The sun is not an average star

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Sometimes biblical creation is spoken of as 'special creation'. This means that God created every planet, moon, star, and galaxy as a special, unique object with special and unique purposes. Though we may not understand these purposes, science does reveal that celestial objects do not fit any rigid pattern of conformity, but that each is distinctively different. Scripture indicates that the sun has a special status in the Creator's purposes. From the standpoint of scientific observation, there are two ways in which the sun might be special: (1) It might be special in and of itself, i.e. taken in isolation; and (2) it might be special when its stellar/planetary environment is included.

Stellar data indicate that the sun is not astrophysically average in its properties such as mass and luminosity. Further, emerging data on stellar/planetary systems suggest that the sun is in a non-typical stellar/planetary environment. At present, it is possible to claim that, unlike most stars, (1) the sun is unassociated with nearby giant companions, (2) its planetary system seems to be a non-typical one, and (3) it is relatively stable. These three characteristics may be related and, taken together, appear to be necessary for the existence of life on earth. The sun can therefore be taken as an evidence of special creation with the purpose of making the earth habitable.

Scriptural claims vs the Anthropic Principle

One meaning of the word 'special' is 'extraordinary' or 'uncommon.'[1] The Bible treats the sun in this sense, for in Genesis 1:14–18 the sun is said to have the purpose of giving light upon the earth, 'to rule the day.' This purpose makes the sun unique since no other star was created for this same reason. The sun also has purposes in common with other stars, such as marking off seasons, days and years, and serving as a sign-giver. However, the sharing of some purposes does not override the specialness of each star, for God 'calleth them all by their names' (Psalm 147:4). This implies not only the distinctiveness of the sun, but also of each star in the heavens.

Considering that the word 'stars' in Genesis 1:16 can include planets as well as the incandescent stellar bodies created on the fourth day of the Creation Week, it could be concluded that the distinctiveness of each planet is also implicit in Psalm 147:4. Certainly the earth is unique, since it alone was created on the first day of the Creation Week (Genesis 1:1), with the other planets having been made later. Further, of all the planets, only the earth is said to have been formed with the purpose of being inhabited by life (Isaiah 45:18). Thus the sun, and whatever special characteristics it may possess, are linked to the performance of God's will in maintaining life on earth.

There are objections one can raise to this conclusion that the sun is designed to support life on earth. One objection invokes the so-called 'Anthropic Principle' which claims that the universe itself has evolved to support life, and especially human life, which is why we are here to observe it. Another objection acknowledges that Scripture addresses the sun as special in relation to the earth, but then claims that astrophysically and environmentally the sun is indistinguishable in its properties from innumerable other stars, so God could have 'chosen' one of these rather than the sun to function as the earth's star.

Promoters of the Anthropic Principle are careful to point out that the presumed evolution of the universe 'does not mean that it cannot be special in *any* way' [emphasis in original].[2] After all, if no part of the universe were specially tailored for life, we could not exist. The Anthropic Principle in fact asserts that special regions of the universe must exist in which life can thrive, but that God as Designer is not responsible.[3]

The question therefore is not, Do special stars(s)/planet(s) exist in the universe, but rather, Who or what is responsible for these special features—God or evolution? The answer to this question is ultimately spiritual. The general revelation addressed in Romans 1:20 'consists only of God's *self*-revelation. … After the Fall, man's knowledge of God through general revelation has been darkened by sin, so that Scripture and the grace of the Holy Spirit are now needed for man to understand properly the message of general revelation' [emphasis in original].[4] Man can choose to discern God as the Designer of the creation or not, but the choice is a spiritual one. The spiritual nature of such a decision is highlighted by the observation that 'the real difficulty that many scientists have with creationists is not so much with the *ad hoc* nature of their theories as with their prior acceptance of the Bible and the restraints it imposes on theorizing'.[5] As a spiritual stratagem to avoid acknowledging the existence of God, the Anthropic Principle is not a valid scientific objection to the conclusion that God has acted as Creator and Designer of the special features of the cosmos.

