In the center of the Milky Way lies a supermassive black hole called Sagittarius A* (Sgr A*). This black hole (inside the central white patch) has been detected by means of emissions just beyond its event horizon and through the motion of very close and very young massive stars. About 10 stars orbit the black hole within 0.04 parsecs and about 40 orbit within 0.1 parsecs, yet no model has been able to explain how these stars can be so close, so young, so massive, and in such relatively stable orbits.

Alexander and Livio propose a three-body dynamical interaction model to knock these stars into their orbits, like billiard balls. The young stars form far from Sgr A* and are scattered into eccentric orbits by the massive black hole. Over time, these stars cross paths with stellar mass black holes (SBHs) that are clustered near Sgr A*. Every so often, a star, a SBH, and Sgr A* undergo a three-body exchange, in which the SBH is ejected from the system and the star gets captured in a tight orbit around Sgr A*. Although the mass and the size of Sgr A* are being defined with increasing precision (see Bower et al., this issue, p. 704), the number and distribution of SBHs are less certain, so how broadly this ingenious model applies will depend on improved specification of the SBHs. — LR


**BIOCHEMISTRY**

**Forespore Foursome**

Proteases catalyze the addition of water across the peptide bond and hence, until recently, were thought to operate in an aqueous milieu. The discovery of intramembrane proteolysis in a wide range of contexts, from cleavage of the amyloid precursor protein implicated in Alzheimer’s disease to developmental signaling via the Notch receptor in *Drosophila*, has stoked interest in finding out how such proteolysis occurs and what the active site looks like.

Zhou and Kroos take a step toward these goals in a mutational analysis of the interaction between the protease, in this instance, a Zn-metalloenzyme called SpoIVFB, and its regulatory inhibitor BoFA. These are part of a complex in the *Bacillus subtilis* forespore that releases a signal, the transcription factor σE, into the mother cell compartment; the inactive precursor Pro-σE is anchored in the forespore membrane and is the substrate of SpoIVFB. These authors propose that a histidine residue of BoFA provides the fourth ligand to the active site Zn (with the other three contributed by SpoIVFB) and that destabilization of the BoFA-SpoIVFB interaction moves the histidine away, allowing for activation of a nucleophilic water molecule by the Zn atom. — GjC


**CHEMISTRY**

**Fine Tuning the Bore**

One approach for synthesizing metal nanotubes is first to create a template with pores of the appropriate outside diameter (such as a polycarbonate membrane) and then to build the nanotube wall via electroless deposition on the inside surface of the pores.

This process allows for good control over the final inside diameter, which can be important in applications such as bioseparations. Hou et al. have extended this approach to a nonmetallic system, in this case the layer-by-layer deposition of *α,ω*-diorganophosphates alternating with Zr cationic species. Sputtering alumina membranes with gold blocked deposition on the membrane faces but not in the pores. By electrochemically measuring ion currents through nanotubes with differing numbers of layers (ranging from 3 to 30), they show that the film thickness increases smoothly and at the same rate as films deposited on flat surfaces. Tubes with inside diameters as small as 23 nanometers were obtained in this way. — PDS


**CELL BIOLOGY**

**Recruitment System**

The targeting of peripheral membrane proteins to the Golgi complex is important in order to maintain the distinct identity of membranes as transport vesicles bud off from and fuse with intracellular organelles. Behnia et al. and Setty et al. describe aspects of the targeting mechanism for a family of Golgi proteins, the golgins, that help direct membrane traffic. In yeast cells, the small GTP-binding protein Arl3 (whose human homolog is ARFRP1) is recruited to the Golgi and is responsible for recruiting a second protein, Arl1, that binds to the GRIP domain in golgins and attaches these vesicle-tethering proteins to the Golgi complex. Unlike other Arf-like GTP-binding proteins, Arl3 is not myristoylated, but instead is acetylated at its N-terminal end. The targeting of Arl3 requires the integral membrane protein Sys1, which appears to interact directly with the acetylated tail of Arl3. Thus, Golgi-localized Sys1 recruits acetylated Arl3, which in turn recruits Arl1, which can then recruit golgins. — SMH


**CHEMISTRY**

**Resisting Dendrimers**

Scanning probe methods have found increasing use for lithographic patterning because of the ability to pattern at tens of nanometers resolution and to align overlayers with similar accuracy, and because the equi-
ment is relatively inexpensive and easy to set up. As with many lithographic methods, a resist, consisting of a thin layer of organic molecules, is used to aid in the selective patterning of the substrate, which is then developed using a chemical etching stage. However, a problem arises for titanium films because the metal and its oxide tend to have similar removal rates when exposed to strong etchants.

Drawing on the success in using dendrimers to enhance silicon lithography, Rolandi et al. have modified the chemistry of the dendrimer’s focal point to make it compatible with titanium surfaces. The resist can be used for either positive or negative image transfers. In positive tone mode, the tip of the atomic force microscope (AFM) is used to scrape away selected dendrimer molecules, leading to a faster etching in these exposed areas. For negative tone patterning, a voltage bias is applied across the AFM tip, causing an oxidation of the dendrimer in the selected regions. The writing oxidizes the titanium and degrades the dendrimers, leading to deposition of amorphous carbon, which is very resistant to the etching solution. — MSL

**BOTANY**

**Good Senses Make Good Neighbors**

Shade avoidance by stem elongation is a key growth response of plants competing for light within a canopy. The initiation of this response has been attributed to the detection of near neighbors by phytochrome photoreceptors sensitive to the ratio of red light to far-red light; more recently, the plant hormone ethylene has been implicated in shade avoidance. Pierik et al. compared the growth of transgenic ethylene-insensitive and wild-type tobacco plants in high-density monocultures, and also monitored light patterns and ethylene concentrations in the plant canopies. Higher plant densities resulted in more vertically oriented (hyponastic) leaves and more elongated stems, and both responses were more pronounced in the wild-type plants. Within the canopies, ethylene concentrations increased, and all light parameters decreased as the plants grew. Further experiments with individual plants grown under different light regimes showed that low levels of blue light—rather than the red to far-red ratio—in¬duced enhanced stem elongation and leaf hyponasty in the wild-type plants and that this response was mediated by high¬er ethylene concentration. This work sheds light on how plants sense their neighbors and relates to ecological and agronomic studies on the mechanisms of plant competition. — AMS

**DEVELOPMENT**

**Neuronal Maturation**

Rett syndrome is a childhood neurodevelopmental disorder that occurs primarily in females and is characterized by progressive autism and mental retardation. Mutations in MECP2, a gene that encodes a methyl-CpG-binding protein, are associated with about 80% of all cases. The MeCP2 protein is highly expressed in postnatal brain neurons, mediates transcriptional silencing by recruiting chromatin-modifying factors, and is thought to regulate genes involved in synaptic activity and neuronal maturation. Mutant mice lacking functional MeCP2 exhibit phenotypes similar to those of Rett syndrome patients, including decreased head growth and smaller and more densely packed neurons. Luikenhuis et al. demonstrate that expression of a Mecp2 transgene in postmitotic brain neurons of these mutant mice restores a normal phenotype; however, overexpression resulted in severe neural dysfunction, suggesting that the amount of MeCP2 may be tightly controlled. Carro et al. have identified a Xenopus protein that binds to human MeCP2 and increases its half-life when expressed in a human cell line. This protein resembles serine protease inhibitors and might furnish a mechanistic clue because some Rett syndrome patients harbor deletions in MeCP2 that yield proteins of reduced stability. — LDC

**EDITORS’ CHOICE**

**Covalently bound dendrimer monolayer on Ti**

**Schematic of positive and negative tone patterning.**

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