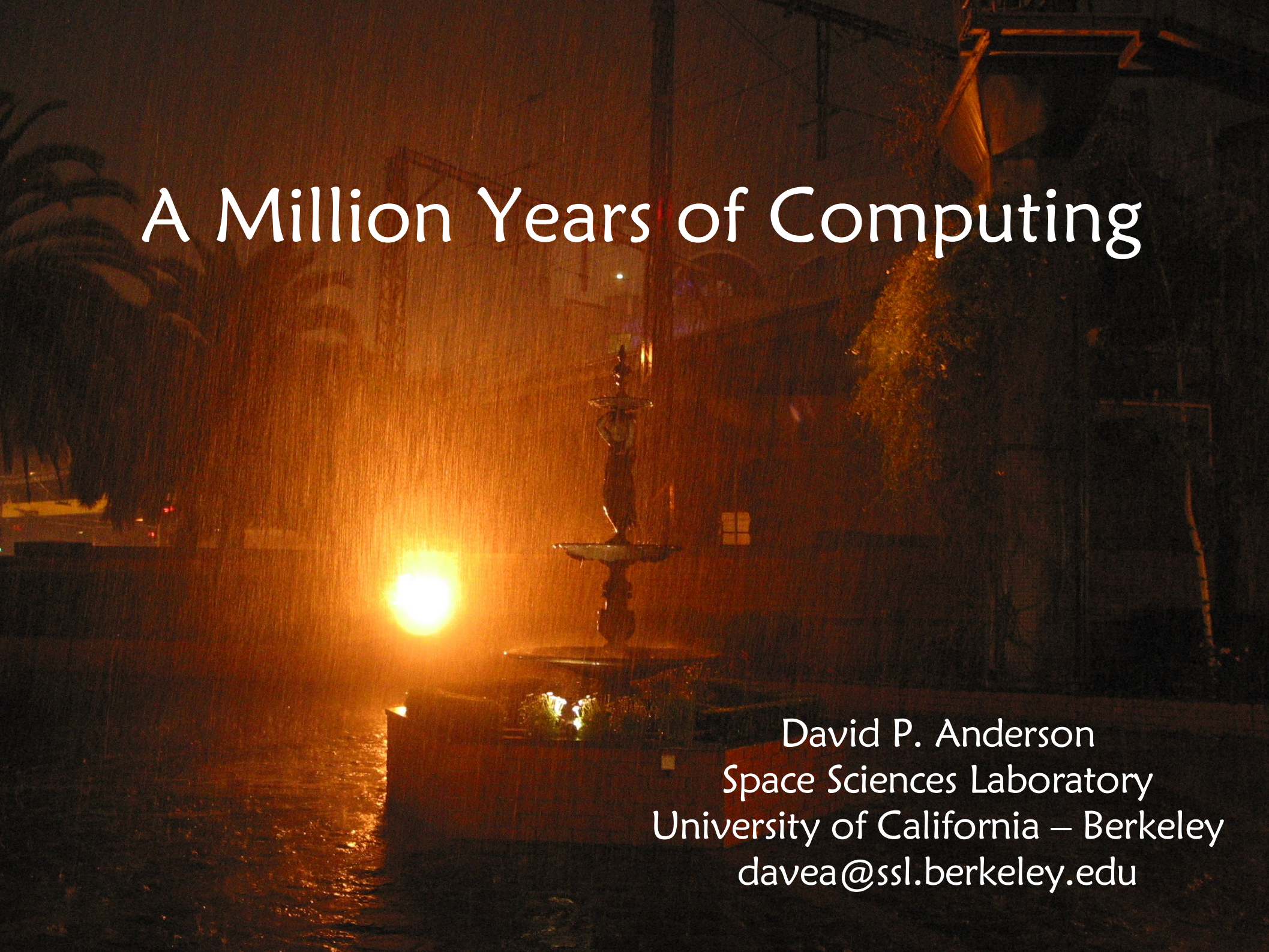


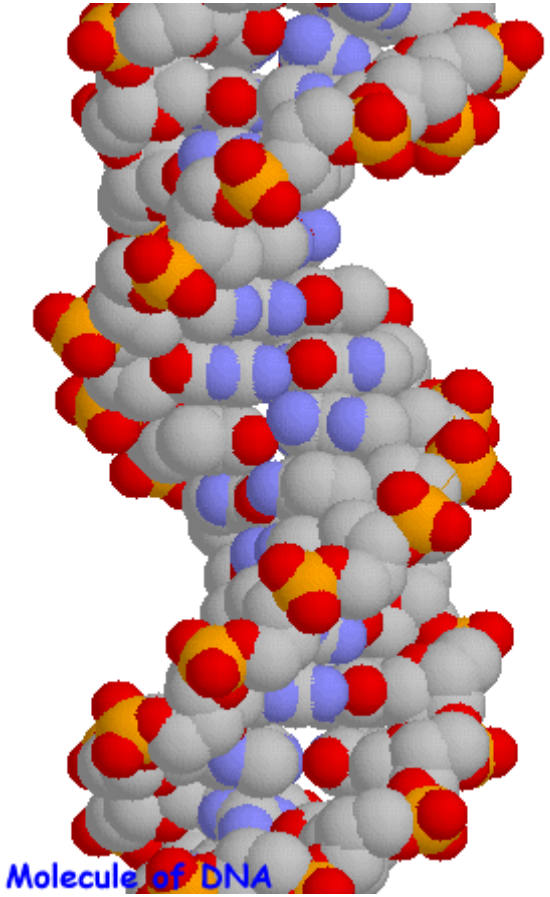
A Million Years of Computing

David P. Anderson
Space Sciences Laboratory
University of California – Berkeley
davea@ssl.berkeley.edu

What is scientific computing?

