Creating a Community Cyberinfrastructure for Advanced Marine Microbial Ecology Research and Analysis (a.k.a. CAMERA)

Invited Talk
Honoring David Kingsbury
Gordon and Betty Moore Foundation
Palo Alto, CA
March 18, 2009

Dr. Larry Smarr
Director, California Institute for Telecommunications and Information Technology
Harry E. Gruber Professor,
Dept. of Computer Science and Engineering
Jacobs School of Engineering, UCSD

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The Beards are Still Working Together Two Decades Later!



David Kingsbury and John Wooley
NSF 1987



Larry Smarr
NCSA 1985

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CAMERA: Community Cyberinfrastructure for Advanced Marine Microbial Ecology Research and Analysis

National LambdaRail Direct Connect Computation and Storage Complex

PI Larry Smarr

Funded by: Gordon and Betty Moore Foundation

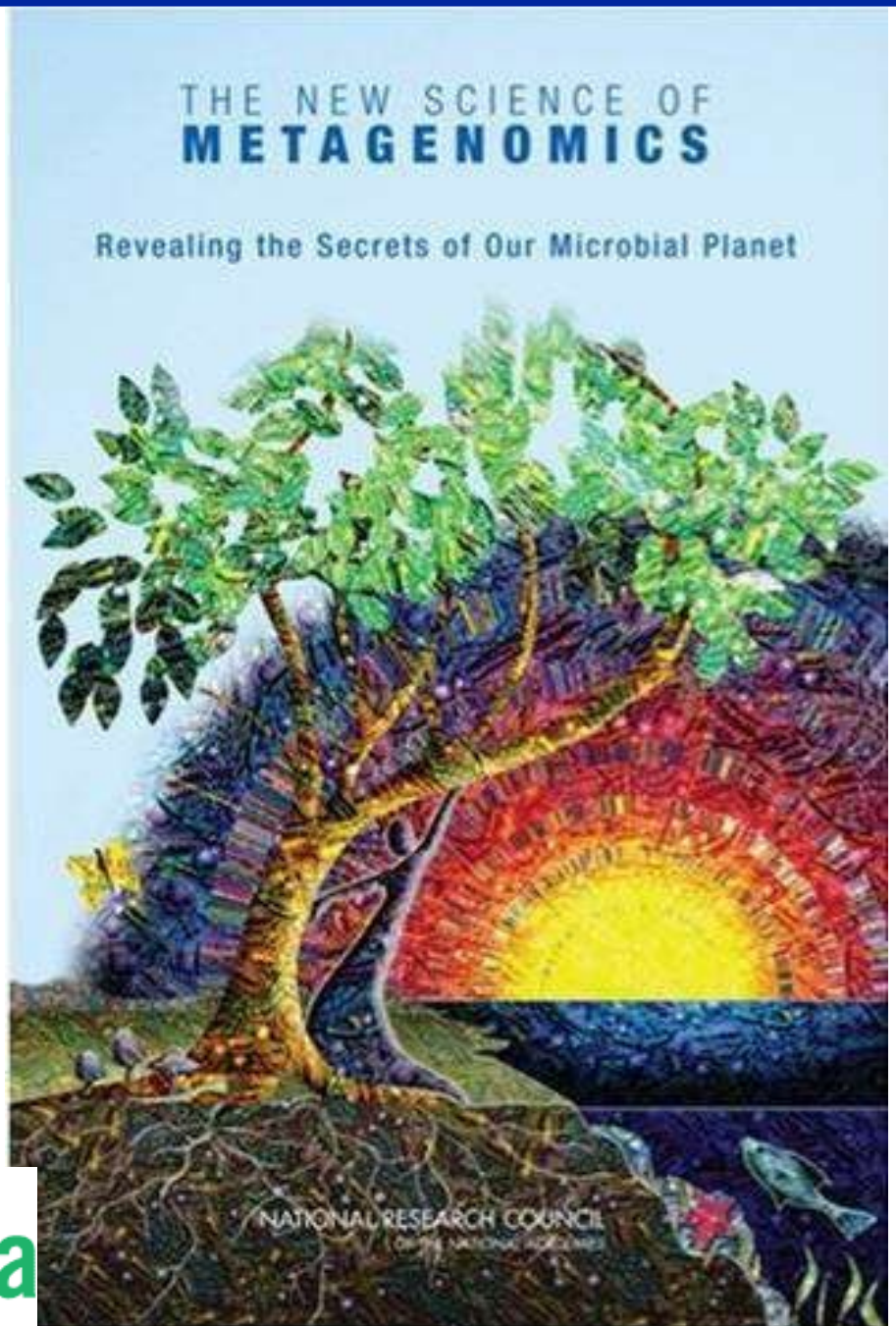
Joint Partnership of:

David Kingsbury Call to LS July 31, 2005
Grant Announced January 17, 2006

The Moore Foundation Was an Early Funder As The National Consensus Emerged

NRC Report:

Metagenomic data should be made publicly available in international archives as rapidly as possible.

