FINAL REPORT
U.S. Dept. of Energy

CONFERENCE GRANT: FASEB Summer Research Conference on Viral Assembly

GRANT NUMBER: DE-FG02-99ER62895

PERFORMANCE PERIOD: 12/01/99 through 11/30/00

GRANT AMOUNT: $6,800

PRINCIPAL INVESTIGATOR: Dr. Michael Feiss

GRANTEE INSTITUTION: Federation of American Societies for Experimental Biology
9650 Rockville Pike
Bethesda, MD 20814-3998

DATE OF REPORT: January 31, 2001
DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.
DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.
The 2000 FASEB Meeting on Virus Assembly was organized by Marie Chow, Michael Feiss, Jack Johnson, and Margaret Kielian and attended by 153 participants drawn from the structural biology, cell biology, and virology communities. Although the number of individuals attending was a little lower than previous years, approximately 20% of the independent investigators were attending this conference for the first time. The increased diversity of participating laboratories and backgrounds is due in part to a deliberate broadening of the scientific program to include emerging areas of virus cell biology and new model virus systems. Thus a major emphasis of the program this year was on the general thematic principles and common mechanistic models which are emerging across a number of viral systems. As in previous years, a major strength unique to this meeting was the active participation and dialog between structural biologists, molecular virologists and more recently cell biologists. In addition, approximately 25% of the attendees were graduate students and post-doctoral fellows. The trainees made significant contributions to the intellectual vitality and ambiance of the meeting as well as being exposed to the highly interdisciplinary nature of the field.

The nine sessions were: 1. Structure of Viruses and Viral Proteins, 2. Dynamics of Virus Structures, 3. Virus Entry: Receptor and Post-Receptor Events, 4. Virus Entry: Fusion, 5. Virus Usurpation of Host Functions, 6. Genome Packaging, 7. Capsid Assembly, 8. Virus Exit/Virus Movement, 9. Applications to Biotechnology. There were usually 5 talks of approximately 25-30 minutes in length, with an additional 15 minutes provided to the Chair at the beginning of the session for an overview. In addition, there was a late-breaking talk which presented for the first time a long awaited a X-ray structure which was solved two weeks before the meeting. Because of the diverse backgrounds of the participants, a special effort was made by almost all speakers to provide sufficient background for the new information being presented and the Chair’s overview was very useful to place the talks in perspective. All talks provided some new unpublished data as well as an opportunity to examine in greater detail unpublished data which supported previously published findings. Overall many of the polled participants indicated that the discussion periods were reasonably well utilized and informative. A total of 85 posters were also presented in 2 sessions of approximately 2 days each. Although the majority of the participants indicated that time allocated for the poster session was sufficient, my own opinion was that there were too many posters for the time available. The significant increase in posters was also seen at the previous meeting (N=81). This suggests that this may be a consistent feature of this meeting and may reflect in part the increased participation by graduate students and post docs. If this trend continues, a possible solution is to devote one of the 9 talk sessions for oral presentations selected from the submitted poster abstracts to reduce the number of posters displayed. Alternatively, if it is possible for the meeting site to increase the number of posters which can be displayed at any given time, then a larger number might be displayed for the entire meeting.

Of the 52 speakers or chairs, 13 were women (33 of the 100 conference participants were women). Two of the speakers were afro-american, three were hispanic and two were chinese. In addition, 16 of the participants were Asian and 7 were hispanic. In addition to the 10 invited
speakers from overseas, 12 of the participants were from Europe, 1 from the UK, 3 from Latin or South America and 3 from Canada.

Fund raising for the Conference was adequate. Contributions from the private sector was very disappointing ($3000 from Eli Lilly and New England Biolabs) and we need to reevaluate our efforts in this direction. However, significant funds were received from two new sources, the Dept of Energy ($6800) and Office of Naval Research ($7500). In addition, NSF contributed $3000, NIH (NCI+NIAID) contributed a total of $10,250, and Office of AIDS Res. contributed $10,000. In addition, one of the speakers received a MARC award from FASEB. Including the $7500 from FASEB, the amount raised ($48,050) enabled us to reimburse approximately 80% of the registration and airfare of the 56 speakers/chairs/meeting organizers. This includes our 10 foreign invitees (6 from Europe, 1 from Israel, 1 from Singapore, 2 from UK). The reimbursement could have been higher, but a decision was made by the organizers to use some of the funds as travel scholarships for young investigators. A total of 7 awards were made.

At the business meeting there was very high enthusiasm for holding the Conference again in 2 years. It was felt that having an organizing committee of 2 Co-Organizers and 2 Vice Co-Organizers was preferred due to the diverse fields and technical expertises spanned by this conference. Thus Jack Johnson and Margaret Kielian were confirmed as Co-Organizers. Lindsay Black and Peter Tattersall were voted in as Vice Co-Organizers. Although there had been some suggestions for moving the Conference site to one of the western sites, it was the collective decision of the attendees to remain at the Vermont site to the minimize the expenditures and travel time of our European colleagues as well as for many of our participants from the east coast.

Marie Chow for
The Conference Organizers
Marie Chow
Michael Feiss
FASEB Summer Research Conferences

VIRUS ASSEMBLY
EMELY

Chairs: MARIE CHOW
MIKE FEISS
Vice-Chairs: JACK JOHNSON
MARGARET KIELIAN

10-15 June 2000
SAXTONS RIVER, VERMONT
2000 FASEB Conference on Virus Assembly
June 10-15, 2000 VERMONT ACADEMY
Saxtons River, Vermont

Chairs: Marie Chow University of Arkansas for Medical Sciences
       Michael Feiss University Iowa
Vice Chairs: Jack Johnson The Scripps Research Institute
            Margaret Kielland Albert Einstein College of Medicine

TABLE OF CONTENTS

Acknowledgments ........................................................ p. 2
Young Investigator Travel Awards .................................... p. 3
Conference Program: Speaker Schedule .............................. p. 4 - 13
Abstracts - Speaker Presentations .................................. p. 14 - 57
Poster Session I: Schedule and Abstracts ......................... p. 58 - 95
Poster Session II: Schedule and Abstracts ........................ p. 96 - 150
Appendix: Virus Assembly Pathways ............................... p. A1 - A31

Notes
ACKNOWLEDGEMENTS

Sponsors
We gratefully recognize support received from the following organizations.

