Correcting Biological Misconceptions on the Premise for Life

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Abstract: Our group used an online database of every known Extrasolar planet as well as writing a temperature equation applicable to Extrasolar planets. Using these two in junction we managed to get the approximate temperature for every known Extrasolar planet. Then, we extrapolated extremophiles to suitable planets to show habitability

Introduction: The goal of our research was to disprove the common misconceptions on the necessary factors for life to develop on Extrasolar planets. Searches for life have continuously worked within the parameters of environments preferable to humans instead of using the full spectrum of known and possible life. For example, extremophiles are organisms that can survive and prosper in environments, such as Antarctica or hydrothermal vents, most other species on earth would consider fatal. Their sizes can range from microscopic to the size of an insect. Given that these creatures can evolve on Earth, when put on an extra-solar planet, they will evolve to survive those conditions even more effectively.

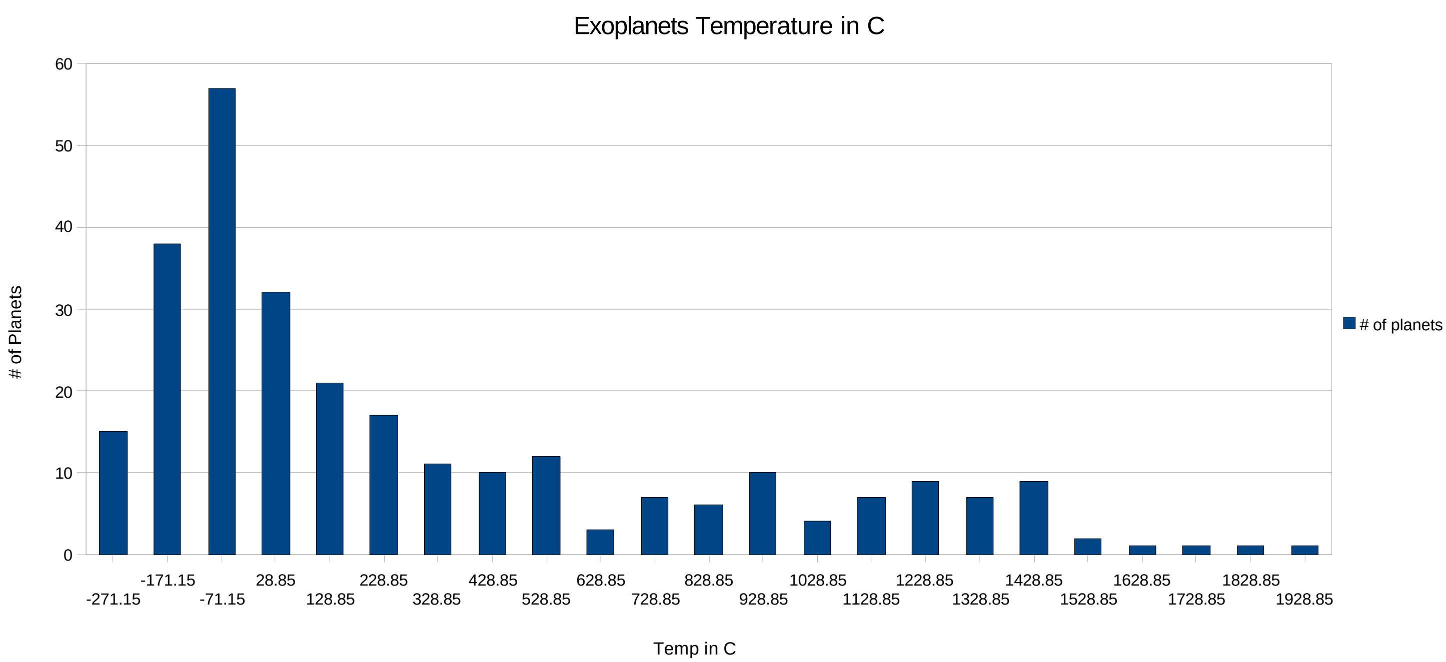
Observations: Our original data on Extrasolar planets, orbit, parent star strength, etc, was gathered using The Extrasolar Planets Encyclopedia (exoplanet.eu/catalog.php). From this we were able to get the base data necessary to calculate the planets temperature using our own equation. This equation is:

T= (L/(16*p*d^2)*s)^(1/4)

Where T equals the approximate temperature of the planet, L equals the absolute luminosity of the parent star in watts, d equals the distance of the planet from its parent star in meters, and s is the Stefan-Boltzmann constant. In order to determine the Luminosity in watts of a star, this equation was used.

