

MSU Atlas Tier 2 Computing Center

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This is a discussion of a proposed computing center for analysis of data and simulation for the CERN experiment, "Atlas."
The collaboration consists of the High Energy Physics groups at MSU and UM.
While we have been collaborators for decades at Fermilab, CERN, BNL, and ANL...this would be the first global collaborative effort.

High Energy Physicists

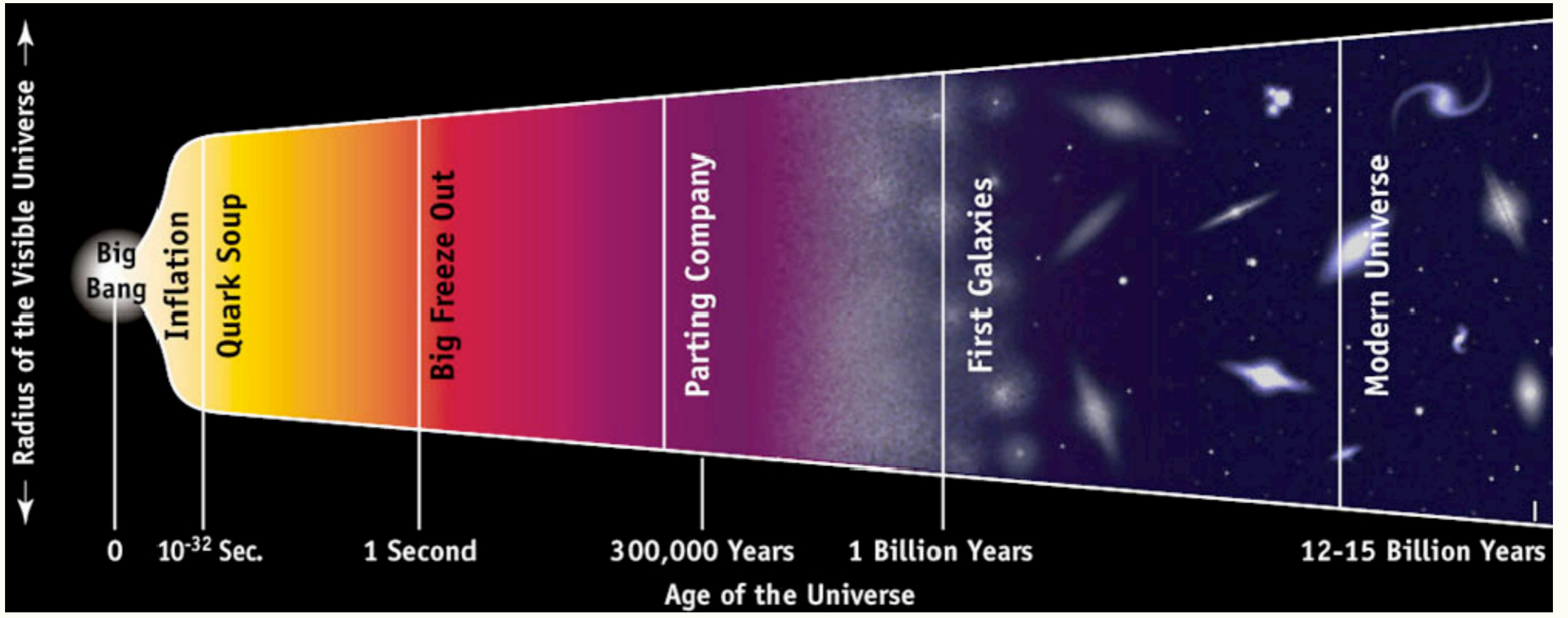
(aka “HEP”)

We work to unravel the processes
which controlled the evolution of the universe $<10^{-8}$ s after its birth

$E = mc^2$
&
beam “luminosity”

the calling cards to fundamental physics

the higher the energy, the heavier the particle masses that can be created
the more particles which collide, the rarer the processes that can be excited



