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Planetary cores, their energy flux relationship, and its implications

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ABSTRACT

Integrated surface heat flux data from each planet in our solar system plus over 50 stars, including our Sun, was plotted against each object's known mass to generate a continuous exponential curve at an R-squared value of 0.99. The unexpected yet undeniable implication of this study is that all planets and celestial objects have a similar mode of energy production. It is widely accepted that proton-proton reactions require hydrogen gas at temperatures of about 15 million degrees, neither of which can plausibly exist inside a terrestrial planet. Hence, this paper proposes a nuclear fission mechanism for all luminous celestial objects, and uses this mechanism to further suggest a developmental narrative for all celestial bodies, including our Sun. This narrative was deduced from an exponential curve drawn adjacent to the first and passing through the Earth's solid core (as a known prototype). This trend line was used to predict the core masses for each planet as a function of its luminosity.

1. Introduction

The Earth's geothermal heat flux and its origin have been of interest to geologists, geophysicists, as well as a few astronomers for well over half a century. The customary explanation for this phenomenon generally involves radiogenic heat production from radioisotopes of Uranium, Thorium, and Potassium.

The earliest heat flow measurements were taken on the Earth's surface. Planetary heat flow measurements were discussed in great detail by Axel Hagermann (other studies on this topic can be found in the reference section of Hagermann's paper) (Hagerman, 2005). The Earth is by far the most thoroughly studied, with a mean value of 65 mW per square meter (mWm⁻²) passing through the continents and a mean value of 101 mWm⁻² flowing through the oceans (Pollack et al., 1993). Since NASA's space probe launchings, and Moon landings by astronauts, heat flow measurements have been obtained for most solar system planets, as well as the Moon. Two separate heat flow measurements were made by the astronauts of Apollo 15 and 17 on different locations on the Moon's surface. The lunar heat flow values were 21 mWm⁻² and 16 mWm⁻² respectively. The latter value was subsequently adjusted by Warren and Rasmussen (1987) to 12 mWm⁻². Jupiter's closest satellite Io exhibits an unusually large heat flow of 2 Wm⁻² (Morrison and Telesco, 1980). The Martian heat flow data was determined to be $6.4 \pm 0.4 \text{ mWm}^{-2}$ by Hahn et al. (2011). The Sun's known parameters were included not only for the sake of completeness, but the Sun after all is the principle component of our solar system. With the exception of Mercury and Venus, there is heat flow data for all the other planets (Spohn, 2015). By integrating the heat flow measurements over the whole surface of the planet, one can establish its luminosity.

2. Methods

A luminosity (L) value for each planetary object was obtained by multiplying its surface area (A) by its average measured heat flow value (H):

$$L = (H) \cdot (A) \tag{1}$$

This assumes that the heat flux measurements taken represent the average value over the entire surface of the planet. Table 1 is a listing of the calculated luminosities of each planet, along with some other properties.

Since stars are characterized by a mass-luminosity relationship, it was hypothesized that there could be a similar relationship among the planets. After plotting the masses versus the luminosities of each planet on a logarithmic scale, it became clear that indeed such a relationship exists.

Next, because the mass of the planet Jupiter is not far removed from that of some nearby stars, a study of the mass-luminosity relationship for those stars was of interest.

Table 2 is a listing of 39 nearby G, K, and M stars, which provides the luminosity and mass of each stellar object (List of the Nearest 100 Stellar Systems, 2012). The G, K, M stellar classification is based on the stellar surface temperature in decreasing order of temperature, the Sun being a G-type star. For completeness, 12 highly luminous stars were added later,

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Table 1

Critical properties of solar system planets.

	5	1		
	Radius (m)	Mean Density (gm/cc)	Mass (kg)	Luminosity (Watts)
Earth Mars Jupiter Saturn Uranus Neptune	$\begin{array}{c} 6.378 \times 10^6 \\ 3.397 \times 10^6 \\ 7.150 \times 10^7 \\ 6.030 \times 10^7 \\ 2.556 \times 10^7 \\ 2.476 \times 10^7 \end{array}$	5.5 3.94 1.24 0.62 1.3 1.61	$\begin{array}{l} 5.970 \times 10^{24} \\ 6.419 \times 10^{23} \\ 1.898 \times 10^{27} \\ 5.685 \times 10^{26} \\ 8.685 \times 10^{25} \\ 1.024 \times 10^{26} \end{array}$	$\begin{array}{c} 3.311 \times 10^{13} \\ 9.333 \times 10^{11} \\ 3.4673 \times 10^{17} \\ 9.1203 \times 10^{16} \\ 3.388 \times 10^{14} \\ 3.311 \times 10^{15} \end{array}$

representing larger, younger, and hotter stars than the Sun. Data therefore includes a wide range of stars in our galaxy.

Stellar luminosity (*L*) was calculated with the solar luminosity ($L_{\odot} = 3.846 \times 10^{26}$ Watts) as a reference using the following equation:

$$\frac{L}{L_{\odot}} = 10^{\frac{2}{5}(M_{V\odot} - M_{V})}$$
(2)

where:

 M_{vo} and M_v are the absolute visual magnitudes of the Sun and the target star, respectively.

The mass-luminosity relationship of a star, including our Sun, is subject to the following equations:

$$\frac{L}{L_{\odot}} = .23 \left(\frac{M}{M_{\odot}}\right)^{2.3} \text{ when } (M < .43M_{\odot})$$
(3)

$$\frac{L}{L_{\odot}} = \left(\frac{M}{M_{\odot}}\right)^4 \quad \text{when } (43M_{\odot} < M < 20M_{\odot}) \tag{4}$$

Table 2

Stellar properties of 39 G, K, and M Stars within 100 parsecs, and of 12 highly luminous stars.

