Experimental Nuclear Physics at Stony Brook
Past, Present, and Future
Prof. Gene D. Sprouse
Stony Brook
• Nov 24, 2006 4:00 pm  Superconducting LINAC completed its last experiment at Stony Brook

• This is an opportune time to review the history of the Van de Graaff and the LINAC and the people involved in their acquisition and operation, and to look into the future a little.
PRESENT CAMPUS
OF
S.U.N.Y. STONY BROOK
March, 1963

A. Physics
B. Chemistry
C. Biology
D. Engineering
Department of Physics 1964

Bob deZafra

Cliff Swartz

Juliet Lee-Franzini

Arnie Feingold

Peter Kahn

Alec Pond
Proposal for EN tandem Van de Graaff to SUNY-Alec Pond

The Master Plan of the Board of Trustees puts us squarely in the business of building here a university-level operation in physics which will sustain comparison with those established institutions (some twenty-five in number) which presently dominate the production of baccalaureate and doctoral physicists in this country. In a Memorandum to Dean Hartzell, dated 19 September, 1962 (appended to the Department's budgetary requests for 1963-64), I have discussed at some length the interplay between instruction and research in these Departments, emphasizing that, in a Department based on a large undergraduate population, a proper balance between instruction and research leads to excellence at every level, from freshman to faculty, and to optimum potential for generating outside support.

8 December 1962
Van de Graaff proposal

The benefits to the students that trace directly to the research laboratories are substantial. For the graduate program, the need is dual, because these students require not only the services of a research-caliber faculty in their instruction, but eventual access themselves to the facilities for their own theses. The periodic use that is made of a Department's large research facilities in undergraduate work (teaching laboratories devoted to contemporary problems, the inclusion of the most talented upperclassmen in research activities, etc.), although it creates unusual opportunities for excellence in instruction, would not in itself justify their purchase. Their impact on the undergraduate program is, however, direct and extremely beneficial: whether a student is a potential scientist or not, he deserves instruction in the chief intellectual accomplishments of our time from a man who has that insight, breadth and enthusiasm that comes from involvement in research and cannot otherwise be simulated by any amount of pedagogical skill. Research facilities are thus quite directly the parent of every excellence in the institution's instructional programs.
## Time Line for proposal

<table>
<thead>
<tr>
<th>Date</th>
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<tr>
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<td>13 Feb 1963</td>
<td>Provost Porter gets positive review</td>
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</tbody>
</table>
March 13, 1963

Dr. Karl D. Hartzell
Chief Administrative Officer
State University at Stony Brook
Stony Brook, New York

Dear Dr. Hartzell:

This letter concerns the proposal by Professor T. A. Pond that the State procure a Tandem Van de Graaff generator and associated laboratories at Stony Brook to serve as a basis for an experimental program in nuclear physics. If Stony Brook is to become a University in the true sense of the word, the scientific departments must carry out research programs of their own choosing. A particle accelerator of the type recommended by Professor Pond would seem to be a good choice from the standpoint of starting up a program of basic research and providing instructional opportunities for advanced physics students. Brookhaven would welcome, in our vicinity, a new research group in nuclear physics and I think both institutions would profit from the exchange of ideas.

Finally, let me say, as a member of the Advisory Council for the Advancement of Industrial Research and Development, that this accelerator would be in keeping with Governor Rockefeller's desire to enlarge the scientific resources of the State.

Sincerely yours,

Maurice Goldhaber
Director
### Time Line for proposal

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<td>State Legislature appropriates $1.35M for machine and $2 of the building,</td>
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</table>
15 April 1964

Professor John S. Toll, Chairman
Department of Physics and Astronomy
University of Maryland
College Park, Maryland

Dear Johnny:

We have just been notified that our Van de Graaff Laboratory Proposal to the State of New York has been approved by the Legislature and funded to the extent of $1,350,000 (for purchase of machine and about half of the building; remainder of the building is at NSF OIP).

With best regards,

Yours truly,

T. A. Pond
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<td>15 April 1964</td>
<td>State Legislature appropriates $1.35M for machine and ½ of the building,</td>
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<td>27 October 1964</td>
<td>NSF grant for ½ of building ($291k) approved.</td>
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MEMORANDUM

TO: Drs. Hartzell and Ross
FROM: T. A. Pond, Chairman
SUBJECT: Proposal for a King-sized Tandem Van de Graaff

SUMMARY

The $291,000 grant received today from NSF for the Van de Graaff Laboratory puts us within striking distance of a most exciting possibility, if it can be regarded as an increment to the State funding: substitution of a King tandem for the presently approved Standard.

