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天文学Astronomy

Accelerated formation of ultra-massive galaxies in the first billion years

最初10亿年超大质量星系的加速形成

▲ 作者：Mengyuan Xiao, Pascal A. Oesch et al.

▲链接：

https://www.nature.com/articles/s41586-024-08094-5

▲摘要：

在此，我们报告对JWST FRESCO调查中的36个大质量尘埃遮蔽星系的系统研究，这些星系的光谱红移在5到9之间。在样本中，我们没有发现Λ 冷暗物质模型具有张力。

然而，三个超大质量星系（logM★/M⊙???11.0，其中M★为恒星质量，M⊙为太阳质量）需要50%的重子转化为恒星——比后期最有效的星系高2到3倍。这不太可能是因为活动星系核，因为它们的辐射范围很广。在大约5到6的红移范围内，超大质量星系占宇宙恒星形成率密度的17%。

▲ Abstract：

Here we report a systematic study of 36 massive dust-obscured galaxies with spectroscopic redshifts between 5 and 9 from the JWST FRESCO survey. We find no tension with the Λ cold dark-matter model in our sample. However, three ultra-massive galaxies (logM★/M⊙???11.0, whereM★ is the stellar mass and M⊙ is the mass of the Sun) require an exceptional fraction of 50 per cent of baryons converted into stars—two to three times higher than the most efficient galaxies at later epochs. The contribution from an active galactic nucleus is unlikely because of their extended emission. Ultra-massive galaxies account for as much as 17 per cent of the total cosmic star-formation-rate density at redshifts between about five and six.

物理学Physics

Observation of vortices in a dipolar supersolid

偶极超固体中涡旋的观测

▲ 作者：Eva Casotti, Elena Poli et al.

▲链接：

https://www.nature.com/articles/s41586-024-08149-7

▲摘要：

在此，掌握了在偶极气体和具有二维结晶顺序的超固体中产生涡旋的方法后，我们报告了超固体相（SSP）中涡旋的理论研究和实验观察。我们的工作揭示了未调制和调制量子流体之间涡旋形成动力学的根本差异。

这为研究具有许多存在于不同领域——如量子晶体和中子星发——中的自对称性破缺的奇异量子系统的流体动力学特性打开了大门。

▲ Abstract：

Here, with the prerequisite pieces at our disposal, namely a method to generate vortices in dipolar gases and supersolids with two-dimensional crystalline order, we report on the theoretical investigation and experimental observation of vortices in the supersolid phase (SSP). Our work reveals a fundamental difference in vortex seeding dynamics between unmodulated and modulated quantum fluids. This opens the door to study the hydrodynamic properties of exotic quantum systems with numerous spontaneously broken symmetries, in disparate domains such as quantum crystals and neutron stars.

Phonon modes and electron – phonon coupling at the FeSe/SrTiO3interface

FeSe/SrTiO3界面处的声子模式和电子—声子耦合

▲ 作者：Hongbin Yang, Yinong Zhou et al.

▲链接：

https://www.nature.com/articles/s41586-024-08118-0

▲摘要：

在此，我们使用动量选择高分辨率电子能量损失谱，在原子尺度上解析FeSe/STO界面上的声子。我们在75—99 meV的能量范围内发现了新的光学声子模式，与电子强耦合。这些模式的特征是界面双层TiOx层中的氧原子和STO中的顶端氧原子的面外振动。

我们的结果还表明，1 uc FeSe/STO的EPC强度和超导间隙与FeSe与TiOx端接STO之间的层间距密切相关。这些发现揭示了界面EPC的微观起源，并为在FeSe/STO和潜在的其他超导系统中实现大规模和稳定的Tc增强提供了见解。

▲ Abstract：

Here we use momentum-selective high-resolution electron energy loss spectroscopy to atomically resolve the phonons at the FeSe/STO interface. We uncover new optical phonon modes, coupling strongly with electrons, in the energy range of 75 – 99 meV. These modes are characterized by out-of-plane vibrations of oxygen atoms in the interfacial double-TiOx layer and the apical oxygens in STO. Our results also demonstrate that the EPC strength and superconducting gap of 1 uc FeSe/STO are closely related to the interlayer spacing between FeSe and the TiOx terminated STO. These findings shed light on the microscopic

origin of the interfacial EPC and provide insights into achieving large and consistent Tc enhancement in FeSe/STO and potentially other superconducting systems.

地球科学Earth Science

Mapping the ionosphere with millions of phones

百万部手机绘制电离层“ 地图 ”

▲ 作者：Jamie Smith, Anton Kast et al.

