Advanced Collaboration and the Access Grid

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URL: www.cs.dal.ca/ddrive

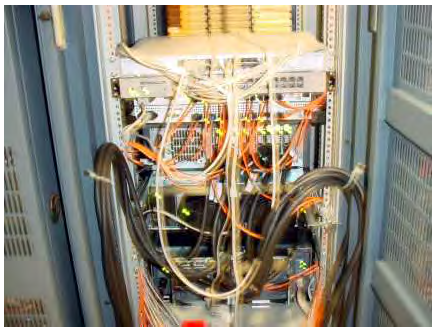
DALHOUSIE University

Advanced Collaboration and the AccessGrid

1. **Introduction**
2. **CEIC—what it is and what it does**
   - Best Practice Statements
   - The WDML
   - The FWDM
3. **The Access Grid, WestGrid and the Future**
   - What they are
   - A slide show
4. **Advanced Collaboration Environments**
   - What they are
   - A slide show

ENIAC (1948)

32 SGI cpu's



SFU fast interconnect

The Access Grid

SFU's `Top500' cluster

Introduction

This presentation is largely pictorial and starts with:

Greetings from Canada

and

Thanks to Alf van der Poorten for agreeing to speechify for me

We advertise 3 CEIC initiatives briefly first and then turn to the main show.

SGI Delivers the Most Powerful Collaborative Visualization Available with Visual Area Networking

Raising the bar again, SGI has increased the performance and interactivity available to remote users and multi-user collaborative teams, enabling them to visually analyze complex data sets and reach decisions faster than ever before.

The combination of OpenGL Vizserver 3.3 with Onyx4 and the new Scalable Graphics Capture card can now deliver full screen visual results to remote clients at up to 30 frames per second, with some scientific visualization and engineering analysis applications able to achieve as high as 60 frames per second for full screen results.

SGI Delivers the Most Powerful Collaborative Visualization Available with Visual Area Networking

Illustrating the benefits of OpenGL Vizserver 3.3 with Onyx4, is WestGrid, a $48 million grid computing infrastructure project that provides high performance computing, networking, and collaboration tools to seven institutions in western Canada. WestGrid is dramatically advancing the visualization capability delivered to the researcher's desktop using an 8-pipe Silicon Graphics Onyx4 as a VAN server at Simon Fraser University, in Vancouver, B.C.

"We are excited by the level of visualization capability this allows us to deliver to the desktop of our computational community," explains Brian Corrie, collaboration and visualization coordinator for WestGrid. "We are able to deliver very data-intensive interactive, collaborative visualizations between researchers in Vancouver, Edmonton, Calgary, Lethbridge, and Banff—a distance of more than 800 km." (May 20)

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The CEIC's work on

Best Practice Statements

MathNet Pages

and

IMU on the Web

IMU

IMU on the Web

- Home
- General
- People
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About the Math-Net Page

Communications and Information from the CEIC

Prior postings: #1, #2

Also known as **imu on the web**, these columns will appear in each **IMU-Net** newsletter and will be accompanied by additional commentary and links. Some will be invited signed opinions and some will come from the CEIC itself. They intend to stimulate interest in and debate about electronic matters. Our first piece, written by the CEIC, is on the vexing problem of Journal pricing.

IMU ON THE WEB #1: WHAT CAN YOU DO ABOUT JOURNAL PRICES?

The IMU Committee on Electronic Information and Communication

Home
About WDML
Digital Math Library
Digitization Projects
Registry
Publications
Contact Us

WDML News

Update on Metadata Standards

In order to create links from the two major reviewing databases to digitized articles, Mathematical Reviews and Zentralblatt have recommended some standards that would allow projects to transfer information simply. An explanation of these standards and their purpose can be found in a new release of the standards called **Simple Metadata**.

Upcoming Event

New Developments in Electronic Publishing of Mathematics, a workshop integrating mathematicians, libraries, editors and publishers will be held in conjunction with the 5th EMANI workshop and the 3rd WDML workshop on June 25 to 27, 2004 in Stockholm, Sweden.

Communications and Information from the CEIC

IMU on the Web is a column that will appear in each IMU-Net newsletter and will be accompanied by additional commentary and links.

Dalhousie Distributed Research Institute and Virtual Environment

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News
Seminars
Research Team
Technologies
Partners
FWDM
Contact Us

Federated World Directory of Mathematicians

Federated searching is a system that provides a common user interface for searching and retrieving information across heterogeneous datasets over the Internet.

Preamble

In 1998 the CEIC was asked to explore the feasibility of an electronic World Directory of Mathematicians to replace the traditional hard copy. The CEIC concluded that intellectual property and privacy issues in different countries made this, while desirable, impossible for the 2002 edition of the WDM. With the emergence of better Internet search tools, we now believe it is realistic to build a federated directory, as defined above. What this provides is a rapid and simple search over existing online databases with no additional work for the user.

Current Directory

- **Electronic World Directory of Mathematicians**

Potential Groups

- **American Mathematical Society**

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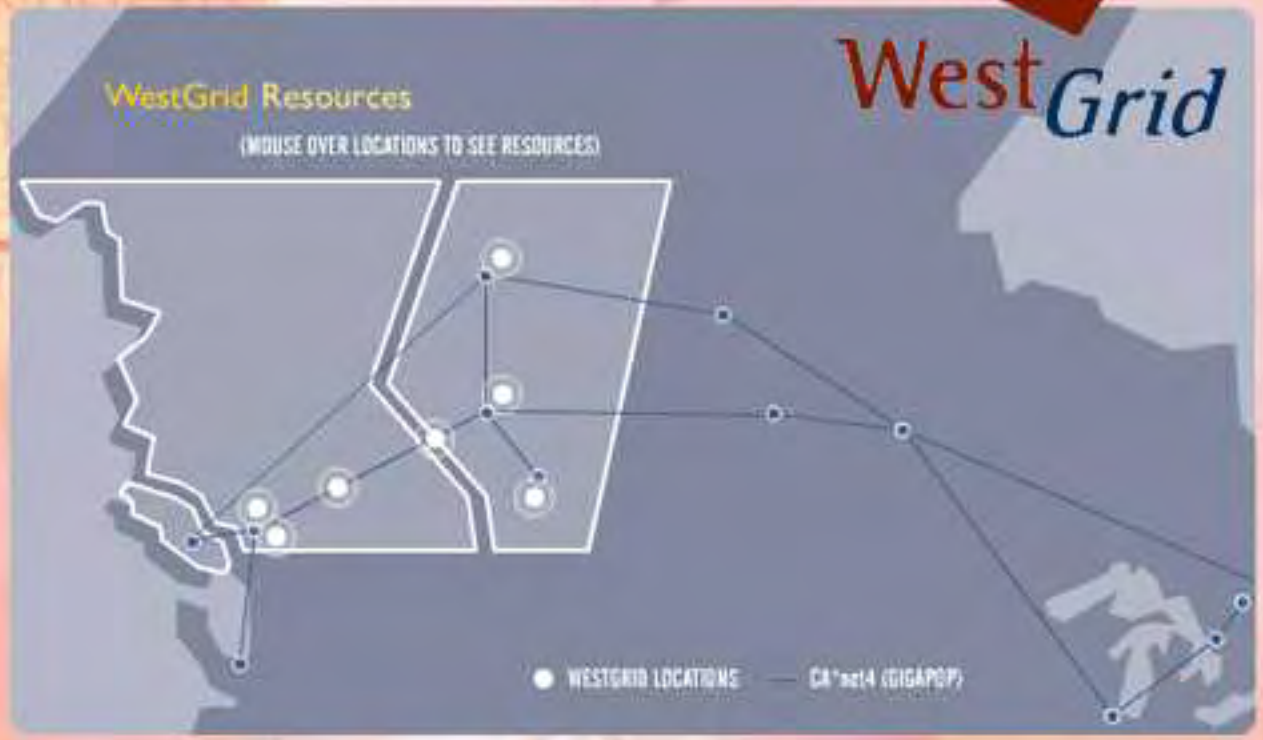
PART I

Grid Computing



C3.ca

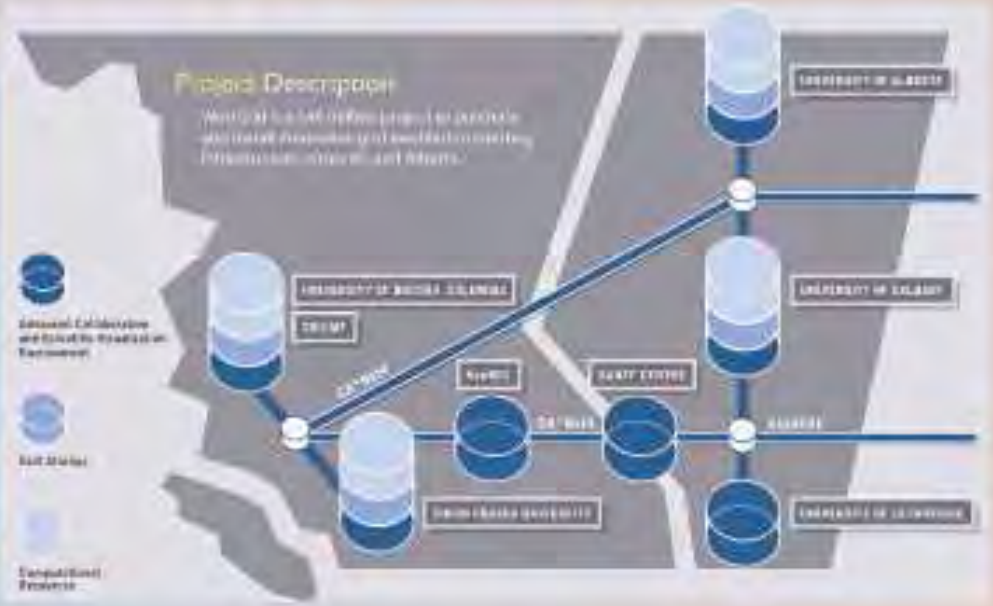
www.westgrid.ca

What is WestGrid?

PROJECT SUMMARY

WestGrid is a $48 million project to acquire and install grid-enabled computational, data storage and collaboration facilities at 8 institutions, including:

- New MIC
- Simon Fraser University
- The Banff Centre
- TRIUMF
- University of Alberta
- University of British Columbia
- University of Calgary
- University of Lethbridge



Five co-principal investigators lead the project (Jonathan Borwein, Grenfell Patey, Jonathan Schaeffer, Brian Unger, Michel Vetterli) with the involvement of over 250 researchers and users, a chief technology officer, distributed systems architect, technical support staff at partner institutions, Netera Alliance, BCNET and CANARIE.

Components

1. UofA: Large shared memory computer:
SGI Origin 256 processor system for shared-memory parallel computing, plus a 5 Terabyte disk storage system and 10 Terabytes of tape storage.

2. UofC: Cluster of Multi-Processors (CluMP):
HP SC45 144 processors for message passing parallel computing, plus a 5 Terabyte disk storage system. "Genematcher2" genome sequence analyzer.

3. UBC/TRIUMF: Large commodity Linux farm:
1008 processor IBM blade cluster for naturally parallel computing jobs, plus a 10 Terabyte disk and 70 Terabyte tape storage facility.

4. SFU: Network storage:
A scalable network storage facility consisting initially of 24 Terabytes of disk and 135 Terabytes of tape silo capacity.

5. Collaboration and Visualization facilities:
Video conferencing and document sharing capabilities, built on the Access Grid technology, enhanced with visualization, virtual reality and other enhanced collaborative facilities.

