Eric Thrane

List of Publications by Citations

150 papers	23,624 citations	55 h-index	153 g-index
157 ext. papers	28,644 ext. citations	6.3 avg, IF	6.5 L-index

#	Paper	IF	Citations
150	GW170817: Observation of Gravitational Waves from a Binary Neutron Star Inspiral. *Physical Review Letters*, **2017**, 119, 161101	7.4	4272
149	GW151226: Observation of Gravitational Waves from a 22-Solar-Mass Binary Black Hole Coalescence. *Physical Review Letters*, **2016**, 116, 241103	7.4	2136
148	Gravitational Waves and Gamma-Rays from a Binary Neutron Star Merger: GW170817 and GRB 170817A. *Astrophysical Journal Letters*, **2017**, 848, L13	7.9	1614
147	GW170104: Observation of a 50-Solar-Mass Binary Black Hole Coalescence at Redshift 0.2. *Physical Review Letters*, **2017**, 118, 221101	7.4	1609
146	GW170814: A Three-Detector Observation of Gravitational Waves from a Binary Black Hole Coalescence. *Physical Review Letters*, **2017**, 119, 141101	7.4	1270
145	Predictions for the rates of compact binary coalescences observable by ground-based gravitational-wave detectors. *Classical and Quantum Gravity*, **2010**, 27, 173001	3.3	869
144	GW170817: Measurements of Neutron Star Radii and Equation of State. *Physical Review Letters*, **2018**, 121, 161101	7.4	867
143	Tests of General Relativity with GW150914. *Physical Review Letters*, **2016**, 116, 221101	7.4	837
142	GW170608: Observation of a 19 Solar-mass Binary Black Hole Coalescence. *Astrophysical Journal Letters*, **2017**, 851, L35	7.9	809
141	Characterization of the LIGO detectors during their sixth science run. *Classical and Quantum Gravity* , **2015**, 32, 115012	3.3	790
140	Enhanced sensitivity of the LIGO gravitational wave detector by using squeezed states of light. *Nature Photonics*, **2013**, 7, 613-619	33.9	572
139	A gravitational wave observatory operating beyond the quantum shot-noise limit. *Nature Physics*, **2011**, 7, 962-965	16.2	554
138	Properties of the Binary Black Hole Merger GW150914. *Physical Review Letters*, **2016**, 116, 241102	7.4	515
137	ASTROPHYSICAL IMPLICATIONS OF THE BINARY BLACK HOLE MERGER GW150914. *Astrophysical Journal Letters*, **2016**, 818, L22	7.9	512
136	A gravitational-wave standard siren measurement of the Hubble constant. *Nature*, **2017**, 551, 85-88	50.4	413
135	GW150914: The Advanced LIGO Detectors in the Era of First Discoveries. *Physical Review Letters*, **2016**, 116, 131103	7.4	328
134	Sensitivity curves for searches for gravitational-wave backgrounds. *Physical Review D*, **2013**, 88,	4.9	222

