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利用原子点阵列的大规模模拟量子模拟

作者：M. B. Donnelly, Y. Chung et al.

链接：<https://www.nature.com/articles/s41586-025-10053-7>

摘要：研究者展示了一种新型平台的实现方案。该平台由大规模二维阵列（包含15000个位点）的亚纳米精度原子量子点构成，可用于模拟强相互作用的低温物理过程。通过观测二维正方晶格原子量子点阵列中的金属—绝缘体相变，研究者证实了可对在位相互作用能 U 和隧穿耦合 t 进行独立且精确的调控。

磁输运测量进一步表明，由莫特—哈伯德/安德森物理机制驱动的绝缘态已经形成，并观测到关联电子物理学的特征信号。这种精密设计的模拟量子模拟器为在任意二维晶格上模拟量子材料提供了独特平台，有望探索量子磁性形成、相互作用拓扑量子物质以及非常规超导等诸多未解之谜。

Abstract： Here we demonstrate the realization of a new platform consisting of large-scale 2D arrays of sub-nanometre precision-engineered atom-based quantum dots (15,000 sites) to simulate strongly interacting, low-temperature physics. By observing a metal – insulator (MI) transition on a 2D square lattice of atom-based quantum dots, we demonstrate independent and precise control of the on-site interaction U and tunnelling t . Magneto-transport measurements further indicate the formation of an insulating state driven by Mott – Hubbard/Anderson physics and promising signatures of correlated electron physics. These precision-engineered analogue quantum simulators provide a unique platform to simulate quantum materials on arbitrary 2D lattices and to explore many unanswered questions in the formation of quantum magnetism, interacting topological quantum matter and unconventional superconductivity.

Spin-wave band-pass filters for 6G communication

用于6G通信的自旋波滤波器

作者：Connor Devitt, Sudhanshu Tiwari, Bill Zivasatienraj Sunil A. Bhave

链接：

<https://www.nature.com/articles/s41586-025-10057-3>

摘要：研究者报告了一种仅需单一外部磁偏置的自旋波滤波器架构，该架构依托于可实现晶圆级生产的现代微机械加工工艺。

研究者开发的滤波器实现了低至2.54 dB的插入损耗、高达663 MHz的带宽、覆盖7.08 GHz至21.6 GHz多个倍频程的中心频率调谐范围，以及通带内输入三阶截点大于11 dBm的高线性度。他们还通过频率可调无线电系统实验验证了该滤波器的运行性能。

Abstract： Here we report a SW ladder filter architecture requiring only a single external magnetic bias, which is enabled by modern micromachining fabrication methods capable of wafer-scale production. The filters developed in this work demonstrate loss as low as 2.54 dB, bandwidths up to 663 MHz, centre-frequency tuning over several octaves from 7.08 to 21.6 GHz and high linearity with an input-referred third-order intercept point of more than 11 dBm in the passband. The operation of the filter is also experimentally

demonstrated in a frequency-tunable radio system.

化学Chemistry

Electrochemical defluorinative Matteson-type homologation

电化学脱氟马特森型同系化反应

作者：Tsoh Lam Cheung, Yujun Li, Peiqi Zhang, Zhiyi Yang, Yangjian Quan Hairong Lyu

链接：

<https://www.nature.com/articles/s41586-025-10002-4>

摘要：研究者报道了一种马特森型同系化反应。这项概念验证性方法结合了电还原脱氟与硼酸酯重排，无需有机锂试剂、低温条件或专业设备。该方法利用易得的三氟甲基芳烃作为类卡宾前体，拓展了马特森反应的适用范围。

通过关键反应中间体鉴定、密度泛函理论计算及电化学分析在内的系统性机理研究，研究者证实了该电化学马特森同系化反应中硼酸酯形成与重排过程的存在。

Abstract：Here we report a Matteson-type homologation, which integrates these three transformations into a one-pot electrochemical process. This proof-of-concept approach combines electroreductive defluorination with boronate rearrangement, eliminating the need for organolithium reagents, cryogenic conditions or specialist setups. The available trifluoromethylarenes are used as carbenoid precursors, expanding the scope of the Matteson reaction. Comprehensive mechanistic studies, including identification of key reaction intermediates, density functional theory calculations and electrochemical analysis, confirm the involvement of boronate formation and rearrangement in this e-Matteson homologation.

