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物理Physics

Observation of Kardar-Parisi-Zhang universal scaling in two dimensions

二维体系中Kardar-Parisi-Zhang普适标度行为的观测

▲ 作者：Simon Widmann, Siddhartha Dam et al.

▲链接：

https://www.science.org/doi/10.1126/science.aeb4154

▲摘要：

物质的平衡态与非平衡态表现呈现出完全不同的行为。一个关键范例是二维空间中的Kardar-Parisi-Zhang（KPZ）普适类，其中微观尺度上偏离平衡态的涨落会导致宏观上无平衡态对应物的标度律。

尽管该理论已得到广泛研究，但二维KPZ标度行为的实验证据此前仅限于界面生长。

研究者报告了在二维激子极化激元凝聚体中观测到KPZ普适标度行为——这些量子流体本质上打破了平衡条件。通过使用光谱学和迈克尔逊干涉法，研究者探测了微观上不同系统中的相位关联。

分析揭示了其关联动力学和标度指数与二维KPZ理论预测高度吻合。这些结果确立了激子极化激元凝聚体作为探索二维非平衡态普适性实验平台的地位。

▲ Abstract：

Equilibrium and nonequilibrium states of matter can exhibit fundamentally different behavior. A key example is the Kardar-Parisi-Zhang universality class in two spatial dimensions (2D KPZ), where microscopic deviations from equilibrium give rise to macroscopic scaling laws without equilibrium counterparts. Although extensively studied theoretically, experimental evidence of 2D KPZ scaling has remained limited to interface growth. Here, we report the observation of KPZ universal scaling in 2D exciton-polariton condensates—quantum fluids of light that inherently break equilibrium conditions. Using spectroscopy and Michelson interferometry, we probed the phase correlations across microscopically different systems. Our analysis revealed correlation dynamics and scaling exponents in excellent agreement with 2D KPZ predictions. These results establish exciton-polariton condensates as an experimental platform for exploring 2D nonequilibrium universality.

地球科学Earth Science

Tectonic origin of Yellowstone’s translithospheric magma plumbing system

黄石跨岩石圈岩浆通道系统的构造起源

▲ 作者：Zebin Cao, Lijun Liu et al.

▲链接：

https://www.science.org/doi/10.1126/science.ady2027

▲摘要：

黄石地区因其地壳岩浆储库及软流圈熔体的补充而广为人知。然而，原生熔体如何穿越刚性岩石圈并演化为双峰式火山活动仍不清楚。

通过整合多学科观测与数据驱动的地球动力学模拟，研究者表明黄石地区岩浆生成与迁移主要受岩石圈构造作用控制，地幔柱的贡献可忽略不计。

模型预测，黄石下方存在一个西南倾的伸展带，该伸展带由岩石圈体力和基底拖曳共同塑造。这一倾斜的跨岩石圈变形带与地球物理成像揭示的岩浆管道系统相吻合，证实了构造伸展在引导软流圈熔体上升至浅部过程中的关键作用。

此外，研究者提出该跨岩石圈岩浆管道系统促进了复杂的岩浆过程，最终驱动了地表双峰式火山活动。

▲ Abstract：

Yellowstone is widely recognized for its crustal magma reservoirs replenished by asthenospheric melts. However, how primary melts traverse the rigid lithosphere and evolve into bimodal volcanism remains unclear. By leveraging multidisciplinary observations and a data-oriented geodynamic modeling approach, we demonstrate that magma generation and migration in the Yellowstone region are primarily governed by lithospheric tectonics, with negligible contribution from the mantle plume. Below Yellowstone, our model predicts a southwest-dipping extension zone, shaped jointly by the lithospheric body force and basal traction. This tilted translithospheric deforming zone resembles the geophysically imaged magma plumbing system, confirming the key role of tectonic extension in tapping asthenospheric melts to shallow depths. Furthermore, we suggest that the translithospheric magma plumbing system facilitates complex magmatic processes, ultimately driving surface bimodal volcanism.

生物学Biology

Emergent predictability in microbial ecosystems

微生物生态系统中的涌现可预测性

▲ 作者：Jacob Moran, Lucas C. Graham et al.

▲链接：

https://www.science.org/doi/10.1126/science.adr1440

▲摘要：

微生物生态学一个由来已久的假设认为，尽管群落具有复杂性，但简单的模式仍可能持续存在，甚至可能因这种复杂性而涌现。然而，“ 涌现简单性 ”这一概念在某种程度上仍停留在直观层面。

研究者基于将单个微生物菌株归类为更宽泛类别的粗粒化描述，定义了微生物生态系统的涌现可预测性。通过使用两个已发表数据集，研究者证明对于物种更丰富的群落，粗粒化描述具有更高的预测能力。

这种特性无法用大群落中的简单平均效应来解释。相反，研究者的分析表明，当生理或环境反馈抵消了群落变异某些维度上的平均效应时，这些维度会随着多样性的增加而变得信息量更大，从而产生涌现可预测性。

▲ Abstract：

A long-standing hypothesis of microbial ecology is that simple patterns might persist despite community complexity or even emerge because of it. However, the concept of “ emergent simplicity ” remains partly intuitive. Here, we defined emergent predictability of microbial ecosystems based on the predictive power of coarsened descriptions that group individual microbial strains into broader classes. We used two published datasets to show that coarse descriptions became more predictive for more species-rich communities. This behavior was not explained by simple averaging effects in large communities. To the contrary, our analysis indicates that emergent predictability arises when physiological or environmental feedback counteracts these averaging effects along certain axes of community variation, allowing these axes to become more informative as diversity increases.

