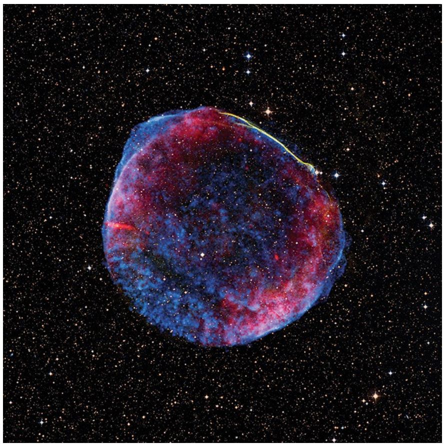
SUPERNOVAE

Different shades of blue

Astrophys. J. Lett. **867**, L31 (2018)



Credit: Stocktrek Images/Alamy Stock Photo

Certain types of star evolve into supernovae (pictured), whose light we can observe with telescopes. Supernovae are classified according to the presence or absence of elements in their optical spectra. But the supernova SN 2017ens shows a spectrum in the ultraviolet and near-infrared range, which fits none of the known categories — so astrophysicists are curious to understand the formation and evolution of this particular supernova.

Now, Ting-Wan Chen and colleagues have reported the observation of SN 2017ens over more than 260 days. The supernova was initially a hot blue object without features. Shortly after the spectral peak was observed, narrow emission lines started to appear in the spectrum, and over time, broader features developed. After 160 days, the spectrum evolved dramatically: although it remained within the blue, the spectrum was dominated by wide emission lines. Accompanying measurements show that SN 2017ens could have been a pulsational pair instability supernova, in which a fraction of the star's mass is disrupted followed by a core collapse or hypernova. *SR*

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CELL BIOPHYSICS

Wave machine

Comm. Phys. **1**, 73 (2018)

Migrating cells use all kinds of tricks to get a sense of their surroundings. The filamentous meshwork under the membrane of many cells transduces forces and establishes the polarity required for directed migration. But it's also known to play host to dynamic pattern formation — including waves in the cell's shape. Now, Cody Reeves and colleagues have come up with a theory predicting that competition between rotating waves may have a role in making the cell transition from a stationary state to a polarized, steadily moving state.

A spontaneous polarization in cell shape usually kick-starts migration, growing in amplitude until it induces persistent motion — and multiple waves can compete to elicit the same effect. Using a phase field approach, Reeves et al. showed that rotating waves emerge within a minimal physical model that doesn't explicitly encode the biochemical or genetic cues typically associated with cell migration. Instead, the model considers only protrusion, adhesion and feedback via adhesive bond breaking. *AK*

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AERODYNAMICS

Immaterial spike

Sci. Adv. **4**, eaau5239 (2018)

Flights travelling supersonically experience large drag caused by shock waves, leading to a considerable increase in fuel consumption. Mounting a spike in front of the blunt body can mitigate this effect, but its aspect ratio is often limited by structural constraints, such as vibrations and mechanical stress. Now Paul-Quentin Elias and co-workers have shown an alternative solution, replacing the rigid spike with plasma filaments formed by ultrashort laser pulses.

The role of this immaterial spike was demonstrated by a test model placed in a Mach 3 supersonic wind tunnel. Intense femtosecond infrared laser pulses emerged from the front, leading to a sudden creation of a short-lived plasma column and leaving behind a long-lived hot and thin neutral air channel of reduced density. A transient reduction of more than 50% of the drag induced by the laser pulse was observed. Further adjusting the direction of the laser resulted in a net asymmetric drag, which may offer a means of control. *YL*

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MOLECULAR PHYSICS

Exciting neighbours

Phys. Rev. Lett. (in the press); preprint at https://arxiv.org/abs/1809.04054

Consider any fundamental chemical process in nature and it is likely to involve energy transfer between molecules. Notable ways for this to happen include fluorescent resonant energy transfer, which takes place between the electronic states of neighbouring molecules, and intermolecular Coulombic decay, where electronic energy transfer leads to ionization. The taxonomy of transfer processes, however, keeps getting richer: Lorenz Cederbaum has now investigated the possibility that the vibrational energy of a molecule can be transferred to a neighbour, thereby ionizing it.

According to his theoretical analysis, this vibrational intermolecular Coulombic decay could be surprisingly efficient at distances much beyond those that would allow a chemical bond. In fact, although the radiation lifetime of isolated vibrationally excited molecules goes from milliseconds to seconds, the small energy scales involved should make the process much faster, down to the nano- or picosecond timescale. *FL*

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ARTIFICIAL PHOTOSYNTHESIS

Straight for the sun

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Strategies for replacing fossil fuels in the Earth's energy cycle use the production of energy carriers from renewable sources — either by photoelectrochemistry or photovoltaic energy production. Devices for both approaches have been presented, but integrating them in a single apparatus with matched performance and without efficiency losses has remained elusive. Now, Ian Sharp and colleagues have come up with a layout that allows light-induced water-splitting and production of electricity simultaneously.

Sharp et al. integrated a transition metal oxide photoanode onto a silicon wafer to form a hybrid photoelectrochemical/voltaic cell with three termini. In this assembly, carriers not used for the photoelectrochemistry can be extracted as electrical current through the third contact, circumventing current mismatches without having a detrimental impact on the hydrogen evolution. This device boosts the overall usable energy output and provides another step toward efficient solar light harvesting. *JPK*

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