生态学Ecology

Protected area management has significant spillover effects on vegetation

保护区管理对植被产生显著的溢出效应

作者：Graeme S. Cumming

链接：

<https://www.nature.com/articles/s41586-025-09837-8>

摘要：研究者以澳大利亚12513个候选保护区为样本，探究了影响植被溢出效应规模的因素。他们将溢出效应定义为：因保护区的存在所导致的其外部植被变化。在2020年能够进行完整分析的3063个保护区中，71%（2189个）在10种植被覆盖类型中至少有一类产生了0.1或以上的正向溢出效应。

多种保护区类型是预测溢出规模的重要指标。保护区类型与本地及环境变量的协方差解释度为14%，这表明内部管理对邻近区域具有调节作用。这些发现凸显了将溢出效应明确纳入全球政策框架的潜力，并为建立支持保护区周边生物多样性保护与生态系统服务的监测核算体系提供了实证基础路径。

Abstract：Here, to address this gap, I explored influences on the effect sizes of vegetation spillovers from a candidate 12,513 Australian protected areas, defining spillovers as the difference in vegetation outside a protected area that occurs as a consequence of the existence of the protected area. In 2020, 71% (2,189) out of the 3,063 protected areas for which full analysis was possible had a positive spillover effect of 0.1 or greater on at least 1 of 10 vegetation cover classes. Many protected area types were significant predictors of spillover magnitude. The covariance explained by protected area type with local and contextual variables was 14%, suggesting that internal management moderates adjacent locations. These findings highlight the potential to include spillover effects explicitly in global policy frameworks and suggest a pathway to an empirical basis for monitoring and accounting schemes that support biodiversity conservation and ecosystem service provision adjacent to protected areas.

生物学Biology

Oxygen-free metabolism in the bird inner retina supported by the pecten

栉膜支持的鸟类视网膜内层无氧代谢

作者：Christian Damsgaard, Mia Viuf Skott et al.

链接：

<https://www.nature.com/articles/s41586-025-09978-w>

摘要：研究者发现，尽管鸟类视网膜外层的感光细胞外节能够接触氧气，但其内层视网膜却在长期无氧状态下运作，依赖视网膜神经元中的无氧糖酵解维持功能。

研究者提供的证据表明，鸟类玻璃体中独特的血管化结构——栉膜（其功能争议已持续数个世纪），为无氧状态的内层视网膜提供葡萄糖并清除乳酸。研究者认为，栉膜通过代谢支持鸟类视网

膜耐受无氧环境，首先推动了细胞密集、无血管厚视网膜的演化，进而这种结构作为扩展适应特征，使鸟类在高海拔迁徙过程中仍能维持视网膜功能。

Abstract : Here we show that, while the photoreceptor outer segments in the outer retina have access to oxygen, the inner bird retina operates under chronic anoxia, supported by anaerobic glycolysis in the retinal neurons. We provide evidence that the pecten oculi—a uniquely vascularized structure in the vitreous humour of birds, the function of which has been debated for centuries^{5,6,7,8,9}—supplies the anoxic inner retina with glucose and removes lactic acid. We suggest that the pecten's metabolic support of the bird retina's anoxia tolerance enabled first the evolution of a thick cell-dense, avascular retina, which secondarily served as an exaptation enabling retinal function during high-altitude migrations.

Neutrophils preserve energy storage in sympathetically activated adipocytes

中性粒细胞维持交感神经激活状态下脂肪细胞的能量储备

作者 : Seunghwan Son, Cindy Xu et al.

链接 :

<https://www.nature.com/articles/s41586-025-09839-6>

摘要 : 研究者发现，脂肪细胞在 β -肾上腺素能激活作用下，会诱导中性粒细胞发生短暂且具有部位特异性的浸润，尤其是在富含脂质的白色脂肪组织（如内脏白色脂肪）中。中性粒细胞的募集需要脂肪细胞中脂肪分解与p38丝裂原活化蛋白激酶通路的双重激活，并通过分泌白三烯B4实现。

被募集的中性粒细胞在原位活化，局部释放白细胞介素-1 β ，从而抑制脂肪分解，防止能量过度消耗。当中性粒细胞被清除或阻断IL-1 β 产生后，脂肪分解加剧，导致在反复 β -肾上腺素能刺激下白色脂肪组织质量减少。综上，研究者揭示了中性粒细胞来源的IL-1 β 在代谢应激状态下维持脂质储备的关键作用，阐明了先天免疫细胞在限制脂质流失、维持能量稳态中的生理功能。

Abstract : Here we report that β -adrenergic activation of adipocytes induces a transient and depot-specific infiltration of neutrophils into white adipose tissue (WAT), particularly in lipid-rich visceral WAT. Neutrophil recruitment requires the stimulation of both lipolysis and p38 MAPK in adipocytes, and is mediated by the secretion of leukotriene B4. Recruited neutrophils undergo activation in situ, and locally secrete IL-1 β , which suppresses lipolysis and limits excessive energy loss. Neutrophil depletion or blockade of IL-1 β production increases lipolysis, leading to reduced WAT mass after repeated β -adrenergic stimulation. Together, these findings reveal a role of neutrophil-derived IL-1 β in preserving lipid stores during metabolic stress, highlighting a physiological function of innate immune cells in limiting lipid loss and maintaining energy homeostasis.

来源 : 科学网微信公众号

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