6. Grid services:
Grid computing tools will form an integral part of WestGrid.

Funding

Funding and other support has been provided by:

- Alberta Innovation and Science
- BC Knowledge Development Fund
- Canada Foundation for Innovation
- Hewlett Packard
- IBM
- SGI

- BCNET
- CANARIE
- Netera Alliance

- NewMIC
- Simon Fraser University
- The Banff Centre
- TRIUMF
- University of Alberta
- University of British Columbia
- University of Calgary
- University of Lethbridge

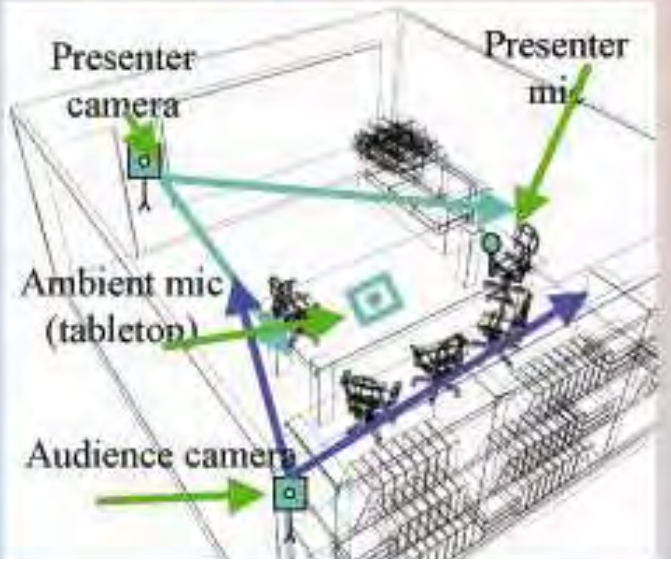
WestGrid Governance and Management

WestGrid Capital Budget: 2003-2005

Revenues	
CFI (Federal)	11,990,839
ASRIP (Alberta Gov't)	5,795,420
BCKDF (BC Gov't)	5,711,591
HP (in-kind)	7,167,218
IBM (in-kind)	5,524,174
SGI (in-kind)	7,224,457
Other private sector	1,030,517
Institutions	384,453
TOTAL:	44,828,669

Access Grid Collaboration

- 180 AG nodes worldwide
- State-or-the-art SGI visualization server (SFU)
- WestGrid will add scientific visualization and virtual reality
- SFU GridRoom in Collaboratory
- 2nd Gridroom coming



Annual User Requirements

- **Annually** - users are expected to complete a CFI "Impact Report" via an on-line web form.
- **Ongoing** - users are expected to acknowledge WestGrid in publications facilitated by use of WestGrid resources.
- **Publications -** when updating project descriptions, users are requested to provide references for the above publications that acknowledge the support of WestGrid resources.

Initial Network

- HPC/storage sites connected by layer-2, gigabit-per-second network
  - Network appears as a local subnet at SFU, UBC, UofC and UofA
- Uses components provided by BCNet, CANARIE, Netera and the local sites
- Lethbridge and Banff connected via NeteraNet

WestGrid

Initial HPC Resources

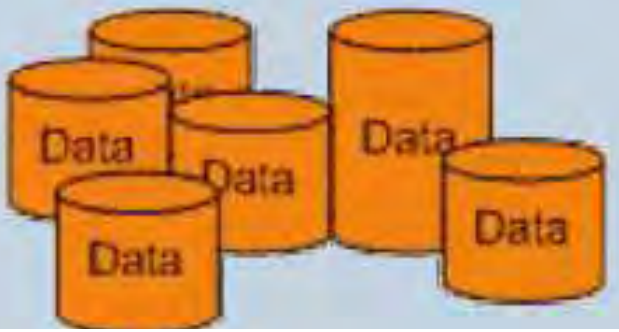
- 1008 processor IBM (Xeon) blade cluster
- 256 processor SGI Origin 3900
- 144 processor HP AlphaServer-SC45
- 28000 processor Parasol Genematcher-II

Also access to:

- 160 processor HP Alpha Cluster
- 192 processor AMD Athlon Cluster
- 236 processors in SGI Origin servers

Initial storage resources

- Central storage site (IBM)
  - 24TB of disk, 135TB of tape
  - Will be expanded as needed
- Local storage
  - Total of over 30TB disk, 30TB tape distributed between 4 campuses



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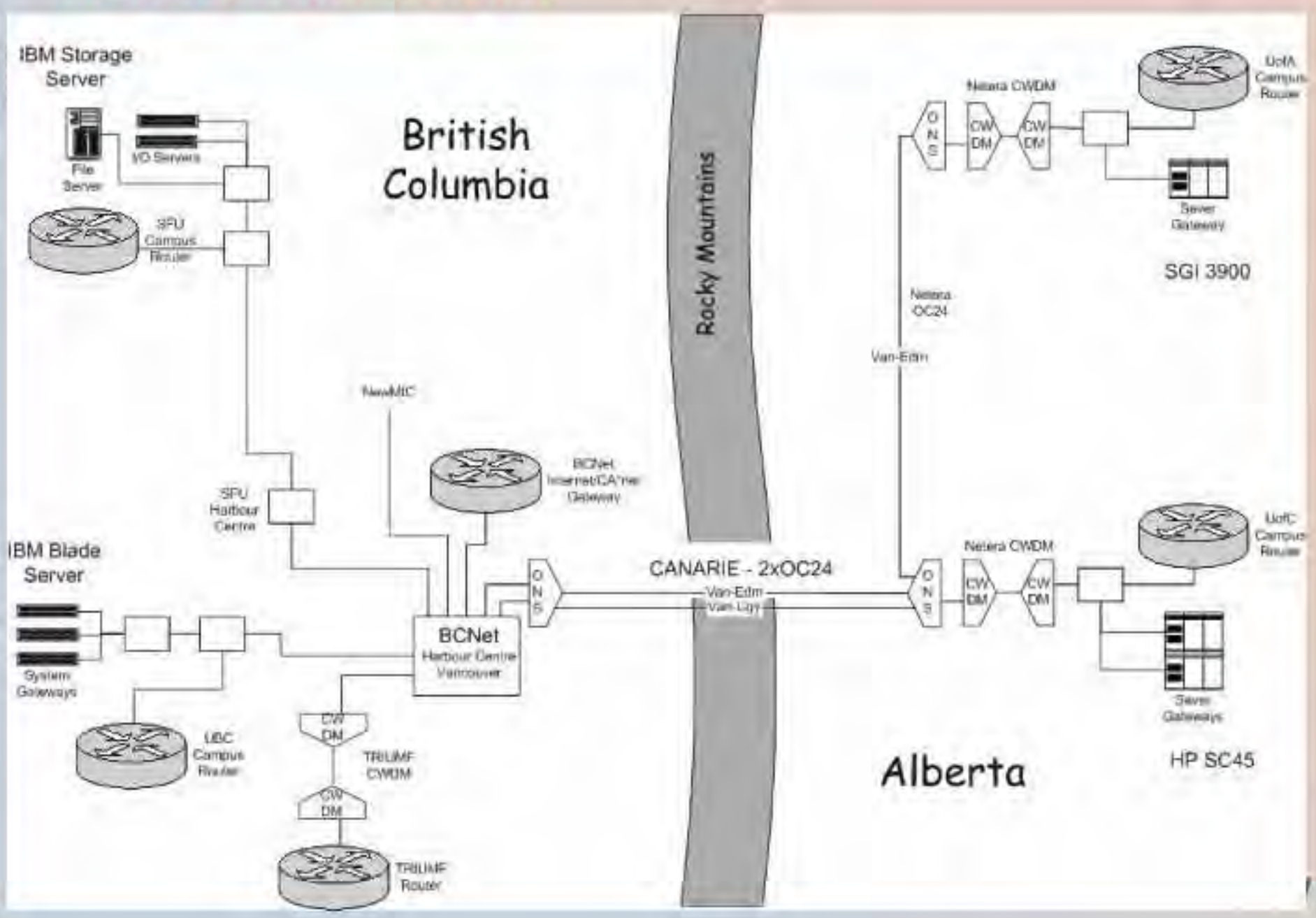
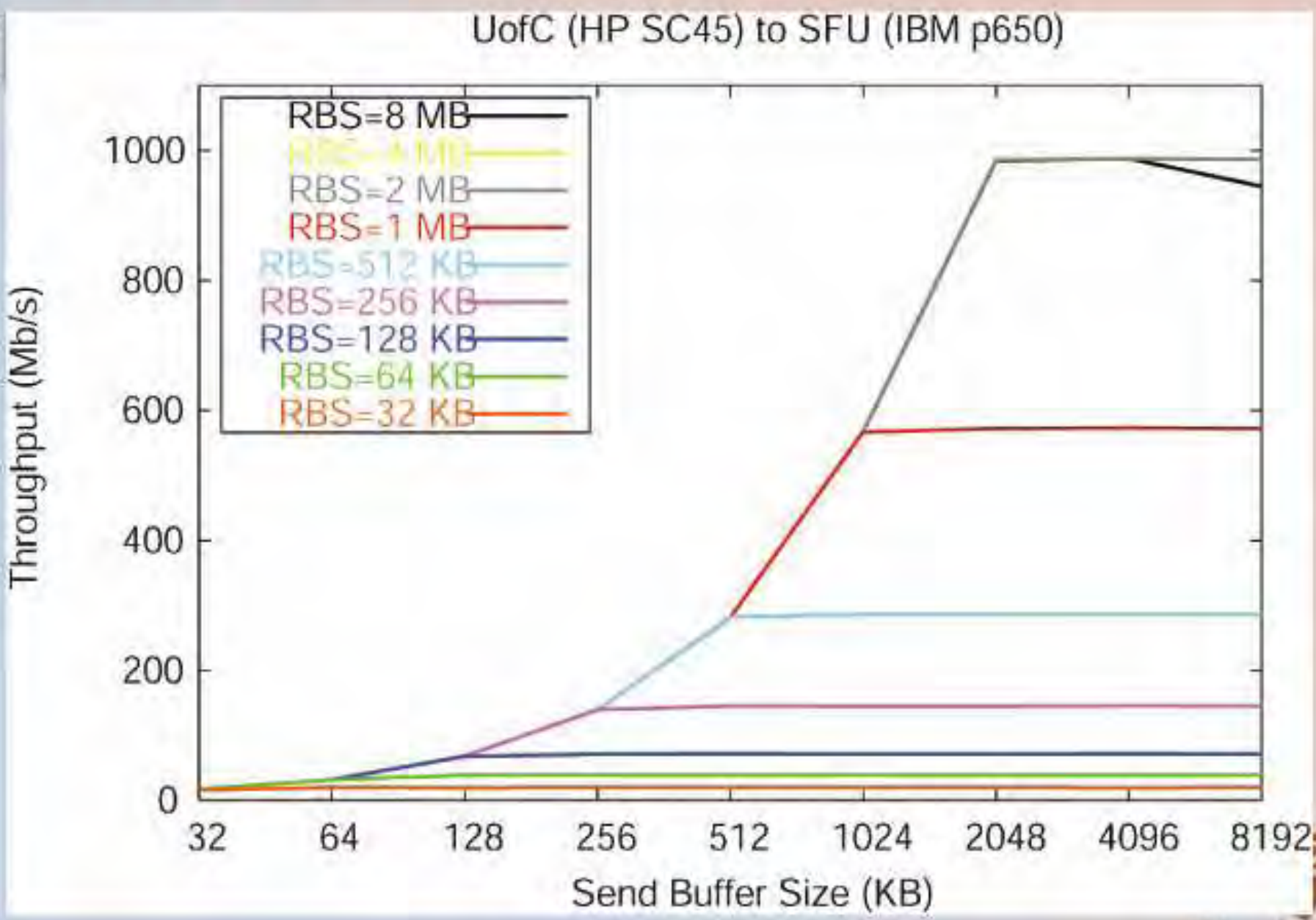
WestGrid-Core network



Network performance – UofC to SFU



Grid Computing

- Grid services provide interoperability between resources in different management domains
- Global user namespace using Certificate Authority (CA) model
  - each CA is unique (signing key is unique)
  - each CA issues unique DNs to users
- Grid user is mapped to local user on "Grid enabled" resource
- Grid use is all about trust - and developing technologies to ensure trusting environments
- Many Grid tools are still rudimentary. Much more research still remains to be done.