133	Bilby: A User-friendly Bayesian Inference Library for Gravitational-wave Astronomy. *Astrophysical Journal, Supplement Series*, **2019**, 241, 27	8	217
132	THE RATE OF BINARY BLACK HOLE MERGERS INFERRED FROM ADVANCED LIGO OBSERVATIONS SURROUNDING GW150914. *Astrophysical Journal Letters*, **2016**, 833, L1	7.9	209
131	GW150914: Implications for the Stochastic Gravitational-Wave Background from Binary Black Holes. *Physical Review Letters*, **2016**, 116, 131102	7.4	188
130	Upper Limits on the Stochastic Gravitational-Wave Background from Advanced LIGO's First Observing Run. *Physical Review Letters*, **2017**, 118, 121101	7.4	137
129	Search for Post-merger Gravitational Waves from the Remnant of the Binary Neutron Star Merger GW170817. *Astrophysical Journal Letters*, **2017**, 851, L16	7.9	133
128	UPPER LIMITS ON THE RATES OF BINARY NEUTRON STAR AND NEUTRON STAR–BLACK HOLE MERGERS FROM ADVANCED LIGO'S FIRST OBSERVING RUN. *Astrophysical Journal Letters*, **2016**, 832, L21	7.9	130
127	AN INDIRECT SEARCH FOR WEAKLY INTERACTING MASSIVE PARTICLES IN THE SUN USING 3109.6 DAYS OF UPWARD-GOING MUONS IN SUPER-KAMIOKANDE. *Astrophysical Journal*, **2011**, 742, 78	4.7	129
126	Estimating the Contribution of Dynamical Ejecta in the Kilonova Associated with GW170817. *Astrophysical Journal Letters*, **2017**, 850, L39	7.9	127
125	Search for Supernova Neutrino Bursts at Super-Kamiokande. *Astrophysical Journal*, **2007**, 669, 519-524	4.7	118
124	GRAVITATIONAL WAVES FROM KNOWN PULSARS: RESULTS FROM THE INITIAL DETECTOR ERA. *Astrophysical Journal*, **2014**, 785, 119	4.7	109
123	First Search for Gravitational Waves from Known Pulsars with Advanced LIGO. *Astrophysical Journal* , **2017**, 839, 12	4.7	107
122	An introduction to Bayesian inference in gravitational-wave astronomy: Parameter estimation, model selection, and hierarchical models. *Publications of the Astronomical Society of Australia*, **2019**, 36,	5.5	102
121	FIRST SEARCH FOR GRAVITATIONAL WAVES FROM THE YOUNGEST KNOWN NEUTRON STAR. *Astrophysical Journal*, **2010**, 722, 1504-1513	4.7	95
120	SEARCH FOR GRAVITATIONAL WAVES ASSOCIATED WITH GAMMA-RAY BURSTS DURING LIGO SCIENCE RUN 6 AND VIRGO SCIENCE RUNS 2 AND 3. *Astrophysical Journal*, **2012**, 760, 12	4.7	94
119	Measuring the Binary Black Hole Mass Spectrum with an Astrophysically Motivated Parameterization. *Astrophysical Journal*, **2018**, 856, 173	4.7	89
118	Determining the population properties of spinning black holes. *Physical Review D*, **2017**, 96,	4.9	89
117	Search for proton decay via p-->e+pi0 and p-->micro+pi0 in a large water Cherenkov detector. *Physical Review Letters*, **2009**, 102, 141801	7.4	86
116	Directional limits on persistent gravitational waves using LIGO S5 science data. *Physical Review Letters*, **2011**, 107, 271102	7.4	85

115	Detecting Gravitational-Wave Memory with LIGO: Implications of GW150914. *Physical Review Letters*, **2016**, 117, 061102	7.4	85
114	Gravitational-Wave Cosmology across 29 Decades in Frequency. *Physical Review X*, **2016**, 6,	9.1	82
113	BEATING THE SPIN-DOWN LIMIT ON GRAVITATIONAL WAVE EMISSION FROM THE VELA PULSAR. *Astrophysical Journal*, **2011**, 737, 93	4.7	75
112	Effects of waveform model systematics on the interpretation of GW150914. *Classical and Quantum Gravity*, **2017**, 34, 104002	3.3	74
111	Improved upper limits on the stochastic gravitational-wave background from 2009-2010 LIGO and Virgo data. *Physical Review Letters*, **2014**, 113, 231101	7.4	74
110	The Mass Distribution of Galactic Double Neutron Stars. *Astrophysical Journal*, **2019**, 876, 18	4.7	70
109	GW190521: Orbital Eccentricity and Signatures of Dynamical Formation in a Binary Black Hole Merger Signal. *Astrophysical Journal Letters*, **2020**, 903, L5	7.9	69
108	Directional Limits on Persistent Gravitational Waves from Advanced LIGO's First Observing Run. *Physical Review Letters*, **2017**, 118, 121102	7.4	65
107	Bayesian inference for compact binary coalescences with bilby: validation and application to the first LIGO–Virgo gravitational-wave transient catalogue. *Monthly Notices of the Royal Astronomical Society*, **2020**, 499, 3295-3319	4.3	62
106	Probing the anisotropies of a stochastic gravitational-wave background using a network of ground-based laser interferometers. *Physical Review D*, **2009**, 80,	4.9	62
105	Evidence for the appearance of atmospheric tau neutrinos in super-Kamiokande. *Physical Review Letters*, **2013**, 110, 181802	7.4	61
104	Search for Tensor, Vector, and Scalar Polarizations in the Stochastic Gravitational-Wave Background. *Physical Review Letters*, **2018**, 120, 201102	7.4	60
103	Constraints on cosmic strings from the LIGO-Virgo gravitational-wave detectors. *Physical Review Letters*, **2014**, 112, 131101	7.4	59
102	The characterization of Virgo data and its impact on gravitational-wave searches. *Classical and Quantum Gravity*, **2012**, 29, 155002	3.3	59
101	SEARCHES FOR CONTINUOUS GRAVITATIONAL WAVES FROM NINE YOUNG SUPERNOVA REMNANTS. *Astrophysical Journal*, **2015**, 813, 39	4.7	58
100	Long gravitational-wave transients and associated detection strategies for a network of terrestrial interferometers. *Physical Review D*, **2011**, 83,	4.9	57
99	SWIFT FOLLOW-UP OBSERVATIONS OF CANDIDATE GRAVITATIONAL-WAVE TRANSIENT EVENTS. *Astrophysical Journal, Supplement Series*, **2012**, 203, 28	8	57
98	Black Hole Genealogy: Identifying Hierarchical Mergers with Gravitational Waves. *Astrophysical Journal*, **2020**, 900, 177	4.7	56

