -28.667 (FU0)27513.24.51474.29669 -28.242 265.215 -26.055 Nearby broad line in H1, disturbed H1 spectrum27713.24.51462.20888 -19.916 268.963 -25.106 (FU0)29613.24.61478.10769 -26.661 225.631 -22.822 Bin-centered line in L1 at 1478 Hz, disturbed H1 spectrum30113.24.61459.94553 -3.364 265.599 -29.328 (FU0)30213.24.61455.78804 -1.216 263.403 -28.173 (FU1)31213.14.71472.96626 -6.889 263.067 -25.410 (FU1)32013.14.81432.48786 -23.659 267.769 -28.544 (FU0)32113.14.81496.76907 -17.039 262.628 -26.112 (FU0)32413.14.81499.42798 -18.013 268.033 -25.498 Nearby broad lines in H1 and L132613.14.81475.08910 -24.164 268.123 -29.057 Nearby strong line in H1, disturbed spectrum32813.14.81430.12480 -23.206 266.342 -24.490 32913.14.81430.12480 -23.204 266.342 -24.490 32913.1<	256	13.3	4.4	1408.11002	-10.656	268.386	-27.919	Strong bin-centered line in H1 at 1408 Hz
26813.34.51443.84829-16.384208.512-28.667(FU0)27513.24.51474.29669 -28.242 265.215 -26.055 Nearby broad line in H1, disturbed H1 spectrum27713.24.51462.20888 -19.16 268.963 -25.106 (FU0)29613.24.61478.10769 -26.661 265.631 -22.822 Bin-centered line in L1 at 1478 Hz, disturbed H1 spectrum30113.24.61459.94553 -3.364 265.599 -29.328 (FU0)30213.24.61455.78804 -1.216 263.403 -28.173 (FU1)31213.14.71472.96626 -6.889 263.067 -25.410 (FU1)32013.14.81432.4876 -23.659 267.769 -28.544 (FU0)32113.14.81496.76907 -17.039 262.628 -26.112 (FU0)32413.14.81499.42798 -18.013 268.803 -25.498 Nearby broad lines in H1 and L132613.14.81430.12480 -23.206 266.342 -24.690 32913.14.81430.12480 -23.204 266.342 -24.690 32913.14.81430.12480 -23.204 266.342 -24.695 (FU0)34613.04.91423.41985 -2.116 264.904 -26.065 (FU0)35213.04.91423.41985 -2.116 266.342 -24.695 (FU0) </td <td>259</td> <td>13.3</td> <td>4.4</td> <td>1482.62319</td> <td>-22.633</td> <td>264.730</td> <td>-27.878</td> <td>Nearby broad line in H1</td>	259	13.3	4.4	1482.62319	-22.633	264.730	-27.878	Nearby broad line in H1
27513.24.5 $1474.29609 - 28.242$ $265.215 - 20.035$ Nearby broad line in H1, disturbed H1 spectrum27713.24.5 $1462.20888 - 19.916$ $268.963 - 25.106$ (FU0)29613.24.6 $1478.10769 - 26.661$ $265.631 - 22.822$ Bin-centered line in L1 at 1478 Hz, disturbed H1 spectrum30113.24.6 $1455.78804 - 1.216$ $263.403 - 28.173$ (FU0)30213.24.6 $1455.78804 - 1.216$ $263.403 - 28.173$ (FU1)31213.14.7 $1472.96626 - 6.889$ $263.067 - 25.410$ (FU1)32013.14.8 $1432.48786 - 23.659$ $267.769 - 28.544$ (FU0)32113.14.8 $1496.76907 - 17.039$ $262.628 - 26.112$ (FU0)32413.14.8 $1499.42798 - 18.013$ $268.803 - 25.498$ Nearby broad lines in H1 and L132613.14.8 $1430.12480 - 23.206$ $266.342 - 24.490$ 28.490 32913.14.8 $1430.12480 - 23.204$ $266.342 - 24.490$ 24.490 32913.14.8 $1430.12480 - 23.204$ $266.342 - 24.690$ 24.695 32613.04.9 $1423.41985 - 2.116$ $264.904 - 26.605$ $(FU0)$ 35213.04.9 $1429.10849 - 0.374$ $267.745 - 26.798$ Broad line in L1	268	13.3	4.5	1445.84829	-16.384	268.512	-28.667	(FUU)
211 13.2 4.3 140.20888 -19.916 208.905 -25.106 $(FC0)$ 296 13.2 4.6 1478.10769 -26.661 205.631 -22.822 Bin-centered line in L1 at 1478 Hz, disturbed H1 spectrum 301 13.2 4.6 1459.94553 -3.364 265.599 -29.328 $(FU0)$ 302 13.2 4.6 1455.78804 -1.216 263.403 -28.173 $(FU1)$ 312 13.1 4.7 1472.96626 -6.889 263.067 -25.410 $(FU1)$ 320 13.1 4.8 1432.48786 -23.659 267.769 -28.544 $(FU0)$ 321 13.1 4.8 1496.76907 -17.039 266.2628 -26.112 $(FU0)$ 324 13.1 4.8 1499.42798 -18.013 268.803 -25.498 Nearby broad lines in H1 and L1 326 13.1 4.8 1475.08910 -24.164 268.123 -29.057 Nearby strong line in H1, disturbed spectrum 328 13.1 4.8 1430.12480 -23.206 266.342 -24.490 329 13.1 4.8 1430.12480 -23.204 266.342 -24.690 329 13.1 4.8 1430.12480 -23.106 266.365 $(FU0)$ 346 13.0 4.9 1423.41985 -2.116 264.904 -26.065 $(FU0)$ 352 13.0 4.9 1499.10849 -0.374 267.745 -26.798	270	13.2	4.5	1474.29009	-28.242	200.210	-20.055	(EUO)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	206	13.2	4.5	1402.20888	-19.910 -26.661	208.903	-23.100 -22.822	Bin contored line in L1 at 1478 Hz, disturbed H1 spectrum
