GAME THEORY

Tolerate thy neighbour

New J. Phys. **18,** 083021 (2016)

As things deteriorate in a society, the temptation to hold fast to one's beliefs intensifies, and opposing those with whom we disagree seems ever more important. But Attila Szolnoki and Matjaž Perc think there might be another way. The pair have come up with a spatial public goods game that suggests we all might be better off with healthy doses of tolerance.

All the usual players factor into Szolnoki and Perc's game: cooperators, defectors and loners. But the pair added another breed into the mix, incorporating players with a certain degree of tolerance for the defectors among them. These players could choose to cooperate or abstain, depending on the actions of other players.

A diversity of tolerance proved optimal. When tolerant players had different thresholds for withstanding defection, they could actually turn the whole group towards cooperation in cases where defection would have otherwise dominated. Certain stable solutions only emerged when the number of players was large enough, lying largely undetected for smaller games. But once they emerged, they remained stable, even in small populations. *AK*

ATOMIC PHYSICS

Puzzle confirmed

Science **353,** 669–673 (2016)

Just over a century ago, by providing an explanation of atomic emission spectra, Bohr's model of the hydrogen atom helped lay the foundations of quantum mechanics. Today, probing energy levels of atomic systems remains an important tool in further developing our understanding of fundamental atomic properties.

Randolph Pohl and colleagues from the Charge Radius Experiment with Muonic Atoms (CREMA) collaboration have now performed laser spectroscopy measurements on muonic deuterium, an exotic atom with a nucleus consisting of one proton and one neutron — a deuteron — orbited by a muon. They prepared atoms in the metastable $2S$ state, and subsequently measured the frequencies of $2S$–$2P$ transitions.

The resulting values enabled a precise determination of the root-mean-square charge radius of the deuteron, which is linked to the value of the Rydberg constant. At $2.12562(78) \times 10^{-15}$ m, this radius is significantly smaller than the conventional value obtained from electron scattering experiments. Together with similar results obtained earlier for muonic hydrogen, the findings of Pohl *et al.* imply a smaller proton radius, posing a serious challenge for the standard model of particle physics. *BV*

BIOTRIBOLOGY

Feel the squeeze

Proc. Natl Acad. Sci. USA **113,** 9210–9215 (2016)

A glass surface feels more slippery to the touch when vibrated at ultrasonic frequencies. The phenomenon has long been known, but the underlying mechanisms have remained unclear. Michaël Wiertlewski and colleagues now suggest that the reduced friction is due to the skin bouncing on a 'squeeze film' that forms as the air between the fingertip and the vibrating glass plate is compressed. This mechanism decreases the contact area and thus the friction.

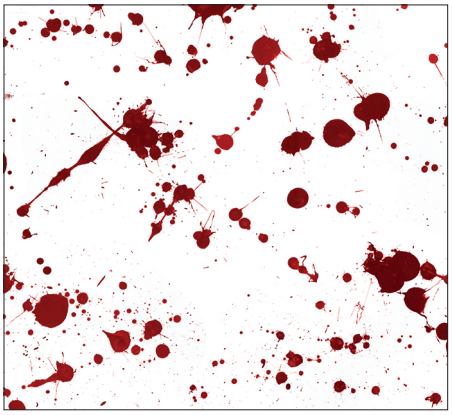
The picture of load sharing between compressed air and the skin emerged from a series of tribometric experiments in which the area of fingertip–surface contact was measured optically. Wiertlewski *et al.* relied on frustrated total internal reflection to image only skin within a few hundred nanometres of the glass surface. They could therefore reliably estimate the area of contact and monitor with high spatiotemporal resolution how that area changed when the surface was vibrated.

How these findings can be of practical value is not difficult to see: as we increasingly interact with our electronic devices using our fingertips, modulating the 'touching experience' using ultrasonic vibrations might form the basis for a new form of haptic feedback. *AHT*

FLUID DYNAMICS

Call the shots

Phys. Rev. Fluids **1,** 043201 (2016)



The spatter pattern of blood caused by a gunshot wound contains a wealth of information that forensic scientists want to tap into in order to reconstruct the scene of a crime. Current methods for analysing blood spatter patterns are relatively simply however, largely ignoring effects such as gravity and air resistance — assumptions that may not be valid when blood drops travel large distances. Patrick Comiskey and colleagues now present a method for determining the origin of blood back-spatter patterns from a gunshot, which takes into account the motion of droplets through air.

Using the Rayleigh–Taylor instability framework, Comiskey *et al.* predicted the initial distribution of drop sizes and velocities, showing that the interaction of the resulting drop cloud with air helps to reduce the drag experienced by each droplet. This information can be used to accurately calculate the trajectory and subsequent impact dynamics of the droplets, giving rise to distinct stain distributions. Using their model, they predicted characteristic stain patterns for realistic gunshot scenarios, which agree well with preliminary experiments conducted on sponges soaked in swine blood. *LF*

NEUTRINO PHYSICS

Push the limits

Phys. Rev. Lett. **117,** 082503 (2016)

It's not yet clear whether the neutrino is a Majorana particle — that is, identical to its antiparticle. The answer could be found in the neutrinoless double-beta decay: a hypothetical radioactive process producing two electrons and two antineutrinos that annihilate each other. Azusa Gando and colleagues report the latest results of the KamLAND-Zen experiment, setting 1.07×10^{26} years as the lower limit on the half-life of this decay. This can be translated into a limit on the effective Majorana neutrino mass. And its value almost reaches a very interesting regime — that of the inverted mass hierarchy, one of the two possible orderings of neutrino masses.

For such precision measurements, one needs an extremely clean background. The KamLAND-Zen experiment uses 13 tons of xenon-loaded liquid scintillator in a nylon balloon inside the KamLAND detector. Gando *et al.* purified the xenon liquid scintillator in several stages to reduce radioactive contamination, but to push sensitivity even further — to the inverted mass hierarchy regime — they will have to upgrade to a larger balloon. *IG*

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