《科学》（20261105出版）一周论文导读

作者：writer 来源：科学网

本文原地址：https://www.iikx.com/news/progress/43107.html

本文仅供学习交流之用，版权归原作者所有，请勿用于商业用途！

《科学》（20261105出版）一周论文导读。编译｜李言

Science, 5 Nov 2026, VOL 394, ISSUE 6824

《科学》2026年11月5日，第394卷，6824期



材料科学Material Sciences

Stacked porous NiTi structure with low cost and ultrahigh fatigue life for elastocaloric cooling

一种可用于弹性冷却的、低成本超长疲劳寿命的层状多孔镍钛结构

▲作者：Changfeng Su, Yang Li et al.

▲链接：

https://www.science.org/doi/10.1126/science.aeh7074

▲摘要：

弹性冷却利用形状记忆合金作为高能效、环保的制冷剂。然而，将形状记忆合金低成本地制成抗疲劳、传热增强的结构，仍是弹性冷却技术商业化的关键障碍。

研究者提出一种“冲压与堆叠”的方法，用于生产多孔、抗疲劳的形状记忆合金结构。蜂窝状芯片由镍钛薄片冲压而成，随后堆叠成层状管状结构，以增加换热表面积，同时避免现有形状记忆合金结构中出现的屈曲和开裂失效。

该堆叠结构可承受超过10?次压缩循环，并能提供高达每千克3850瓦的高比冷却功率。与现有方法相比，这种方法将制造成本降低一个数量级，使弹性冷却制冷剂结构的商业化大规模生产成为可能。

▲ Abstract：

Elastocaloric cooling (eC) uses shape memory alloys (SMAs) as energy-efficient, eco-friendly refrigerants. However, cost-effectively fabricating SMAs into fatigue-resistant, heat transfer – enhanced structures remains a key obstacle to commercialization of the eC technology. We introduce a “stamping and stacking” (S-S) method for producing porous, fatigue-resistant SMA structures. Honeycomb-like chips are stamped from nitinol (NiTi) thin sheets and then stacked into a layered tubular structure to increase heat exchange surface and at the same time avoid buckling and splitting failures encountered in existing SMA structures. The stacked structure endures >108 compression cycles and can deliver high specific cooling power of 3850 watts per kilogram. Our S-S method reduces fabrication costs by one order of magnitude compared with existing approaches, enabling mass production of eC refrigerant structures for commercial deployment.

物理学Physics

Quantum gas microscopy of three-flavor Hubbard systems

三组分哈伯德系统的量子气体显微研究

▲ 作者：Jirayu Mongkolkiattichai, Liyu Liu et al.

▲链接：

https://www.science.org/doi/10.1126/science.adv1247

▲摘要：

哈伯德系统是强关联多体系统的典型实现。引入额外组分会打破哈伯德模型的SU(2)对称性，并导致多种新的奇异量子相。在此，研究者将量子气体显微技术扩展至哈伯德区域的三组分费米子晶格气体。

依靠格点和状态分辨探测，研究者研究了三组分哈伯德模型的相图，并在低至隧穿能量尺度的温

度下发现了状态选择性局域化和选择性配对的迹象。

随后，研究者将测量结果与数值关联簇展开计算进行了比较。进一步提高相空间密度可能有助于在半填充时观察到独特的配对莫特相，并展示了通往研究颜色超流和量子色动力学其他方面的路径。

▲ Abstract：

Hubbard systems are paradigmatic realizations of strongly correlated many-body systems. Introducing additional species breaks the SU(2) symmetry of the Hubbard model and leads to a wide variety of new exotic quantum phases. Here, we extended quantum gas microscopy to three-flavor Fermi lattice gases in the Hubbard regime. Relying on site- and flavor-resolved detection, we studied the phase diagram of the three-flavor Hubbard model and found signatures of flavor-selective localization and selective pairing at temperatures down to the tunneling energy scale. Our measurements were then compared with numerical linked-cluster expansion calculations. Further increase of phase space density may enable the observation of a distinct pair Mott phase at half filling and shows a path toward the study of color superfluidity and other aspects of quantum chromodynamics.

地球科学Earth Science

Seafloor geodesy delineates fast megathrust relocking after the giant 2011 Tohoku earthquake

海底大地测量揭示2011年东日本大地震后巨型逆冲断层的快速重新闭锁

▲ 作者：Fumiaki Tomita, Tianhaozhe Sun et al.

▲链接：

https://www.science.org/doi/10.1126/science.aeg7301

▲摘要：

大地震后俯冲带巨型逆冲断层如何以及何时恢复其闭锁状态，对于理解地震周期物理和未来灾害至关重要。在此，研究者报告了基于14年震后海底大地测量观测，对2011年9级东日本大地震后重新闭锁过程的刻画。

这些数据与陆上大地测量观测、重复地震分析以及数值模拟相结合，揭示了巨型逆冲断层上余滑如何中断闭锁的恢复，并伴随着上覆粘弹性上地幔中的应力松弛。

结果表明，尽管应力松弛仍在持续，巨型逆冲断层如今已达到与地震前相似的闭锁状态。所获得的认识有助于理解其他俯冲带的巨型逆冲断层地震周期。

▲ Abstract：

How and when the subduction megathrust recovers its locking state after a great earthquake is important to understanding earthquake-cycle physics and future hazards. Here we report the delineation of the relocking process after the 2011 magnitude 9 Tohoku earthquake with 14 years of postseismic seafloor geodetic observations. These data, combined with onshore geodetic observations, analyses of repeating earthquakes, and numerical modeling, reveal how the recovery of locking is interrupted by afterslip on the megathrust and accompanied by stress relaxation in the viscoelastic upper mantle. The results indicate that the megathrust has already arrived at a locking state today similar to that before the earthquake despite the ongoing stress relaxation. The acquired knowledge aids understanding of megathrust earthquake cycles at other subduction zones.