SumConvertie <thc< th=""><th>Name</th><th>Spectral type</th><th>Absolute magnitude</th><th>L (Watts)</th><th>Log of L</th><th>Mass (kg)</th><th>Log of mass</th></thc<>	Name	Spectral type	Absolute magnitude	L (Watts)	Log of L	Mass (kg)	Log of mass				
99 6, k, and M Stare (within 100 parsec) OJ S59 A G2 OV 4 380 5 2920-26 26.77 2.166-30 30.35 GJ S59 B K0 V 5.710 1.74221-26 26.24 2.0708-30 30.36 GJ 406 M5.5 V 16.64 7.3968-71 21.22 21.35 4.358 28.35 GJ 411 M2 OV 10.44 2.348-24 24.35 6.508-12 23.23 1.358 28.35 GJ 729 M3 V 1.368 1.00812-12 23.15 4.4588-38 28.351 GJ 729 M3 V 1.368 1.00812-12 23.12 1.4581-30 23.17 GJ 147 M4 OV 1.353 1.2797-123 23.11 1.1668-33 23.07 GJ 128 M3 S V 1.177 1.4361 2.4404 5.5688-39 2.924 GJ 128 M3 S V 1.331 2.371 2.440 2.5688-39 2.927 GJ 158 M3 S V 1.331 2.371 2.440 2.5688-39 2.372	Sun	G2.0VN	4.85	3.846E+26	26.59	1.989E+30	30.2986				
G1 559 A G2 0 V 4.80 5229E i.26 26.7 2.16 i.30 30.43 G1 599 B K0 V 5.710 1.742E i.26 26.24 2.207E i.30 30.43 G1 699 M3.5 V 13.25 1.679E i.32 23.23 1.344E i.20 20.12 G1 411 M2.0 V 10.644 2.234E i.24 24.35 5.691E i.32 29.74 G1 720 M3.5 V 13.68 1.097E i.22 2.15 4.35E i.32 29.14 G1 720 M3.5 V 13.68 1.097E i.22 2.61 1.458E i.30 20.14 G1 470 M4.0 V 7.353 1.297E i.23 2.53 1.136E i.39 29.74 G1 470 M4.0 V 13.35 1.297E i.23 2.53 1.136E i.39 29.74 G1 725 B M3.5 V 10.31 2.518E i .24 2.40 5.558E i.29 29.75 G1 15 R M3.5 V 13.30 1.60E i .23 2.21 5.43E i.28 2.80 G1 71 G6.0 V 7.71 5.492 2.911 2.911 2.911 2.911 G1 111 M6.0 V	39 G, K, and M Stars (within 100 parsecs)										
G3 559 B K0 V 5.710 1.7428:26 2.624 2.670E:30 30.43 GJ 460 M5.5 V 16.64 7.3966:421 2.137 3.358E:428 2.833 GJ 460 M5.5 V 16.64 7.3966:421 2.135 4.458E:428 2.835 GJ 558 M6.0 V 15.33 1.4228:122 2.13 4.458E:428 2.815 GJ 411 K2.0 V 6.200 1.109E:42 2.63 1.346E:32 2.33 1.346E:32 2.34 1.366E:32 2.33 1.346E:32 2.34 1.346E:32 2.34 1.346E:32 2.34 1.345E:32 2.37E 1.345E:33 3.03 1.538 3.345E:32 2.34 1.346E:32 2.34E:32 GJ 125 A M5.5 V 1.330 1.268E:423 2.42 2.58E:42 2.43 5.35E:428 2.87F:43 GJ 146 A	GJ 559 A	G2.0 V	4.380	5.929E+26	26.77	2.216E + 30	30.35				
G1 699 M5.5 V 12.5 1.6798-23 23.23 1.304E-29 29.12 G1 410 M5.0 V 10.64 2.234E-24 2.35 5.491E-29 29.74 G1 411 M6.0 V 15.93 1.422E-22 22.15 4.458E-23 28.65 G1 729 M5.5 V 13.08 1.668E-23 22.30 1.366E-29 29.14 G1 447 M1.0 V 9.760 4.178E+12 26.05 1.449E-30 30.16 G1 427 M1.0 V 1.83 1.397H+23 23.11 1.166H-29 29.07 G1 25 A M5.0 V 7.400 3.412E+23 23.51 3.144+30 30.12 G1 725 A M5.0 V 1.117 1.140E+24 24.05 2.999E+23 29.48 G1 71 G4 55 1.530 2.401 2.184 2.184 2.184 G1 71 G4 55 1.530 2.404 2.184 2.997E+24 2.144 5.99 2.937 G1 101 M5.0 V 1.526 2.636E+22	GJ 559 B	K0 V	5.710	1.742E + 26	26.24	2.670E + 30	30.43				
GJ 406 M5. V 16.64 7.396E-721 21.87 3.356E+28 28.53 GJ 65B M6.0 V 15.33 1.422E+22 22.15 4.58E+28 28.65 GJ 729 M3.5 V 13.06 1.9568+23 23.29 1.396E+29 29.14 GJ 144 K2.0 V 6.200 1.109E+26 26.62 1.458E+30 30.16 GJ 447 M4.0 V 13.53 1.297E+23 23.11 1.166E+29 29.07 GJ 25A M3.0 V 11.17 1.146E+24 24.62 6.421E+29 29.34 GJ 725 M3.0 V 11.17 1.146E+24 24.04 5.686E+29 29.75 GJ 15A M1.5 V 10.31 2.518E+24 24.34 5.686E+29 29.07 GJ 111 M6.0 V 17.10 4.842E+21 2.16.9 2.797E+28 28.25 GJ 161 M5.0 V 1.836 2.636E+22 24.24 5.881E+28 28.07 GJ 171 G&5.V 5.680 1.971E+28 28.17 28.164 28.07 GJ 161 M5.0 V 1.877 5.498E+21	GJ 699	M3.5 V	13.25	1.679E + 23	23.23	1.304E + 29	29.12				
G) 411M2.0 V10.442.234F+242.4355.491 F+2929.74G) 56BM6.0 V15.931.422E+222.2154.458E+282.865G) 729M3.5 V13.081.9683+232.3291.3966+292.9.14G) 144K2.0 V6.2004.178E+242.4626.421 E+292.9.81G) 477M4.0 V13.531.297E+232.3111.166E+292.9.07G) 420M3.0 V11.171.140E+242.4062.999E+292.9.48G) 725 AM3.0 V11.171.140E+242.4062.999E+292.9.48G) 725 BM3.5 V10.302.508E+232.3712.108E+292.9.71G) 110M6.0 V17.104.508E+232.3742.108E+292.9.71G) 111M6.0 V17.101.6062+212.0691.64E+392.8.45G) 111M6.0 V15.262.656E+222.642.679E+282.8.73G) 110M5.0 V15.262.656E+222.741.08E+282.8.65G) 1245 CM5.5 V19.471.375E+212.1642.470E+282.8.65G) 1245 BM6.0 V15.271.726E+232.3.441.638+292.9.20G) 1245 CMV18.471.375E+212.1.641.538+292.9.20G) 1245 BM6.0 V15.271.726E+232.3.441.638+292.9.20G) 1245 CMV1.591.227E+242.4.144.938+292.9.20G) 126 C	GJ 406	M5.5 V	16.64	7.396E+21	21.87	3.355E + 28	28.53				
G1 658 M6.0 V 15.93 1.42E+22 2.15 4.4886+28 28.65 GJ 729 M35 V 13.08 1.9636+23 23.29 1.366+29 29.14 GJ 144 K2.0 V 6.200 1.109E+26 26.05 1.4586+30 30.16 GJ 477 M40 V 15.33 1.297E+23 23.11 1.1666+29 29.07 GJ 250 M3.0 V 1.1.17 1.1462+24 24.60 2.999E+29 29.44 GJ 15A M3.0 V 1.1.37 1.446+24 24.06 2.999E+29 29.44 GJ 15A M3.5 V 10.31 2.518E+24 24.40 5.658E+29 29.34 GJ 111 M6.0 V 17.10 4.442E+21 21.69 2.791E+28 28.45 GJ 161 M5.0 V 15.26 2.636E+22 2.424 5.881E+28 2.877 SCR 1845-6357 A M8.5 V 19.37 5.496H+20 20.74 1.086H+28 2.8.03 GJ 1245 C M4 V 15.26 2.636H+22 2.244	GJ 411	M2.0 V	10.44	2.234E+24	24.35	5.491E+29	29.74				