- Office of AIDS Research, NIH
- FASEB
- Office of Naval Research
- Department of Energy
- National Institute of Allergy and Infectious Disease
- National Cancer Institute
- National Science Foundation
- Eli Lilly and Company
- New England Biolabs

Acknowledgements
This conference was possible due to the collective efforts of many individuals. We express our appreciation for the administrative skills of Adele Hewitt (FASEB) - who went with the flow with every unexpected crisis as well as shame NSI into considering our proposal for funding, the detailed eye and communication skills of Sally "LeLe" Waits for the preparation of the Conference book, the cover art by Roger Hendrix (U. Pittsburgh), Sara Bucher (U. Helsinki), Mavis Agbandje-McKenna (U. Florida), Anette Schneemann (Scripps) and the Medical Graphics Unit at the University of Iowa, and to our many colleagues who provided pathway diagrams and graphics.

Front cover art

Top: A HK97 "whiffle", i.e., a prohead 1 from a HK97 mutant that, in vitro, assembles proheads lacking pentamers. The picture shows the whole prohead with the difference map (i.e., the pentamers) colored blue. See Poster by Li et al, p. 73.

Middle (left to right): A surface view of a three-dimensional image reconstruction of the phi6 procapsid (polymerase complex) from cryo-electron micrographs. The procapsid is approximately 45 nm in diameter, and is shown viewed down a two-fold axis of symmetry (See Posters by de Haas, et al, p.70; Poranen et al, p.76); cryo-EM reconstruction of Aleutian mink disease parvovirus (See Poster by Agbandje-McKenna et al, p. 84); a surface view of a three-dimensional image reconstruction at 14 Å resolution of a packaging mutant of PRD1 from cryo-electron micrographs. The virus is approximately 70 nm in diameter, and is shown viewed down a five-fold axis of symmetry. (See Poster by San Martin et al, p.68).

Bottom: Schematic diagram illustrating current model of Flock House Virus assembly. Three coat protein monomers initially form a homotrimer. Two such homotrimers then interact with the viral genome to form a ribonucleoprotein complex. Formation of the ribonucleoprotein complex involves the N- and C termini of the coat protein and specific encapsidation signals on viral RNAs. The complex has the same configuration as the contact observed perpendicular to the two-fold axes of crystallized virions. The ribonucleoprotein is propagated into a spherical particle by accretion of coat protein trimers which are guided into the growing shell by binding to helical structures on the RNA. See Abstract by Schneemann et al. p. 43.
Young Investigator Travel Awards

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anabela Isidro</td>
<td>Instituto de Tecnologia Química e Biológica</td>
</tr>
<tr>
<td>Andrea Bertolotti-Ciarlet</td>
<td>Baylor College Of Medicine</td>
</tr>
<tr>
<td>Angela Christensen</td>
<td>University of Connecticut Health Sciences Center</td>
</tr>
<tr>
<td>Michael Mitchell</td>
<td>The Catholic University of America</td>
</tr>
<tr>
<td>April Burch</td>
<td>University of Arizona</td>
</tr>
<tr>
<td>Akash Parnaik</td>
<td>Pennsylvania State College of Medicine</td>
</tr>
<tr>
<td>Scott Bowers</td>
<td>Medical University of South Carolina</td>
</tr>
<tr>
<td>Time</td>
<td>Event</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------</td>
</tr>
<tr>
<td>2:00 PM</td>
<td>Registration</td>
</tr>
<tr>
<td>6:00 PM</td>
<td>Reception/Mixer</td>
</tr>
<tr>
<td>7:30 PM</td>
<td>Dinner: Welcome</td>
</tr>
</tbody>
</table>
Sunday, June 11, 2000

Structure of Viruses and Viral Proteins (sponsored in part by Eli Lily and Co)

Session Chair: Mavis Agbandje-McKenna  
U. Florida

8:45 AM  Overview: Mavis Agbandje-McKenna

9:00 AM  The RNA-Dependent RNA Polymerase Of Hepatitis C Virus: Crystal Structure And Functional Implications  
Felix Rey, CNRS

9:30 AM  Visualizing α Helices In Large Viruses: CryoEM Structures Of Cypovirus And Human Cytomegalovirus  
Z Hong Zhou, UT Houston

10:00 AM  The Reovirus Core: The 3.6Å Structure Of A Complex Molecular Machine  
Karin Reinisch, Harvard

10:30 AM  => Coffee Break

11:00 AM  Structure And Maturation Of Bacteriophage HK97  
William Wikoff, Scripps

11:30 AM  Structural Characterization Of Adenovirus/Receptor Complexes By Cryo-Electron Microscopy  
Phoebe Stewart, UCLA

12:00 PM  => Lunch

6:00 PM  => Dinner
### Sunday, June 11, 2000

#### Session II

**Dynamics of Virus Structures**

**Session Chair:** Carol Teschke  
**U. Connecticut**

<table>
<thead>
<tr>
<th>Time</th>
<th>Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 PM</td>
<td>Overview: Carol Teschke</td>
</tr>
</tbody>
</table>
| 7:45 PM | Tails And Tail Fibers: Assembly And Structure Of The Helical Parts Of Phage Lambda  
Roger Hendrix, U. Pittsburgh |
| 8:15 PM | Conformational Transition In The MVM Virion Allow Extrusion Of The VP1 Specific Region And The Viral Genome  
Peter Tattersall, Yale |
| 8:45 PM | Examination Of Human Rhinovirus Capsid Dynamics  
Thomas Smith, Purdue |
| 9:15 PM | => Coffee Break                                                             |
| 9:30 PM | Large Conformational Changes in the Maturation of a Simple RNA Virus, Nudaurelia Capensis ø Virus (NøV)  
Mark Yeager, Scripps |
| 10:00 PM | Assembly And Expansion Of The Phage HK97 Capsid  
James Conway, LMES |
### Monday, June 12, 2000