High-energy physics

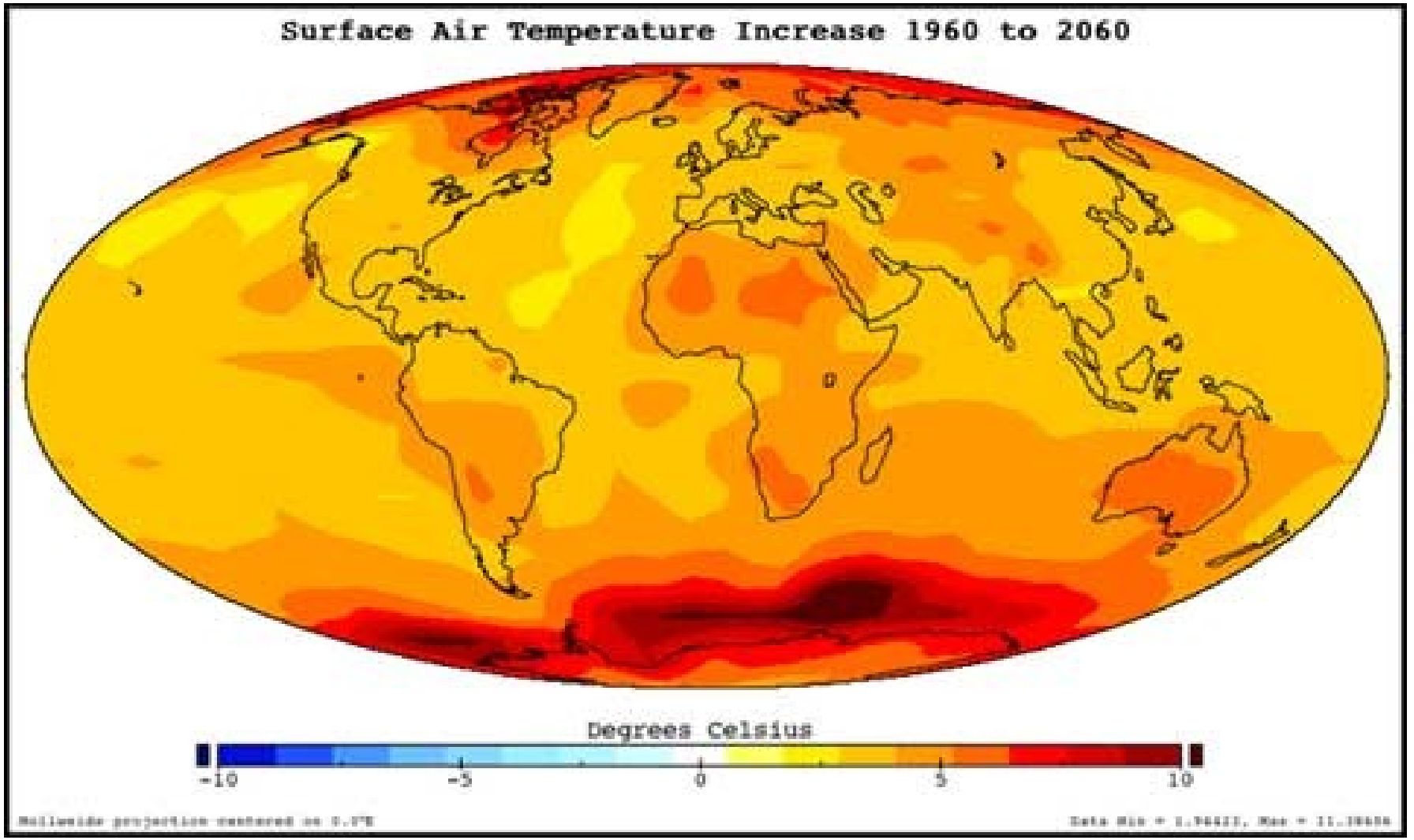
Molecular biology



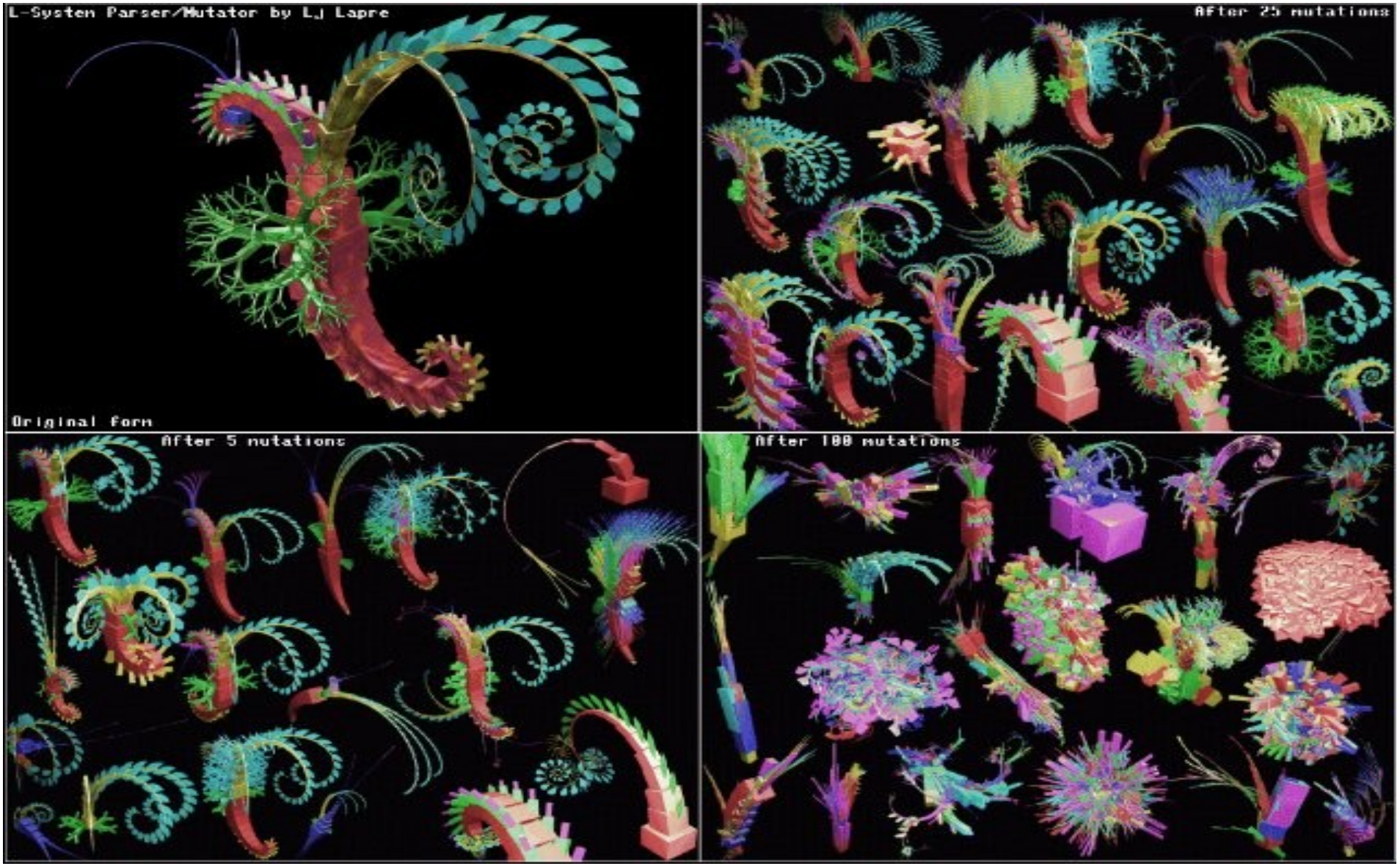
DNA

protein

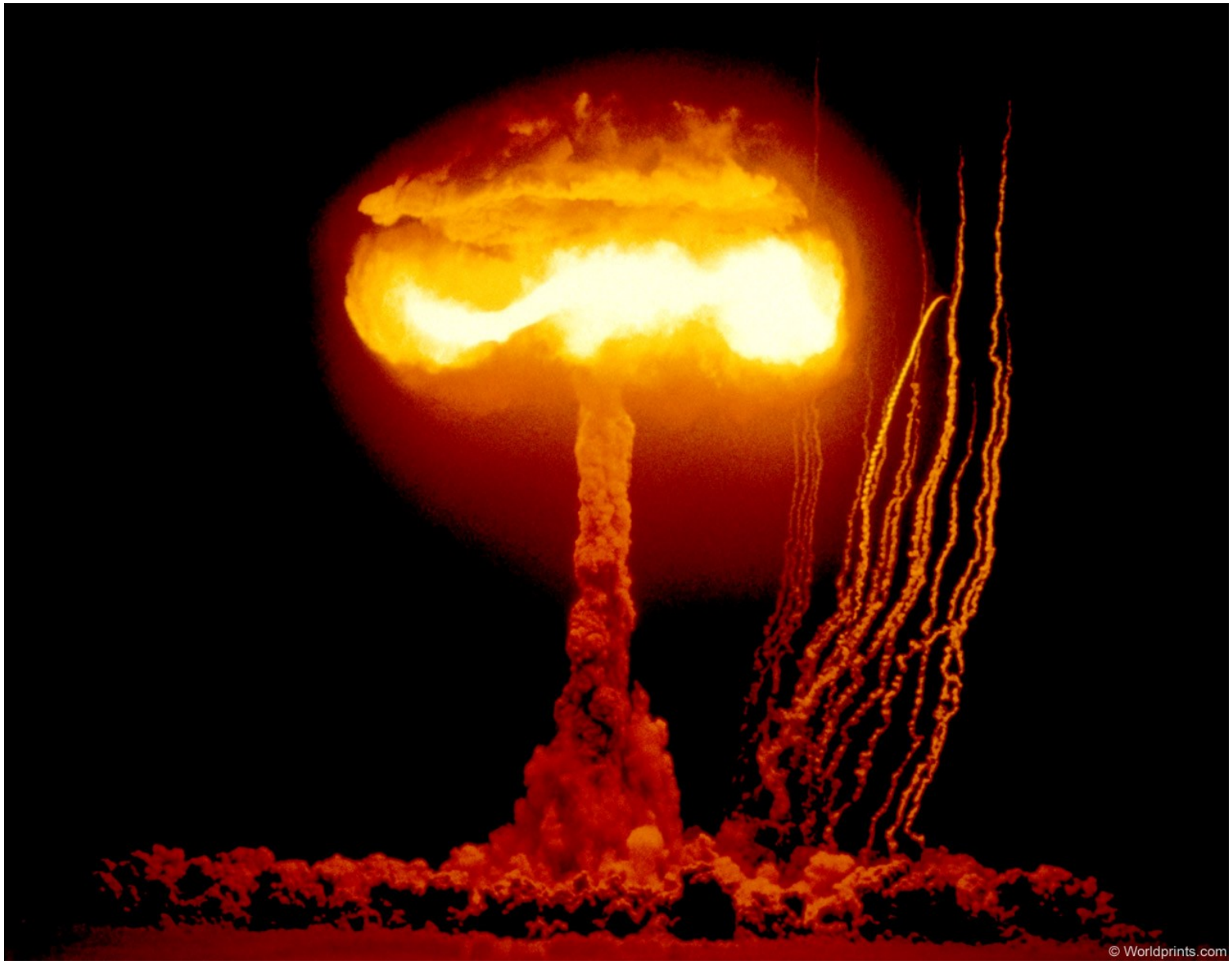
Climate change study



Artificial life



Weapons of mass destruction



Measuring computing power

- FLOPS: floating-point operations per second
  - e.g. 2.458817 + 15.49848 = 17.957297
