Eisenstein observes electron states

BY SHANNON STERNMAN

In the field of condensed matter physics, a number of multibody phenomena have been found in two dimensional electron gases. Two of the most noteworthy, the integer quantum Hall effect and the fractional quantum Hall effect, have been so unexpected as to warrant Nobel prizes.

Recently, Caltech physicist Jim Eisenstein appears to have uncovered another unexpected multibody phenomenon in two-dimensional electron gases. When electrons trapped in a two-dimensional plane are lowered to 25-150 milliKelvin, or within tenths of a degree above absolute zero, and subjected to a magnetic field of 1-3 Tesla perpendicular to that plane, they obtain a directional preference for current flow within that plane.

Dr. Eisenstein, along with postdoctoral scholar Mike Lilly and graduate student Ken Cooper, have conducted experiments measuring the resistance of current flow of a two-dimensional electron gas trapped between two semiconductor crystals. The electron gas is created by a process known as molecular beam epitaxy, where a semiconductor crystal of gallium arsenide doped with aluminum is grown directly on top of a uniform surface of a crystal of undoped gallium arsenide. The two-dimensional electron gas exists at the interface of these crystals.

To conduct the measurements, indium contacts are placed around the 5-mm square crystals, obtained from Dr. Eisenstein’s collaborators at Lucent Technologies, Loren Pfeiffer and Ken West, so current can be circulated in different directions through the electron gas.

When these crystals are lowered to 25 milliKelvin, and subjected to a 1-3 Tesla magnetic field, the resistances measured when running current in perpendicular directions is dramatically different, indicating an anisotropy in the electron system, or a moment preference. When electrons are subjected to a magnetic field, they begin to circulate, as predicted by classical electromagnetic theory, in circular orbits. When the temperature is lowered enough, quantum considerations come into play and these orbits are quantized at electron energy levels, or Landau levels, which function in a manner conceptually similar to a hydrogen atom’s energy levels.

As the magnetic field increases in strength, the electron orbits decrease in radius, but the quantization of the electron orbits forces the electrons into the lowest Landau level, or the electron ground state. In this lowest Landau level, effects like the fractional quantum Hall effect are seen, which is an effect of many electrons functioning in a uniform manner, or electrons engaged in cooperation.

Eisenstein and his colleagues have found this anisotropic behavior when the electrons of the two-dimensional gas are induced into a state where the third, or higher, Landau level is half full.

The anisotropic effect may be similar to that of ferromagnetism. A ferromagnetic substance consists of many small domains of magnetism which are oriented in random fashion, statistically negating any magnetic moment.

Eisenstein observes electron states
nematic dipole in the substance. However, if a slight magnetic dipole preference is induced and the temperature of the substance is lowered, the domains align in a fashion which gives the ferromagnetic substance a large combined magnetic dipole. In the case of the electron gas, Einstein believes some small directional preference is given to the electrons as they are cooled, causing them to align in a similar manner.

What the factor is has not yet been determined, and currently Einstein's group is looking for preferential alignment of defects on the surface of the crystal with an atomic force microscope. Condensed matter theorists have yet to fully explain the phenomenon, but at least one theory has been proposed; that electrons form ribbons where their density is linearly uniform in one direction but is modulated in the other, which may explain the differences in resistance. However, as Einstein and his colleagues indicate, the leap from this anisotropic effect to the theory of "ribbons" is large, and this is just one possibility.

KoNNIN LECTURe

CONTINUED FROM PAGE 1

Simulations, scientists hope to better understand how the earth's magnetic field is generated. To touch on the problem of representing computed data, for some complex data sets like these, a two-dimensional graphical model that can be turned into a movie that shows the movement of ocean currents over time to make the data easily understandable. Other problems, such as the amino acid folding simulations, require a three-dimensional graphical model that can be rotated or moved on screen.

Peter Schröder's group at Caltech has developed a Responsive Workbench for viewing complex data sets like these. A user sits at the workbench and wears a set of goggles. The workbench tracks the user's head movements, renders the data set from an appropriate perspective, and projects the data onto the tabletop in 3D. This allows the user to view the data set from any perspective, even from "inside" the bounds of the set.

KoNNIN cited Moore's Law as an indicator that supercomputer development will continue to grow at a remarkable rate. Gordon Moore, the founder of Intel, postulated in the early 1960's that chip capability would double every two years. This theory has held true for more than 30 years, and is expected to continue for some time.