**Session III**

**Virus Entry: Receptor and Post-Receptor Events**

**Session Chair:**
Lynn Enquist

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:45 AM</td>
<td>Overview: Lynn Enquist</td>
</tr>
<tr>
<td>9:00 AM</td>
<td>Interactions Between Primate Lentiviruses And Cellular Receptors</td>
</tr>
<tr>
<td></td>
<td>Benhur Lee, U. Pennsylvania</td>
</tr>
<tr>
<td>9:30 AM</td>
<td>Avian Leukosis Viruses Enter Cells By A pH-Dependent Mechanism</td>
</tr>
<tr>
<td></td>
<td>John Young, U. Wisconsin</td>
</tr>
<tr>
<td>10:00 AM</td>
<td>Universal Mechanisms In Virus Entry Pathways</td>
</tr>
<tr>
<td></td>
<td>Dennis Bamford, U. Helsinki</td>
</tr>
<tr>
<td>10:30 AM</td>
<td>Coffee Break</td>
</tr>
<tr>
<td>11:00 AM</td>
<td>Nuclear Binding And Import Of Hepatitis B Virus Capsid And Genome</td>
</tr>
<tr>
<td></td>
<td>Michael Kann, Justus-Liebig University Giessen</td>
</tr>
<tr>
<td>11:30 AM</td>
<td>Modulation Of HIV And SIV Infection By The Accessory Protein VIF</td>
</tr>
<tr>
<td></td>
<td>Michael Malim, U. Pennsylvania</td>
</tr>
<tr>
<td>12:00 PM</td>
<td>Lunch</td>
</tr>
<tr>
<td>4:00 PM</td>
<td>POSTER SESSION I</td>
</tr>
<tr>
<td>6:00 PM</td>
<td>Dinner</td>
</tr>
</tbody>
</table>
**Session IV**

**Virus Entry: Fusion**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker/Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 PM</td>
<td>Overview: Judy White</td>
<td><strong>U. Virginia</strong></td>
</tr>
<tr>
<td>7:45 PM</td>
<td>A Point Mutation In The Binding Subunit Of A Murine Retrovirus Arrests Virus Entry At Hemifusion</td>
<td>Lorraine Albritton, UT Memphis</td>
</tr>
<tr>
<td>8:15 PM</td>
<td>Structural Studies Of The Paramyxovirus Fusion Protein Core</td>
<td>Theodore Jardetzky, Northwestern</td>
</tr>
<tr>
<td>8:45 PM</td>
<td>Visualizing Fusion Complexes In GPI-HA And HA Mediated Fusion</td>
<td>Joshua Zimmerberg, NIH</td>
</tr>
<tr>
<td>9:15 PM</td>
<td>=&gt; Coffee Break</td>
<td></td>
</tr>
<tr>
<td>9:30 PM</td>
<td>Cellular Receptors And Viral Proteins In Membrane Fusion For Entry of Herpes Simplex Virus</td>
<td>Oveta Fuller, U. Michigan</td>
</tr>
<tr>
<td>10:00 PM</td>
<td>D-Peptide Inhibitors Of HIV-1 Entry</td>
<td>Debra Eckert, MIT</td>
</tr>
<tr>
<td>Time</td>
<td>Session</td>
<td>Presenter</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>8:45 AM</td>
<td>Overview: Volker Vogt</td>
<td>Cornell</td>
</tr>
<tr>
<td>9:00 AM</td>
<td>Inhibition Of Host RNA Synthesis</td>
<td>Douglas Lyles, Wake Forest</td>
</tr>
<tr>
<td></td>
<td>By The Matrix Protein Of Vesicular</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stomatitis Virus</td>
<td></td>
</tr>
<tr>
<td>9:30 AM</td>
<td>The Functional Interactions Of</td>
<td>Robert Krug, UT Austin</td>
</tr>
<tr>
<td></td>
<td>The Influenza Virus NS1 Protein</td>
<td></td>
</tr>
<tr>
<td></td>
<td>With Host Cell Proteins</td>
<td></td>
</tr>
<tr>
<td>10:00 AM</td>
<td>Cis-Acting Signals In Retroviral</td>
<td>David Rekosh, U. Virginia</td>
</tr>
<tr>
<td></td>
<td>RNA That Affect Trafficking And</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Packaging</td>
<td></td>
</tr>
<tr>
<td>10:30 AM</td>
<td>⇒ Coffee Break</td>
<td></td>
</tr>
<tr>
<td>11:00 AM</td>
<td>The Biology of Bacteriophage-</td>
<td>Costa Georgopoulos, U. Geneva</td>
</tr>
<tr>
<td></td>
<td>Encoded Cochaperonins</td>
<td></td>
</tr>
<tr>
<td>11:30 AM</td>
<td>Viral And Host Functions In</td>
<td>Paul Ahlquist, U. Wisconsin</td>
</tr>
<tr>
<td></td>
<td>Bromovirus RNA Replication,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Translation And Encapsidation</td>
<td></td>
</tr>
<tr>
<td>12:00 PM</td>
<td>⇒ Lunch</td>
<td></td>
</tr>
<tr>
<td>6:00 PM</td>
<td>⇒ Dinner</td>
<td></td>
</tr>
</tbody>
</table>
**Tuesday, June 13, 2000**

