



# Dialogue

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## Texas bound

The men lost, but the women's basketball team is heading to the Final Four in San Antonio. Games will be broadcast in Cameron Indoor Stadium.

Page 16

## State budget woes

Paul Vick explains how the state Medicaid budget woes will affect DUHS.

Page 3

## Beaufort via video

Video technology is helping students at the Marine Lab in Beaufort participate in a Nicholas School class.

Page 11



## After surgery

A Duke study shows how physicians can identify which patients are at risk for postoperative nausea and vomiting.

Page 5

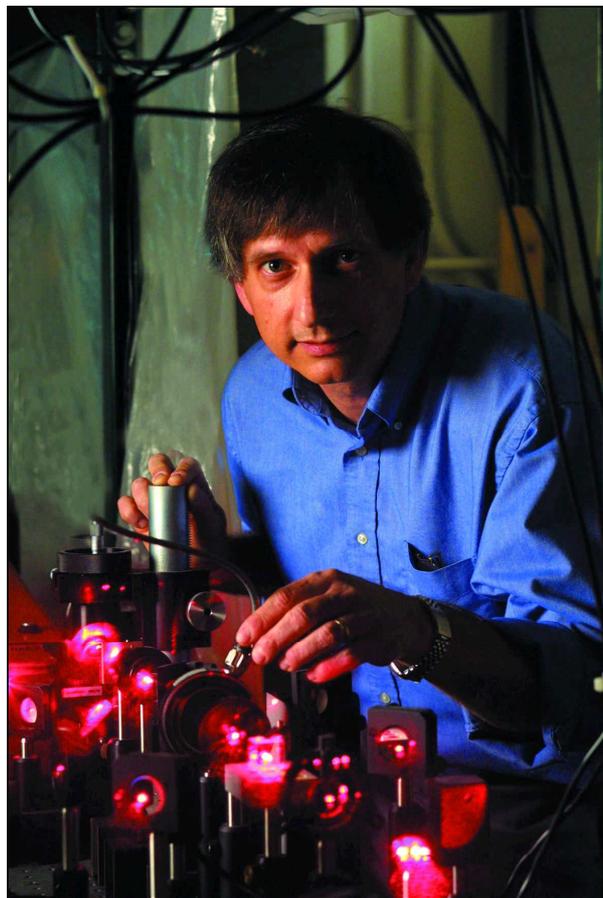
## Council on dating

The Academic Council approves a policy on consensual relationships that does not prohibit faculty from dating students but requires them to eliminate conflicts of interest.

Page 16

## Departments

Trading Post .....	13
Duke University News Briefs .....	2
Professional News .....	4
Calendar of Events .....	8
Grant Deadlines .....	12



John Thomas and a team from the Department of Physics has for the first time trapped a type of atom called a fermion with an "optical bowl" of laser light. The work has significant implications for the study of the phenomenon known as superconductivity. See story, page 7.

Photo: Jim Wallace

## Bodies of silicon and steel

### Speaker looks at our mechanical future

by Karen Hines

Three decades ago, moviegoers sat transfixed by the specter of HAL the computer controlling man's destiny in Stanley Kubrick's film "2001: A Space Odyssey." At a party 10 years ago, researcher Rodney Brooks pondered the status of computers and launched his quest to build a human-like robot.

Brooks, who directs the Artificial Intelligence Laboratory at the Massachusetts Institute of Technology (MIT), doesn't think robots will control us. But he does believe man and machine will ultimately merge.

"I think we're going to be changing our bodies with silicon and steel," Brooks said.

Brooks gave a primer on the history of robots and discussed aspects of his work developing robots with human characteristics at a March 19 presentation sponsored by the FOCUS Program, "Exploring the Mind."

The two big questions asked about robots, Brooks told a capacity audience at Love Auditorium, are whether they will be accepted and whether (See FLESH, page 6)

## Resurrecting a lost classic in dance

by Noah Bartolucci

A ballet that has not been performed in more than 50 years is being reconstructed by the Duke dance program and will be presented at the university's Reynolds Theater next week.

The ballet, titled "The Planets," was created in 1934 by Antony Tudor, one of the foremost choreographers of the 20th century and the architect of such masterworks as "Pillar of Fire," "Dark Elegies" and "Romeo and Juliet."

The preservation of Tudor's work is critical to understanding 20th century ballet, according to Barbara Dickinson, director of the Duke Dance program. Since Tudor's death in 1987, his creations have gained in recognition, even though few survive.

"Planets" has four movements: Mars, Venus, Mercury and Neptune. Duke's dance program is (See DANCE, page 6)



Choreographer Donald Mahler works with student dancers reconstructing the 1934 Antony Tudor ballet "The Planets."

Photo: Les Todd

# Trapped in an 'optical bowl'

Physicists capture elusive fermions and raise potential for superconductivity studies

by Monte Basgall

A Duke Department of Physics team has for the first time trapped a gas of ordinarily "unsociable" types of atoms within an "optical bowl" of laser light, achieving nearly the maximum packing densities permitted by the laws of physics.