GJ 729M3.5 V13.081.968:H2323.291.396E:H2323.14GJ 144K20 V6.200H.109E:H2424.626.421E:H2929.81GJ 887M1.0 V9.760H.128E:H2424.626.421E:H2929.81GJ 820 AK5.0 V7.4803.412E:H2525.531.314E:H3030.12GJ 725 AM3.0 V11.171.140E:H2424.062.996:H2929.48GJ 725 BM3.5 V10.311.508E:H2323.742.166E:H292.975GJ 15 AM1.5 V10.311.608E:H2323.211.278E:H292.911GJ 15 BM3.5 V15.301.608E:H2323.211.278E:H292.845GJ 171GS.5 V5.6601.701E:H262.6251.438E:H292.877SCR 1845-6357 AM8.5 V19.375.964E:H202.0741.206E:H232.843DEN 1048-3956M5.5 V19.375.964E:H202.0781.124E:H282.803DEN 1048-3956M5.5 V19.375.964E:H202.0741.124E:H282.803DEN 1048-3956M5.5 V19.375.964E:H202.0741.246E:H282.803GJ 1245 GM40 V18.471.371E:H242.141.618E:H282.803GJ 1245 GM40 V18.721.276E:H232.3441.619E:H282.804GJ 1245 GM40 V1.6272.26E:H232.3441.619E:H282.803GJ 1245 GM40 V1.2772.66E:H232.3441.618E:H	GJ 65B	M6.0 V	15.93	1.422E + 22	22.15	4.458E+28	28.65				
G) 144 K20 V 6,200 1.109E+26 26.05 1.458E+30 30.16 G) 447 M4.0 V 35.3 1.297E+23 23.11 1.166E+29 29.81 G) 447 M5.0 V 7.480 3.412E+25 25.53 1.314E+30 30.12 G) J 258 M3.5 V 1.196 5.508E+23 2.374 2.186E+29 2.934 G) J 5.5 M3.5 V 1.031 2.518E+24 2.440 5.658E+29 2.9.75 G) J 15 M3.5 V 1.30 1.603E+23 2.2.42 1.638E+30 30.22 G) J 101 M6.0 V 1.710 4.842E+21 21.69 2.7.91E+28 2.8.03 G) J 101 M5.0 V 15.26 2.636E+22 2.2.42 5.831E+28 2.8.77 SCR 1945-6357 A M6.5 V 1.7.21 4.37E+21 2.1.64 2.670E+28 2.8.03 SO 0233 + 1652 M6.5 V 1.52 2.636E+22 2.2.42 4.850E+28 2.8.03 G) 1245 C MV 18.47 1.371E+21 2.1.64 2.670E+28 2.8.05 G) 1245 C MV 1.	GJ 729	M3.5 V	13.08	1.963E + 23	23.29	1.396E + 29	29.14				
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G) 47°M4.0 V13.531.297E+2323.111.166E+2929.07G) 320 AK5.0 V7.4003.412E+2525.531.314E+303.0.12G) 725 AM3.0 V11.171.140E+242.4062.999E+292.9.34G) 15 AM1.5 V10.312.518E+242.4.405.658E+292.9.75G) 15 BM3.5 V13.301.603E+232.321.278E+292.9.11G) 11 DM6.0 V7.7.104.842E+2121.692.791E+282.8.45G) 71G.8.5 V5.6061.701E+262.6.251.643E+303.0.22G) 1061M5.0 V15.262.636E+222.2.425.831E+282.8.03SO 0233 + 1652M6.5 V19.375.964E+202.0.741.008E+282.8.03SO 0233 + 1652M6.5 V19.375.964E+202.0.781.124E+282.8.03G) 1245 CM5.0 V15.721.726E+222.2.44.850E+282.8.03G) 1245 CM4.0 V15.721.726E+232.3.411.612E+282.8.03G) 1266 DD.4 N1.031.297E+242.4.114.793E+292.9.06G) 1266 DM4.0 V12.712.761E+232.3.411.619E+392.9.01G) 1266 DM4.0 V12.712.761E+232.3.411.619E+392.9.01G) 1266 DM4.0 V12.712.761E+232.3.411.619E+292.9.02G) 1266 DM4.0 V12.711.060E+232.3.411.619E+29 <td>GJ 887</td> <td>M1.0 V</td> <td>9.760</td> <td>4.178E+24</td> <td>24.62</td> <td>6.421E+29</td> <td>29.81</td>	GJ 887	M1.0 V	9.760	4.178E+24	24.62	6.421E+29	29.81				
G J 220 A K50 V 7,480 3,412E+25 25.53 1.314E+30 30.12 GJ 725 A M3.0 V 11.17 1.106NE+24 24.06 2999E+29 29.48 GJ 725 B M3.5 V 10.31 2518E+24 24.06 2999E+29 29.34 GJ 15 A M1.5 V 10.31 2518E+24 24.0 5.6588E+29 29.75 GJ 15 B M3.5 V 13.30 1.603E+23 23.21 1.278E+29 29.11 GJ 15 B M3.5 V 17.10 4.842E+21 21.69 2.791E+28 28.45 GJ 71 G8.5 V 5.680 1.791E+26 26.25 1.6438+30 30.22 GJ 1061 M5.0 V 15.26 2.636E+22 24.2 5.831E+28 28.03 SO 0233 + 1652 M5.5 V 19.47 5.458E+20 20.74 1.080E+28 28.03 SO 0253 + 1652 M5.5 V 19.47 5.458E+20 20.74 1.080E+28 28.03 DEN 1048-3956 M8.5 V 19.47 5.458E+20 20.74 1.080E+28 28.03 DEN 1048-3956 M8.5 V 19.37 5.984E+20 20.78 1.124E+28 28.03 DEN 1048-3956 M8.5 V 15.72 1.726E+22 22.4 4.850E+28 28.69 GJ 166 B D44 N 15.72 1.726E+22 22.4 4.850E+28 28.69 GJ 166 B D44 N 1.275 2.601E+23 23.43 1.598E+29 29.68 GJ 166 D44 N 12.75 2.601E+23 23.43 1.619E+29 29.20 GJ 166 B D44 N 1.359 1.227E+23 23.09 1.134E+28 28.09 GJ 166 B D44 N 1.359 2.2761E+23 23.44 1.619E+29 29.20 GJ 45 M3.5 V 12.71 2.761E+23 23.44 1.619E+29 29.21 LIS 1723 M40 V 1.359 2.2761E+23 23.67 2.026E+29 29.31 GJ 245 M3.5 V 12.15 4.624E+23 23.67 2.026E+29 29.31 GJ 251 M3.5 V 12.15 4.624E+23 23.67 2.026E+29 29.31 GJ 251 M3.5 V 12.15 4.624E+23 23.67 2.026E+29 29.31 GJ 251 M3.5 V 12.25 3.09E+20 20.73 1.067E+28 28.03 GJ 752 B M3.5 V 12.25 3.09E+20 20.73 1.067E+28 28.03 GJ 752 B M3.5 V 12.59 3.300 2.339E+26 26.37 1.756E+30 30.32 GJ 753 M3.0 V 13.27 9.931E+23 23.33 1.447E+29 29.04 GJ 750 G8.0 V 4.620 4.753E+26 26.37 1.756E+30 30.32 GJ 750 M3.5 VJ 2.58 3.112E+23 23.33 1.447E+29 29.24 GJ 130 MV 12.99 2.138E+23 23.33 1.447E+29 29.24 GJ 130 MV 13.79 2.138E+23 23.33 1.447E+29 29.24 GJ 130 MV 12.99 2.026E+27 2.757 4.018E+30 30.63 GJ 250 H MV 12.99 2.256E+27 2.757 4.018E+30 30.63 GJ 250 H MV 12.99 2.256E+27 2.757 4.018E+30 30.63 GJ 230 B M2 VJ 12.79 2.556E+23 2	GJ 447	M4.0 V	13.53	1.297E+23	23.11	1.166E + 29	29.07				