The balance of this paper focuses on the other objection previously mentioned, that the sun may be special to God, but astrophysically and environmentally it is no different from many other stars. While it is a truism that scientific knowledge of the stars is incomplete, the knowledge we do have appears to suggest that the sun is indeed uncommon and not average. In contrast to this conclusion is the 'prin-

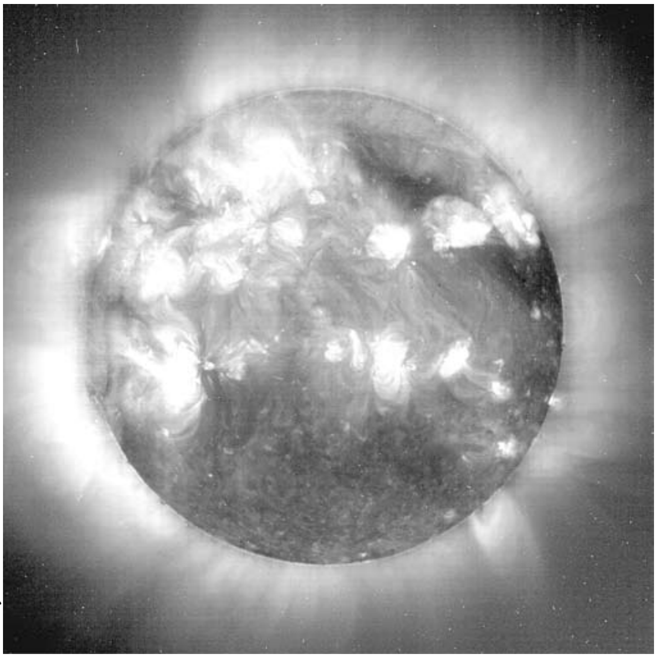
Photo by NASA.

Image of the sun taken by SOHO's EIT (Extreme-ultraviolet Imaging Telescope) in the 284 Å wavelength.

ciple of mediocrity' which claims that no part of the universe is special above any other. The principle of mediocrity is in conflict with the Anthropic Principle's prediction of special life-supporting places in the universe.[6] If the sun is uncommon, one can choose to believe that evolution developed it that way, but the door is also open for the decision that God the Designer exists and made the sun and the life which the sun supports.

The Anthropic Principle vs the principle of mediocrity

Though the Anthropic Principle has gained popularity in recent years as a way of explaining evidence of design without recourse to a Designer, the principle of mediocrity has a longer history with roots in the Copernican revolution, which claimed that the earth has no central place in the universe. The assertion that the earth has no central place was transmuted into the belief that the earth is not special at all, but is merely another evolving planet on which evolving life exists. With the rise of evolution in the 1800s, other reasons emerged for accepting the principle of mediocrity. Indeed, despite the recent popularity of the Anthropic Principle—which we have seen is in conflict with the principle of mediocrity—evolution has difficulty with atypical features of planets and stars, and requires conformity for two reasons. One is that evolution tries (unsuccessfully) to explain how all planets and stars could have developed by the same natural causes acting uniformly everywhere. This is manifestly impossible if each celestial body is special and different from others.

It could be objected that this last statement does not follow from the expectation of conformity. For example, no two identical snowflakes have been catalogued, so each snowflake is 'special' in some sense, yet all snowflakes are formed by the same natural causes. However, the belief that non-conformities are an obstacle for evolutionary theory is a point made by evolutionists themselves. It is evolutionists who sense the impossibility of modeling evolutionary development via natural law if every celestial body is special or unique. It is evolutionists who constrain themselves to expect conformity. Astronomer Theodore P. Snow expresses this attitude:

> 'We believe that the earth and the other planets are a natural by-product of the formation of the sun, and we have evidence that some of the essential ingredients for life were present on the earth from the time it formed. Similar conditions must have been met countless times in the history of the universe, and will occur countless more times in the future.'[7]

Another reason for evolutionary acceptance of the principle of mediocrity is the belief that extraterrestrial life exists throughout the universe. 'If the "assumption of mediocrity" is valid, life should eventually arise on all planets that can possibly support it.'[8]

The Anthropic Principle also leads to the conclusion that life must have evolved in the cosmos,[9] but generally, promoters of the Anthropic Principle tend to use it as an explanation of why extraterrestrial life has not been found. The conditions required are so special, the reasoning goes, that life will arise only rarely, and possibly has arisen only once—on the earth.[10] This is still not a majority opinion, but along with the rise of the Anthropic Principle, the evolutionary consensus as to the number of habitable sites in the universe has altered radically downward over the last several decades.