97	First study of neutron tagging with a water Cherenkov detector. *Astroparticle Physics*, **2009**, 31, 320-328	2.4	55
96	Measuring eccentricity in binary black hole inspirals with gravitational waves. *Physical Review D*, **2018**, 98,	4.9	55
95	IMPLICATIONS FOR THE ORIGIN OF GRB 051103 FROM LIGO OBSERVATIONS. *Astrophysical Journal* , **2012**, 755, 2	4.7	53
94	FIRST SEARCHES FOR OPTICAL COUNTERPARTS TO GRAVITATIONAL-WAVE CANDIDATE EVENTS. *Astrophysical Journal, Supplement Series*, **2014**, 211, 7	8	51
93	Polarization-Based Tests of Gravity with the Stochastic Gravitational-Wave Background. *Physical Review X*, **2017**, 7,	9.1	50
92	On the Progenitor of Binary Neutron Star Merger GW170817. *Astrophysical Journal Letters*, **2017**, 850, L40	7.9	50
91	Search for Subsolar-Mass Ultracompact Binaries in Advanced LIGO's First Observing Run. *Physical Review Letters*, **2018**, 121, 231103	7.4	49
90	Exploring the sensitivity of gravitational wave detectors to neutron star physics. *Physical Review D*, **2019**, 99,	4.9	48
89	SEARCH FOR GRAVITATIONAL WAVE BURSTS FROM SIX MAGNETARS. *Astrophysical Journal Letters*, **2011**, 734, L35	7.9	47
88	Parameter estimation in searches for the stochastic gravitational-wave background. *Physical Review Letters*, **2012**, 109, 171102	7.4	46
87	Searching for eccentricity: signatures of dynamical formation in the first gravitational-wave transient catalogue of LIGO and Virgo. *Monthly Notices of the Royal Astronomical Society*, **2019**, 490, 5210-5216	4.3	46
86	The basic physics of the binary black hole merger GW150914. *Annalen Der Physik*, **2017**, 529, 1600209	2.6	45
85	Study of TeV neutrinos with upward showering muons in Super-Kamiokande. *Astroparticle Physics*, **2008**, 29, 42-54	2.4	43
84	Optimal Search for an Astrophysical Gravitational-Wave Background. *Physical Review X*, **2018**, 8,	9.1	42
83	Search for Gravitational Waves Associated with Gamma-Ray Bursts during the First Advanced LIGO Observing Run and Implications for the Origin of GRB 150906B. *Astrophysical Journal*, **2017**, 841, 89	4.7	42
82	SUPPLEMENT: □OCALIZATION AND BROADBAND FOLLOW-UP OF THE GRAVITATIONAL-WAVE TRANSIENT GW150914□(2016, ApJL, 826, L13). *Astrophysical Journal, Supplement Series*, **2016**, 225, 8	8	38
81	Colloquium: Multimessenger astronomy with gravitational waves and high-energy neutrinos. *Reviews of Modern Physics*, **2013**, 85, 1401-1420	40.5	38
80	Inferring the population properties of binary neutron stars with gravitational-wave measurements of spin. *Physical Review D*, **2018**, 98,	4.9	37