G J 25 A M30 V 11.17 1.140E+24 24.06 2.999E+29 29.48 G J 75 B M35 V 10.31 2.518E+24 24.40 5.658E+29 29.34 G J 15 A M1.5 V 10.31 2.518E+24 24.40 5.658E+29 29.34 G J 15 B M35 V 13.30 1.603E+23 23.21 1.278E+29 29.11 G J 111 M60 V 17.10 4.842E+21 21.69 2.791E+28 28.45 G J 71 66.5 V 5.680 1.791E+26 26.5 1.643E+30 30.22 G J 1061 M50 V 15.26 2.636E+23 20.42 5.831E+28 28.77 SCR 1845-6357 A M8.5 V 19.47 5.458E+20 20.74 1.080E+28 28.03 S0 0253 + 1.652 M6.5 V 17.21 4.375E+21 21.64 2.670E+28 28.43 D EN 1048-3956 M8.5 V 19.47 5.458E+20 20.74 1.080E+28 28.03 S0 0253 + 1.652 M6.5 V 17.21 4.375E+21 21.64 2.670E+28 28.43 D EN 1048-3956 M8.5 V 19.47 5.984E+20 20.78 1.124E+28 28.21 G J 1245 C M V 18.47 1.371E+21 21.14 1.612E+28 28.65 G J 1265 C M40 V 15.72 1.726E+22 22.24 4.850E+28 28.66 G J 166 B D.44 N 11.03 1.297F+24 24.11 4.793E+29 29.06 G J 166 C M40 V 12.75 2.661E+23 23.43 1.593E+29 29.02 G J 069-049 M3.5 V 12.71 2.761E+23 23.43 1.593E+29 29.02 G J 066 G M40 V 12.75 2.661E+23 23.43 1.593E+29 29.02 G J 066 G M40 V 12.75 2.061E+23 23.43 1.593E+29 29.03 G J 455 M3.5 V 12.15 4.624E+23 23.67 2.026E+29 29.31 G J 251 M3.0 V 11.27 1.040E+24 24.02 2.882E+29 29.06 G J 455 M3.5 V 12.15 4.624E+23 23.67 2.026E+29 29.31 G J 752 B M3.0 V 1.950 5.309E+20 20.73 1.057E+29 29.46 G J 730 G 8.0 V 5.390 2.339F+26 26.67 1.756E+30 30.24 G J 780 G 8.0 IV 4.620 4.753E+26 26.67 1.756E+30 30.24 G J 730 G 8.0 IV 4.620 4.753E+26 26.67 1.756E+30 30.24 G J 730 G 8.0 IV 4.620 4.753E+26 26.67 1.756E+29 29.20 G 0.1 G 15 B MV 13.27 9.931E+23 23.30 1.4476E+29 29.20 G 0.1 G 15 B MV 13.79 1.278 2.138E+23 23.30 1.4476E+29 29.20 G 0.1 G 15 B MV 13.79 2.138E+23 23.30 1.4476E+29 29.20 G 0.1 G J 730 G 8.0 IV 7.77 2.173E+21 21.34 1.756E+29 29.20 G J 2130 MV 13.79 1.2258 3.1122E+23 23.31 1.4476E+29 29.20 G J 2130 MV 13.79 1.2258 3.132E+23 23.31 1.4476E+29 29.20 G J 2130 MV 13.79 1.2264 2.378 3.316+30 30.63 G 740 L 797 4.048E+30 30.63 G 741 L 797 4.246E+31 31.03 G 1661B A MV 13.79 4.256	GJ 820 A	K5.0 V	7.480	3.412E+25	25.53	1.314E + 30	30.12				
G J 25 B M3.5 V 11.96 5.508E+23 23.74 2.186E+29 29.34 G J 15 A M1.5 V 10.31 2.518E+24 24.04 5.658E+29 29.75 G J 15 B M5.V 13.30 1.603E+23 23.21 1.278E+29 29.11 G J 1111 M5.V 17.10 4.842E+21 21.69 2.791E+28 28.45 G J 71 G5.5 V 5.680 1.791E+26 26.25 1.643E+30 30.22 G J 1061 M5.0 V 15.26 2.636E+22 24.2 5.831E+28 28.77 SCR 1845-6357 A M5.5 V 19.47 5.458E+20 20.74 1.080E+28 28.03 SO 0253 + 1.652 M5.5 V 17.21 4.375E+21 21.64 2.670E+28 28.43 D EX 1048-3956 M5.5 V 17.21 4.375E+21 21.64 2.670E+28 28.43 D EX 1048-3956 M5.5 V 17.21 4.375E+21 21.64 2.670E+28 28.63 G J 1245 C M V 18.47 1.371E+21 21.14 1.612E+28 28.21 G J 1245 B M6.0 V 15.72 1.726E+22 22.4 4.850E+28 28.69 G J 166 C M4.0 V 18.72 2.661E+23 23.43 1.593E+29 29.06 G J 166 C M4.0 V 12.75 2.661E+23 23.43 1.593E+29 29.20 G 099.049 M3.5 V 12.71 2.761E+23 23.44 1.619E+29 29.21 L 151 72.3 M4.0 V 13.59 1.277E+24 21.04 1.612E+28 28.21 G J 245 M M3.5 V 12.71 0.060E+24 23.09 1.138E+29 29.06 G J 245 M3.5 V 12.71 0.060E+24 23.09 1.138E+29 29.01 G J 456 M3.5 V 12.72 1.060E+23 23.43 1.593E+29 29.46 G J 166 C M4.0 V 13.59 1.277E+23 23.09 1.138E+29 29.21 L 151 72.3 M4.0 V 13.59 2.277E+23 23.49 1.619E+29 29.21 L 151 72.3 M8.5 V 19.50 5.309E+20 20.73 1.067E+28 28.31 B 20.575 M8.5 V 19.50 5.309E+20 20.73 1.067E+28 28.31 B 20.575 M8.5 V 18.61 1.205E+21 21.68 1.524E+28 28.18 G J 750 68.0 V 5.390 2.339E+26 26.37 1.756E+30 30.24 G J 750 M8.5 V 18.61 1.205E+21 21.68 1.524E+28 28.18 G J 750 68.0 V 7.5390 2.339E+26 26.37 1.756E+30 30.24 G J 750 M8.5 V 12.25 3.312E+23 23.34 1.478E+29 29.45 G J 1450 MV 12.29 9.31E+23 23.34 1.478E+29 29.24 G J 1450 MV 12.29 2.133E+23 23.41 1.558E+29 29.24 G J 2130 MV 13.27 2.931E+23 23.33 1.447E+29 29.24 G J 2130 MV 13.27 2.931E+23 23.33 1.447E+29 29.24 G J 2130 MV 13.27 2.931E+23 23.33 1.447E+29 29.24 G J 2130 MV 13.57 1.258 3.112E+23 23.33 1.447E+29 29.24 G J 2130 MV 12.29 2.656E+23 23.41 1.558E+29 29.24 G J 2130 MV 13.57 1.258 3.112E+23 23.33 1.447E+29 29.24 G J 2130 MV 13.57 1.258 3.112E+23 23.33 1.447E+29 29.24 G J 2130 MV 14.620 2.926E+27 2.757 2.188E	GJ 725 A	M3.0 V	11.17	1.140E + 24	24.06	2.999E+29	29.48				
GJ 15 A M1.5 V 10.31 2.518E+24 24.40 5.68E+29 29.75 GJ 15 B M3.5 V 13.30 16.081+23 23.21 1.278E+29 29.11 GJ 111 M6.0 V 17.10 4.842E+21 21.69 2.791E+28 28.45 GJ 1061 M5.0 V 15.26 2.636E+22 2.24 5.831E+28 28.77 SCR1 1845-6357 A M8.5 V 19.47 5.848E+20 20.74 1.080E+28 28.03 SO 0253 + 1652 M6.5 V 17.21 4.375E+21 21.64 2.670E+28 28.43 DEN 1048-956 M5.5 V 19.37 5.984E+20 20.76 1.124E+28 28.61 GJ 1245 C M6.0 V 15.72 1.726E+22 22.14 4.850E+28 28.62 GJ 166 C M4.0 V 12.71 2.751E+23 2.343 1.592E+29 29.20 GJ 245 J M4.0 V 13.59 1.227E+23 2.367 2.026E+29 29.31 GJ 251 M3.0 V 1.27 1.040E+24 24.02 2.828E+29 29.46 GJ 752 B M8.5 V 1	GJ 725 B	M3.5 V	11.96	5.508E+23	23.74	2.186E+29	29.34				
