

14 days ago

Understanding gamma-ray flares in the Crab Nebula

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By  [astronomyjc](#) with    

The transcript for the 23rd meeting of the astronomy twitter journal club. We were discussing Extreme particle acceleration in magnetic reconnection layers. Application to the gamma-ray flares in the Crab Nebula (Cerutti et al. 2012, <http://arxiv.org/abs/1110.0557>)



Evening all and welcome to the 23rd [#astrojc](#) meeting. This is on extreme particle acc'n in magnetic reconnection layers in the Crab nebula.

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You can grab the paper at <http://t.co/eKQfJgre> [#astrojc](#)

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The rest of the tweets from this [#astrojc](#) will come from [@chrisarridge](#) who will be hosting this meeting.

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Evening [#astrojc](#) folks - anyone around? [#astrojc](#)

chrisarridge 18 days ago



Yep, reading the abstract and being puzzled [#astrojc](#)

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Too much relativistic particle acceleration for a Thursday night? :-p [#astrojc](#) [#astrojc](#)

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[@ivbemmel](#) Is this your specific area of research? Or a little off-piste? [#astrojc](#)

chrisarridge 18 days ago



Majority of my work doesn't involve such highly relativistic environments but a lot of the mathematical development is familiar. [#astrojc](#)

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Sorry, this topic is way out of my comfort zone [#astrojc](#)

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I work on AGN but the low energy bits [#LOFAR](#) stuff [#astrojc](#)

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[@ivbemmel](#) the first sections (particularly 3-4) were quite heavy IMHO but the apps stuff in



section 6 was quite accessible. [#astrojc](#)

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[@ivbemmel](#) The electrons I usually study observationally are ~ 1 keV - not used to such large Lorentz factors! [#astrojc](#)

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[@ivbemmel](#) They do actually propose that their mechanism could be at work in AGN jets (penultimate paragraph of §7). [#astrojc](#)

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It sounds interesting, lack of time today though. Was hoping to tune in and hear the experts discuss, but it's quiet... [#astrojc](#)

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[@ivbemmel](#) In my view the biggest problem is that the mechanism requires pre-acceleration to work. [#astrojc](#)

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[@ivbemmel](#) Seems to be a familiar issue in astro/plasma physics. Lots of ways of generating high E particles- all need pre-accn mech [#astrojc](#)

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Do they not explain where or how pre-acceleration would occur? [#astrojc](#)

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Discussing particle acceleration in magnetic reconnection regions in the Crab Nebula. How to get e^-/e^+ to $\gamma \sim 1e6$ in first place. [#astrojc](#)

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[@ivbemmel](#) No- start with a population between $\gamma \sim 1e6$ and $1e9$ and all end up with $\gamma \sim 1-3e9$. [#astrojc](#)

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[@ivbemmel](#) I suppose it's fine as an assumption - but still need a way to get them that energetic. [#astrojc](#)

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[@chrisarridge](#) Sorry, bit late. What sort of gamma would e^-/e^+ have if they were responsible for the quiet-time emission? [#astrojc](#)

a_p_walsh 18 days ago



Do they discuss any link with the low frequency events, e.g. giant pulses? [#astrojc](#)

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[@ivbemmel](#) They do mention that there are no lower energy emissions - but can't find the



bit in the paper. [#astrojc](#)

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[@a_p_walsh](#) Just trying to find that spot in the paper. Do mention it. [#astrojc](#)

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[@a_p_walsh](#) They say ultrarelativistic but don't specify a gamma associated with that. [#astrojc](#)

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[@ivbemmel](#) There are some related observational papers showing spatial structure at other wavelengths. [#astrojc](#)

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[@ivbemmel](#) Out of interest - is this mathematically similar to the sort of papers in ApJ that you might read? [#astrojc](#)

chrisarridge 18 days ago



[@chrisarridge](#) Ah. I guess if it was high enough to explain the pre-acceleration they would mention it specifically. [#astrojc](#)

a_p_walsh 18 days ago



[@ivbemmel](#) are the mechanisms associated with giant pulses well understood? [#astrojc](#)

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[@chrisarridge](#) I generally try to stay away from math :-)) usually read phenomenological papers, but like to learn new stuff [#astrojc](#)

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[@a_p_walsh](#) [@ivbemmel](#) Problem with particle acceleration models as I see it is that they operate over specific energy ranges. [#astrojc](#)

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[@a_p_walsh](#) [@ivbemmel](#) Separate accn models then need sticking together in different scenarios. [#astrojc](#)

chrisarridge 18 days ago



[#astrojc](#) I have to go, small kid crisis upstairs... (work at home is not all its made up to be) Thx!

ivbemmel 18 days ago



RT [@ivbemmel](#) [@chrisarridge](#) no. As far as I know giant pulses are a riddle still. [#astrojc](#)

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[@ivbemmel](#) No problem - thanks for joining! [#astrojc](#)



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Last 20 minutes discussing gamma-ray flares in the Crab Nebula. Where might the acceleration region lie? [#astrojc](#)

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[@chrisarridge](#) [@ivbemmel](#) Not always appropriate, true, but can some processes only accelerate to a certain energy. (1/2) [#astrojc](#)

a_p_walsh 18 days ago



[@chrisarridge](#) [@ivbemmel](#) Nothing to say further acceleration can't then happen via something else. Not always smooth acceleration. [#astrojc](#)

a_p_walsh 18 days ago



[@a_p_walsh](#) Agree completely. Think need an integrated system to solve the "problem" of astrophysical particle acceleration tho. [#astrojc](#)

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Is it a valid criticism of a paper like this if it assumes the existence of a population of pre-accelerated particles? [#astrojc](#)

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My view is that it isn't - as long as there is some mechanism that can provide such a population. [#astrojc](#)

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Or should I say it isn't a deal-breaker. [#astrojc](#)

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[@chrisarridge](#) quick dive in. Some accn restricted to E range due to resonance conditions required for wave-e interaction [#astrojc](#)

stpkav 18 days ago



[@chrisarridge](#) I'm not sure where it would come from - nonadiabatic acceleration is energy-dependant by definition, for example. [#astrojc](#)

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[@a_p_walsh](#) plus need right frequency range for doppler shifted resonance. Swich, of course is only one mechanism... [#astrojc](#)

stpkav 18 days ago



[@stpkav](#) [@a_p_walsh](#) absolutely. But some ppl criticise studies which only work over some energy ranges. [#astrojc](#)

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[@stpkav](#) [@a_p_walsh](#) Do you think that's a valid critique? [#astrojc](#)



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[@chrisarridge](#) In this case it's one assumption amongst many, assumed velocity profile as source of E is bigger difficulty for me. [#astrojc](#)

a_p_walsh 18 days ago



[@a_p_walsh](#) You mean the power-law they assume? [#astrojc](#)

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This brings us to the natural end of this week's [#astrojc](#). Thanks to all who contributed!

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[@chrisarridge](#) [@stpkav](#) Sometimes it is. Not necessarily the most important thing to fix though- depends on the circumstances. [#astrojc](#)

a_p_walsh 18 days ago



[@a_p_walsh](#) I think it's important to justify that assumption by saying that there are ways to generate that source pop. [#astrojc](#)

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[@a_p_walsh](#) Often don't have in situ observations - f.x., not clear what source pop for 50 keV ions is. [#astrojc](#)

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[#ff](#) [#astrojc](#) guest host [@chrisarridge](#) Thanks for running things yesterday.

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