**Session VI**

**Genome Packaging**

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 PM</td>
<td>Overview: Lindsay Black</td>
<td>Lindsay Black, U. Maryland</td>
</tr>
<tr>
<td>7:45 PM</td>
<td>Biophysical And Structural Characterization Of gpNu1, A Viral DNA Packaging Protein</td>
<td>Carlos Catalano, U. Colorado</td>
</tr>
<tr>
<td>8:15 PM</td>
<td>Genome Maturation And Encapsulation In HSV-1</td>
<td>Sandra Weller, U. Connecticut</td>
</tr>
<tr>
<td>8:45 PM</td>
<td>General Architecture Of The DNA Packaging System In Phage φ29 Proheads</td>
<td>José Carrascosa, Universidad Autonoma, Madrid</td>
</tr>
<tr>
<td>9:15 PM</td>
<td>Coffee Break</td>
<td></td>
</tr>
<tr>
<td>9:30 PM</td>
<td>Participation Of Host Factors In SV40 Assembly</td>
<td>Ariella Oppenheim, Hebrew University</td>
</tr>
<tr>
<td>10:00 PM</td>
<td>Nodaviral RNA Packaging</td>
<td>Anette Schneemann, Scripps</td>
</tr>
</tbody>
</table>
Wednesday, June 14, 2000

Capsid Assembly

Session Chair: Sherwood Casjens

Sherwood Casjens
U. Utah

8:45 AM  Overview: Sherwood Casjens

9:00 AM  In Vitro Assembly Of Bacteriophage P4 Capsids
Terja Dokland, U. Singapore

9:30 AM  Norwalk Virus Capsid Structure and Mechanisms of Assembly and Disassembly
Mary Estes, Baylor

10:00 AM  A Comparison Of Polyoma And Papillomavirus
Robert Garcea, U. Colorado

10:30 AM  => Coffee Break

11:00 AM  Molecular Events In The Assembly And Budding Of Retroviral Capsids
Eric Hunter, U. Alabama

11:30 AM  Structure And Assembly Of The HIV-1 Capsid
Wesley Sundquist, U. Utah

12:00 PM  => Lunch

1:30 PM  POSTER SESSION II
**Wednesday, June 14, 2000**

**Session VIII**

**Virus Exit / Virus Movement**

**Session Chair:** Tom Wileman

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
<th>Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:45 PM</td>
<td>Overview: Tom Wileman</td>
<td>Tom Wileman</td>
<td>abstract page 49</td>
</tr>
<tr>
<td>4:00 PM</td>
<td>The Mechanism And Regulation Of Phage Lysis In Complex And Simple Phages</td>
<td>Ry Young, Texas A&amp;M</td>
<td>page 49</td>
</tr>
<tr>
<td>4:30 PM</td>
<td>Role Of pI And pXI In Filamentous Phage Assembly</td>
<td>Robert Webster, Duke</td>
<td>page 50</td>
</tr>
<tr>
<td>5:00 PM</td>
<td>The Entry And Exit Of Vaccinia Virus</td>
<td>Geoffrey Smith, Oxford</td>
<td>page 51</td>
</tr>
<tr>
<td>5:30 PM</td>
<td>Nuclear Shuttling In Plant Virus Movement</td>
<td>Sondra Lazarowitz, Cornell</td>
<td>page 52</td>
</tr>
<tr>
<td>6:00 PM</td>
<td>Genetics Of Directional Alpha Herpesvirus (PRV) Transneuronal Infection</td>
<td>Lynn Enquist, Princeton</td>
<td>page 53</td>
</tr>
<tr>
<td>7:00 PM</td>
<td>⇒ Dinner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:30 PM</td>
<td>⇒ Party Time</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Thursday, June 15, 2000

Applications to Biotechnology (sponsored in part by New England Biolabs)

Session Chair: Ben Fane
Ben Fane
U. Arizona

9:00 AM Overview: Ben Fane

9:15 AM Structurally-Biased Combinatorial Design of Antivirals
James Hogle, Harvard

9:45 AM Recombinant Vesicular Stomatitis Viruses As Cell-Specific Targeting Vectors
Michael Whitt, U T Memphis

10:15 AM Implications Of Latent And Endogenous Viruses For Xenotransplantation
Clive Patience, BioTransplant Incorporated

10:45 AM Viral Protein Cages As Novel Templates For Material Synthesis And Entrapment
Mark Young, Montana State

11:15 AM Conference Close

11:30 AM Bus Departs to Boston Airport
Karen L. Adelman  
Cornell Univ.  
Microbiology and Immunology  
VMC C5-184  
Ithaca, NY 14853  
607-253-3417  
607-253-3384  
mailto:kadelman@yahoo.com

Mavis . Agbandje-Mckenna  
Univ. of Florida/Gainesville Col. of Med.  
Biochemistry and Molecular Biology  
The Brain Inst./PO Box 100245  
Gainesville, FL 32610-0245  
352-392-5694  
352-392-2953  
mailto:mckenna@ufl.edu

Paul . Ahlquist  
Univ. of Wisconsin/Madison  
HHMI/Inst for Molecular Virology  
1525 Linden Dr.  
Madison, WI 53706-1596  
608-263-9213  
608-265-9214  
mailto:ahlquist@facstaff.wisc.edu

Lorraine . Albritton  
Univ. of Tennessee/Memphis  
Microbiology and Immunology  
858 Madison Ave./Rm. 101  
Memphis, TN 38163  
901-448-5521  
901-448-8462  
mailto:labritton@utmem.edu

Joel D.. Baines  
Microbiology and Immunology  
C5169 Vet. Med. Center  
Ithaca, NY 14853-6401  
607-253-3391  
607-253-3384  
mailto: idb11@cornell.edu

Dennis . Barnford  
Univ. of Helsinki  
Biocenter  
Vilkkaaari S/P O Box 56  
Helsinki, 00014 FINLAND  
358-9-191-59100  
358-9-191-59098  
mailto:dennis_bamford@helsinki.fi

