MOLECULAR BIOLOGY

# Untranslated Regulators

A variety of short noncoding RNA molecules—microRNAs, small interfering RNAs, and Piwi-interacting RNAs (piRNAs)—play regulatory roles in eukaryotes. Many piRNAs are derived from transposon-related sequences and, through complementary sequence interactions and a "ping-pong" amplification process, act to silence those selfish and potentially mutagenic elements in germline cells.

However, Robine et al. show that a substantial population of piRNAs found in a Drosophila somatic ovarian cell line are in fact derived from a distinct subset of genes, and also that the bulk of these piRNAs arise directly from the 3′ untranslated regions (3′ UTRs) of the sense strands. This suggests that the complementary targets of these piRNAs may not be the parental transcripts. Ping-pong amplification is not required for the generation of these 3′ UTR piRNAs, nor does it appear as if they are aberrant products of the primary piRNA processing pathway. Furthermore, Saito et al. have found that the Drosophila gene traffic jam (tj) gives rise to 3′ UTR piRNAs and that one of its targets is the fasciclin III gene transcript, and Robine et al. note that the subset of functional categories of mRNAs that gives rise to the 3′ UTR piRNAs is broadly conserved between fruit flies and mice. — GR

*Curr. Biol.* **19**, 2066 (2009); *Nature* **461**, 1296 (2009).

## PHYSICS

### A Second Second Sound?

Superfluids, such as $^4$He below its transition temperature around 2 K, make for a great science demonstration: They flow without viscosity through tiny holes, creep up vertical walls, and refuse to boil. This last property arises because heat, which normally propagates by diffusion, travels through a superfluid following a wave equation (often referred to as the "second sound"), resulting in extremely high thermal conductivity. Meppelink et al. realize an analog of this phenomenon in a weakly interacting

Bose-Einstein condensate of sodium atoms by physically separating the condensed (superfluid) from the thermal (normal) portion of the gas. They then cause out-of-phase oscillations of the two components during which the center of mass remains stationary, much as in the case of the second sound. The amplitude of these oscillations is damped as the condensate passes through the thermal cloud, leading to energy exchange between the two (Landau damping). The damping rate is measured as a function of the temperature and confinement of the gas. In the collisionless regime (gas cloud size smaller than the mean free path), the Landau damping

mechanism explains the results, whereas in the hydrodynamic regime the experiments suggest another, collision-dependent mechanism, which lacks a thorough theoretical description. — JS

*Phys. Rev. Lett.* **103**, 265301 (2009).

## CANCER

### Unfaithful Encounters

Chromosomal translocations, whereby nonadjacent regions of chromosomes are inappropriately joined, are a hallmark of several different types of cancer. They can result in the generation of fusion proteins that bypass normal control mechanisms and can wreak havoc in cells. It has been assumed that translocation events occur randomly; whether more ordered processes are involved has been unclear.

The androgen receptor is a transcription factor that regulates gene expression during prostate development. Fusions between an androgen receptor target gene and genes encoding members of the ETS family of transcription factors place ETS proteins under the control of androgen and are associated with prostate cancer. Using androgen-responsive prostate cells, Lin et al. could produce cancer-specific gene fusions by inducing genotoxic stress and adding androgen. The activation of the androgen receptor promoted encounters between physically separate genes in the nuclei of prostate cells, and genotoxic stress induced double-stranded breaks in intronic regions of these genes. Furthermore, androgen and genotoxic stress recruited proteins involved in sensing DNA breaks and mediating chromosomal rearrangements. — HP

*Cell* **139**, 1069 (2009).

## CHEMISTRY

### Jumping off the Page

Few marriages of analytical methods have been as successful as that of chromatography and
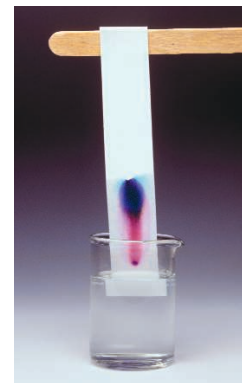


mass spectrometry; together they can tease out the chemical composition of extraordinarily complex mixtures. A typical apparatus incorporates a gas or liquid chromatograph, in which analytes travel through a separation column, and a