  - 1 GigaFLOPS = 1 billion (10^9) FLOPS
  - 1 TeraFLOPS = 1 trillion (10^{12}) FLOPS
  - 1 PetaFLOPS = 1 quadrillion (10^{15}) FLOPS
- Storage (memory, disk)
  - 1 byte = 8 bits (e.g. 00100011)
  - Megabytes, Gigabytes etc.

Computing paradigms

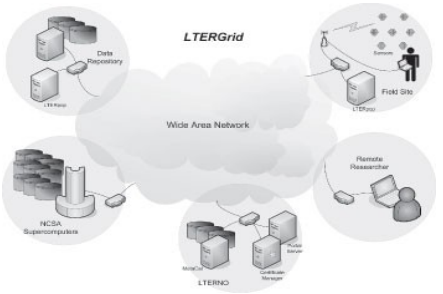
mainframes

supercomputers

personal computers

cluster computing

Grid computing



Volunteer computing

Supercomputer history

1938	Zuse Z1	0.9 FLOPS
1946	ENIAC	50 KFLOPS
1958	UNIVAC LARC	500 KFLOPS
1975	Burroughs ILLIAC IV	150 MFLOPS
1976	Cray-1	250 MFLOPS
1983	Cray X-MP/4	941 MFLOPS
1985	Cray-2/8	3.9 GFLOPS
1993	Thinking Machines	65.5 GFLOPS
1996	Hitachi SR2201	220 GFLOPS
2000	IBM ASCI White	7.2 TFLOPS
2002	NEC Earth Simulator	35 TFLOPS
2006	IBM Blue Gene/L	280 TFLOPS