GJ 15 BM3.5 V13.301.6038+2323.211.278E+2929.11GJ 1111M6.0 V17.104.842E+2121.692.791E+2828.45GJ 71G8.5 V5.6801.791E+2626.251.643E+3030.22SCI 1845-6357 AM5.0 V15.262.636E+2222.422.5831E+2828.03SO 0253 + 1652M5.5 V19.475.964E+2020.741.806E+2828.03DEN 1048.3956M5.5 V19.375.964E+2020.781.124E+2828.05GJ 1245 CM V18.471.371E+2121.141.612E+2828.69GJ 1245 BM6.0 V15.722.726E+2222.244.850E+2929.06GJ 166 CM4.0 V12.752.661E+2323.441.159E+2929.02G 099-049M3.5 V12.712.761E+2323.441.619E+2929.06GJ 425M3.0 V1.3591.227E+2323.091.138E+2929.06GJ 425M3.0 V1.8572.9302.309E+202.0311.067E+2828.03GJ 752 BM8.0 V1.8512.9302.308E+202.0731.067E+2828.03GJ 752 BM8.0 V1.8611.205E+2121.081.32E+2929.46GJ 780G8.0 V5.3002.339E+262.6571.756E+303.032GJ 780G8.0 V1.8611.205E+2121.341.976E+2929.29GJ 780G8.0 V1.7972.173E+232.3401.076E+29 <t< td=""><td>GJ 15 A</td><td>M1.5 V</td><td>10.31</td><td>2.518E+24</td><td>24.40</td><td>5.658E+29</td><td>29.75</td></t<>	GJ 15 A	M1.5 V	10.31	2.518E+24	24.40	5.658E+29	29.75				
GJ 111 M6.0 V 17.10 4.842E+21 21.69 2.791E+28 28.48 GJ 71 G5.5 V 5.680 1.791E+26 26.25 1.6438+30 30.22 GJ 1061 M5.0 V 15.26 2.636E+122 22.42 5.831E+28 28.77 SCR 1845-6357 A M5.5 V 19.37 5.984E+20 20.74 1.060E+28 28.03 SO 0253 + 1652 M5.0 V 15.72 1.721E+21 21.14 1.612E+28 28.61 GJ 1245 C M V 18.47 1.371E+21 21.14 1.612E+28 28.69 GJ 1245 C M V 18.47 1.371E+21 21.14 1.612E+28 28.69 GJ 166 C M4.0 V 12.75 2.661E+23 23.43 1.593E+29 29.68 GJ 165 M M3.5 V 12.17 2.761E+23 23.43 1.619E+29 29.21 LHS 1723 M4.0 V 13.59 1.227E+23 23.67 2.026E+29 29.31 GJ 251 M3.5 V 12.15 4.624E+23 23.67 2.688 2.077 2.882E+29 29.46 GJ 415	GJ 15 B	M3.5 V	13.30	1.603E + 23	23.21	1.278E + 29	29.11				
GJ 10 GS V 5.680 1.791E+22 2.625 1.643E+30 30.22 GJ 1061 MS 0 V 15.26 2.636E+22 2.242 5.831E+28 28.77 SCR 1845-6357 A MS 5 V 19.47 5.458E+20 20.74 1.080E+28 28.63 SO 0253 + 1652 MS 5 V 19.37 5.984E+20 20.78 1.124E+28 28.63 GJ 1245 B M6.0 V 15.72 1.726E+22 22.24 4.850E+28 28.69 GJ 166 C M4.0 V 12.75 2.661E+23 23.43 1.593E+29 29.20 G 090-040 M5.5 V 12.71 2.2761E+23 23.44 1.619E+29 29.21 LHS 1723 M4.0 V 13.59 12.27E+23 23.67 2.026E+29 29.30 GJ 251 M3.5 V 12.15 4.624H+24 24.02 2.882E+29 29.66 204 A 1835 + 3259 M5.5 V 19.50 5.309E+20 20.73 1.076E+28 28.03 GJ 752 B M6.0 V 18.61 1.205E+21 21.08 1.524E+28 28.18 GJ 730 GA.0 V	GJ 1111	M6.0 V	17.10	4.842E+21	21.69	2.791E+28	28.45				
GJ 1061 M5.0 V 15.26 2.636±+22 22.42 5.831±+28 28.77 SCR 1845-6357 A M6.5 V 17.21 4.375±+21 21.64 2.670±+28 28.43 SO 2235 + 1652 M6.5 V 19.37 5.984±+20 20.76 1.124±+28 28.05 GJ 1245 C M V 18.47 1.371±+21 21.14 1.612±+28 28.69 GJ 1245 B M6.0 V 15.72 1.726±+22 22.44 4.850±+28 28.69 GJ 166 C M4.0 V 12.75 2.661±+23 23.43 1.593±+29 29.20 GJ 66 C M4.0 V 13.59 1.271±+24 23.14 1.619±+29 29.20 GJ 66 C M3.0 V 13.59 1.227±+23 23.44 1.619±+29 29.20 GJ 64 S M3.5 V 12.51 4.624±+23 23.67 2.056±+29 29.31 GJ 251 M3.0 V 11.27 1.040±+24 24.02 2.882±+29 29.46 GJ 752 B M8.0 V 15.30 5.309±+20 20.73 1.667±+28 28.03 GJ 752 B M8.0 V 1.32	GJ 71	G8.5 V	5.680	1.791E+26	26.25	1.643E+30	30.22				
SLCI 1845-637 A M5. V 19.47 5.4884-20 20.74 1.0800±28 28.03 SO 0253 + 1652 M6.5 V 17.21 4.3758±21 21.64 2.6700±28 28.43 DEN 1048.3956 M5. V 19.37 5.984±20 20.78 1.124E±28 28.24 GJ 1245 C M V 18.47 1.371E±21 21.14 1.612E±28 28.69 GJ 166 D D44 N 11.03 1.297E±22 22.24 4.850E±28 28.69 GJ 166 C M4.0 V 12.75 2.661E±23 23.43 1.599E±29 29.20 G 099.049 M3.5 V 12.71 2.761E±23 23.44 1.619E±29 29.21 LHS 1723 M4.0 V 13.59 1.227E±23 23.67 2.026E±29 29.31 GJ 251 M3.0 V 1.127 1.040E±23 23.67 1.756E±30 30.24 GJ 752 B M8.5 V 19.50 5.309E±20 20.73 1.756E±30 30.24 GJ 780 G8.0 V 18.61 1.205E±21 21.08 1.524E±28 28.18 GJ 139 G8.0 V 18.	GJ 1061	M5.0 V	15.26	2.636E+22	22.42	5.831E+28	28.77				
S0 0253 + 1652 M6.5 V 17.21 4.376+21 21.64 2.670k+28 28.43 DEN 1048.3956 M5.5 V 19.37 5.984E+20 20.78 1.124E+128 28.05 GJ 1245 C M V 18.47 1.371k+21 21.14 1.612E+128 28.69 GJ 166 B M6.0 V 15.72 1.726E+22 22.44 4.850E+28 28.69 GJ 166 C M4.0 V 12.75 2.661E+23 23.43 1.593E+29 29.20 LHS 1723 M4.0 V 13.59 1.227E+23 23.64 1.619E+29 29.21 LHS 1723 M3.0 V 12.15 4.624E+23 23.67 2.026E+29 29.31 GJ 251 M3.0 V 11.27 1.60E+24 24.02 2.882E+29 29.66 GJ 752 B M8.0 V 18.61 1.205E+21 21.08 1.524E+28 28.18 GJ 139 G8.0 V 5.390 2.339E+26 26.66 2.097E+30 30.32 GJ 752 B M3.0 V 11.32 9.931E+23 24.00 2.824E+29 29.45 LHS 3003 M7.0 V 17.97	SCR 1845–6357 A	M8.5 V	19.47	5.458E+20	20.74	1.080E+28	28.03				
DEN DVMS-3950 MS, V 19.37 5.984+20 20.78 1.124+1-28 28.13 GJ 1245 C M V 18.47 1.371E+21 21.14 1.612E+128 28.21 GJ 1245 B M60 V 15.72 1.726E+22 22.24 4.850E+28 28.69 GJ 166 C M40 V 12.75 2.661E+23 23.43 1.593E+29 29.20 G 09-049 M3.5 V 12.71 2.761E+23 23.44 1.619E+29 29.06 GJ 1245 M M3.5 V 12.15 4.624E+23 23.67 2.026E+29 29.46 GJ 251 M3.0 V 18.61 1.006E+21 21.08 1.524E+28 28.03 GJ 752 B M8.0 V 18.61 1.205E+26 26.67 1.756E+30 30.24 GJ 780 G8.0 V 4.620 4.753E+26 26.68 2.097E+30 30.32 GJ 61 B M V 1.99 2.138E+23 23.34 1.476E+29 29.45 LHS 3003 M7.0 V 17.97 2.173E+21	SO 0253 + 1652	M6.5 V	17.21	4.375E+21	21.64	2.670E+28	28.43				