▲链接：

https://www.nature.com/articles/s41586-024-08072-x

▲摘要：

在此，我们展示了一个由噪声传感器组成的分布式网络——以数百万部安卓手机的形式——可以填补许多这些空白，并将测量覆盖范围扩大一倍，在世界上传统基础设施服务不足的地区提供电离层的准确图像。

通过智能手机测量，我们分析了印度和南美上空的等离子体气泡、北美上空太阳风暴增强的密度以及欧洲上空的中纬度电离层槽等特征。我们还表明，由此产生的电离层“ 地图 ”可以提高定位精度，这是我们的主要目标。

这项研究展示了使用大型分布式智能手机网络作为监测地球的强大科学仪器的潜力。

▲ Abstract：

Here we demonstrate that a distributed network of noisy sensors—in the form of millions of Android phones—can fill in many of these gaps and double the measurement coverage, providing an accurate picture of the ionosphere in areas of the world underserved by conventional infrastructure. Using smartphone measurements, we resolve features such as plasma bubbles over India and South America, solar-storm-enhanced density over North America and a mid-latitude ionospheric trough over Europe. We also show that the resulting ionosphere maps can improve location accuracy, which is our primary aim. This work demonstrates the potential of using a large distributed network of smartphones as a powerful scientific instrument for monitoring Earth.

High CO2 dampens then amplifies N-induced diversity loss over 24 years

24年来，高二氧化碳浓度的抑制放大了氮引起的多样性损失

▲ 作者：Peter B. Reich, Neha Mohanbabu et al.

▲链接：

https://www.nature.com/articles/s41586-024-08066-9

▲摘要：

氮沉降导致了全球局部生物多样性的损失，但二氧化碳浓度的上升是否会加剧或抑制损失情况，以及如何加剧或抑制这些损失，目前尚不清楚，而且几乎完全没有研究过。

通过一个露天实验，我们回答了这一认知空缺。露天实验中，108块草地在不同的二氧化碳和氮水平下生长了24年。我们初步发现，增加氮对植物物种丰富度的降低在二氧化碳浓度升高的情况下比在二氧化碳浓度升高的情况下要小。

然而，随着时间的推移，这种相互作用发生了逆转，二氧化碳浓度的升高放大了富氮导致的多样性损失，在过去8年的研究中，氮添加导致的物种丰富度减少了三倍。

这些相互作用源于多样性驱动因素的时间变化，尤其是光有效性，而光有效性又由二氧化碳和氮输入以及植物生物量的相关变化驱动。这一机制在许多草地上可能是相似的，因为植物资源中二氧化碳和氮的添加可能会增加优势物种的丰度。

如果二氧化碳的上升普遍加剧了氮沉降对植物多样性的广泛负面影响，这对全球草地生物多样性的保护来说是一个不好的兆头。

▲ Abstract：

Nitrogen deposition causes local biodiversity loss globally, but whether, and if so how, rising CO2concentrations amplify or dampen those losses remains unclear and is almost entirely unstudied. We addressed this knowledge gap with an open-air experiment in which 108 grassland plots were grown for 24 years under different CO2 and N regimes. We initially found that adding N reduced plant species richness less at elevated than at ambient CO2. Over time, however, this interaction reversed, and elevated CO2 amplified losses in diversity from enriched N, tripling reductions in species richness from N addition over the last eight years of the study. These interactions resulted from temporal changes in the drivers of diversity, especially light availability, that were in turn driven by CO2 and N inputs and associated changes in plant biomass. This mechanism is likely to be similar in many grasslands, because additions of the plant resources CO2 and N are likely to increase the abundance of the dominant species. If rising CO2 generally exacerbates the widespread negative impacts of N deposition on plant diversity, this bodes poorly for the conservation of grassland biodiversity worldwide.

生物学Biology

Inducing novel endosymbioses by implanting bacteria in fungi

通过在真菌中植入细菌诱导新的内共生

▲ 作者：Gabriel H. Giger, Chantal Ernst et al.

▲链接：

https://www.nature.com/articles/s41586-024-08010-x

▲摘要：

在此，我们将细菌植入丝状真菌小孢根霉，进行人工诱导的内共生。大肠杆菌植入细胞质后可诱导隔膜形成，有效阻止内共生，而根瘤菌则以低频率垂直传播给后代。

在适应进化过程中，内共生的持续正向选择将初始适应度约束降低了几个数量级。随着系统的稳定，宿主中突变的积累强调了表型变化。该细菌在其新宿主体内产生了根毒素同系物，证明了通过诱导内共生的代谢功能的转移。

因此，单细胞植入提供了一种强大的实验方法来研究内共生发生开始时的关键事件，并为设计具有所需性状的内共生的综合方法提供了机会。

▲ Abstract：

Here we implant bacteria into the filamentous fungus Rhizopus microsporus to follow the fate of artificially induced endosymbioses. Whereas Escherichia coli implanted into the cytosol induced septum formation, effectively halting endosymbiogenesis, Mycetohabitans rhizoxinica was transmitted vertically to the progeny at a low frequency. Continuous positive selection on endosymbiosis mitigated initial fitness constraints by several orders of magnitude upon adaptive evolution. Phenotypic changes were underscored by the accumulation of mutations in the host as the system stabilized. The bacterium produced rhizoxin congeners in its new host, demonstrating the transfer of a metabolic function through induced endosymbiosis. Single-cell implantation thus provides a powerful experimental approach to study critical events at the onset of endosymbiogenesis and opens opportunities for synthetic approaches towards designing endosymbioses with desired traits.

来源：科学网微信公众号