PCs versus Supercomputers

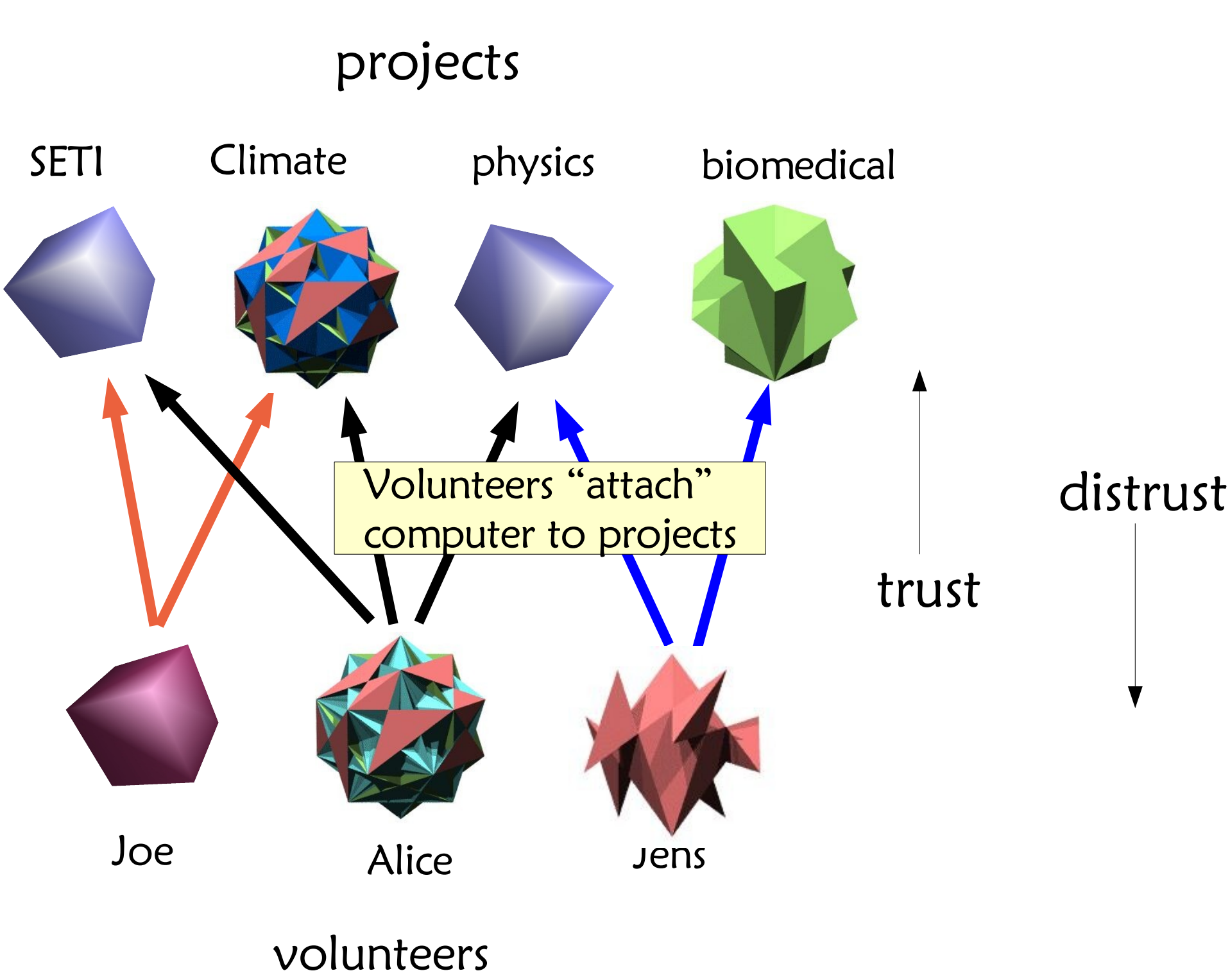
- PCs trail supercomputers by about 20 years
- 100,000 PCs == 1 supercomputer
- There are ~ 1 billion PCs on the Internet
- Consumer products (PCs, game consoles) are getting faster faster
- PC owner buys PC, maintains it, buys electricity
- But: PCs are unreliable and untrusted

Volunteer computing

Project	start	where	area	peak #hosts
GIMPS	1994		math	10,000
distributed.net	1995		cryptography	100,000
SETI@home I	1999	UCB	SETI	600,000
Folding@home	1999	Stanford	biology	200,000
United Devices	2002	commercial	biomedicine	200,000
CPDN	2003	Oxford	climate change	150,000
LHC@home	2004	CERN	physics	60,000
Predictor@home	2004	Scripps	biology	100,000
WCG	2004	commercial	biomedicine	200,000
Einstein@home	2005	LIGO	astrophysics	200,000
SETI@home II	2005	UCB	SETI	850,000
Rosetta@home	2005	U. Wash	biology	100,000
SIMAP	2005	T.U. Munich	bioinformatics	10,000