Evolutionists have come to the realization that life can live only under 'earth-like' conditions. With respect to the type of star necessary for life support, once virtually any star was seen as suitable. Now there is the realization that for life to exist, a planet must be at a suitable distance from a 'sun-like' star. At least in this sense, even evolutionary thinking has come around to the realization that only the sun—or stars like it—can provide the stellar requirements for life.

The principle of mediocrity and claims that the sun is average

The principle of mediocrity continues to guide much evolutionary thinking. In other words, there is an evolutionary bias that demands the principle of mediocrity to be valid whatever science may show. As an example, though only the earth has been shown to harbor life, the hope continues to be held out that the earth is not special, and that the principle of mediocrity is true. Donald Goldsmith writes, 'We have no definitive proof that any planets exist beside the sun's … [but] we need … a second example to feel confident that our own solar system does not represent a cosmic anomaly, a unique (or nearly unique) circumstance.'[11] This statement illustrates the difficulty of evolutionary theorizing with special or unique occurrences, and why the expectation persists that conditions in the solar system will be found to be typical on a cosmic scale. Since the time of Goldsmith's statement, planets have reportedly been detected, but none likely to have life, making Goldsmith's evolutionary quest still an ongoing one.

To maintain a thoroughly non-privileged status for the earth, the earth cannot exist in association with a non-typical star. Following the principle of mediocrity, therefore, the claim is often made that the sun is only a typical or average star. A non-specialist writer opines: 'Today we know that the Sun really is a very ordinary star, of middling size and middle age … It is just one star among a hundred billion others; and even the Milky Way is just one among a hundred billion galaxies in the universe'.[12] Astronomers make similar statements: 'Our star, the sun, is rather ordinary … In many respects the sun is entirely a run-of-the-mill entity'.[13] Again, 'Our sun, so important to us, is merely an ordinary, "garden-variety" star'.[14] Well-known planetary scientist Carl Sagan concluded that, 'The Sun is an ordinary, even a mediocre star'.[15]

Is the sun really of 'middling size' and 'middle age'? Is it really 'ordinary', 'run-of-the-mill', and 'mediocre'? The suspect nature of such characterizations is apparent when one reflects on the fact that calling the sun 'middle age' is a deduction based on nothing more than evolutionary scenarios of the sun's history and operation. The sun is typically taken to be some 5 billion years old, with a presumed lifetime of the order of 10 billion years, placing the sun in the middle of its presumed lifetime at 'middle age'. Clearly, if the evolutionary presuppositions behind this characterization are wrong, the description of the sun as middle aged is also wrong.

The other characterizations of the sun just quoted are derived from the fact that the sun lies in the middle of the range of stellar types plotted on the Hertzsprung–Russell (H–R) diagram (Figure 1).[16] This means that the sun occupies a median position of possible stellar types in the H–R diagram. However, the median of a population corresponds to the mean only if the population follows a normal distribution, but the distribution of star types does not follow a normal distribution. As an example, consider 'the 100 stars closest to the sun. Stars at this range are near enough for us to measure accurate distances and to detect even very faint examples. They are also numerous enough to provide a good sample. Stars in such a random sample are believed to be representative stars—that is, a representative sample of all stars in our general neighborhood of the galaxy. … The Sun is brighter [in absolute terms] than most representative stars.'[17] The sun does not have a mean 'brightness', i.e. absolute magnitude. It is believed that this trend generally applies in more distant regions.[20]

In contrast to the median, which is the middle value of a range of values, there is the 'average', which is defined as the 'mean proportion' of values actually occurring in the range.[18] That is, the average is computed as the mean value of a particular property, not as the middle of a range.[19] Descriptions of the sun as 'average' are biased descriptions issuing from expectations consistent with the principle of mediocrity. Further, when such descriptions are rationalized by appeal to the sun's location in the H–R diagram, the average is being confused with the median. Even this assessment is too generous, however, for the apparent median position of the sun in the H–R diagram is due to the use of non-linear axes. Plotted on a (very inconvenient) linear scale, the sun would not be in a middle position.