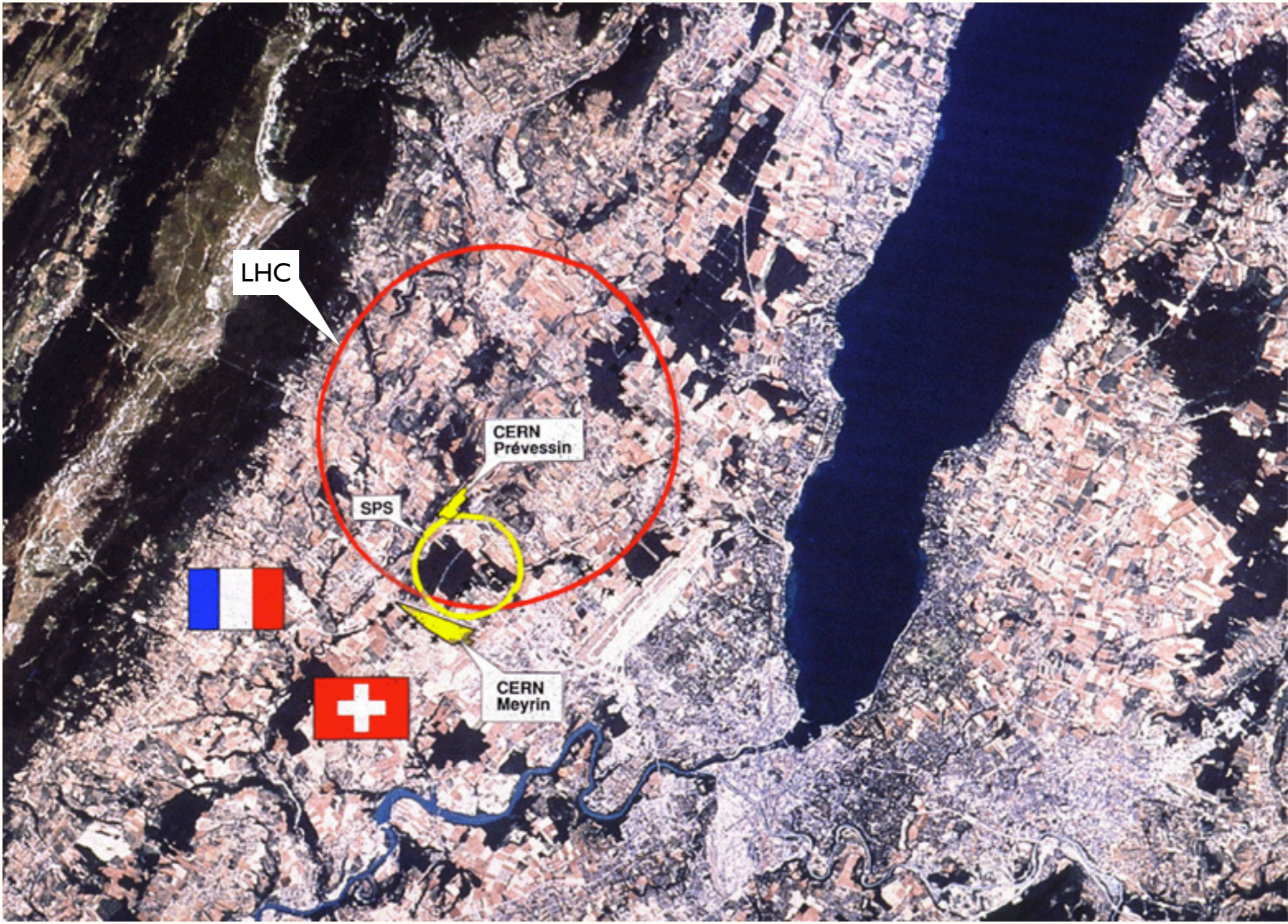
HEP@CERN

High Energy Physics requires enormous facilities

Typically, circular or linear particle accelerators are measured in miles around or in length.
Collaborations are now regularly 500-1000 PhD's.
Future collaborations are 1500 PhD's.
Costs are negotiated at the level of State Departments and obligations extend over decades.

MSU has been productively involved in HEP since the late 1970's and currently has a group of 8 experimental and 7 theoretical faculty. Our groups are well-regarded and funded very well: three experimental NSF grants totaling ~\$1.5M/year and DOE supported electronics and detector design and construction projects of well over \$10M over the last 15 years. Our theory group has become one of the most highly funded in the NSF, now a total of approximately \$1M/year.