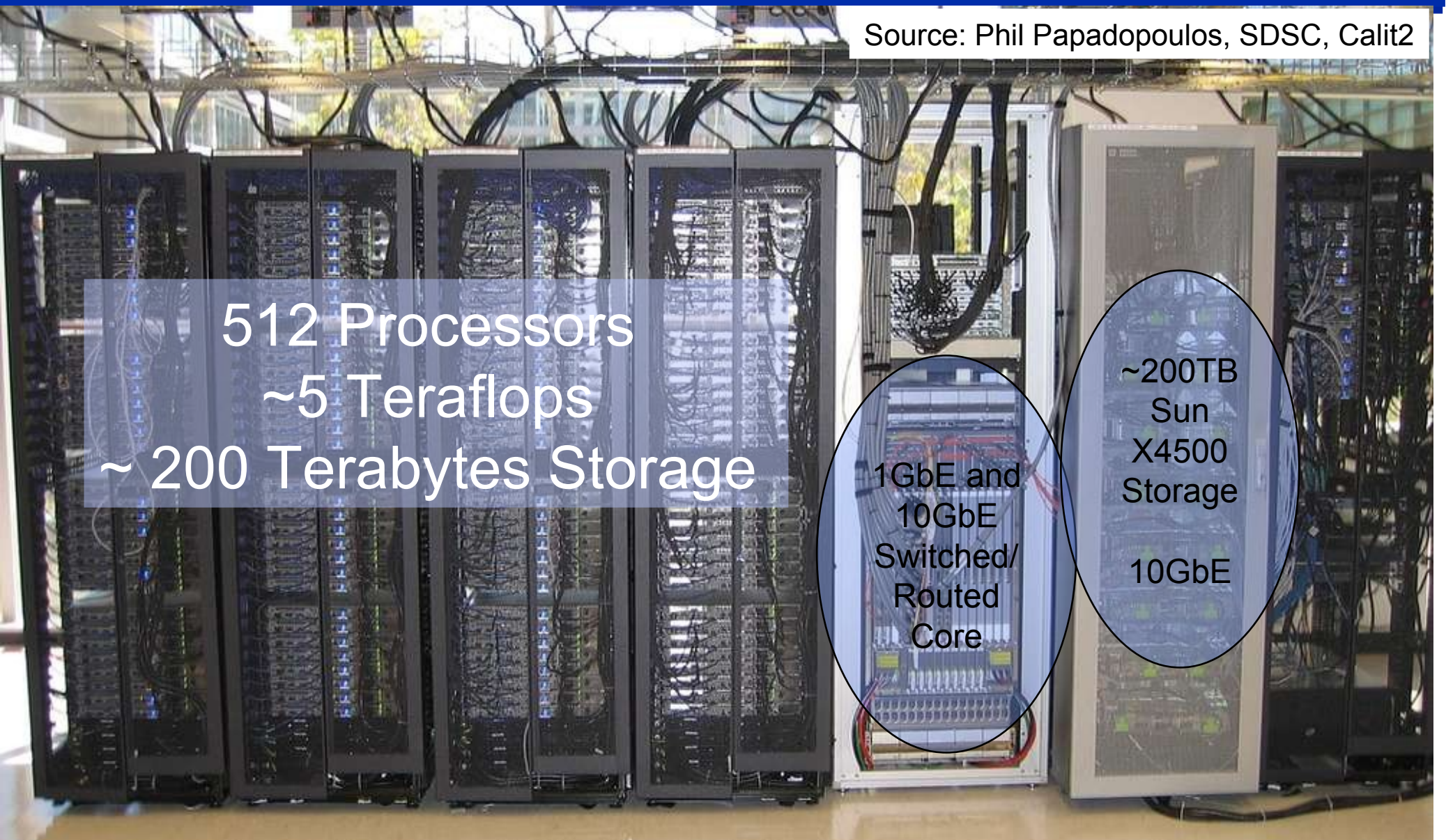


"The emerging field of metagenomics, where the DNA of entire communities of microbes is studied simultaneously, presents the greatest opportunity -- perhaps since the invention of the microscope – to revolutionize understanding of the microbial world." –

