The Dimensionless Quantity Connecting Sun-like Stars to Red Dwarfs on a Mass-Radii Diagram: The Cassandra Ratio

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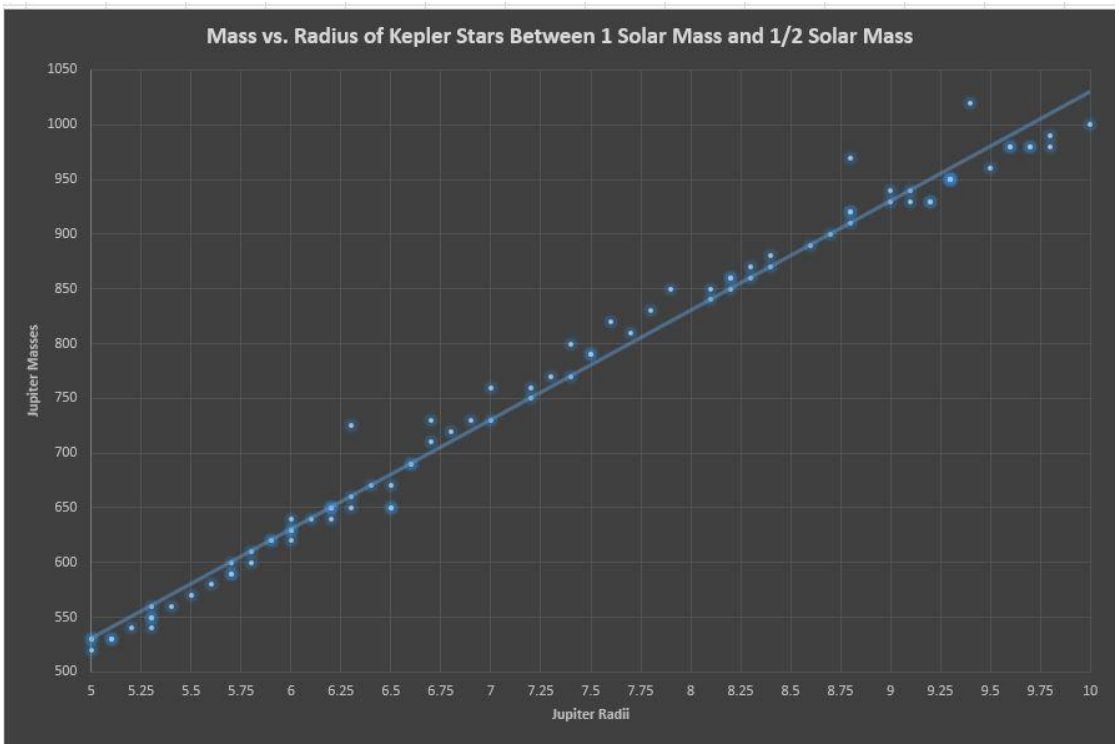
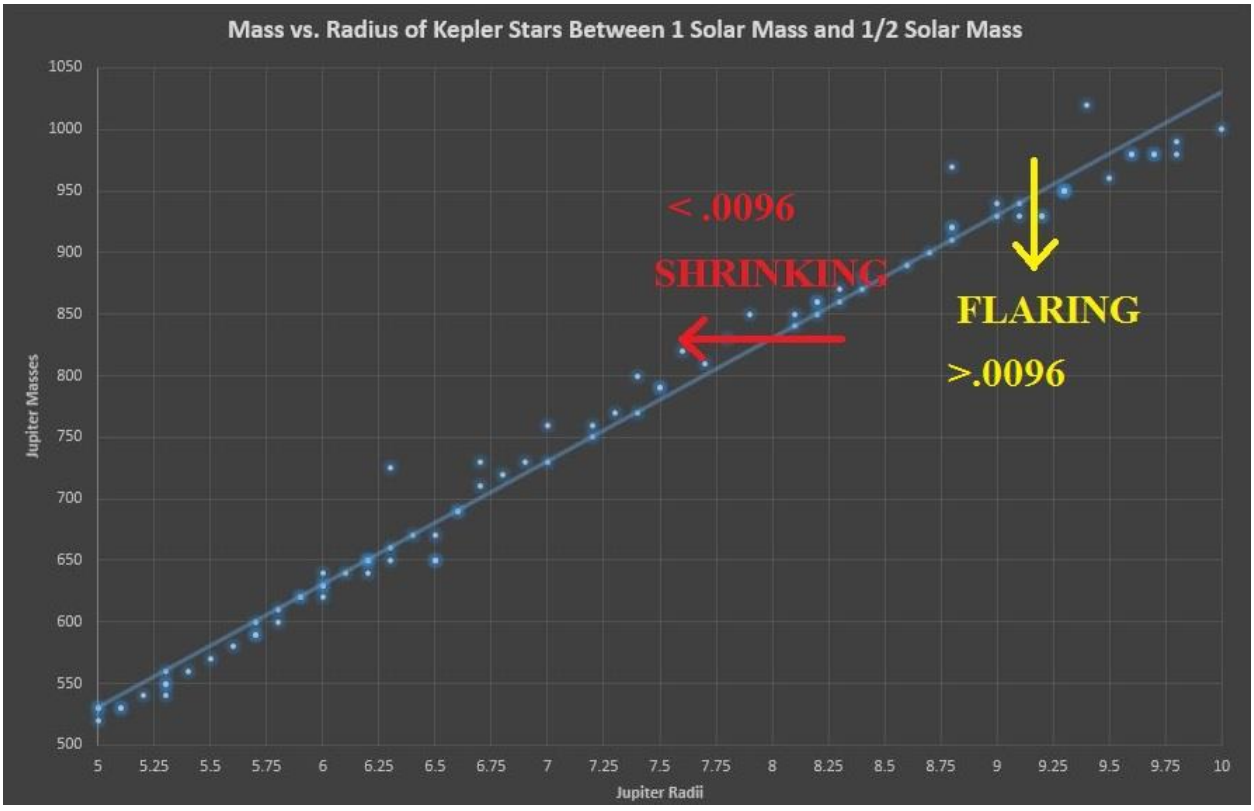
Abstract: It is presented a dimensionless quantity that predicts the radii of G, K and M type stars between 1/2 and 1 Solar mass. That quantity is 9.6/1000, or ~1/100. So if you have a G, K or M type star with the radii of 5-10 Jupiters, you can multiply that radii by 100 to find its mass in Jupiter masses. The dimensionless quantity and graph shows that the Sun will not become a red giant, it will lose its size due to mass loss via the mass loss principle at a rate of ~1/100 per unit mass. Data is taken from the Kepler data set and is listed, as well as a line of best fit on the graph. The line on the graph is the location of the Cassandra Ratio.