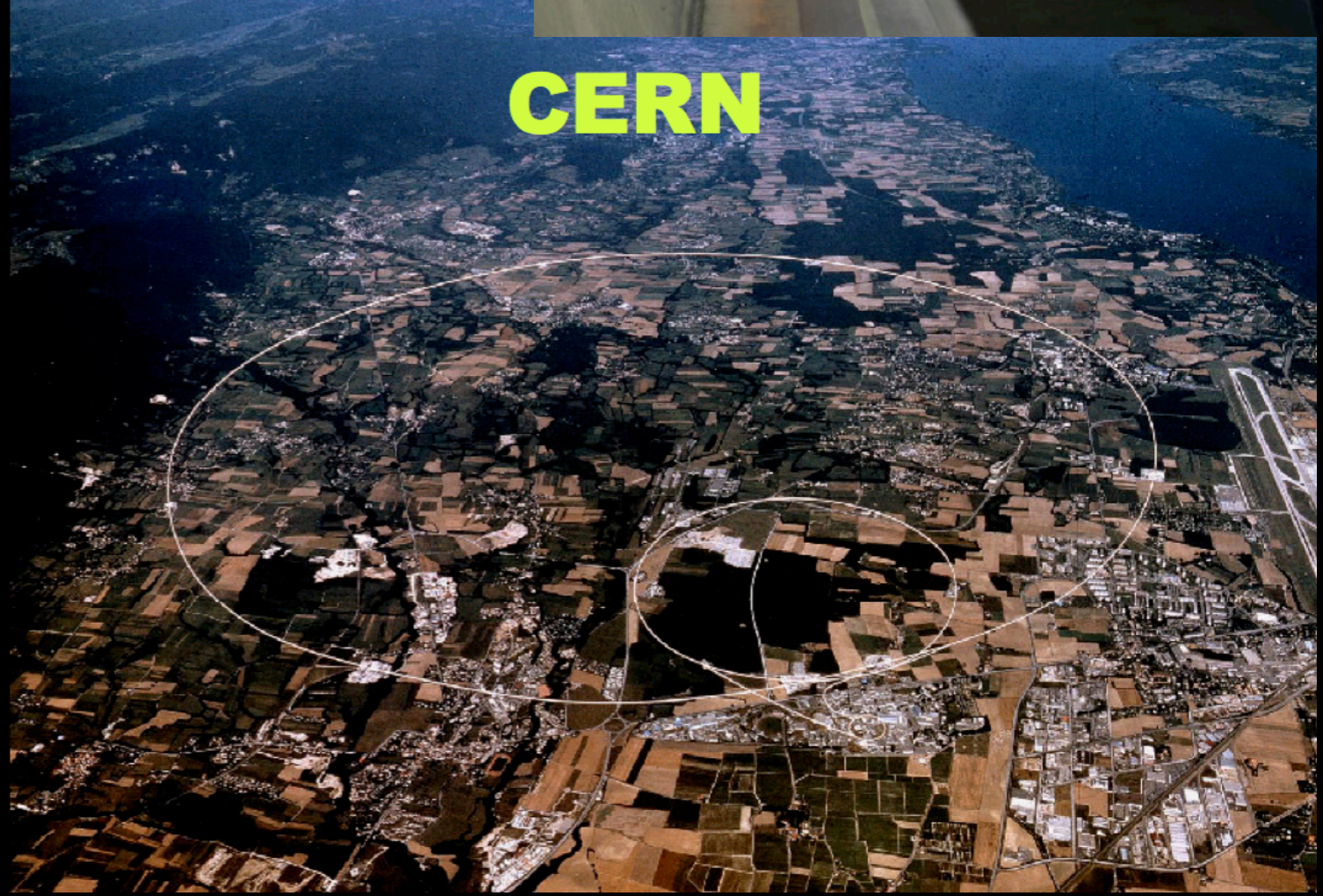
Support from MSU in the form of resources, laboratory and technical support, and matching opportunities has made our steady grant increases possible over the years.