L= 4*10^26(10^((M-4.83)/-2.5)

Where M equals absolute magnitude of the host star. This equation, however, does not include the atmosphere of the planet which of course affects temperature. Because the only way to obtain data of the said planet's atmosphere is through direct transit studies, and only a very small amount of Extrasolar planets directly transit their parent stars it would be impractical to include atmosphere as a factor for the large percentage of known Extrasolar planets. Instead, this equation treats the Extrasolar planet in question as though it were a perfect blackbody, absorbing and reflecting an equal amount of light. The following chart displays the number of planets in each temperature band.



Results: What we found, was that most of the extra-solar planets actually fell into a temperature range that was habitable forms of earth life. The range of extremophiles, from thermophiles such as Strain 121, which can live at 121 C, to cryophiles, such as deinococcus, which is known to live in locations where the temperature can reach -85 C, the final results showed 89 habitable planets. In total, the planet temperatures stretched from -271.15 C to 1928.5 C with most planets falling on the low to middle end of the scale.

Discussion: We originally had three goals. The third goal was to modify Drake's equation to account for non earth based life. However, there didn't seem to be a reason to change the equation, because it is already as accurate as we could have made it. Another planned aspect of the project was to find a common extremophile known as a Tardigrade or Water Bear. This extremophile is commonly found in moss and is known to live all over earth. Tardigrades are unique because when they become dehydrated they replace all of the water in their body with sugar. In this state Tardigrades can survive intense heat, radiation, temperatures approaching 0 K and the vacuum of space. Once we found them, we were going to test them with simulated environments of extra-solar planets. The problem was, however, that we did not have enough time to find any Tardigrades and we also didn't have the proper equipment to simulate the environments.

The fact that so many planets are capable of sustaining even Earth based life completely redefines our definition of life and how to look for it. Our entire search for life up to now has been based off of the "Habitability Zone" which is based on where a planet would have to be placed in order for water to exist. However as our data shows, there are Huge amounts of gas giants that exist within this habitability zone, and yet are ignored because of our predisposition to needing a solid planet. Also, the theory exists that not all forms of life need water, for example, Ammonia has proved to be a substitute to water in some biology experiments.

Although a lot of data was gathered, there still exists a lot of information yet to be collected. Given more time we would have like to observe directly transiting planets in order to gain knowledge about their atmosphere. When a planet crosses between its star and the observer on Earth, the absorption line the atmosphere projects can be used to determine the composition of the air and direct knowledge on the atmospheric effect on temperature. Another aspect that needs to be added is the how the planets mass effects the thickness, and thusly temperature of the atmosphere so that more data could be inferred from non-directly transiting planets.

Another add on to the research would be to discover different variable factors for individual planets such as radiation effects, ph of the atmosphere, gravitational effects from various sources on the planet, etc. and apply these conditions as closely as possible to extremophiles found on Earth to have concrete evidence for life’s durability. Another, much longer term, experiment is to experiment with bacteria that reproduce quickly and place them in simulated environments. Theoretically, if observed long enough, possibly over the course of a few years, a new species could develop that is suited to the exact environment of the Extrasolar planet in question. If this were done there would be no question as to whether or not life could develop on planets unlike Earth.

Summary: The search for life has always been on the forefront of the human mind and Extrasolar planets provide the best field of study in which to find life. However, if we as a species allow our search for life to only encompass what we consider favorable to us, than we may overlook planets that could contain entire civilizations. Our view of life has always been centered around what we see on Earth, how could it not be? However, if we want to find life elsewhere in the galaxy, the search has to be expanded.