Even more, the mean value of virtually any property of representative stars is at variance with the value of the same property for the sun. As already noted, most stars have an absolute magnitude less than the sun's, and the sun's mass exceeds that of most stars. The sun's luminosity thus exceeds that of most stars. Further, the sun is a type G star, a distinction held by only 9% of stars generally.[20] Given that spectral type depends on surface temperature,[21] the sun therefore has a temperature shared by only a minority of stars. These non-typical features of the sun explain why—in contrast to the faulty characterizations quoted above—the sun is often recognized as not mediocre after all: 'The Sun is a main sequence star with an age of 4.5 billion years, a spectral type G2 and, of course, a mass of 1.00 $M_{\odot}$. Its absolute magnitude … is +4.85. Contrary to popular belief, these properties make the

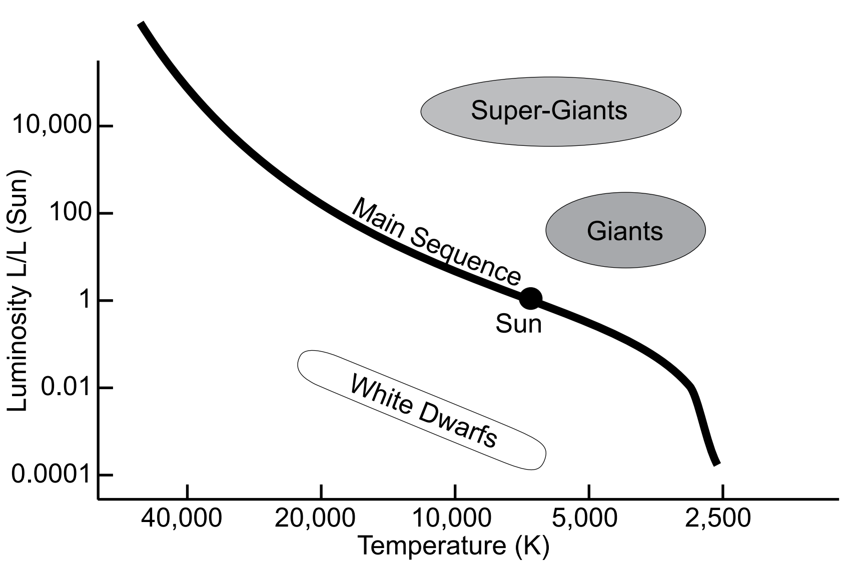

Figure 1. *The Hertzsprung-Russell (HR) Diagram where a star's temperature is plotted against its luminosity. The first such diagram was plotted by Ejnar Hertzspung in 1911, and (independently) by Henry Norris Russell in 1913.*

Sun a very “unaverage” star’.[22] Astronomer Stephen Maran has made the point that, ‘Some of the popular perception of the Sun is downright wrong. Writers sometimes tell us that it is “just an average star.” Not so. The vast majority of stars are smaller, cooler, dimmer, and less massive than the Sun.’[23] These same data are the reason why astronomer Donald C. Brownlee concludes that when ‘people say the sun is a typical star … that’s not true.’[12]

With these considerations, it is clear that the sun is not an average star.

The sun is not average, but is it special?