Fermilab



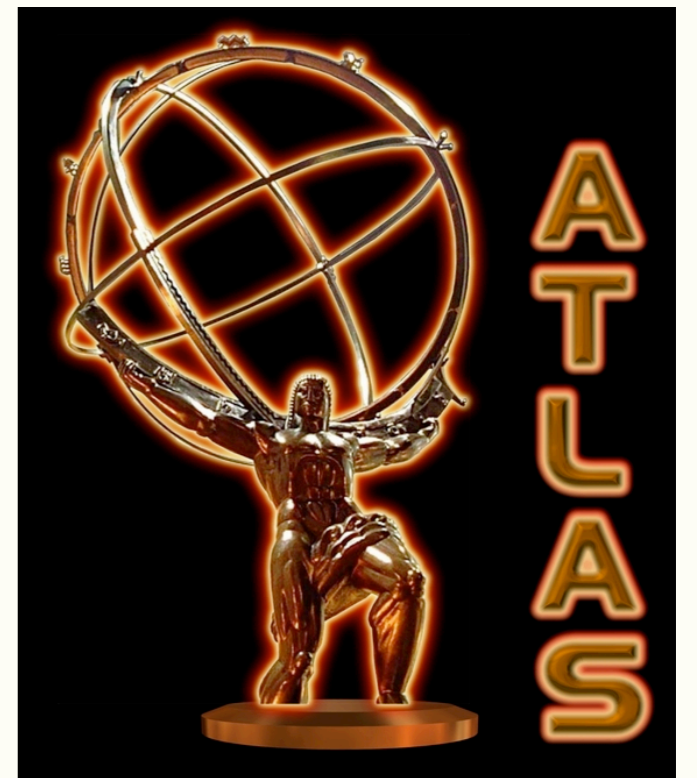
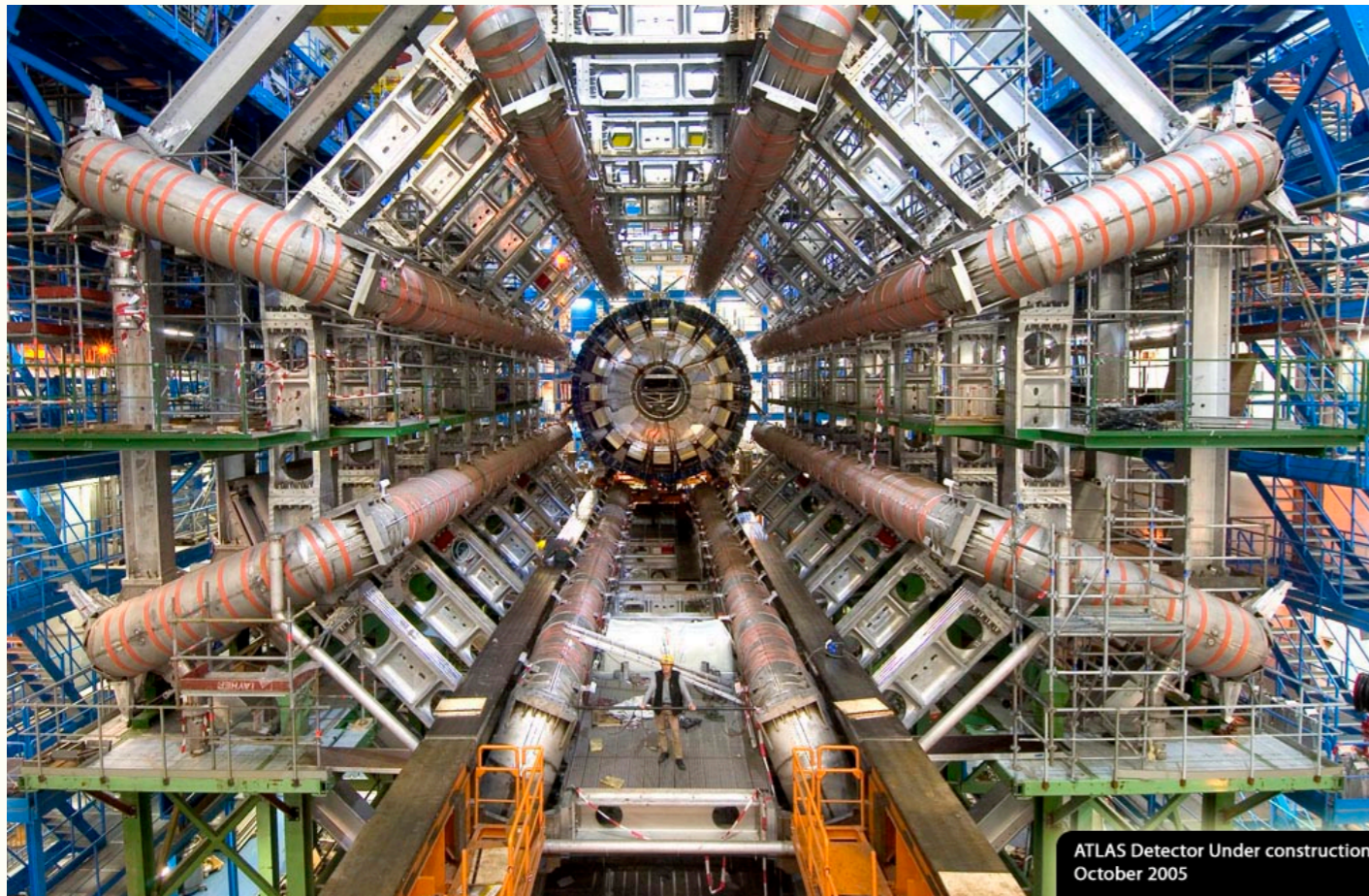