National Research Council
March 27, 2007

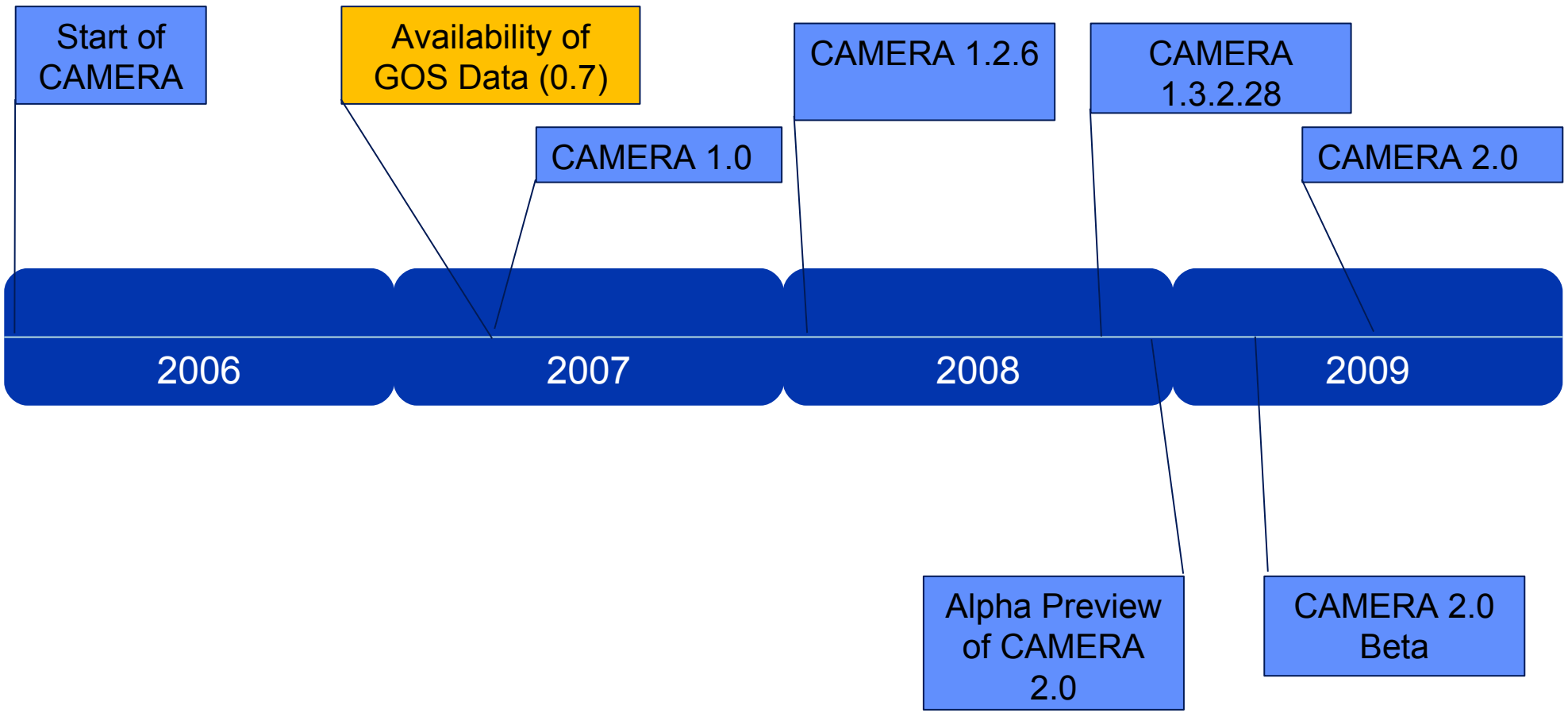
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Calit2 Microbial Metagenomics Cluster- Next Generation Optically Linked Science Data Server



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SDSC
ROCKS
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CAMERA Timeline



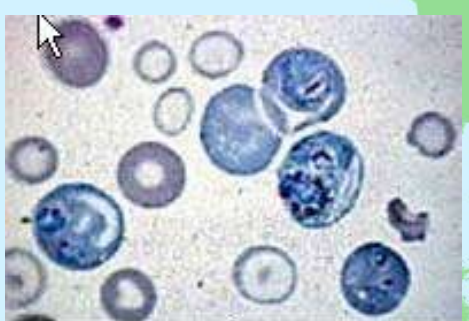
Source: Jeff Grethe, NCMIR, CAMERA, UCSD

Marine Genome Sequencing Project – CAMERA Anchor Dataset Launched March 13, 2007

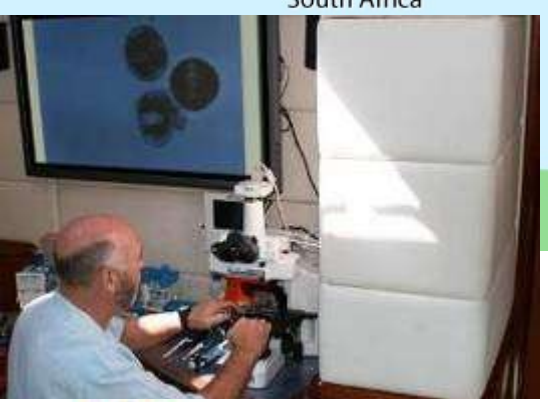


Each Sample ~2000 Microbial Species

Canada
United States
Mexico
Puerto Rico
Honduras
Costa Rica
Panama
Galapagos Islands
x 10 samples
Tanzania/ Zanzibar
x 7 samples
Seychelles
Madagascar
Specify Ocean Data
South Africa
Cocos-Keeling Is.
Vanuatu
x 17 samples
Fiji
Tonga
French Polynesia
Cook Islands
Australia
New Caledonia
x 8 samples



Analyzed
Sampled, but not Analyzed



MARINE MICROBIOLOGY INITIATIVE

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Measuring the Genetic Diversity of Ocean Microbes

