《自然》（20260806出版）一周论文导读

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物理学Physics

An entangling gate for dual-rail erasure qubits

双轨擦除量子比特的纠缠门

▲ 作者：D-Wave Quantum Inc.

▲ 链接：https://www.nature.com/articles/s41586-026-10822-y

▲摘要：

在此，研究者设计并实现了一种用于双轨量子比特（一种编码在一对超导微波腔中的擦除量子比特）的两量子比特纠缠门。实验证明，在操作过程中，错误层级结构基本得以保持。该门速度快（持续约500纳秒），擦除率低（每门约0.5%），剩余泡利错误低于0.1%，且具有强偏置的去相位错误特征，其中比特翻转错误实际上不存在，处于10-6水平。

这些结果为实现快速抑制错误、可扩展的纠错系统提供了更快捷的路径，研究者通过详细的表面码模拟支持了这一论断。

▲ Abstract：

Here we design and realize a two-qubit entangling gate for dual-rail cavity qubits, a type of erasure qubit encoded in a pair of superconducting microwave cavities. Our experimental demonstration confirms that the error hierarchy is largely preserved during the gate. The gate is fast (about 500 ns duration) and shows low erasure rates of approximately 0.5% per gate, remaining Pauli errors below 0.1%, and a strong bias towards dephasing errors, in which bit-flips are practically non-existent at the 10-6 level. These results enable a faster path to error-corrected systems that rapidly suppress errors as they scale; a claim we support with our detailed surface code simulations.

材料科学Material Sciences

Non-epitaxial perovskite polariton laser diode operating under direct current

非外延钙钛矿极化激元激光二极管实现直流驱动

▲ 作者：Anatoly P. Pushkarev, Daria Khmelevskaia et al.

▲链接：

https://www.nature.com/articles/s41586-026-10824-w

▲摘要：

研究者开发了一种实现钙钛矿激光器电泵浦的新策略。研究者将溶液中生长的CsPbBr3微晶片与化学惰性的单壁碳纳米管电极集成，并将其嵌入光学微腔中。

通过将微器件在恒定电流下降温至8K，形成了钙钛矿p-i-n二极管，从而在高电流密度下实现平衡的载流子注入。该钙钛矿微腔二极管工作在强耦合区间，在65 μ A直流电流下表现出极化激元激光。

▲ Abstract：

CHere we develop a new strategy for achieving direct electrical pumping of a perovskite laser. We integrate a solution-grown CsPbBr3 microplate with chemically inert single-walled carbon nanotube (SWCNT) electrodes and embed them into an optical microcavity. By cooling the microdevice down to 8 K at a constant current, a perovskite p – i – n diode is formed that facilitates a balanced carrier injection at high current densities. The perovskite microcavity diode operates in the strong coupling regime, exhibiting polariton lasing under a direct current of 65 μ A.

人工智能Artificial Intelligence

Large language models can predict the results of social science experiments

大语言模型能够预测社会科学实验的结果

▲ 作者：Ashwini Ashokkumar, Luke Hewitt, Isaias Ghezae Robb Willer

▲链接：

https://www.nature.com/articles/s41586-026-10742-x

▲摘要：

研究者构建了一个包含70项预注册、具有全国代表性的美国调查实验的档案库，涵盖469个实验效应和119330名参与者。研究者提示一个大语言模型模拟具有代表性的美国个体样本对实验刺激的反应，然后通过比较不同条件下的模拟响应来推断处理效应。由GPT-4（其训练数据截止日期早于档案中许多研究的发表日期）得出的预测与实际处理效应高度相关，其准确性与聚合的人类预测相当。

对于模型训练数据截止日期之前尚未发表或公开的研究，以及来自主流开源权重模型的预测，相关性仍然较高。尽管相关性较高，但预测系统性地高估了效应量。在一个包含606个效应的15项大型研究的次级档案库中，相关性较低，但与聚合专家预测者的水平相当。

为评估对科学实践的影响，研究者调查了460位社会科学家关于可能用途和感知风险的意见，并利用档案库评估了若干应用（试点测试、干预选择、识别需要复现的效应）和风险（偏差、滥用）。综合来看，这些结果表明，大语言模型可以增强科学和实践中的实验方法，同时也引发了关于负责任使用的重要考量。

▲ Abstract：

Here we built an archive of 70 preregistered, nationally representative survey experiments in the USA involving 469 experimental effects and 119,330 participants. We prompted an LLM to simulate how representative samples from American individuals would respond to experimental stimuli, and then we inferred treatment effects by comparing simulated responses across conditions. Predictions derived from GPT-4, whose training-data cutoff predated the publication of many studies in our archive, were strongly correlated with actual treatment effects, achieving accuracy similar to pooled human forecasts. Correlations remained high for studies not published or publicly posted by the model ’s training-data cutoff date and for predictions from prominent open-weight models. Despite high correlations, predictions systematically overestimated effect sizes. In a secondary archive of 15 megastudies featuring 606 effects, correlations were lower but comparable to those of pooled expert forecasters. To assess implications for scientific practice, we surveyed 460 social scientists about probable uses and perceived risks and used our archives to assess several applications (pilot testing, intervention selection, identifying effects needing replication) and risks (bias, misuse). Together, these results indicate that LLMs can augment experimental methods in science and practice while raising important considerations for responsible use.