Brandi . Baros  
Univ. of Pittsburgh  
Pittsburgh Bacteriophage Inst.  
Biological Sciences  
A340 Langley Hall/Hendrix Lab.  
Pittsburgh, PA 15260  
412-624-4651  
412-624-4759  
mailto:baros@pitt.edu

David M. Belnap  
NIAMS/NIH  
Lab. of Structural Biology Research  
Building 6, Room B2-34  
Bethesda, MD 20892-2717  
301-402-2361  
301-480-7629  
mailto:David_Belnap@nih.gov

James M. Benevides  
Univ. of Missouri - Kansas City  
Biological Sciences  
5100 Rockhill Road  
Kansas City, MO 64110  
816-235-2499  
816-235-1503  
mailto:benevidesj@umkc.edu

Stacy D.. Benson  
The Wistar Inst.  
Structural Biology  
3601 Spruce St.  
Philadelphia, PA 19104  
215-696-2202  
215-696-3868  
mailto:benson@wistar.upenn.edu
Ricardo A. Bernal  
Purdue Univ.  
Biological Sciences  
1392 Lilly Hall  
West Lafayette, IN 47907-1189  
765-494-4507  
765-496-1189  
mailto: rbernal@purdue.edu

Smita Bhatia  
Florida State Univ.  
Molecular Biophysics  
255-MBB  
Tallahassee, FL 32306-4380  
850-644-1115  
850-561-1406  
mailto: smita@sb.fsu.edu

Michael Scott Bowers  
Med. Univ. of South Carolina  
Physiology and Neuroscience  
PO Box 250677  
167 Ashley Avenue/Suite 607  
Charleston, SC 29425  
843-792-1838  
843-792-4423  
mailto: bowersms@msc.edu

Jay C. Brown  
Univ. of Virginia Health System  
Microbiology/Box 800734  
1300 Jefferson Park Ave.  
Charlottesville, VA 22908  
804-924-1814  
804-982-1071  
mailto: jcb2@virginia.edu

Roger M. Burnett  
The Wistar Inst.  
3601 Spruce St  
Philadelphia, PA 19104  
215-898-2201  
215-898-3668  
mailto: burnett@wistar.upenn.edu

Andrea F. Bertolotti-Ciarlet  
Baylor Col. of Medicine  
Molecular Virology and Microbiology  
One Baylor Plaza/BCM385  
Houston, TX 77030  
713-798-4445  
713-798-3586  
mailto: ciarel@bcm.tmc.edu

Linsay Black  
Univ. of Maryland/UMB Med. Sch.  
Biochemistry and Molecular Biology/Rm. 408  
108 N. Greene St.  
Baltimore, MD 21201-1503  
410-706-3510  
410-706-8297  
mailto: lblack@umbc.edu

Edward J. Brignole  
Johns Hopkins Sch. of Med.  
Pharmacology and Molecular Science  
725 North Wolfe Street  
Baltimore, MD 21205  
410-955-8580  
410-955-3023  
mailto: brignole@jhmi.edu

April Burch  
Univ. of Arizona  
Vet. Sci./Microbiology  
Bldg 90/Rm. 101 A/B  
1117 E. Lowell SL  
Tucson, AZ 85721  
520-621-8539  
520-621-6366  
mailto: burch@u.arizona.edu

Stephen J. Campbell  
NCI-FCRDC  
HIV Drug Resistance Program  
Retroviral Assembly  
Frederick, MD 21702 USA  
301-646-1844  
301-646-7146  
mailto: campbells@mail.ncifcrf.gov
Rebecca C. Craven
Pennsylvania State Univ. Col. of Med.
Microbiology and Immunology
500 University Drive/ Mail Code H107
Hershey, PA 17033
717-531-3528
717-531-6522
mailto:rcraven@psu.edu

Sue E. Delos
Univ. of Virginia Health System Sch. of Med.
Cell Biology
PO Box 800732
Charlottesville, VA 22908-0732
804-524-2009
804-582-3912
mailto:sed7a@virginia.edu

Robert L. Duda
Univ. of Pittsburgh
Biological Sciences
Langley Hall
Pittsburgh, PA 15260
412-624-4651
412-624-4759
mailto:duda@pitt.edu

Debra M. Eckert
Whitehead Inst.
Biology
9 Cambridge Ctr.
Cambridge, MA 02142
617-258-5190
617-258-7226
mailto:eckert@wi.mit.edu

Mary . Estes
Baylor Col. of Med.
Molecular Virology and Microbiology
Mailstop BCM-385
1 Baylor Plaza
Houston, TX 77030
713-798-3585
713-798-3586
mailto:mesles@melnick.mvir.bcm.tmc.edu

Alan R.. Davidson
Univ. of Toronto
Molecular and Medical Genetics/Biochemistry
Medical Sciences Bldg. - Rm. 4176
1 King's College Circle
Toronto, ONT M5S 1A8 CANADA
416-978-0332
416-978-6885
mailto:davidson@hkl.med.utoronto.ca

Terje . Dokland
Institute of Molecular Agrobiology
1 Research Link NUS
Singapore, 117604 SINGAPORE
65-872-7405
65-872-7007
mailto:dokland@ima.org.sg

Rebecca . Dutch
Northwestern Univ.
Biochemistry/Molecular Biology/Cell Biology
2153 N. Campus Dr.
Evanston, IL 60208
847-491-5432
847-491-2467
mailto:red457@nwu.edu

Lynn W. Enquist
Princeton Univ.
Molecular Biology
314 Schultz Lab.
Princeton, NJ 08544
609-258-2415
609-258-1035
mailto:lenquist@molbio.princeton.edu