WestGrid "Grid philosophy"

- Promote use of Grid technologies to users/projects that can benefit from them
- Encourage use of "robust" Grid tools in place of traditional alternatives
- Don't impose the use of Grid technologies on users that don't need them, or that already have good solutions that are not Grid enabled

WestGrid needs world class scientific discovery; we don't want to get in the way of this

Grid Components

Basic services:

- Security/authentication service
- Remote job starting service
- Information discovery service
- Data movement service

High level systems/services:

- Meta-scheduling
- Repository management tools

AG and Advanced Collaborative Environments

- The Access Grid (AG) is a "voice, image etc over IP" collaboration technology which offers a uniquely cost effective and high-quality experience for users and participants of collaborations---each site being different.

- It is described on the Argonne access grid website as "an ensemble of resources including multimedia large-format displays, presentation and interactive environments, and interfaces to Grid middleware and to visualization environments."

Access Grid and ACE's

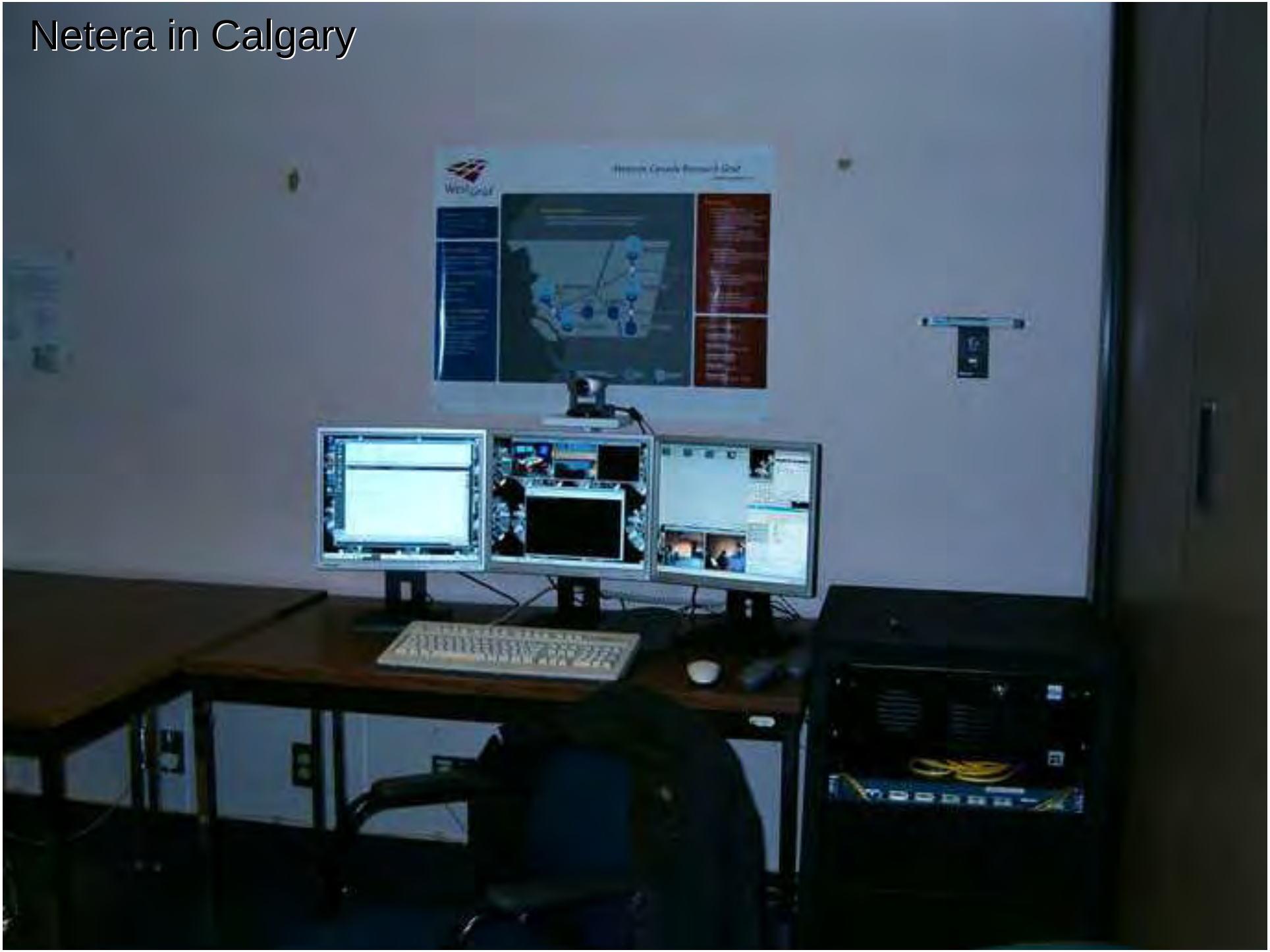
- AG technology is used at over 180 sites worldwide for activities such as very large distributed meeting, lectures, seminars, and other interactive collaborative tasks.

- WestGrid is utilizing the Access Grid as an enabling technology to provide collaborative resources to all 7 (soon 12) WestGrid sites.

- Leveraging AG's capabilities and integrating visualization tools and other services, AG is a base for scientific visualization and for research into new collaborative technologies.


U of L PE 256
SFU - Colab
Pierre Boulanger
SFU - Colab
University of Alberta
The AG in Action
in CoLab
westgrid...
UBC - MAGIC
Netera AG

Netera in Calgary




Lethbridge Alberta


UBC Magic Lab


University
of Calgary

Simon Fraser Colab

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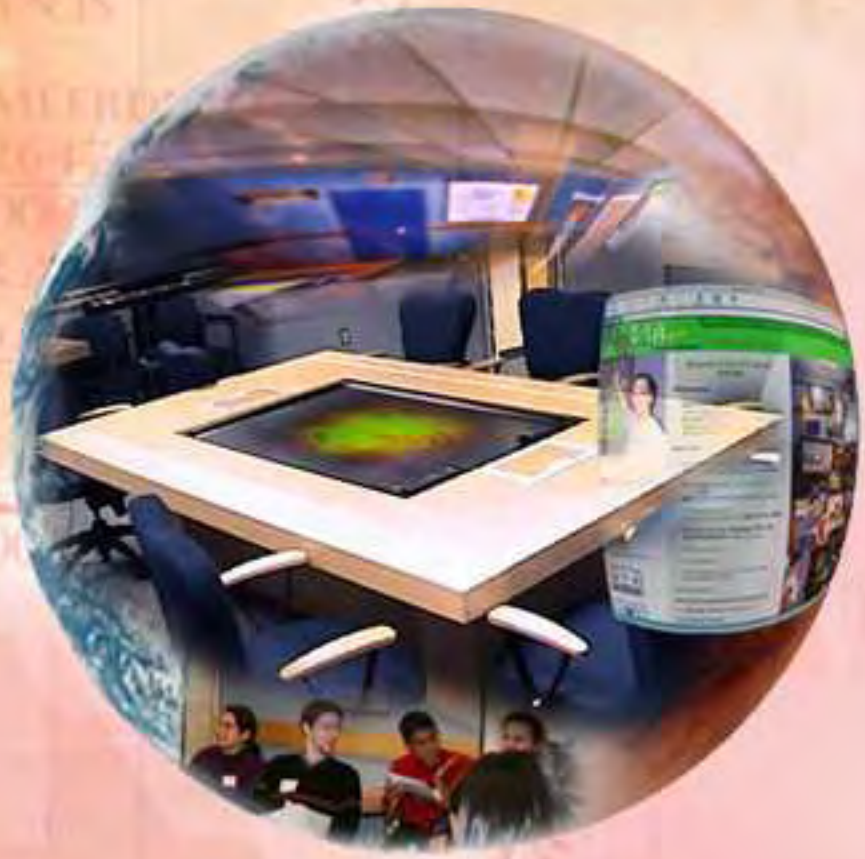
PART II

SFU CoLab



www.colab.sfu.ca

SFU CoLab

One of six or so such "smart" i-rooms or ACE's; with focus on

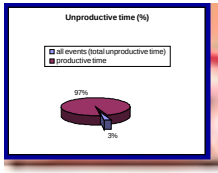
- mathematical science and computational science
- science education and advanced publishing

Built to facilitate and study face-face and distant collaboration

- heterogeneous, synchronous and asynchronous

Cost of about 750K but a Grid Station or Grid Room

- with commodity components can be built for 5K, 50K etc.



HCI Study

Tools of CoLab

Four 50" plasma screens and one 72" back projected screen

- two conventional smart white boards
- one plasma in table, one "portable"– can be tiled variously
  - all touch sensitive (soon optically)
  - can be written on and captured

Connects to a 192 cpu Beowulf and 32 cpu COMPAQ alpha

- "top 500" machine in June 2002 (for $250K)
- run directly out of Maple or Matlab

