【系所領航】物理系教師薛宏中潘璽安 研究成果登上國際重要期刊

學習新視界

【記者黃柔蓁淡水校園報導】物理系教師發表兩份重要國際期刊研究成果，教授薛宏中與應用科學博二許誌恩、物理碩二許詠甯的論文「Efficient light upconversion via resonant exciton-exciton annihilation of dark excitons in few-layer transition metal dichalcogenides」，3月刊登於《Nature Communications》，影響因子14.7，為目前科學發現重要成果的期刊之一；助理教授潘璽安為第一作者的「SDSS-IV MaNGA: Spatial Evolution of Gas-phase Metallicity Changes Induced by Galaxy Interactions（星系互擾所誘發之氣態金屬元素的空間分布變化）」，4月2日刊登於《The Astrophysical Journal》天文物理期刊。系主任莊程豪表示，該期刊已出刊30年，為天文領域的Q1期刊，2023年影響因子4.8，展現物理系在理論與觀測研究領域的發展成果。

薛宏中表示，該論文探討過渡金屬二硫族化合物（TMDs）材料中的電子激發態特性，研究團隊專注於奈米材料TMDs的電子與光學特性，這類材料具備應用於次世代光電與量子元件的潛力。團隊成功預測材料在激發態下的電子交互作用與能帶結構變化，為未來材料設計與半導體開發提供理論依據。他說，研究成果顯示，本校在計算物理與量子材料領域具備相當競爭力，也將持續提供學生參與尖端研究的機會。

潘璽安的論文則針對星系碰撞現象進行分析，探討當星系互相靠近或合併時，氣體與金屬元素在星系中的流動與變化。研究資料來自大型天文巡天觀測計畫 MaNGA，詳細觀測數百個鄰近星系。結果顯示，星系中心會因低金屬含量的氣體流入而產生金屬稀釋現象，隨後恆星生成會釋放新金屬，使金屬含量回升。該研究進一步說明，星系演化的多樣性與複雜性，對理解宇宙的形成與發展具有重要意義。

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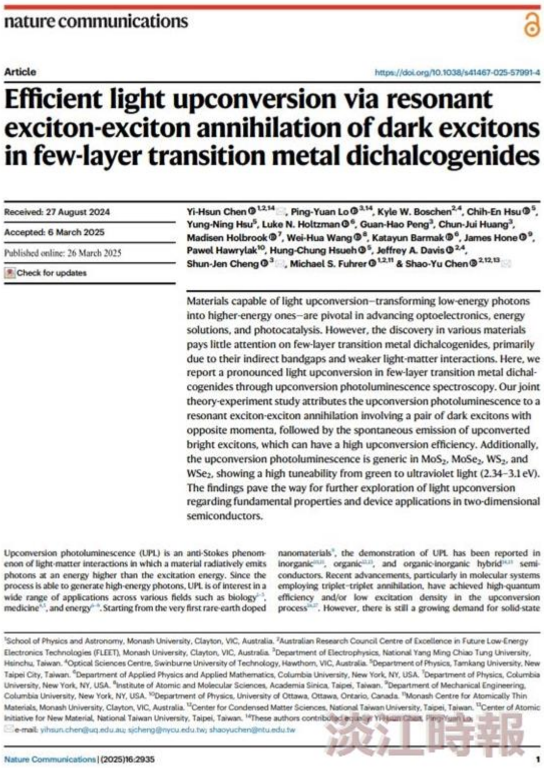
物理系教授薛宏中與應用科學博二許誌恩、物理碩二許詠甯發表論文刊登《Nature Communications》。（圖／物理系提供）



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Efficient light upconversion via resonant exciton-exciton annihilation of dark excitons in few-layer transition metal dichalcogenides

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Materials capable of light upconversion—transforming low-energy photons into higher-energy ones—are pivotal in advancing optoelectronics, energy solutions, and photocatalysis. However, the discovery in various materials pays little attention on few-layer transition metal dichalcogenides, primarily due to their indirect bandgaps and weaker light-matter interactions. Here, we report a pronounced light upconversion in few-layer transition metal dichalcogenides through upconversion photoluminescence spectroscopy. Our joint theory-experiment study attributes the upconversion photoluminescence to a resonant exciton-exciton annihilation involving a pair of dark excitons with opposite momenta, followed by the spontaneous emission of upconverted bright excitons, which can have a high upconversion efficiency. Additionally, the upconversion photoluminescence is generic in MoS_2, $MoSe_2$, WS_2, and WSe_2, showing a high tuneability from green to ultraviolet light (2.34–3.1 eV). The findings pave the way for further exploration of light upconversion regarding fundamental properties and device applications in two-dimensional semiconductors.

Upconversion photoluminescence (UPL) is an anti-Stokes phenomenon of light-matter interactions in which a material radiatively emits photons at an energy higher than the excitation energy. Since the process is able to generate high-energy photons, UPL is of interest in a wide range of applications across various fields such as biology[1–3], medicine[4,5], and energy[6–8]. Starting from the very first rare-earth doped nanomaterials[9], the demonstration of UPL has been reported in inorganic[10,11], organic[12,13], and organic-inorganic hybrid[14,15] semiconductors. Recent advancements, particularly in molecular systems employing triplet–triplet annihilation, have achieved high-quantum efficiency and/or low excitation density in the upconversion process[16,17]. However, there is still a growing demand for solid-state

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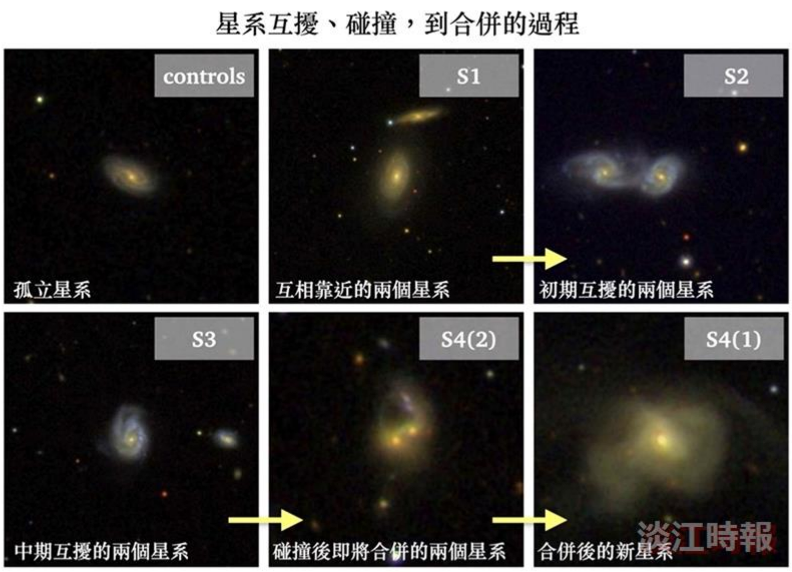

物理系助理教授潘璽安刊登於《The Astrophysical Journal》天文物理期刊，呈現星系互擾、碰撞，到合併的過程。（圖／物理系提供）