Stellar Metamorphosis: Red stars evolve into brown dwarfs

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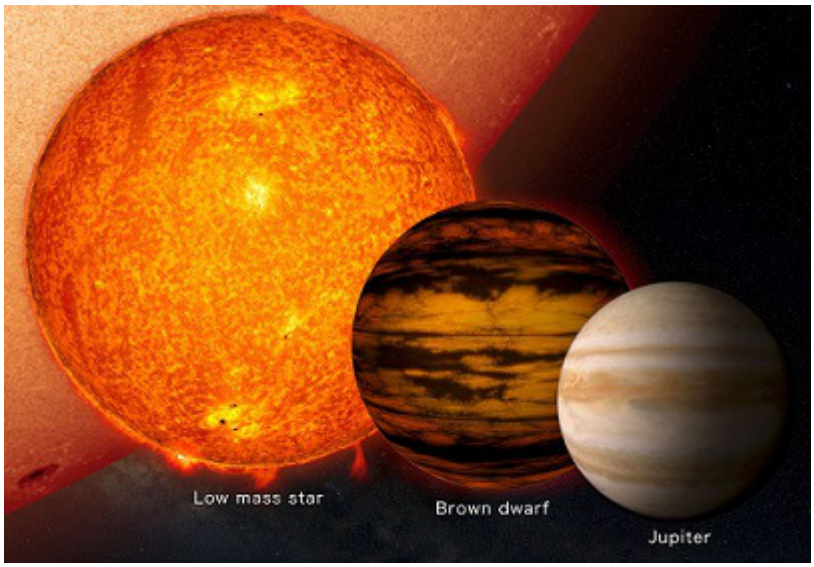
Abstract: In Stellar Metamorphosis[1] red stars evolve into brown dwarfs. In this paper it is shown why and how this happens and supporting evidence is provided.



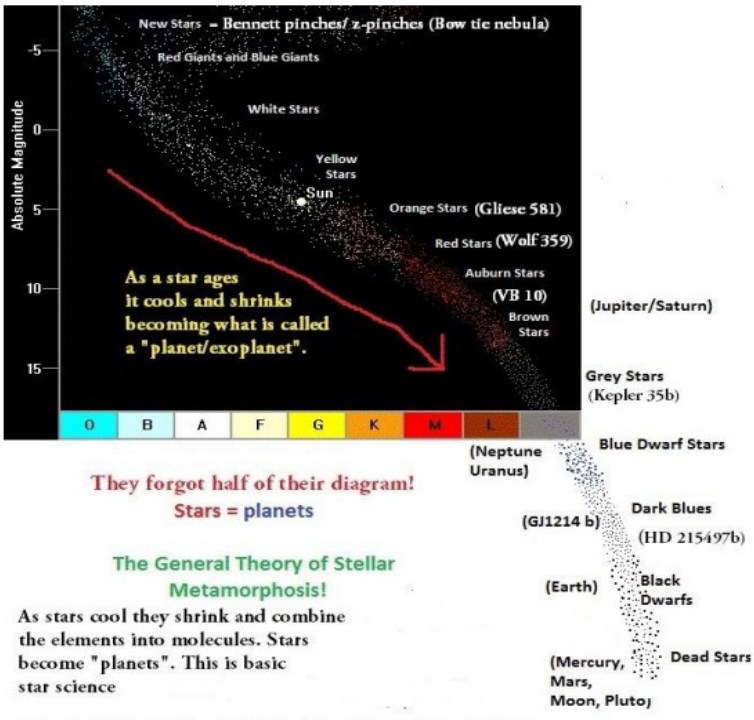
In astronomy a lot is known about red stars and brown dwarfs and in pictures such as the picture above they group some of them together but they do not say that the red star (low mass star in picture) evolves into a brown dwarf and beyond. They always keep them as separate entities. Brown dwarfs are called failed stars in their lexicon, unfortunately the astronomers fail to realize that brown dwarfs are not failed at all, they were stars before they became brown dwarfs.

I quote a google answer to the question: How does a red (dwarf) star die?

