

# Larry Lamm

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## Education

B.S. East Carolina University, Greenville, NC 1978  
M.S. East Carolina University, Greenville, NC 1983  
Ph.D. University of Notre Dame, Notre Dame, IN 1989

## Positions

2003-present Research Professor  
1996-2003 Associate Research Professor, Technical Director,  
Nuclear Structure Laboratory, University of Notre Dame  
1994-1996 Assistant Research Professor, Technical Director,  
Nuclear Structure Laboratory, University of Notre Dame  
1991-1994 Assistant Professor, Presbyterian College, Clinton, SC  
1989-1991 Post-Doctoral Research Scientist, University of Wisconsin, Madison, WI

## Memberships

APS, AAPT, SPS, SNEAP (Symposium of North Eastern Accelerator Physicists)

## University Activities

Departmental Committees  
1994-present Research Services Committee  
Chair 1996-2000, 2002

University Committees  
1994-present Radiation Control Committee

## **Contributions to the Nuclear Structure Laboratory**

### **General**

My position as the Technical Director of the Nuclear Structure Laboratory at the University of Notre Dame is extremely broad and far ranging, and allows me to interact, on a daily basis, with essentially every aspect of the work being done in the laboratory. In addition to my efforts and responsibilities relating to every aspect of the technical operation of our accelerator-based experimental nuclear physics laboratory, I also interact daily with essentially every student in the laboratory, serving as a general resource in their training as experimentalists.

### **Technical Director**

At the present time, our laboratory is home to three independent nuclear particle accelerators, and I am responsible for insuring reliable and consistent operations for all three accelerators as well as all the associated ancillary systems. Every aspect of the technical operations for all the equipment within the laboratory is under my direction, and I am personally involved in essentially every facet of these operations.

### **Education**

I train our students, visiting scientists, and new faculty in the safe and secure operation of these particle accelerators and ancillary systems. We offer training classes generally twice each year, which provide explanations of the fundamental technical aspects of operation as well as practical “hands-on” training and testing. Additionally, I serve as a general resource for our students, providing expertise and instruction on a wide variety of topics relating to experimental nuclear physics.

### **Liaison**

I also interact with the many groups of visiting scientists that travel to Notre Dame from across the country and around the world to take advantage of the unique opportunities that our laboratory has to offer. I typically serve as a multi-purpose liaison for these groups, sometimes acting as the point of contact, and generally providing whatever services may be required to complete the research. In this capacity, I am often called upon to provide technical solutions to experimental challenges, such as designing new hardware to allow us to adapt our existing beam line structures with the various detector and/or target requirements of the experiment.

### **Interdisciplinary Research**

I am also involved in projects designed to try to match our experimental capabilities with the needs of industry. One such project that I have started includes a study irradiating certain polymers used to construct artificial human limbs in an effort to measure the long-term wear of these materials. There is also a collaboration with the Snite Museum on campus to develop a method to determine the ages of various archeological objects.

### **New Technologies**

I also bring new technologies and implement them into the laboratory, such as the superconducting solenoid magnets used in the Radioactive Beam Facility. I was involved in the construction and testing of this facility, as well as several additional experiments, and I am responsible for maintaining this system, and extending its capabilities in the future. I will also

develop the PIXE method for testing the ages of archeological objects.

### **Design and Development**

I am involved in the design, development, and testing of a wide variety of new hardware systems throughout the lab, including the new helium ion source, the pulse selector used in our bunched beam facility, and a variety of electrostatic and magnet steering and focusing devices. In general, these devices require the construction of electronic control modules, and I have been responsible for the design and construction of these systems as well, including relay logic to provide interlocked protection schemes. I also produce all the technical and many of the electronic drawings required to construct and document these devices.

### **Computer Control**

I have designed, written, and developed a collection of software using the LabView architecture and the Control Net fiber optic, distributed I/O system which has made possible, for the first time, remote computer control of a variety of laboratory systems. Most importantly, we are now able to operate our ion sources entirely by remote computer control, which has significantly improved and simplified ion source operations. We also use similar software that I developed to continuously monitor the performance characteristics of our particle accelerators. I am currently extending and refining these systems to include more systems throughout the laboratory.