79	GRAVITATIONAL WAVES FROM FALLBACK ACCRETION ONTO NEUTRON STARS. *Astrophysical Journal*, **2012**, 761, 63	4.7	37
78	Upper Limits on Gravitational Waves from Scorpius X-1 from a Model-based Cross-correlation Search in Advanced LIGO Data. *Astrophysical Journal*, **2017**, 847, 47	4.7	35
77	The NINJA-2 project: detecting and characterizing gravitational waveforms modelled using numerical binary black hole simulations. *Classical and Quantum Gravity*, **2014**, 31, 115004	3.3	34
76	Evidence for Hierarchical Black Hole Mergers in the Second LIGO–Virgo Gravitational Wave Catalog. *Astrophysical Journal Letters*, **2021**, 915, L35	7.9	34
75	Parallelized inference for gravitational-wave astronomy. *Physical Review D*, **2019**, 100,	4.9	33
74	Searching for gravitational-wave transients with a qualitative signal model: Seedless clustering strategies. *Physical Review D*, **2013**, 88,	4.9	32
73	Measurement and subtraction of Schumann resonances at gravitational-wave interferometers. *Physical Review D*, **2018**, 97,	4.9	30
72	On the Evidence for a Common-spectrum Process in the Search for the Nanohertz Gravitational-wave Background with the Parkes Pulsar Timing Array. *Astrophysical Journal Letters*, **2021**, 917, L19	7.9	30
71	On the origin of GW190425. *Monthly Notices of the Royal Astronomical Society: Letters*, **2020**, 496, L64-L69	4.3	29
70	Higher order gravitational-wave modes with likelihood reweighting. *Physical Review D*, **2019**, 100,	4.9	29
69	Search for nucleon decay via n->[bver]0 and p->[bver]+ in Super-Kamiokande. *Physical Review Letters*, **2014**, 113, 121802	7.4	28
68	Implementation of an $mathcal{F}$-statistic all-sky search for continuous gravitational waves in Virgo VSR1 data. *Classical and Quantum Gravity*, **2014**, 31, 165014	3.3	27
67	Challenges for testing the no-hair theorem with current and planned gravitational-wave detectors. *Physical Review D*, **2017**, 96,	4.9	27
66	Measuring the neutron star equation of state with gravitational waves: The first forty binary neutron star merger observations. *Physical Review D*, **2019**, 100,	4.9	26
65	Measuring gravitational-wave memory in the first LIGO/Virgo gravitational-wave transient catalog. *Physical Review D*, **2020**, 101,	4.9	25
64	Detecting Gravitational Wave Memory without Parent Signals. *Physical Review Letters*, **2017**, 118, 181103	7.4	25
63	Mock data and science challenge for detecting an astrophysical stochastic gravitational-wave background with Advanced LIGO and Advanced Virgo. *Physical Review D*, **2015**, 92,	4.9	25
62	Measuring the non-Gaussian stochastic gravitational-wave background: A method for realistic interferometer data. *Physical Review D*, **2013**, 87,	4.9	25

