BROOKHAVEN BULLETIN
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BROOKHAVEN NATIONAL LABORATORY

Physics for the Defense: Part I

The Case of Rotational Motion

BNL guest physicists Arthur Damask and Arthur Paskin, professors of physics at Queens College, made legal history in their spare time by producing the first computer graphics of a vehicular accident reconstruction used in a U.S. court.

A tape of Damask and Paskin's computer displaying the physical actions and reactions involved in a fatal auto accident was shown in The Bronx County Supreme Court last May during the trial of a 17-year-old boy on four counts of felony manslaughter in the second degree and one count of the misdemeanor reckless driving.

As a result of a defense based on the laws of physics and the use of computer graphics, the jury acquitted the boy, Michael McHugh, of the four counts of manslaughter.

Alex Reben

Physicists Arthur Damask (left) and Arthur Paskin sketch the path of the Mustang preparatory to writing the equations of motion for the computer.

Damask and Paskin were brought into the case by the boy's defense attorney who found them through a classified advertisement in the New York Law Journal. The physicists, partners in Accident Analysis Associates, had placed the ad hoping to use the accidents they would reconstruct as cases for a physics-for-lawyers textbook they were planning to write.

"As educators, we realized that lawyers don't take physics, though they need to understand the physics of motion if they practice general law," says Damask, a collision theorist in the field of radiation damage. "We considered giving a series of lectures on physics, but realized that lawyers like to learn from case studies. So we decided to collect some real life case studies while we performed our service as accident analysts."

"When we formed our partnership two years ago, I thought that the computer would be a natural tool to use," explains Paskin, a solid state physicist who studies the fracture of metals using computer simulation, "but when we started getting cases, we discovered that lawyers are very conservative and were reluctant to use the computer in court because, as we learned during this case, it had never been done before. In this case, the lawyer was braver than others because he had no defense for the accused before we analyzed the accident."

Accident analysis is usually left to police officers and insurance investigators who have had a short training course in vehicular accident reconstruction. Since they, like lawyers, usually have not studied mathematics and physics, accident investigators are taught how to use the tables and equations found in a textbook published in 1954 by the Traffic Research Institute.

"They can plug into one of the tables the coefficient of friction of a tire, plug into another table the length of the tire track, and find out how fast a car was going," explains Damask, "which is very good for accidents involving strictly linear motion. However, there is nothing in the book about rotational motion, for example when one car strikes something and spins out."

Since this car crash involved rotational motion, Damask and Paskin's reconstruction differed from that of the police accident investigator. It was the policeman's scenario and McHugh's blood alcohol level obtained immediately after the accident that convinced the grand jury to formally charge the boy with manslaughter and reckless driving.

The Accident

What neither the prosecution nor the defense disputed is that one night in March 1983, Michael McHugh and four of his high school friends aged 16 and 17 drove their 1972 Mustang, which was registered in McHugh's name but which the five boys had jointly purchased, through the sleet and slush to two neighborhood pubs in The Bronx to drink beer. Though they were not asked for proof of age, the youngest boy, Skehan, did not drink alcohol that evening.

As a bartender later told the police, when McHugh left at 1 a.m., he was accompanied by three of his four buddies, Cremin, Flynn and Youngs, but not Skehan. However, Skehan, McHugh and the other three boys were later found strewn about the wreck of their Mustang on the Mosholu Parkway. All but McHugh, who was lying on the road by the right front wheel of the car, were dead.

The first police officer to arrive asked McHugh if he had been the driver. The boy replied, "I think so, but I don't remember." An ambulance took him to a hospital where he was diagnosed as having a shattered left wrist, fractured right ribs and a fractured right shoulder.

As part of the routine examination, McHugh had a blood sample drawn which was reported to contain 0.11% alcohol, a concentration above the New York State legal limit of 0.1%. McHugh was placed under arrest.

Cause of Crash?

The day after the accident, McHugh's stepfather visited the crash site. The Mustang had negotiated a long downhill stretch, missed a shallow left turn, driven up on the shoulder, and struck the end of a three-foot-wide and -thick concrete guardrail. Two lights had been knocked down in previous accidents, so the turn was dark.

McHugh's stepfather found a two by three foot open manhole, which contained the electrical connections for the downed lights, on the grassy shoulder about one foot from the curb of the turn. Electrical workers had left its cover off in the middle of repairing the two lights. A chip of the projecting rim around the manhole on the side nearest the concrete rail was missing.

After several visits to the scene, examination of the police photos and analytical evaluation of the evidence, Damask and Paskin agreed with McHugh's stepfather that the open manhole, not reckless driving, had caused the car to spin out of control.

The police investigator envisioned a different sequence. He believed that the Mustang was traveling at 82.25 mph, and felt that the right front wheel struck an open manhole 200 feet before the one found by McHugh's stepfather. He supposed that the broken right front wheel then dug into the grass, causing the auto to rotate counterclockwise and bounce into the concrete obstacle sideways.

Damask and Paskin found that the police investigator's scenario "violates Newton's second law of motion, force equals mass times acceleration, and its corollary for rotational motion, torque equals moment of inertia times angular acceleration — and several laws of common sense," says Damask. "We took umbrage at this corruption of physics. Since the boy could not afford our services, we donated them on principle."

According to the physicists' reconstruction, when the driver, within a sober reaction time, attempted to turn back onto the road from the shoulder at an angle of about 30° to the road and a speed of 35 miles per hour, the car's right front wheel fell into the manhole, chipping the manhole flange and receiving a deep notch in its rim.

The auto swung around counterclockwise and hit the corner of the concrete rail with the right front passenger door. The impact pulled that door from its hinges and split the car into back and front sections. The two attached parts of the car then skidded on the road, spewing the occupants from the car.

Tell It to the Jury

"Though any physicist could understand our reconstruction, we wondered how we could explain it to the jury," admits Damask. "We had to explain three separate rotations: first, the turning of the car to return to the road; second, the rotation of the auto after striking the open vault; and third, the rotation of the rear part relative to the front part after the car was split in two and left the wall. Chalk drawings and posters showing stop action were customary in court, but are inadequate for explaining continuous rotational motion."

