Colour Magnitude Diagrams of Transiting Exoplanets III

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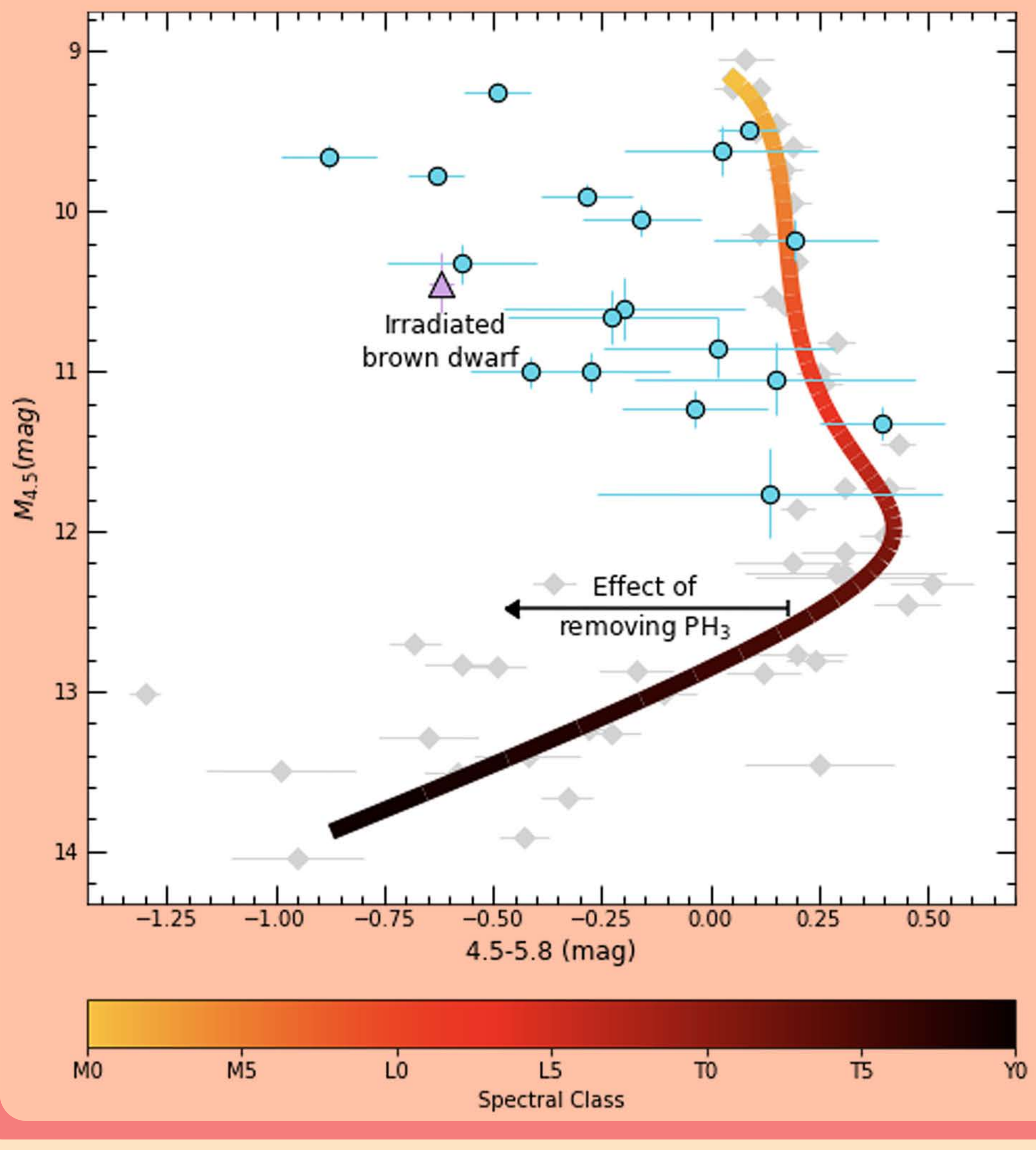
In all our plots planets are represented by circles in the foreground, while brown dwarfs are diamonds in the bacground.

Why are exoplanets so much bluer than brown dwarfs in [4.5-5.8]?



One key difference between hot Jupiters and ultra-cool dwarfs is irradiation: the brown dwarfs tend to be isolated while the planets are subjected to high levels of irradiation. However, WD01037-349B, an irradiated brown dwarf, sits with the hot Jupiters in this plot. We therefore propose that Phosphine could be responsible for the colour difference.

