

# NIH Bio Hollebeek

## BIOGRAPHICAL SKETCH

NAME Hollebeek, Robert John		POSITION TITLE Professor of Physics		
eRA COMMONS USER NAME (credential, e.g., agency login) HOLLEBEEK				
EDUCATION/TRAINING <i>(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)</i>				
INSTITUTION AND LOCATION		DEGREE <i>(if applicable)</i>	MM/YY	FIELD OF STUDY
Calvin College		A.B., B.S.	1970	Physics
University of California, Berkeley		Ph.D.	1974	
University of Pennsylvania		M.A. Hon.	1987	

### A. Personal Statement

The goal of the proposed research is to implement and extend current state of the art techniques in particle physics proton detector design, high speed electronics, and high speed processing, producing a detector that can characterize proton treatment beams with much higher precision than currently available and with real-time measurements. This advancement will open up new treatment possibilities in the field of proton and other particle cancer therapy. In 2009, I suggested that it would be possible to design such a detector. After considering many possible detector mechanisms, we focused on a new technology (micromegas) that is ideally suited to the intense beam conditions and varying doses in beam radiation therapy. A pilot device was constructed and verified that this approach was not only possible, but in fact far exceeded our expectations. Designing and building such a device requires combined expertise in chamber design and operation, high speed and high channel count electronics design, large scale data processing and computing. We have overcome numerous technical challenges in the detector construction. The Physics department also has an electronics group which specializes in high speed electronics design that I work closely with. I firmly believe that the combined expertise in detectors, electronics, computing, radiology, radiation therapy, and the unique facilities in beam therapy available at the Roberts Center can provide very important advances in patient treatment. I have over 40 years of experience in constructing particle detectors of many different types. I have also been responsible for the construction of high speed electronic systems used to gather data from large detectors and have extensive experience in writing the software and designing the computer architectures required for processing the data from detectors that produce very large and fast data streams. As a graduate student, I was involved in the construction of shower detectors for the SPEAR experiment and one of the principal authors of the tracking and imaging software. That experiment discovered the charm quark (Nobel Prize 1975) and later the third heavy lepton (Nobel Prize 1995). I constructed wire drift chambers for the CCOR experiment at CERN and was in charge of software analysis. At Stanford, I was involved in the construction of liquid argon detectors and later was principle investigator of the ASP detector which was one of the first supersymmetric particle searches and the first to detect neutrino decays of the Z boson. At Penn, I was a member of the CDF collaboration which used high energy protons and anti-protons to discover the top quark. Later I started a project in clustered computer processors which was the prototype for today's cloud architectures. I also collaborated with Penn Medicine in the construction of one of the first large digital collections of mammography images.

In the Proton Therapy project, the pilot detector and the new designs which we have constructed provide state of the art position, time, and energy measurements which will enable a new more precise measurement of therapy beams, proton radiography, and personalized therapy.

## **B. Positions and Honors**

### **Academic Appointments**

- 1970 - 1974 Graduate Student, University of California, Berkeley
- 1975 - 1978 Research Associate, Columbia University
- 1979 - 1985 Assistant Professor of Physics, Stanford Linear Accelerator Center
- 1986 - 1989 Associate Professor of Physics, University of Pennsylvania
- 1989 - Professor of Physics, University of Pennsylvania

### **Activities**

- 1970 - 1974 Member SPEAR colliding detector collaboration (Nobel Prize, B. Richter, 1975)
- 1975 - 1978 Member CERN Columbia Oxford Rockefeller Collaboration
- 1979 - 1986 Member Mark II collaboration, SLAC
- 1979 - 1986 Member, SLAC Advanced Accelerator Task Force
- 1982 - 1986 PI, Anomalous Single Photon Experiment, SLAC
- 1983 Co-chair 3rd International Conference on Instrumentation (Novosibirsk)
- 1986 - 2000 member, CDF collaboration, High Energy Physics at Fermi National Laboratory
- 1993 - 1995 Chair, Penn Vice-Provost Computing Committee
- 1994 - 1995 Joint program in fMRI with Children's Hospital, Philadelphia
- 1994 - 1996 Co-chair, Supersymmetry group, Next Linear Collider Study Group
- 1994 - 2002 PI, Director, National Scalable Cluster Project (NSCP)
- 1995 - 1996 Chair, Penn High Performance Computing Committee
- 1995 - 1997 Graduate Chair, Department of Physics, University of Pennsylvania
- 1996 - 1999 Principal Investigator, vBNS connections program at University of Pennsylvania
- 1997 - 1999 San Diego SuperComputing Center (NPACI) Associated Partner
- 1997 - 2001 Radiology storage pilot with Hospital of the University of Pennsylvania
- 1998 - 1999 City of Philadelphia eCommerce Commission
- 1998 - 1999 PA director, LINKS Educational Technology Consortium with Washington State
- 1998 - 1999 Organizer, US Next Linear Collider Study Group
- 1999 - 2003 co-PI, National Digital Mammography Archive
- 2003 - 2007 Chief Technology Officer, I3Archive, Inc.
- 2009 - Proton Therapy project