In recent weeks, it has become clear that the King is an amazing bargain: it combines the simplicity of operation of the smallest tandems with the maximum energy of the largest tandems (still under design). The King installation costs about $450,000 more than the Standard, but something in excess of $1,800,000 less than the large machines. The King's maximum energy (expected to reach 23 MeV, while the Standards will go to 15 MeV) makes very large additional areas in the physics of heavier nuclei accessible, giving the machine much greater and longer-lived value as a research facility (the return being much more strongly than linearly dependent on maximum energy).

Substitution of a King for the Standard conserves all of the arguments in our original proposal: complementarity with Brookhaven, economy of operation, suitability for use by graduate students, etc. It also would conserve all building planning done to date, because the King will fit in the building that is already being programmed.

The situation is reviewed in the attached paper, and the many advantages to SUNY of considering a King at this time are pointed out. The problem of finding the necessary additional capital is discussed.
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<td>State Legislature appropriates $1.35M for machine and ½ of the building, other ½ ($291k) from NSF funding.</td>
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<td>Jan 1 1965</td>
<td>First NSF research grant for $34,000</td>
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<tr>
<td>Sept 1965</td>
<td>Lin Lee, Dave Fossan hired</td>
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<tr>
<td>Sept 1966</td>
<td>Peter Paul, Bob Weinberg hired</td>
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<tr>
<td>Oct 1966</td>
<td>Building started</td>
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</table>
October-10-1966  (view from top of Harriman Hall toward Old Chemistry. Trees are site of Grad Chemistry building)
Completed Van de Graaff building

Trees at right rear of the building will become site of Grad Physics Building
Delivery of the Van de Graaff tank

We all live in a yellow submarine,
Yellow submarine, yellow submarine,
We all live in a yellow submarine,
Yellow submarine, yellow submarine,
Tank entering the building
Current picture of the Van de Graaff
# Nuclear Experiment Facilities and Faculty 1965-2007

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*resigned*
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<td>Gamma Ray Spectroscopy</td>
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<td>Giant Dipole Resonance</td>
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<td>Charged Particle Reactions</td>
<td>Bob McGrath</td>
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<tr>
<td>Nuclear moments and applications to Solid State, Atomic Physics</td>
<td>Lin Lee, Gene Sprouse</td>
</tr>
</tbody>
</table>
Two PDP-9 computers from DEC, each costing $100,000. The “big” machine had 16k 18 bit memory cells, and the “small” one 8k!
The machine ran 24-7, and we hired people to operate the machine at night.
Dr. Ron Chestnut, CPE at SLAC

Dr. Dan Dietrich, Livermore. (Metcalf student who did thesis with van de Graaff)

Dr. Phil Goldstone, Los Alamos
The lab ski trip
Fred Raab, head of the LIGO Hanford Observatory (Metcalf student)

Prof. Steve Rolston, Assoc. Chairman, Univ of Md.

Prof. Partha Chowdhury, Univ of Mass. Lowell

Ehud Dafni, VP Business Development, CMT
• Friedlander Panel on Future of Nuclear Science NAS/NRC, 1975–77 recommends that two University Van de Graaffs should get “booster accelerators”

• Peter Paul motivates the group to compete for one of these two.

• Collaboration initiated with Cal Tech to build a superconducting LINAC at Stony Brook (We could not buy LINAC like vdG)

• Paul and Sprouse stop physics research to devote full time to the project
To expedite the transfer of the superconducting resonator technology to Stony Brook, Sprouse spends a semester at Cal Tech. Whose car is this??
Collaboration with Cal Tech to build superconducting resonators
• There were competing development proposals to NSF from:
  – Stanford (Hanna, Glavish and Ben Zvi)
  – Stony Brook (Paul and Sprouse)
• Stony Brook won!
Testing the Prototype superconducting resonator with beam

Ilan BenZvi, Director of the Accelerator Test Facility, BNL
Next step: Test a prototype module containing 3 resonators
What is the difference between these two proposals?
MEMORANDUM

To  Faculty and Staff

From  Anthony J. Bastin

Subject  New appointment

Date  June 22, 1979

I am pleased to announce the appointment of Mr. Charles Pancake as Senior Electronic Engineer and Supervisor of the Electronic Shop effective June 25, 1979. His office will be in S114. His phone number is 6-6549.

AJB:ec
The advanced computer control system of the accelerator was developed primarily by a PhD. Student.