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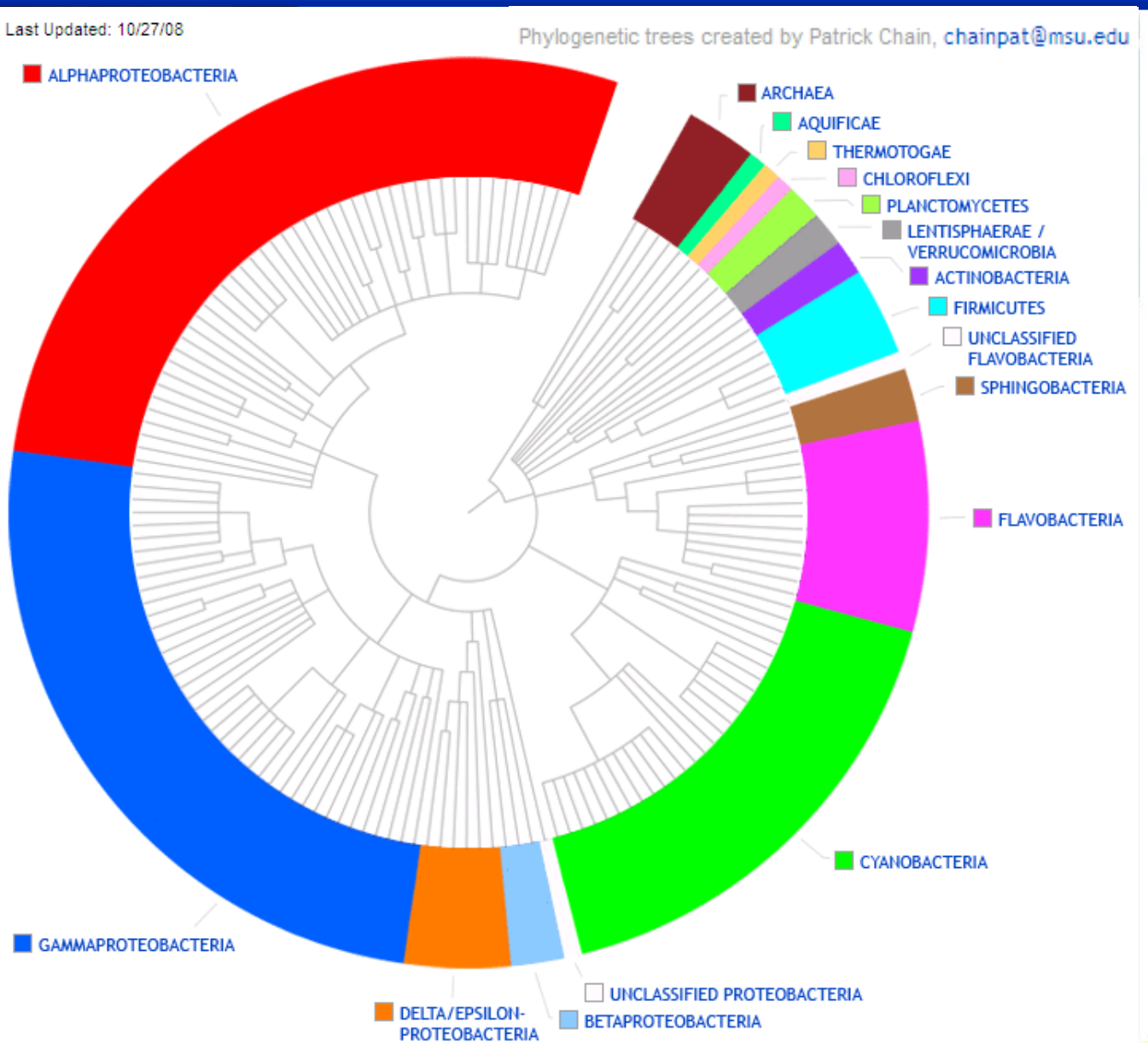
Moore Foundation Enabled the Sequencing of the Full Genome Sequence of 155+ Marine Microbes

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Microb Sequ

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www.moore.org/microgenome

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CAMERA Houses the Community's Expanding Environmental Metagenomics Datasets

March 16, 2008

Project ▲	Principal Investigator	Organization
Acid Mine Drainage Metagenome	Jillian F. Banfield	DOE Joint Genome Institute
Alvinella pompejana Epibiont Metagenome	Alison Murray	University of Delaware/Desert Research Institute
Chesapeake Bay Virioplankton Metagenome	Eric Wommack	University of Delaware
Dauphin Island Cubitainer Experiment (DICE)	Mary Ann Moran	University of Georgia
Global Ocean Sampling Expedition ★	J. Craig Venter	J. Craig Venter Institute
Marine Bacterioplankton Metagenomes	David Karl	University of Hawaii
Mediterranean Bathypelagic Habitat Metagenome	Francisco Rodriguez-Valera	Evolutionary Genomics Group
Mediterranean Gutless Worm Metagenome	Edward M. Rubin	DOE Joint Genome Institute
Metagenome of Marine NaCl-Saturated Brine	Francisco Rodriguez-Valera	Evolutionary Genomics Group
Metagenomic Analysis of the North Atlantic Spring Bloom	Stephen J. Giovannoni	Oregon State University
Microbial Community Genomics at the HOT/ALOHA	Ed Delong and David Karl	Center for Microbial Oceanography: Research and...
Monterey Bay Microbial Study	Edward F. Delong	Massachusetts Institute of Technology
Moore Marine Microbial Sequencing ★	Various	The Gordon and Betty Moore Foundation
Ocean Viruses	Forest Rohwer	SDSU Center for Universal Microbial Sequencing
Phosphorus Removing (EBPR) Sludge Community	Philip Hugenholtz	Doe Joint Genome Institute
Polyamine Metatranscriptomic Study	Mary Ann Moran	University of Georgia
Sargasso Sea Bacterioplankton Community	Mary Ann Moran	University of Georgia
Surface Water Marine Microbial Community Gene Expression	Jonathan P. Zehr	University of California, Santa Cruz
Viral Metagenomes from Terrestrial Hot Springs	Thomas Schoenfeld	Lucigen Corporation
Waseca County Farm Soil Metagenome	Edward M. Rubin	DOE Joint Genome Institute
Whale Fall Metagenome	Edward M. Rubin	DOE Joint Genome Institute

