

Case Study – Superflares

Overview

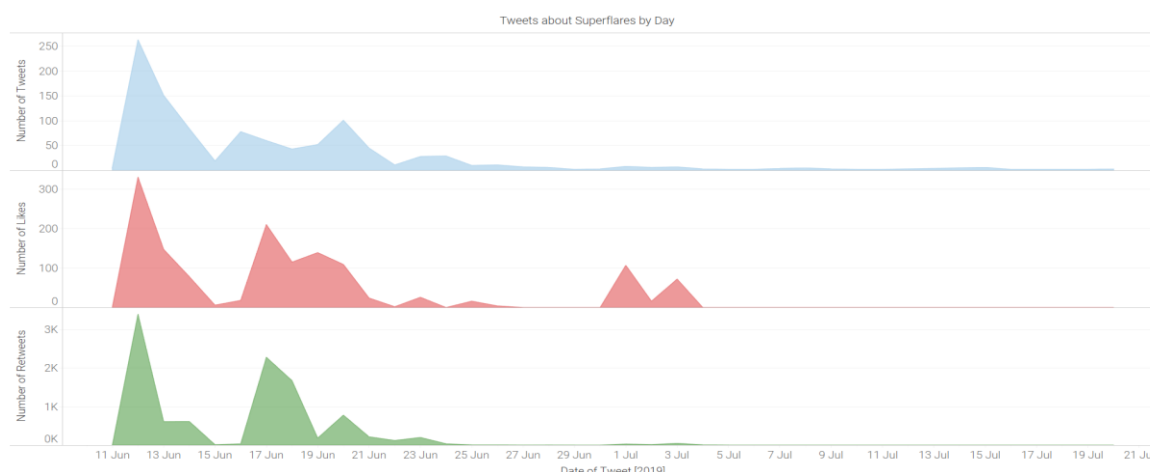
'Superflares' are massive explosions on stars, which have occasionally been observed in stars of a similar age to our sun. They belong to that peculiar class of events which include meteor strikes, or the evolution of a superintelligent, destructive AI - highly unlikely to occur, but potentially catastrophic. The effects of a hypothetical superflare in our solar system could range from the disruption of satellite and global electrical systems, to widespread damage to the biosphere and permanent destruction of the ozone layer.¹

To examine public response to this vague but possibly existential threat, we looked at the reaction to a study, *Do Kepler Superflare Stars Really Include Slowly Rotating Sun-like Stars?*², by researchers in Colorado and Japan. The research examines whether superflares can occur from slowly rotating sun-like stars, and points to the possibility of the Earth experiencing such a superflare from the Sun in the next 100 years or so.

Our research below is based on a targeted collection of 1068 Tweets mentioning 'superflares', sent between 12th of June and 22nd of July 2019. As this specific area of astronomy is a somewhat niche topic, the discussion of superflares on Twitter between the focuses almost exclusively on this single scientific study.

We found that, although superflares appear to be a rather impersonal topic with very unlikely elements of personal experience, discussion on Twitter throws up some interesting themes and engaging reactions from the public.

Popularity over time



Discussion of the study generally declines over time as we move further away from the publication date. However, some of the most liked tweets appear towards the beginning of July, long after any news coverage has stopped, demonstrating the staying power of social media - organic discovery of the studies online can extend their shelf-life in the public consciousness beyond the traditional news cycle.

¹ <https://en.wikipedia.org/wiki/Superflare>

² <https://iopscience.iop.org/article/10.3847/1538-4357/ab14e6/meta>

Superflares in context

Perhaps not surprisingly given the subject matter, mentions of superflares were not a major part of the general online discussions around R&D. We collected ~193,000 tweets between the 3rd of June and the 22nd of July which mentioned research and development related words (see appendix 1 for full list) and of those ~193,000 we only found only 84 tweets that also mentioned superflares. Similarly, discussions around superflares tended not to use generic terms about research; these appeared in only 84 of the 1068 tweets found through a targeted search for superflares across the period (8%).

This highlights an important point in research communications – Tweets relevant to research often do not discuss it explicitly in terms of being R&D, but rather focus often on the content of the findings themselves.

Reactions

Looking across the themes mentioned above, we built an algorithm to classify people's reactions into three categories: positive, negative and neutral.

Reaction	Positive	Negative	Neutral	Total
Number of Tweets	65	275	728	1068
Percentage	6%	26%	68%	100%

An overwhelmingly high proportion – 68% - of reactions to this topic were neutral, suggesting that people were generally content to simply pass on existing commentary on the research without engaging with it personally. This is potentially due to the scientific, impersonal nature of the topic, as well as the literal distance between astronomical research and people's earthly concerns. When emotions are expressed, they tend to be negative, as people often reacted to the potential harms of a superflare indicated in the study.