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	301	13.2	4.0	1450 04553	-3 364	265 599	_20.328	(FU0)
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	302	13.2	4.0	1455 78804	-1.216	263 403	-28.173	(FU1)
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	312	13.1	4.7	1472,96626	-6.889	263.067	-25.410	(FU1)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	320	13.1	4.8	1432.48786	-23.659	267.769	-28.544	(FU0)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	321	13.1	4.8	1496.76907	-17.039	262.628	-26.112	(FU0)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	324	13.1	4.8	1499.42798	-18.013	268.803	-25.498	Nearby broad lines in H1 and L1
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	326	13.1	4.8	1475.08910	-24.164	268.123	-29.057	Nearby strong line in H1, disturbed spectrum
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	328	13.1	4.8	1430.12480	-23.206	266.342	-24.490	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	329	13.1	4.8	1430.12480	-23.204	266.342	-24.625	(FU0)
352 13.0 4.9 1499.10849 -0.374 267.745 -26.798 Broad line in L1	346	13.0	4.9	1423.41985	-2.116	264.904	-26.065	(FU0)
	352	13.0	4.9	1499.10849	-0.374	267.745	-26.798	Broad line in L1

TABLE V. Outliers above 1400 Hz that passed the detection pipeline excluding regions heavily contaminated with violin modes. Outliers marked with "line" had strong narrowband disturbances identified near the outlier location. We have marked outliers not consistent with the target signals at one of the semi-coherent \mathcal{F} -statistic follow-ups with "(FU0/1/2)", depending on the stage at which they did not pass the detection thresholds. Frequencies are converted to epoch GPS 1130529362.

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4 27.3 -25.0 508.26088 -9.104 269.109 -29.202 Broad line in H1 at 508.222 7 23.6 -16.9 1030.75807 -24.288 265.630 -28.137 Forest of strong lines in L1	
7 23.6 -16.9 1030.75807 -24.288 265.630 -28.137 Forest of strong lines in L1	
1 28.0 10.0 1000.10001 21.200 200.000 20.101 Forest of Strong mes in Ef	
9 23.2 -16.0 501.54872 -22.486 264.981 -23.309 Large line in H1, violin mode regio	n
10 22.7 -14.9 1018.71452 -13.869 268.055 -23.245 Strong line in L1	
11 22.0 -13.4 505.62039 -6.776 264.643 -27.775 Large lines in H1, violin mode regi	on
14 21.0 -11.2 1027.44609 -28.797 266.018 -29.859 Forest of strong lines in L1	
22 18.9 -6.7 1014.13265 -5.347 269.223 -28.565 Forest of strong lines in L1	
25 17.9 -4.7 1030.76062 -27.591 269.921 -27.663 Forest of strong lines in L1	
27 17.7 -4.4 $505.63342 -0.324 266.622 -29.454$ Large lines in H1, violin mode regi	on
28 17.7 -4.3 505.68386 -20.164 267.657 -25.001 Large lines in H1, violin mode regi	on
31 17.6 -4.1 1008.58625 0.313 263.517 -27.178 Strong broad line in H1, line in L1	
38 17.0 -2.9 505.72151 -16.584 265.219 -27.670 Large line in H1, violin mode regio	n
40 10.5 -1.9 1000.00395 -14.300 207.235 -24.920 Strong broad lines in H1	
40 10.5 -1.9 $1021.20313 - 22.564 - 207.135 - 24.951$ Lines in E1 40 16.4 1.7 $500.10731 - 0.030 - 266.011 - 20.803$ Violin mode region	
50 16.3 -1.5 1031.0805 -27.254 263.465 -24.793 Lines in L1	
51 16.3 -1.5 506.0000 -12.404 265.161 -27.594 Large line in H1 violin mode regio	m