61	SEARCH FOR ASTROPHYSICAL NEUTRINO POINT SOURCES AT SUPER-KAMIOKANDE. *Astrophysical Journal*, **2009**, 704, 503-512	4.7	25
60	Seedless clustering in all-sky searches for gravitational-wave transients. *Physical Review D*, **2014**, 89,	4.9	24
59	Estimates of maximum energy density of cosmological gravitational-wave backgrounds. *Physical Review D*, **2014**, 90,	4.9	24
58	Limits of Astrophysics with Gravitational-Wave Backgrounds. *Physical Review X*, **2016**, 6,	9.1	24
57	Search for Multimessenger Sources of Gravitational Waves and High-energy Neutrinos with Advanced LIGO during Its First Observing Run, ANTARES, and IceCube. *Astrophysical Journal*, **2019**, 870, 134	4.7	23
56	Search for dinucleon decay into kaons in Super-Kamiokande. *Physical Review Letters*, **2014**, 112, 131803	7.4	22
55	Measuring neutron-star ellipticity with measurements of the stochastic gravitational-wave background. *Physical Review D*, **2014**, 89,	4.9	21
54	Subtraction of correlated noise in global networks of gravitational-wave interferometers. *Classical and Quantum Gravity*, **2016**, 33, 224003	3.3	21
53	Gravitational-wave memory: Waveforms and phenomenology. *Physical Review D*, **2018**, 98,	4.9	21
52	Detecting Gravitational-Wave Transients at 5□A Hierarchical Approach. *Physical Review Letters*, **2015**, 115, 181102	7.4	20
51	Detecting very long-lived gravitational-wave transients lasting hours to weeks. *Physical Review D*, **2015**, 91,	4.9	19
50	Identifying and mitigating noise sources in precision pulsar timing data sets. *Monthly Notices of the Royal Astronomical Society*, **2021**, 502, 478-493	4.3	19
49	First Demonstration of Electrostatic Damping of Parametric Instability at Advanced LIGO. *Physical Review Letters*, **2017**, 118, 151102	7.4	18
48	High-Energy Neutrino Astronomy Using Upward-going Muons in Super-Kamiokande I. *Astrophysical Journal*, **2006**, 652, 198-205	4.7	18
47	Statistical properties of astrophysical gravitational-wave backgrounds. *Physical Review D*, **2014**, 89,	4.9	17
46	Measuring the Primordial Gravitational-Wave Background in the Presence of Astrophysical Foregrounds. *Physical Review Letters*, **2020**, 125, 241101	7.4	15
45	Search for Diffuse Astrophysical Neutrino Flux Using Ultra□High-Energy Upward-going Muons in Super-Kamiokande I. *Astrophysical Journal*, **2006**, 652, 206-215	4.7	15
44	Evidence for an intermediate-mass black hole from a gravitationally lensed gamma-ray burst. *Nature Astronomy*, **2021**, 5, 560-568	12.1	15

43	Search for GUT monopoles at Super-Kamiokande. *Astroparticle Physics*, **2012**, 36, 131-136	2.4	13
42	Identification of noise artifacts in searches for long-duration gravitational-wave transients. *Classical and Quantum Gravity*, **2012**, 29, 095018	3.3	13
41	Building Better Spin Models for Merging Binary Black Holes: Evidence for Nonspinning and Rapidly Spinning Nearly Aligned Subpopulations. *Astrophysical Journal Letters*, **2021**, 921, L15	7.9	13
40	Inferring the population properties of binary black holes from unresolved gravitational waves. *Monthly Notices of the Royal Astronomical Society*, **2020**, 496, 3281-3290	4.3	12
39	Detectability of Gravitational Waves from High-Redshift Binaries. *Physical Review Letters*, **2016**, 116, 101102	7.4	11
38	Heavy Double Neutron Stars: Birth, Midlife, and Death. *Astrophysical Journal Letters*, **2021**, 909, L19	7.9	11
37	Gravitational-wave inference in the catalog era: Evolving priors and marginal events. *Physical Review D*, **2020**, 102,	4.9	10
36	Gravitational-wave astronomy with a physical calibration model. *Physical Review D*, **2020**, 102,	4.9	9
35	All-sky radiometer for narrowband gravitational waves using folded data. *Physical Review D*, **2018**, 98,	4.9	9
34	Constraining the gravitational-wave afterglow from a binary neutron star coalescence. *Monthly Notices of the Royal Astronomical Society*, **2020**, 492, 4945-4951	4.3	8
33	SEARCH FOR NEUTRINOS FROM GRB 080319B AT SUPER-KAMIOKANDE. *Astrophysical Journal*, **2009**, 697, 730-734	4.7	8
32	A scalable random forest regressor for combining neutron-star equation of state measurements: a case study with GW170817 and GW190425. *Monthly Notices of the Royal Astronomical Society*, **2020**, 499, 5972-5977	4.3	8
31	Gravitational wave detection without boot straps: A Bayesian approach. *Physical Review D*, **2019**, 100,	4.9	8
30	The minimum and maximum gravitational-wave background from supermassive binary black holes. *Monthly Notices of the Royal Astronomical Society*, **2019**, 482, 2588-2596	4.3	8
29	Standard-siren Cosmology Using Gravitational Waves from Binary Black Holes. *Astrophysical Journal* , **2021**, 908, 215	4.7	8
28	Searching for anisotropy in the distribution of binary black hole mergers. *Physical Review D*, **2020**, 102,	4.9	7
27	Prospects for searches for long-duration gravitational-waves without time slides. *Physical Review D*, **2015**, 92,	4.9	7
26	All-sky, narrowband, gravitational-wave radiometry with folded data. *Physical Review D*, **2015**, 91,	4.9	7

