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《科学》（20261015出版）一周论文导读。编译李言

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物理学Physics

Electrically driven chiral emission from plasmonic tunnel junctions

等离激元隧道结的电驱动手性发射

▲ 作者：Yuanyang Xie, Alexey V. Krasavin, and Anatoly V. Zayats

▲ 链接：

<https://www.science.org/doi/10.1126/science.aeh4015>

▲ 摘要：

手性在物理、化学和生物学的广泛过程中，包括光—物质相互作用中发挥着关键作用，而量子隧穿为纳米尺度光产生提供了一种有前景的机制。通过将隧道结与手性等离激元纳米螺旋体集成，研究者实现了单粒子水平上的电诱导纳米级手性光产生。

隧穿驱动的手性偶极模式共振激发导致发射出涡旋光束，该光束同时具有手性选择度超过0.8的自旋角动量和大小相等、符号相反轨道角动量。研究者的电驱动方法为纳米尺度光子自旋产生工程化提供了一种手段，凸显了其在显示应用、量子信息处理和光化学中作为下一代光学组件的潜力。

▲ Abstract：

Chirality plays a crucial role in a broad range of processes, including light-matter interactions in physics, chemistry, and biology, while quantum tunneling provides a promising mechanism for light generation at the nanoscale. By integrating tunnel junctions with chiral plasmonic nanohelicoids, we achieved electrically induced nanoscale generation of chiral light at the single-particle level. The tunneling-driven resonant excitation of chiral dipolar modes of the nanohelicoids results in emission of a vortex light beam possessing both spin angular momentum with handedness selectivity of more than 0.8 and orbital angular momentum equal in magnitude and opposite in sign. Our electrically driven approach offers a means for engineering photon spin generation at the nanoscale, highlighting its potential for next-generation optical components in display applications, as well as quantum information processing and photochemistry.

计算机科学Computer Science

Dendritic computation for abstract rule-based flexible decision-making

树突计算实现抽象规则引导的灵活决策

▲ 作者：Yuan Zhang, Yanhe Liu et al.

▲ 链接：

<https://www.science.org/doi/10.1126/science.adz5323>

▲摘要：

智能行为涉及感觉输入与抽象规则知识的灵活整合。树突计算已被证明参与感觉加工的自上而下调控；然而，它是否以及如何参与灵活的认知加工仍有待阐明。

研究者将基于规则的灵活决策任务与小鼠在体双光子成像及光遗传学相结合，发现听觉皮层第5层端脑外神经元的单一胞体内，顶端树突优先编码推断出的抽象规则，胞体优先表征感觉刺激，而选择信号在两者中均有呈现。光遗传学树突抑制损害了规则依赖的胞体选择编码，支持了树突与胞体区室之间任务相关的整合。研究结果表明，皮层神经元的树突计算介导了灵活行。

▲ Abstract：

Intelligent behavior involves flexible integration of sensory input and abstract rule knowledge. Dendritic computation has been shown to contribute to top-down modulation of sensory processing; however, whether and how it is involved in flexible cognitive processing remains to be elucidated. Combining a rule-based flexible decision-making task with in vivo two-photon imaging and optogenetics in mice, we found that within single layer 5 extratelencephalic neurons in the auditory cortex, apical dendrites preferentially encoded the inferred abstract rule and somata preferentially represented sensory stimuli, whereas choice signals were present in both compartments. Optogenetic dendritic inhibition impaired rule-dependent somatic choice coding, supporting a task-relevant integration across the dendritic and somatic compartments. These results indicate that dendritic computation in cortical neurons mediates flexible behavior.

材料科学Material Sciences

Engineering ordered two-dimensional defect phases to strengthen structural alloys

工程化调控二维缺陷相以强化结构合金

▲作者：Andreas Bezold, Manuel K?brich et al.

▲链接：

<https://www.science.org/doi/10.1126/science.aeh1409>

▲摘要：

晶体中的缺陷通常被视为变形的结果，但也可以被设计为强化特征。平面缺陷可以强化结构合金，但通常仅在变形或服役过程中形成，限制了对某密度、稳定性和化学组成的控制。

研究者表明，预变形后时效可以将此类缺陷转化为有序缺陷相的设计架构。在单晶钴镍基高温合金和多晶钴铬钨合金中，该处理创建了致密的共格、原子级薄、有序缺陷限域相网络。这些网络

将室温强度提高超过200兆帕，并将高温合金的最小蠕变速率降低三倍以上。

电子显微镜和模拟表明，局部化学有序放大了强化效果，且有序缺陷相在阻碍滑移传递的同时仍可被剪切。

▲ Abstract：

Defects in crystals are usually considered to be consequences of deformation, but they can also be engineered as strengthening features. Planar defects can strengthen structural alloys but usually form only during deformation or service, limiting control over their density, stability, and chemistry. We show that predeformation followed by aging can convert such defects into a designed architecture of ordered defect phases. In a single-crystal cobalt-nickel – based superalloy and a polycrystalline cobalt-chromium-tungsten alloy, this treatment creates dense networks of coherent, atomically thin, ordered defect – confined phases. These increase room-temperature strength by more than 200 megapascals and reduce the superalloy ' s minimum creep rate by more than threefold. Electron microscopy and simulations show that local chemical ordering amplifies strengthening and that the ordered defect phases remain shearable while impeding slip transmission.