We found that expressed sentiment broadly fell along the following lines:

Positive

Positive reactions are the minority, making up only 6% of the relevant Twitter discussion. These often focus on the content of the study itself, and tend to be light-hearted, joking and sarcastic, rather than sincere.

Neutral

The majority of the tweets reacted to the study in a neutral way without emotional expression. These tweets often quote directly from an article without much self-processing. The majority either mention the findings in a neutral statement, or pose a question regarding the study without explicit expressions of either positive or negative emotion.

Negative

A significant proportion of the tweets collected present negative reactions towards the study. Such tweets often use dire expressions to describe the effect of a superflare, highlighting 'devastating effects' or 'extremely damage', or focus on the existential risks highlighted in the research in an exaggerated way, warning that superflares could 'cripple humanity' or herald the 'end of the Earth'.

Another much less sizable group of negative reactions treated the study with disbelief, questioning the authenticity of the findings.

Media and Link Sharing

In a minority of cases, users choose to attach media to their tweets - in this case almost exclusively static images. This adds context to their tweets, giving us an idea of how they are imagining the study they are sharing. The images are commonly dramatic images of the sun itself, suggesting that those sharing the otherwise abstract findings of the study focus their communication about it onto physical and relatable aspects of the work.

Provision of images with abstract work will make the research stand out when shared on social media and give readers something to identify with when reading the study. Further, authors themselves providing those images may allow them to somewhat control the perception of their work as it is shared online, e.g. providing more realistic depictions of what might happen.

Types of Tweets	Number of Tweets	Percentage
All	1068	100%
Tweets with Media	138	12.92%
Media Tweets with Photos	137	12.83%
Media Tweets with Gifs	1	0.09%

Some examples of the photos used alongside discussion of superflares include:



A clear majority of the tweets in the dataset, 724 of the 1068 tweets (68%), contained a link to external content. These links led to a diverse selection of content, with the top 5 most shared links including a video by Russia Today and an American capital markets blog. These are seemingly rather unusual outlets to be covering an abstract scientific paper but they shared a common focus on the impact of a superflare on electronic infrastructure.

Focusing on this aspect of the study allows the abstract idea of superflares to be grounded in real-world consequences for the readers of these publications, who appear to take the findings seriously. Russia Today, for example, spent 12 minutes on the topic, including asking a scientist specific questions (notably, “could it just affect part of the planet - like China?”) Providing a clear consequential hook to real-world problems in even the most abstract work can allow it to reach a wider audience.

Top 5 most shared links in the dataset		
Total tweets sharing link	Summary	Sentiment
46	<u>Link to a 12 minute Youtube video by Russia Today America directly discussing the study.</u>	All tweets sharing this link were classified as neutral
46	<u>An Independent article, a British news website, writing up the findings of the study.</u>	Almost all tweets sharing this link were classified as neutral, with 3 negative tweets and 1 positive
33	<u>An American capital markets blog writing up the findings of the study.</u>	All tweets sharing this link were classified as neutral
27	<u>Unknown, link broken.</u>	All tweets sharing this link were classified as neutral
27	<u>The same Independent article as above. The parameters on the URL suggest that those sharing it found it originally by Twitter and have then reshared it on Twitter themselves.</u>	All tweets sharing this link were classified as neutral

The top 10 most mentioned websites were, with the exception of Youtube, a mix of generalist and specialist news websites, rather than links to the academic work itself. Moreover, they were all professional outlets rather than personal blogs, and the Youtube content linked to was generally from corporate accounts, demonstrating the extent to which professional news controls the public engagement with this scientific literature on social media.

Top 10 most shared websites		
Websites	Type of Website	Total number of tweets citing the website
youtube.com	Video Streaming	101
independent.co.uk	British General News	84
on.forbes.com	American Business Publication	43
zerohedge.com	Capital markets finance blog run by ABC	38
onezero.medium.com	Medium's Science Publication	37
space.com	Specialist Science News	25
9news.com.au	Australian General News	25
sciencealert.com	Specialist Science News	23
livescience.com	Specialist Science News	21
express.co.uk	British General News	20

Key Findings

Due to the impersonal nature of the topic, people tended to comment by using the ‘link-sharing’ function of articles with minimum self-processing and personal engagement

It is very common for authors of tweets to directly share a link via articles featuring the study. These tweets either quote the articles without amendments or paraphrase them in a neutral way without sentimental elements.

