"I played around with various ideas, and it eventually sank into my mind that no mechanism based on a thermal equilibrium distribution of energy was going to explain this," Leggett recalls. His baked Alaska model emerged out of this line of reasoning.

"I had to convince myself you couldn't apply the normal laws of hydrodynamics or thermal transport under these conditions because you're so far from equilibrium," he says. "It really matters how the heat spreads out."

To check whether radiation can indeed trigger the nucleation of the B phase within the A phase of superfluid helium-3, the Stanford group used a specially designed, long, thin, silica glass tube with microscopically smooth surfaces. Within this tube, the team discovered it could dramatically supercool samples of the A phase to temperatures as low as 0.37 millikelvins, much lower than temperatures achieved by other groups.

In addition, by placing sources of radiation near the sample cell, they discovered that they could greatly reduce the length of time before nucleation occurs in the supercooled A phase. Both gamma rays and neutrons produced comparable effects.

"It's clear that radiation does play a part," Osheroff says.

These findings indirectly suggest that the presence of surface irregularities or defects also has a strong influence on the nucleation of phase B. This factor may have thwarted previous attempts to detect radiation-induced nucleation.

Moreover, the Stanford experiment demonstrates the conditions necessary for observing the A phase at lower temperatures and lower magnetic fields than previously possible. "Now that we've got it pinned down, I think there's going to be a burst of activity," Leggett says. "A lot of people would love to have [A-phase] helium-3 in low magnetic fields at low temperatures. There are all sorts of things you can do with it."

Precisely how surface roughness and the presence of minute traces of such impurities as radioactive tritium contribute to the nucleation of phase B remains unclear. Osheroff and his team are now discussing the design of sample containers specially fabricated to have a certain roughness. The researchers would also like to observe nucleation at different pressures and magnetic fields.

"Helium-3 is an ideal system for understanding physics that would be completely masked in any other system," Osheroff says.

To Leggett, the A-B transition in superfluid helium-3 represents a particularly clear example of how locally concentrated energy that can't dissipate through normal channels can induce events that by any other, reasonable, statistical measure would seem astronomically improbable. *– I. Peterson*

Courts challenge feds on health rules

Last week, an appeals court struck down a 1989 federal air-pollution standard that set new or lower workplace-exposure limits on 428 toxic chemicals. The next day, a second federal appeals court upheld a classical interpretation of the nation's food-additives law – a move that effectively revokes Environmental Protection Agency regulations allowing trace levels of certain carcinogenic pesticides in processed foods.

Science proved pivotal in both decisions, though in distinctly different ways. In the first case, the court argued that the Occupational Safety and Health Administration (OSHA) failed to justify scientifically not only that each new exposure limit was feasible, but also that it would substantively reduce workers' health risks.

In the second case, the court argued that improved analytical methods and toxicological data gave EPA no right to reinterpret how it administers a 34-year-old law.

At press time, neither OSHA nor EPA had decided whether to appeal the ruling affecting it to the Supreme Court.

Between its founding in 1970 and its promulgation of the now-contested air-contaminants rule, OSHA issued just 24 chemical-specific health regulations. To tackle a growing backlog of toxic substances needing new or revised limits, OSHA issued a "generic" standard for widely diverse agents. OSHA can do that if it provides separate scientific studies and economic analyses to justify the limits on each agent, notes Peter T. Fay in an opinion he issued for the 11th Circuit Court of Appeals, in Atlanta. But OSHA did not provide such backup.

For instance, Fay notes, OSHA cited no scientific studies to justify its new limits on vegetable-oil mists or fumes from aluminum welding. The agency did cite data establishing risks for carbon tetrachloride and vinyl bromide, two carcinogens.

However, even OSHA acknowledged that those new limits would allow hazardous exposures. OSHA's argument for why it didn't set lower limits – time and resource constraints – "is unpersuasive," Fay argued, and appears to violate the law under which the new limits were promulgated.

"Given OSHA's history of slow progress in issuing standards, we can easily believe OSHA's claim that going through detailed analysis for each of the 428 different substances regulated was not possible, given the time constraints set by the agency," Fay wrote. However, current law does not permit the scientific shorthand and analytic shortcuts presented by OSHA as justification for the new limits, the court ruled.

"We agree that the way OSHA arrived at some of its permissible-exposure limits was less than ideal," observes Colleen M. O'Neill, a spokesperson for unionized workers with the AFL-CIO in Washington, D.C. However, she adds, "We were dismayed that the court chose to throw all [those limits] out and revert back to the 1971 limits."

The Washington, D.C.-based Chemical Manufacturers Association (CMA) also called the ruling "a major disappointment." OSHA's shorthand approach "permitted the agency to set exposure standards for individual substances years quicker than it could by conducting chemical-by-chemical reviews," according to CMA Vice President Morton L. Mullins. Rewriting separate limits for all 428 chemicals "is simply too much of a burden for the agency's limited resources," he says.

EPA's reinterpretation of the "Delaney clause" – a section of the amended Food, Drug, and Cosmetic Act dealing with food additives – came under equal attack. The Delaney clause prohibits the sale of processed foods containing higher levels of carcinogens than the raw foods from which they were made – regardless of whether those carcinogens represent a health risk at the levels present in processed foods.

In 1988, after learning that four approved pesticides can accumulate in processed foods to levels higher than those in raw produce, grains, and oils, EPA decided to reinterpret the Delaney clause: It would allow concentrated residues in foods – if they posed only a "de minimis" (negligible) cancer risk.

Last week, however, the U.S. Court of Appeals for the Ninth Circuit, in San Francisco, ruled that regardless of how reasonable that approach might be, revising existing law "is neither our function nor the function of EPA."

"We hope EPA will seek and the Supreme Court will agree to review this decision," says C. Manly Molpus, president of the Grocery Manufacturers of America in Washington, D.C. Calling the Delaney clause "bad science and bad public policy," he argues that since 1987, "every major scientific organization, including the prestigious National Academy of Sciences, has called for the federal government to adopt a . . . 'de minimis' approach" to regulating pesticide residues in foods.

Congress has a chance to undo, at least partially, what the court rulings have wrought. One bill currently before the House and Senate would formally incorporate a de minimis provision in the Delaney clause. Another would require that OSHA regularly update its air-exposure limits for workers. *– J. Raloff*