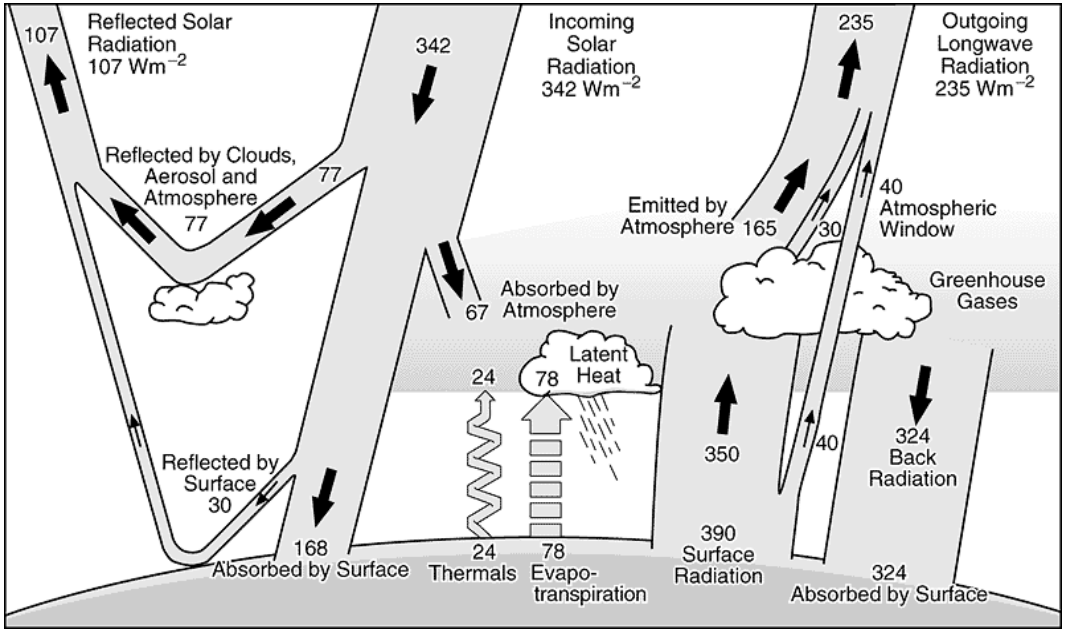
Performance of BOINC projects

- 680,000 participants in 245 countries
- 1,000,000 computers
- 400 TeraFLOPS (more than BlueGene!)
- 12 Petabytes of free disk space
- SETI@home: 2.7 million years of computer time
- But the potential is much larger!

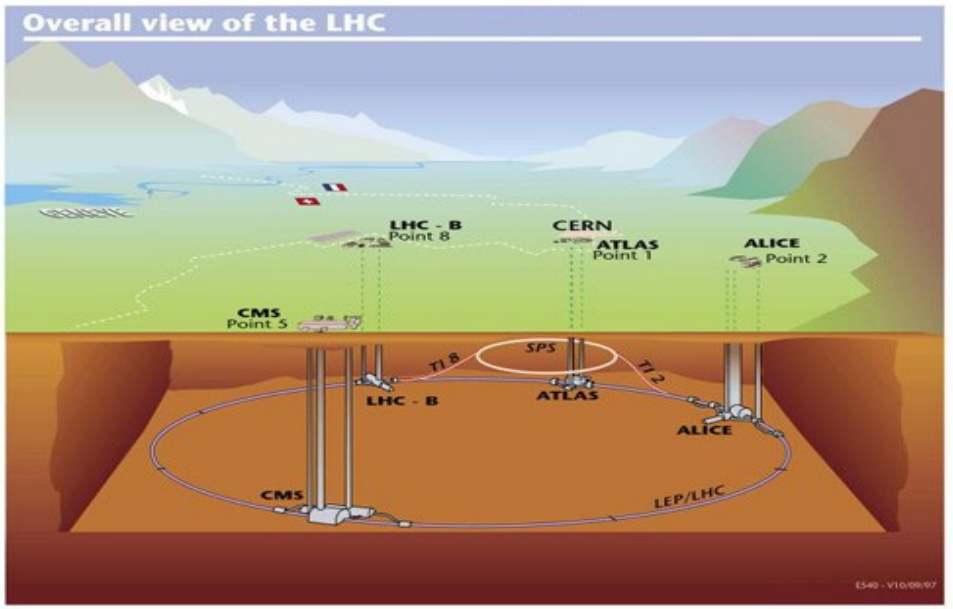

projects
SETI
Climate
physics
biomedical
Volunteers "attach" computer to projects
trust
distrust
Joe
Alice
Jens
volunteers

Some BOINC-based projects

Climateprediction.net
(Oxford University)