52 16.3 -1.4 1027.53960 -15.576 269.243 -24.104 Forest of strong lines in L1	
54 15.8 -0.6 509.19626 -0.289 264.906 -26.767 Violin mode region	
57 15.6 -0.2 1017.17041 -15.632 263.374 -24.850	
61 15.4 0.3 1029.13774 -21.237 263.826 -28.459 Forest of strong lines in L1 (FU0)	
	1, L1, violin mode region
65 15.3 0.5 1027.53447 - 15.899 264.371 - 27.442 Forest of strong lines in L1	
66 15.3 0.6 1014.13550 -0.511 269.734 -28.397 Forest of strong lines in L1	
71 15.1 0.9 992.02121 -22.994 269.830 -28.298 Strong broad line in H1, lines in L	1
79 14.9 1.4 503.01053 -14.412 204.576 -29.521 Large lines in H1, violin mode regi	on oog 1 H-
35 14.8 1.3 1000.10012 -21.094 264.600 25109 bin-centered line in L1 at 1	000.1 Hz
57 14.7 1.0 1003.70644 -17.054 204.009 -23.125 Forest of strong lines in E1	
97 14.6 2.0 1013 03947 -0.404 268 508 -28 506 Disturbed background in H1	
98 14.5 2.0 1026.14462 -28.021 267.878 -27.584 Broad line in L1	
105 14.4 2.3 1004.02592 -2.816 265.980 -25.168 (FU0)	
108 14.3 2.4 1004.02591 -2.814 265.980 -25.265 (FU0)	
109 14.3 2.4 1003.73614 -16.516 266.800 -28.487 Strong broad line in H1	
110 14.3 2.5 1029.19672 1.012 270.018 -27.237 Forest of lines in L1	
$122 14.1 \qquad 2.8 \qquad 993.55783 -25.844 265.053 -24.977 (FU0)$	
124 14.1 2.9 $511.99612 - 0.903 266.165 - 25.709$ Sharp bin-centered line at 512 Hz	
131 14.0 3.0 1000.00019 -15.359 200.092 -20.390 Lines in H1 and L1 134 14.0 3.1 1011.00500 -18.582 260.680 -25.59 Strong line in L1 disturbed H1 sp.	octrum
154 14.0 5.1 1011.00009 -16.003 20000 -25.009 Strong me in Li, distinct for 115	ectrum
155 13.8 3.4 $1025.63609 - 7.339$ $265.091 - 23.025$ Forest of lines in L1	
157 13.8 3.4 $994.50537 - 0.149$ $264.616 - 28.649$ (FU0)	
164 13.8 3.5 990.28898 -0.769 264.972 -26.915 Disturbed H1 spectrum	
168 13.7 3.5 $1031.39556 - 7.501 263.845 - 23.332$ Forest of lines in L1	
178 13.7 3.7 1010.61505 - 17.337 265.335 - 24.634 Disturbed H1 spectrum, lines in L1	1
184 13.6 3.8 $991.26021 - 23.166 266.511 - 27.602$ Disturbed H1 spectrum, lines	
185 13.6 3.8 1006.00396 -14.314 267.225 -27.634 Strong broad lines in H1, lines in I	1
187 13.6 3.8 1031.16138 -14.838 264.511 -23.556 Forest of lines in L1	
197 13.0 3.9 509.19895 0.414 209.053 -27.167 Large lines, violin mode region	
212 10.5 4.0 1017.50540 -10.019 200.645 -24.200 (FOO) 217 13.5 4.1 1018.80200 -17.301 264.300 -26.832 (FUO)	
221 13.4 4.1 1011.02816 -16.411 267.760 -22.824 Disturbed H1 spectrum lines in L ²	1
222 13.4 4.1 1016.77536 -0.176 267.870 -23.024 (FU0)	-
225 13.4 4.2 993.08901 -25.739 269.788 -25.063 (FU1)	
234 13.4 4.3 992.25622 -22.391 265.644 -27.798 Forest of lines in H1 and L1	
$240 13.3 \qquad 4.3 \qquad 1005.02179 -22.107 269.152 -28.822 (FU0)$	
280 13.2 4.5 $1031.49141 - 25.294 266.685 - 27.054$ Forest of lines in L1	
281 13.2 4.5 1013.13666 -22.974 268.774 -25.644 Large disturbance in H1	
292 13.2 4.6 997.43474 -5.569 266.898 -26.932 Strong bin-centered line in L1 at 9	97.4, disturbed H1 spectrum
304 13.2 4.6 1002.78826 -1.404 268.608 -27.280 Strong line in L1	
315 13.1 4.7 991.62069 -12.746 263.013 -27.125 Strong broad line in L1	

TABLE VI. Outliers in 495-520 Hz and 990-1033 Hz regions heavily contaminated with violin modes. Outliers marked with "line" had strong narrowband disturbances identified near the outlier location. We have marked outliers not consistent with the target signals at one of the semi-coherent \mathcal{F} -statistic follow-ups with "(FU0/1/2)", depending on the stage at which they did not pass the detection thresholds. Frequencies are converted to epoch GPS 1130529362.

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