Bentley A. Fane
Univ. of Arizona
Veterinary Sci. and Microbiology
Bldg. 90
Tucson, AZ 85721
520-626-6634
520-621-6366
mailto:bfane@u.arizona.edu
<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>Address</th>
<th>Phone Numbers</th>
<th>Email Addresses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joanna M. Gilbert</td>
<td>Harvard Med. Sch. Pathology</td>
<td>D2-23, 200 Longwood Ave., Boston, MA 02115</td>
<td>617-432-1998, 617-277-5291</td>
<td><a href="mailto:gilbert@hms.harvard.edu">mailto:gilbert@hms.harvard.edu</a></td>
</tr>
<tr>
<td>Katie Goetzinger</td>
<td>Catholic Univ. of America Biology</td>
<td>103 McCort Ward, 620 Michigan Avenue, NE, Washington, DC 20064</td>
<td>202-319-5271, 202-319-5616</td>
<td><a href="mailto:30goetzinger@cua.edu">mailto:30goetzinger@cua.edu</a></td>
</tr>
<tr>
<td>Mira Grattinger</td>
<td>Heinrich-Pette-Institut Virology</td>
<td>Martinistr. 52, Hamburg, 20251 Germany</td>
<td>49-40-48051-245, 49-40-48051-184</td>
<td><a href="mailto:mira@hpi.uni-hamburg.de">mailto:mira@hpi.uni-hamburg.de</a></td>
</tr>
<tr>
<td>Susan Hafenstein</td>
<td>Univ. of Arizona Vet. Sci./Microbiology</td>
<td>Bldg. 90/Rm. 101A/B, 1117 E. Lowell St. Tucson, AZ 85721</td>
<td>520-621-8539, 520-621-6366</td>
<td><a href="mailto:shafenst@u.arizona.edu">mailto:shafenst@u.arizona.edu</a></td>
</tr>
<tr>
<td>Yongning He</td>
<td>Purdue Univ. Dept. of Biological Sciences</td>
<td>West Lafayette, IN 47907</td>
<td>765-494-1662, 765-495-1189</td>
<td><a href="mailto:he0@bilbo.bio.purdue.edu">mailto:he0@bilbo.bio.purdue.edu</a></td>
</tr>
<tr>
<td>Roger Hendrix</td>
<td>Univ. of Pittsburgh Pittsburgh Bacteriophage Inst. Biological Sciences</td>
<td>Pittsburgh, PA 15250</td>
<td>412-624-4674, 412-624-4870</td>
<td><a href="mailto:rhx@mitt.edu">mailto:rhx@mitt.edu</a></td>
</tr>
<tr>
<td>Eric Hunter</td>
<td>Univ. of Alabama at Birmingham</td>
<td>1530 3rd Ave. South, Birmingham, AL 35294-2170</td>
<td>205-934-4321, 205-934-1640</td>
<td><a href="mailto:ehunter@uab.edu">mailto:ehunter@uab.edu</a></td>
</tr>
<tr>
<td>James Hogle</td>
<td>Harvard Univ. Sch. of Med. Biological Chemistry/Molec. Pharmacology</td>
<td>240 Longwood Ave. Boston, MA 02115</td>
<td>617-432-3918, 617-332-2462</td>
<td><a href="mailto:hodle@hodes.med.harvard.edu">mailto:hodle@hodes.med.harvard.edu</a></td>
</tr>
<tr>
<td>Anabela Lopes. Isidro</td>
<td>Inst. for Chemical and Biological Technology Microbial Genetics, Lab 5.02</td>
<td>Av. Da Republica, Apt. 127 Oeiras, 2781-901 Portugal</td>
<td>351-21-445 9525, 351-1-441 1277</td>
<td><a href="mailto:alisidro@itcb.unl.pt">mailto:alisidro@itcb.unl.pt</a></td>
</tr>
</tbody>
</table>
Paul J., Jardine  
Univ. of New Brunswick  
Biology  
Fredericton, NB E2B 6E1 Canada  
506-453-4790  
506-453-3583  
mailto:pf@unb.ca

Wen. Jiang  
Baylor Col. of Med.  
Structural and Computational Biol./Molec. Biophys.  
One Baylor Plaza, N420  
Houston, TX 77030  
713-798-6989  
713-798-1625  
mailto:wi617811@bcm.tmc.edu

Jack . Johnson  
The Scripps Res. Inst.  
Molecular Biology/MB31  
10550 N. Torrey Pines Rd.  
La Jolla, CA 92037  
619-784-2947  
619-784-8660  
mailto:jacki@scripps.edu

Karyn N. Johnson  
Univ. of Alabama at Birmingham  
Microbiology  
BBRB 373/17  
845 19th Street South  
Birmingham, AL 35205  
205-934-0454  
205-934-1636  
mailto:Karyn_Johnson@microbio.uab.edu

Michael . Kann  
Justus-Liebig-Universitaet  
Medical Virology  
Frankfurter Str. 107  
Giessen, D-35392 GERMANY  
49-641-9941243  
49-641-9941209  
mailto:michael.kann@viro.med.uni-giessen.de

Borries . Kemper  
Univ. of Cologne  
Institute for Genetics  
Zulpicher Strasse 47  
Koln, 50674 Germany  
49-221 470 5287  
49-221 470 5172  
mailto:b.kemper@uni-koeln.de

Margaret. Kiellian  
Albert Einstein Col. of Med.  
Cell Biology  
1300 Morris Park Ave.  
Bronx, NY 10461  
718-430-3538  
718-430-8574  
mailto:kiellian@aecon.yu.edu

Jason A.. King  
German Cancer Research Ctr.  
Tumor Virology - DKFZ  
Im Neuenheimer Feld 242  
Heidelberg, D-69115 GERMANY  
49-6221 424648  
49-6221 424962  
mailto:j.king@usa.net

Neel K. Krishna  
The Scripps Research Inst.  
Molecular Biology  
10550 North Torrey Pines Road, MB-31  
La Jolla, CA 92037  
858-784-8650  
858-784-8650  
mailto:nkrishna@scripps.edu