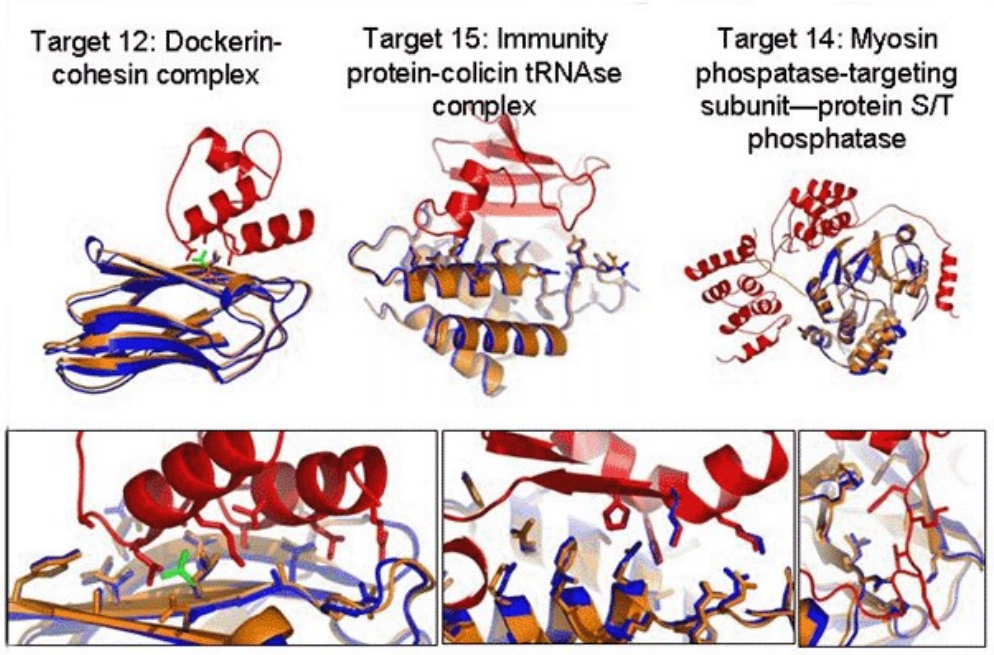


LHC@home
(CERN)



SETI@home
(U.C. Berkeley)

Rosetta@home
(Univ. of Washington)



How to participate

- Install and run BOINC client software
  - http://boinc.berkeley.edu
  - Available for Windows, Mac OS X, Linux
- Enter the URL of a project
  - e.g.: http://setiathome.berkeley.edu
- Enter your email address and password
- Done!

Credit

Leading multi-project participants - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

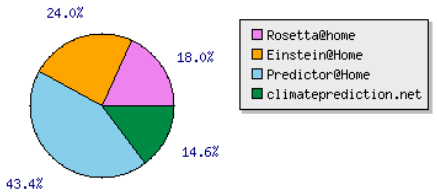
http://boinc.berkeley.edu/chart_list.php

LEADING MULTI-PROJECT PARTICIPANTS

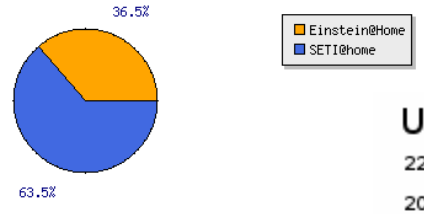
Last modified 5:05 PM UTC, November 05 2005

The following users participate in two or more projects (5% or more of their recent average credit).

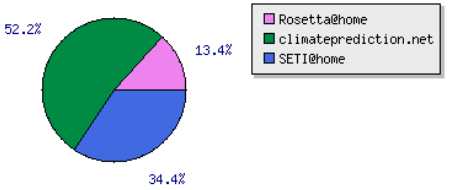
lunarcom
Credit: 24,344/day, 3,783,291 total
Country: Canada
Team: Boinc@Canada



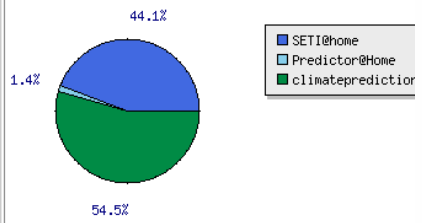
OSU Mechanical Engineering
Credit: 20,594/day, 5,643,548 total
Country: United States
Team: Ohio State University



SETI@QC
Credit: 17,499/day, 2,046,254 total
Country: United States



duemling
Credit: 15,034/day, 5,238,790 total
Country: United States
Team: BroadbandReports.com Team Ecology



Condor
Credit: 11,179/day, 625,376 total
Country: United States
Team: Free-DC

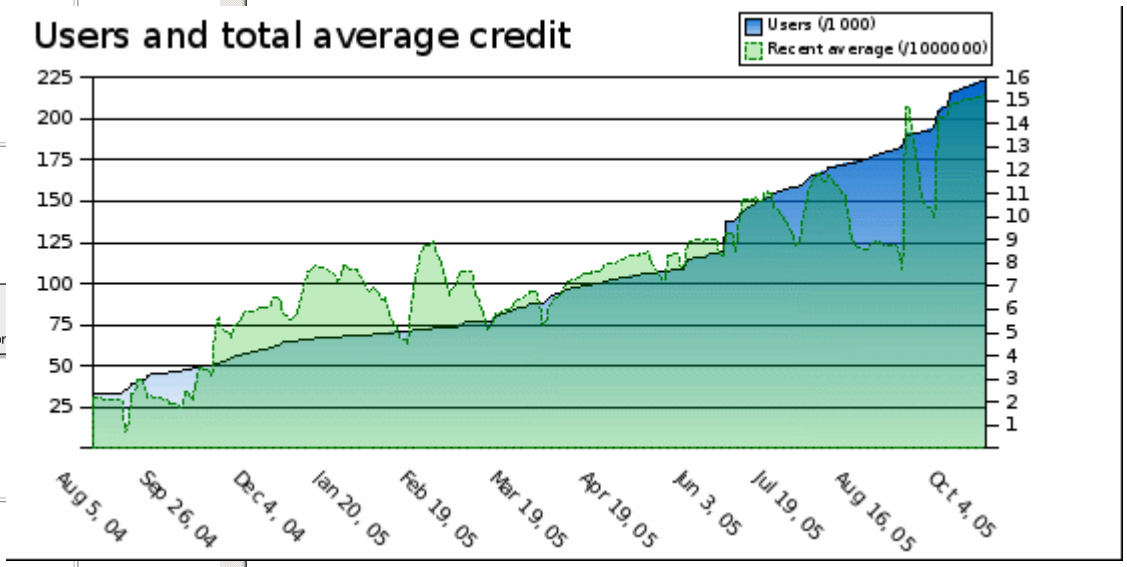
Martin H Burall
Credit: 10,087/day, 1,154,521 total
Country: United States
Team: BOINC Synergy