### **Supervisor**

The laboratory currently has only one additional person devoted to technical support of the laboratory, and I am the primary supervisor for this accelerator technician, directing his efforts on a daily basis.

### **Point of Contact**

I am the primary point of contact for any maintenance or facility operations within the lab, and I am often called upon to coordinate activities with these groups within the university, as the need arises. I am also responsible for choosing the parts and services we purchase from outside vendors and for dealing with these vendors to insure that goods and services are provided as required.

### **Mentoring**

I have mentored many students through the years as they have studied in our laboratory, either as visitors or through programs such as Research Experiences for Undergraduate (REU) or Research Experiences for Teachers (RET). Some of these students with whom I worked more than others are:

Edward J. Stech (1994)  
Nathan Cuka (1994,1995)  
Aaron Couture (1995)  
Steven Fiedler (1996)  
Aaron LaCluyze (1996)  
Anna Susalla (1997)  
Chris White (1997)  
Mark Denton (1998)

Paul Hosmer (1998)  
 Shelly Leshner (1998)  
 Leah Johnson (1999)  
 Matthew A. Quinn (1999, 2000)  
 Brian J. Laughman (1999, 2000)  
 Matt C. Pyle (2000)  
 Jeremiah Heilman (2000)  
 William F. Zech (2001)  
 Warren J. Lyberger, Jr. (2001)  
 Paul J. LeBlanc (2002)  
 Michael G. Marino (2002)  
 Sheridan Griffin (2002)  
 Nicole Deterie (2002)  
 Shawn O'Brian (2002)  
 Kelly Vaughan (2002)  
 Mary Beard (2002)  
 Lena Simon (2002)  
 Eddie Honorato (2002)  
 Elmar Baeumle (2002)

### **The FN Tandem Van de Graaff Accelerator**

I am responsible for all aspects of the operation of the FN Tandem Van de Graaff accelerator. This large accelerator (40 ft long by 12 ft diameter) is capable of terminal voltages in excess of 10 MV, and has been the focal point of the laboratory for many years. It is of fundamental importance that this machine be maintained in a fully operational status for the majority of the year. We typically cease operations two or three times per year to perform required maintenance, but otherwise experiments are scheduled using this accelerator in nearly continuous, 24-hour duty. This accelerator is now more than 30 years old, but our care and recent efforts to enhance and improve operations have resulted in a system that is now more stable and more reliable than ever before. Some of the highlights during my tenure include:

- Installed pelletron charging system, requiring a complete conversion of the charging process for the FN accelerator, resulting in outstanding performance improvements.
  - Installed new Dowlish, spiral inclined field accelerating tubes which have improved stability and beam transmission.
  - Installed new high-precision column resistors to facilitate uniform gradient control, resulting in significantly improved stability.
  - Conducted measurement and re-alignment of accelerating tubes to account for terminal sag during tank pressurization, resulting in significant improvement in beam transmission.
  - Conducted the addition of SF<sub>6</sub> to the insulating gas mixture to improve the dielectric strength of the insulating gas, resulting in new record terminal voltages in excess of 10.6 MV.
  - Instituted new policies regarding accepted procedures during FN tank openings.
  - Developed diagnostic monitoring software and hardware that have improved our ability to detect and diagnose performance problems.
- Maintained operational up time in excess of 75%

## **Ion Source and Beam Development**

The FN Tandem accelerator requires an external ion source capable of producing negatively charged ion beams, and our lab maintains two independent negative ion sources. The SNICS II Sputter Ion Source is used to produce all the beams injected into the FN Tandem accelerator, with the exception of helium beams, which are produced by the HIS Duoplasmatron Ion Source. The laboratory also maintains a buncher system which can be used to produce pulsed beams of 1.5 nsec FWHM at intervals of 100 nsec multiples. A pulse selector can be used to increase the interval between bunches, or to provide very slowly pulsed beams suitable for implantation studies.

### **SNICS II Sputter Ion Source**

- I am responsible for every aspect of the day-to-day operations of the SNICS II Sputter Ion Source, including general care and routine maintenance, cathode preparation, and serving as operator for several of the research groups within the laboratory. I have helped develop new techniques for producing certain ion beams, such as lithium, resulting in significantly improved source output.
- I designed, developed, and implemented a fiber optic based distributed I/O communications system based on the LabView software language and Control Net hardware architecture that allows for complete computer remote control of the SNICS II Sputter Ion Source, even at the high voltages (80kV) present inside the source platform. This package has become the standard for ion source operations in the laboratory, and we no longer manually operate the SNICS II Sputter Ion Source.