So Damask and Paskin, with the help of Damask's 16-year-old son Jay, programmed their home computer to display successive graphics representing their reconstruction at almost movie frame speed so it would be seen as dynamic action. They taped the computer display so that it could be shown through a VCR on a TV screen in court.

The trial began on Monday, May 7, with Damask as a witness for the defense. After he was certified by the judge as an expert witness both in accident reconstruction and medical physics, Damask taught the jury the elementary physics concepts, such as center of mass and Newton's laws of motion, necessary for them to understand why his and Paskin's reconstruction was the physically correct one. For his physics lecture, Damask used the blackboard, charts and a wooden model of a car broken in two.

Admissible Evidence?

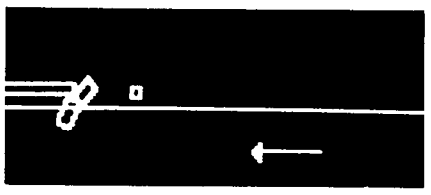
On the second day of the trial, the judge excused the jury so the defense and prosecution could argue whether or not the tape could be shown as evidence. The assistant district attorney prosecuting the case argued against its use, saying that people who had been raised on TV might assume that whatever they see on the screen is true.

Again on the witness stand, Damask stated that only with this technique could the jury see precisely that since the car's center of mass was above its right front wheel, it had to strike the open manhole at an angle greater than or equal to 25° but less than 45° with the road in order to pivot around the right front wheel counterclockwise, and hit the concrete barrier with the right door as it did.

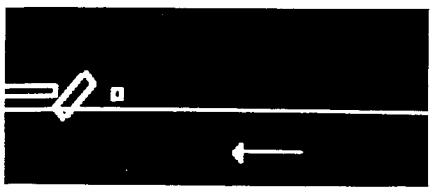
The graphics also would show that the counterclockwise rotation described by the police investigator was physically impossible because he had positioned the car at an angle of less than 25°.

The judge sided with the defense. In his opinion, the judge noted, "Every new development is entitled to its first day in court. A computer is not a gimmick, and a court should not be shy about its use when proper. In this case the graphics can help the jury

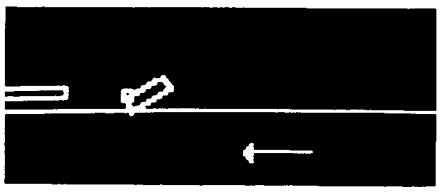
(Continued on page 2)



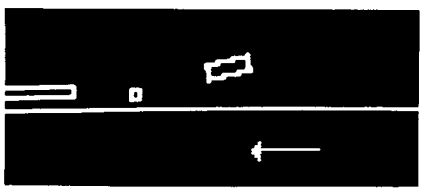
4. The Mustang hits the barrier with its right front door, breaking in two.



3. The car rotates counterclockwise, heading towards a concrete guardrail (long rectangle).



2. Before reaching the road, the auto's right front wheel falls into an open manhole (small square).



1. Traveling north, the Mustang (large rectangle) heads back to the road from the shoulder.

Dress Rehearsal for ASCOT

No, that wasn't the Goodyear Blimp flying over BNL last week. In case you missed it last Wednesday, an orange, helium-filled balloon was suspended about 200 feet above the grounds adjacent to the Personnel building, prompting curious passers-by to stop and inquire.

While most people focused their attention on the balloon, DAS chemical engineer Russell Dietz and technician Bob Wieser were busily monitoring the new cable they and staff engineer Ted D'Ottavio had designed and built, which was connected to the balloon. They were also readying their equipment for an excursion to Grand Junction, Colorado, next month to study atmospheric and meteorological conditions. They will be there for about four weeks, beginning in early September.

The trip is one phase of the Atmospheric Studies in Complex Terrain (ASCOT) program, sponsored by DOE, and will involve scientists from 14 other national laboratories and research institutions.

BNL has participated in the ASCOT program since 1980, performing ground and vertical sampling of perfluorocarbon tracers (PFT's), a class of organic compounds which are easily detected at very low concentrations in the atmosphere. Brookhaven has also done much experimental work through its own Atmospheric Tracer and Instrumentation Development program, leading to the design of samplers and analytical equipment for use in long-range atmospheric tracer experiments and for the measurement of air infiltration in homes.

The goal of the ASCOT program is to better understand how drainage flows that are established in mountainous terrain during nighttime cooling travel from higher levels into lower valleys, transporting pollutants along the way. As a result, long-term planning of industrial growth in such regions can be made. Upon analyzing the samples, meteorologists will ultimately be able to test their models to determine the destination of pollutants.

The 500-meter polypropylene cable which attaches to the balloon has an inside diameter of one-sixteenth of an inch, and will be one of 10 vertical sampling cables used in the Brush and Roan Creek Valleys of Colorado. "It will allow air to be sampled at approximately 50-meter increments," says Dietz, "all the way up to 500 meters in altitude." During the trip, meteorological measurements, including wind speeds at different altitudes, temperature distribution, and turbulence, will be taken. Three different PFT's will be released from separate locations to simulate pollutant sources, and the concentrations will be measured at over 85 ground sampling sites in addition to the vertical sites.

The polyurethane balloon, with an area of five and one-quarter cubic meters, and blimp-shaped to stay oriented while in flight, presents a practical means of taking vertical samples from the air, Dietz says. Other methods, such as building a tower or flying aircraft, wouldn't be feasible because of the terrain and because the sampling will be done at night.

—Maurice A. DuBois

Mort Rosen

Are they trying to lasso the Goodyear Blimp? Wieser and Dietz tow this object from the sky.

Mort Rosen

Russell Dietz, left, and Bob Wieser attend to equipment on the ground.

Case (Cont'd)

understand the defense's case." The judge had earlier ruled, however, that if the tape were shown, the narration would not be allowed because a voice-over could not be sworn or subject to objection. So Damask explained what was being shown to the jury as the tape played.

Though he was pleased that the computer graphics had been allowed as evidence, Damask was unhappy that McHugh's blood alcohol percentage had been leaked to and published in a daily paper. In pretrial arguments, the boy's defender had successfully argued that McHugh's blood test result should not be presented to the jury because it was done without McHugh's consent. Though the jurors swore they had not read the news story on the trial, four copies of the newspaper were found in the jurors' room.