地球科学Earth Science

Empirical constraints on ice cliff calving

冰崖崩解的约束限制

▲ 作者：Caroline Needell, Catherine C. Walker, and Jeremy N. Bassis

▲ 链接：

<https://www.science.org/doi/10.1126/science.aee0658>

▲ 摘要：

当地球冰盖边缘的崩解冰崖超过临界高度时，可能引发一种称为海洋冰崖不稳定性的失控退缩过程。然而，足够高的冰崖很少被观察到。为填补这一空白，研究者利用激光测高仪测量了地球冰盖边缘15330座冰崖的特征。

研究表明，冰崖高度与混杂岩厚度、水深和裂隙发育高度相关。他们发现，高冰崖的崩解速度比参数化方案所假设的更快，但动态减薄和向低冰厚度梯度区域的退缩阻止了失控退缩。这些观测表明，模型预测可能低估了冰崖崩解的次年度速率，但失稳的可能性将敏感地取决于额外变量，而不仅仅是冰崖高度。

▲ Abstract：

When calving cliffs at the margins of Earth ' s ice sheets exceed a critical height, runaway retreat may be

initiated in a process called the marine ice cliff instability. However, sufficiently tall ice cliffs have rarely been observed. To address this gap, we measured the characteristics of 15,330 ice cliffs across Earth's ice sheet margins using laser altimetry. We show that cliff height is highly correlated with ice thickness, water depth, and crevassing. We found that tall cliffs calve more rapidly than parameterizations assume, but dynamic thinning and retreat into regions with low ice thickness gradients prevent runaway retreat. These observations suggest that model projections may underestimate subannual rates of cliff calving, but that the potential for instability will depend sensitively on additional quantities, not cliff height alone.

Airflows redefine the cost of aerial transport in the wild

气流重新定义野外空中运输的成本

▲ 作者：Martina Scacco, Jeroen B. Smaers et al.

▲ 链接：

<https://www.science.org/doi/10.1126/science.aee6550>

▲ 摘要：

燃料经济性对动物和机器都很重要，因为运输成本决定了移动可能在何处、何时以及多远距离内实现。然而，现有的动物飞行运输成本估算来自实验室，并将大气视为恒定不变，尽管自由飞行的动物通常会从大气流动中获取能量。利用高分辨率运动数据，研究者估算了50种鸟类和蝙蝠在野外飞行的运输成本。

研究结果修正了经典的移动成本排序，表明飞行可能比游泳更便宜，但几乎与奔跑一样昂贵，这取决于物理环境、形态和行为之间的相互作用。将运输成本与大气条件联系起来，为预测变化的风景将如何重塑飞行动物的能量学、移动和分布提供了机制基础。

▲ Abstract：

Fuel economy matters to both animals and machines, as the cost of transport can determine where, when, and how far locomotion is possible. However, established estimates of these values for animal flight come from laboratories and treat the atmosphere as constant, even though free-flying animals routinely extract energy from atmospheric flows. Using high-resolution movement data, we estimate the cost of transport for 50 bird and bat species flying in the wild. Our results revise the classic ranking of locomotion costs, suggesting that flying can be cheaper than swimming though almost as costly as running, depending on interactions between physical environment, morphology, and behavior. Linking transport costs to atmospheric conditions provides a mechanistic basis for predicting how changing windscares will reshape the energetics, movements, and distributions of flying animals.

生物学Biology

Glycan recognition by a plant damage-sensing immune receptor

植物损伤感知免疫受体的聚糖识别

▲ 作者：Pedro Jim é nez-Sandoval, Owen Kentish et al.

▲ 链接：

<https://www.science.org/doi/10.1126/science.aec6740>

▲ 摘要：

病原体靶向并降解植物细胞周围的细胞外基质。一个核心问题是细胞壁来源的损伤相关分子模式如何被识别并整合以触发免疫反应。研究者通过解析糖感知受损1 (IGP1) 受体胞外多结构域在无配体状态和结合纤维素来源的损伤相关分子模式纤维三糖状态下的结构，来解答这一问题。

结构分析揭示，富亮氨酸重复序列—苹果酸酶结构域的组成性相互作用使IGP1预先配置好以进行配体识别，并且该受体在富亮氨酸重复序列结构域中具有一个高度特异性的糖结合口袋，能够区分聚糖结构的细微差异。通过直接感知纤维寡糖，IGP1作为一个细胞壁监视受体发挥作用，将病原体诱导的细胞壁降解与免疫警报联系起来，使植物能够启动快速而强大的防御反应。

▲ Abstract：

Pathogens target and degrade the extracellular matrix surrounding plant cells. A central question is how cell wall – derived damage-associated molecular patterns (DAMPs) are recognized and integrated to trigger immune responses. We address this question by determining the structure of the extracellular multidomain of the impaired in glycan perception 1 (IGP1) receptor in both apo form and bound to the cellulose-derived DAMP cellotriose. Structural analyses reveal that constitutive interactions of leucine-rich repeat (LRR) – malectin domains preconfigure IGP1 for ligand recognition and that the receptor features a highly specific sugar-binding pocket in the LRR domain capable of distinguishing fine variations in glycan structures. By directly sensing cello-oligomers, IGP1 operates as a cell wall surveillance receptor that links pathogen-induced wall degradation to immune alerting, equipping plants to mount rapid and robust defense responses.

作者：李言 来源：科学网微信公众号

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