### **HIS Duoplasmatron Ion Source**

- We have developed a new helium ion source to replace the original FN Tandem ion source and I have been involved in this project nearly from the beginning, having inherited the original design from my predecessor in this position, Dr. Edgar Berners. It has been necessary to significantly modify those original designs, but the project is now nearing completion, having been operational for some time now. I am currently involved in re-designing the charge-exchange region for this source, which should result in significantly improved output.
- I also extended the remote computer control operations to the HIS Ion Source, replacing many of the badly outdated power supplies in the process. We can now operate the HIS Ion Source completely by remote computer control, and the overall stability of operations is improving as the re-design nears completion.

### **Beam Development**

- I have designed and built many beam related components, such as parallel plate electrostatic steering elements, electrostatic Einzel lenses, magnetic steering elements, and magnetic lenses (quadrupole elements). Nearly all of these components have been fabricated in the departmental machine shop, based on my drawings.
- I participated in the design and development of the slow pulse selector, which allows us to select one of multiple bunches from the beam bunching system or to configure the beam delivery system to facilitate the long bunch separation times required for implantation studies.
- I participated in the construction of a specialized extremely low energy proton source to be used as a test facility in the emiT experiments, which was based on the duoplasmatron source used in the HIS Ion source.

## Ancillary Systems

A large number of ancillary systems are required to support the operations of the particle accelerators in the Nuclear Structure Laboratory, and I take care of nearly all the technical aspects of these systems. A few of the more important systems are:

### High Vacuum Systems

- I am responsible for day-to-day operations of several cryogenic pumping systems, including network control and monitoring, compressor maintenance, routine regeneration, helium decontamination and routine maintenance.
- I am responsible for day-to-day operations of several oil diffusion pumping systems, including monitoring and control, water-cooling, mechanical backing pump systems, general repairs, and routine maintenance.
- I am responsible for day-to-day operations of several turbo-molecular drag pumping systems, including monitoring and control, water-cooling, mechanical backing pump systems, general repairs, and routine maintenance.
- I am responsible for day-to-day operations of several ion getter pump systems, including monitoring and control, general repairs, and routine maintenance.

### Safety Interlock Systems

- I am responsible for maintaining the safety interlock systems which protect laboratory personnel during accelerator operations by safeguarding various areas of the laboratory during accelerated beam operations. I designed and installed modifications to the relay logic based safety interlock system associated with securing target rooms during operations of the FN Tandem accelerator. These modifications include the addition of an audible alarm, a time-delayed latch of the room lights to allow exit time, and the addition of emergency exit (scram) switches.

### Water Cooling Systems

- I am responsible for maintaining the closed loop chilled water systems in use throughout the laboratory. I have installed filtration elements to help purify the laboratory chilled water, and I am responsible for the routine maintenance of the heat exchanger elements in these systems.

### KN Van de Graaff Accelerator

Starting the summer of 2001, I am in charge of the developments in the KN Van de Graaff accelerator laboratory as well. This 4 MV single-ended accelerator came to Notre Dame in 1995 after being decommissioned at Queen's University, and has seen only limited operations over the last few years, due to limited funding and manpower issues. Many compromises were made in the original installation and the early stages of operations, and we are now in the process of significantly re-configuring this system to improve the operational aspects. Some of the major efforts are listed below:

- Significantly improved the electrical power distribution for vacuum systems by removing the outdated original installation and completely re-wiring vacuum power.