"This got my dander up," admits Damask. OK, Damask thought, the kid had been drinking. But, he asked himself, was McHugh driving the car at the time of the crash? And if the boy weren't the driver, which one of his dead friends was? And could Damask prove it? — Marsha Belford

[*The conclusion will appear in next week's Bulletin.*]

Arrivals & Departures

Arrivals

Anu Banerjee ..... Staff Services
Maryanne Rignola ..... S&EP
Sergio Rescia ..... Instrumentation

Departures

This list includes all employees who have terminated from the Laboratory, including retirees:

Gino F. Aurelio ..... Plant Eng.
John E. Carlson ..... Accelerator
Michael J. Jenkins ..... Physics
Michael R. Sullivan ..... Accelerator

Kindergarten

Staff of the JUST KIDS early childhood learning center serving Laboratory employees will present information about the State-approved kindergarten program to be introduced this fall. Linda Feddersen and Chris Clark of JUST KIDS will be on hand in Room D, Berkner Hall, from noon to 1:00 p.m. on Thursday, August 23 to meet with interested employees.

Reports Available

The following reports are now available to the Laboratory staff and to affiliates of the DOE, AUI and NRC. Others may purchase the reports from the National Technical Information Service, U.S. Dept. of Commerce, 5285 Port Royal Rd., Springfield, VA 22161. Staff members should call Ext. 5068.

NUREG/CR-2987
BNL-NUREG-51592
Identification and Analysis of Human Errors Underlying Electrical/Electronic Component Related Events Reported by Nuclear Power Plant Licensees. D.M. Speaker, K.J. Voska, W.J. Luckas, Jr.

BNL-51604
Study of Baseline Energy Requirements of the Pulp and Paper Industry in the Bonneville Power Administration Service Area from 1980 to 2000. B.L. Pierce, C. Balzer.

BNL 51625
A Study of Air Pollution Mixing Heights and Atmospheric Turbulence over New York City — Data Report. S. SethuRaman, et al

BNL-51631
Transport, Fate and Effects of Energy-Related Pollutants: Evaluation of Surface and Groundwaters. Third Progress Report. G.R. Hendrey, N.F. Gmur, E.T. Balzer, Jr.

BNL 51632
Data Report for the 1977 Land-Air-Sea Interaction Experiments. S. SethuRaman, C. Henderson

BNL-NCS-51647
Thermal Neutron Capture Gamma-Rays. J.K. Tuli

BNL 51652
Chemical/Hydrogen Energy Systems. Annual Report Jan. 1, 1982 to Dec. 31, 1982. M. Beller, et al

BNL-NCS-51655
Evaluated Nuclear Structure Data File. A Manual for Preparation of Data Sets. J.K. Tuli

BNL-51732
Case Study of the Blouin Superheated House. D.A. Hagan, R.F. Jones

NUREG/CR-3604
BNL-NUREG-51735
Bolting Applications. C.J. Czajkowski

BNL-51741
Biological Effects Summary Report — Acridine. D. Keimig, S. Muff

BNL-51748
Energy Efficiency and Conservation in West Africa, Proceedings of a Seminar Lome, Togo Mar. 30—Apr. 8, 1983. D. Jhirad, Editor

BNL-51762
BNL Neutral Beam Development Group Progress Report FY 1983 and Final Report, K. Prelec, Th. Sluyters

BNL-51765
Monitoring Building Energy Performance. An Informal Review and Characterization of Research in Progress. T. Vonier

NUREG/CR-3383
BNL-NUREG-51691
Irradiation Effects on the Storage and Disposal of Radwaste Containing Organic Ion-Exchange Media. K.J. Swyler, C.E. Dodge, R. Dayal

NUREG/CR-3627
BNL-NUREG-51738
FRANTIC II: Applications to Standby Safety Systems. T. Ginzburg, J.L. Boccio, R.E. Hall

NUREG/CR-3664
BNL-NUREG-51746
A Description and Assessment of RAMONA-3B: A Computer Code with Three-Dimensional Neutron Kinetics for BWR System Transients. W. Wulff, H.S. Cheng, D.J. Diamond, M. Khatib-Rahbar

NUREG/CR-3716
BNL-NUREG-51754
CONTEMPT4/MOD4: A Multicompartment Containment System Analysis Program. C.C. Lin, C. Economos, J.R. Lehner, G. Maise, N.K. Ng

Employee Seminar

On August 22 at noon in Berkner Hall, Gus Sarro, Community Service Representative of the Town of Brookhaven's STOP DWI Program, will present the next Employee Health Seminar. Sarro will show a film entitled "Drugs, Drinking and Driving," and will outline how the average citizen can help in the fight to reduce the number of alcohol-related traffic deaths.

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Equipment Demo

Exxon Office Systems Company will be in the lobby of Berkner Hall on August 21 from 11 a.m. to 2 p.m. They will be demonstrating office automated equipment, specifically information processors with ink jet printer technology, facsimile and the expanded capabilities of the QYX Intelligent Typewriter.

Cafeteria Menu

Week Ending August 24

Monday, August 20

Cream of mushroom soup	(cup)	.65
	(bowl)	.85
Veal Rosemary over noodles		2.05
Breaded pork chops w/apple rings		2.00
Hot Deli — Chicken patty club	(bread)	2.15
	(roll)	2.30

Tuesday, August 21

Beef barley soup	(cup)	.65
	(bowl)	.85
Swedish meatballs over rice		1.95
Baked French bread pizza & 1 veg.		2.00
Hot Deli — Boneless BBQ ribs sandwich	(bread)	1.85
	(roll)	1.95

Wednesday, August 22

Canadian cheese chowder	(cup)	.65
	(bowl)	.85
Corned beef & braised cabbage & boiled potato		2.30
Turkey pot pie		1.95
Hot Deli — Philadelphia steak sandwich w/pepper & onions	(bread)	2.00
	(roll)	1.95