Rapidly Expanding to Include New Community Datasets
Now Releasing An Additional Dataset Per Week!

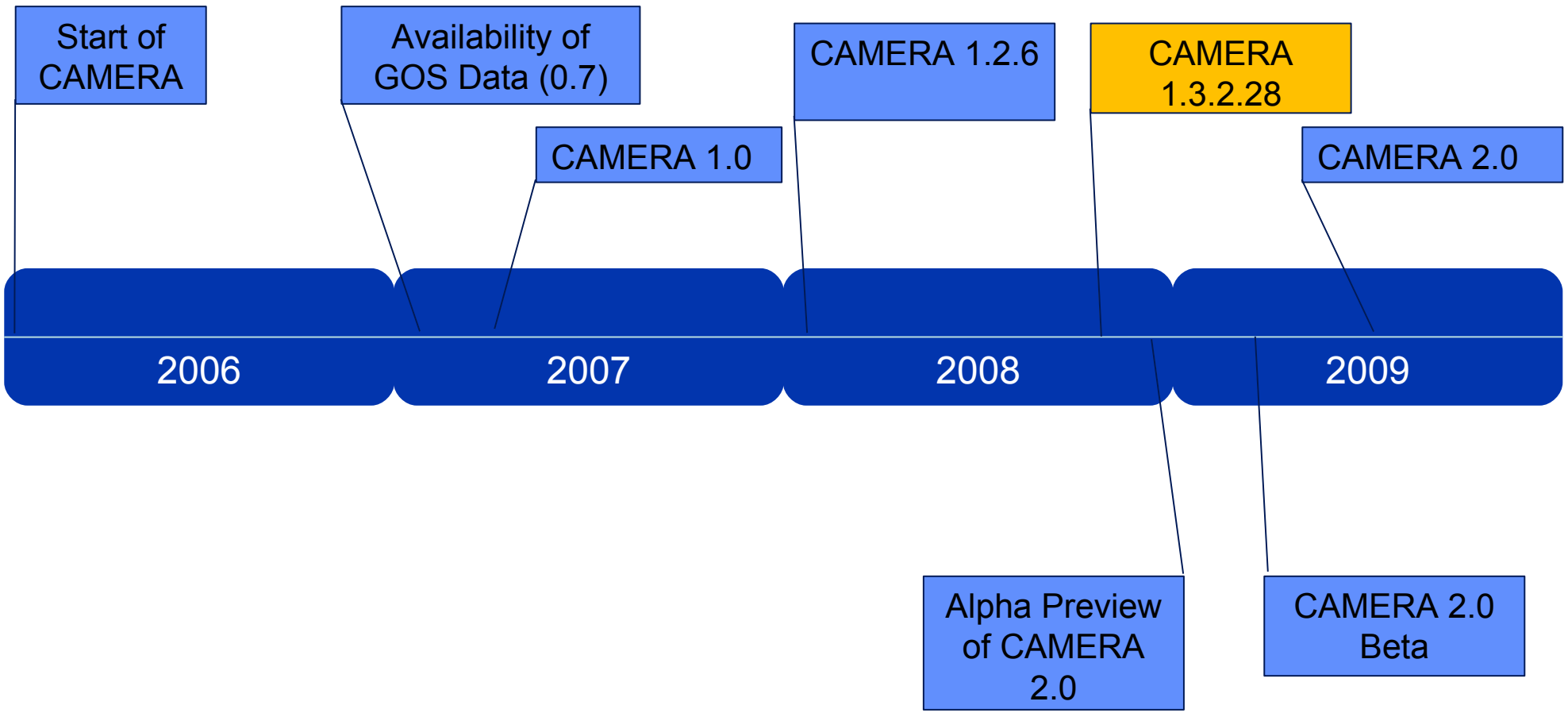
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CAMERA Timeline



Source: Jeff Grethe, NCMIR, CAMERA, UCSD

Current CAMERA Interface
March 17, 2009

Log out Contact Help

Search

Advanced Search

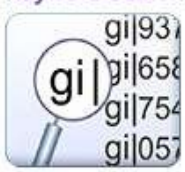
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About Camera ▾ Education ▾ Community ▾ Tools ▾ Projects & Data ▾

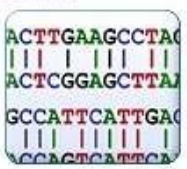
CAMERA - Community Cyberinfrastructure for Advanced Marine Microbial Ecology Research and Analysis

Hello pgilna. Welcome to CAMERA.