Resources:

1 The Extrasolar Planets Encyclopedia (exoplanet.eu/catalog.php)

2 Daily Galaxy (dailygalaxy.com/my_weblog/2008/05/non-carbon-life.html)

3 Doctor Mike Castellaz

Appendix:

Temp (K)	Temp (C)	Temp (F)	Planet	
119.16	-153.99	-245.18	MOA-2007-BLG-192-L b	
4.55	-268.6	-451.48	UScoCTIO 108 b	
22.86	-250.29	-418.53	GQ Lup b	
2.79	-270.36	-454.65	2M1207 b	
4.55	-268.6	-451.47	SCR 1845 b	
13.37	-259.78	-435.6	AB Pic b	
92.59	-180.56	-293.01	OGLE235-MOA53 b	
2077.82	1804.67	3280.4	WASP-12 b	
1528.59	1255.44	2291.79	OGLE-TR-56 b	
Err:502	Err:502	Err:502	TrES-3	
780.25	507.1	944.79	HD 41004 B b	
1698.37	1425.22	2597.4	WASP-4 b	
2503.02	2229.87	4045.77	OGLE-TR-113 b	
#DIV/0!	#DIV/0!	#DIV/0!	CoRoT-Exo-1 b	incalculable
1692.02	1418.87	2585.96	WASP-5 b	
1605.17	1332.02	2429.64	OGLE-TR-132 b	
#DIV/0!	#DIV/0!	#DIV/0!	CoRoT-Exo-2 b	incalculable
726.59	453.44	848.2	SWEEPS-11	
1958.66	1685.51	3065.92	WASP-3 b	
124.01	-149.14	-236.45	Gliese 876 b	
156.8	-116.35	-177.44	Gliese 876 c	
391.93	118.78	245.8	Gliese 876 d	
1794.74	1521.59	2770.87	WASP-9 b	
1751.16	1478.01	2692.41	HD 86081 b	
1174.76	901.61	1654.9	WASP-2 b	

2221.98	1948.83	3539.9	HAT-P-7 b	
1150.9	877.75	1611.95	HD 189733 b	
1884.93	1611.78	2933.21	WASP-14 b	
1730.18	1457.03	2654.65	HD 212301 b	
1514.31	1241.16	2266.09	TrES-2	
Err:502	Err:502	Err:502	WASP-1 b	incalculable
1322.46	1049.31	1920.76	HD 73256 b	
1310.44	1037.29	1899.12	XO-2 b	
436.06	162.91	325.24	GJ 436 b	
1832.37	1559.22	2838.59	HAT-P-5 b	
742.23	469.08	876.35	55 Cnc b	
513.79	240.64	465.15	55 Cnc c	
104.79	-168.36	-271.06	55 Cnc d	
1291.21	1018.06	1864.51	55 Cnc e	
284.82	11.67	53	55 Cnc f	
986.57	713.42	1316.15	HD 63454 b	
1770.65	1497.5	2727.51	HD 149026 b	
1057.31	784.16	1443.49	HAT-P-3 b	
1332.04	1058.89	1938.01	HD 83443 b	
1241.13	967.98	1774.37	HD 46375 b	
1132.64	859.49	1579.07	TrES-1	
1711.39	1438.24	2620.84	HAT-P-4 b	
1571.85	1298.7	2369.67	HD 179949 b	
715.77	442.62	828.71	WASP-10 b	
1528.26	1255.11	2291.2	HD 187123 b	
142.96	-130.19	-202.35	HD 187123 c	
1650.94	1377.79	2512.02	OGLE-TR-10 b	
2144.35	1871.2	3400.16	XO-3 b	
1733.82	1460.67	2661.2	Tau Boo b	
1663.53	1390.38	2534.68	WASP-6 b	
1071.41	798.26	1468.86	HD 330075 b	
1703.59	1430.44	2606.8	HD 88133 b	
1075.57	802.42	1476.35	HD 2638 b	
Err:502	Err:502	Err:502	BD-10 3166 b	incalculable
1572.92	1299.77	2371.59	HD 75289 b	
1502.38	1229.23	2244.61	HD 209458 b	
1780.96	1507.81	2746.05	TrES-4	
762.33	489.18	912.52	TW Hya b	
Err:502	Err:502	Err:502	OGLE-TR-211 b	incalculable
760.3	487.15	908.86	WASP-11 b	
1776.81	1503.66	2738.59	WASP-15 b	
1678.21	1405.06	2561.1	HD 219828 b	
1490.71	1217.56	2223.61	HAT-P-6 b	