古生物学Palaeontology

High-fidelity modular skeletons authenticate a Cambrian origin for Bryozoa

高保真模块化骨架证实苔藓虫起源于寒武纪

▲ 作者：Baopeng Song (宋宝鹏), Zhifei Zhang (张志飞) et al.

▲链接：

https://www.nature.com/articles/s41586-026-10590-9

▲摘要：

研究者报告了来自中国寒武纪早期仙女洞组的P. gatehousei以及一个新分类单元Dayingomelission hexaclitia（新属新种）的精美化石。这些标本在模块化骨架中原位保存了磷酸盐化软组织，揭示了关键解剖结构，包括针状体、环肌、膜囊和环形隔膜。这一系列特征为这些分类单元属于苔藓动物门提供了确凿证据。

纳入这些新特征的系统发育分析将其鉴定为窄唇纲冠群。这些结果确认了苔藓动物门在寒武纪的起源，并揭示了其群体构型中出乎意料的高度早期分异，表明苔藓动物多样化是寒武纪辐射的组成部分。此外，已分化的窄唇纲冠群的早期出现，暗示苔藓动物干群的起源比最初显现的更为古老。

▲ Abstract：

Here we report exquisite fossils of P. gatehousei and a new taxon, Dayingomelission hexaclitia gen. et sp. nov., from the early Cambrian Xiann ü dong Formation of China. These specimens preserve in situ phosphatized soft tissues in modular skeletons, revealing critical anatomical structures, including styles, annular muscles, membranous sacs and ring septa. This suite of traits provides definitive evidence that these taxa belong to the Bryozoa. Phylogenetic analysis incorporating these new features identifies them as crown group stenolaemates. These results confirm a Cambrian origin for the phylum and reveal an unexpected early disparity in colonial architecture, demonstrating that bryozoan diversification was an integral component of the Cambrian radiation. Moreover, the early appearance of a differentiated stenolaemate crown group indicates a still deeper origin for the bryozoan stem lineage than was first apparent.

医学Medicine

Disparate privacy risks from medical AI

医疗人工智能带来的差异化隐私风险

▲ 作者：Moritz A. Knolle, Martin J. Menten et al.

▲链接：

https://www.nature.com/articles/s41586-026-10688-0

▲摘要：

研究者呈现了医疗诊断应用中AI模型首批针对患者层面的隐私审计之一。他们聚焦于旨在确定特定个体的数据是否被用于训练模型的成员推断攻击。在一系列多样化的医疗数据集上，研究者表明成员推断攻击可对单个患者达到近乎完美的成功率，即使聚合性能并未显著偏离随机猜测。

进一步发现，攻击成功率高的患者数量随模型容量增加而大幅上升，而代表性不足的群体——按疾病状态、自报种族、保险类型、性别或成像方案分层——面临不成比例的高攻击成功率。综合来看，研究结果表明，聚合隐私指标可能严重低估个体隐私风险。

研究者所观察到的差异化风险概况是否延伸到成员推断攻击之外，仍是一个有待解答的问题，这促使我们进一步开发适用于所有数据贡献患者的风险评估与缓解技术。

▲ Abstract：

Here we present one of the first patient-level privacy audits of AI models for medical diagnostic applications. We focus on membership inference attacks (MIAs), which seek to determine whether the data of a given individual were used to train a model. Across a diverse range of medical datasets, we show that MIAs can achieve near-perfect success rates for individual patients, even when the aggregate performance does not substantially deviate from random guessing. We further find that the number of patients with high attack success increases substantially with model capacity, and that underrepresented groups—stratified by disease status, self-reported race, insurance, sex or imaging protocol—face disproportionately high attack success. Together, our findings show that aggregate privacy metrics can severely underestimate individual privacy risk. Whether the disparate risk profiles we observe extend to attacks beyond MIAs remains an open question, motivating the further development of risk assessment and mitigation techniques that cater to all data-contributing patients.

Targeting cancer-specific mutations with RNA-triggered chromatin shredding

利用RNA触发染色质碎屑靶向癌症特异性突变

▲ 作者：Jingkun Zeng, Zhiyuan Cheng et al.

▲链接：

https://www.nature.com/articles/s41586-026-10738-7

▲摘要：

研究者利用Cas12a2（一种具有反式核酸酶切割活性的RNA引导CRISPR核酸酶）进行编程，通过靶向癌症特异性转录本选择性地杀死癌细胞。该方法通过诱导染色质反式碎屑并触发DNA损伤反应和细胞死亡，从而限制细胞生长。

与现有方法不同，RNA引导的Cas12a2能够感知细胞RNA特征，实现对不可成药的突变进行精准靶向。转录本激活的染色质碎屑为针对不可成药靶点的精准疾病治疗提供了一种创新方法。

▲ Abstract：

Here we program Cas12a2, an RNA-guided CRISPR nuclease with trans-nucleolytic cleavage activity, to kill cancer cells selectively by targeting cancer-specific transcripts. This approach limited cell growth by inducing trans shredding of chromatin and triggering DNA-damage responses and cell death. In contrast to existing methods, RNA-guided Cas12a2 senses cellular RNA signatures, enabling precise targeting of undruggable mutations. Transcript-activated chromatin shredding provides an innovative approach to precision disease treatments for undruggable targets.

作者：李言 来源：科学网微信公众号

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