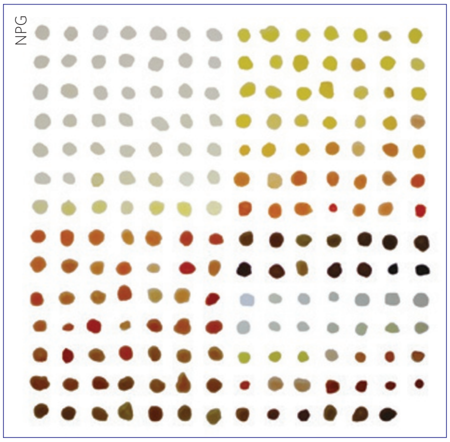
research highlights

SPECTROMETRY

Connect the dots

Nature **523,** 67–70 (2015)



How many scientists would love to have a small and cheap spectrometer? Jie Bao and Moungi Bawendi have come up with a solution by integrating almost two-hundred absorptive filter arrays made of colloidal quantum dots and a charge-coupled device detector into a coin-sized digital camera capable of resolving spectral peaks separated by mere nanometres. Such resolution and compactness may find applications in medicine or space exploration.

Colloidal quantum dots can be thought of as artificial atoms whose absorption and emission properties can be designed during fabrication by controlling their size and composition. This flexibility allowed Bao and Bawendi to create 195 unique broadband filters covering a spectral range of 300 nm. The spectrum was efficiently reconstructed by measuring a set of light intensities in parallel with an array detector whose elements were each set to one filter.

Besides their minimal size and cost, one advantage of these spectrometers is the possibility to enhance spectral resolution and range simultaneously — simply by adding more dots. *IG*

COMPLEX NETWORKS

Bring the noise

Nature Commun. (in the press); preprint at http://arxiv.org/abs/1408.1168 (2015)

The Black Death spread across Europe leaving few in its wake, so it's natural to think about it as a wave of devastation. But spare a thought for how it might have travelled, had the afflicted been able to hop on an airplane: long-distance flights foster the appearance of clusters in the spatial evolution of a contagion, with potentially more disastrous consequences. And now, Dane Taylor and colleagues have used a well-known model to map contagions in space, showcasing a technique for predicting — and perhaps controlling — spreading on complex networks.

Many networks are connected by spatially constrained edges (like roads on a map, for example), but may also incorporate additional edges connecting distant nodes. Taylor *et al.* cast these long-range connections as a source of noise in an otherwise geometric network, and observed two competing phenomena: wavefront propagation on the underlying geometric network, and the formation of clusters due to the noisy edges. Within their model, the team found regimes in which the spreading was almost unaffected by the noise edges — hinting at a possible means of contagion control. *AK*

DWARF GALAXIES

Plane speaking

Mon. Not. R. Astron. Soc. **452,** 1052–1059 (2015)

Matter, as well as dark matter, is not uniformly distributed throughout the Universe. There are clumps, filaments and voids, for example, the Local Void — a vast emptiness — near our own Local Group of galaxies that includes the Milky Way, Andromeda and many dwarf galaxies.

To better understand the structure and dynamics of galaxies, Noam Libeskind and co-workers use the Cosmicflows-2 survey of peculiar velocities to map the movement of local galaxies out to 150 parsecs. They find a filament of dark matter bridging the Local Group and the massive Virgo cluster roughly 50 million light years away. It is simultaneously being stretched by the Virgo cluster and squeezed by the Local Void plus smaller voids from the sides.

This dark matter 'superhighway' channels dwarf galaxies between galaxy clusters. Other studies have revealed that dwarf galaxies are often compressed into planes that are possibly co-rotating. The authors show that four out of the five vast planes of dwarf galaxies are aligned with the main direction of compression (and the direction of expansion of the Local Void). This connection between large-and small-scale structures will help refine models, such as the prevailing cold dark matter model. *MC*

VALLEYTRONICS

Jump across

Phys. Rev. Appl. **4,** 014002 (2015)

The electronic band structure of certain semiconductors can contain conically shaped valleys. When there are two non-equivalent valleys, such as in graphene, the system has an additional quantum number, known as the valley index. In much the same way that the electron spin is used in spintronic devices, valleytronic devices aim to make use of the valley index.

Many of the materials that offer this valley degree of freedom are single layers, but how do these valley electronic states move between layers? Ryosuke Akashi and colleagues have now shown that the stacking geometry can control how many dimensions the valley states travel in.

Using monolayers of a typical transition metal dichalcogenide, the authors showed that the motion of valley electronic states was confined to just one of the two-dimensional monolayers for a particular type of stacking, known as 3*R* stacking. For 2*H* stacking, on the other hand, the valley states could jump between different monolayers, and travel in three dimensions. *LF*

RANDOM WALKS

Competitive advantage

Phys. Rev. E **91,** 062815 (2015)

Many a statistical physicist looking for stochastic processes to study will have considered competitive team sports and wondered about the dynamics at play, and perhaps even thought about how they might best be modelled and understood. Appreciating their complexity is one thing, but making meaningful insights that might translate into quantitative predictive capability is altogether more challenging.

Aaron Clauset and colleagues have focused on a simple, yet decisive, characteristic of sporting contests, namely the times in a game when the lead changes. Using random walk theory, they showed that the number of lead changes in any individual game follows a Gaussian distribution. More surprisingly, they also show that the probability that the last lead will change and the time when the largest lead size occurs follow the same bimodal distribution that diverges at the start and the end of the game. Finally, they evaluated the probability that any given lead is 'safe' and maintained until the game is over.

Most importantly for sports fans, the authors demonstrated a good agreement with an exhaustive body of empirical data, particularly in the case of professional basketball, where the number of scoring events in each game is very high. Sport isn't random; it's a random walk. *AT*

Written by May Chiao, Luke Fleet, Iulia Georgescu, Abigail Klopper and Andrea Taroni .