Err:502	Err:502	Err:502	Lupus-TR-3 b	incalculable
1284.23	1011.08	1851.94	XO-1 b	
1452.87	1179.72	2155.49	HD 76700 b	
Err:502	Err:502	Err:502	OGLE-TR-182 b	incalculable
Err:502	Err:502	Err:502	CoRoT-Exo-5 b	incalculable
1346.89	1073.74	1964.74	OGLE-TR-111 b	
1513.11	1239.96	2263.92	HD 149143 b	
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1031.07	757.92	1396.26	HD 102195 b	
1673.49	1400.34	2552.62	XO-4 b	
1208.06	934.91	1714.83	XO-5 b	
680.25	407.1	764.79	SWEEPS-4	
1285.27	1012.12	1853.81	51 Peg b	
Err:502	Err:502	Err:502	CoRoT-Exo-3 b	incalculable
#DIV/0!	#DIV/0!	#DIV/0!	HD 40307 b	incalculable
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1259.11	985.96	1806.73	WASP-13 b	
1237.32	964.17	1767.5	HAT-P-1 b	
1594.39	1321.24	2410.23	Ups And b	
425.09	151.94	305.49	Ups And c	
244.45	-28.7	-19.67	Ups And d	
336.77	63.62	146.51	GJ 674 b	
1110.25	837.1	1538.78	HD 49674 b	
1441.81	1168.66	2135.58	WASP-7 b	
1277.54	1004.39	1839.91	HD 109749 b	
294.6	21.45	70.61	Gl 581 b	
220.78	-52.37	-62.26	Gl 581 c	
119.3	-153.85	-244.92	Gl 581 d	
1626.33	1353.18	2467.73	HAT-P-2 b	
1508.36	1235.21	2255.38	HD 118203 b	
1167.94	894.79	1642.63	HD 68988 b	
127.05	-146.1	-230.98	HD 68988 c	
1117.43	844.28	1551.7	HD 168746 b	
881.87	608.72	1127.69	HD 102272 b	
551.49	278.34	533.01	HD 102272 c	
463.28	190.13	374.24	HD 208487 b	
479.53	206.38	403.49	HD 52265 b	
380.93	107.78	226.01	HD 216770 b	
579.33	306.18	583.13	70 Vir b	
376.74	103.59	218.47	HD 80606 b	
577.9	304.75	580.55	HD 114762 b	