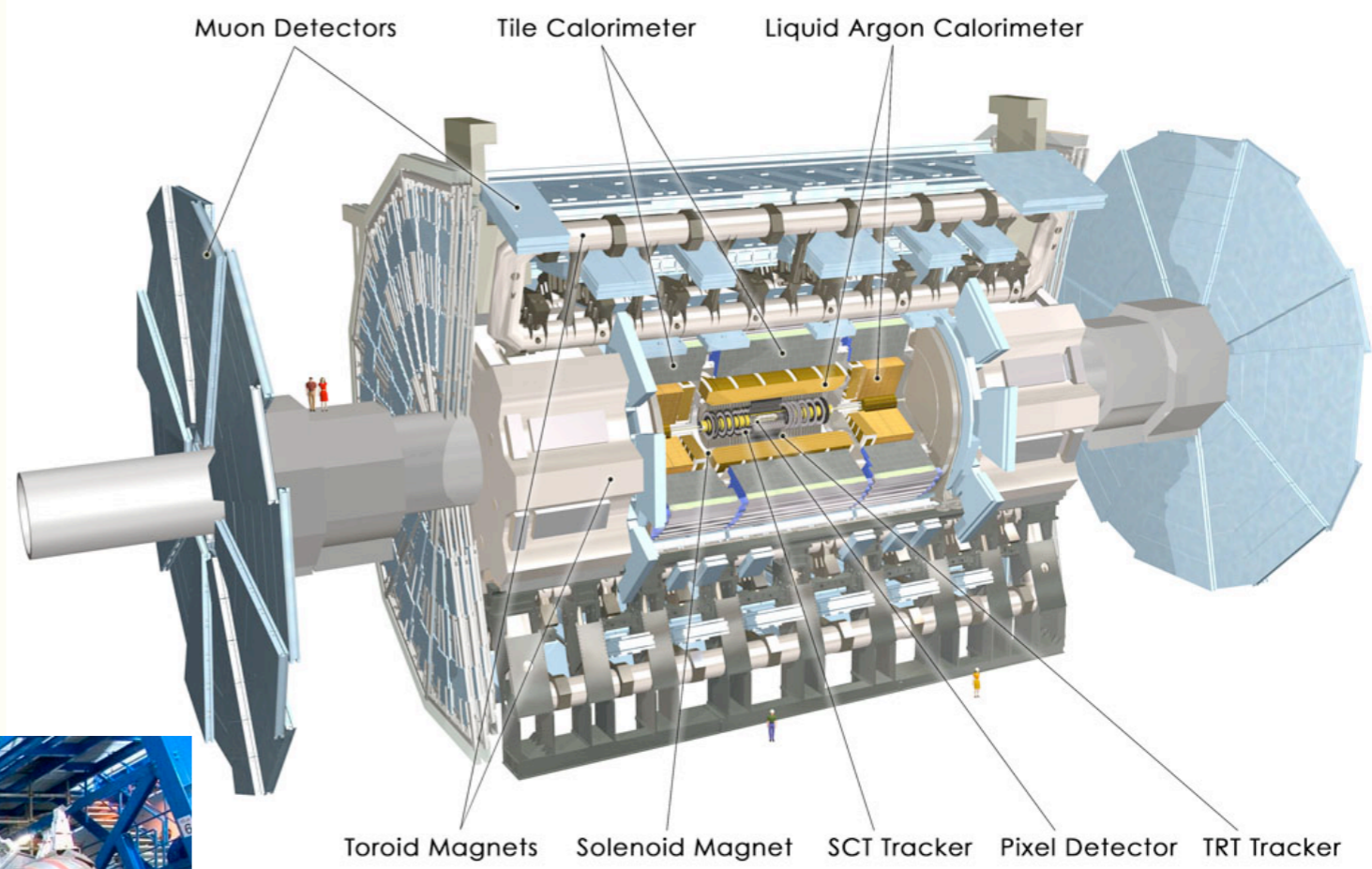
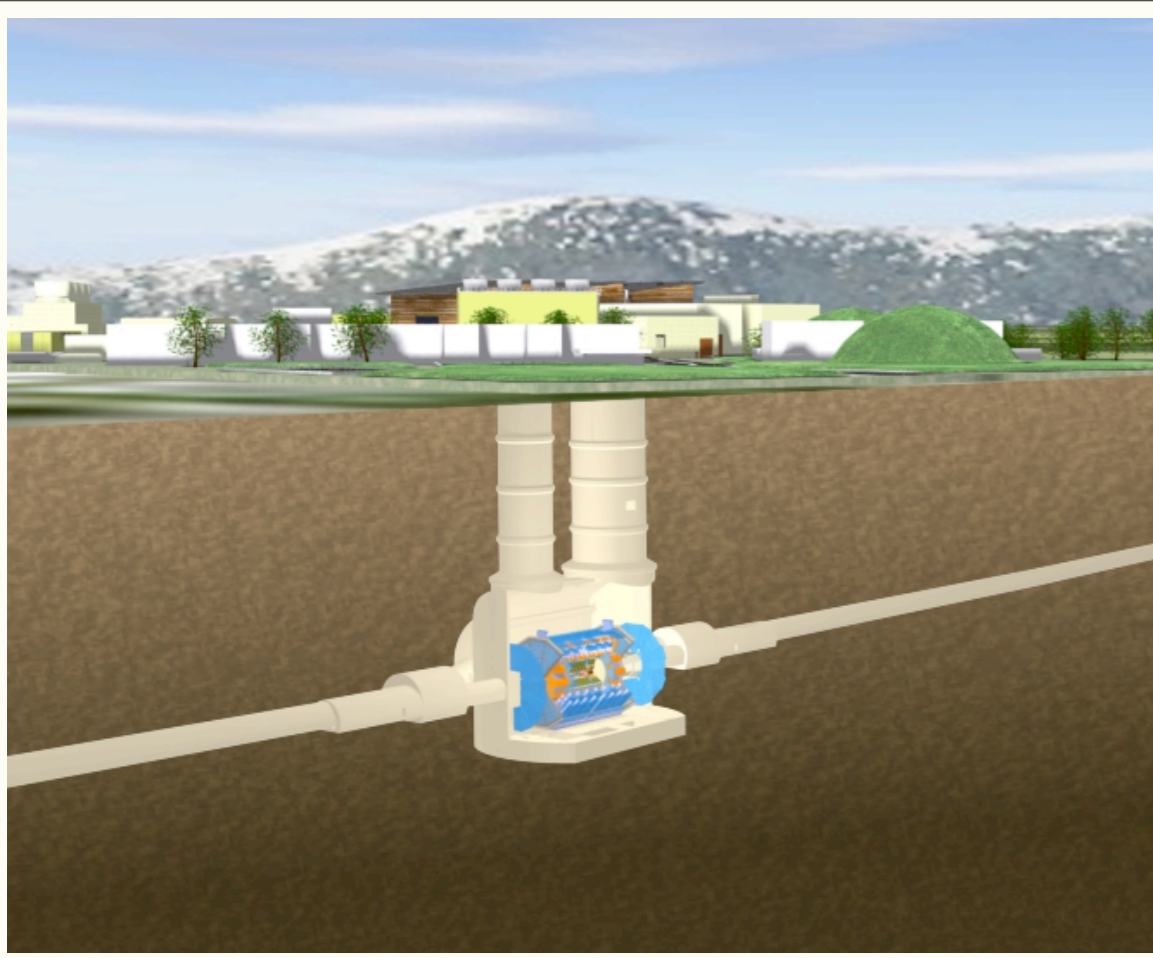
CERN