downstream detector where their masses are measured. An early, no-frills variant of chromatography involved spotting samples on paper, an inexpensive and highly portable support medium. Wang *et al.* now show that this simple material can also be used as an ionization platform for introducing samples into mass spectrometers. Samples such as blood are spotted on the paper, which is then cut to a sharp triangular point. The paper is wet with a methanol-water solution, and a high positive bias (4.5 kV) is applied to the paper relative to the nearby inlet of a tandem mass spectrometry under ambient conditions; the precise mechanism for ion release remains somewhat unclear. The authors demonstrate the detection of drugs such as Gleevec in blood, as well as picogram quantities of cocaine swabbed from a surface. Chromatographic methods can also be used to separate components in a sample along the paper, which can then be cut into separate pieces for further analysis. — PDS

*Angew. Chem. Int. Ed.* **49**, 10.1002/anie.200906314 (2010).

### CLIMATE SCIENCE
## Model Behavior

Most of what we believe about how climate will change in the future is based on projections made by sophisticated climate models. There are currently multiple highly complex mathematical representations of the climate system, and although most of them generally make similar predictions about the future course of climate, they differ significantly in many particulars. Because it is not normally clear which models' scenarios are likely to be the most realistic, the question arises of which specific models to believe and why. Knutti *et al.* discuss some major sources of differences between models, how their predictive skill can be evaluated, and how confidence in their projections can be improved by combining the results of multiple models. As climate models become more complex, and the amount of data from them increases, it becomes even more important to have quantitative methods available through which to extract and synthesize information needed to guide climate policy decisions. — HJS

*J. Clim.* 10.1175/2009JCLI3361.1 (2009).

### BIOCHEMISTRY
## Uninhibited Mimicry

*Helicobacter pylori* is a pathogen that causes gastric disease and is associated epidemiologically with gastric cancer. This bacterium injects its protein CagA into epithelial cells lining the

stomach in order to disrupt cellular functions, and a domain of CagA that contains contiguous repeats acts to inhibit the PAR1-MARK family of protein serine-threonine kinases.

Neŝić *et al.* describe the 2.2 Å crystal structure of the human kinase MARK2 in complex with a 120-residue repeat-containing subdomain of CagA. Unusually, the kinase adopts an active conformation even though there is no magnesium or ATP present, and a 14-residue CagA segment was observed to occupy the MARK2 substrate-binding site. This peptide appeared to promote and stabilize the active conformation of MARK2 by mimicking conserved features of the host substrates of this protein kinase family in a fashion reminiscent of the inhibition of the cAMP-dependent protein kinase by the endogenous peptide PKI. — VV

*Nat. Struct. Mol. Biol.* **17**, 130 (2010).
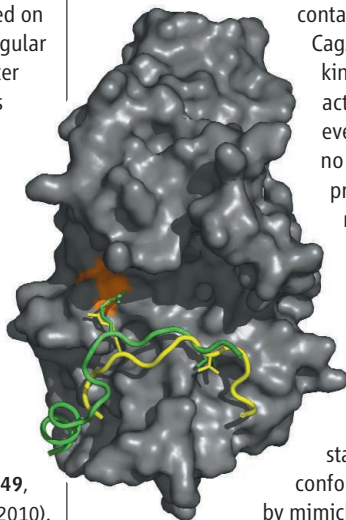
### BIOMEDICINE
## Calculating Unmeasurables

In assessing an epidemic, it would be helpful to know how many people were being infected each day. The objective data, however, are more likely to reflect how many people either became ill or died on a given day, time-lagged tallies that represent subgroups of the total infected population. For latent infections that simmer for years before producing symptoms, such as HIV, or for acute infections where time to death is variable, derivations of the desired incidence curve can be uncertain.

Goldstein *et al.* apply a mathematical method that was originally used for the purpose of extracting images from blur. Information about the time to death and the deaths per day was combined to calculate the incidence distribution, and the authors applied their approach to the influenza epidemic that struck Philadelphia in 1918. Their analysis suggests that in the few days between when the size of the epidemic became clear and when the city enacted closure of public gathering places, the spread of influenza was already being slowed significantly, probably by changes in individual behavior. — PJH

*Proc. Natl. Acad. Sci. U.S.A.* **106**, 21825 (2009).