575.24	302.09	575.76	HD 16141 b
520.67	247.52	477.53	HD 178911B b
410.59	137.44	279.4	HD 101930 b
561.44	288.29	550.93	HD 121504 b
442.97	169.82	337.68	HD 3651 b
617.99	344.84	652.71	HD 168443 b
198.42	-74.73	-102.51	HD 168443 c
479.29	206.14	403.05	HD 37605 b
603.46	330.31	626.56	HD 117618 b
693.66	420.51	788.91	HD 74156 b
191.69	-81.46	-114.64	HD 74156 c
374.25	101.1	213.97	HD 74156 d
590.91	317.76	603.96	HD 107148 b
524.35	251.2	484.17	HD 45652 b
694.66	421.51	790.72	rho CrB b
751.68	478.53	893.35	HD 11964 b
202.13	-71.02	-95.84	HD 11964 c
839.34	566.19	1051.15	HD 43691 b
817	543.85	1010.93	HD 224693 b
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Err:502	Err:502	Err:502	PSR 1257+12 c
Err:502	Err:502	Err:502	PSR 1257+12 d
518.46	245.31	473.56	HD 192263 b
749.98	476.83	890.3	HD 6434 b
913.71	640.56	1185	HD 17156 b
802.29	529.14	984.45	HD 102117 b
661.69	388.54	731.38	HD 195019 b
959.25	686.1	1266.98	HD 33283 b
584.37	311.22	592.19	HD 27894 b
146.3	-126.85	-196.32	HD 190360 b
809.64	536.49	997.69	HD 190360 c
572.36	299.21	570.57	HD 99492 b
653.64	380.49	716.88	Gl 86 b
831.97	558.82	1037.87	HD 4308 b
1249.91	976.76	1790.17	HD 38529 b
234.02	-39.13	-38.44	HD 38529 c
1042.19	769.04	1416.26	HD 108147 b
782.81	509.66	949.39	HD 130332 b
309.84	36.69	98.04	HD 285968 b
264.02	-9.13	15.57	HD 160691 b
158.35	-114.8	-174.64	HD 160691 c
1077.86	804.71	1480.47	HD 160691 d
336.94	63.79	146.82	HD 160691 e
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871.14	597.99	1108.38	HD 69830 b
565.93	292.78	559.01	HD 69830 c
307.5	34.35	93.84	HD 69830 d
681.03	407.88	766.18	HD 162020 b
688.33	415.18	779.33	WASP-8 b
1474.95	1201.8	2195.23	HD 217107 b
189.77	-83.38	-118.09	HD 217107 c
1439.26	1166.11	2131	HD 185269 b
1051.99	778.84	1433.91	HIP 14810 b
433.78	160.63	321.13	HIP 14810 c
881.87	608.72	1127.69	HD 102272 b
355.83	82.68	180.82	GJ 3021 b
876.43	603.28	1117.9	ksi Aql b
478.98	205.83	402.49	HD 231701 b
311.55	38.4	101.12	HD 93083 b
364.3	91.15	196.06	HD 37124 b
148.49	-124.66	-192.39	HD 37124 c
207.1	-66.05	-86.9	HD 37124 d
1257.14	983.99	1803.18	HD 219449 b
812.79	539.64	1003.34	HD 81688 b
417.24	144.09	291.36	HD 73526 b
330.8	57.65	135.76	HD 73526 c
396.8	123.65	254.57	HD 155358 b
284.22	11.07	51.93	HD 155358 c
815.81	542.66	1008.79	HD 104985 b
444.34	171.19	340.14	HD 75898 b
288.35	15.2	59.35	HD 82943 b
364.18	91.03	195.86	HD 82943 c
465.77	192.62	378.71	HD 169830 b
220.93	-52.22	-61.99	HD 169830 c
400.31	127.16	260.89	HD 8574 b
314.61	41.46	106.63	HD 202206 b
179.49	-93.66	-136.58	HD 202206 c
483.81	210.66	411.18	HD 89744 b
346.94	73.79	164.83	HD 134987 b
326.46	53.31	127.97	HD 12661 b
185.89	-87.26	-125.07	HD 12661 c
308.83	35.68	96.22	HD 150706 b
367.32	94.17	201.51	HD 40979 b
604.14	330.99	627.77	4 Uma b
474.81	201.66	394.99	HD 175541 b
775.3	502.15	935.88	HD 59686 b
322.09	48.94	120.1	HR 810 b
333.93	60.78	141.41	HD 142 b

477.9	204.75	400.55	HD 210702 b
881.46	608.31	1126.96	HD 122430 b
466.82	193.67	380.6	HD 192699 b
425.22	152.07	305.73	HD 156846 b
1464.72	1191.57	2176.83	HD 17092 b
292.43	19.28	66.7	HD 92788 b
277.12	3.97	39.14	HD 28185 b
278.76	5.61	42.1	HD 100777 b
284.94	11.79	53.22	HD 142415 b
366.9	93.75	200.74	HD 33564 b
398.81	125.66	258.18	HD 177830 b
290.66	17.51	63.51	HD 108874 b
182.02	-91.13	-132.04	HD 108874 c
309.22	36.07	96.93	HD 4203 b
385.12	111.97	233.54	HD 154857 b
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424.47	151.32	304.38	HD 167042 b
381.27	108.12	226.62	HD 27442 b
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246.34	-26.81	-16.26	HD 99109 b
258.66	-14.49	5.92	HD 210277 b
186.59	-86.56	-123.81	HD 128311 b
147.45	-125.7	-194.27	HD 128311 c
349.38	76.23	169.21	HD 19994 b
290.81	17.66	63.79	HD 221287 b
271.05	-2.1	28.23	HD 188015 b
473.52	200.37	392.66	HD 13189 b
287.45	14.3	57.74	HD 20367 b
202.75	-70.4	-94.72	HD 114783 b
264.94	-8.21	17.22	HD 125612 b
627.68	354.53	670.15	HIP 75458 b
258.5	-14.65	5.63	HD 4113 b
333.55	60.4	140.72	HD 171028 b
251.45	-21.7	-7.07	HD 147513 b
256.33	-16.82	1.72	HD 222582 b
254.59	-18.56	-1.41	HD 20782 b
513.63	240.48	464.87	HD 62509 b
579.65	306.5	583.7	eps Tau b
215.59	-57.56	-71.61	HD 65216 b
261.55	-11.6	11.12	HD 183263 b
239.15	-34	-29.19	HD 141937 b
210.33	-62.82	-81.08	HD 41004 A b
320.49	47.34	117.22	HD 5319 b
1488.94	1215.79	2220.43	NGC 4349 No 127 b