The Fermilab complex is in Batavia, Illinois and houses the DØ and CDF collider detectors. MSU has been involved in these experiments, fulfilling leadership roles in the physics, engineering, and management of the collaborations.

The CERN accelerator complex has now been called the Large Hadron Collider (LHC) which straddles the border between Switzerland and France, just outside of Geneva, Switzerland. MSU has been involved in experiments at CERN off-and-on for two decades, but most recently for the last nearly 10 years as the slow, complicated ramp-up to a new proton-proton collider facility commences.

Atlas Detector





100,000,000

electronic channels

raw
pulses



Atlas Computing Model

“Tier’d” computing centers, worldwide:

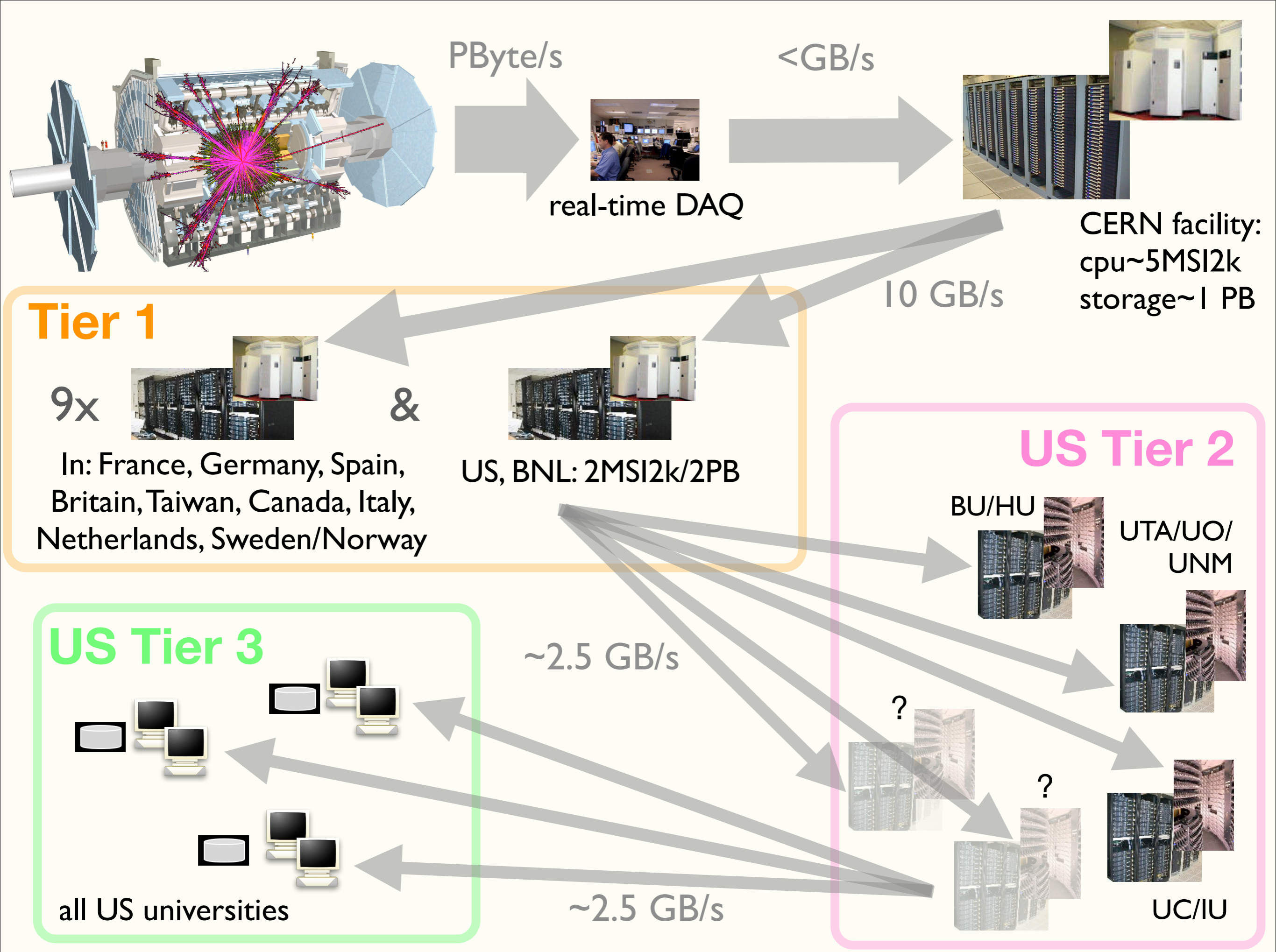
Tier 0: DAQ, reconstruction, archive
(*CERN*)