The Sun is the very top right star, and the evolutionary path of stars goes down and to the left on this graph towards red dwarfs. As we can see, the path of stars as they evolve at this stage is that in order to maintain their stable evolution, they alternate between losing mass and physically becoming smaller, but not strictly, as they shrink and lose mass simultaneously as well. This means that the Sun, per the line of best fit (Cassandra ratio), is going to shrink, and then lose mass faster, then shrink again, then lose mass. What this means is that there are going to be flare periods that lose mass faster than the star physically shrinks, and there are periods where the star will shrink faster than it loses mass. So we cannot look at its current physical mass loss rate as any indication of its future mass loss rate during short periods of time as it evolves and cools, but what we can do is predict that it will shrink (gravitationally collapse). This of course is just interpreting the Kepler data in a way that is vastly different than what dogma accepts.

What this does is also provide a reason why some red dwarfs are flaring, it is because they are alternating their mass loss with their physically shrinking. What this also means is that there are feedback mechanisms that prevent the star from exploding or expanding, but that allow the star to both flare and gravitationally collapse alternatively to keep stable (or do so simultaneously), so that it is very stable as it becomes the brown dwarf (which in turn experiences different evolutionary processes that continue the planet formation process internally). Most importantly it firmly connects the Sun to red dwarfs, which are extremely numerous, and it shows that stars evolve simply.



The Cassandra (Ratio) term originates in Greek mythology. Cassandra was a daughter of Priam, the King of Troy. Struck by her beauty, Apollo provided her with the gift of prophecy, but when Cassandra refused Apollo's romantic advances, he placed a curse ensuring that nobody would believe her warnings. Cassandra was left with the knowledge of future events, but could neither alter these events nor convince others of the validity of her predictions.

Evelyn De Morgan painting of Cassandra

K03094	*5*	*520*
K02983	*5*	*530*
K00818	*5*	*530*
K00251	*5.1*	*530*
K00854	*5.1*	*530*
K04427	*5.2*	*540*
K00812	*5.3*	*540*
K02793	*5.3*	*550*
K04087	*5.3*	*550*
K00314	*5.3*	*560*
K00252	*5.4*	*560*
K06910	*5.5*	*570*
K00247	*5.6*	*580*
K04252	*5.7*	*590*
K00784	*5.7*	*590*
K00778	*5.7*	*600*
K02873	*5.8*	*600*
K03712	*5.8*	*610*
K00227	*5.9*	*620*
K00227	*5.9*	*620*
K00250	*6*	*620*
K00248	*6*	*630*
K00739	*6*	*630*
K00253	*6*	*640*
K00610	*6.1*	*640*
K06799	*6.2*	*640*
K00455	*6.2*	*650*
K00455	*6.2*	*650*
K00531	*6.2*	*650*
K00430	*6.3*	*650*
K00736	*6.3*	*660*
TW Piscis Austrini	*6.3*	*725*
K00503	*6.4*	*670*
K00326	*6.5*	*650*
K00326	*6.5*	*650*
K00641	*6.5*	*670*
K07034	*6.6*	*690*

K03920	*6.6*	*690*
K02811	*6.7*	*710*
K00241	*6.7*	*730*
K00222	*6.8*	*720*
K00588	*6.9*	*730*
K00218	*7*	*730*
K00231	*7*	*760*
K06007	*7.2*	*750*
K04795	*7.2*	*760*
K04746	*7.3*	*770*
K06904	*7.4*	*770*
K00082	*7.4*	*800*
K04733	*7.5*	*790*
K00189	*7.5*	*790*
K00197	*7.6*	*820*
K06003	*7.7*	*810*
K00245	*7.8*	*830*
K00612	*7.9*	*850*
K00188	*8.1*	*840*
K00216	*8.1*	*850*
K06716	*8.2*	*850*
K00223	*8.2*	*860*
K00226	*8.2*	*860*
K00221	*8.3*	*860*
K00235	*8.3*	*870*
K03932	*8.4*	*870*
K07009	*8.4*	*880*
K00604	*8.6*	*890*
K06004	*8.7*	*900*
K00191	*8.8*	*910*
K00815	*8.8*	*920*
K02874	*8.8*	*920*
K00217	*8.8*	*970*
K00190	*9*	*930*
K01334	*9*	*940*
K00195	*9.1*	*930*
K00205	*9.1*	*940*
K00236	*9.2*	*930*
K06005	*9.2*	*930*
K06918	*9.3*	*950*
K03609	*9.3*	*950*

K06750	*9.3*	*950*
K00215	*9.3*	*950*
K00198	*9.4*	*1020*
K06001	*9.5*	*960*
K03085	*9.6*	*980*
K00234	*9.6*	*980*
K03389	*9.7*	*980*
K00196	*9.7*	*980*
K00213	*9.8*	*980*
K00214	*9.8*	*990*
Sun	*10*	*1000*