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THE OUTSIDE WORLD

by Cheryl Forrest

Camp LeJeune, North Carolina / Italy: Marine pilot Capt. Richard Ashby was found innocent of involuntary manslaughter and other charges this past Thursday. Capt. Ashby's jet flew into a gondola cable last year; twenty people died as a result of the cord severing. Italian Prime Minister Massimo D'Alema was quoted as saying "the verdict is disturbing. We expected that justice would be done." According to another Italian official, the verdict is a "provocation."

Lagos, Nigeria: General Olusegun Obasanjo won an overwhelming victory in Sunday's presidential election. He is the first elected president in Nigeria in sixteen years. In the past, Nigeria has suffered under oppressive military dictatorships; Gen. Obasanjo was released from jail only eight months ago for criticizing the then-current military regime.

Jasper, Texas: A Texas jury, with the sole black member leading as foreman, awarded the death penalty to John William King late last week. King was found guilty of capital murder in the case of James Bryd Jr., a 49-year-old black man whose body was raped apart when he was dragged behind a pickup truck down a rough rural road last year. Mr. King, along with two other white men, had allegedly wanted to gain notoriety and attract new members to their white supremacist gang.

Somewhere over Iraq: A British jet attacked an Iraqi military radar site in the southern no-fly zone this past Thursday. According to U.S. Central Command, the attack was in response to "two Iraqi violations in the no-fly zone." This latest attack comes on the heels of Monday's bombing blitz; allegedly, U.S. jets dropped more than thirty bombs on various communication and air defense sites.

Yugoslavia: Kosovo is again awash in blood.

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OPINIONS
A bit of clarification of copyright law

I would like to respond to Dean Revel’s article in the February 15th issue of the Daily. What he said is technically accurate, I feel it might leave some people with misunderstandings about the role of intellectual property.

Intellectual property does not act like physical property— if you want a chair that you have or you can use it. Individuals have a right to copy material, but only to the extent that their copying does not deprive the original author of his or her work.

That right is a far cry from taking property away. Copying is a far cry from taking physical property away. Similarly, ‘piracy,’ boarding, and looting ships at sea, and often killing innocent passengers is quite a bit different than copying. I think if people want to copy, they should adapt to UNICEF reports. Today, this policy will kill 250 people in Iraq, and it will tomorrow. Since 1991, more than one million people have died due to the scarcity of food and medicine and the spread of water-borne diseases. All direct consequences of the sanctions.

Since 1991, United Nations agencies and independent human rights organizations have been reporting on the devastating impact of the sanctions on human life. Four years ago, UNICEF reported that ‘piracies’ were reducing the importation of spare parts, chemicals, reagents, and the means of transportation required for the health and sanitation services to the civilian population of Iraq. What has been increasingly clear is that no significant movement towards food security can be achieved so long as the embargo remains in place.

And what is our government’s response? When asked “60 Minutes” about the death of half a million children in Iraq—more children than died in Hiroshima, Madлен Albright responded “we think the price is worth it.” We say NO! The death of one child is a death too many. As Noam Chomsky, Howard Zinn, Edward Herman, and other humanitarian workers stated in their national call for action, “the time has come for a call to action to people of conscience. We are past the point where siccence is passive consent—when a crime reaches these proportions, silence is complicity.” We refuse to be silent in the face of this war.

We denounce the trade sanctions against the people of Iraq as immoral, illegitimate and contrary to fundamental principles of human rights. We demand that Congress and the President immediately end the ongoing sanctions war against the people of Iraq.

We support the University of Michigan’s Student Assembly which passed a resolution in January condemning the sanctions against the people of Iraq.

We call upon all students dedicated to peace to join the growing movement to end the war against Iraq. Get more information on how you can help end the war by sending an e-mail to studentinfo@tech.net. Check our website at http://leb.net/ics/students.html.

It was the collective voice of the students that woke our nation to the horror of the Vietnam War. We must once again issue the wake-up call to the conscience of our nation.

Sincerely,

Byron Philhour
Committee of the Iraq Action Coalition

Record industry should adapt to proliferation of mp3 format

Dean Revel seems to have missed part of the point in his article (as he is often wont to do). Moral implications of hoarding mp3s aside, the record industry is so far behind in the digital age that it will probably never catch up.

For more than eight years, our government has been waging a silent war against the people of Iraq. This month, the US-led sanctions will kill 4,400 infants and toddlers, according to UNICEF reports. Today, this policy will kill 250 people in Iraq, as it did yesterday, and it will tomorrow. Since 1991, more than one million people have died due to the scarcity of food and medicine and the spread of water-borne diseases. All direct consequences of the sanctions.