GJ 1245 C M V 18.47 1.7246+22 21.14 1.6128+28 28.21 GJ 1245 B M6.0 V 15.72 1.7266+22 22.24 4.8508+28 28.69 GJ 166 B D44 N 11.03 1.275F 2.661E+23 23.43 1.593E+29 29.20 G 099-049 M3.5 V 12.71 2.761E+23 23.44 1.6198+29 29.21 LHS 1723 M4.0 V 13.59 1.227E+23 23.07 2.066E+29 29.31 GJ 251 M3.0 V 11.127 1.040E+24 24.02 2.882E+29 29.46 ZMA 1835 + 3259 M8.5 V 19.50 5.309E+20 20.73 1.0678+28 28.13 GJ 139 G8.0 V 5.300 2.339E+26 2.6.37 1.756E+30 30.32 GJ 145 M V 11.32 9.31E+23 24.00 2.84E+29 29.45 LHS 3003 M7.0 V 17.97 2.138E+23 23.31 1.477E+29 29.16 LF 771-095 B M3.5 VJ 12.58 3.112E+23 23.41 1.568E+29 29.23 GJ 2130 C M V <td>DEN 1048-3956</td> <td>M8.5 V</td> <td>19.37</td> <td>5.984E+20</td> <td>20.78</td> <td>1.124E+28</td> <td>28.05</td>	DEN 1048-3956	M8.5 V	19.37	5.984E+20	20.78	1.124E+28	28.05				
GJ 1245 BMb.0 V15.721.72b+2222.244.850b+2828.69GJ 166 BDA4 N11.031.297b+2424.114.793b+2929.20G 099-049M3.5 V12.712.761E+2323.441.619b+2929.21LHS 1723M4.0 V13.591.227b+2323.091.138b+2929.06GJ 445M3.5 V12.154.624b+2323.672.026b+2929.31GJ 251M3.0 V11.271.040b+2424.022.882b+2929.46GJ 752 BM8.0 V18.611.205b+2121.081.524b+2828.13GJ 139G8.0 V5.3902.339F+2626.632.097b+3030.24GJ 780G8.0 IV4.6204.753b+2626.682.097b+3030.32GJ 61 BM V11.329.931b+2324.002.824b+2929.45LHS 3003M7.0 V17.972.173b+2121.341.970b+2828.29G 041-014 BM V12.992.133b+2323.331.447b+2929.16LP 771-095 BM3.5 VJ12.583.112b+2323.411.568b+2929.20GJ 2130 CM V13.791.021b+2323.011.050b+2929.20CJ 2130 CM V13.791.021b+2323.672.188b+3030.64Vega4.3805.929b+2626.772.188b+3030.64Vega0.4009.26b+2729.974.018b+3030.63Vega-<	GJ 1245 C	M V	18.47	1.371E+21	21.14	1.612E+28	28.21				
GJ 166 bDAY N11.03 1.275 $2.661E+23$ 23.143 $1.59E+29$ $2.9.20$ G 09-049M3.5 V12.71 $2.761E+23$ 23.43 $1.598E+29$ $2.9.21$ LHS 1723M4.0 V13.59 $1.227E+23$ 23.09 $1.138E+29$ $2.9.06$ G 1445M3.5 V12.15 $4.624E+23$ 23.67 $2.026E+29$ $2.9.31$ G J 251M3.0 V11.27 $1.040E+24$ 24.02 $2.882E+29$ $2.9.46$ G J 752M8.5 V19.50 $5.309E+20$ 20.73 $1.067E+28$ 28.03 G J 752G 8.0 V5.309 $2.339E+26$ $2.6.73$ $1.756E+30$ 30.24 G J 780G 8.0 IV4.620 $4.758E+26$ $2.6.68$ $2.077E+30$ 30.32 G G 64 10 MM V11.32 $9.391E+23$ 24.00 $2.824E+29$ $2.9.45$ LHS 3003M 7.0 V17.97 $2.173E+21$ 21.34 $1.970E+28$ 28.29 G O 41-014 BM V12.99 $21.33E+23$ 23.49 $1.705E+29$ 29.23 G J 2130 CM V13.79 $1.021E+23$ 23.41 $1.568E+29$ 29.20 G J 2130 CM V13.79 $1.021E+23$ 23.49 $1.705E+29$ 29.20 G J 2130 CM V13.79 $1.021E+23$ 23.29 $4.246E+30$ 30.63 Capella Aa -0.630 $5.929E+26$ $2.77.77$ $4.018E+30$ 30.63 Vega -0.630 $5.929E+26$ $2.77.77.77.77.74.018E+30$ 30.53 Pid	GJ 1245 B	M6.0 V	15.72	1.726E+22	22.24	4.850E+28	28.69				
G 196 CM40 V12/52.561E+232.3.431.593E+292.9.20G 099-049M3.5 V12.712.761E+2323.641.619E+292.9.61G 145M4.0 V13.591.227E+2323.091.138E+292.9.61G 145M3.0 V11.271.040E+2424.022.882E+292.9.462MA 1835 + 3259M8.5 V19.505.309E+2020.731.067E+2828.03G J 752 BM8.0 V18.611.205E+2121.081.524E+2828.02G J 780G 8.0 IV5.3902.339E+2626.632.07FE+3030.24G J 780G 8.0 IV4.6204.753E+2324.002.824E+292.9.45LHS 3003M7.0 V17.972.173E+2121.341.970E+2828.29G 041-014 BM V12.992.133E+2323.331.447E+2929.16LP 771-095 BM3.5 VJ12.792.565E+2323.411.566E+2929.02G J 2130 CM V13.791.021E+2323.011.050E+2929.02G J 2130 CM V13.792.236E+2727.974.018E+3030.64Srins A0.5301.963E+2828.652.188E+3030.34Srins A0.3104.475E+2828.652.188E+3030.64G 2130 CM V13.792.175E+2828.652.188E+3030.64G Srins A0.5301.963E+2828.294.246E+3130.65 </td <td>GJ 166 B</td> <td>DA4 N</td> <td>11.03</td> <td>1.29/E+24</td> <td>24.11</td> <td>4.793E+29</td> <td>29.68</td>	GJ 166 B	DA4 N	11.03	1.29/E+24	24.11	4.793E+29	29.68				
G 09-04-9 M3.5 V 12.71 2.761E+23 2.3.44 1.019E+29 29.06 GJ 445 M3.5 V 12.15 4.624E+23 23.67 2.026E+29 29.31 GJ 251 M3.0 V 11.27 1.040E+24 24.02 2.882E+29 29.06 GJ 752 B M8.0 V 18.61 1.205E+21 21.08 1.524E+28 28.18 GJ 752 B G8.0 V 5.300 2.339E+26 26.37 1.756E+30 3.024 GJ 780 G8.0 IV 4.620 4.753E+26 26.68 2.097E+30 3.032 GJ 61 B M V 11.32 9.931E+23 24.00 2.824E+29 29.45 LHS 7020 G8.0 IV 4.620 4.753E+26 26.68 2.097E+30 3.032 GJ 61 B M V 12.99 2.133E+23 24.00 2.824E+29 29.45 LHS 701-095 B M3.5 VJ 12.58 3.112E+23 23.41 1.568E+29 29.20 GJ 2130 C M V 13.79 1.021E+23 23.01 1.050E+29 29.02 GJ 2130 C M V 13.79 <	GJ 166 C	M4.0 V	12.75	2.001E+23	23.43	1.593E+29	29.20				
$ \begin{array}{ c c c c c } Ln S & M4.0 V & 13.99 & 1.227 E+23 & 23.09 & 1.136 E+29 & 29.06 \\ G1 445 & M3.5 V & 12.15 & 4.624 E+23 & 23.67 & 2.026 E+29 & 29.46 \\ 2MA 1835 + 3259 & M8.0 V & 11.27 & 1.040 E+24 & 24.02 & 2.882 E+29 & 29.46 \\ 2MA 1835 + 3259 & M8.0 V & 18.61 & 1.205 E+21 & 21.08 & 1.524 E+28 & 28.18 \\ G1 139 & G8.0 V & 5.390 & 2.339 E+26 & 26.37 & 1.756 E+30 & 30.24 \\ GJ 752 & MV & 11.32 & 9.391 E+23 & 24.00 & 2.824 E+29 & 29.45 \\ G1 61 B & M V & 11.32 & 9.391 E+23 & 24.00 & 2.824 E+29 & 29.45 \\ LHS 3003 & M7.0 V & 17.97 & 2.173 E+21 & 21.34 & 1.970 E+28 & 28.29 \\ G 041-014 B & M V & 12.99 & 2.133 E+23 & 23.33 & 1.447 E+29 & 29.16 \\ LP 771-095 B & M3.5 VJ & 12.58 & 3.112 E+23 & 23.41 & 1.556 E+29 & 29.23 \\ G J 2130 B & M2 VJ & 12.79 & 2.555 E+23 & 23.41 & 1.556 E+29 & 29.20 \\ G J 2130 B & M2 VJ & 12.79 & 2.555 E+23 & 23.41 & 1.556 E+29 & 29.20 \\ G J 2130 B & M2 VJ & 12.79 & 2.555 E+23 & 23.41 & 1.556 E+29 & 29.20 \\ G J 2130 B & M2 VJ & 12.79 & 2.555 E+23 & 23.41 & 1.556 E+29 & 29.20 \\ G J 2130 B & M2 VJ & 12.79 & 2.555 E+23 & 23.41 & 1.556 E+29 & 29.20 \\ G J 2130 C & M V & 1.379 & 1.021 E+23 & 23.41 & 1.556 E+29 & 29.20 \\ G J 2130 C & M V & 0.379 & 0.058 & 0.965 E+23 & 23.21 & 0.556 E+29 & 29.20 \\ G J 2130 B & M2 VJ & 12.79 & 2.555 E+23 & 23.41 & 1.556 E+29 & 29.20 \\ G J 2130 C & M V & 0.379 & 0.021 E+23 & 23.41 & 0.558 E+29 & 29.20 \\ G J 2130 C & M V & 0.379 & 0.363 & 0.563 & 0.965 E+28 & 28.29 & 4.246 E+30 & 30.63 \\ Capella Aa & -0.630 & 5.924 E+27 & 27.97 & 4.018 E+30 & 30.61 \\ Capella Aa & -0.630 & 5.934 E+28 & 28.87 & 5.110 E+30 & 30.71 \\ Arcturus & -0.630 & 5.948 E+28 & 28.78 & 3.381 E+30 & 30.53 \\ Polaris Aa & -0.630 & 5.948 E+28 & 28.78 & 3.381 E+30 & 30.53 \\ Polaris Aa & -3.600 & 9.226 E+29 & 29.97 & 1.074 E+31 & 31.03 \\ Bellatrix & -2.640 & 3.811 E+29 & 29.58 & 1.671 E+31 & 31.29 \\ Polaris Aa & -3.600 & 9.226 E+29 & 29.97 & 1.074 E+31 & 31.03 \\ Bellatrix & -2.640 & 3.811 E+29 & 29.58 & 1.671 E+31 & 31.29 \\ Antares & -7.200 & 2.541 E+31 & 31.41 & 2.466 E+31 & 31.29 \\ Antares & -7.800 & 5.309 & 5.458$	G 099-049	M3.5 V	12.71	2./01E+23	23.44	1.019E+29	29.21				
GJ 445M3.5 V12.134.6248+2325.672.0268+2929.31GJ 251M3.0 V11.271.0408+2424.022.8828+2929.462MA 1835 + 3259M8.5 V19.505.309E+2020.731.067E+2828.03GJ 752 BM8.0 V18.611.205E+2121.081.524E+2828.18GJ 780G8.0 V5.3092.339E+2626.671.755E+3030.24GJ 780G8.0 IV4.6204.753E+2626.682.097E+3030.32GJ 661 BM V11.329.931E+2324.002.824E+2929.45LHS 3003M7.0 V17.972.173E+2121.341.970E+2828.29G 041.014 BM V12.992.133E+2323.331.447E+2929.16LP 771-095 BM3.5 VJ12.583.112E+2323.411.568E+2929.20GJ 2130 CM V13.791.021E+2323.011.050E+2929.02CJ 2130 CM V13.792.26E+2727.974.018E+3030.60Vega0.5801.963E+2828.294.246E+3030.63Capella Aa0.4002.317E+2828.652.188E+3030.44Aldebaran0.6305.984E+2828.783.381E+3030.53Polaris Aa5.934E+2929.971.074E+3131.03Bellatrix3.643.612E+3131.63Arturus<		M4.0 V	13.59	1.22/E+23	23.09	1.138E+29	29.06				
GJ 251 M3.5 V 11.27 1.0401+24 24.02 2.8622+29 29.46 GJ 752 B M8.0 V 18.61 1.205E+21 21.08 1.524E+28 28.18 GJ 752 B G8.0 V 5.390 2.339E+26 26.37 1.756E+30 30.24 GJ 760 G8.0 V 4.620 4.753E+26 26.68 2.097E+30 30.32 GJ 661 B M V 11.32 9.931E+23 24.00 2.824E+29 29.45 LHS 3003 M7.0 V 17.97 2.173E+21 21.34 1.970E+28 28.29 G 041-014 B M V 12.99 2.133E+23 23.33 1.447E+29 29.16 G 2130 C M V 12.79 2.565E+23 23.41 1.568E+29 29.20 GJ 2130 C M V 13.79 1.021E+23 23.01 1.050E+29 29.02 I 2130 C M V 13.79 1.021E+23 23.01 1.050E+29 29.02 I 2130 C M V 13.79 2.02E+27 27.97 4.018E+30 30.63 Sirius A -0.630 5.929E+26 26.7	GJ 445	M3.5 V M2.0 V	12.15	4.024E+23	23.07	2.020E+29	29.31				
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	GJ 251 2MA 1925 + 2250	MOEV	11.27	1.040E+24	24.02	2.882E+29	29.40				
GJ 132 G MGU V 1601 12001121 21.05 1.7561123 20.16 GJ 139 G8.0 V 5.390 2.3392+26 26.37 1.7562+30 30.24 GJ 780 G8.0 IV 4.620 4.7532+26 26.68 2.097E+30 30.32 GJ 661 B M V 11.32 9.931E+23 24.00 2.824E+29 29.45 LHS 3003 M7.0 V 17.97 2.173E+21 21.34 1.970E+28 28.29 G 041-014 B M V 12.99 2.132E+23 23.33 1.447E+29 29.16 LP 771-095 B M3.5 VJ 12.58 3.112E+23 23.41 1.568E+29 29.20 GJ 2130 C M V 13.79 1.021E+23 23.01 1.050E+29 29.20 GJ 2130 C M V 13.79 1.021E+23 23.01 1.050E+29 29.20 GJ 2130 C M V 1.379 1.021E+23 23.01 1.050E+29 29.20 GJ 2130 C M V 1.400 9.226E+27 27.97 4.018E+30 30.63 Vega .4000 2.317E+28 28.	2MA 1835 + 3259	MO.5 V MO.0 V	19.50	1.205E+20	20.73	1.00/E+20 1.524E+28	20.03				
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	GJ 732 B	C8 0 V	5 200	2 220E 26	21.00	1.324E+20	20.10				
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	GJ 780	G8.0 V	4.620	2.339E+20	20.37	1.750E+50	30.24				
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	GJ 661 B	M V	11 32	9.031F±23	20.00	2.097E+30 2 824F+29	29.45				
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	LHS 3003	M7 O V	17.97	2 173E+21	24.00	1.070F+29	29.45				
GOVENULY MX 12.79 2.1351 (2) 25.35 1.477 (12) 2.1351 (2) GJ 2130 B M3.5 VJ 12.58 3.112E+23 23.49 1.765E+29 29.20 GJ 2130 C M V 13.79 1.021E+23 23.01 1.050E+29 29.02 12 Highly Luminous Stars 4.380 5.929E+26 26.77 2.188E+30 30.34 Sirius A 1.400 9.226E+27 27.97 4.018E+30 30.60 Vega 0.580 1.963E+28 28.37 5.110E+30 30.61 Capella Aa 0.400 2.317E+28 28.37 5.110E+30 30.34 Aldebaran -0.630 5.984E+28 28.78 3.381E+30 30.53 Polaris Aa -3.600 9.226E+29 29.97 1.074E+31 31.03 Bellatrix -2.640 3.811E+29 29.58 1.671E+31 31.22 Canopus -5.530 5.458E+30 30.74 1.949E+31 31.23 Antares -7.200 2.541E+31 31.41 2.46E+31 31.99 Rigel -7.840 4.582E+3	G 041-014 B	MV	12.99	2.173E+21 2.133E+23	21.34	1.570E+20	20.25				
