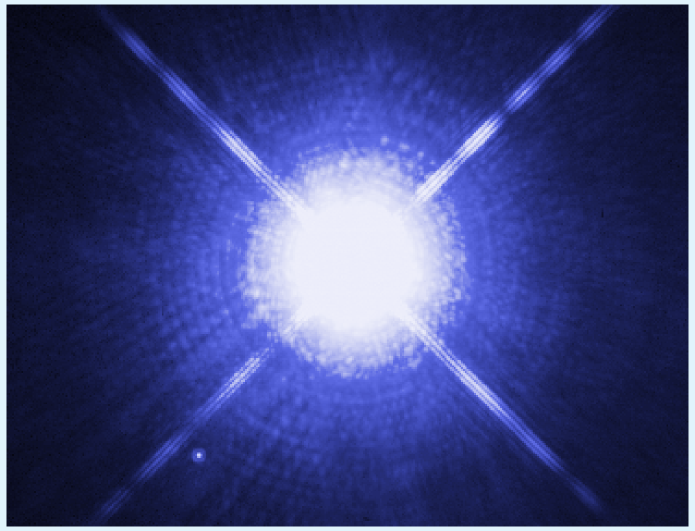


Sirius B is the small dot on the bottom left. It is dwarfed by its massive companion Sirius A (Bond H.E. Journal of Physics conference series, 2009)

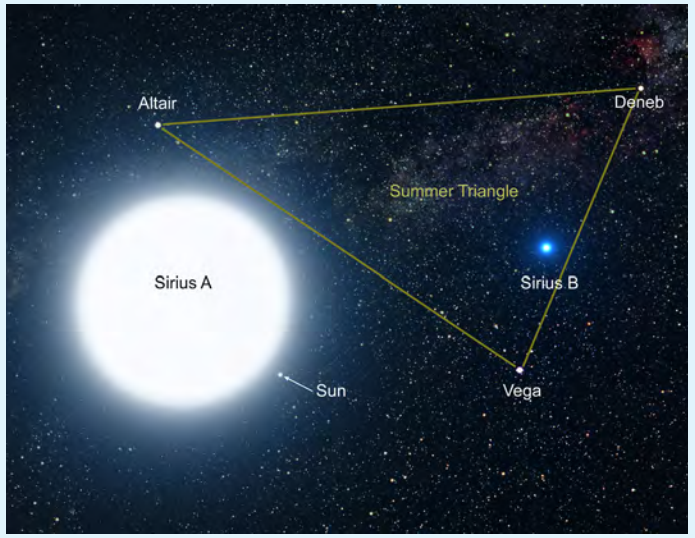
Shifting focus

Sirius B now provides an excellent opportunity for scientific study. A key part of our work is the measurement of the mass of Sirius B along with several other white dwarfs. They provide an opportunity to test theories such as general relativity and quantum mechanics. The best method to test these theories is to determine if they can provide correct predictions in extreme conditions – such as the high density environment of a white dwarf. For example, quantum mechanics predicts that white dwarfs should have some very strange behaviour. Normal stars and planets are bigger the more matter they have. But with white dwarfs, the more matter they have, the smaller they are. This is exactly what we see. Sirius B is a high-mass white dwarf, but it is actually much smaller than low mass white dwarfs.

> “A key part of our work is the measurement of the mass of Sirius B… to test theories such as general relativity and quantum mechanics”

> “White dwarfs are a glimpse into our solar system’s future”

Despite the vast improvement in telescopes since the time of Bessel, observations of white dwarfs remain a challenge. I am using observations of Sirius B and other white dwarfs taken with the Hubble Space Telescope. The HST is a huge improvement over the instruments available to Bessel. Nevertheless, a large part of my work is focused on understanding the systematic problems which can affect the results. For example, the motion of the HST as it orbits the Earth introduces a shift in the wavelength of the measured light and I had to develop a method for removing this shift from the data. I was then able to calculate the mass of Sirius B using the spectroscopic or the gravitational red-shift method (see box). Our collaborators are using a third method called astrometry to measure the orbit and then derive the mass. We have found that our measurements of the mass of Sirius B made using the three different methods do not exactly match. This may indicate another missing piece in our understanding of physics, or in our understanding of the methods involved in making the measurements. Either way, finding the solution could prove to have important implications for the way we study stars and may even alter our view of the universe once again.



Artist impression of how the Sun would appear to an observer in the Sirius system

Three ways to weigh a star

Spectroscopic

When we observe the spectrum of a white dwarf we see dark lines caused by the absorption of certain wavelengths of light in the atmosphere of the star. Its a bit like shining a torch through a cloud. The shape and depth of these dark lines depends on the mass of the white dwarf.