25	Constraining Short Gamma-Ray Burst Jet Properties with Gravitational Waves and Gamma-Rays. *Astrophysical Journal*, **2020**, 893, 38	4.7	7
24	Toward the Unambiguous Identification of Supermassive Binary Black Holes through Bayesian Inference. *Astrophysical Journal*, **2020**, 900, 117	4.7	7
23	Accelerated detection of the binary neutron star gravitational-wave background. *Physical Review D*, **2019**, 100,	4.9	7
22	Memory effect or cosmic string? Classifying gravitational-wave bursts with Bayesian inference. *Physical Review D*, **2020**, 102,	4.9	6
21	Ultrarelativistic astrophysics using multimessenger observations of double neutron stars with LISA and the SKA. *Monthly Notices of the Royal Astronomical Society*, **2020**, 493, 5408-5412	4.3	6
20	Method for estimation of gravitational-wave transient model parameters in frequency–time maps. *Classical and Quantum Gravity*, **2014**, 31, 165012	3.3	6
19	Gravitational-wave astronomy with an uncertain noise power spectral density. *Physical Review Research*, **2020**, 2,	3.9	6
18	Implications of Eccentric Observations on Binary Black Hole Formation Channels. *Astrophysical Journal Letters*, **2021**, 921, L43	7.9	6
17	Black-hole spectroscopy, the no-hair theorem, and GW150914: Kerr versus Occam. *Physical Review D*, **2021**, 103,	4.9	6
16	Constraints on Weak Supernova Kicks from Observed Pulsar Velocities. *Astrophysical Journal Letters*, **2021**, 920, L37	7.9	5
15	Signs of Eccentricity in Two Gravitational-wave Signals May Indicate a Subpopulation of Dynamically Assembled Binary Black Holes. *Astrophysical Journal Letters*, **2021**, 921, L31	7.9	5
14	Inference with finite time series: Observing the gravitational Universe through windows. *Physical Review Research*, **2021**, 3,	3.9	5
13	The astrophysical odds of GW151216. *Monthly Notices of the Royal Astronomical Society*, **2020**, 498, 1905-1910	4.3	5
12	Effects of transients in LIGO suspensions on searches for gravitational waves. *Review of Scientific Instruments*, **2017**, 88, 124501	1.7	4
11	Is there a spectral turnover in the spin noise of millisecond pulsars?. *Monthly Notices of the Royal Astronomical Society*, **2020**, 497, 3264-3272	4.3	4
10	Memory remains undetected: Updates from the second LIGO/Virgo gravitational-wave transient catalog. *Physical Review D*, **2021**, 104,	4.9	4
9	An introduction to Bayesian inference in gravitational-wave astronomy: parameter estimation, model selection, and hierarchical models—Corrigendum. *Publications of the Astronomical Society of Australia*, **2020**, 37,	5.5	3
8	Exploring a search for long-duration transient gravitational waves associated with magnetar bursts. *Classical and Quantum Gravity*, **2017**, 34, 164002	3.3	3

7	Gravitational waves as a probe of globular cluster formation and evolution. *Monthly Notices of the Royal Astronomical Society*,	4.3	3
6	Bayesian Inference for Gravitational Waves from Binary Neutron Star Mergers in Third Generation Observatories. *Physical Review Letters*, **2021**, 127, 081102	7.4	2
5	Suspending test masses in terrestrial millihertz gravitational-wave detectors: a case study with a magnetic assisted torsion pendulum. *Classical and Quantum Gravity*, **2017**, 34, 105002	3.3	1
4	Probing Extremal Gravitational-wave Events with Coarse-grained Likelihoods. *Astrophysical Journal*, **2022**, 926, 34	4.7	1
3	Flexible and Accurate Evaluation of Gravitational-wave Malmquist Bias with Machine Learning. *Astrophysical Journal*, **2022**, 927, 76	4.7	1
2	Measuring the Properties of Active Galactic Nuclei Disks with Gravitational Waves. *Astrophysical Journal*, **2022**, 931, 82	4.7	1
1	The Imprint of Superradiance on Hierarchical Black Hole Mergers. *Astrophysical Journal*, **2022**, 931, 79	4.7	0