Bottoms down

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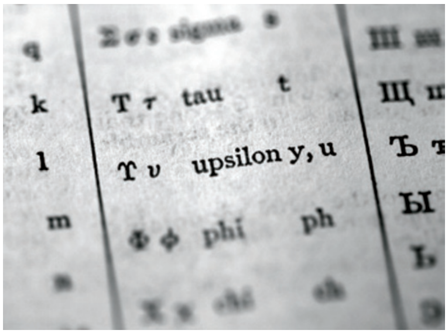

For part of each data-taking year, CERN's Large Hadron Collider is given over to the acceleration of lead ions, rather than protons. These heavy-ion collisions potentially create conditions of such extreme temperature and density that the ion components 'melt' into a quark–gluon plasma (QGP). Heavy quarks, such as bottom quarks, that would usually bind into quark–antiquark pairs ('bottomonium', denoted Υ) in the interaction region are less likely to do so, their confining potential screened by the soup of quarks and gluons.

Hence the suppression of bottomonium states is a useful probe of QGP. Through a comparison of Υ production in proton–proton and lead–lead collisions collected in 2011, the CMS collaboration (S. Chatrchyan *et al.*) have updated their results proving the suppression of Υ states in heavy-ion collisions, relative to proton interactions. Moreover, they are now able to resolve three states — $\Upsilon(1S)$, $\Upsilon(2S)$ and $\Upsilon(3S)$ — and show that the suppression is sequential: the most excited, least tightly bound $3S$ state being most greatly suppressed, and the $1S$ state the least, as expected. *AW*

On the spot and on the move

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Nature **491,** 421–425 (2012)

A combination of the long-distance transport offered by flying qubits — quantum information stored in light — and the storage capabilities of stationary matter-based qubits is central to many of the designs for future quantum-information processors. Two teams of researchers have now demonstrated how this can be achieved in nanoscale semiconductor devices by entangling a single spin with a single photon.

Both Weibo Gao and Kristiaan De Greve and their respective co-workers investigated quantum dots that stored a single electron. To this they added an optically excited electron–hole pair, which emitted a photon as it relaxed. The researchers demonstrated a quantum correlation between the properties of this photon and the spin of the electron left behind.

Gao and colleagues demonstrated entanglement between spin and photon wavelength; De Greve *et al.*, on the other hand, chose the polarization of the photon. This allowed them to shift the wavelength of the light from 900 nm to potentially more useful telecommunication wavelengths. *DG*

Quantized attraction

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The presence of boundaries leads to measurable manifestations of vacuum fluctuations, such as the attractive Casimir force between two parallel metal plates. This Casimir force could be useful for applications in nano-electromechanical systems, but it is not tunable — or at least not in common materials. Wang-Kong Tse and Allan H. MacDonald predict that things might be different for the Casimir force between two graphene sheets in a strong magnetic field.

Tse and MacDonald studied two parallel graphene sheets that are driven into the quantum Hall regime by a strong perpendicular magnetic field. In this unusual setting, the Casimir energy gains an extra contribution from the Hall current, which results in several unexpected features. When the sheets are separated by large distances, the Casimir force becomes quantized; the force can be either attractive or repulsive depending on the signs of the charge carriers in the two graphene sheets. Moreover, for charge-neutral graphene sheets the Casimir force is strongly suppressed.

These observations, bringing together quantum electrodynamics and Hall physics, hint at the possibility of controlling the Casimir effect. *IG*

Come together

Biophys. J. **103,** 2223-2232 (2012)

There is an elegance inherent in the linear-polymer encoding of our genetic information. But what happens when distant locations along a single DNA strand need to occupy a single region in space? It turns out that many important cellular processes require such co-localization, but there is as yet no single plausible physical mechanism for it.

Now, Valentino Bianco and colleagues have shown that the interaction of specific DNA loci with diffusing molecular species can effectively induce co-localization, via a crossover characterized by the formation of a single unstable loci pair — the appearance of which should be observable in experiment.

Bianco *et al.* designed a pair of schematic models, implicating a general molecular mechanism for the self-organization of DNA in three dimensions. The two models differ in terms of the constraint they place on the valency of molecular species, which determines their ability to bridge two or more regions along the polymer.

When multiple bonds were allowed, Bianco *et al.* found that DNA loci came together in a single group, whereas the single-valency model engendered a more complex picture, involving independent sub-groups of loci. A comparison of their results with experimental data revealed scenarios corresponding to both models. *AK*

Dust to dust to dust

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Planets form within circumstellar, or protoplanetary, disks made up of dust and gas left over from the formation of a star. The disk around the star UX Tauri A, in the constellation Taurus, might have a gap separating its inner and outer disks, which is suggestive of planet formation. Ryoko Tanii and co-workers have used the Subaru Telescope to image the 'pre-transitional' disk at infrared wavelengths. They find unusual polarization data — but no gap.

Normally, light scattering from small interstellar dust grains — typically 0.1 μm in size — is strongly polarized regardless of the scattering angle. However, in the case of UX Tauri A, the polarization varies from 2% to 66%. None of the existing scattering models for protoplanetary disks can explain the measured profile. What does work, however, is a geometric model based on a thin disk of non-spherical dust grains of 30-μm diameter. The authors suggest that repeated collisions cause the dust grains to stick together, forming irregular clumps on a timescale of 10^5 years. In other words, around UX Tauri A, a planetary object could be forming right now. *MC*

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