There is no doubt that the sun is special in Scripture because of its relationship to the earth, and we have seen also that the properties of the sun in isolation make it an ‘unaverage’ star. Can we conclude that the sun is therefore ‘special’, i.e. extraordinary? Psalm 147:4, considered previously, does suggest that the sun, and each other star, may in fact be special, even unique. Astrophysically, however, we are prevented from reaching this conclusion by the paucity of stellar data (as opposed to the abundance of stellar theory). Theories of solar operation are routinely extrapolated to describe how other stars work. While this extrapolation is logical, it is based to an extent on the fact that no other star has been studied as much as the sun. H.B. Van der Raay states: ‘Clearly if we do not understand our own closest star, the implications on the whole field of cosmology are enormous.’[24]

The point here is not to suggest that the extrapolation of solar models to other stars is invalid, but simply to highlight how little we really do know about other stars in comparison with the sun. Therefore we are not in a position to make a comparison between the sun and other stars which would allow us to characterize the sun as astrophysically special or unique. We can go so far as to claim, however, that the sun, taken in isolation as an astrophysical system, appears to be non-typical. Considered in the light of its own properties, the sun is not an average star. Table 1 summarizes some of these solar characteristics, plus additional items to be discussed below.

We turn now to a consideration of the sun’s existence in its stellar/planetary environment. In the last several decades the search for extraterrestrial life has spawned a great amount of research on stellar/planetary systems, much of it devoted to determining possible abodes for life beyond the solar system near suitable stars. Despite the explosion of activity in this type of research, our knowledge of stellar/planetary systems is still in its infancy. However, it is possible to conclude that such research has consistently made the sun appear less typical and more unusual than used to be the case. Whether the sun will eventually emerge as astrophysically special or even unique remains to be seen.

It has long been realized that not any star of random mass could support life on a nearby planet. Stars above a critical mass would be too unstable to permit the survival of life, and stars of insufficient mass would require such a close proximity of a planet for heating that the planet would be devastated by tidal forces. Significantly, the sun has been determined by extraterrestrial researchers to be in just the mass-range suited for life support.[25] Yet the sun is more massive than the average star. The average star will therefore not support life. It may be that if ever the sun is shown to be special or unique, such uniqueness may be inherent in the stellar/planetary environment of the sun.

Are single stars rare?

Though planetary systems have been modelled around binary and multiple star systems, doubt remains that any planets in such a system could harbor life.[26] Astronomer John Fix states:

> ‘Compared with binary and multiple stars, single stars like the Sun are a distinct minority. Of every 100 star systems, it is estimated that only 30 contain single stars, 47 are binaries, and the remaining 23 are multiples, most of which are triples. The 100 star systems contain about 200 stars, so if only 30 of them are single stars, then 85% of them are in binary or multiple systems. The proportion of stars that are in binary or multiple systems may be even higher than 85%, moreover, because faint distant companions of what appear to be single stars or close binaries may have been overlooked or gone undetected.’[27]

With the sun being single, and less than 15% of other stars being single, the sun is not in an average stellar environment, but even so, the number of single stars, though a majority, must be huge—or is it? As astronomer William K. Hartmann has noted, ‘Kitt Peak astronomers Helmut Abt and Saul Levy (1976) … found that about two-thirds of all stars have detectable companions … . But from statistics of companions masses, they estimated that the other seemingly single stars probably all have companions too small to detect! … . According to this estimate, virtually all stars have at least one companion.’[28] Thus the number of single stars may be quite small, a finding which could lead to the perception of the sun as distinctly ‘unaverage’ in the context of its stellar environment.

An objection could be raised at this point that the sun has companions, too—the planets of the solar system. As we will see, however, the search for extraterrestrial life on extra-solar planets appears to be revealing that the sun’s solar system is not typical, again leading to the conclusion that the sun is not in a typical stellar/planetary environment.

The sun’s environment: average or not?

The sun has long been recognized as unusually stable and has been dubbed by solar astronomers ‘the constant sun’, meaning that its energy output rate is always about the same. As more has been learned of the sun in recent decades, the realization has emerged that the sun is not stable in an absolute sense. Some instability would seem to be inherent in any celestial body such as the sun which releases energy at such a prodigious rate that planets tens of millions of meters distant are greatly warmed. Indeed, the sun has been described as an 'inconstant, irregular, and a magnetically-variable star'.[29] Nevertheless, the fact remains that 'its total [energy] output changes little',[30] at most on the order of 1% or less. Such variability is too insignificant to directly affect life on earth.