All sorts of (research) HCI issues – some anticipated

- prototype for IRMACS and for WestGrid

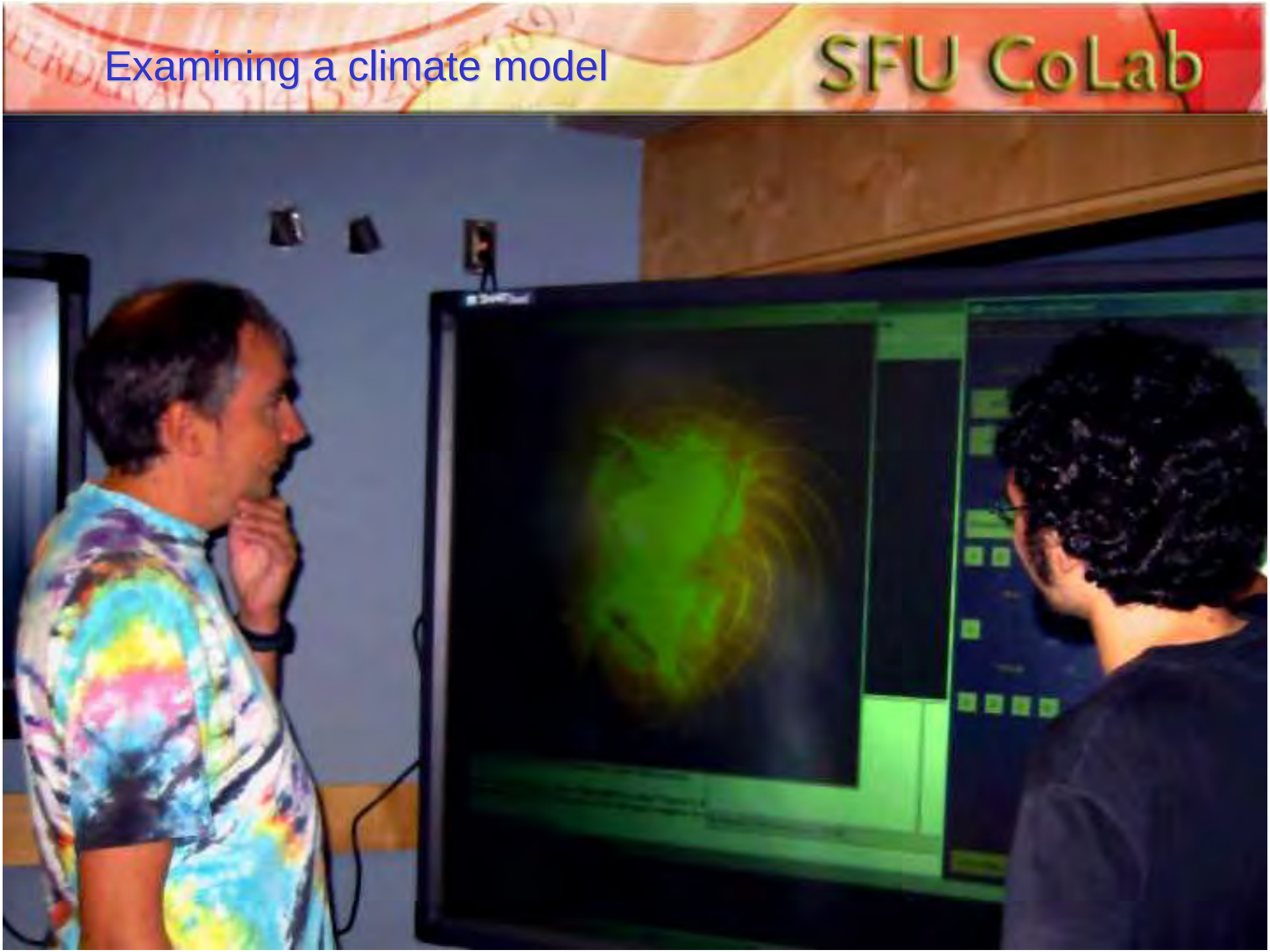

CoLab
empowering collaboration
SFU CoLab


SFU CoLab

A Grade 4 math class


SFU CoLab

Examining a climate model



A typical use

Steve Wolfram in a new kind of lab

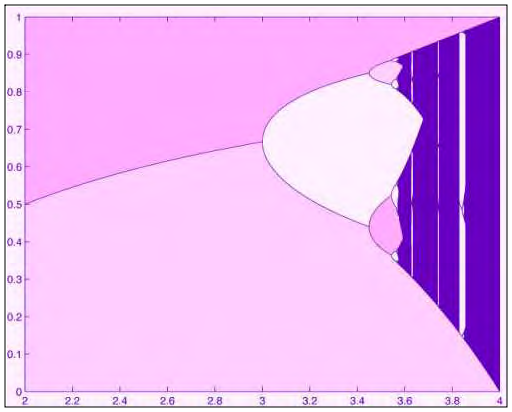
SFU CoLab

JMB

Users of CoLab

All levels and many disciplines (can squeeze in 30 users)

- Grade four through "infinity"
  - Naïve and sophisticated
  - Peer-to-peer and one-many

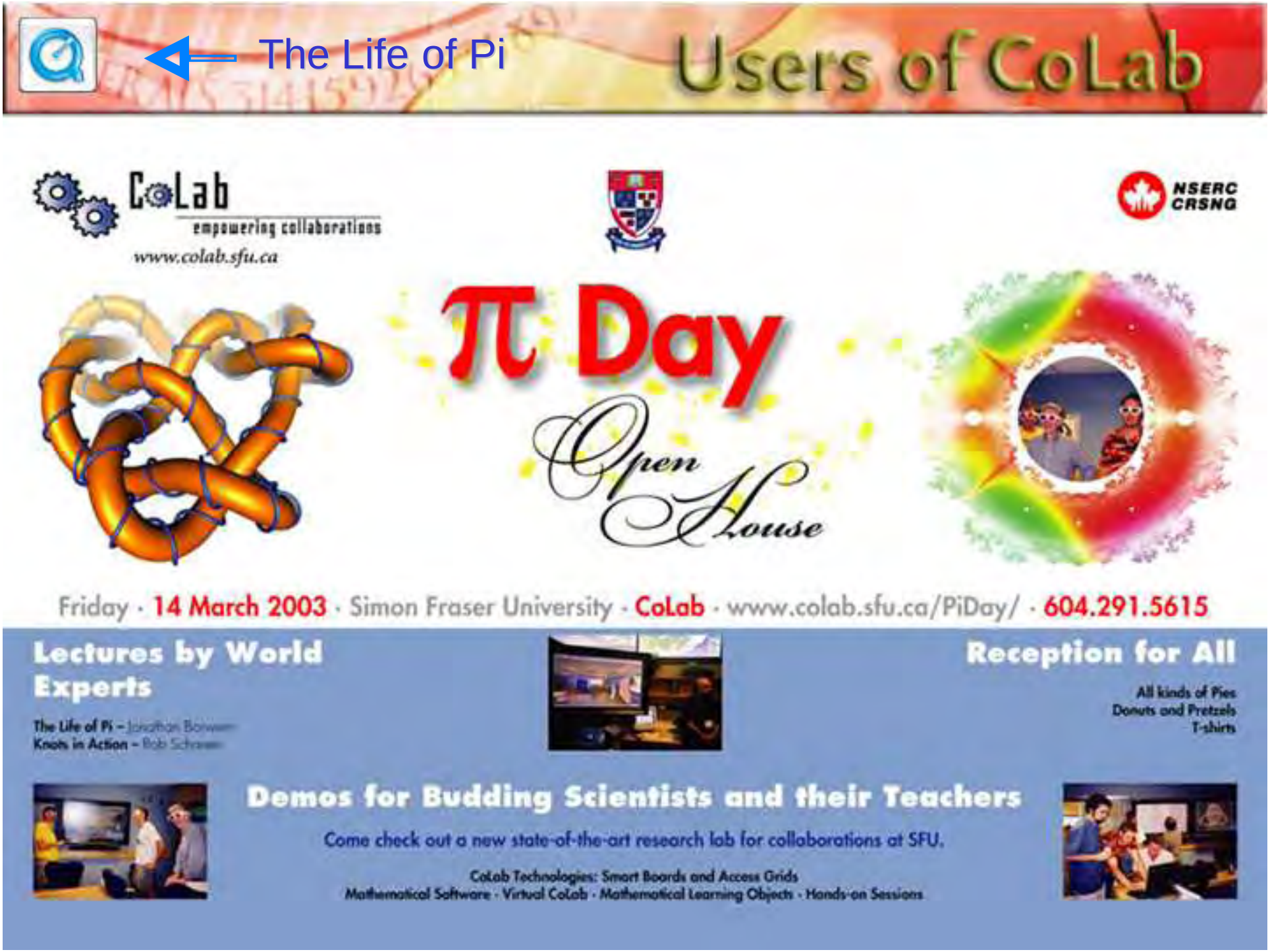


Many uses

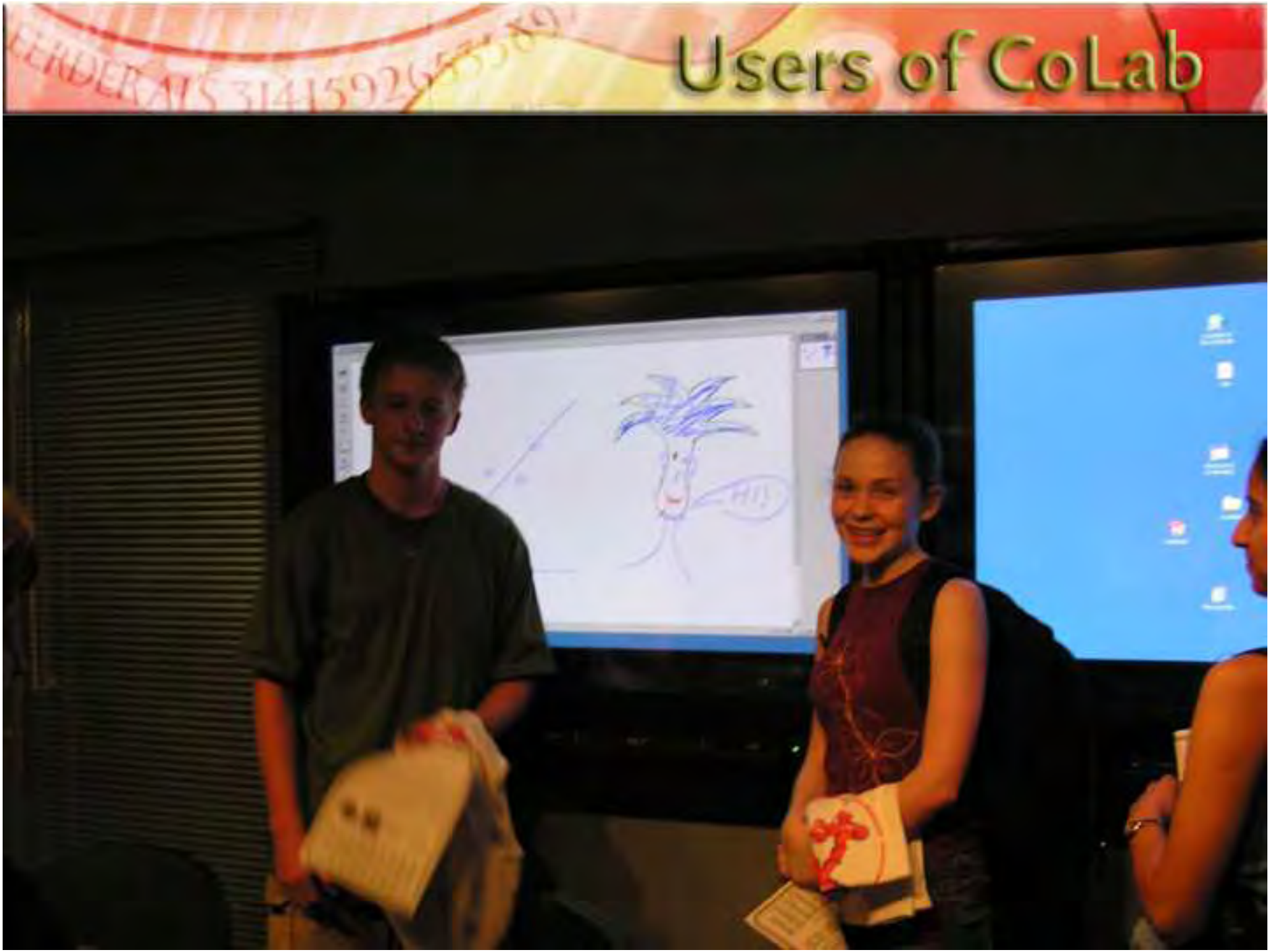
- Research "proofs and refutations"
  - proof reading, brainstorming
  - grant writing, business meetings
- Teaching
- Outreach

