Bringing astronomy down to earth

Analysing starlight seems about as far removed from solving problems here on earth as it’s possible to get. ‘Astronomical spectroscopy is a long way ahead of applicability,’ admits UCL’s Professor Jonathan Tennyson. ‘I’m a blue-sky physicist. And yet my work has more subtle applications than you might imagine.’

One focus is on what Tennyson calls ‘very hot water’ – very hot indeed. The fusion process that powers stars leads either to a carbon – or an oxygen-rich solar environment. Water vapour arises in the latter case when oxygen combines with the star’s hydrogen. Researchers at UCL have identified water not only in these oxygen-rich stars and in comets, but also in planets beyond our solar system, unknown when they began the research. To their surprise, they also found it around carbon stars, a finding which overturned previous assumptions about the relative abundance of the two elements.

The research turns out to have relevance to terrestrial problems as well. The water spectra can be used for the early detection of forest fires, for example. Connections like these underline the value of theoretical physics. ‘Our latest list has 500 million water spectral lines. You couldn’t hope to measure them all. So I’d argue the only way forward is to build a really robust theoretical model,’ says Tennyson.

Although his own work involves the fundamental quantum mechanics that govern molecular interactions, Tennyson tries to pick problems where his contribution might have practical use. One application where it is especially important to know about these collisions is in the plasma etching processes used to make integrated circuits. ‘The etching industry is based on empiricism – it’s like cooking.’ Manufacturing tends to rely on chef-like skill as much as science. Yet it is hugely expensive. ‘So it’s clear that if you can gain an insight into where to go on theoretical grounds, you can make real progress.’

Tennyson now leads a project, which aims, using a computer program, to model what happens in processes involving electron collisions with gas phase molecules. It is available as freeware on his website, but with Dan Brown, ‘entrepreneur in residence’ at UCL’s Computer Science Department, he has also set up a company, Quantemol. With funding from NESTA, Quantemol has developed an expert system to run the code for commercial clients.

One company that recognized the superiority of Tennyson’s modelling is Surface Technology Systems (now SPTS), which used the program in its own, manufacturing and has worked with Tennyson on subsequent versions, which are being developed with help from UCL Business. Leslie Lea, formerly chief scientist at STS, found Tennyson ‘the stereotypical professor in that he was very excited about the work’ but also ‘good at recognizing where an idea can be used in a different field.’
About Research Collaborations & Studentships

UCL is recognized as a research powerhouse; our research ranges across all disciplinary areas, from fundamental biological research that develops our understanding of the nature of life, or from philosophical discourse, through applied engineering and biochemical manufacturing, to clinical practice and drug discovery.

UCL establishes collaborative research partnerships with charities, commerce and industry to enable the impact of our research to be widened and deepened, to benefit the global community and deliver social and economic benefit to the UK.

Postgraduate research students are essential to the development of the research base, the future academic community and researchers in business and industry. UCL’s innovative PhD programmes also provide excellent opportunities for collaborative research activity with external organisations.

About Spin-outs

UCL Business (UCLB) has a long and successful track record in creating some of the most successful spin-out businesses in key new industries. From discovery disclosure to commercialisation strategy, business plan development, contractual advice and formalisation, and through to incubation support, including the recruitment of management teams and identification of investors, UCLB’s services cover the entire process.

About UCL

UCL (University College London) was established in 1826 and is ranked as one of the world’s top-ten universities. The university is a modern, outward-looking institution, with more than 4,000 academic and research staff committed to engaging with the major issues of our times. It has a global reach, with 34% of its students coming from outside the UK, from almost 140 countries.

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About UCL Business

UCL Business PLC (UCLB) is a leading technology transfer company, which supports and commercialises research and innovations arising from UCL, one of the UK’s leading research-led universities. UCLB has a successful track record and strong reputation for identifying and protecting promising new technologies and innovations from UCL academics. It invests directly in development projects to maximise the potential of the research and manages the commercialisation process of technologies from the laboratory to be market ready. UCLB supports UCL’s Grand Challenges of increasing UCL’s positive impact on and contribution to Global Health, Sustainable Cities, Intercultural Interaction and Human Wellbeing.

UCL Business is affiliated with UCL Enterprise, which provides UCL’s structures for engaging with business for commercial and societal benefit.

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