Keyword Search



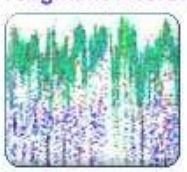
BLAST



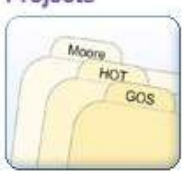
Job Results



Fragment Recruitment



Projects



Samples



File server download



Publications



About CAMERA



Education



Community



Help



What's New

- Participate in the January 2009 CAMERA survey
- CAMERA has been updated to v1.3.2.28. For more information, see the release notes
- Stay updated by subscribing to the mailing list or following us on Twitter

Current Status

- Current application version - 1.3.2.28 (release notes) deployed 01/26/2009
- Available datasets: **21**
- 2632 registered users as of 03/17/09 (see registration map)

Upcoming events

- 2009 DOE JGI User Meeting (8 days)
- 164th Society for General Microbiology Meeting (13 days)

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The CAMERA Project Has Established a Global Marine Microbial Metagenomics Cyber-Community

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2700 Registered Users
From 76 Countries

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Building the Metagenomics Community Through Annual Meetings

Sponsors

UC San Diego

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454 SEQUENCING

SESSION 1

Genomic and Metagenomic Metadata



Setting the Stage: Mobilizing the Metagenomics Community
John Wooley, UC San Diego; Chair, Metagenomics 2008
Length: 2:49 [video]



CAMERA and Metadata Standards
Iddo Friedberg, CAMERA-Calit2/UC San Diego
Length: 08:14 [video]



GSC and the Minimum Information About a (Meta) Genome Sequence (MIGS) Specification
Dawn Field, Oxford Centre for Ecology and Hydrology
Length: 12:27 [video]

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Prototyping Next Generation User Access and Analysis- Between Calit2 and U Washington