Dr. Alfred Scholldorf,
VP for development at Reuters
Joseph M. Brennan,
AGS Department, BNL
Mike Brennan and Chen Chia-erh, work on the beam sweeper

Chen later becomes President of Beijing University and President of the Chinese Physical Society
Linac room before
Professor Miriam Rafailovich, Director, Garcia Center, Materials Science Department, Stony Brook
Helium gas storage tank delivery
Installation of Bob McGrath’s scattering chamber “big mac”
Linac room before
Linac room after
LINAC CONSTRUCTION

WILLIAM BURT*, Project Engineer
BEN-ZION LEVY*
JIM ROSE*
JOHN SIKORA

ADMINISTRATIVE

MANDY TUCKER
LINDA JOHNSON
JANE POMERantz*
NANCY WARBURTON*

COMPUTER CONTROL SYSTEM

AL SCHOLLDORF
JOHN HASSTEDT
CHARLES PANCAKE
ZIPORA COLENBERG*

ELECTRONICS SHOP

CHARLES PANCAKE, Supervisor
AL HILZ
ROY SMALL
TOM TARANTOWITZ
WARREN EGBERT

MACHINE SHOP

LOU LENZI, Supervisor
JOE SPIGONARDO, Master Welder
JIM CURRAN
RICHARD YOEPP
TONY STABILE
JIM GARFIELD

TANDEM OPERATING AND UPGRADING

JOHN NOE, Supervisor
BILL POLVENT
RICH BUNDY
ART GUTSHOW
TED LUBICICH
DAN RIEL
STUDENT ASSISTANTS

ROBERT BAERTSCH*
TONY BOEMIO
WENDY GEFFIN*
ROBIN HARRINGTON
GREG LEPORE
RICHARD MEINECKE*
TONY MORRONGIELLO
EVERARD PAMPPELLONE
JIM REY
SUSAN SNITZER*

BILL BIANCO*
SHAUN COMFORT*
TOM GENTILE*
EVAN GLYGAKIS
MARK LAXER*
KURT LEVITAN*
RICHARD MIGLIACCIO*
HAMID NEJATI—BUSHARI*
DENNIS PATRICK*
KIM SIMMONS*

SUZI YOAKUM
Nuclear Physics: Nuclei Crash Through The Looking-Glass

David Voss

Gloves do it. Toupees do it. Even twists of DNA do it. And now, for the first time, physicists have discovered that atomic nuclei come in right- and left-handed models, too. In the 5 February issue of Physical Review Letters (PRL), a team of researchers from the State University of New York (SUNY), Yale, the University of Tennessee, and Notre Dame reports observations of rapidly spinning nuclei morphing into mirror-image forms. In the process, the physicists also uncovered solid evidence that a long-disputed feature of nuclear anatomy really does exist.
Nuclear Lifetimes of Fr Isotopes
(work done with Luis Orozco, now at UMd.)

<table>
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<tr>
<th>Isotope</th>
<th>Lifetime (seconds)</th>
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<td>201</td>
<td>Made at Stony Brook</td>
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</table>
Apparatus for Production and Trapping of Francium

- Production
  - Au or Pt target
  - ~100 MeV $^{18}$O beam from Stony Brook LINAC
  - 10m path through target room wall

- Trapped Fr
  - Magnetic field coils
  - Dry-film coated glass cell
  - Laser beams

- Neutralizer
Francium Atomic Level Scheme
(work done with Luis Orozco, now at UMd.)

- 9s
  - 8s
    - 7s
      - 7p3/2
        - 7p1/2
          - 6d5/2
            - 6d3/2
              - 53.48 ± 0.33 ns
              - 21.02 ± 0.11 ns
              - 29.45 ± 0.11 ns
              - 73.60 ± 0.3 ns
              - 67.7 ± 2.9 ns
              - 73.60 ± 0.3 ns

- 8p3/2
  - 107.53 ± 0.90 ns
  - 83.5 ± 1.5 ns

- 8p1/2
  - 149.3 ± 3.5 ns

trapping transition 718 nm

Found at Stony Brook
Still unknown
DAVID B. FOSSAN (1934-2003)

21 Ph.D. students, 17 postdoctorates,
260 refereed publications
First recipient of “Chancellor’s Award for Excellence in Research and Creative Activity”

Dave Fossan, one of the creators of “Gammasphere”
NSF Funding of Nuclear Structure Laboratory

\[ \int = \$41.2M \]
<table>
<thead>
<tr>
<th>LName</th>
<th>FName</th>
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June 13, 1989

Dr. Peter Paul, Chairman
DOE/NSF Nuclear Science Advisory Committee
Physics Department
SUNY at Stony Brook
Stony Brook, NY

Dear Peter:

This letter is to request that the DOE/NSF Nuclear Science Advisory Committee (NSAC) conduct a new study of scientific opportunities and priorities in U.S. basic nuclear physics research and that NSAC recommend a long range plan which will provide a framework for coordinated advancement of the Nation's basic nuclear research programs over the next decade. The NSAC 1979 and 1983 Long Range Plans are appropriate and important reference documents for this new long range plan you will be formulating. It is a consequence of those earlier long range plans that the nuclear science community has a high-energy CW electron accelerator, CEBAF, now under construction and the relativistic heavy ion collider, RHIC, in an advanced stage of planning. These high priorities recommendations of the previous two NSAC Long Range Plans should provide the starting point of your new plan, which must first and foremost attempt to identify the most important nuclear physics questions to be attacked in the next decade. Please submit your report to the National Science Foundation and the Department of Energy by December 1, 1989.
2. We strongly reaffirm the very high scientific importance of the Relativistic Heavy Ion Collider (RHIC). Since the last LRP, theoretical progress has strengthened the case for the existence of a quark-gluon plasma, and recent experiments demonstrate the likelihood that conditions favorable to its formation will be attained. RHIC will provide unprecedented opportunities to produce and study ultradense matter. Therefore, we strongly endorse the recommendation of the 1983 LRP and subsequent NSAC deliberations that RHIC has the highest priority for new construction in the nuclear physics program. We urge a swift beginning for this important project.
Nuclear Experiment Facilities and Faculty 1965-2007

Van de Graaff
LINAC
RHIC
Van de Graaff
Van de Graaff
Dept. Chair
BNL Dep Dir
Provost
Dept. Chair
APS
Nuclear Structure Laboratory
Relativistic Heavy Ions
Neutrino Group
Retired
Deceased
Left
Leave without pay
Department Chair
Van De Graaff
Superconducting LINAC
weinberg
lee
fossan
paul
mcgrath
sprouse
braun-munzinger/pietralla
stachel
hemmick
Marx
jacak
drees
deshpande
Department Visiting Committee
Comments on Nuclear Physics

Over the past decade, this group has managed a remarkable transition from its original research focus on an in-house facility to being a leading user group at Brookhaven (RHIC). The committee was impressed by the vigor of group, which has a very healthy age structure and includes many graduate students. The group appears to be integrated well across different parts of the RHIC science program. It is one of the strongest university groups working at RHIC and is widely recognized for its intellectual leadership in the RHIC science program.
The Future:

Linac:

Beijing Atomic Energy Institute wishes to acquire the LINAC as a booster for their tandem.

Van de Graaff:

MARIACHI (Cosmic ray detectors for outreach to high schools)

Tandem Teaching Lab (experiments for advanced laboratory, and C\(^{14}\) dating for outreach)

Detector Research and Development

A. Deshpande, A. Drees, T.K. Hemmick, B. Jacak, M. Marx
Mariachi Workshops

Detector Building Workshops

- Brookhaven National Laboratory hosts Roosevelt HS
- Sachem East HS (Sachem East and Shoreham)
- LIGASE hosts Brentwood and Rocky Point HS

Students are in 10th and 11th grade (sometimes we involve students from 9th grade)
Accelerator Mass Spectrometry

- AMS is well established for $^{14}\text{C}$, $^{10}\text{Be}$, $^{26}\text{Al}$, $^{36}\text{Cl}$, $^{41}\text{Ca}$, $^{129}\text{I}$.
- $^{14}\text{C}$ is the familiar “dating” isotope for biological samples.
- Living materials contain $^{14}\text{C}/^{12}\text{C} \sim 10^{-12}$
- After death, ratio decays $t_{1/2}=5730 \text{ yr}$
- Accelerator used to strip ions to $+3$ charge state, eliminating molecules.
- $^{12}\text{C}$ via beam current, $^{14}\text{C}$ via count rate
Proposed Lab Layout:

- MARIACHI
- $^{14}$C
- Grad Lab
- Det R&D
- Winder
Concluding remarks

• Alec Pond’s vision has largely been realized: The purchase of the Van de Graaff was one of several statements that Stony Brook intended to be a major research university.

• Peter Paul’s vision to go after the LINAC has paid off well.

• Peter also played a pivotal role in securing RHIC for BNL.

• The Van de Graaff will continue as a productive educational and outreach tool.
Personal remarks

- Came to Stony Brook, January 1970
- Will go on 5 year leave, starting January 2007 to become Editor in Chief of the American Physical Society.
- I have worked hard for Stony Brook, and Stony Brook has been good to me. I’ve enjoyed my interactions with my colleagues and the outstanding SB students, especially the last 4 years teaching Honors Physics 141-2.
- My new job is different, with new challenges, and I’m excited about taking them on.
Monthly Manuscript Receipts of all Phys. Rev. and PRL

\[ y(\text{fit}) = (1591 + 3.65t + 0.016t^2)(1 + 0.07\cos((t + 7.1)/12)) \]

\[ t = \text{months after 1/1/93} \]
Monthly Manuscript Receipts of all Phys. Rev. and PRL

\[ y(\text{fit}) = (1591 + 3.65t + 0.016t^2)(1 + 0.07\cos((t+7.1)/12)) \]
\[ t = \text{months after 1/1/93} \]
The End

For material used in this presentation, many thanks to:
Peter Kahn, Lin Lee, and John Noe