- Designed and constructed vacuum control systems to provide control for various pumps and valves, and to provide protection for these systems by providing relay logic interlocks for the first time.
- Designed and constructed a new target station to significantly improve the existing mounting hardware and to extend the capabilities to allow the MSU Neutron Detector tests to be conducted.
- Constructed and installed a new safety interlock system for the accelerator system, replacing the existing system, which was significantly outdated.
- Instituted new computer control and monitoring facilities using LabView and Control Net, similar to systems which I created for use in the FN Tandem accelerator system.
- Designed new control systems for quadrupole magnet control, analyzing magnet control, and helped develop an entirely new Master Reference system, which will enable users to significantly simplify operations.
- Designed and constructed new beam line mounting structures, to improve stability and improve alignment.
- Installed a new cryogenic pumping station for the KN Target room, to improve vacuum conditions in all target stations.
- Re-defined standard maintenance procedures which should lead to more reliable overall operations for the KN accelerator.
- Developed procedures and tools to allow for uniform spacing of the accelerator column hardware during accelerator maintenance.
- Discovered critical misalignment of the KN column structure and the KN charging belt mounting, and am responsible for developing a plan to address these problems.
- Designed, developed, and installed an infrared detection system to monitor the charging belt motion in the KN accelerator.

### **JN Van de Graaff Accelerator**

The JN Van de Graaff accelerator is a 1 MV single-ended machine brought to Notre Dame in 1999 after being decommissioned at the University of Toronto. We are now installing it. Some highlights of this process are listed below:

- Directed the installation of the analyzing magnet and the beam line to interface the JN system with the switching magnet for the KN Target Room, so that both the JN and the KN accelerator can be used to deliver beams to the KN Target Room.
- Directed the construction of beam line mounting structures, including alignment structures and vacuum pump mounting structures.
- Directed the mounting of the JN accelerator, including alignment of the structure.
- Directed the construction of a portable tank support structure, to simplify the removal and installation of the JN pressure vessel.

- Directed the construction of a new electrical distribution system for the entire JN facility.
  - Directed the construction of an overhead cable tray to allow for future wiring of various components along the JN beam line.
  - Directed the construction of new chilled water lines and new compressed air lines for the JN system.
  - Designed and constructed a new charging current feed through for the JN accelerator.
- Directed the construction of vacuum control systems for the JN pumping stations.

### **Future Plans**

The Nuclear Structure Laboratory continues to grow in funding and activities. We have the experimental facilities to carry out experiments uniquely possible at Notre Dame. We continue to lead the way in experimental nuclear research, and expose our students to the challenges of cutting edge research. Our plans for the future continue to evolve as the field of experimental nuclear physics evolves, but a few of the planned efforts are listed below:

- Expand and extend the computer control facilities that I have created to allow for improved overall accelerator operations while still maintaining a facility that allows our students to be fundamentally involved in accelerator operations.
- Design, develop, and construct new beam station facilities, including the possibility of building a recoil mass separator facility at Notre Dame that would open new avenues of research by allowing the study of inverse kinematics in nuclear astrophysics.
- Develop and install new ion source for the KN and JN accelerators that would allow the production of higher mass beams as well as higher charge state beams, significantly expanding the range of experiments that could be accomplished with both systems.
- Design new grading resistors for the KN accelerator similar to those developed for the FN accelerator, to significantly improve the operational characteristics of the KN accelerator.
- Design modifications and upgrades to the Twin Sol radioactive beam facility to extend its use for nuclear astrophysics experiments.
- Renovate the broad range magnetic spectrograph facility to extend its use for nuclear astrophysics experiments.