Tier 1: reconstruction, simulation, archive, mining, analysis
(*national labs*)

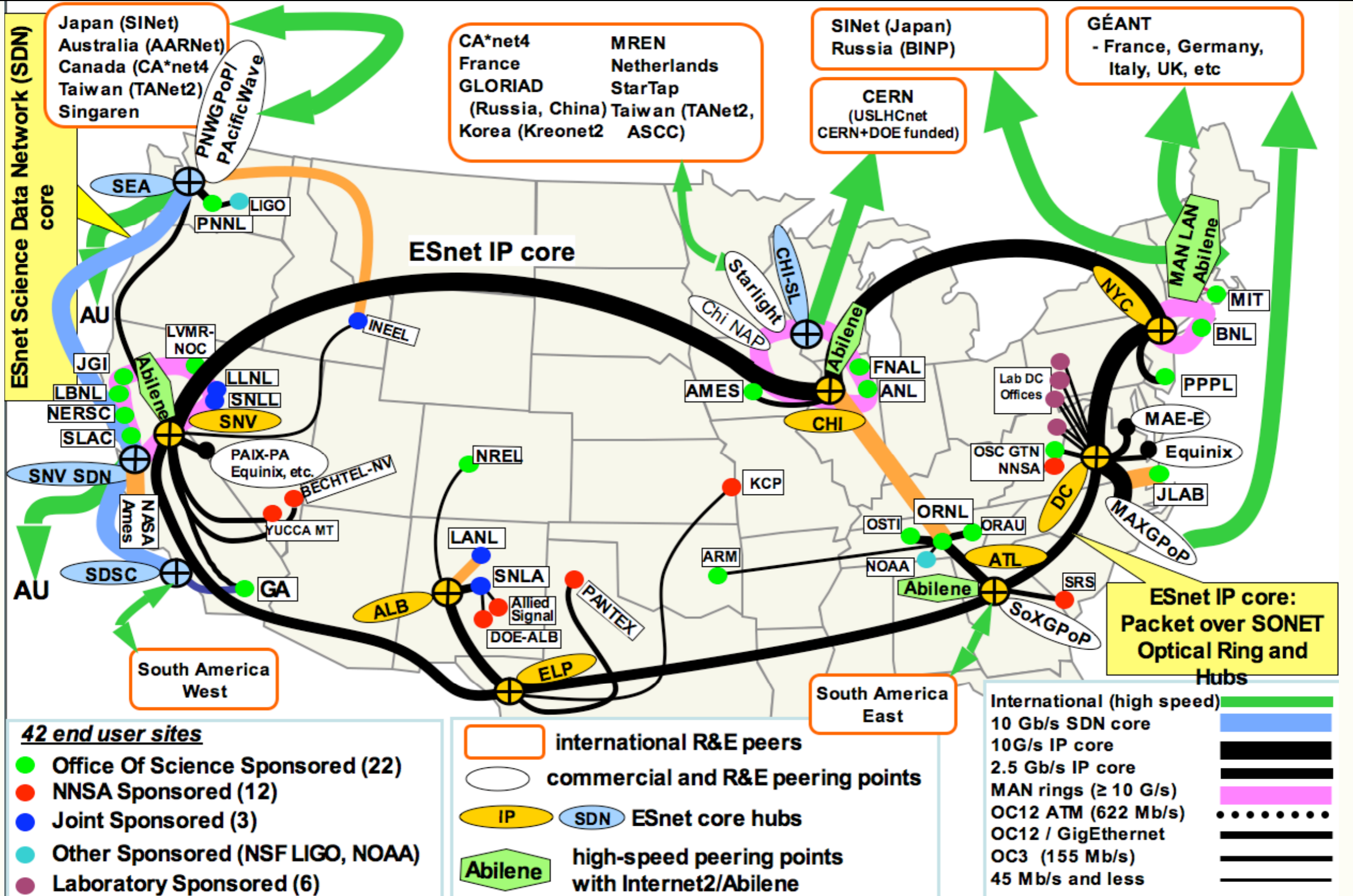
Tier 2: analysis, simulation, archive
(*few universities*)