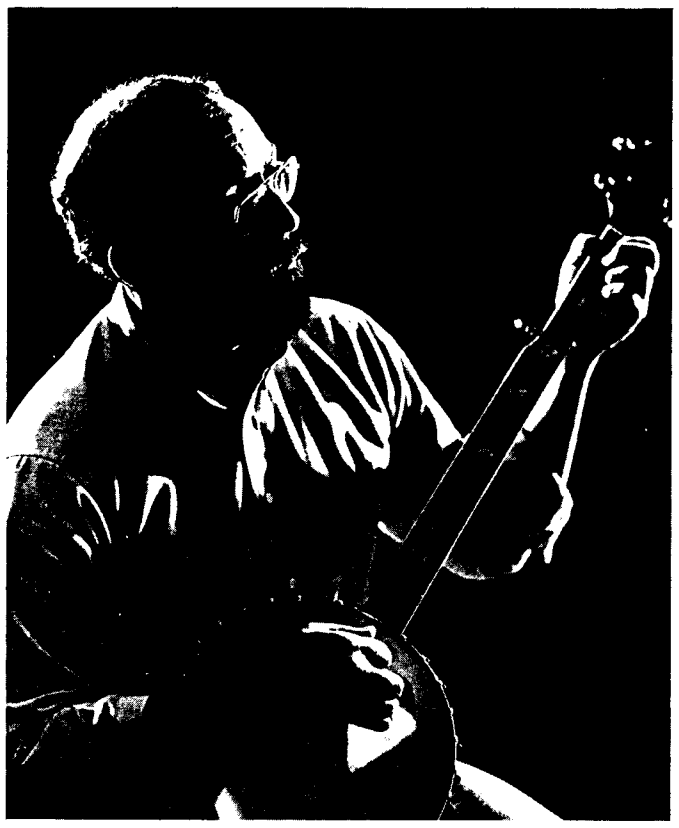
Thursday, August 23

Minestrone soup	(cup)	.65
	(bowl)	.85
Baked Italian lasagne & 1 veg.		2.05
Braised liver & onions & 1 veg.		1.90
Hot Deli — Reuben		1.90
Top your own baked potato w/chili & cheese sauce		.75
Plus two toppings of your choice		.25

Friday, August 24

Fish chowder	(cup)	.65
	(bowl)	.85
Polish style stuffed pepper & 1 veg.		1.95
Macaroni & cheese		1.85
Hot Deli — Seafood cheddar melt	(bread)	1.90
	(roll)	2.05

BERA News



Mort Rosen

BNL's musical master of satire, Karl Swyler, is just one of the many talented local performers who will be appearing in the 7th annual BERA Vaudeville Show. This delightful program of comedy, song and dance will be presented cabaret-style in the North Room of the Brookhaven Center on Friday and Saturday, August 24 and 25, at 8 p.m. Admission is $3; or $2 for those under 18 or over 65. There will be a cash bar and snacks. Bring your family and friends for an evening of entertainment and socializing. For information, call Penny Baggett, Ext. 5154.

V a u d e v i l l e

Tennis

Players who played the annual tournament or the tennis ladder this summer are invited to get together for wine and cheese and the presentation of awards in the Physics Department courtyard, Thursday, August 23 at 5:15 p.m. If it rains the party will move into the lobby.

Softball

Games for week of August 6

League I
Games rained out
Playoff Game:
Blue Jays 13 — Ravens 1

League II
Lights Out 7 — Random Errors 1

League III
Farm Team 4 — No Names 3

League IV
Mole-Esters 10 — Turkeys 9
Septembers 18 — Underalls 6
TNT 8 — Kidz-R-Us 2

League V
Mudville Sluggers 12 — Foul Ups 8
No Feedback 24 — Erasers 11

First Half Winners
League I — Blue Jays
League II — Dirty Sox
League III — Survivors
League IV — TNT
League V — Who Cares

NYC Train Trips

The Hospitality Committee is planning two group railroad trips to the city in the next two weeks.

One is a special on Saturday, August 25, leaving at 8:31 a.m. Round-trip fare is $6.50 and must be received no later than Wednesday, August 22. Reservations will be accepted on a first-come, first-served basis.

The second is a regularly scheduled trip on Wednesday, August 29, leaving at 7:55 a.m. The round-trip fare is $5.00, and must be received by Thursday, August 23. Refunds will be made only if cancellations are received by the Monday morning preceding the trip.

Children under five years ride free on both trips. All departures are from the Patchogue LIRR station. To reserve a ticket send your fare through the U.S. mail to BNL, P.O. Box 322, Upton, New York 11973. Checks or money orders should be made payable to BNL. Do not send cash. Put the date of the trip, your telephone number and BNL life number on the check. Tickets will be given to you on the train.

Friday Pool Special

Winners of last week's pool races were:

Ping Pong Ball in Spoon Race — Ages 4 & 5
1st Lydie Vignola
2nd Kristin Losquadro
3rd Kevin Holden

Ages 6 & 7
1st Christine Hsieh
2nd Jennifer Chen
3rd Theresa LoMonte

Ages 8 & 9
1st Judith Mathewson
2nd Keith Chan
3rd Jeffrey Chen

Balloon Race — Ages 10 and over
1st Gregg Stodosky
2nd Amit Ilberg
3rd Ronit Ilberg

Today, August 17, will be the last Pool Special of the season. Kids of all Lab employees are invited to come join the fun!

Cast Call

Tryouts for the BNL Theater Group's next production, "Morning's At Seven," will be held on Monday and Tuesday, August 27 and 28 in the Physics Building auditorium. On Monday, the auditions will begin at 5:30 p.m.; on Tuesday, at 7:30 p.m. Performance dates are scheduled for November 9, 10, 16 and 17.

Written in 1939 by Paul Osborn, "Morning's At Seven" offers a nostalgic and entertaining picture of life in a quiet little American town during the late 30's. Five women and four men are needed to portray a variety of characters, most of them getting on in years. We are actively seeking new faces; if you think you might enjoy a turn on stage, come by and read for a part. If you have questions, call the director, Neil Baggett, on Ext. 3830.

Help is also needed on sets, costumes, makeup, props, etc. Those who would like to participate backstage should contact the producer, Kurt Fuchel, on Ext. 4116, or stop by at one of the tryouts.