Many partners

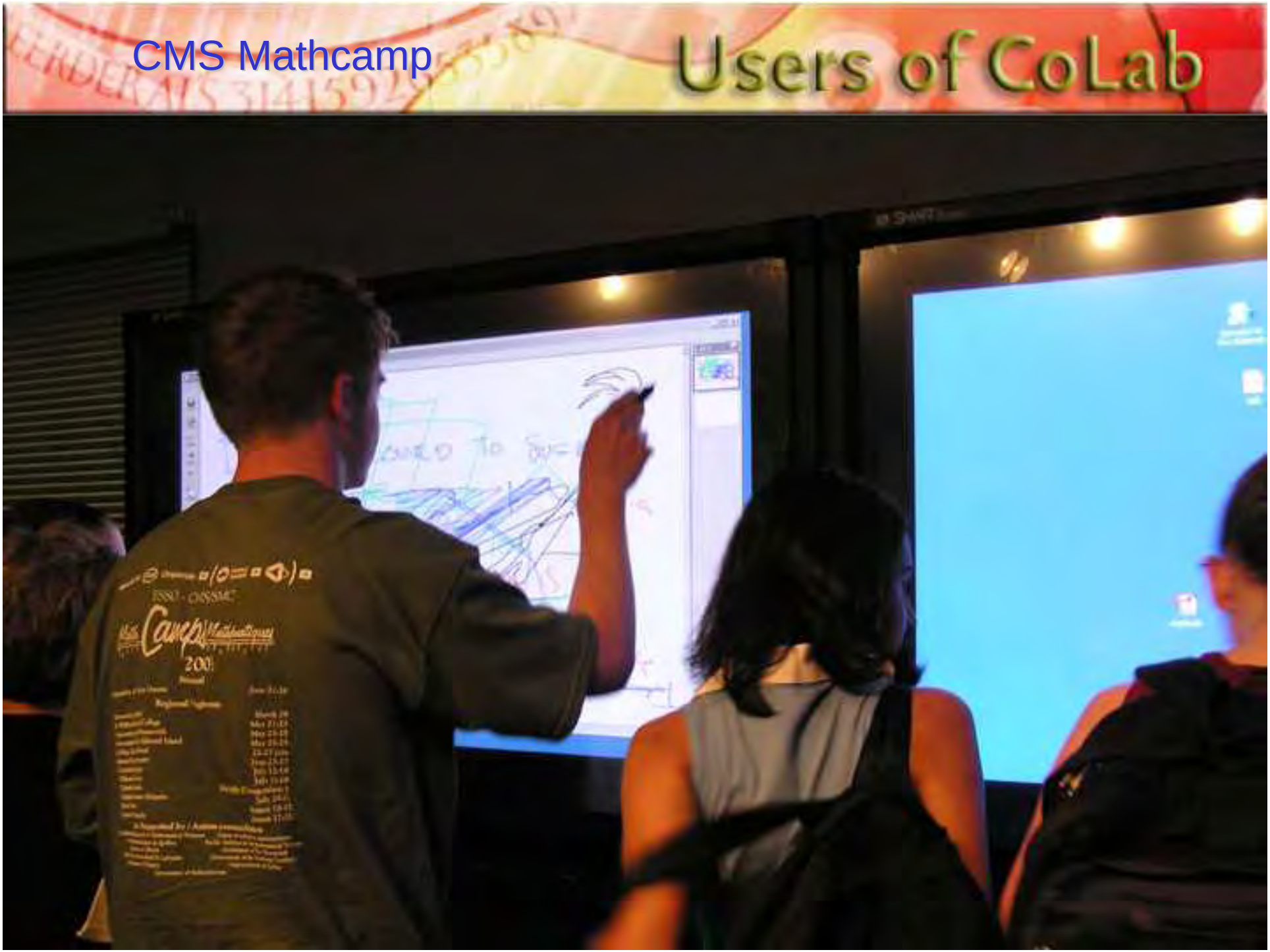
- Vendors, private sector, government, academic


The Life of Pi
Users of CoLab
CoLab
empowering collaborations
www.colab.sfu.ca
NSERC
CRSNG
π Day
Open House
Friday · 14 March 2003 · Simon Fraser University · CoLab · www.colab.sfu.ca/PiDay/ · 604.291.5615
Lectures by World Experts
The Life of Pi – Jonathan Borwein
Knots in Action – Bob Scharein
Reception for All
All kinds of Pies
Donuts and Pretzels
T-shirts
Demos for Budding Scientists and their Teachers
Come check out a new state-of-the-art research lab for collaborations at SFU.
CoLab Technologies: Smart Boards and Access Grids
Mathematical Software · Virtual CoLab · Mathematical Learning Objects · Hands-on Sessions

Users of CoLab



CMS Mathcamp



For Education Day

SAMPLE Education Project

sample.colab.sfu.ca

Funded by Canada's Initiative on New Economy: (Sample)
Advanced Mathematically Productive Learning Environment

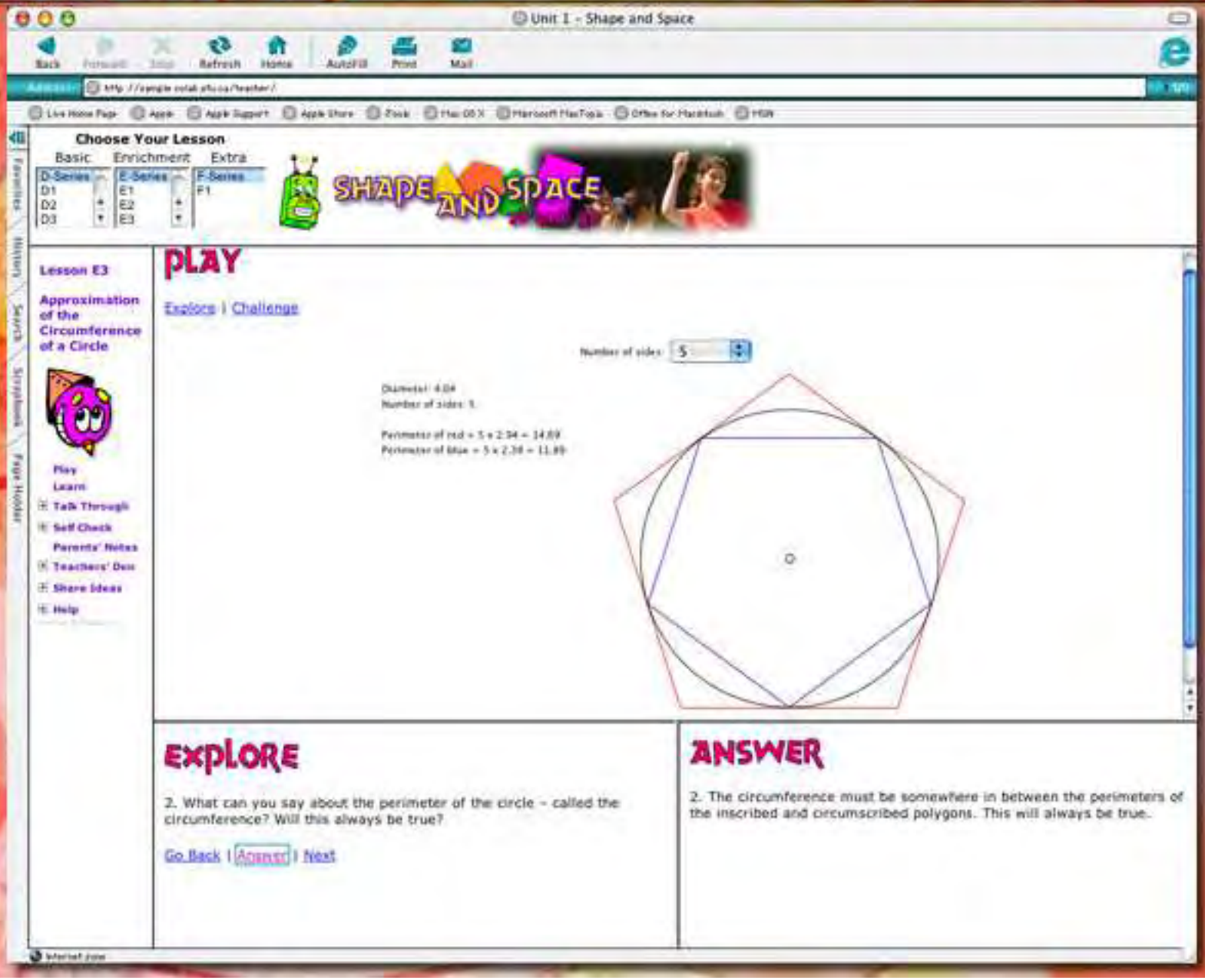
- built from ground up – content for a digital age
- based on Learning Object Repository principles
  - paper and scissors, spaghetti, chat-rooms and applets
    - "Contemporary look and feel"

Software & hardware exploration – cognitive styles

- e.g., MathPads

Partnered by CECM spin-off MathResources

- is building commercial counterpart
  (3 year project with "regional development money")


Unit 1 - Shape and Space
Choose Your Lesson
Basic
Enrichment
Extra
D-Series
D1
D2
D3
E-Series
E1
E2
E3
F-Series
F1
SHAPE AND SPACE
Lesson E3
Approximation of the Circumference of a Circle
Play
Learn
Talk Through
Self Check
Parents' Notes
Teachers' Den
Share Ideas
Help
PLAY
Explore | Challenge
Number of sides: 5
EXPLORE
2. What can you say about the perimeter of the circle - called the circumference? Will this always be true?
Go Back | Answer | Next
ANSWER
2. The circumference must be somewhere in between the perimeters of the inscribed and circumscribed polygons. This will always be true.

Unit 1 – Shape and Space

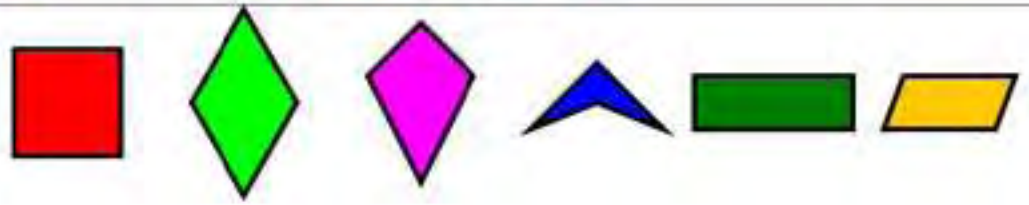
Choose Your Lesson

Basic	Enrichment	Extra
D-Series	E-Series	F-Series
D1	E1	F1
D2	E2	
D3	E3	

Lesson D5

Precise Description of Shapes

Play
Learn
Talk Through
Self Check
Parents' Notes
Teachers' Den
Share Ideas
Help



Show all

Number of sides: any number
Parallel sides: any number
Right angles: any number
Length of sides: any lengths
Interior angles: any number
Polygon type: any type

EXPLORE

4. On grid paper, draw two of the polyhedra that you made in the Play Window

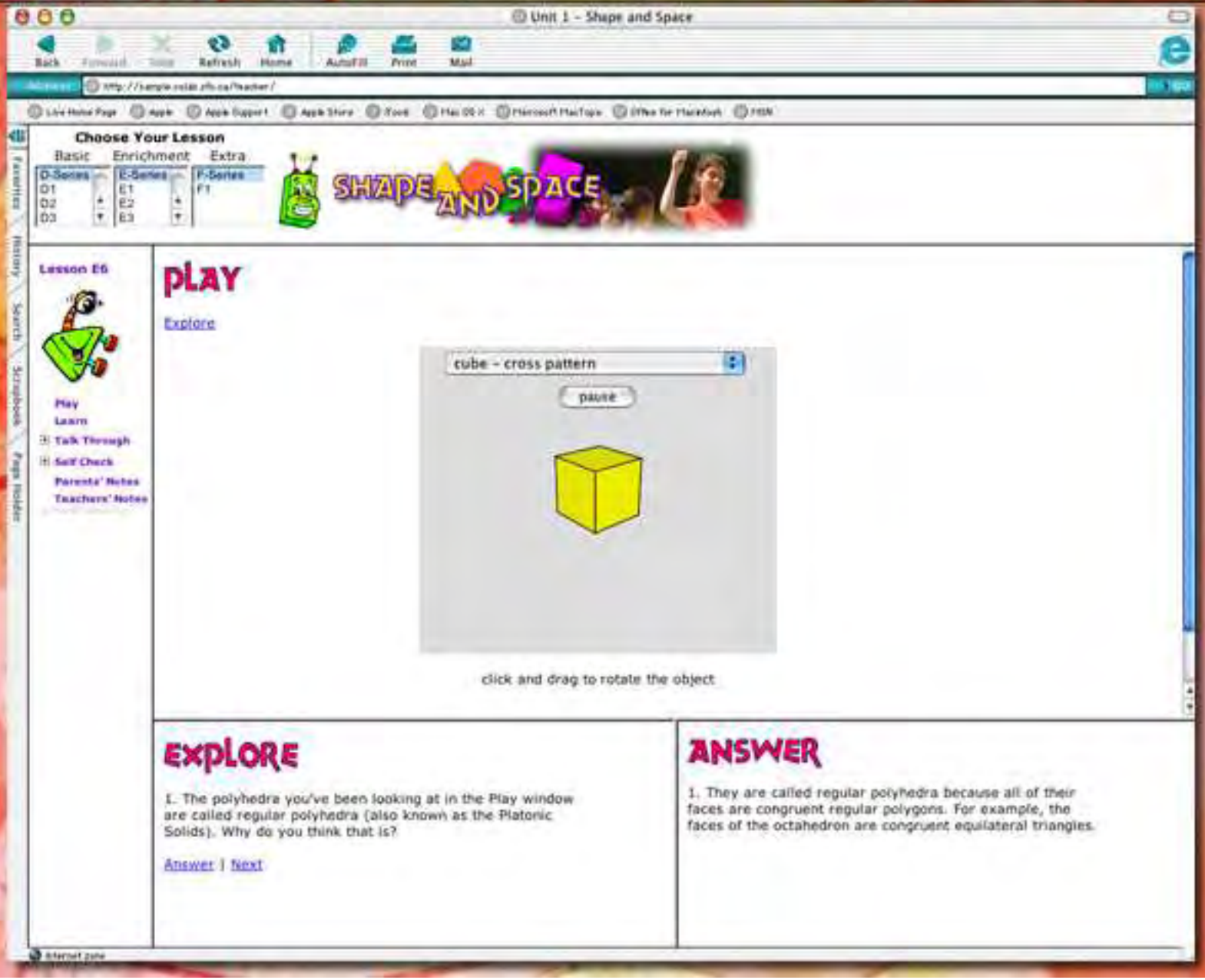
Go Back | Answer

ANSWER

4. We can draw these polyhedra by following the steps below.

For prisms:

1. Draw a base.
2. Draw the other base.
3. Connect the vertices.
4. Dot the hidden edges, or


Unit 1 - Shape and Space
Back
Refresh
Home
AutoFill
Print
Mail
Choose Your Lesson
Basic
Enrichment
Extra
D-Series
D1
D2
D3
E-Series
E1
E2
E3
F-Series
F1
SHAPE AND SPACE
Lesson E6
Play
Learn
Talk Through
Self Check
Parents' Notes
Teachers' Notes
PLAY
Explore
cube - cross pattern
pause
click and drag to rotate the object
EXPLORE
1. The polyhedra you've been looking at in the Play window are called regular polyhedra (also known as the Platonic Solids). Why do you think that is?
Answer | Next
ANSWER
1. They are called regular polyhedra because all of their faces are congruent regular polygons. For example, the faces of the octahedron are congruent equilateral triangles.

Virtual CoLab

Virtual CoLab

Built on Muse, an avatar-based "chat room" software

- Provides "plug and play" design
- Affords good architectural metaphors
- Yields 3D navigation with live interfaces
- Client needs only free plugin on a PC

"The most prominent requisite to a lecturer, though perhaps not really the most important, is a good delivery; for though to all true philosophers science and nature will have charms innumerably in every dress, yet I am sorry to say that the generality of mankind cannot accompany us one short hour unless the path is strewed with flowers."

— Michael Faraday

Virtual CoLab

Portable CoLab


colab.msite
Virtual CoLab
Muse - muse://142.58.12.161:6888/colab.msite
muse://142.58.12.161:6888/colab.msite
vCoLab
Axis Mode: Z
Geom File: archi.3ds
Attach Pt: cameras
Animation: OFF
Position : [0, 0, 0]
http://www.cecm.sfu
Chat
MuseServer: You have entered 'Virtual CoLab @ SFU'
MuseServer: There is 1 other visitor at this site.
MuseServer: Jen has entered the site.
digs: Hi Jen, nice to see you here!
Jen: Hey Steve, How is the Vcolab Development going?
digs: Its really coming along now!! hey try this....
digs
EXIT
menu

PART III

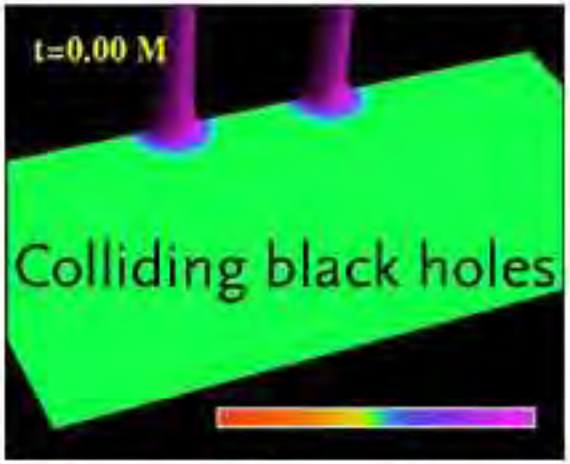
Visualization

JavaViewLib

Visualization

Obvious issues include cost and when to use

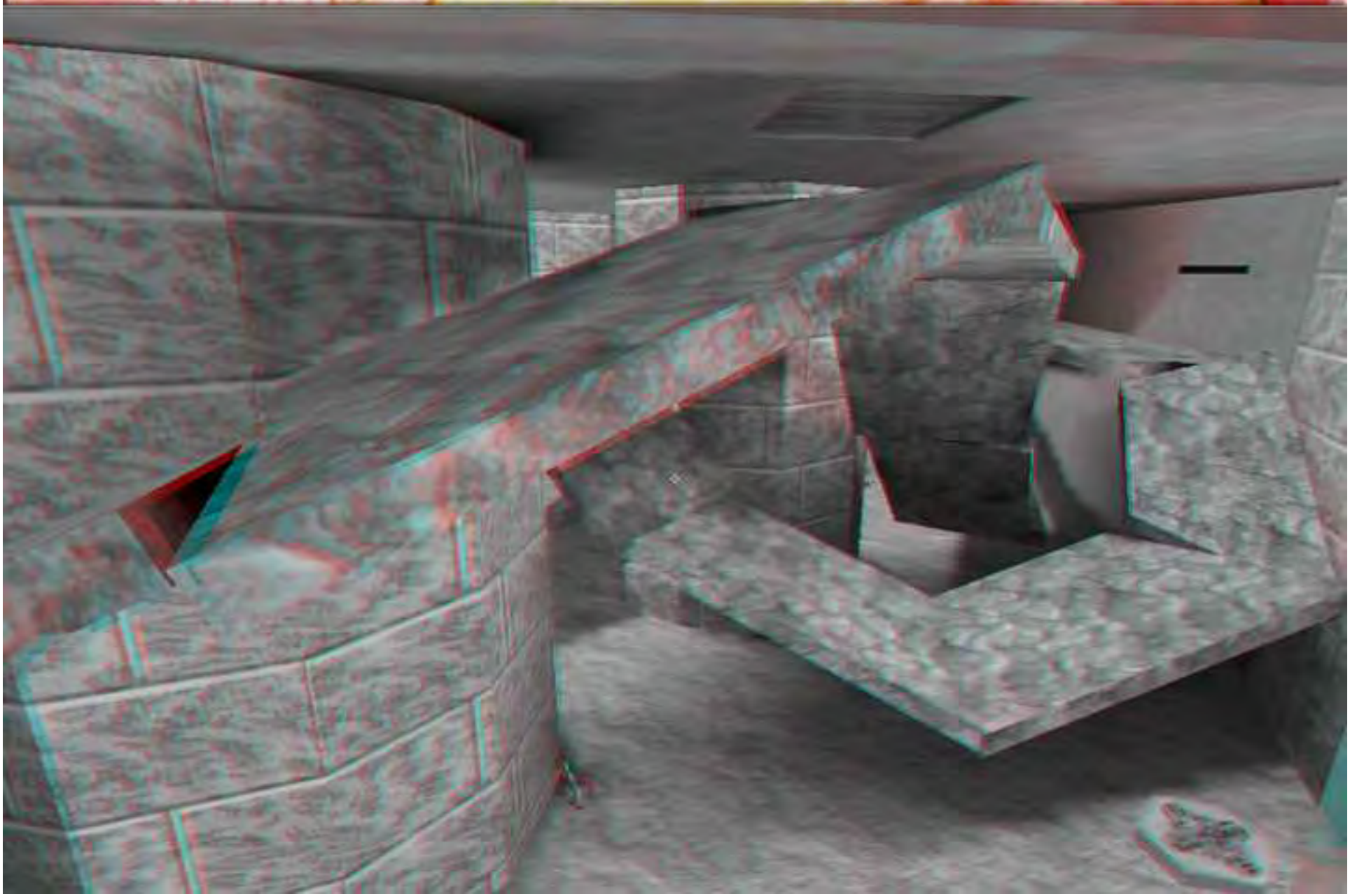
- 3D or 2D?
- Passive or active?
- Local or distant delivery?
- Precomputed or real-time?
- "Shock and awe" or shared?



- Sound quality is often more of an issue for collaboration.

- Have used Rob Scharein's KnotPlot and Konrad Polthier's JavaView as prototypes for mathematical visualization tools.