### **Advisory Committees**

- Member, National Science Foundation vBNS Review 1995, 1996, 1997, 1998
- Former Member, Stanford University Scientific Policy Committee
- Former Member, SLAC Program Advisory Committee
- Former Vice-Chair, Superconducting Super Collider (SSC) Board of Overseers

### **Honors and Awards**

- 1966 National Merit Scholar
- 1970 Woodrow Wilson Fellow
- 1995 IBM Supplemental University Research Grant
- 1995 SuperComputing 95 Award for High Performance Data Management and Mining
- 1996 AT&T National Information Infrastructure Telecollaboration Semi-finalist
- 1996 Gold Medal for Innovation, SuperComputing 96
- 1996 IBM Supplemental University Research Grant
- 1998 SuperComputing 98, Most Innovative of Show, High Performance Challenge
- 1998 IBM Supplemental University Research Grant
- 1999 Supercomputing 99, High Performance Computing Award
- 2001 Radiological Society of North America Red Ribbon, NDMA Exhibit
- 2002 InfoWorld "Top 100 Innovation Awards", Ranked #1
- 2002 IBM Supplemental University Research Grant

### **Commercial Experience**

- 2003 – 2007 founder and CTO of NDMA Inc., based on commercialization of research at the University of Pennsylvania on data mining and medical records storage. Established Data Centers in Los Angeles and New York with over 100 Terabytes of indexed storage for medical records, assisted in obtaining 25 M\$ in venture

funding, filed 7 patents for medical storage, authored proposals for national medical infrastructure for Ontario Canada, Finland, and the Netherlands.

### **Detector and Electronics Experience**

1970-1974 Grad Student: Responsible for writing track finding, fitting, and pattern recognition software for the first large scale digital high energy physics detector.

Participated in particle shower detector testing and construction and spark chamber operation

1975-1978 Post doc: Tested, constructed and maintained the high speed (1ns) drift chamber acquisition systems at CERN for the Cern Columbia Oxford Rockefeller collaboration (CCOR).

Designed and manufactured delay line readouts for longitudinal position sensors in the CCOR drift chambers.

1979-1986 Asst. Prof.: Constructed the calibration chamber used to test Liquid Argon Chamber Purity for the PEP experiment at SLAC.

Designed and constructed the first drift chamber capable of operation in the high radiation environment next to the machine beam pipe.

Co-PI Proposed and constructed an experiment to search for Supersymmetry and neutrino events. Designed and constructed the Lead Glass Detectors and electronics for low energy photon detection.

1986-1989 Assoc. Prof.: Participated in the search for the top quark. Designed clustered computer systems for high speed computation Monte Carlo Simulations.

2000-2003 Prof.: Designed Warm Liquid Calorimeters for future SuperCollider experiments and associated low noise amplifier systems.

Co-PI for implementation of high speed networks from Penn to Chicago and Maryland.

Co-PI on implementation of wide area networks and large-scale cluster computing for data intensive computing

Co-PI Digital Mammography and responsibility for networks, security devices, and distributed storage systems.

2009- Ionization chambers and Micromegas chambers for proton beam therapy

### **Most Influential Peer-reviewed Publications (selected from over four hundred)**

#### **Large scale storage and mining of medical records.**

White Paper: NSF Workshop on New Visions for Large Scale Networks: Research and Applications. R.

Hollebeek, M. Schnall, B. Beckerman, "Petabyte Scale Radiology Archiving and Retrieval", Mar, 2001.

#### **High speed network connected clusters: now known as "Clouds"**

"The National Scalable Cluster Project: Three lessons about high performance data mining and data intensive computing", R. Hollebeek and R. Grossman, HANDBOOK OF MASSIVE DATA SETS, Kluwer Academic Publishers

#### **Four Most Important Physics Publications**

##### **Discovery of the top quark**

Observation of top quark production in anti-p p collisions.

By CDF Collaboration (F. Abe et al.). Mar 1995.

Published in Phys.Rev.Lett.74:2626-2631,1995.

##### **Discovery of charmed quarks**

Discovery of a Narrow Resonance in e+e- annihilation.

By J.E. Augustin, et al. SLAC-PUB-1504, Nov 1974. 6pp.

##### **First search of supersymetry and limits on numbers of lepton families**

Search for Anomalous Single Photon Production at PEP.

By G. Bartha, et al., SLAC-PUB-3817, Oct 1985. 14pp.

Published in Phys.Rev.Lett.56:685,1986.

##### **Discovery of focusing effects in intense beam dynamics**

Disruption Limits for Linear Colliders.

By R.J. Hollebeek (SLAC), SLAC-PUB-2535, Jun 1980. 41pp.

Published in Nucl.Instrum.Meth.184:333,1981.