Gravitational red-shift

The same absorption lines used in the spectroscopic method also get shifted to longer wavelengths by the gravity of the white dwarf. This is equivalent to the Doppler effect where soundwaves change to lower pitch as an ambulance drives away from us. The stronger the gravity, the more the lines are shifted. So if we measure how much the lines are shifted, we can calculate what mass and radius the white dwarf must have to cause that shift.

Astrometric

Sirius A and B are in a binary and they orbit around each other once every 50 years. Careful observations over the last 150 years have allowed us to calculate what mass the two stars must have to produce the observed orbit.

Simon Joyce is a 2nd year PhD student in the Department of Physics & Astronomy. His work on white dwarfs is done in collaboration with Martin Barstow and Sarah Casewell (University of Leicester), Jay Holberg (University of Arizona) and Howard Bond (Pennsylvania State University).

My life as a part-time PhD researcher in Law

Undertaking a PhD is tough work. Now imagine studying part-time whilst living across the Atlantic Ocean and running your own legal firm. Law PhD student Marcelo Henrique Lapolla Andrade writes how he handles these conditions and how his research can improve the legal system in Brazil.

I started my PhD in Leicester back in 2015. After a thorough search for schools that allow part-time distance learning, I found that the University of Leicester had it all: a programme designed for distance learners; a great reputation in law with highly respected academic staff, the pleasant environment of the city; the courteous citizens, and not to mention the best football team in the country! These aspects all convinced me that I had made the right decision.

Climbing the academic ladder

Prior to starting this PhD, I had recently finished my Masters at Mackenzie Presbyterian University in Brazil, which focused on antitrust law – regulations on the conduct of companies regarding fair competition for consumers – and earned a separate postgraduate Master of Laws (LLM) degree on U.S. Law at Washington University in St. Louis, United States. Thus, aiming for a higher degree in the United Kingdom – with its old and widely respected legal system – was not only my dream, but also a natural step in terms of my educational development.

Since I started the program, I have visited the campus twice; to attend the graduate conference and to take part in training sessions. Being on campus is always a great opportunity to use the library facilities and to meet my supervisors in person – though our online meetings have proven to be quite productive and made me confident that the distance will not be an issue that will affect my research.

A working knowledge

Alongside the difficulty of studying for my PhD at a distance, my professional life is very busy here in Brazil. I own a law firm with over 100 employees. As such, finding a practical research topic would make my efforts in taking on a PhD twice as useful; for myself and for Brazilian legislation. It was in handling my clients’ interests and problems that I identified what I believed to be a gap in our legal system; the absence of a specific provision in current Brazilian legislation regulating one’s duty to mitigate another party’s losses, known worldwide as the ‘mitigation doctrine’.

The basic idea of the mitigation doctrine is simple; you must take reasonable steps to limit your losses even if they were caused by another. For example, if a supplier of bricks fails to deliver the bricks to a construction company on the date agreed in their contract, the construction company must take reasonable steps to limit the losses caused by the late delivery – by perhaps obtaining bricks from a different supplier and/or assigning other tasks to its employees so that they do not sit idly while being paid. The practical effect of this is that a court will refuse to order the brick supplier to compensate any loss that the construction company could have avoided through taking reasonable steps. The doctrine is usually supported by reference to notions of good faith and economic efficiency in the use of resources.

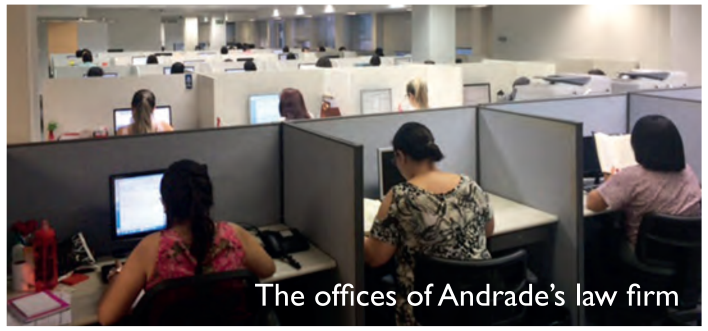
> “Finding a practical research topic would make my efforts in taking on a PhD twice as useful: for myself and for Brazilian legislation”

Shedding light on Brazilian law

Building on this background, the first goal of my thesis is to compare the mitigation doctrine to various existing principles of Brazilian law which can affect the compensation of losses. Here I aim to demonstrate that the existing principles leave significant gaps in the law. The second goal is to research how other jurisdictions have filled these gaps by developing a mitigation doctrine and to investigate how they apply this doctrine to law. Finally, as the conclusion, I will come up with a proposal for the most adequate provision to be added to the Brazillian legal framework.

So far, I am very happy with the support I am getting from the University. This includes the IT team, various staff across the university and – of course – my supervisors. I am doing my best to enjoy every single moment of it and working really hard to achieve something I will be very proud of.

Marcelo Henrique Lapolla Andrade is a PhD student studying Commercial Law at the Leicester Law School in the University of Leicester..



The offices of Andrade’s law firm