Robert , Krug  
Univ. of Texas/Austin  
Inst. for Cellular and Molecular Biology  
2500 Speedway  
Austin, TX 78712  
512-232-5553  
512-232-5555  
mailto:rkrua@icmb.utexas.edu
Michael A. McVoy  
Medical Coll. of Virginia  
Pediatrics  
Box 163 MCV Station  
Richmond, VA 23298  
804-828-0132  
804-828-6455  
mailto:mcvoy@hsc.vcu.edu

Leonard . Mindich  
Public Health Research Inst.  
Microbiology  
455 First Avenue  
New York, NY 10016  
212-578-0845  
212-578-0804  
mailto:mindich@phrinc.nci.nih.gov

Michael Mitchell  
Catholic Univ. of America  
Biology  
103 McCort Ward  
620 Michigan Avenue, NE  
Washington, DC 20064  
202-319-5271  
202-319-5721  
mailto:82mitchell@ca.edu

Yorgo E. Modis  
Harvard Medical School  
Children's Hospital  
Enders 673  
320 Longwood Ave.  
Boston, MA 02115  
617-355-7920  
617-355-3506  
mailto:modis@crystal.harvard.edu

Ian J. Molineux  
Univ. of Texas  
Molecular Genetics and Microbiology  
Austin, TX 78712-1095  
512-471-3143  
512-471-7088  
mailto:molineux@mail.utexas.edu

Sean. Moore  
Univ. of Alabama at Birmingham  
Microbiology  
BBRB #414  
845 South 19th St.  
Birmingham, AL 35294  
205-975-5339  
205-975-5479  
mailto:sdmoore@uab.edu

Marc C. Morais  
Purdue Univ.  
Dept. of Biological Sciences  
1392 Lilly Hall of Life Sciences  
Lafayette, IN 47907  
765-496-4910  
765-496-1189  
mailto:dmorais@indiana.bio.purdue.edu

DePhippe . Muraux  
NC/NIH  
HIV Drug Resistance Program/Retrovirus Assemb. Sec  
FCRDC  
PO Box B/Bldg. 535  
Frederick, MD 21702  
301-845-1846  
301-845-7146  
mailto:dmuraux@ncifcrf.gov

Jacob K. Nellissery  
Univ. of Connecticut Hlth. Ctr.  
Microbiology  
263 Farmington Ave.  
Farmington, CT 06030  
860-679-3788  
860-679-1239  
mailto:nellissery@neuron.uchc.edu

Ariella. Oppenheim  
Hebrew Univ./Hadassah Med. Sch.  
Hematology  
Jerusalem, 91120 ISRAEL  
972-2-677-6753  
972-2-642-3067  
mailto:ariella@cc.hhu.jil.ac.il
Venigalla B. Rao  
Catholic Univ. of America  
Biology  
103 McCort Ward  
620 Michigan Ave. NE  
Washington, DC 20064  
202-319-5271  
202-319-6161  
mailto:rao@cua.edu

Karin . Reinisch  
Harvard Univ.  
Molecular and Cellular Biology  
7 Divinity Ave.  
Cambridge, MA 02138  
617-495-4091  
617-495-9613  
mailto:reinisch@xtala00.mcb.harvard.edu

Felix . Rey  
CNRS  
Lab. de Genetique des Virus  
1, Avenue de la Terrasse/BAT 14C  
Gif-Sur-Yvette Cedex, 91198 FRANCE  
33-169-623844  
33-698-24308  
mailto:rev@av.cnrs-aif.fr

Richard J.. Roller  
Univ. of Iowa  
Microbiology  
BSB3-752  
iowa City, IA 52242-1109  
319-335-9958  
319-335-9006  
mailto: richard-roller@uiowa.edu

Pia . Rydman  
Univ. of Helsinki  
Biosciences  
Viikki Biocenter  
Vilkkaaari 5/Box 56  
Helsinki, FIN 00014 Finland  
358-9-19159106  
358-9-19159098  
mailto: pia.rydman@helsinki.fi

Alan . Rein  
National Cancer Institute/FCRDC  
HIV Drug Resistance Program  
PO Box B  
Frederick, MD 21702 USA  
301-846-1361  
301-846-7146  
mailto: rein@ncifcrf.gov

David . Rekosh  
Univ. of Virginia HSC  
Microbiology  
Jordan Hall 7-87/Box 441  
Charlottesville, VA 22908  
804-982-1599  
804-982-1590  
mailto: dr4u@virginia.edu

Maria A.. Rodriguez-Casado  
Univ. of Missouri - Kansas City  
Cell Biology & Biophysics  
Sch.of Biological Sciences  
5100 Rockhill Road  
Kansas City, MO 64110  
816-235-2500  
816-235-1503  
mailto: casadom@umkc.edu

Michael G. . Rossmann  
Purdue University  
Biological Sciences  
Lafayette, IN 47907  
765-494-4911  
765-496-1189  
mailto: mgr@indiana.bio.purdue.edu

Michael . Säkälin  
Univ. of Alabama at Birmingham  
Microbiology  
BBRB 471  
1530 3rd Avenue South  
Birmingham, AL 35294-2117  
205-934-9149  
205-934-3164  
mailto: msak@uab.edu
Carmen San Martin  
The Wistar Inst.  
3601 Spruce St.  
Philadelphia, PA 19104  
215-898-2202  
215-698-3868  
mailto:carmen@wistar.upenn.edu

Robert Seckler  
Universitat Potsdam  
Physikalische Biochemie  
Karl-Liebknecht-str 24-25, Haus 25  
Golm, 14476 GERMANY  
49-331-977-5240  
49-331-977-5062  
mailto:sackler@rz.uni-potsdam.de

Chiaho Shih  
Univ of Texas Medical Branch  
Dept of Pathology  
3.146 Keiller Bldg  
Galveston, TX 77555-0609  
409-772-2563  
409-747-2429  
mailto:eschih@utmb.edu