"A red dwarf dies when it burns all of its fuel. To start with, the fuel is the chemical element hydrogen. At present, ***no red dwarf star is known which has gone beyond this stage.*** *Red dwarfs are small stars that are around 0.2 solar mass (the sun is equal to 1 solar mass)."*

I bolded the strangest part from this answer; no red star is known to have gone beyond the stage of being a red star. This may be technically true, because once a red star stops shining the astronomers can no longer see it with their telescopes and thus it no longer exists as a star and that is the reason why no red stars are known to have gone beyond the red star stage. It is unobservable to them.

This does not mean that red stars have not gone past the point of being a red star, they have in the past and they will in the future. The key insight in Stellar Metamorphosis by Jeffrey Wolynski is the realization that red stars continue to cool and shrink and become the planets![2] This allowed the completion of the HR diagram to include the old stars (ie planets), see the picture on the next page:



Above the tip of the red arrow you can see the red stars (M type) going into brown stars (L type or brown dwarfs). An example in the diagram is VB 10 (Van Biesbroeck's star) a very small and dim red star. I quote wiki:

"*VB 10 is historically notable as it was the coolest, least massive and least luminous known star from its discovery in 1944 until the discovery of LHS 2924 in 1983. VB 10 is the primary standard for the M8V spectral class*"

An aside about LHS 2924[3]

"The possibilities of a very cool white dwarf, late M subdwarf, or dusty M dwarf are eliminated. A super-metal-rich late M dwarf seems very unlikely. A white dwarf-red dwarf composite can satisfy photometric and spectroscopic requirements but requires the combination of two kinds of rare objects, each uniquely cool, and with an implied conflict in their ages. A single very late M dwarf or **substellar-mass brown dwarf** is favored, despite difficulties in explaining the spectrum and colors."

They try to explain this brown dwarf in all kinds of ways, not grasping the simplest answer: it was a red star that is still cooling and shrinking and is a brown dwarf or we can even call it a gas giant, there is no radius mentioned for LHS 2924 so we can not look it up in the the astron classification table[4].

We can classify VB 10, its radius is 0,102 solar radius, this makes VB 10 a brown dwarf (i have also gas giant in the classification table above 0,01 solar radius but this was a mistake, above 0,01 it is a brown dwarf; at or below 0,01 solar radius it is a gas giant. Gas giants evolve in to grey dwarfs and then you get gas dwarfs, i hope to update all this in a future astron classication 2.0 table), but a hotter brown dwarf, there is a lot of leeway or room in what classifies as a small dim red star and a brown dwarf, this is because they are the same objects; just at different ages. There is a variety of size and temperature gradients to classify them either as small dim red stars of brown dwarfs. There is no missing link; we can see that it is a continuum.

What are the characteristics of red stars evolving into brown dwarfs? We can take VB 10 as an example, this small dim red star is also known as a variable star or flare star. It was observed[5] to have violent flares of up to 100,000 Kelvin. Typically all red stars are flare stars and the 'older'*/cooler the star the more violent their flares[6].

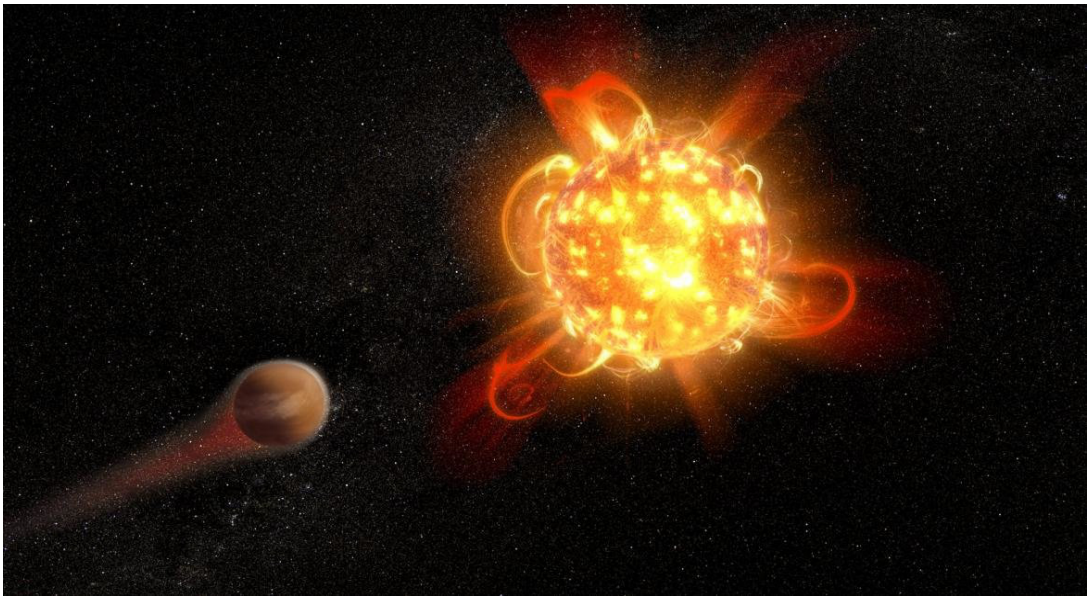
Quote from the abstract of reference 6:

"Flares from the youngest red dwarfs surveyed are 100 to 1,000 times more energetic than when the stars are older"

*in stellar metamorphosis red stars are older, mainstream says red dwarfs are young, that may be but they are not older than orange/yellow/white stars. What they observed was that the red stars which are older and cooler flare more violently.

Although the frequency of flares does decrease with age[7]. I quote:

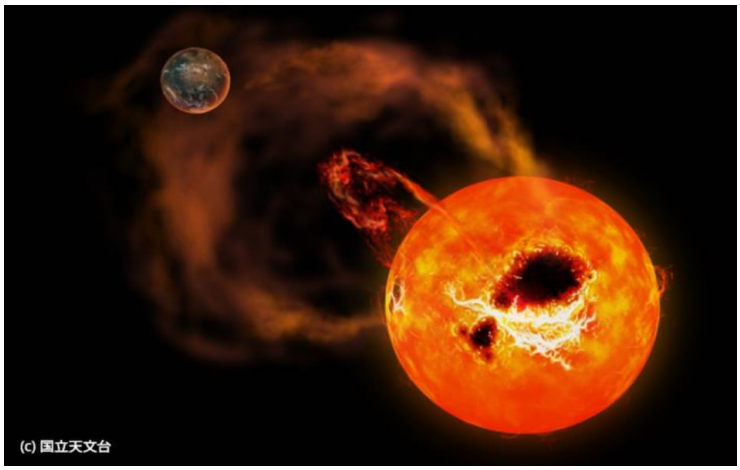
"All methods we studied, however, show definitively that flare activity decreases for all low-mass field stars as their rotation rates decrease (i.e., increasing age)."



flare star

Another example of a flare star is AD Leonis[8,9] , quote from the news article reference 8:

"The star appears to have temperatures lower than that of our Sun, which results in a high incidence of flares"



super flare

And from reference 8 this quote:

"As a result, the maximum superflare energy continuously decreases as the rotation period P_{rot} *increases."*

This means that when the rotation period decreases the superflare energy increases.

This is already a lot of characeteristics so i will list them here:

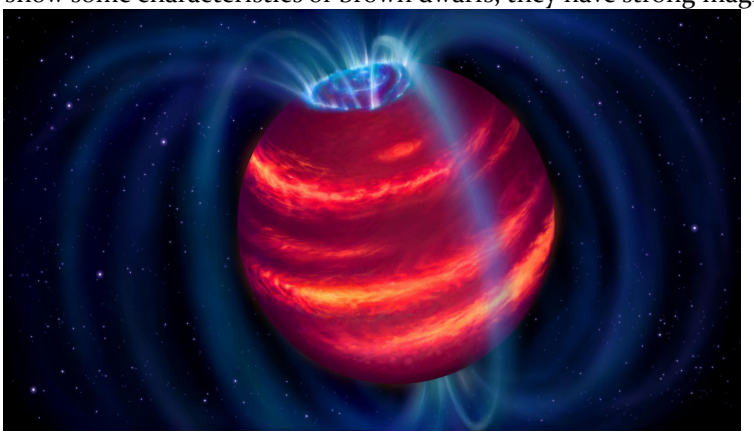
1) Red stars have more violent flares then other stars
2) Red stars have less flare activity (number of of flares) with decreased rotation (ie age).
3) A lower temperature for stars results in higher flare activity
4) Red stars have more energetic superflare energy as their rotation period decreases (ie age).