The group's feat, announced March 25 in the print edition of *Physical Review Letters*, is significant because the trapped gas is made up of lithium-6 atoms, among a large group of particles classified as "fermions."

Studied of the trapped atomic fermions will provide new insights into a variety of fundamental phenomena ranging from the interactions of nuclear matter to very high temperature superconductivity, said John Thomas, a physics professor who heads Duke's Quantum Optics research group and leads the continuing research efforts.

To date, the work has been funded by the Army Research Office, the National Science Foundation, the Department of Energy and the National Aeronautics and Space Administration.

Two classifications of atoms exist in nature, fermions and bosons. Of the two, bosons are the party animals. Some can snuggle up close enough to form so-called Bose-Einstein condensates in which individual atoms act like one big "superatom" when trapped by magnetic fields at extremely low temperatures.

Fermions are the Greta Garbos of physics, with the propensity to shun such close contact. They come in two possible states of "spin," a term physicists use that is analogous to rotation. Those rotating clockwise are said to be "spin-up," while those with counterclockwise rotation are "spin-down."

The crucial fact is that fermions with the same spins avoid each other, while those with opposite rotations can interact. So squeezing atoms like lithium-6 together, which are mixtures of both spins, spells trouble.

When researchers tried to confine and condense groups of lithium-6 atoms in magnetic traps, previously used to confine bosons, those dual spins interfered with togetherness. "If spin-up is attracted to a

magnetic trap, spin-down is repelled. So some atoms want to roll out, and the other ones want to stay in," Thomas said.

Beginning in 1997, Thomas's team — comprised of graduate students Stephen Granade, Michael Gehm and Ken O'Hara — began a different trapping strategy in an optical laser bowl. "The beauty of these optical bowls is that they can trap any state of the atom," he said. "It doesn't matter whether it's spin-up or spin-down."

Thomas' group reported its first success in a May 1999 issue of *Physical Review Letters*, describing the tight confinement of lithium atoms by a carbon dioxide laser. Their latest success went further.

"Not only did we trap the atoms. We were also able to cool them directly in the same trap," he added. And as the gas of trapped atoms began to collide, "they evaporated in the same way coffee evaporates and gets cold."

This bowl is not an actual hard object, but the laser-energetic equivalent, Thomas said. That means lowering the intensity of the laser is like lowering a real bowl's lip. It allows more atoms to escape and the rest to cool.

As the more-energetic atoms left the bowl, the more apathetic remainder were chilled to temperatures of about 400 billionths of a degree above Absolute Zero. Under those conditions, the remain-

ing atoms — a scant 100,000 to 500,000 — were packed about as densely as possible under the rules of quantum mechanics that governs the physics of very small spaces.

The investigators suspect this atypically dense atomic mixture can be "tuned" in future research to emulate traits of extremely high-temperature superconductors, hotter-operating equivalents of substances known to let electricity flow without resistance.

They would do this by modifying the interactions between atoms with a strong magnetic field, which could now be used because the fermions have already been light-trapped.

Their goal is to achieve a kind of "super-pairing" between fermionic atoms, Thomas said. These super pairs would be much stronger than those teams of electrons — called "Cooper Pairs" — with which present-day "high temperature" superconducting crystals can channel electricity at still-frigid liquid nitrogen temperatures.

"It would be the equivalent of a superconductor that operates at almost liquid metal temperatures," said Thomas. Even though these tiny gasballs of neutral atoms could never actually conduct electricity, we have atoms that are behaving as electrons do, and our optical bowl behaves like a giant crystal," he added.

## Krzyzewski recovering from hip surgery

Mike Krzyzewski, head coach of the Duke men's basketball team, underwent successful hip joint replacement surgery Wednesday morning at Duke University Hospital.

Krzyzewski, 55, was resting comfortably following the two-hour procedure on his right hip, said Dr. Thomas Parker Vail, director of adult reconstructive surgery at Duke, who performed the surgery. Krzyzewski is listed in good condition.

"I'm very pleased with how the entire procedure went and with his early recovery. He's feeling great.

He was sitting up in bed this afternoon and we anticipate that he will be out of bed by tomorrow," Vail said.

Krzyzewski had a similar procedure performed on his left hip on April 4, 1999. Both procedures were necessitated by arthritis.

Vail said Krzyzewski could be released from the hospital within four days. Fans who would like to offer well-wishes can send them by e-mail by visiting <<http://goduke.fansonly.com/sports/m-baskbl/spec-rel/coachk-well-wishes.html>>.

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## Feeling Protected

Jose Apoinares, right, places a toy fireman's hat on his son Caesar Apoinares' head as the two pass by one of the seven cars involved in a wreck at the intersection of Erwin Road and Research Drive Monday afternoon. The Apoinares' car is not pictured. According to Durham police, a truck driver from Selma was charged with failure to reduce speed. Five people were sent to local hospitals with minor to moderate injuries. One pedestrian was hit by a car in the wreck and was treated for cuts and bruises.

Photo: Jon Gardiner