Alan A. Simpson  
Purdue University  
Biological Sciences  
Life Sciences  
Dept of Biological Sciences 1392 Lilly Hall of  
West Lafayette, IN 47907-1392  
765-494-4925  
765-496-1189  
mailto:asimpson@new-mexico.bio.purdue.edu

Thomas J. Smith  
Purdue Univ.  
Biological Sciences  
B135 Lilly Hall  
West Lafayette, IN 42907  
765-494-6038  
765-496-1189  
mailto:tom@bragg.bio.purdue.edu

Geoffrey Smith  
Univ. of Oxford  
Sir William Dunn Sch. of Pathology  
South Parks Rd.  
Oxford, OX1 3RE UNITED KINGDOM  
44-1865-275521  
44-1865-275501  
mailto:gsmith@molbiol.ox.ac.uk

Alasdair C. Steven  
NIAMS/NIH  
LSBR  
6 Center Drive/MSC 2717  
Bethesda, MD 20892  
301-495-0132  
301-480-7629  
mailto:alasdair_steven@nih.gov

Phoebe Stewart  
Univ. of California/Los Angeles Sch. of Med.  
Molecular and Medical Pharmacology/A-324  
CiBi/Box 951770  
Los Angeles, CA 90024-1770  
310-206-7055  
310-206-8975  
mailto:pstewart@mednet.ucla.edu

Anne Struble  
Scripps Research Inst.  
Molecular Biology  
10550 N. Torrey Pines Road MB-31  
La Jolla, CA 92037  
858-784-7731  
858-784-8660  
mailto:astruble@scripps.edu
Sandra Weller  
Univ. of Connecticut Hlth. Ctr.  
Microbiology MC 3205  
263 Farmington Ave.  
Farmington, CT 06085  
860-679-2310  
860-679-1239  
mailto:weller@usoz.uchc.edu

Judith M. White  
Univ. of Virginia Health System  
Cell Biology  
1300 Jefferson Park Ave.  
Charlottesville, VA 22908-0732  
804-924-2593  
804-952-3912  
mailto:judywhite@virginia.edu

Michael Whitt  
Univ. of Tennessee/Memphis  
Microbiology and Immunology  
858 Madison Ave./Rm. 101  
Memphis, TN 38163  
901-448-4634  
901-448-8462  
mailto:mwhitt@utmem.edu

Douglas J. Wieczorek  
Univ. of Iowa  
Microbiology  
3-352 BSB  
Iowa City, IA 52245  
319-335-8866  
319-335-9006  
mailto:douglas-wieczorek@uiowa.edu

William R. Wikoff  
The Scripps Res. Inst.  
Molecular Biology/MB31  
10550 N. Torrey Pines Rd.  
La Jolla, CA 92037  
858-784-2647  
858-784-8660  
mailto:billw@scripps.edu

Tom Wileman  
Inst. for Animal Health/Pirbright Labs.  
Immunology  
Ash Road  
Woking  Surrey, GU24 ONF UNITED KINGDOM  
44-01483-232-441  
44-01483-232-448  
mailto:thomas.wileman@bbasc.ac.uk

Chuan Xiao  
Purdue Univ.  
Dept. of Biological Sciences  
1392 Lilly Hall  
West Lafayette, IN 47907-1392  
765-494-4507  
765-496-1189  
mailto:xao@purdue.edu

Jun Xu  
Univ. of Pittsburgh  
Biological Sciences  
A340 Langley Hall  
Pittsburgh, PA 15232  
412-624-4651  
412-624-4759  
mailto:juxu@pitt.edu

Lan Xu  
The Wistar Inst.  
Structural Biology  
3601 Spruce SL/Rm., 320  
Philadelphia, PA 19104  
215-898-2202  
215-898-3868  
mailto:xulan@wistar.upenn.edu

Mark Yeager  
The Scripps Res. Inst.  
Cell Biology  
10550 N. Torrey Pines Rd.  
La Jolla, CA 92037  
858-784-8584  
858-784-2504  
mailto:yeager@scripps.edu
Mark J. Young
Montana State Univ.
Plant Sciences/307 ABS
Bozeman, MT 59717
406-994-5158
406-994-1848
mailto:myoung@montana.edu

John Young
Univ. of Wisconsin/Madison
Oncology
McArdle Lab. for Cancer Res.
1400 University Ave.
Madison, WI 53703
608-265-5151
608-262-2824
mailto:young@oncology.wisc.edu

Ryland F. Young
Texas A&M Univ.
Biochemistry and Biophysics
2128 TAMUS
College Station, TX 77843-2128
409-845-2087
409-862-4718
mailto:ryland@tamu.edu

Hong Zhou
Univ. of Texas/Houston Med. Sch.
Pathology and Laboratory Med.
6431 Fannin
Houston, TX 77030
713-500-5358
713-500-0730
mailto:z.h.zhou@uth.tmc.edu

Joshua Zimmerberg
NIH
Bldg. 10/Rm. 10D14
10 Center ST/MSC 1855
Bethesda, MD 20892
301-496-6571
301-594-0813
mailto:joshz@helix.nih.gov

Adam Zlotnick
Univ. of Oklahoma HSC
Biochemistry and Molecular Biology
PO Box 26901/BRC 464
Oklahoma City, OK 73190
405-271-6030
405-271-3910
mailto:adam-zlotnick@ouhsc.edu
Supplementary Participant List 1151

Tom G. Bernhardt  
Biochemistry & Biophysics Dept.  
Texas A & M Univ.  
Rm 315 Biochemistry Building  
College Station, Tx 77843  
(409) 845-2853  
(409) 862-4718  
tbern@pop.tamc.edu

Douglas S. Lyles  
Dept. of Microbio. & Immun.  
Wake Forest Univ. Sch. of Med  
Medical Center Blvd.  
Winston-Salem, NC 27157  
(336) 716-4237  
(336) 716-9928  
dlyles@wfubmc.edu