In 17050 b M2 VJ 12.00 5.112±120 25.53 17.00±120 25.53 GJ 2130 B M2 VJ 13.79 2.565±23 23.01 1.050±29 29.02 GJ 2130 C M V 13.79 1.021±23 23.01 1.050±29 29.02 12 Highly Luminous Stars 4.380 5.929±26 26.77 2.188±30 30.34 Sirius A 1.400 9.226±27 27.97 4.018±30 30.60 Vega 0.580 1.963±28 28.29 4.246±30 30.63 Capella Aa 0.400 2.317±28 28.55 2.188±30 30.34 Aldebaran -0.630 5.984±28 28.78 3.381±30 30.53 Polaris Aa -0.630 5.984±28 28.78 3.381±30 30.53 Polaris Aa -2.640 3.811±29 29.58 1.671±81 31.02 Bellatrix -2.640 3.811±29 29.58 1.671±81 31.22 Canopus -5.530 5.458±30 30.74 1.949±813 31.29 Antares -7.200 2.541±31 31.66	IP 771-095 B	M35VI	12.55	2.135E+23	23.33	1.747E+20 1.705E+20	20.23				
GJ 2130 C M V 13.79 1.0501 120 10.01 125 10.0501 1	GI 2130 B	M3.5 V5 M2 VI	12.30	2565F+23	23.45	1.705E+29	29.20				
12 Highly Luminous Stars 100 mm	GJ 2130 C	M V	13.79	1.021E+23	23.01	1.050E+29	29.02				
Alpha Centauri A4.3805.929E+2626.772.188E+3030.34Sirius A1.4009.226E+2727.974.018E+3030.60Vega0.5801.963E+2828.294.246E+3030.63Capella Aa0.4002.317E+2828.375.110E+3030.71Arcturus-0.3104.457E+2828.652.188E+3030.53Polaris Aa-0.6305.984E+2828.783.31E+3030.53Polaris Aa-3.6009.226E+2929.971.074E+3131.03Bellatrix-2.6403.811E+2929.581.671E+3131.22Canopus-5.5305.458E+3030.741.949E+3131.29Antares-7.2002.541E+3131.412.466E+3131.39Rigel-7.8404.582E+3131.663.580E+3131.55Betelgeuse-8.0005.309E+3131.731.531E+3131.18	12 Highly Luminous Star	5	1017 5	110212 20	20101	1.0001 15	23102				
Night CharacterNoticeNoticeNoticeNoticeNoticeNoticeSirius A1.4009.226E+2727.974.018E+3030.60Vega0.5801.963E+2828.294.246E+3030.63Capella Aa0.4002.317E+2828.375.110E+3030.71Arcturus-0.3104.457E+2828.652.188E+3030.34Aldebaran-0.6305.984E+2828.783.381E+3030.53Polaris Aa-3.6009.226E+2929.971.074E+3131.03Bellatrix-2.6403.811E+2929.581.671E+3131.22Canopus-5.5305.458E+3030.741.949E+3131.29Antares-7.2002.541E+3131.663.580E+3131.55Betelgeuse-8.0005.309E+3131.731.531E+3131.18	Alpha Centauri A		4 380	5 929E+26	26 77	2.188E + 30	30.34				
Vega0.4001.963E+2828.294.246E+3030.63Capella Aa0.4002.317E+2828.375.110E+3030.71Arcturus-0.3104.457E+2828.652.188E+3030.34Aldebaran-0.6305.984E+2828.783.381E+3030.53Polaris Aa-3.6009.226E+2929.971.074E+3131.03Bellatrix-2.6403.811E+2929.581.671E+3131.22Canopus-5.5305.458E+3030.741.949E+3131.29Antares-7.2002.541E+3131.412.466E+3131.39Rigel-7.8404.532E+3131.663.580E+3131.55Betelgeuse-8.0005.309E+3131.731.531E+3131.18	Sirius A		1 400	9.226E+27	27.97	4.018E+30	30.60				
Capella Aa0.4002.317E+2828.375.110E+3030.71Arcturus-0.3104.457E+2828.652.188E+3030.34Aldebaran-0.6305.984E+2828.783.381E+3030.53Polaris Aa-3.6009.226E+2929.971.074E+3131.03Bellatrix-2.6403.811E+2929.581.671E+3131.22Canopus-5.5305.458E+3030.741.949E+3131.29Antares-7.2002.541E+3131.412.466E+3131.39Rigel-7.8404.532E+3131.663.580E+3131.55Betelgeuse-8.0005.309E+3131.731.531E+3131.18	Vega		0.580	1.963E+28	28.29	4.246E+30	30.63				
Arcturus-0.3104.457E+2828.652.188E+3030.34Aldebaran-0.6305.984E+2828.783.381E+3030.53Polaris Aa-3.6009.226E+2929.971.074E+3131.03Bellatrix-2.6403.811E+2929.581.671E+3131.22Canopus-5.5305.458E+3030.741.949E+3131.29Antares-7.2002.541E+3131.412.466E+3131.55Betelgeuse-8.0005.309E+3131.731.531E+3131.18	Capella Aa		0.400	2.317E+28	28.37	5.110E + 30	30.71				
Aldebaran-0.6305.984E+2828.783.381E+3030.53Polaris Aa-3.6009.226E+2929.971.074E+3131.03Bellatrix-2.6403.811E+2929.581.671E+3131.22Canopus-5.5305.458E+3030.741.949E+3131.29Antares-7.2002.541E+3131.412.466E+3131.39Rigel-7.8404.582E+3131.663.580E+3131.55Betelgeuse-8.0005.309E+3131.731.531E+3131.18	Arcturus		-0.310	4.457E+28	28.65	2.188E+30	30.34				
Polaris Aa -3.600 9.226E+29 29.97 1.074E+31 31.03 Bellatrix -2.640 3.811E+29 29.58 1.671E+31 31.22 Canopus -5.530 5.458E+30 30.74 1.949E+31 31.29 Antares -7.200 2.541E+31 31.41 2.466E+31 31.39 Rigel -7.840 4.582E+31 31.66 3.580E+31 31.55 Betelgeuse -8.000 5.309E+31 31.73 1.531E+31 31.18	Aldebaran		-0.630	5.984E+28	28.78	3.381E+30	30.53				
Bellatrix -2.640 3.811E+29 29.58 1.671E+31 31.22 Canopus -5.530 5.458E+30 30.74 1.949E+31 31.29 Antares -7.200 2.541E+31 31.41 2.466E+31 31.39 Rigel -7.840 4.582E+31 31.66 3.580E+31 31.55 Betelgeuse -8.000 5.309E+31 31.73 1.531E+31 31.18	Polaris Aa		-3.600	9.226E+29	29.97	1.074E+31	31.03				
Canopus -5.530 5.458E+30 30.74 1.949E+31 31.29 Antares -7.200 2.541E+31 31.41 2.466E+31 31.39 Rigel -7.840 4.582E+31 31.66 3.580E+31 31.55 Betelgeuse -8.000 5.309E+31 31.73 1.531E+31 31.18	Bellatrix		-2.640	3.811E+29	29.58	1.671E+31	31.22				
Antares -7.200 2.541E+31 31.41 2.466E+31 31.39 Rigel -7.840 4.582E+31 31.66 3.580E+31 31.55 Betelgeuse -8.000 5.309E+31 31.73 1.531E+31 31.18	Canopus		-5.530	5.458E+30	30.74	1.949E+31	31.29				
Rigel -7.840 4.582E+31 31.66 3.580E+31 31.55 Betelgeuse -8.000 5.309E+31 31.73 1.531E+31 31.18	Antares		-7.200	2.541E+31	31.41	2.466E+31	31.39				
Betelgeuse -8.000 5.309E+31 31.73 1.531E+31 31.18	Rigel		-7.840	4.582E+31	31.66	3.580E+31	31.55				
	Betelgeuse		-8.000	5.309E+31	31.73	1.531E + 31	31.18				

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