## Publications in Refereed Journals

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2. "Thermal Energy Transport from Underground Sources and Sinks," L.O. Lamm and J.W. Byrd, Proceedings of the INTERSOL 85 (International Solar Energy Society) Meeting, Montreal, Canada, 518 (June 1985).
3. "The Elimination of Cosmic Errors in the Calibration of Tilted Pyranometers," L.O. Lamm, C.G. Adler, A. Larkins, and S. Kelly, Proceedings of the INTERSOL 85 (International Solar Energy Society) Meeting, Montreal, Canada, 566 (June 1985).
4. "A Generalized Technique for Evaluating Reflection Coefficients for Ground-Plane Systems," L.O. Lamm and C.G. Adler, *Solar Energy* 35, 243 (1985).
5. "A New Method for Determination of Direct Insolation," L.O. Lamm and C.G. Adler, *Solar Energy* 39, 109 (1987).
6. "Level Structure of  $^{20}\text{Na}$  near the Proton Threshold," L.O. Lamm, C.P. Browne, J. Görres, M. Wiescher, A.A. Rollefson, *Zeitschrift für Physik* A327, 239 (1987).
7. "New Experimental Results for Nuclear Reactions in Explosive Hydrogen Burning," M. Wiescher, J. Görres, L.O. Lamm, C.P. Browne, B.W. Filippone, R.B. Vogelaar, *Nuclear Astrophysics Lecture Notes in Physics* 287, 54 (1987).
8. "Reinvestigation of Proton Threshold States in  $^{26}\text{Al}$ ," A.A. Rollefson, C.P. Browne, M.A. Gummin, L.O. Lamm, M. Wiescher, V. Wijekumar, *Zeitschrift für Physik*, A331 101 (1988).
9. "A Modified Position Sensitive Proportional Counter with Improved Particle Identification Capability," L.O. Lamm, S.M. Graff, M. Wiescher, J. Görres, C.P. Browne, U. Giesen, *Nuclear Instruments and Methods* A281, 143 (1989).
10. "The Level Structure of  $^{20}\text{Na}$  and its Implication for the Stellar Reaction Rate of  $^{19}\text{Ne}(p,\gamma)^{20}\text{Na}$ ," L.O. Lamm, C.P. Browne, J. Görres, S.M. Graff, M. Wiescher, A.A. Rollefson and B.A. Brown, *Nuclear Physics* A510, 503 (1990).
11. "Measurement of the Electric Polarizability of  $^3\text{He}$ ," F. Goeckner, L.O. Lamm, and L.D. Knutson, *Physical Review* C43, 66 (1991).
12. "Determination of the Phase Shifts for p-d elastic Scattering at  $E_p = 3$  MeV," L.D. Knutson, L.O. Lamm, and J.E. McAninch, *Physical Review Letters* 71, 3762 (1993).
13. "The reaction rate for  $^{31}\text{S}(p,\gamma)^{32}\text{Cl}$  and its influence on the SiP-cycle in Hot Stellar hydrogen burning," S. Vouzoukas, C.P. Browne, U. Giesen, J. Görres, S.M. Graff, C. Iliadis, L.O. Lamm, J. Meissner, J.G. Ross, K.W. Scheller, L. Van Wormer, M. Wiescher, A.A. Rollefson, H. Herndl, *Physical Review* C50, 1185 (1994).

14. "Analyzing Power in Neutron-Deuteron Elastic Scattering at  $E_n^{\text{lab}} = 3 \text{ MeV}$ ," J.E. McAninch, L.O. Lamm, and W. Haeberli, *Physical Review C* 50, 589 (1994).
15. "Stability of Column Resistors in Shielded Mounts in the FN Tandem," L.O. Lamm, *Proceedings of the 1996 Annual meeting of SNEAP*, KF von Reden and RJ Schneider, eds., (World Scientific, Singapore), 105, (1996).
16. "Twinsol: A Dual Superconducting Solenoid System for Low-Energy Radioactive Nuclear Beam Research," M.y. Lee, F.D. Becchetti, J.M. Holmes, T.W. O'Donnell, M.A. Ratajczak, D.A. Roberts, J.A. Zimmerman, J.J. Kolata, L.O. Lamm, J. von Schwarzenberg, and M. Wiescher, *Proceedings of the 14<sup>th</sup> International Conference on the Application of Accelerators in Research and Industry*, J.L. Duggan and I.L. Morgan, eds. (AIP Press, New York), 397 (1997).
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18. "Elastic scattering and transfer in the  ${}^6\text{He} + {}^{209}\text{Bi}$  system below the Coulomb barrier," E.F. Aguilera, J.J. Kolata, F.D. Becchetti, P.A. DeYoung, J.D. Hinnefeld, Á. Horváth, L.O. Lamm, Hye-Young Lee, D. Lizcano, E. Martinez-Quiroz, P. Mohr, T.W. O'Donnell, D.A. Roberts, and G. Rogachev, *Physical Review C* 63, 061603 (2001).
19. "Reaction cross sections for  ${}^6\text{He} + {}^{209}\text{Bi}$  below the Coulomb barrier," C. Lizcano, E.F. Aguilera, E. Martinez-Quiroz, J.J. Kolata, G. Rogachev, H. Lee, L.O. Lamm, A. Horvath, F. Becchetti, T. O'Donnell, D. Roberts, P. DeYoung, and J.D. Hinnefeld, *Mex. Revista Mexicana de Fisica*, 47, 78-82 (2001).
20. "Elastic scattering and transfer in the  ${}^8\text{Li} + {}^{208}\text{Pb}$  system near the Coulomb barrier," J.J. Kolata, V.Z. Goldberg, L.O. Lamm, M.G. Marino, C.J. O'Keefe, G. Rogachev, E.F. Aguilera, H. García-Martínez, E. Martinez-Quiroz, P. Rosales, F.D. Becchetti, T.W. O'Donnell, D.A. Roberts, J.A. Brown, P.A. DeYoung, J.D. Hinnefeld, and S.A. Shaheen, *Physical Review C* 65, 054616 (2002).
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22. "Gamma-ray spectroscopy with a low-energy  ${}^6\text{He}$  radioactive ion beam", S.M. Vincent, A. Aprahamian, J.J. Kolata, L.O. Lamm, V. Guimarães, R.C. de Haan, D. Peterson, P. Santi, A. Teymurazyan, F.D. Becchetti, T.W. O'Donnell, M. Lee, D.A. Roberts, J.A. Zimmerman, and J.A. Brown, *Nucl. Instrum. Methods in Phys. Res. A* 491, 426-436 (2002).
23. "A zero-to-few-hundred eV proton beam for calibrations of neutron  $\beta$  decay experiments," F. Naab, L.O. Lamm, W. Zech, A. García, and P. Mumm, *Nuclear Instruments and Methods B* 197, 278-281 (2002).