New studies continue to emphasize that the sun is more stable than most stars. It is more stable even than most other stars thought of as 'sun-like'. One recent investigation studied sun-like stars to assess the likelihood of communications disruption or environmental destruction (e.g. ozone depletion) by a major solar flare, assuming that such stars would behave like the sun. While the study acknowledged that the 'Sun often sends flares toward Earth', it was concluded that, 'This kind of solar activity is mild compared with that of the Sun's sister stars. … Sun-like stars had produced superflares that made them dramatically brighter for minutes or even days'.[31] It was further stated that, 'Sun-like stars normally produce a bright superflare about once a century', and the report ended by posing a question:

> 'Why a superflare has not occurred on the Sun in recorded history is unclear. "I think a consensus is emerging that our Sun is extraordinarily stable," suggests Galen Gisler, an astronomer at the Los Alamos National Laboratory in New Mexico.'[40]

Stars of class M, the most common type of star, have long been recognized as flare stars,[32] a feature in addition to their small mass making them an improbable location for any planets harboring life. However, the finding of massive flare activity in sun-like stars was unexpected. Most significant was the lack of comparable flare activity in the sun itself, with the point being made that 'astronomy records going back for 2,000 years have never recorded a superflare [in the sun]',[33] and that 'there is no evidence that [a superflare] has ever happened during the 4 billion year [sic] history of the sun'.[34]

The detection of superflares in sun-like stars together with their complete absence in the sun challenges the principle of mediocrity. Astronomer Eric Rubenstein explains the influence of the principle of mediocrity on the search for places where life might live:

> 'We have traditionally assumed, for instance, that if a star has roughly the same surface temperature and luminosity as the Sun, is a single star and rotates at a speed similar to that of the Sun, it will likewise have only modest levels of chromospheric activity. Such stars are commonly called *Solar analogues*. The unspoken assumption that all solar analogues are, in essence, interchangeable underlies much of the thinking about habitable worlds, and perhaps life, existing elsewhere in the cosmos' [emphasis in original].'[35]

He concludes, 'This assumption was premature—and wrong'.[44]

The sun is now being recognized as evidently different in some way from other 'sun-like' stars, but what factors are responsible for the difference? What is causing the superflares? Is the cause an astrophysical one residing in the stars themselves, or are the superflares caused by interactions between the stars and companion objects nearby? Whichever cause is confirmed, the sun would come out looking less typical than before. A confirmation of the first possibility would lead to the conclusion that the sun is astrophysically different from other sun-like stars in some way. The second possibility would imply that the sun functions in a non-typical planetary environment.

At present the favored explanation is that companion bodies in tight orbits cause flare instabilities in the stars. It is thought that a Jupiter-size planet in close orbit might cause the observed superflares, but as Rubenstein points out, 'What is needed now is some direct evidence for giant planets in close orbit around these stars'.[36] According to this view, a Jovian-type planet interacts magnetically with its star,[37] and 'the lack of SFs [superflares] on our Sun [is due to the fact that] our solar system does not have a planet with a large magnetic dipole moment in a close orbit'.[38]

The type of planetary system necessary to meet this scenario is sufficiently different from the sun's planetary system to be characterized as 'strange',[45] requiring the existence of a large Jupiter-like planet in closer orbit than the orbit of Mercury around the sun. If this is the actual cause of SFs, it would really be our solar system that is the strange one, however, since many sun-like stars studied so far exhibit SFs, but the sun does not. Confirmation of this scenario by study of more sun-like stars with suitable companions would indicate that the sun is in a non-typical planetary environment.

One reason for invoking planetary companions as the cause of SFs is the difficulty of explaining the huge energy released by SFs, typically 100 to ten million times more than the energy released in a solar flare.[46] It has long been recognized that solar flares are connected with magnetic disturbances,[39] but existing theoretical models cannot explain the huge energy releases of SFs without the presence of a companion to interact magnetically with the star.