PHOSPHINE:

* Is highly susceptible to photolysis

* Absorbs strongly in the 4.5 µm band

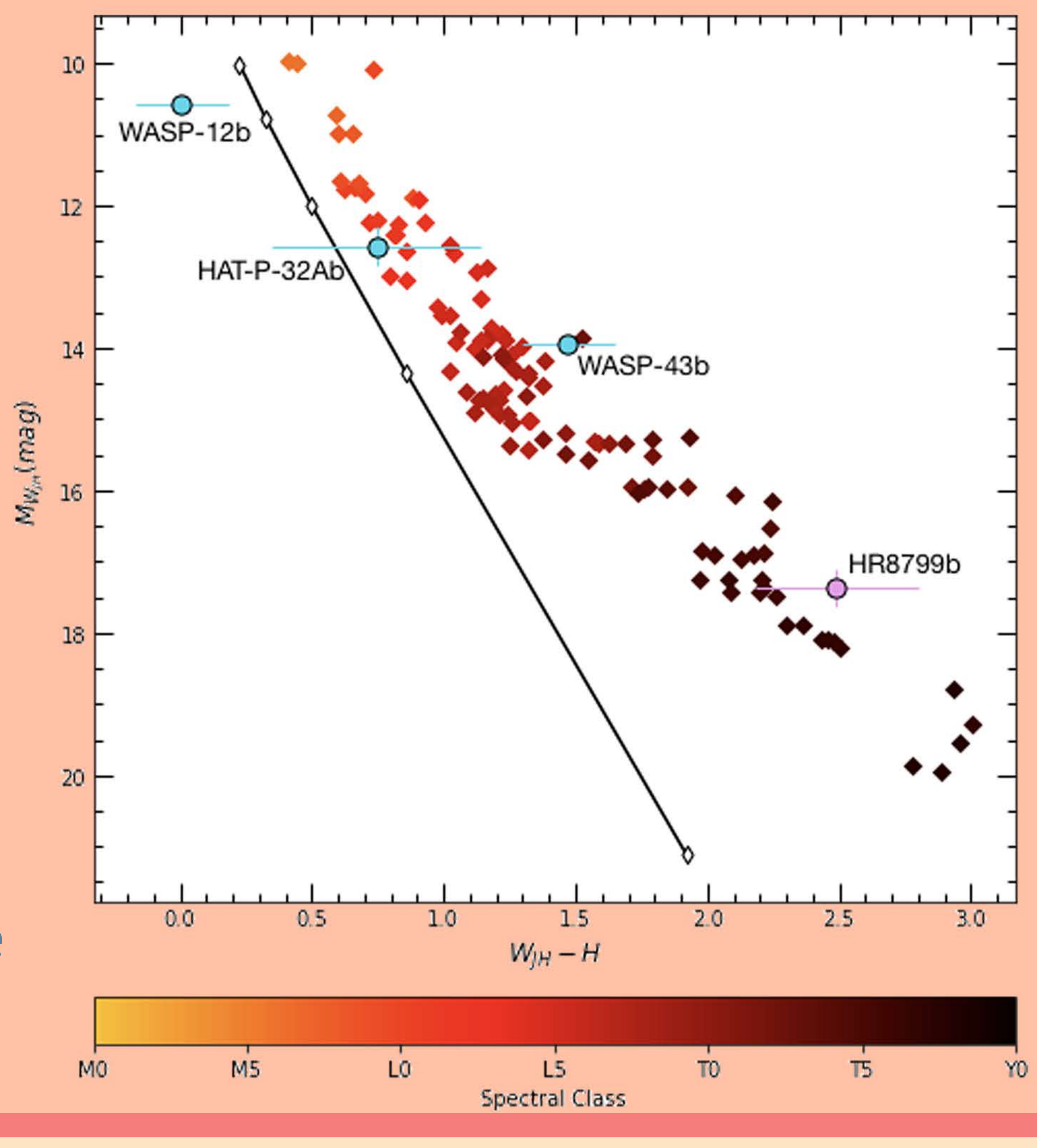
* Is likely to be present in the atmospheres of mid-L and T dwarfs.

WASP-12b has been troubling people for years...