Rob's anaglyph world



Passive to Active

The cave opened out

Passive to Active

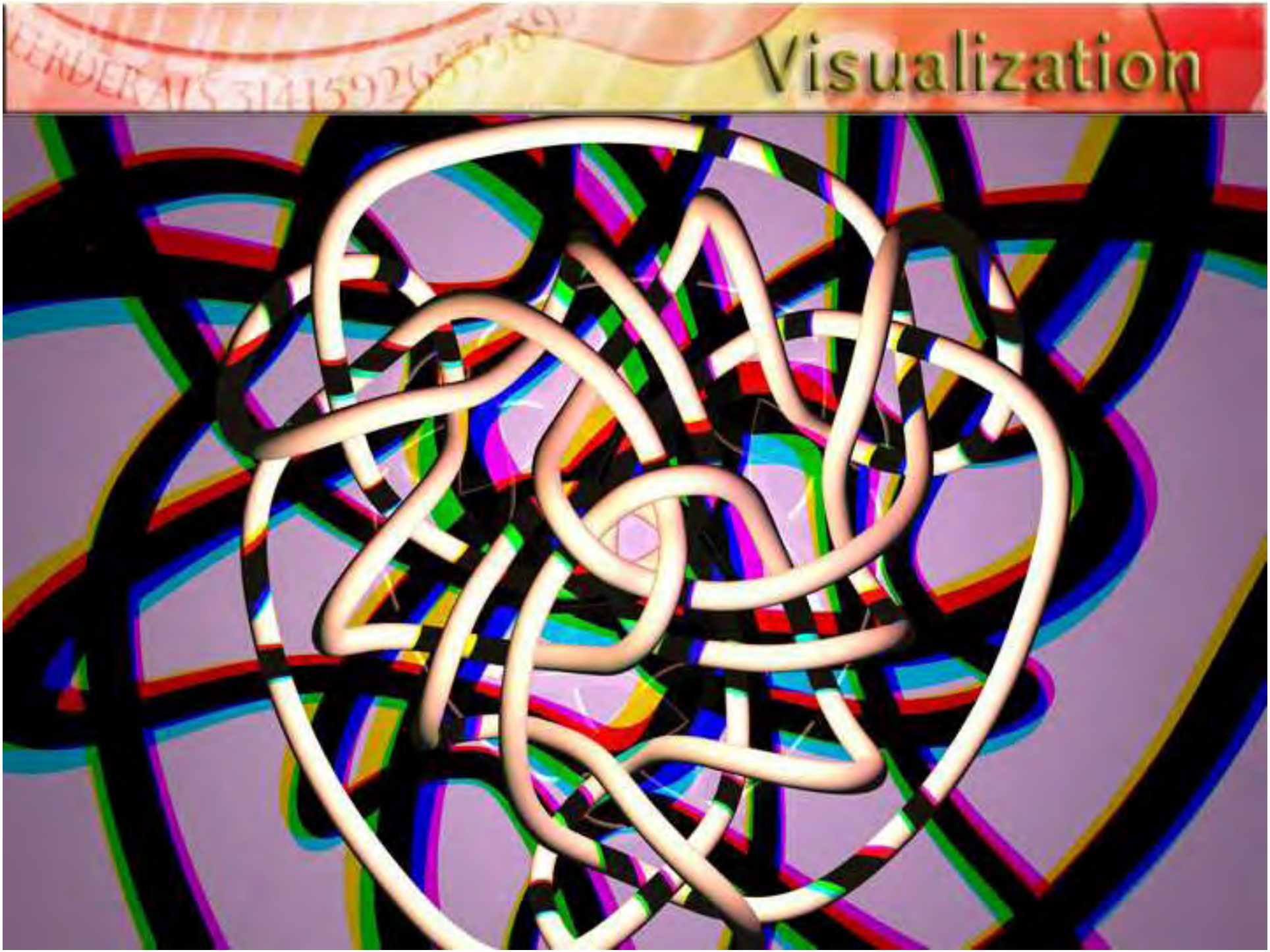
Heart Muscle

Polyhedra

Mathematical Cave Knots

Visualization


KnotPlot freeware
Visualization

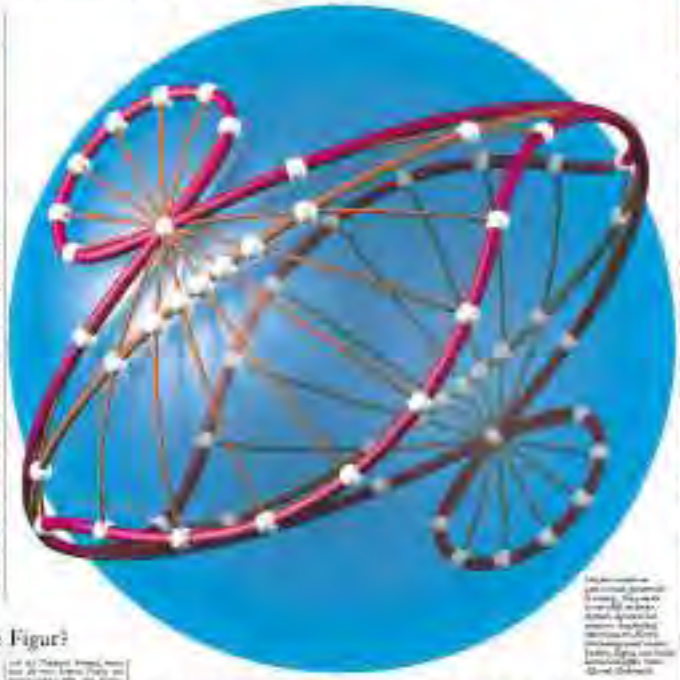

Visualization

Springer Calendar

Visualization

Visuelle Mathematik Aktuelle Forschung, anschaulich wie Kino aus Hollywood

Glänzende Ideen, brillant ins Bild gesetzt



65 seltsame Stellen

Gibt es diese Figur?