Speaking Out

Do you own a pet? What kind? Those were our leadoff questions for these BNL'ers. Of pet pet owners, we also inquired: Did you choose your pet, or did it choose you? And if they weren't pet owners, we were curious about their feelings on the subject.

Anita Cohen, Reporter
Mort Rosen, Photographer

Freddie Lawson (Medical) — Tropical fish. I was stationed in the South Sea Islands when I was in the service, and I saw a variety of marine life for the first time. I just fell in love with tropical fish. They're beautiful to watch. Th y really relax you.

John Tighe (Fiscal) — Do I have a pet? Pets-s-s-s! We have two dogs and a cat which were found in the street, two parakeets and whatever other creatures the kids bring home from school, such as rats and gerbils.

Chris Moore (Directors Office) — I don't own a pet. We'd like to have a dog, but there's no one home to take care of it. The kids want a dog, but for now we're working on getting a bird. We figure it doesn't need much care.

Amy Rubenstein (Nuclear Energy) — Yes, I own two female dogs, mutts. They're so wonderful, and I love them very much, even if they do keep me up in the middle of the night when I have to let them out. My brother found one on the center court of Forest Hills so we named her Shlomo, after Shlomo Glickstein, an Israeli tennis player. The other one we sought out. We went to ARF [Animal Rescue Fund]. I could talk to you forever about my dogs.

Liam McDonnell (Physics, visitor from Ireland) — A pet? No, I'm afraid not. We had a cat, but the cat was killed. In Ireland, we live in a country area, so people tend to have some cats and dogs, but less so as household pets than as a sort of pest control. Dogs in country areas tend to be working dogs, and the cats take care of the mice. That's essentially why we had a cat.

Jennifer Brown (Nuclear Energy, summer student) — I live with my folks, and we have three dogs. They were all strays. Trick or treaters brought one of them. We found one at Friendly's, jumping up on people who came out with their ice cream cones. And the other one was hit by a car in front of my mother, so she stopped to help her. That one's my dog.

Boyce Grier (Physics) — No, but we're planning to get a dog, probably in a couple of years. My son is two years old now, and when he's old enough, we'll probably give him a dog. I'd like to have a Labrador, but I don't know yet whether we'll talk his mother into one of those.

Lily Liu (Photography & Graphic Arts) — No, I don't own a pet. I like pets, but they're too much hassle. If I were going to get one, I'd get a dog, but you have to take them out for walks everyday.

Classified Advertisements

Placement Notices

The Laboratory's placement policy is to select the best-qualified candidate for an available position, with consideration given to candidates in the following order of priority: (1) present employees within the department, with preference to those within the immediate work group; (2) present employees within the Laboratory as a whole; and (3) outside applicants. In keeping with the Affirmative Action plan, selection decisions are made without regard to age, race, color, religion, national origin, sex, handicap or veteran status.

Each week, the Personnel Office lists new personnel placement requisitions. The purpose of these listings is, first, to provide open placement information on all non-scientific staff positions; second, to give employees an opportunity to request consideration for themselves through Personnel; and, finally, for general recruiting purposes. Because of the priority preference policy stated above, each listing does not necessarily represent an opportunity for all candidates. As a guide to readers, the listings are grouped according to the anticipated area of recruitment.

Except when operational needs require otherwise, positions will remain open for one week following publication date.

For further information regarding a placement listing, contact the Personnel Placement Supervisor, Ext. 2882.

OPEN RECRUITMENT — Opportunities for Laboratory employees and outside applicants.

2097. TECHNICAL POSITION - Requires AAS degree in mechanical technology or equivalent and a minimum of 5 years' experience in the installation, operation and maintenance of UHV components and systems. A thorough knowledge of the maintenance and repair of leak detectors, turbomolecular sputter ion pumps and related equipment necessary. Background in electronics desirable. National Synchrotron Light Source Department.

2098. OPERATIONS COORDINATOR - Requires BS degree or equivalent in physics or electrical engineering. Experience with power supplies, computer controls, peripherals and/or RF systems desirable. Responsibilities include troubleshooting, liaison with experimenters, electronics design and/or programming and superivision of AGS shift operations. Rotating shift work. Accelerator Department.

2099. SCIENTIFIC ASSOCIATE - Requires BS (MS preferred) in physics or engineering or equivalent experience. Background in ultrahigh vacuum techniques, the design and fabrication of intricate instruments, electronics and computer programming is necessary. Knowledge of UHV analytical methods (Auger and thermal desorption spectroscopy, LEED and x-ray photoemission) is desirable. Will be responsible for the coordination of scientific experiments on the Exxon Corporation beam lines. (Term appointment — one year.) National Synchrotron Light Source Department.

2100. PROGRAMMER - Requires a bachelor's degree in computer science or equivalent capabilities. Position involves coding and testing of programs relating to operation of special design computer interfaced accelerator hardware. Must have good knowledge of FORTRAN. TOPS — 10 and data base experience a plus. Accelerator Department.

Autos & Auto Supplies

72 VOLVO - 144, needs some work, $500. Ext. 2018 or 928-3568 eves.

ROADCRUISER - slide-on, 11' camper, sleeps 6, full bath, very good cond., asking $2,225. 878-0492.

78 TOYOTA CELICA GT - hatchback, 5 spd., p/s, p/b, a/c, am/fm 8-track stereo, new brakes, shocks, s/b radials, $4,000. Ext. 2829.

80 BUICK CENTURY LTD - 4 dr., white, loaded, Michelins, excel. cond., $5,500. Ext. 3392 or 475-8330.

TIRES - 15" & 14". 473-6432.

72 MOBILE TRAILER - pull type, sleeps 6, bath & shower, refrig., heater, very airy, needs some work, $2,600. Ext. 2964.

75 BUICK - 350 engine, 4 dr., p/s, p/b, new tires, new parts, reliable transportation, good cond., $1,000. Walter, 878-8967.

71 DODGE DART - 1318, 4 dr., p/b, p/s, a/c, excel. running cond., body fair, 127K, $750 or best offer. Ext. 4260.

MINI-PICKUP CAP - 6' bed, good cond., $100. Ken, 281-6070.

80 KAWASAKI MOTORCYCLE - KDX250, new in '82, 1,100 mi., $700 or best offer. 369-0089.

VW RIMS - 4 x 13, $15 ea. or 4 for $50. Gary, 689-7725 after 6 p.m.