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Adam Villani: Media Guy

Rushmore

This new black comedy from Bottle Rocket director Wes Anderson is sure to become a favorite around Caltech. Newcomer Jason Schwartzmann plays Max, an extremely ambitious yet academically challenged prep school student who finds himself on the losing side of a down-on-their-luck father and a schoolboy outcast. Max tries to play off to Bill Murray. This movie challenges our sympathy as the geek-with-an-attitude struggles with his passions and the demands of society. Though the story kind of moves in fits and starts, Rushmore never loses its edge and is hilarious through-out.

Blast From the Past

Blast From the Past is predictable and doesn’t always work, but it is amusing and like the characters. The first act, which introduces Max’s character is growing up in a time-capsule bomb shelter, might sound good if described, but as it is, the jokes seem forced. Once there’s some grounding in the present-day world, the fish-out-of-water humor begins to click. Brendan Fraser is pretty good at playing affable dopes, Alicia Silverstone is a perfect Doris Day, and Christopher Walken perfectly cast as the paranoid ex-Caltech professor dad who drinks hot Dr Pepper and has engineered every detail under the California Tech.

The Ticket Stub

by Justin Ho

October Sky

October Sky (***/***)

The real life story of Homer, who does the science thing, though not very well, and probably sans donuts and Dr Pepper. And, it’s a movie which actually casts West Virginians in a good light—no connotations about incest work force. The film October Sky is based circa 1957 as the United States braced for a very scary basketball—like bee-eep object circling overhead, scribbling its way into the message “Soviet airspace.” It’s a bit difficult now to envision the paranoia of those late 50’s, beginnings of the Cold War when the Soviet Union launched Sputnik into space. But the eyes facing skyward offers a nice contrast between the ponderances of space even as Coalwood, WV sends its broadsheet men and boys into the depths of coal mines under ground. The landmark event is marked by a day of serenity in front of radios before a return to the routine of daily mining in a town whose only commodity is the self-same soot which darkens the countenances of its blue-collar work force.

But along comes an upstart, who can’t imagine his descent into the depths of darkness and likewise can’t make it out of the town via the only ostensibly avail-able alternative—a football scholarship. After a grueling foot-ball practice, Homer shows that he is definitely not the lucky type, but he is adamant in not becoming just another product of the education system, showing stu-dents into the coal mines. What may have been an industry year before has faded under the exhaustive efforts of the miners and growing minorities of union support-ers. Homer’s dad accepts the gauntlet and not caring, the family atmosphere is cast West Virginia in a good light; almost everyone here, ‘cause it’s rated PG.

It’s a masterwork which星级酒店, Naive and Sentimental Music

Two weeks ago I had the pleasure of watching one of the premiere performances of John Adams’ new masterwork Naive and Sentimental Music at the Dorothy Chandler Pavilion. This marmmous, 48-minute symphony for a 12-piece L.A. Philharmonic, vigorously conducted by Esau-peka Salonen, was welcomed by a roaring ovation by the mostly elderly Southern music crowd. Words I heard from the other persons describ-ing the show included “exciting” and “thrilling,” and those are apt indeed. As Adams described it, the piece starts off with a simple, sparse melody which, like a Dickens character venturing out into the world, then goes on many adventures and strange encounters before finally coming to a finish, much older and wiser. While retaining some characteristics of Minimalist music and echoing earlier Adams compositions like Grand Pianola Music and Harmonieleuse, Naive and Sentimental Mu-sic is his longest, most complex composition yet. After the concert, I asked the guard nicely at the artist’s entrance and was able to speak briefly with the composer, who was eager to talk to fans and hearing the positive reception. No wonder; his newest work will surely be one of the artistic and popular high points of the decade.

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Caltech Hockey Gets First Win of Season

BY BIFF YAMAZAKI

The Caltech Hockey team earned its first victory of the season, blowing out San Jose State Spartans 7-0. The team got on the board early and quickly, with three first period goals including a power play goal by Mark Stewart (BS ’97) with 3 seconds left in the first period, which gave them a 3-0 lead going into first intermission. Joe Danzer and Pavel Svitek accounted for the other two first period goals. After a scoreless second period, Hafen McCormick’s goal early in the third increased the lead to 4 goals, and the Beavers scored three times in the last 5 minutes of the game, on Svitek’s second goal of the game, and two goals from Mark Guman. Frank Monzon set up 4 of the game’s goals. The Caltech strategy of placing some of their prolific scorers on defense work to perfection, as the defensemen were able to penetrate the Spartanzone with speed. On their own end, the team protected their goal effectively, outshooting the Spartans 43-17, giving Biff Yamazaki the easy shutout.