Indeed, until recently the possible occurrence of significant chromospheric disturbances in sun-like stars was denied. For decades, an apparent flare event in S Fornacis occurring in 1899 was proclaimed to be an illusion, despite its sighting by three professional astronomers working independently.[40] In the 1970s the occurrence of a superflare in the sun-like star Groombridge 1830 was reported based on photographic plates which had been overlooked since the 1920s.[41] However, this star is actually a binary system with a companion of class M, and M stars are known to be classical flare producers. Beardsley and colleagues noted that 'the question remains as to whether the primary or the secondary [the M-class companion] flared',[42] thus avoiding the possibility of a flare in the sun-like star. As recently as the 1980s, a SF event in the solar-type star π^1 UMa was acknowledged, but was attributed to the possibly high rotation rate of this star, a characteristic which could produce instabilities manifested as flares.[43]

Such assessments began to change with the awareness that apparently many 'normal' stars actually experience tremendous energy-release events. In 1989 a study considered 24 such stars, concluding that 'an "average" star undergoes a flash [a superflare] every century or so',[44] making the sun distinctly 'unaverage'. The S Fornacis SF event of 1899 is no longer considered an illusion, the view now being that '[t]he *independent* discovery by three widely separated and skilled observers and the three astrometric positions remove all doubt … that S For was flaring' [emphasis in original].[45] Opinion now also holds that Groombridge 1830 flared and not its companion.[54] Further, high rotation rates in sun-like stars as a cause of SFs are also typically ruled out.

Does the sun have a high internal spin rate?

As noted above, the acceptance of stellar companions as a cause of SFs has not yet been confirmed by actual detection. In addition it is not certain that high rotation rates within sun-like stars could not be a cause. High rotation rates are ruled out based on evolutionary models of stellar operation which presume long age.[52,46] The older a star is, presumably the less its spin rate. Sun-like stars are supposed to be 'middle aged' and no longer young. To the creationist who realizes that stars are not 'old' but were created recently, such reasoning is seen to be irrelevant, and slow spin rates must be inferred in some other way.

There is another indicator also taken to imply that sun-like stars have too slow a spin rate to cause SFs.

> 'Rapidly rotating stars usually contain a lot of lithium, a rather fragile element that is destroyed when it gets mixed into a hot stellar interior. Rapid rotation is thought to prevent such mixing. So by estimating the abundance of lithium, astronomers can gauge the rotation rate of a star … . The nine superflaring stars all have low lithium values, which confirms that they are indeed spinning comparatively slowly.'[47]

Although this reasoning is widely accepted, it may not be accurate. The sun is claimed to be depleted in lithium by a factor of 150 compared with the expected value.[48] This is a deduction from the presumed composition of the putative primordial solar nebula,[57] but from a creationist standpoint, the solar system did not originate from a solar nebula, so the lithium depletion problem for the sun may not be real. Nonetheless, it is real to those who accept the solar nebula as the precursor of the solar system, and Christensen-Dalsgaard *et al*.[57] propose that the solar lithium depletion problem in the sun could be resolved by a greater amount of mixing in the sun than is generally assumed.

How valid is this possibility? Data confirm that a relatively high degree of mixing may be occurring in the sun. The high angular momentum of the planets compared to the sun has been a long-standing problem for evolutionary models of solar system origins. It has become accepted that the sun, which allegedly possessed high angular momentum acquired from the solar nebula, has undergone a process of angular momentum transfer to the planets mediated by the solar magnetic field. This model of the sun's relatively low angular momentum leads to the expectation that the sun would now have a small internal rotation. '… it is therefore believed that the sun has been losing angular momentum over its lifetime through its magnetized wind, thereby spinning down its outer convection zone and probably the bulk of its interior'.[49] Thus, both the sun and other sun-like stars are believed to have a low spin rate due to the assumption of great age.