Done

barbarossa / mithfang

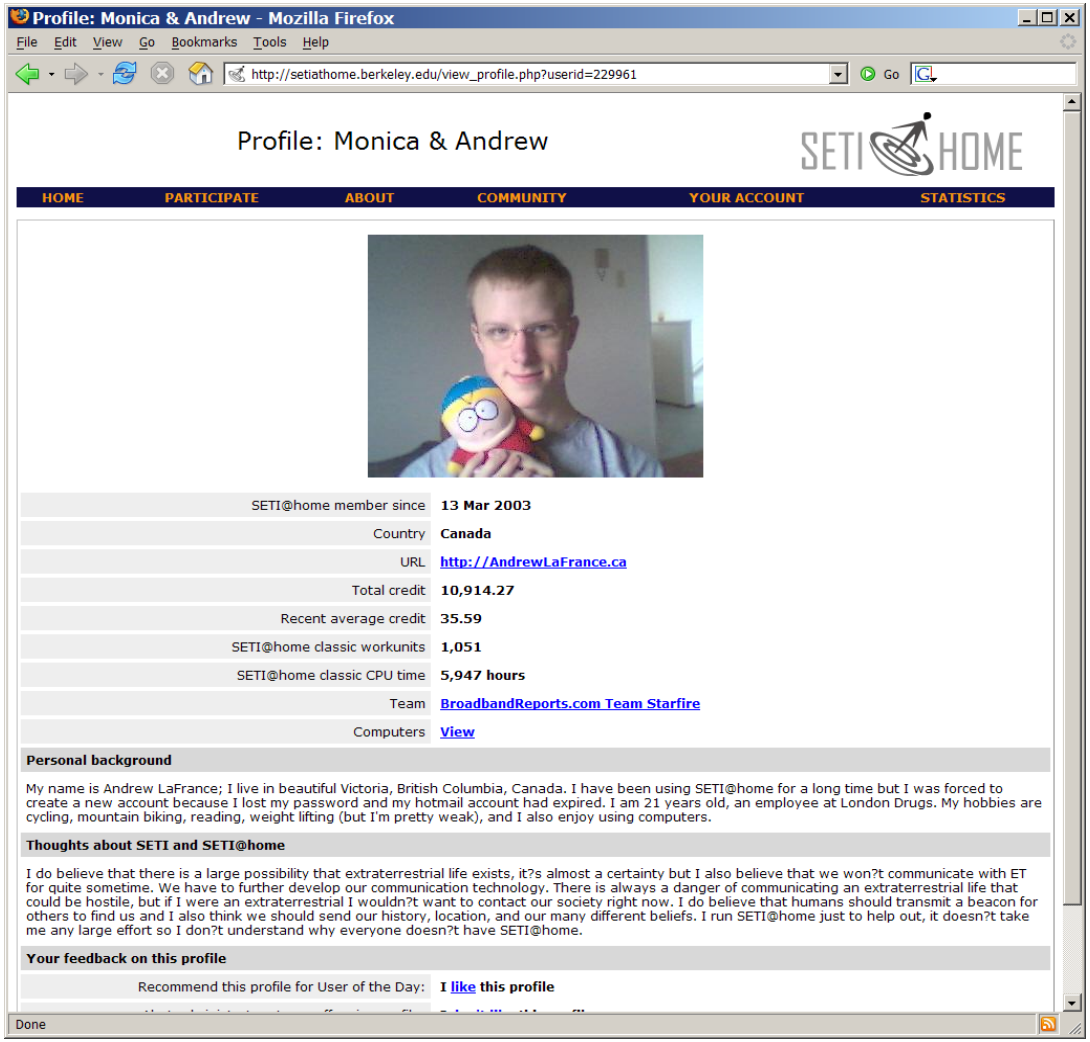
	Credits:	RAC:	Rank:
SETI	215514	1912	2094
CPDN	40926	216	5381
Einstein	25798	236	5399
Rosetta	652	30	3984
BOINC	282892	2396	2235

BOINCSTATS user stats
www.boincstats.com



Community features

- Message boards
  - Science, technical, social
- User profiles
- Teams
- Translations
- Web sites
  - (statistics, teams)



Account managers

GridRepublic

Conclusion

- Scientific computing
  - Will always need more computing power
- Volunteer computing
  - The computing paradigm of the future
- BOINC
  - Middleware for volunteer computing
- Goals
  - 1000+ projects
  - 10 million volunteers
  - Give the public a voice in science research policy