Dissipating Decoherence

Exploiting macroscopic quantum coherence effects of superconducting systems is thought to be one promising route for developing qubits, the logical devices from which quantum computers will be built. Within this framework, the Josephson junction is one of the key components that requires further study, especially the decoherence dynamics of the junction. Han et al. (p. 1457) present time-resolved measurements of the decoherence dynamics of the quantum two-level system that reveal a temperature-dependent decay of the system from the ground state and the first excited state. They also observed a prominent double-exponential decay for intermediate temperatures. The measured decoherence time (>11 microseconds) shows sufficient promise for device applications.

Dense Rutile

Rutile (titanium dioxide) is a common accessory mineral in terrestrial rocks and meteorites. The titanium cation is coordinated to four oxygen anions, but with increasing pressure and temperature, more oxygen anions may be coordinated. Now, El Goresy et al. (p. 1467) have found an extremely dense phase of rutile in shocked gneisses from the Ries impact crater in Germany. The titanium cation is coordinated to seven oxygen anions, which has not previously been found in natural samples, and provides a useful diagnostic for determining the environment in which rocks and meteorites may have formed.

Underground Activity

The strontium isotopic composition of ocean water is an important indicator of changes in continental weathering in the geologic past that has been used to infer variations in tectonic uplift, the types of rocks eroded, and glaciation. Oceanic Sr budgets are based mostly on river inputs, and have not considered groundwater as a significant source. Basu et al. (p. 1470) have measured groundwater Sr fluxes and isotopic ratios and found that groundwater can transport large amounts of Sr with values of 87Sr/86Sr similar to those of river water from the Ganges-Bramaputra river delta into the Bengal Basin. Their data suggest that variations of oceanic Sr isotopes that have occurred during the past 40 million years should be interpreted in light of these higher inputs.

Deep Earthquakes

The mechanisms that cause a fault plane to rupture at depths greater than 100 kilometers are poorly understood. Wiens and Snider (p. 1463) analyzed three clusters of deep earthquakes along the Tonga subduction zone near Fiji and found that these events created small ruptures at about the same time and same location. This spatial and temporal distribution suggests that thermal shear instabilities cause these kinds of ruptures and that subsequent events can be triggered by the thermal energy of the initial shear that has not had time to dissipate.

Polarized Photodetectors

Quantum confinement effects can lead to polarized photoemission from ellipsoidal quantum dots. However, classical effects also can lead to strongly polarized photoluminescence from relatively wide nanowires (20-nanometer diameter) made of indium phosphide. Wang et al. (p. 1455) demonstrate an order-of-magnitude difference in the parallel and perpendicularly polarized emission and explain this difference in terms of dielectric contrast. They exploit these effects to create a polarization-dependent photodetector.

Two Elephant Species in One

Elephants in Africa inhabit two major vegetation types—savannah/bush and forest. Forest elephants differ in various aspects of size and morphology from savannah/bush elephants, but—with some dissenting voices—most systematists have regarded them as members of a single species, Loxodonta africana. Roca et al. (p. 1473; see the news story by Vogel) compared the DNA sequences from the two forms in four nuclear genes and found extensive genetic divergence between them and very little hybridization. The molecular data suggest separate evolution for at least the past 2.5 million years and that the forest and savannah elephants should be classified as two distinct species that require individual attention in conservation programs.

Following Plant Fertilization

In flowering plants, fertilization is facilitated by the pollen tube, which must wend its way from where the pollen grain lands to its target, the female gametophyte, to which the immotile male gamete is delivered. Higashiyama et al. (p. 1480; see the cover and the Perspective by Cheung and Wu) have used laser ablation to in-
vestigate the sources of signals that guide the growing pollen tube to its destination. Ab- 
lation of the two synergid cells only, which lie adjacent to the egg cells, resulted in mis-
targeted pollen tubes. The synergid cells, which send an attractive signal before fertiliza-
tion, ceased to be attractive after fertilization, offering one line of defense against super-
numery fertilizations.

**Starting With a Leg Up**

The ventral appendages of the fruit fly *Drosophila melanogaster*, which include the antennae, legs, genitalia, and analia, are structurally very different from each other. It is known that the selector genes specify the identity of these appendages. Altering the expression of various selector genes will "transform" one appendage into another. Casares and Mann (p. 1477) hypothesized that in the absence of selector gene activity, one could detect a "ground state" appendage. They go on to show that when selector gene function was eliminated, a simple leglike appendage resulted which contained only two segments—a proximal segment and a distal tarsus. This finding suggests that the predecessor of arthropods may have had simpler, unsegmented legs.

**Connecting Plaques and Tangles**

Controversy still rages over which of the two hallmark pathologies of Alzheimer’s disease, amyloid plaques and tau tangles, is the primary cause of neurodegeneration in the brain. Two reports by Lewis et al. (p. 1487) and Götz et al. (p. 1491) now show that the two pathologies are not unconnected (see the Perspective by Lee). Working with transgenic mice, the two groups independently demonstrate that β-amyloid deposits in the brain influence the formation of tau tangles in areas of the brain known to be affected in Alzheimer’s disease.

**Sensory Rhodopsin Structure**

Retinal (of which vitamin A is the alcohol) is the chromophore of the rhodopsin family of proteins. Haloarchaea contain four members of this family, two of which, halorhodopsin and bacteriorhodopsin, convert solar energy (green-orange light) into transmembrane gradients of chloride and protons, respectively. Luecke et al. (p. 1499) describe the crystal structure of a third member, known as sensory rhodopsin II, which mediates avoidance of more energetic and potentially harmful blue light and coordinated repression of bacteri- 
orhodopsin and halorhodopsin under environmental conditions that allow the use of other sources of nutrients and energy. Three points now become clear: (i) How the local environment of the retinal chromophore is tuned to optimize absorbance of shorter wavelength light; (ii) why this family member does not transport ions; and (iii) how this sensor communicates with downstream signaling components.

**Priming Speeds Replication**

Human immunodeficiency virus (HIV) depends on cellular activation for efficient replica-
tion, so the resting state of most T cells is not ideal for viral propagation. Wu and Marsh (p. 1503) observed that two HIV proteins produced early in the HIV replication cycle have the capacity to sensitize T cells toward cellular activation. Remarkably, the two pro-
teins, Nef and Tat, are produced by the selective transcription of the pro-viral DNA before it has integrated into the host genome. This distinctive mode of early cellular activation may be an important means by which the T cell host is primed for HIV replication.

**Seeing Shapes Versus Curves**

The representation of objects is central to visual perception, yet it has been surprisingly dif-
cult to pinpoint precisely where in the visual processing pathways this occurs. Kourtzi and Kanwisher (p. 1506) present evidence in favor of the lateral occipital complex. By comparing brain activation responses to changes in contours (whilst maintaining the same shape) with responses to changes in shapes (holding contours constant), they conclude that this region of the brain "sees" entire shapes and not merely the constituent curves.