80 PONTIAC SUNBIRD - 6 cyl., 4 spd., excel. cond., $3,500. 929-8317.

75 MGB - convertible, am/fm 8-track, 81,000 mi., good cond., $2,600. John, Ext. 7671.

CARS - (2), 1972, high mi., some rust, running, cheap. 727-1789 eves.

PICK-UP CAMPER - 11', slide-in, self contained, sleeps 6, alum., step bumper, excel. cond., $2,395. 821-1081.

61 JAGUAR MARK IX - silver, excel. cond., $9,500; 1966 Austin Healey 3000, MK III, green, conv. top & tonneau cover, excel. cond., $7,000. 289-9752.

78 MOTORCYCLE KZ400 - lo mi., dealer maint., many recent parts & tune-up, saddle seat, roll bars & rack, $850. Ext. 7148 noon.

74 CHRYSLER NEWPORT - $450 or best offer: 727-5912.

78 CADILLAC - 4 dr. sedan, D'Elegance model, 66,000 mi., excel. cond., full power, cruise control. Ext. 3319 or 744-9802.

75 SKYHAWK - V6, auto., p/s, p/b, a/c, good transp., good cond., $1,000. Charlotte, 286-0913.

74 CAPRI - hi mi., but good transportation, $700. 286-9611.

83 PLYMOUTH RELIANT - 4 cyl., p/s, p/b, excel. cond., $6,000. Ext. 4120 or 588-8492 after 6 p.m.

73 DODGE MONACO - 4 dr., V8, p/s, p/b, p/seats, & p/brakes, am/fm, needs some work, $400. Ext. 5283.

83 CHEVROLET CAVALIER - p/b, p/s, sunroof, a/c, excel. mi., excel. cond., Lois, Ext. 2959 or 751-0023.

82 DIRT BIKE - RM125, excel. cond., Pluss Bell Moto III, chest protector, kidney belt, new. 722-4821.

71 DODGE DART - 1318, 4 dr., p/b, p/s, a/c, excel. running cond., body fair, 127K, asking $750. Ext. 4260.

SHOP MANUAL - for 1977 Honda Accord CVCC, $10. Gordon, Ext. 4095.

72 VW BUG - many new parts, good cond. Ext. 3059 or 744-7242 after 6 p.m.

78 NOVA - 4 dr., a/t, p/s, p/b, am/fm stereo, new exhaust, red/black, 60K, excel., $2,650. Ext. 7759 or 3073 eves.

73 MERCURY MONTEGO - 302 V8, 4 dr., 46,000 orig. mi., needs paint, $1,300. Pete Eterno, Ext. 4167.

HONDA CR80 DIRT BIKE - $525. 736-1525 eves.

81 KAWASAKI 650 - 4,000 mi. clear, $800. 757-1380.

68 DATSUN SPL311 ROADSTER - conv., restored, must see. Chris, 929-6543 after 6 p.m.

76 HONDA 750 - excel. cond., asking $950. Jungreis, 363-7032.

81 HONDA XR80 - very lo mi., mint, $375. 286-1358.

74 CHEVY MONTE CARLO - 350, a/t, p/s, p/b, a/c, am/fm radio, good cond., $1,095. 286-0984.

77 FORD F250 - 4 wheel drive, p/s, p/b, a/c, am/fm, sunroof, cap, plow, 1980 mtr., $6,400. 567-4333 days or 924-4965 eves.

76 PLYMOUTH VOLARE - wagon, 4 spd., good cond., $850, avail. end Aug. Tom, Ext. 3128 or 928-7344.

VESPA BRAVO MOPED - Super Deluxe, Class B, excel. cond., used very little, $500. Lloyd, Ext. 3381 or 286-1024.

70 FORD VAN - parkway windows, 6 cyl., std., good running cond., $245. Frank, Ext. 2022 or 399-4480.

69 HOLIDAY TRAILER - 17', sleeps 6, self-contained, awning, very clean, $2,400. 728-2802 after 6 p.m.

72 FORD GRAN TORINO - 302 cu. in., auto., body good, engine needs work, $300. 878-8964.

74 CAMARO - 3 spd., 350, new tires, exhaust, starter, looks and rides excel., $1,600. Ext. 4672.

Boats & Marine Supplies

80 EVINRUDE - w/controls, Mennino Garvey boat, $1,950. V. Racaniello, 286-9606.

12' FIBERGLASS BOAT - Sears gamefisher, extras, excel. cond., asking $300. Greg, 286-0065.

BOAT ACCESSORIES - trailer, tire & wheel, new, unused, 5.30x12, 4-hole, $25. Joe, Ext. 2575 or 281-2767 eves.

FLASHER RECORDER - Rathyeon chart, $125. John, Ext. 4312.

18' WINNER - 1971, all glass inboard-outboard, 155 HP OMC, fresh water cooled, $3,200. 722-3905 after 5 p.m.

28' OWENS - very good cond., new canvas & hard top, stand-up head, stove, sink, ice box, sleeps 4, equipped, asking $2,800. Ext. 7148 noon.

SUNFISH - excel. cond., trailer, beach wheels, $900. 929-8287.

MERCURY CRUISER - outdrive, model 120 A, $700; boat trailer, E-2 roller, shoreline, 3,200 lbs., cap for 18-21' boat, $1,300. 929-8876 after 6 p.m.

LADDER - EEz-In, hook type, w/adjustable standoffs, new $35, asking $25. Ext. 7518 or 589-5490.

21' T-CRAFT - 1972, w/trailer, VHF, 307 Chevy OMC I/O, sleeps 4, canvas, excel. cond. Ext. 3319 or 744-9802.

25' CHRIS CRAFT - 1969, fiberglass, new canvas, new engine, depth finder, gauges, CB, sleeps 4, excel. cond., $9,000. 234-7225.

14' PHANTOM - sailboat, excel. cond., extras, $1,000. Ext. 4227.

Miscellaneous

WOMEN'S BIKE - 10 spd., very good cond., $45. Toni, Ext. 5257 or 821-0379 eves.

BARBER CHAIR - early 1900's, white & green upholstery, great conversation piece, must see, $100. 422-1846 after 6 p.m.