53.05	-220.1	-364.19	GJ 317 b
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538.23	265.08	509.15	HD 11977 b
586.6	313.45	596.21	NGC 2423 3 b
242.32	-30.83	-23.5	HD 23079 b
231.73	-41.42	-42.55	16 Cyg B b
202.8	-70.35	-94.62	HD 4208 b
186.01	-87.14	-124.85	HD 70573 b
272.08	-1.07	30.08	HD 16175 b
150.72	-122.43	-188.38	HD 114386 b
222.73	-50.42	-58.75	HD 45350 b
309.77	36.62	97.91	Gamma Cephei b
253.31	-19.84	-3.71	HD 213240 b
231.54	-41.61	-42.89	HD 132406 b
262.26	-10.89	12.39	HD 159868 b
240.42	-32.73	-26.92	HD 187085 b
402.54	129.39	264.9	18 Del b
187.4	-85.75	-122.34	HD 81040 b
230.86	-42.29	-44.12	HD 190647 b
217.9	-55.25	-67.46	HD 10647 b
248.59	-24.56	-12.2	HD 10697 b
215.18	-57.97	-72.35	47 Uma b
169.76	-103.39	-154.1	47 Uma c
269.57	-3.58	25.55	HD 190228 b
237.87	-35.28	-31.5	HD 114729 b
180.01	-93.14	-135.65	HD 111232 b
220.07	-53.08	-63.54	HD 170469 b
173.67	-99.48	-147.07	HD 164922 b
271.13	-2.02	28.36	V391 Peg b
304.81	31.66	89	kappa CrB b
217.65	-55.5	-67.91	HD 2039 b
261.05	-12.1	10.22	HD 136118 b
228.65	-44.5	-48.1	HD 23127 b
201.34	-71.81	-97.25	HD 50554 b
229.76	-43.39	-46.1	HD 11506 b
208.43	-64.72	-84.5	HD 196050 b
210.03	-63.12	-81.62	HD 216437 b
219.59	-53.56	-64.4	HD 196885
237.07	-36.08	-32.94	HD 216435 b
188.23	-84.92	-120.86	HD 106252 b
223.39	-49.76	-57.58	HD 23596 b
33.45	-239.7	-399.46	ChaHa8 b
148.91	-124.24	-191.62	14 Her b
94.35	-178.8	-289.84	14 Her c (unconfirmed)
116.97	-156.18	-249.13	OGLE-06-109L b

82.71	-190.44	-310.79	OGLE-06-109L c
47.54	-225.61	-374.1	Gj 849 b
164.48	-108.67	-163.6	HD 142022 A b
168.39	-104.76	-156.58	HD 66428 b
183.29	-89.86	-129.74	HD 39091 b
153.56	-119.59	-183.26	HD 70642 b
111.38	-161.77	-259.18	Epsilon Eridani b
32.43	-240.72	-401.3	Epsilon Eridani c (unconfirmed)
179.59	-93.56	-136.4	HD 50499 b
150.26	-122.89	-189.2	HD 117207 b
147.31	-125.84	-194.52	HD 30177 b
150.17	-122.98	-189.37	HD 89307 b
169.93	-103.22	-153.79	HD 72659 b
76.64	-196.51	-321.72	OGLE-05—169L b
119.01	-154.14	-245.45	HD 154345 b
405.21	132.06	269.71	OGLE-05-390L b
91.93	-181.22	-294.2	OGLE-05-071L b
13.85	-259.3	-434.74	PSR B1620-26 b