Swim season ends with a splash

BY GERALD PALMROSE AND TIM RAUB

The Swim Team finished their season making a splash at the SCIAC Conference Championship. The three day meet went along extremely well for the first day when the men were in fourth, just one point behind La Verne for third place. The women held on to a strong sixth place position that they kept throughout the meet, keeping Whittier College at bay. However, the second day, Caltech was tripped up in their attempt to keep up the winning streak. The Beavers had soundly thrashed Oxy during the regular season, though, the teams shared the fifth position in the year-end conference tallies. Remarkably, the team finished with a total of nine Caltech Swim Records. Individual records were broken by Kristen Cook and Eagle Jones. Eagle broke the 500 yard freestyle record with a time of 4:52.86 previously held by 1983 All American Chris McKinnon (4:53.42). He also rewrote his own record in the 1000 yard freestyle (10:07.83) and kept swimming to set a new mark in the 1650 yard race (16:49.28).

Cook did the same in his mile swim with a finishing time of 19:18.39 to set another Caltech record. She nearly broke another mark in the 400 IM (5:10.74) in the prelims. The rest of the records were set in the women’s relays. The team of Captain Phyllis Chen, Emma Huang, Sarah Mahoney, Paula Whitten and Linda Soo all took part in record breaking swims to write some Caltech history. The rest of the team all performed extremely well, dropping huge amounts of time and improving their lifetime bests. Singled out by Coach Dodd, “Captain Koen Verbrugghe dropped 20 seconds in his 400 IM while Tory Sturges and Jeanette Hagen were impressive in the sprints.” Tory dropped into the “sub 30 club” dropping a 29.89 in her last 50 yard sprint of the year. Hanna Kim and Mandy Booth also had nice races in the 500 yard swim, both achieving season bests.

Finally, a passing of the guard happened in Spring-board Diving as three seniors competed in their last meet. The event has been a Caltech strength for the past four years, and this meet was no exception. As it turns out, only freshmen Katherine Kohlner is left to carry on the tradition. The seniors went out strong with Mike Fisher finishing second on both boards (1m and 3m) and Robert Osada finishing 4th on 1m and 2nd on 3m. Fisher was first team SCIAC Conference in both events, while Osada earned the honor for 3m. Finally, Rachel Steinberger finished her diving career by competing a full list on 1m, while Kohlner competed full lists on both boards. Said diving coach Adam Burgess, “Mike [Fisher] has been a strong and consistent diver for the team.” All three seniors will be missed.

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March 5, 1999

SPORTS

The California Tech

March 5, 1999
Dean's Corner

Wheelies first in Szigetszentmarton
by Jean-Paul Revel

It is common to belittle someone else's achievements by stating that he is reinventing the wheel. I guess the wheel is such a basic tool in everyday life that it is seen as a very mundane part of our brains. That too has been a major reason to threaten other people's right to a safe and relaxed walk. The same can be said of course about the use of more massive wheeled vehicles such as cars. So far as I know they have no business on campus, except as the lugubrious announcer at LAX reminds us, "for loading and unloading only".

When we use wheels we are using a technology that is some 5-6000 years old perhaps more if one includes the rollers that were likely the precursors of wheels. As long as oxen powered the wheels, the dangers from unexpected encounters were low, but probably not zero. Just as many of his (and our) Neolithic ancestors, Pierre Curie, in the last century, died in an encounter with a horse drawn vehicle. Starting towards the end of the XXth century, speeds have increased, and so have the chances of catastrophic collisions. Slow down, slow down please, and watch out for human ten pins. Come to think of it, perhaps someone should design airbags for pedestrians.

The Californian Tech
March 5, 1999
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FEATURES

For With Food

This week I will be stepping down as IHC Food Chair. By the time you read this, the IHC will have selected the new chairmain and I will be a mere mortal once again. For this, my final article, I thought we would recap all the changes that have happened under my tenure as food chair.

As I began, I started by instituting a policy of both taking minutes and meeting with the IHC monthly. With the resignation of Lee Reavis, I personally insured that undergraduates were part of the interview process for his replacement.

Under my tenure we saw the return of the In N Out van, the first ever vending Fair, waffle machines, and the introduction of two new bars to augment omelette day, wrap/pasta day and sushi day. The first ever comprehensive survey of Dining Services took place, and we saw the introduction of a Summer Board Plan.

And of course, Fun With Food.

This year, the menu has been completely altered, moving from a five to six week cycle. The number one complaint against the board plan, monotony, have been alleviated with the addition of many newer, lighter, healthier entrees. Caltech also saw the introduction of a Rabbinically Certified Kosher Board plan which some of us. I don't know if the protests come from the archetypal "little old ladies in tennis shoes" that are supposed to populate our fair city, or brawny types. It makes no difference. Riding on sidewalks is verboten, and even if it were not, there is no legitimate reason to threaten other people's right to a safe and relaxed walk.

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