24. "The TwinSol low-energy radioactive nuclear beam apparatus: status and recent results," F.D. Becchetti, M.Y. Lee, T.W. O'Donnell, D.A. Roberts, J.J. Kolata, L.O. Lamm, G. Rogachev, V. Guimarães, P.A. DeYoung, and S. Vincent, *Nucl. Inst. Methods in Physics Research A* 505, 377 (2003).
25. "Final state interaction or a  $^3\text{H}$  excited state?" G.V. Rogachev, J.J. Kolata, V.Z. Goldberg, L.V. Grigorenko, F.D. Becchetti, P.A. DeYoung, J.D. Hinnefeld, L.O. Lamm, J. Lupton, T.W. O'Donnell, D.A. Roberts, and S. Shaheen, *Phys. Rev. C* 68, 024602 (2003).
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27. "Isobaric analog states of neutron-rich nuclei. Doppler shift as a measurement tool for resonance excitation functions," P. Boutachkov, G.V. Rogachev, V.Z. Goldberg, A. Aprahamian, F.D. Becchetti, J.P. Bychowski, Y. Chen, G. Chubarian, P.A. DeYoung, J.J. Kolata, L.O. Lamm, G.F. Peaslee, M. Quinn, B.B. Skorodumov, and A. Woehr, *Euro. Phys. J. A* 25, s01, 259-260 (2005).
28. "Doppler shift as a tool for studies of isobaric analog states of neutron-rich nuclei: application to  $^7\text{He}$ ," P. Boutachkov, G.V. Rogachev, V.Z. Goldberg, A. Aprahamian, F.D. Becchetti, J.P. Bychowski, Y. Chen, G. Chubarian, P.A. DeYoung, J.J. Kolata, L.O. Lamm, G.F. Peaslee, M. Quinn, B.B. Skorodumov, and A. Wöhr, *Phys. Rev. Lett.* 95, 132502 (2005).
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31. "Doppler Shift as a Tool for Studies of Resonant (p,n) Reactions with RIBs, Spectroscopy of  $^7\text{He}$ ," P. Boutachkov, G.V. Rogachev, V.Z. Goldberg, A. Aprahamian, F.D. Becchetti, J.P. Bychowski, Y. Chen, G. Chubarian, P.A. DeYoung, J.J. Kolata, L.O. Lamm, G.F. Peaslee, M. Quinn, B.B. Skorodumov, and A. Wöhr, *Proceedings of 12th International Symposium on Capture Gamma-ray Spectroscopy and Related Topics*, Notre Dame, Indiana, A. Woehr and A. Aprahamian, Eds., pp. 221-225 (2006).

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