If we follow some logic of deduction we can come to many conclusions with this evidence. For startes, what will happen when the rotation and temperature decrease even more? Answer: the flares would stop, the red star will stop shining and basically become a brown dwarf.

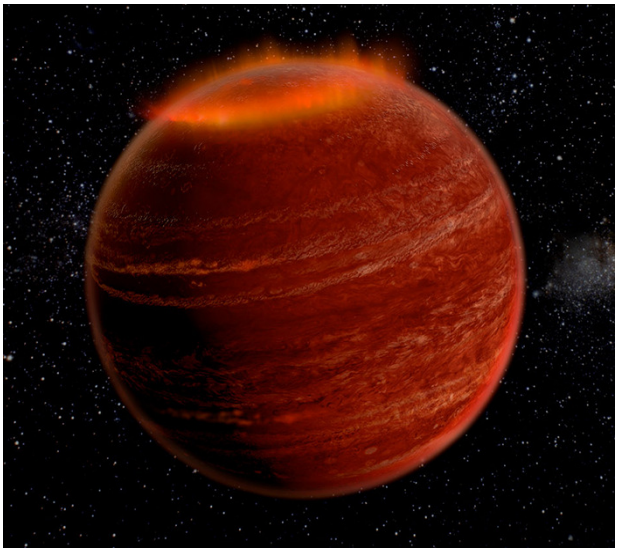
I have listed some quotes and references but these are just observations, they show us what happens but not how. For that we would need to look at plasma physics.

A red star surface is in the plasma state, it is highly ionized matter, in time a star loses heat to space (2nd law of thermodynamics), stars do generate heat (energy) and also receive heat (energy) from the galaxy, but overall entropy is obeyed and heat/energy is lost over time. This results in cooling. The plasma surface can only be sustained with sufficient heat, the heat is needed to ionize the matter present. As stars cool with age the heat decreases making it more and more diffcult to keep the surface ionized. Astronomers talk about flare stars as storing up magnetic energy, but this is false. There is no such thing as magnetic energy. What happens is that the heat/energy the star has is not enough to ionize the surface but the little heat/energy that is their does not dissipate it continues to build up. Instead of being able to sustain a plasma surface you get a flare. The harder it gets for the star to maintain its plasma surface the more it will flare and the flares will get stronger when the star gets cooler.

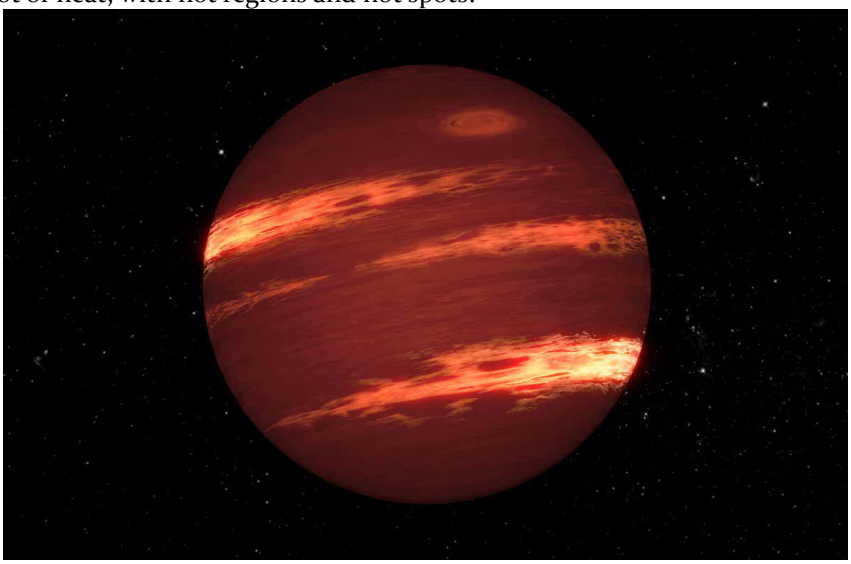
Before concluding i will show some characteristics of brown dwarfs, they have strong magnetic fields:



Auroras:



They also retain a lot of heat, with hot regions and hot spots:



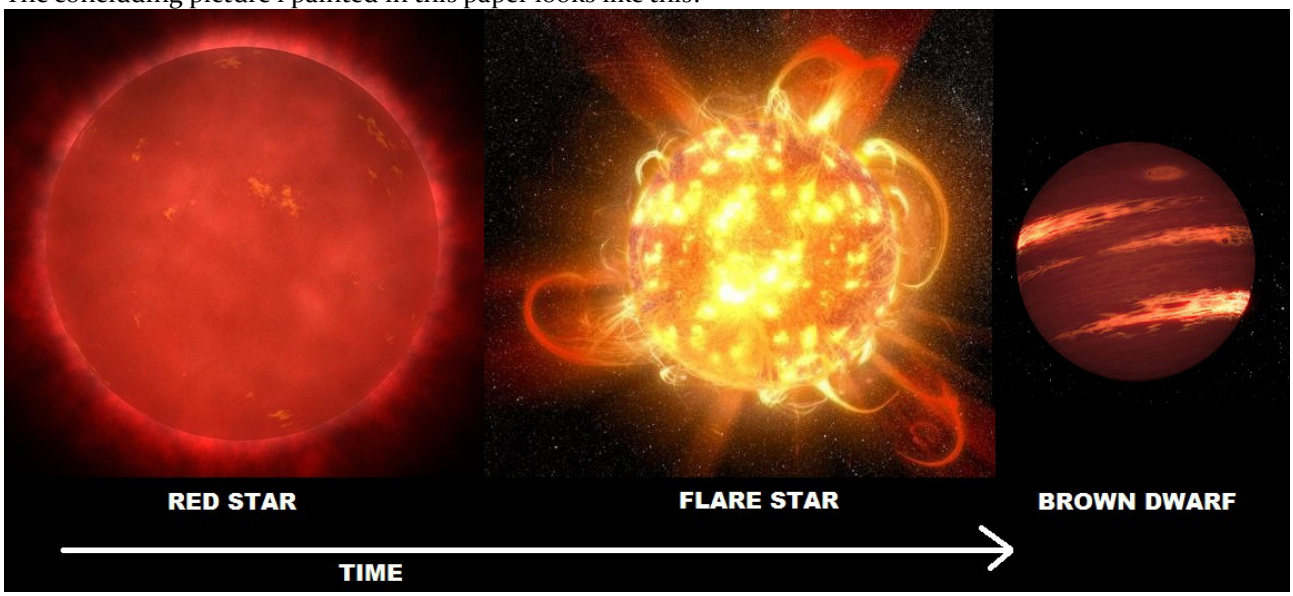
As they age brown dwarfs keep cooling down, i quote from the wiki[10] page on brown dwarfs:

"The coolest free-floating objects discovered such as WISE 0855, as well as the lowest-mass young objects known like PSO J318.5−22, are thought to have masses below 13 MJ, and as a result are sometimes referred to as planetary mass objects due to the ambiguity of whether they should be regarded as rogue planets or brown dwarfs. There are planetary mass objects known to orbit brown dwarfs, such as 2M1207b, MOA-2007-BLG-192Lb, and 2MASS J044144b"

We thus also have cool brown dwarfs[11,12], they are larger than Jupiter/Saturn and have planets orbiting them. As they continue to cool and shrink they will become just like Jupiter and Saturn and beyond. Evolving as per Stellar Metamorphosis.

Brown dwarfs are thus not failed stars[13], they are the embers of former stars and still cooling and shrinking; i hope this paper provides ample evidence of this. I think this is the best way to explain the existence of brown dwarfs.

The concluding picture i painted in this paper looks like this:



"Quid enim necesse est calidum frigus"

References on the last page.

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