Contrary to this expectation, helioseismic observations imply the existence of a relatively high spin rate in the solar interior.[50,51] Such a conclusion imposes constraints on the alleged 4.5 billion year age of the sun, since evidently the sun has not had so much time to spin down. In a biblical creationist model, spin down, over 4.5 billion years, has not occurred, and there is indeed 'rapidly rotating plasma deeper in the convection zone' than previously believed.[52]

Interpreting such plasma motion as an artefact of spin down, GONG (Global Oscillation Network Group) researchers have acknowledged that, 'The spin down to the present state … may have involved material motion or

Table 1. *Distinctive Characteristics of the Sun.*

	Characteristic	Comparison with Other Stars	Certainty of Distinctive
1.	Dimensions[(a)]	Larger than most	Certain
2.	Mass	Higher than most	Certain
3.	Luminosity	Greater than most	Certain
4.	Absolute magnitude	Brighter than most	Certain
5.	Spectral class	Different from most	Certain
6.	Surface temperature	Higher than most	Certain
7.	No stellar companions	Most have one or more	Certain
8.	Stable (no superflares)[(b)]	Superflares in most sun-like stars	Probable
9.	No giant planet in close orbit	Most sun-like stars have such a planet	Possible
10.	Spin rate	Less than most sun-like stars	Possible

(a) Characteristics 1-6 are related, showing that the sun in a holistic sense is not an average star.
(b) Item 8 is probably related to one of items 9 and 10, or both.

instabilities, leading to mixing in the solar interior and thus affecting the structure of the present sun … .'[57] Though the rotation rate of the core is not certain,[61] it is thought that the core rotation rate may be 'considerably faster than that of the solar surface',[53] a conclusion echoing the earlier claim of Claverie *et al*. that the core rotation is '2–9 times [faster] than the observed surface rotation.'[59]

Not surprisingly, Douglas Gough and colleagues have written, 'Immediately beneath the convection zone and at the edge of the energy-generating core, the sound-speed variation is somewhat smoother in the sun than it is in the [typical theoretical solar] model. This could be a consequence of chemical inhomogeneity that is too severe in the model … or to neglected macroscopic motion that may be present in the sun.'[54] In other words, there is a degree of mixing in the solar interior caused by rapid rotation of solar matter, but this fact has been generally ignored. If the spin rate of solar matter is higher than is generally expected, perhaps spin rates in other sun-like stars may also be high. Thus the possibility remains that unexpectedly high spin rates in sun-like stars may be a cause of SFs. The sun has an apparently high spin rate but no observed SFs, suggesting that solar-type stars with SFs may have spin rates at even greater variance with expected values.

With our current level of knowledge, we cannot yet say with certainty what is the cause of superflares. We do not know whether there is 'a causal or casual connection between planets and superflares',[55] and much remains unknown about stellar interiors. Whatever the cause(s) of SFs, however, it is clear that the earth is the object of God's providential care. The extent of God's care for the earth can be illustrated by considering the dire effects of a SF on a hypothetical earth-like planet: 'Possible effects include temporary heating … and ozone depletion … with normal stellar ultraviolet light then irradiating the surface. … The effects of temperature rises and ultraviolet light at the surface could prove to be damaging to existing life, perhaps to the extent of causing extinctions.'[64]

Conclusion

Scripture teaches that the sun is special in its purposes which include life support on the earth. Psalm 147:4 also implies that the sun might be special in its own right. Stellar and solar astrophysics confirms that the sun is not average, with most stars being smaller and dimmer than the sun. Observations of sun-like stars reveal that generally they are less stable than the sun, emitting superflares which could extinguish life on earth. The cause(s) of superflares are not certain, but possibly include (1) destabilizing effects of Jupiter-size companions in close orbit, or (2) the existence of high spin rates in sun-like stars. If the first possibility were confirmed, this would imply that our solar system is not typical and the sun is not in an average environment. Confirmation of the second possibility could be taken to imply that the sun is astrophysically unusual and not average. Progress in stellar/solar research has strengthened the conclusion that the sun is not average rather than weakening it. A special, or even non-typical, sun can be taken as evidence of God's provision for life on earth, and could be taken to suggest that life existing as on earth may be unusual, rather than a common occurrence in the cosmos.

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Evolution superfluous?

'The subject of evolution occupies a special, and paradoxical, place within biology as a whole. While the great majority [of] biologists would probably agree with Theodosius Dobzhansky's dictum that "nothing in biology makes sense except in the light of evolution", most can conduct their work quite happily without particular reference to evolutionary ideas. "Evolution" would appear to be the indispensible [sic] unifying idea and, at the same time, a highly superfluous one.'

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