COLONIAL COUCH - & matching chair, plaid Herculon, mint cond., $200. 587-2625.

CHILD'S BIKE - 16", red, very good cond., asking $22. Ext. 4935 or 4618.

LENS - Ricoh F 2.8, 35 mm, wide angle for Ricoh 126C. Susan, Ext. 4267.

BEDSPREADS - twin size, red, white & blue; king size, gold & beige, $15/ea. Les, Ext. 2920.

VIOLINS - 1/2 size, German, $175; 3/4 size, Japanese, $150. Ext. 3388 or 286-3903.

CABBAGE PATCH DOLLS - Koosas (pets) & clothes, going fast. 286-3623.

UP-RIGHT FREEZER - Sears, 25 cu. ft., good cond., new door gasket & paint, $200. Walter, 878-8967.

COLONIAL CAPTAIN'S BED - Broyhill, twin size, dark pine, excel. cond., $150. 472-2581.

CHAIN LINK FENCE - galvanized, 2" mesh, 5' high, 1 piece 30' long, 1 piece 10' long, good cond $35. Sam, Ext. 4749.

AIR CONDITIONER - Well Built (brand name), 8,500 BTU's, $150. 475-5448.

HI-LO GAS RANGE - Caloric ultra ray, lower w/rotisserie, avocado, $200. Ellie, Ext. 3395 or 325-1537.

JACOBSEN LAWN MOWER - $50. Joe, 475-8440.

VANITY LOUVER WINDOW - 3'x7', $15. Ext. 3859 or 286-1712 after 6 p.m.

ENGAGEMENT RING - 1.01 ct., 2-12 pt. baguettes. Dan, Ext. 2319.

BEDSPREADS - twin size, "Jay Yang Growing Poppies," brand new in package, $25 ea.; twin boxspring & frame, $25. 286-9389.

MEN'S BIKE - 26", Ross, 10 spd., $50. Greg, 286-0065.

BRIDAL ENSEMBLE - gown, veil, slip, really pretty. Cindy, 924-5533 Ext. 223 or 736-5365.

ATARI 2600 GAME CARTRIDGES - most $5; game console dust cover, $10. Richie, Ext. 2175.

FIREPLACE SCREEN - $10; (6) storm windows, $2 ea.; sewing machine & cabinet, $20; GE electric dryer, new, $150. Victor, Ext. 2395.

FRANKLIN WOOD STOVE - $25; Moorsan tent, 7x7, $65. John, Ext. 4312.

LACROSSE STICKS - (2), $20; Wilson tennis racket, $15; TCR racing car set, $20. Jay, 286-3679.

CONTENTS OF HOME - modern pictures, rug, lamps, chairs, furniture, excel. cond., price neg. 325-9580 after 6 p.m.

MET OPERA TICKETS - 2 ea., Manon Lescaut, Mar. 8; Rigoletto, Apr. 12, balcony, Row E, center, $20/ea. Dave, Ext. 2694.

KENMORE WATER SOFTENER - 3 yrs., $100; Mark 10 glass lined tank, $25; Sears pump, $25. Anna, 281-4202.

FUEL TANK - 275, heavy gauge metal w/legs. 286-0904 after 5 p.m.

MOVING SALE - water skis; typewriter; proj. screen; life jackets; Jr. Brit. Encyclopedia Life Sci. Series; guitar; many other items. 261-7825.

SPEAKERS - 1 pr., K.E.I., columns 18"x56" ea., has two 12" and 3/7" speakers, $250. 924-7677.

HARDMAN SPINET PIANO - like new, $1,200. 399-0177 or 929-4701.

CHILD'S BIKE - red, 16", very good cond., $22. Ext. 4935.

NATIONAL GEOGRAPHIC MAGAZINES - 1970's issues, make offer. Ext. 3082 or 727-5912.

SPANISH BEDROOM - 6 pices w/bedding, excel. cond., sacrifice, $300. 289-2274.

SWIMMING POOL - 15'x4', plus access., you disassemble, best offer. 473-0961.

REFRIGERATOR - manual defrost, old but good; lawnmower, good for rough work, $20. Joe, Ext. 2975.

REFRIGERATOR - 17 cu. ft., good cond., copper, $125. Linda, 467-5811 after 5 p.m.

BOW WINDOW - 8'x5', 12 glass panels, $100; alum. storm door, 36"x81", w/screens, $10. Mickey, Ext. 3173.

DESIGNER LOUNGE CHAIRS - (2), Calif. redwood w/thick vinyl covered cushions, orig. $300/ea., like new, $100/ea. 744-1081 after 5 p.m.

BABY STROLLER - $20; variable speed 48" ceiling fan, $75; humidifier, never used. $100. Ext. 2410.

CAPTAIN'S BED - unfinished, brand new, must sell since it won't fit upstairs, $80. Dan, Ext. 3631 or 689-8040.

MARTIN GUITAR - model 7-28, 3/4 size, excel. cond., lifetime guar., must sell. 821-0137.

FULL LENGTH MINK COAT - size 8-10, appraised at $2,250, will trade for a dependable car. 929-6543 after 6 p.m.

MAGNAVOX STEREO - hi/fi console, good cond., nice piece of furniture, good sound, $150; Wurlitzer Organ, Spinet, solid cherry, model 4300D, multimatic percussion, excel. cond., $900. Lloyd, Ext. 3381 or 286-1024.

TWIN BED - boxspring, $15; redwood lawn furniture, $50/set; Turkish leather footstools, $10/ea. Tom, Ext. 3128 or 928-7344.

PVC DARKROOM SINK - 72"x22, splash board, print drying racks, cabinet underneath, excel. cond., $250. 732-6822.

ELECTRONIC TUBES - 70 types incl. ancient #56, #58, sell as lot only, best offer. Ext. 3552.

KITCHEN TABLE - and 4 chairs, wrought iron, excel. cond., $100. 821-0080 after 5 p.m.

DUPLICATOR - REX rotary, w/supplies, $50. 473-4333.

TENT - 7'x10', good cond., reasonable. 363-7032.

CABBAGE PATCH KID - boy, brown hair & eyes, w/pacifier, $60. Henry, Ext. 4547 or 924-6688.