Ein Punkt geht wandern

Schocks machen Wirbel

Nullstellen eines Polynoms

Glitzerndes Erbmolekül

Chaos mit Struktur

Wie man eine Kugel umkrempelt

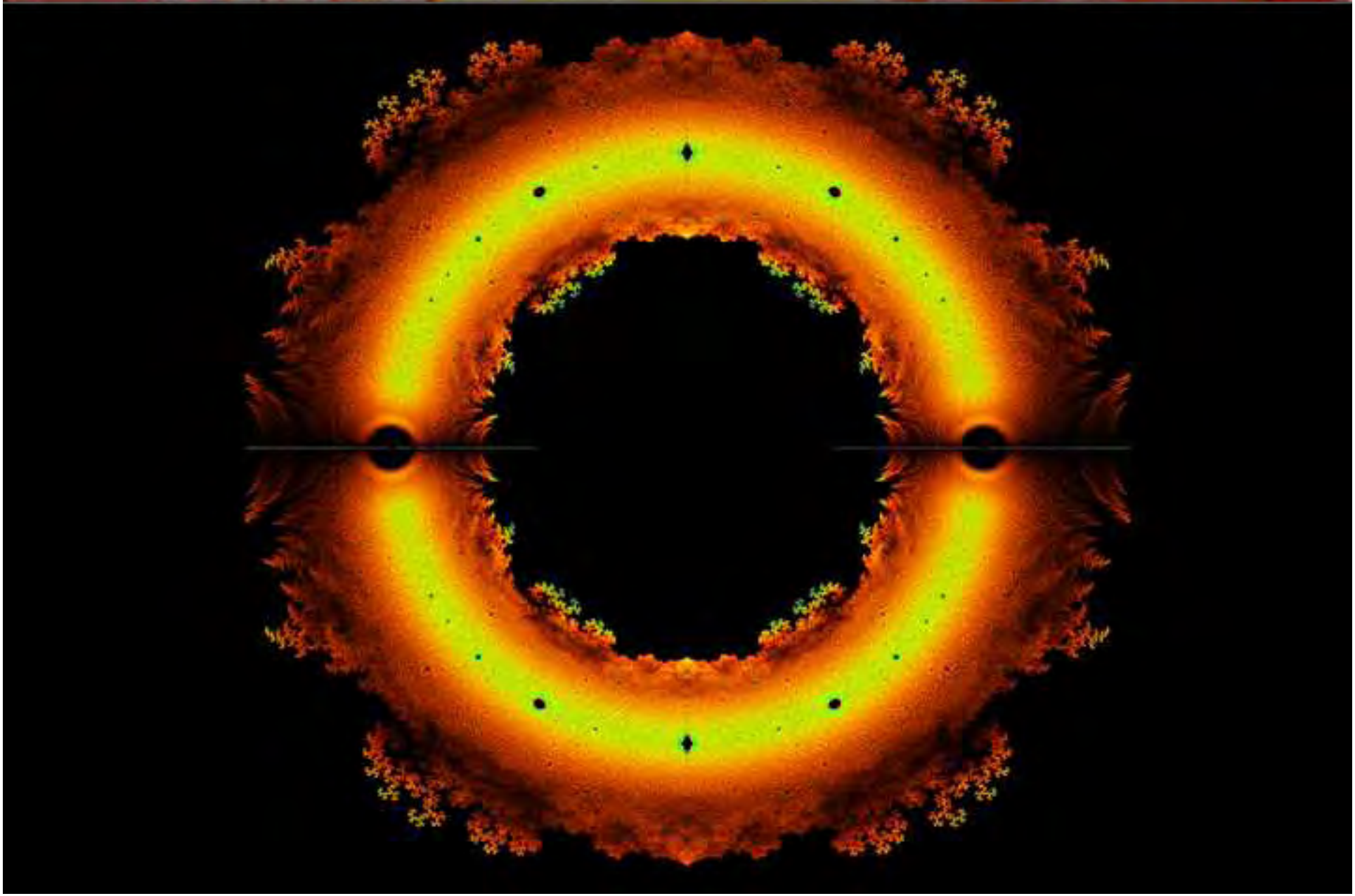
Bilder aus Schall

35 Millionen Bälle

Molekulares Ballett

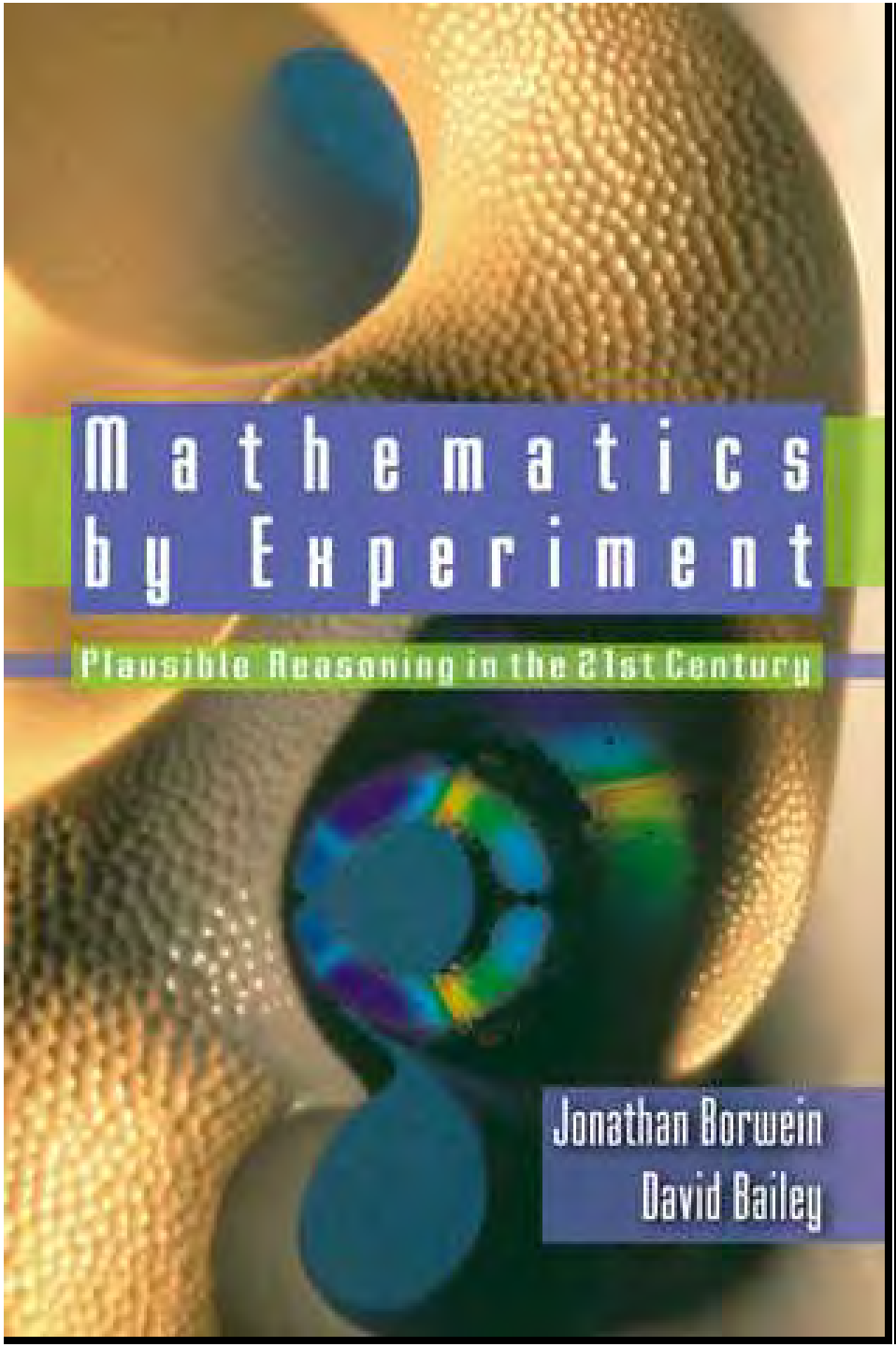
Virtuelles Ätzen

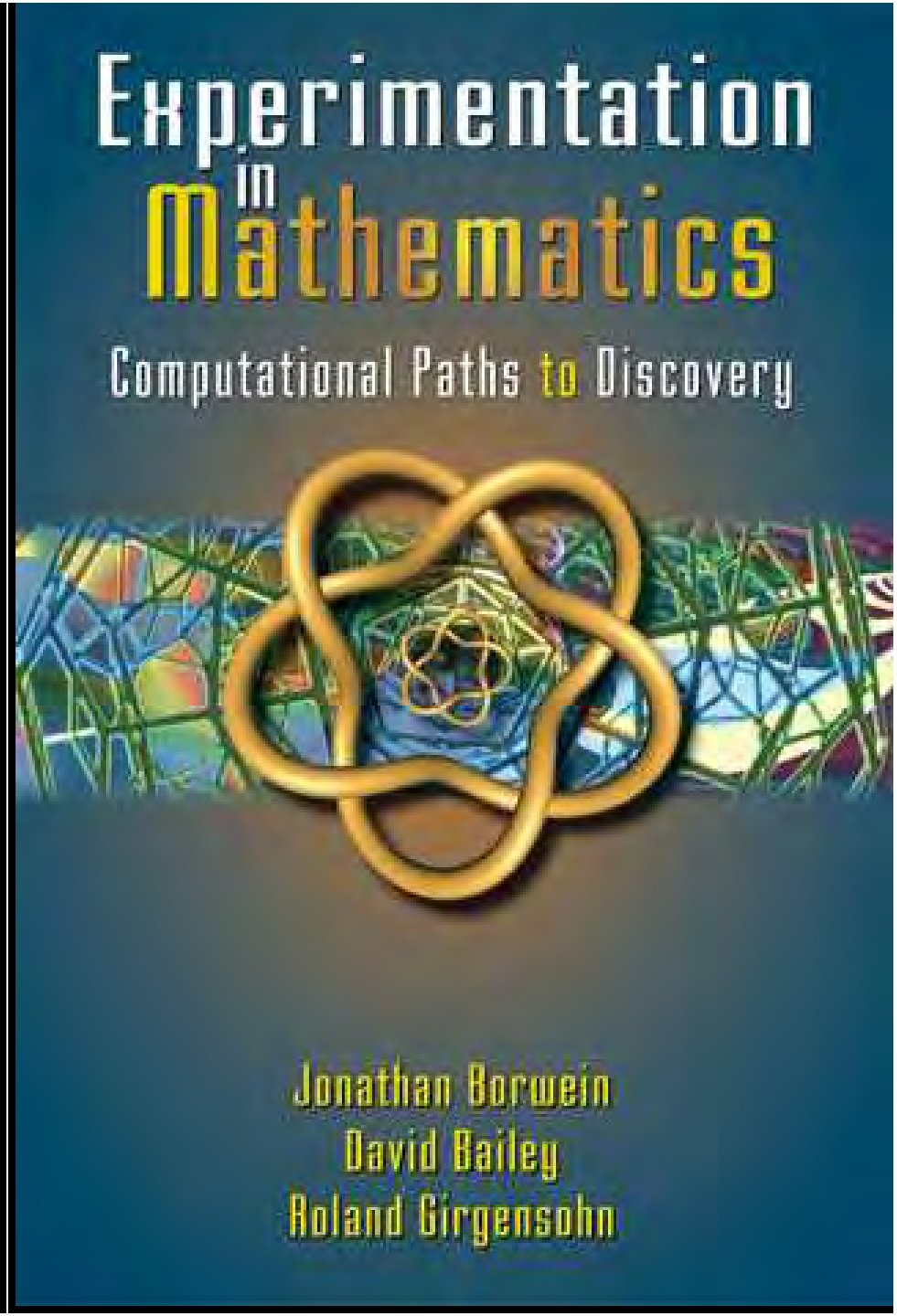
Visualization



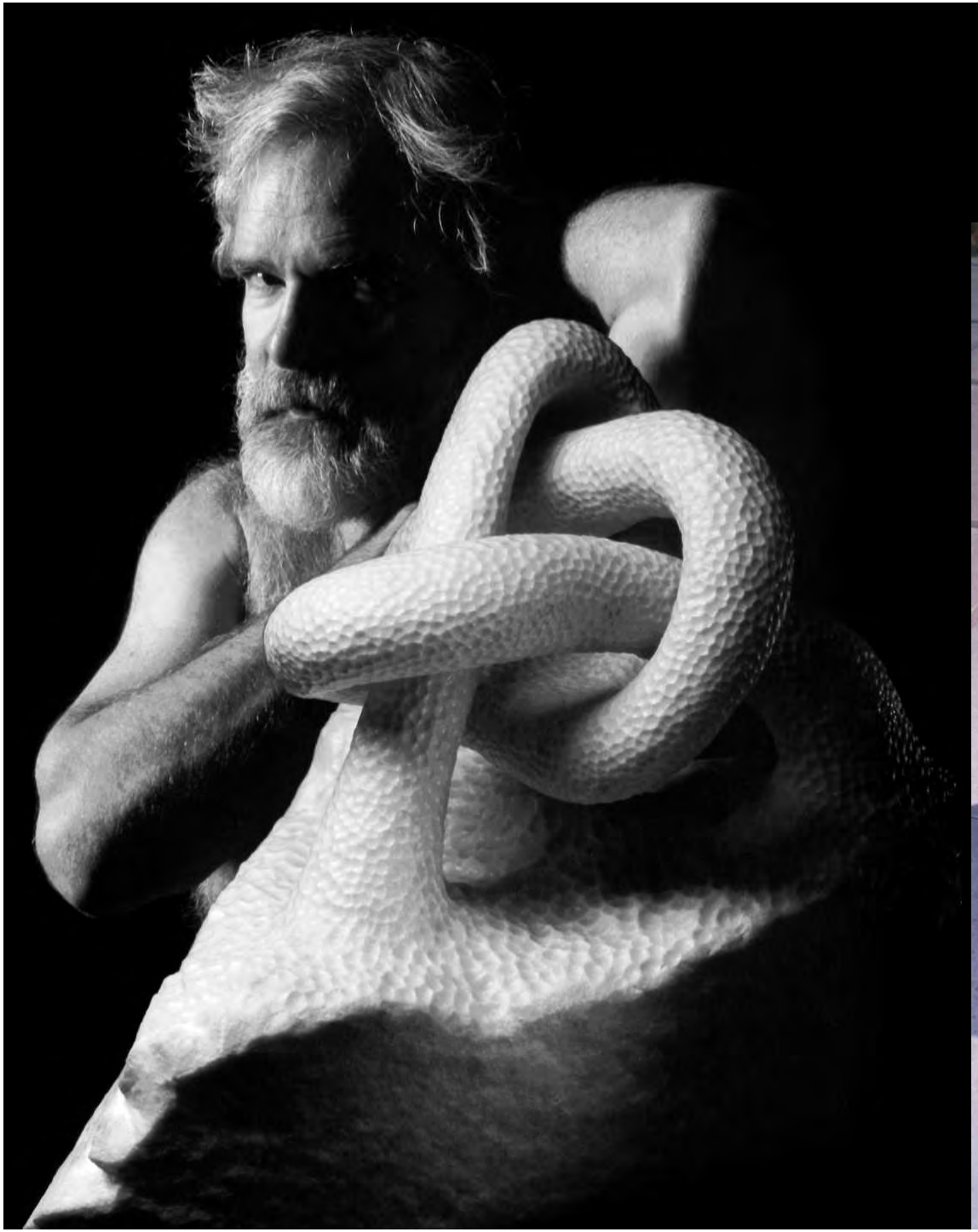
Helaman Ferguson

Visualization


Mathematics by Experiment
Plausible Reasoning in the 21st Century
Jonathan Borwein
David Bailey


Experimentation in Mathematics
Computational Paths to Discovery
Jonathan Borwein
David Bailey
Roland Girgensohn

A man and his art



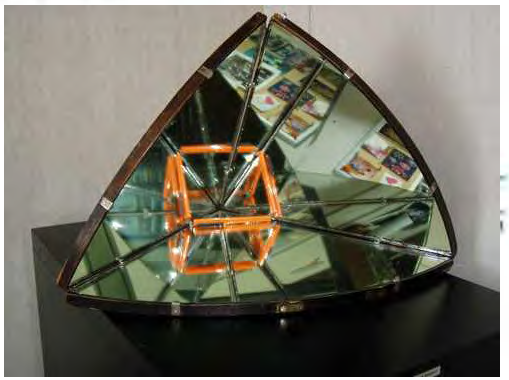
SFU

High Performance Computing

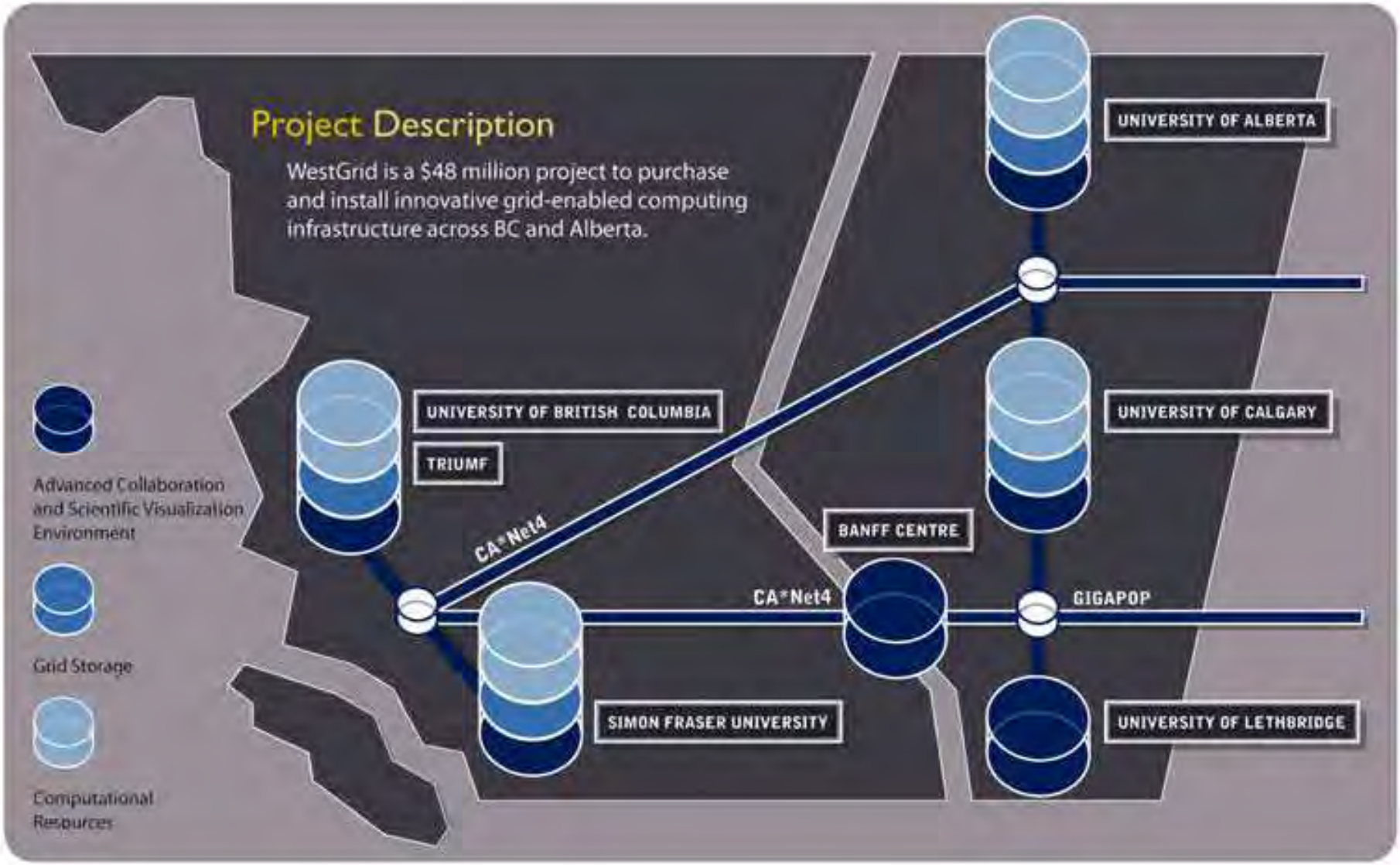
Three (small) SFU prototypes for **WestGrid**

- 192 cpu (home built Athlon) **Beowulf** cluster being cloned
- 32 cpu **COMPAQ alpha** clump
- 8 (+48) cpu **SGI Origin** SMP
  - Single image login, file management, etc.

- SFU has 3 geographically separated locations
  - All with high tech programs
  - Immersive resources
    (making for a fine test-bed)



Grid Computing



West Grid High Performance Computing

- Resources 48 million dollar installation (cost effective)
  - 256 Cpu Origin Edmonton
  - 1008 Cpu IBM Blade server UBC
  - 156 CPU Compac Alpha Calgary
  - Archival storage and Visualization server SFU
- Single sign on and Grid enabled
- 1500km GigE private network
- Going National

Access Grid again

Four city opening

Based on these experiences we are now building the

Dalhousie Distributed Research Institute and Virtual Environment

Come and visit **www.cs.dal.ca/ddrive**

Grid Computing