“Astronomers warn of solar ‘superflare’ that could hit Earth <https://t.co/J8391whXJl> <https://t.co/a9biWUqAHj>”

“Beware the superflare. Research from @CUBoulder shows that Earth’s sun could produce a potentially catastrophic “superflare” in the next several thousand years. <https://t.co/AYf9FIdjQo> via More in the #Sun at @sim_manchester <https://t.co/jQBPv9ffZZ>”

Often these quotes contained dramatic or sarcastic language, giving the impression that the author of the tweet shares this emotion:

“End of the world: Solar ‘superflare’ forecast with power to destroy civilisation <https://t.co/Plm21Hu8Lb><https://t.co/GjD9GVAdP9>”

Sarcasm is very often used by people to contextualise distant subjects, bringing research closer to their everyday life.

Sarcasm and jokes are a common theme among the ‘self-written’ tweets, with people using this tactic to respond to the impersonal and abstract topic. Sarcastic expressions made reference to people’s real-life experience, turning ‘superflares’ into a relevant and approachable subject. Feelings expressed are mostly negative.

“In case you needed something else to worry about at night. <https://t.co/l4JOeTFxlo>”

“Every day under #tRump feels like a catastrophic natural disaster. 🤖 <https://t.co/zZGPNr1MLA>”

In response to the negative impacts of a potential ‘superflare’, concerns and worries are very often expressed.

Expressions of concern is another common theme among the ‘self-written’ tweets; i.e. those which do not quote directly from an article. Unsurprisingly, people find the idea of the earth being attacked by a superflare from the Sun worrying or even frightening.

“One of the most troubling things we will see happen, but this would also stop a lot of whats causing climate change, us. A massive CME like described would put us back to the stone ages. <https://t.co/5AETkZ9aAP>”

The findings of the study were often seen as surreal, inviting responses of disbelief.

A minor theme among the ‘self-written’ tweets involves expressing disbelief. These tweets often treat the study with contempt, accuse news organisations of ‘fearmongering’, or point out perceived insufficiencies in the research.

“Get this rubbish out of my GOOGLE NEWS APP 🤖🤖 #FEARmon <https://t.co/jZXVzFusRr> via @GoogleNews”

“@Medium Case in point, from section 6.3. We don’t even have the theory of superflares developed enough to justify a claim the Sun could develop a superflare in the next hundred million years, let alone the next hundred years. <https://t.co/M8ROIMfsjW>”

Some tweets went further to question the motive for the study, alleging it to be a tactic for collecting funding.

"Huge 'superflare' could be hurled out of the Sun and threaten Earth, scientists warn <https://t.co/27xNpt6T3h> - No doubt they will now be looking for some mug for funding to try to find ways of mitigating the effects. Nice work if you can get it!"

Due to the scientific nature of the topic, a trustworthy source and authoritative ways of expression are important for drawing people's attention

Scientific authority in both the source and content of the tweets was an important factor in determining the attention a tweet received. The top two most liked and retweeted tweets were both sent by Science News:

'By comparing superflare frequencies with star age, the scientists predict that the roughly 4.6-billion-year-old sun might experience a superflare 100 times as strong as normal flares in the next 1,000 years' (194 likes, 65 retweets)

'A superflare 100 times as strong as normal flares would likely be extremely damaging to society on Earth. <https://t.co/sKKQVsxZd>'. (114 likes, 46 retweets)

The account @ScienceNews, who tend to tweet with an air of expertise and authority, stood out as being more appealing than other scientific accounts. This account neutrally described the research findings in scientific terms with some details on how the findings were arrived at. Explicit reference to scientific expertise - 'scientists predict' - was present.

This language contributes to raising the trustworthiness of the tweets. Compare them with the following tweet from Nine News Melbourne, which generates significant fewer likes and retweets:

'Earth's sun could produce a massive superflare in the next 100 years that could wipe out all technology on Earth. #9News' (12 likes, 2 retweets)

It points to a rather negative and extreme prediction, 'wipe out all technology', without referring to any scientific proof. A lack of authoritativeness makes it less likely to be taken seriously by the readers.

Conclusion

The brief study above shines some light onto how people react to a topic which they have likely recently been introduced to, which draws on a single piece of technical research, and which poses a vague but ominous existential threat. We found that, when faced with a subject on which they were unable to draw on personal experience, many people reached for other sources of expertise, either quoting directly from articles or sharing messages from sources which presented themselves as authoritative, neutral and scientifically convincing.

Notably, a number of people responded to this glimpse of the unknown by turning to sarcasm and dark humour or attacking media outlets who published shared it for stirring fear in the populace. This speaks directly to the often impossible task of framing journalistic responses to research, especially when this research is abstract, and the level of general knowledge around it is low.