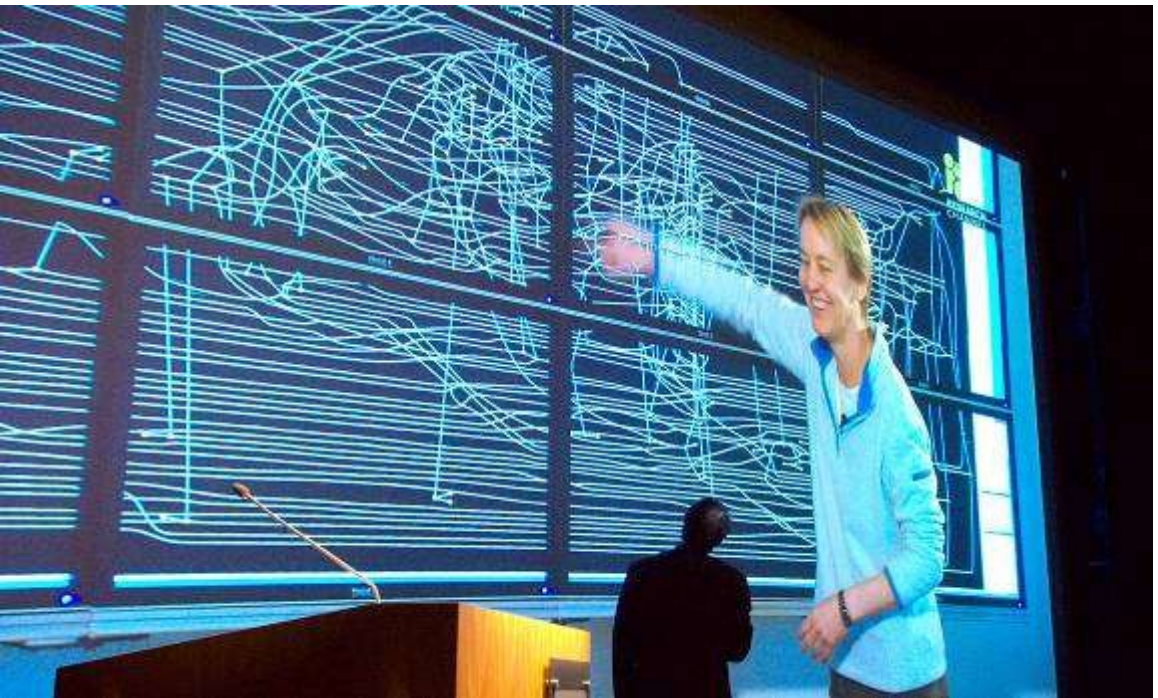


OptIPuter

Ginger Armbrust's Diatoms: Micrographs, Chromosomes, Genetic Assembly

ROCKS





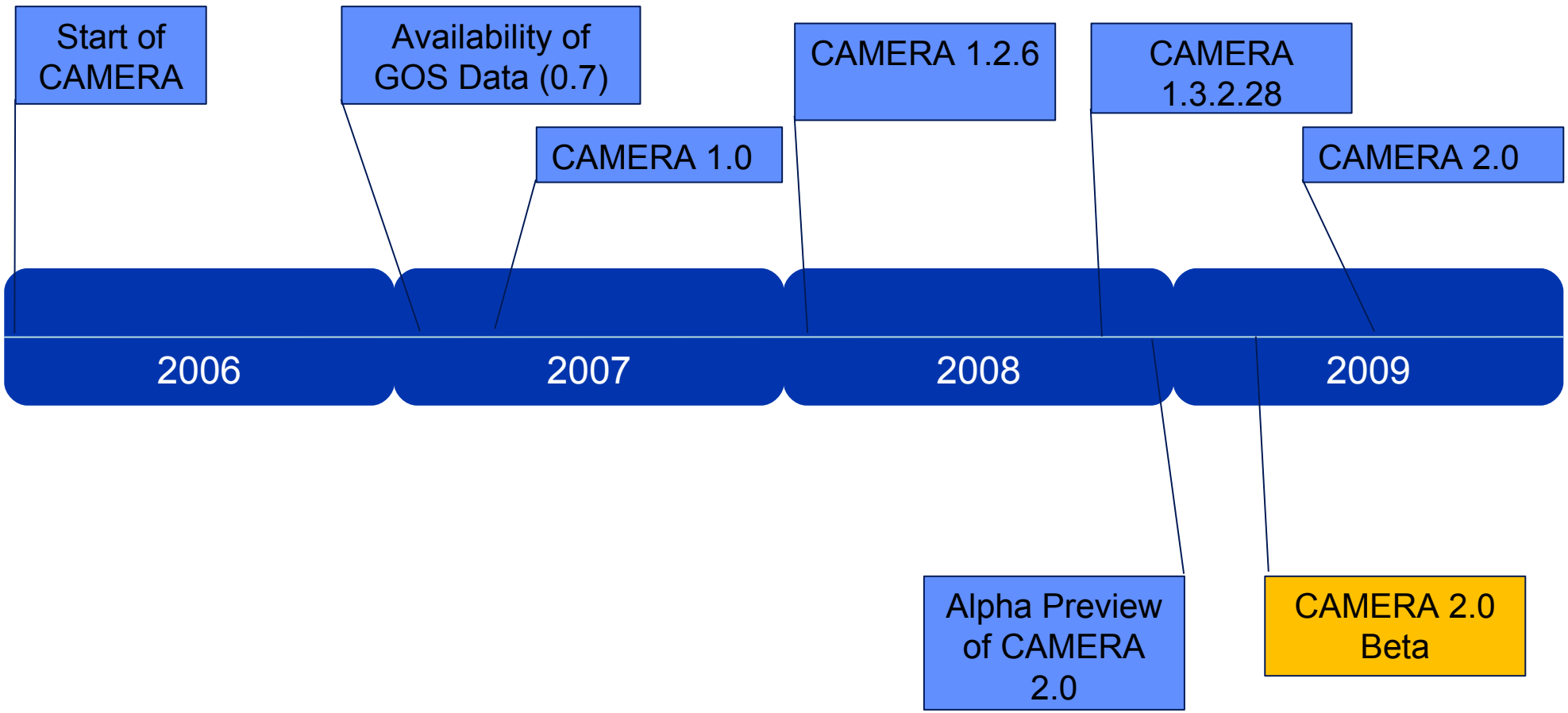
NSF

The Disease is Spreading!