Hyaluronic acid and tissue mechanics orchestrate mammalian digit tip regeneration

透明质酸与组织力学协同调控哺乳动物指尖再生

▲ 作者：Byron W. H. Mui, Joseph J. Y. Wong et al.

▲链接：

https://www.science.org/doi/10.1126/science.ady3136

▲摘要：

组织再生在哺乳动物中较为罕见，但指尖截断后通常能够再生，而损伤范围超过这一范围则无法再生。微环境如何导致不同的再生结果尚不清楚。

研究者发现，细胞外基质与组织力学决定了小鼠指尖的截断响应。非再生区域更硬，含有致密且有序排列的胶原蛋白；而再生区域质地柔软，富含透明质酸。

去除透明质酸会抑制再生并促进纤维化，表明透明质酸—胶原蛋白的平衡调控着组织力学与修复信号。

在非再生截断后，使用透明质酸与蛋白聚糖连接蛋白1稳定透明质酸，可调节细胞外基质力学、减少瘢痕形成并促进骨修复。因此，细胞外基质组成与力学特性能够影响细胞行为，靶向细胞外基质的策略有望解锁哺乳动物的再生潜力。

▲ Abstract：

Tissue regeneration is rare in mammals, but the digit tip can regrow after amputation, whereas injuries beyond the nail do not. How the microenvironment drives divergent outcomes remains unclear. In this study, we found that the extracellular matrix (ECM) and tissue mechanics govern the amputation response in mouse digits. Nonregenerative regions were stiffer and contained dense, organized collagen, whereas regenerative regions were soft and enriched in hyaluronic acid (HA). Depleting HA inhibited regeneration and promoted fibrosis, demonstrating that the HA-collagen balance shaped tissue mechanics and repair signaling. Stabilization of HA with hyaluronan and proteoglycan link protein 1 (HAPLN1) after nonregenerative amputations tuned ECM mechanics, reduced scarring, and enhanced bone repair. Thus, ECM composition and mechanics influence cell behavior and ECM-targeted strategies could help unlock mammalian regeneration.

医学Medicine

Wildlife trade drives animal-to-human pathogen transmission over 40 years

四十年间的野生动物贸易促使动物源病原体向人类传播

▲ 作者：J é r?me M. W. Gippet, Colin J. Carlson et al.

▲链接：

https://www.science.org/doi/10.1126/science.adw5518

▲摘要：

野生动物贸易影响着全球四分之一的陆生脊椎动物，并为病原体的跨物种传播创造了机会，但其在塑造动物—人类病原体交换中的确切作用尚不明确。

通过对四十年间全球野生动物贸易数据的分析，研究者发现，被交易的哺乳动物与人类共享病原体的可能性是未被交易的哺乳动物的1.5倍，而非法贸易和活体动物贸易进一步加剧了病原体共享。

物种在贸易中所处的时间可以预测其携带的人畜共患病原体数量。平均而言，一个物种被交易的时间每增加十年，就会多出一种与人类共有的病原体。

▲ Abstract：

The wildlife trade affects a quarter of terrestrial vertebrates and creates opportunities for cross-species

pathogen transmission, but its precise role in shaping animal-human pathogen exchange remains unclear. In our analysis of 40 years of global wildlife trade data, we show that traded mammals are 1.5-fold as likely to share pathogens with humans as nontraded mammals, and that illegal and live-animal trade further exacerbate pathogen sharing. Time spent in trade predicts the number of zoonotic pathogens that a wildlife species hosts. On average, a species shares an additional pathogen with humans for every 10 years it is traded.

动物学Zoology

Lethal conflict after group fission in wild chimpanzees

野生黑猩猩群体分裂后的致命冲突

▲ 作者：Aaron A. Sandel, Yixuan He et al.

▲链接：

https://www.science.org/doi/10.1126/science.adz4944

▲摘要：

动物间的领土冲突可为理解人类战争的某些方面提供启示，但此前尚未观察到伴随群体身份动态变化的“内战”现象。研究者报告了已知最大野生黑猩猩群体中一次罕见的永久性分裂事件。

基于30年的行为观察与网络分析，研究者描述了该群体从2015年的凝聚状态转向极化，并于2018年形成两个截然不同亚群的过程。在随后的7年间，其中一个亚群的成员发动了24次攻击，导致另一亚群至少7只成年雄性及17只幼崽死亡。

这些发现表明，在人类现存最近的近亲中，即便缺乏通常被视为人类战争必需的文化标志，群体身份认同仍可能发生转变并升级为致命敌对行为。

▲ Abstract：

Territorial conflicts in animals can inform aspects of human warfare, but civil war, with its shifting group identities, has not been previously observed. We report a rare, permanent fission in the largest-known group of wild chimpanzees (Pan troglodytes). Using 30 years of behavioral observations and network analyses, we describe a transition from cohesion to polarization in 2015 and the emergence of two distinct groups by 2018. Over the next 7 years, members of one group made 24 attacks, killing at least seven mature males and 17 infants in the other group. These findings indicate that group identities can shift and escalate into lethal hostility in one of our closest living relatives in the absence of the cultural markers often thought necessary for human warfare.

作者：李言 来源：科学网微信公众号