

BATS' EARS MAY SOLVE AN EVOLUTIONARY PUZZLE

Despite the common saying, bats aren't actually blind—but about 85% of bat species can hunt in the dark by tracking the echoes of their own voices, an ability called laryngeal echolocation. (See the article by Whit Au and Jim Simmons, *PHYSICS TODAY*, September 2007, page 40.) The remaining 15%, a group called the Old World fruit bats (for example, the lesser short-nosed fruit bat shown here), rely on plain old eyesight. This finding has led to a fierce debate among evolutionary biologists: Did bats descend from a single ancestor capable of laryngeal echolocation, with fruit bats losing the ability somewhere along the way? Or did laryngeal echolocation evolve independently in different branches of the bat family tree?

A team of researchers led by Shuyi Zhang at Shenyang Agricultural University may have uncovered new clues to this evolutionary mystery by studying the fetal



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development of bats' ears. Many animals exhibit vestigial structures inherited from distant ancestors during early stages of development. Human embryos, for example, begin with a tail.

Zhang's team, along with Emma Teeling at University College Dublin, analyzed the development of the cochlea, a spiral-shaped bone in the inner ear. Species that use laryngeal echolocation have extremely large cochleae relative to their

skull size; that trait enables greater sensitivity to the vibrations generated by their echoing voices.

The researchers tracked relative cochlear size at different stages of fetal development for seven species of bat and for five other mammals. They found that at early stages of fetal development, the relative cochlear size of the Old World fruit bats was similar to that of bat species capable of laryngeal echolocation. Whereas more-developed fruit bat fetuses had smaller cochleae than their laryngeal-echolocating relatives, they still had relatively large cochleae compared with other non-echolocating species such as mice and hedgehogs. The presence of large fetal cochleae suggests that Old World fruit bats did indeed descend from an ancestor capable of laryngeal echolocation. (Z. Wang et al., *Nat. Ecol. Evol.* **1**, 0021, 2017.) —MB

second cation, and a halogen anion make for solar cells of remarkably high efficiency despite rather modest charge-carrier mobilities (see *PHYSICS TODAY*, May 2014, page 13). Yet the nature and fate of

the photoexcited charge carriers remain little understood. A Swiss team led by Majed Chergui of the

Swiss Federal Institute of Technology in Lausanne has now peeled back some of that mystery. With time-resolved x-ray absorption spectroscopy, the researchers studied two inorganic perovskites— CsPbBr_3 and $\text{CsPb}(\text{Cl}_x\text{Br}_{1-x})_3$ —at the Swiss Light Source. By tuning the energy of the pulsed x rays, they

could interrogate each element independently with a resolution of 80 ps. For both materials, the team found that the excited electrons are delocalized in the conduction band, whereas the holes left behind in the valence band are localized at the Br sites. The Br signal consisted of one component that decayed quickly and one that decayed slowly; the photoluminescence kinetics of organic-inorganic perovskite solar cells show a similar biexponential decay. Meanwhile, the Cs^+ cations showed no evidence of being involved in the charge transport, which suggests that organic cations would likewise be uninvolved. (F. G. Santomauro et al., *Struct. Dyn.* **4**, 044002, 2017.) —RJF

A FAST RADIO BURST'S EXTRAGALACTIC HOME

Discovered in 2007, fast radio bursts (FRBs) emit luminous pulses of radio light that last mere milliseconds. To date, astronomers have reported about 20 FRBs but don't know what causes them. One, identified in 2014 by Laura Spitler and colleagues, stands apart because it has been observed to burst repeatedly (see

PHYSICS TODAY, April 2016, page 22). The source was first detected on 2 November 2012, hence its designation FRB121102. An international team took advantage of FRB121102's ongoing intermittent activity to run a series of follow-up observations with several radio telescopes in the US and Europe and has located FRB121102 with unprecedented precision. The radio observations didn't just refine the location of FRB121102, they also spotted a persistent source coincident with the FRB, to within experimental uncertainty. It is possible that the persistent source is related to the FRB; it could be, for example, a highly energetic neutron star in a young supernova remnant or an unusual active galactic nucleus.

The researchers also observed the neighborhood of FRB121102 with the Gemini North optical telescope. They determined that the location of the FRB coincides with that of a dwarf galaxy some 3 billion light-years distant from Earth. Although astronomers had expected FRBs to lie beyond the Milky Way, some models allowed for sources in our galaxy; the new work provides the first direct confirmation of the earlier consensus. Dwarf galaxies are more likely than regular galaxies to host two other classes of high-energy transients: superluminous supernovae and long-duration gamma-ray bursts. The observation of an FRB in a dwarf galaxy creates the tantalizing prospect that all three types of high-energy events may be generated by massive progenitors. (S. Chatterjee et al., *Nature* **541**, 58, 2017; S. P. Tendulkar et al., *Astrophys. J. Lett.* **834**, L7, 2017; B. Marcote et al., *Astrophys. J. Lett.* **834**, L8, 2017.) —SKB 



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