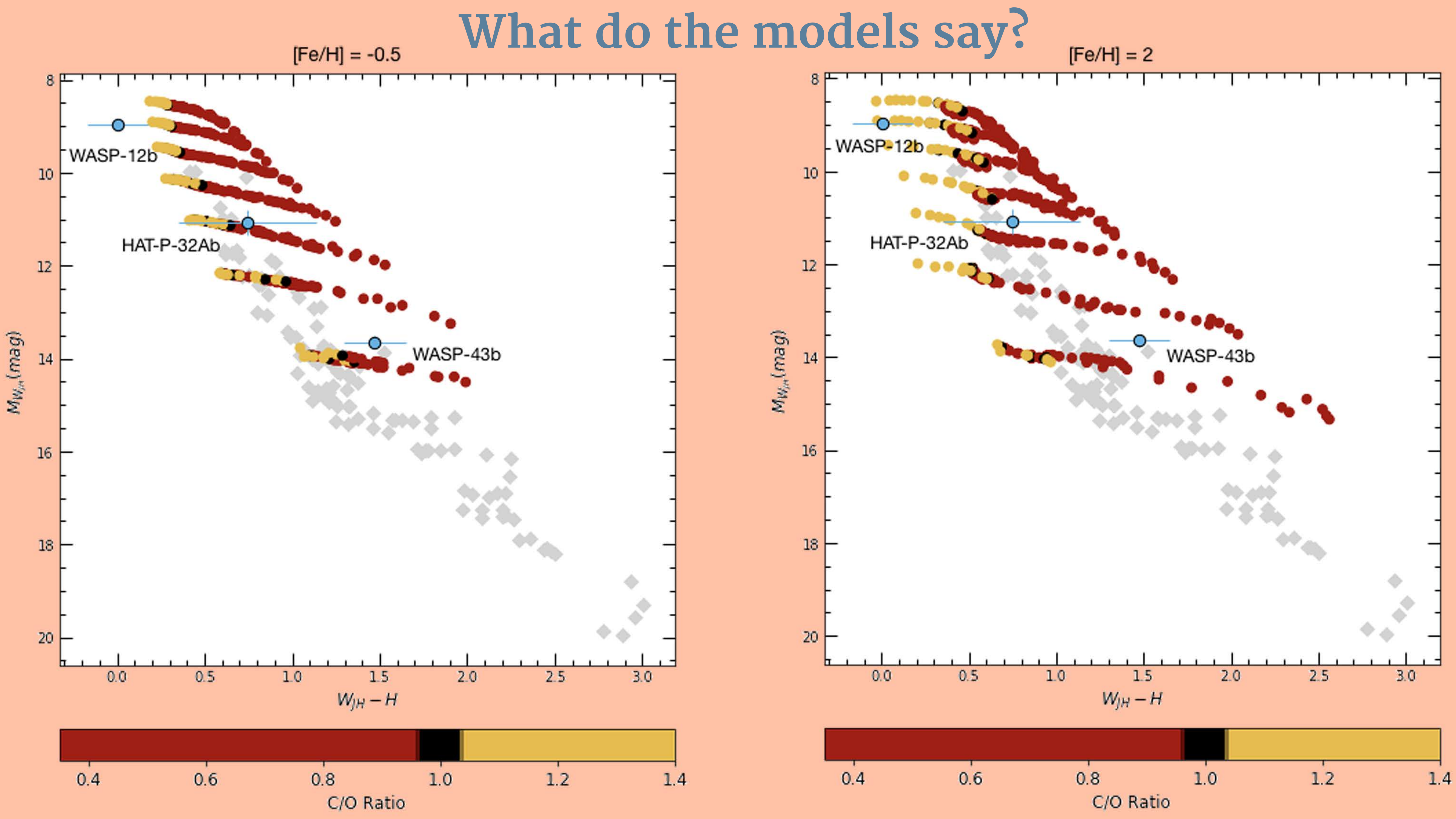
The W_{JH} band is a new photometric band we made by cutting the HST WFC3 G141 grism to make a band centred on the 1.4 µm water absorption feature.

In the plot to the right we can see that WASP-12b stands out in colour from the brown dwarfs *and* the other planets. WASP-12b is a well studied yet controversial planet, with claims of thermal inversions and a carbon-rich atmosphere to explain its puzzling measurements.

We used Molliere's model planetary spectra to explain the possible physical significance of the $[W_{JH}-H]$ colour index.



What do the models say?



The black, red and yellow circles here are model planetary spectra. These plots allow us to see that this colour is highly influenced by by the C/O ratio.
For all valuesof logg and metallicity, WASP-12b appears consistent with a carbon-rich atmosphere, while WASP-43b is consistent with an oxygen-rich atmosphere.
Being able to use a colour-magnitude diagram to get a quick upper limit on the C/O ratio will be vital for target selection for follow-up in future missions like Ariel & JWST.

Get in touch to chat about colour-magnitude diagrams!
Email me at gxg831@bham.ac.uk
or... read my full paper: https://arxiv.org/abs/2008.00995