Dmitri Krioukov (2012), *The proof of innocence,* arXiv:1204.0162

The article can be accessed at https://arxiv.org/abs/1204.0162 (you just need to click the PDF button in the download section). The paper is also available from the *Annals of Improbable Research* where you can find a whole host of other… interesting research.

You can also download the Cornell notes template for this paper (which includes the same questions) as a Word Document or PDF. Teachers, feel free to download this and forward it on to your students.

This week we're looking at a slightly more theoretical paper, but another paper where scientists show off their award winning sense of humour. We've discussed the arXiv in previous weeks, so this article has not gone through a thorough peer review. The reason for that, in this case, is that the author is not coming up with any new ideas, just using basic physics ideas to try and get out of paying a fine for a traffic violation in America.

As you've not encountered some of the maths ideas yet, we're going to practice the art of 'not worrying too much about it'. We're going to accept that some of the maths doesn't make total sense to us and when we read it, we might skim over it. But the graphs should still make sense and this should tell most of the story for us. We've made this applet to illustrate dynamically the two situations that the author describes. You can alter the acceleration of the car and the distance away the observer is to see (from the arrows) how the angular speed changes.

We're also going to progress a little more with our notetaking. We won't provide any prompts during your reading, you can write these yourself. Do try and stick with the Cornell note style, even if its brief handwritten notes – we know some of you have been doing it by hand the whole time and it's how I prefer to note-take too. We're just going to give summary questions for each section.

We've also provided a second article – in the further reading section – that is short and on a completely different topic, just in case you feel lost in this paper and want to practice your note taking on something else. It's completely understandable that this first paper might feel difficult at your stage in education, so don't worry at all if you get stuck.

I. INTRODUCTION

Why does a stationary observer not measure the speed of an object?	
What scenarios is the author going to consider?	

In the next section, the author will choose to use the point when the car is at the stop sign (when C is at S) as the origin of time – the point when $t = 0s$. Dealing with negative time is always a little confusing, but importantly for the argument running through this paper, all of the scenarios will be in some sense symmetrical about $t = 0s$. You can understand all of the maths by simply considering positive values for time (and this is sometimes beneficial).

II. CONSTANT LINEAR SPEED

This link gives an example of how I would take notes and convince myself of all the steps in the working out through a paper. I'm annotating all of the steps, clarifying *why* things are the way they are and filling in the intermediate steps to check the maths. Again, this involves all of the details of the maths – we don't expect you to understand it, or even recognise it yet, but the words between the steps should highlight what is going on.

Describe the graph shown in Figure 2. Link it to what is physically happening in the example of the car moving at a constant speed.	.

III. CONSTANT LINEAR DECELERATION AND ACCELERATION

Remember, we have made this applet to help you visualise the difference in motion.

Describe the graph shown in Figure 3. Link it to what is physically happening in the example of decelerating/accelerating car.	.

IV. BRIEF OBSTRUCTION OF VIEW AROUND $t = 0s$

Remember, we have made this applet to help you visualise the difference in motion.

What are x_f and x_p?	
What is the biggest assumption made in this section?	
What is the time t'?	

What conclusion does the author draw from the fact that $t_p > t'$?	

V. CONCLUSION

Describe how the three bullet points in the conclusion link to Figure 5.	

SUMMARY QUESTIONS (submit these, along with your SKIM-READ answers to thomas.millichamp@warwick.ac.uk)

Explain why an object moving at a constant speed does not necessarily appear that way to an observer as it moves towards, past and then away from a stationary observer.

In a similar way to my notes for section II. Constant Linear Speed, send in your notes on how you arrived at the solution for section III. Constant Linear Deceleration And Acceleration. You can submit this as a photo of your hand-written notes if that's easier – however suits you best.

As budding physicists, do you think that this paper presents an adequate defence for the author's position that he did actually stop at the stop sign?

FURTHER READING

This week, we don't have further reading tied to the topic, just a completely separate (and short) article from Physics Today entitled *Transportable clocks achieve atomic precision* about using portable atomic clocks to measure gravitational redshift. This is an excellent opportunity to practice writing your own skim-read and summary questions. Feel free to send in your work!