CRAFTSMAN SAND BLASTER - 1 qt. cannister, $25; Craftsman solid-ox torch kit, never used, $20. Ext. 7158 or 589-5490.

DINING ROOM - dark pine, hutch 80"Hx70"W, 72" trestle table w/2 leaves, 5 captain's chairs, $950. 981-3750.

ELECTRIC TYPEWRITER - Smith Corona, script letters, like new; ITT touch tone trim line phone, brown; Petite curie phone, ivory. 751-6418.

Free

CARTOP CARRIER - w/platform; 4' x 5' folding table. 475-8440.

CAT - beautiful, affectionate, declawed, spayed, needs loving home. Carol, Ext. 2907 or 698-8510-eves.

POODLES - 2 female, 1 1/2 yrs., beautiful, champion background, adult home only. 473-6432.

Real Estate

Real Estate advertised for sale or rent is available without regard for the race, color, creed or national origin of the applicant.

For Rent

RIDGE - 1 bdrm. apt., priv. entrance, oil heat, carpeting, parking, 2 mi. from Lab, 1 mo. rent, 1/2 mo. security, $480 includes util. Wally, Ext. 2468.

CORAM/NORTH ISLES - studio apt., clubhouse, swimming, $425/mo. w/heat. Bob, Ext. 3306 or 744-6506.

MOUNT SINAI - furnished room w/new carpet, desk, bed, etc., $300/mo., 2 meals avail. w/additional $300, 1 mo. security. Shoko, 331-4648.

CORAM - 1 bdrm. apt., kitchen, lr., bath, w/w, private ent., garage, single or couple, avail Sept. 15, $550. includes util. Diana, 473-2183 or 582-6400.

YAPHANK - condo town house, 3 bdrms, 2-1/2 baths, cent. air, w/w, full basement, appl., pool, club house, tennis, 2 1/2 mi. from Lab, furn/unfurn. Leo, Ext. 4615 or 924-3928.

PORT JEFFERSON VILLAGE - 2 bdrm. house, new eik, all appliances, front and back porches, walk to everywhere, $1000. Ext. 4853 after 1 p.m. or 473-4948 after 6 p.m.

PORT JEFFERSON VILLAGE - room for rent, furnished. 473-6432.

MIDDLE ISLAND - private 4 acres w/pond, 3 bdrms, 1-1/2 baths, f/p, w/d, dishwasher, furnished, 5 min from Lab, $800. avail Sept. 1. 924-7480 after 6 p.m.

E. PATCHOGUE - lg, 1 bdrm., lvrm., near beach, marina, swimming pool and tennis court, separate entrance, $450 includes util. 289-9724.

CENTEREACH - unfurnished 3 rm. apt., full bath, private entrance, 20 min. from Lab, in-ground pool priv., no pets, $500. includes all util. Bill, 331-5528.

CENTER MORICHES - 1 bdrm. apt., galley kit., liv. rm., bath, priv. entrance, no pets, $425. 878-0897.

For Sale

CORAM - Birchwood at Bretton Woods, condo., Dalton model, 3 bdrms., den, formal dr., 1 1/2 baths, gas heat, central air, patio, 1/2 blocks to clubhouse. 732-6822.

RIDGE - 1800 sq. ft., colonial, 4 bdrms., l/r, d/r, eik., den w/brick fpl., 1-1/2 baths, laundry, full basement, 2 car garage, quiet 1/3 acre part. wooded, 12 yrs. old, energy efficient, excel. cond., $82,500. 924-0425.

CONNECTICUT - lake front cottage, 2 bdrm., $24,000, will hold mortgage. 757-1380.

MT. ADIRONDACK - 4 bdrm. house, view of Whiteface (15 mi.), 1-1/2 baths, screened patio, deck, 2 car garage, 20 x 40 in ground pool, 1 acre, $69,900. 518-647-8613.

SO. SHIRLEY - 3 bdrm, ranch, w/garage, full basement. 399-4122.

COOPERSTOWN - 180 acres adjoining state forest, drilled well, bldgs., reas. 363-7032.

Car Pools

HUNTINGTON STATION/MELVILLE - 2 person carpool looking for 3rd & 4th. Joe, Ext. 4259.

Lost & Found

LOST - (2) domestic cats, black & white male, tan & white female, 6 yr. old, 7/1/84, vicinity of Rt. 112 between Granny & Horseblock Rd. Victor, Ext. 2395.

Wanted

ORGANIST - for congregation that appreciates good music, antique pipe organ, Old South Haven Church. 286-0542.

TANK - to hold rain water, 100 gal. plus capacity. George, Ext. 4100.

HOUSE - 3 bdrm., Bethpage, Wantaugh or Mineola area. Victor, Ext. 2395.

HOUSEMATE - share 4 bdrm., 3 bath house, 20 min. from Lab, washer/dryer, sundeck, $233/mo. $ 1/3 util. Ext. 2521 or 928-8379.

LAWN MOWER - riding, 8hp or larger. 757-1380.

HOUSE - to sit, free, responsible, any period or duration, Aug. 20 to Nov. 1. J. Allentuck, Ext. 2412.

DISHWASHER - portable, good cond., reas. cost. Victor, Ext. 2395.

HOME - for neutered male cat, loving affectionate, well trained. Liz, 286-0913.

GOLF CLUBS - starter set for beginner, with bag., used, good cond., reas. Adam, Ext. 4561.

TRAILER - aluminum galvanized, for 16 ft. runabout boat. Ralph, Ext. 2368 or 928-6654.

MOTHER - responsible, non smoking, to care for 2 yr. old, p/time, M,W,F, on site or in Cntr. Moriches. 878-0717.

OLD CAR LOVERS - show, Sunday 8/19, Neighborhood Rd., Mastic Beach, classy cars, fun, food, handcrafts, etc.

HOUSEMATE - male with child, to share large house in good school district, finances negotiable. Bob, Ext. 3401 or 744-6229.

BIKE RACK - to fit hatchback, to borrow or buy. Janet, Ext. 2345 or 929-8152.

Classified Ad Policy Deadline is 4:30 p.m. Friday for publication Friday of the next week.