生态学Ecology

Echoes of the Anthropocene: Noise pollution as a global threat

人类世的回响：噪声污染作为全球性威胁

▲作者：Hansjoerg P. Kunc and Rouven Schmidt

▲链接：

https://www.science.org/doi/10.1126/science.adu9593

▲摘要：

人为噪声是一种迅速扩展的全球性污染物，但其从个体到生态系统各生物层级的影响仍未得到量化。研究者对177种水生和陆生物种的214项实验研究进行了系统发育控制的荟萃分析，这些物种的分布范围横跨六大洲。

噪声改变了80%受研物种至少一种生理、发育或行为特征，伴随着适合度和丰度的下降以及捕食者—猎物相互作用的破坏。每一个栖息地都产生了此类影响。某些特征和物种的响应机制各不相同，从而产生了赢家和输家。只有多物种分析才能揭示人为压力源的这种物种和生态系统层面的影响。

研究结果确立了噪声作为一种重塑生态系统动态的新型选择压力，以及一种普遍存在的压力源，需要在栖息地保护的同时进行声景保护。

▲ Abstract：

Anthropogenic noise is a rapidly expanding global pollutant, but its effects across biological levels from individuals to ecosystems remain unquantified. We conducted phylogenetically controlled meta-analyses of 214 experimental studies on 177 aquatic and terrestrial species with ranges that span six continents. Noise altered at least one physiological, developmental, or behavioral trait in 80% of species studied, with declines in fitness and abundance and disruptions of predator-prey interactions. Effects occurred in every habitat, although response mechanisms varied for some traits and species, creating winners and losers. Only

multispecies analyses can reveal such species- and ecosystem-level impacts of anthropogenic stressors. Our results establish noise as a novel selection pressure reshaping ecosystem dynamics and as a pervasive stressor requiring soundscape protection alongside habitat conservation.

神经科学Neuroscience

The first 1000 days: Modeling language learning from individual children ’ s everyday speech

最初的1000天：从个体儿童日常言语中建模语言学习

▲ 作者：Hadas Raviv, Arkadii Tsyhanov et al.

▲链接：

https://www.science.org/doi/10.1126/science.aeh9311

▲摘要：

儿童通过周围的言语学习理解和说话，然而日常输入如何塑造学习仍未可知。大语言模型表明，语言可以从数据中学习，但其规模和训练条件与儿童的自然经验截然不同。

研究者基于8名儿童生命最初1000天的纵向家庭录音，训练了认知上可行的、儿童特异性的模型。每个模型从单个儿童有序的言语输入中增量学习，不依赖先前的语言知识，发展出类音素和词形表征，并追踪每个儿童的学习节奏。

学习依赖于密集的每日采样和对近期输入的复现，表明经验相关和记忆相关的过程都是必要的。这些发现表明，日常经验包含足够支持语言学习的结构，并确立了儿童特异性建模用于检验发展理论。

▲ Abstract：

Children learn to understand and speak from the speech around them, yet how that everyday input shapes learning remains unresolved. Large language models show that language is learnable from data, but their scale and training conditions differ sharply from a child ’ s natural experience. We trained cognitively feasible, child-specific models on longitudinal home recordings from eight children across their first 1000 days of life. Each model learned incrementally from a single child ’ s ordered speech input without prior linguistic knowledge, developing phoneme-like and word-form representations that tracked each child ’ s learning pace. Learning was dependent on dense daily sampling and replay of recent input, indicating that both experience- and memory-related processes are necessary. These findings show that everyday experience contains sufficient structure for language learning and establish child-specific modeling for testing developmental theories.

人类学Anthropology

Denoising the US Census: Succinct block hierarchical regression

美国人口普查去噪：简洁的区块分层回归

▲ 作者：Badih Ghazi, Pritish Kamath et al.

▲链接：

https://www.science.org/doi/10.1126/science.aej1765

▲摘要：

2020年美国人口普查采用差分隐私来保护个人机密性，在汇总人口统计测量值中加入校准噪声，随后将这些测量值协调成人口表。

研究者结合了线性回归和约束优化技术，同时利用测量结构来提高效率，开发了一种后处理算法BlueDown。

在2020年人口普查数据中，BlueDown将县级按种族分组的误差降低了21%至36%，将所有县级分组的误差降低了9%至58%；在普查区级，这一算法将按住房类型分组的误差降低了38%至61%。

这些改进没有以机密性或计算效率为代价，并将提高依赖这一权威数据集的研究的有效性，以及用于指导每年超过1.5万亿美元联邦支出分配的分析的有效性。

▲ Abstract：

The 2020 United States Census adopted differential privacy to protect individual confidentiality, adding calibrated noise to summary demographic measurements that are then reconciled into population tables. We developed BlueDown, a postprocessing algorithm that combines techniques from linear regression and constrained optimization while exploiting measurement structure for efficiency. On 2020 Census data, BlueDown reduced the error of groupings by race at the county level by 21 to 36% and of all county-level groupings by 9 to 58%; at the tract level, it reduced error of groupings by housing type by 38 to 61%. These gains came at no cost to confidentiality or computational efficiency and would improve the validity of research relying on this definitive dataset and analyses used to guide the distribution of more than $1.5 trillion in annual federal spending.

作者：李言 来源：科学网微信公众号

更多 科学进展 请访问 https://www.iikx.com/news/progress/

本文版权归原作者所有，请勿用于商业用途，爱科学iikx.com转发