- c.f. Dave Karl, Hawaii
- Ed DeLong, MIT

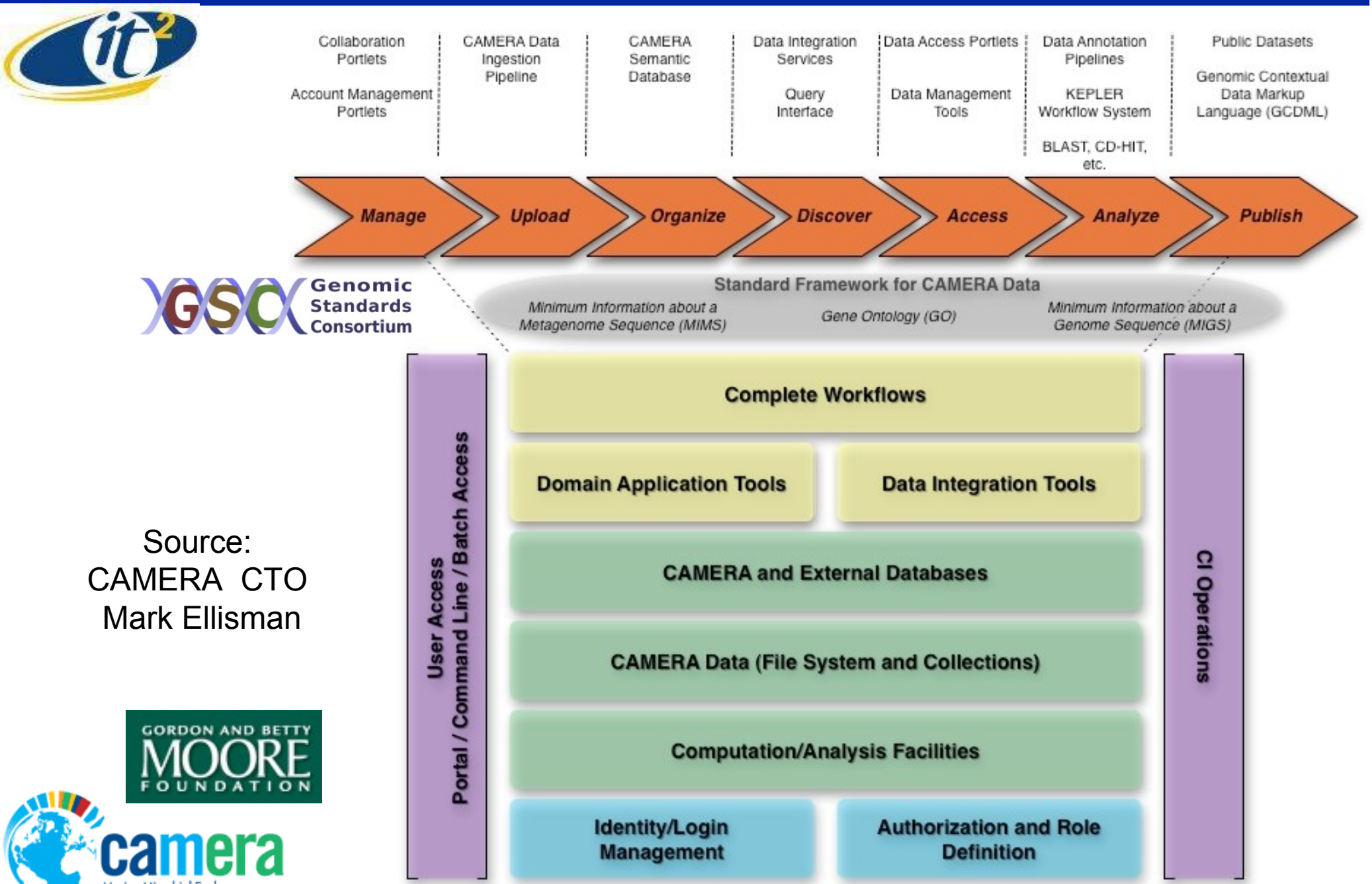
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CAMERA Timeline



Source: Jeff Grethe, NCMIR, CAMERA, UCSD

Calit2 is Creating CAMERA 2.0 --
Advanced Cyberinfrastructure Service Oriented Architecture



Source:
CAMERA CTO
Mark Ellisman

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CAMERA Is a Contributing Member of the Genome Standards Consortium

Source: Paul Gilna, John Wooley, Calit2

- **Standardizing Contextual Metadata**
  - Members from EU, UK, US
- **Goals are to Promote**
  - Standardization of Genomic Descriptions
  - Exchange & Integration of Genomic Data
- **Metadata Standardization Key Enabler**
  - MIMS: Min Info for Metagenomic Sample
  - GCDML: Standard format
- **NSF Research Coordination Network for Genomic Standards Consortium (John Wooley = PI)**
  - Allows Calit2 to Support Genomic and Metagenomic Standards
  - Extends the GSC to Broader Biocommunity
  - Provides Through CAMERA Another Channel for GBMF Investigators and CAMERA to be Central to Community Dialogue

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GSC Genomic Standards Consortium

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GBMF Data Acquisition Pipeline: A New Data Submission Paradigm-Metadata First!

Source: Paul Gilna, Calit2

Solexa and SOLiD Next!

Investigator submits proposal to GBMF

Investigator submits metadata to CAMERA

Metadata now collected *before* sequence data: GSC-compliant

CAMERA sends acknowledgement to Investigator, Seq. Group, GBMF

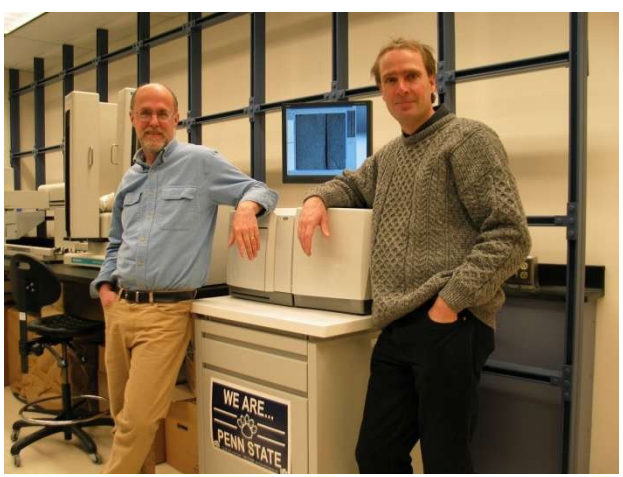
Project-ID serves as acceptance-proof

Seq. Group send barcoded sample "kit" to investigators

Sample is Received and Sequenced

Seq. Group Upload data to CAMERA (& Investigator)

Data & Metadata Released in six months



Webb Miller and Stephan C. Schuster, and Roche / 454 Genome Sequencer