BIOMECHANICS

Take the plunge

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Seabirds are notorious for plunge diving at seemingly break-neck speeds. But does hunting like this really pose a threat to their slender necks? And might humans be able to withstand similarly treacherous descents? Brian Chang and colleagues sought to find out by developing a mechanical understanding of neck stability during plunge diving.

The team focused on two seabird species that both endure strong axial forces when they dive, despite having distinctly different styles. A slender body subject to axial forces should buckle, but seabirds only injure themselves diving when they collide with other birds. To make sense of this, Chang *et al.* conducted experiments on a model seabird made of a long, thin elastic beam attached to a rigid cone, and performed a linear stability analysis to predict the buckling transition.

Their analysis suggested that the birds' neck muscles and morphology render them ideally suited to plunge diving at high speeds. A similar consideration of humans diving feet first found that the compressive forces for comparable speeds would be far too high for our bodies to endure. *AK*

HISTORY OF PHYSICS

Long before LIGO

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When the first successful detection of gravitational waves occurred early this year, LIGO became a household name. But the history of gravitational wave detection goes back to the early 1960s. And now, Guido Pizzella has given us a personal account of these experiments — some already forgotten.

Joseph Weber built the first detectors, now known as Weber bars, in the 1960s. These were gravitational wave antennas made of massive aluminium cylinders acting as resonators. Weber's observations, claimed as evidence for detection, could not be confirmed by experiments performed during the following two decades in laboratories worldwide. But despite the disappointment, work continued with cryogenic detectors. Going colder and heavier did improve sensitivity and several experiments ran in the 1990s and early 2000s. However, evidence remained scarce.

Resonant bar detectors never quite managed to detect gravitational waves, but the lessons learned during their construction and operation helped the development of large-scale laser interferometers like LIGO and VIRGO. It seems now that 40 years of work was worth all these efforts. *IG*

ELASTOMERS

Morph on demand

Nat. Commun. **7,** 13140 (2016)

Wouldn't it be nice to have an elastomer that could change into any given shape? Most definitely — if only for applications like microfluidic valves, Braille readers or artificial muscles.

Andraž Rešetič and colleagues have made an important step towards the manufacture of such functional rubbers. They took low-viscosity polydimethylsiloxane, a conventional elastomer, and added elastomeric liquid-crystal microparticles exhibiting shape memory — the ability to return from a deformed state into the undeformed state through heating. Under the application of an external magnetic field, the particles collectively align, and the shape-memory effect is carried over to the macroscopic structure. Subsequent hardening via thermal treatment results in a material that will deform when heated. The composite's shape-memory behaviour depends on the concentration and distribution of the fillers — enabling control of its thermoelastic response.

The authors further showed that macroscopic bilayers of these elastomeric composites with different deformational directions can result in any of five basic thermomechanical deformation modes. The future looks bendy. *BV*

TOPOLOGICAL MATTER

A fine line

Phys. Rev. Lett. **117,** 136401 (2016)

Dirac semimetals are materials whose electronic band structures are three-dimensional analogues of graphene, featuring electron bands with linear dispersion close to a Dirac point, forming Dirac cones. Bulk cadmium arsenide was thought to fall into this class of material, containing a single pair of Dirac cones that are protected by crystal symmetry, but experiments by Ana Akrap and colleagues suggest that the situation may be a little more complex.

Previous experiments classified the charge carriers in bulk cadmium arsenide as massless symmetry-protected Dirac fermions, which is what you'd expect for a Dirac semimetal. And although magneto-optical experiments by Akrap *et al.* support the idea that the carriers are massless, for certain energies, they suggest that they are actually massless Kane fermions.

Kane fermions are a type of carrier that can appear in some narrow-gap semiconductors that have conical electronic band dispersions. And although they exhibit several behaviours similar to Dirac fermions, they have quite a different origin, and are not protected by crystal symmetry. Could this material contain both massless Dirac and Kane fermions over different energy scales? The authors think so. *LF*

AGGREGATION PHENOMENA

Collective diversity

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The concerted movements of birds and fish are captivating examples of collective motion. A number of models have been developed to describe such behaviour. However, which pattern a given ensemble of self-propelled particles — be they starlings, bacteria or robots — will eventually assume, and the stability of that pattern, remains difficult to predict. Now, Zhao Cheng and colleagues report that various 'pattern phase transitions' can be captured in a model that factors in the vision range of the particles and their tendency to avoid obstacles.

The authors found that for short vision ranges particles move, gas-like, in a widely uncorrelated fashion. Longer-sighted particles get locked into 'crystalline' patterns with identical inter-particle distances and, for even longer-ranging interactions, into liquid patterns with varying, but short distances between constituents. The liquid phase co-exists with various milling phases — stationary circulating patterns (as observed in nature; pictured) that change depending on the particles' obstacle-avoidance tendency, which defines the short-range interactions. Cheng *et al.* expect that these insights should enable, for example, changing the collective motion of vehicles or robots by simply tweaking a few dynamical parameters. *AHT*

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