Tier 3: interactive analysis
(*all universities*)

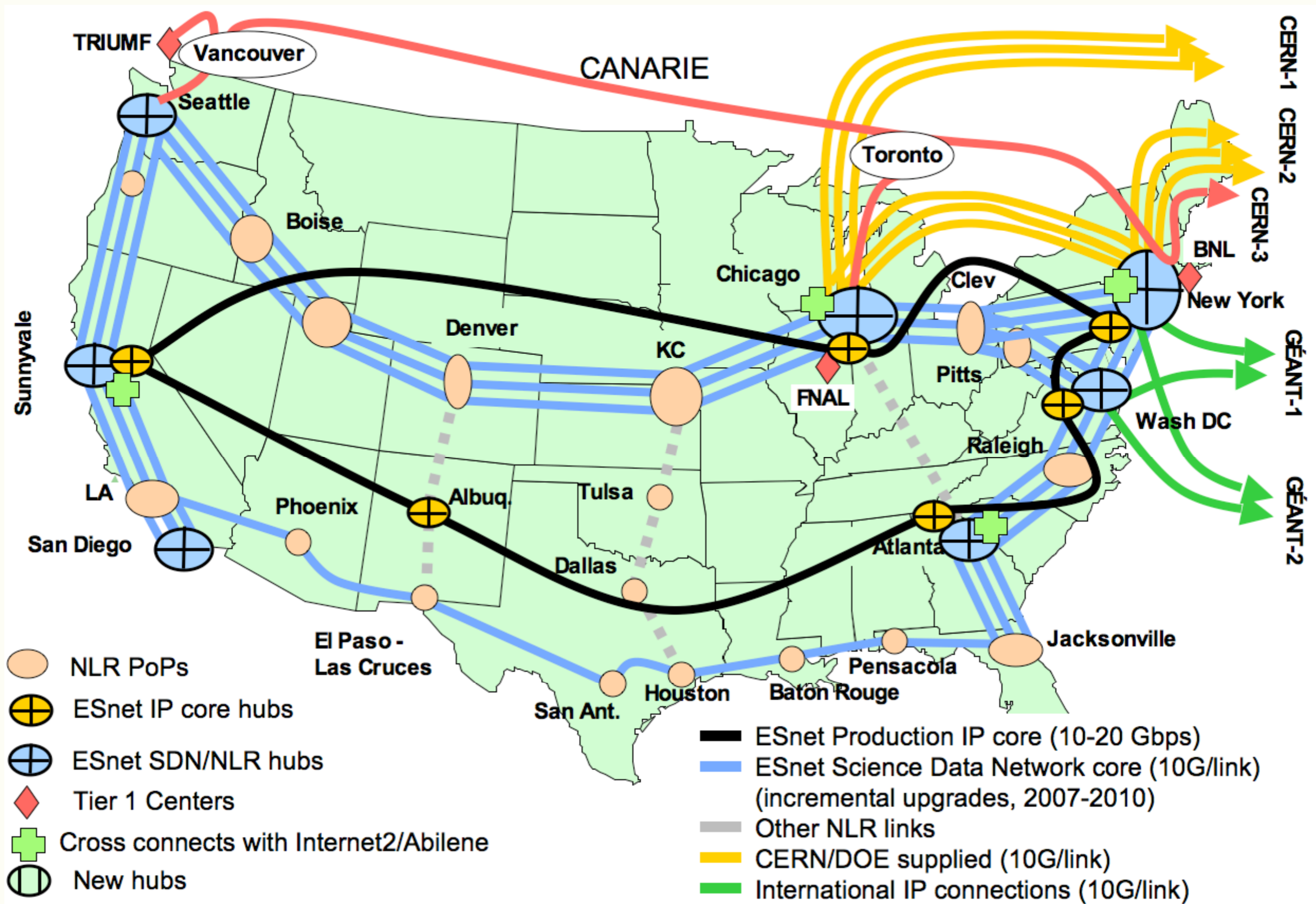
CERN Tier 0: Exactly 1
Record/Archive Raw Data, Prompt Reconstruction, Distribute Raw, ESD, etc.
CERN Analysis Facility: 1
Like a large scale Tier 2 supporting ~100 users
Major calibration activity, little simulation
Tier 1: ~10 (capacities vary as defined in MoU)
Archive, perform post calibration (and any later) re-reconstruction of a share of the raw and simulated raw data
Group level programmatic analysis
Store, serve, reprocess – share of ESD, AOD, TAG
Tier 2: ~30 (5 in US, aggregate capacity defined by MoU)
Bulk of simulation, analysis support for ~20 active users/site
Store, serve – TAG’s, AOD, small select ESD sample
Institutional Facilities & Individual Users (Tier 3 ...)
Primarily analysis



how do data move around?



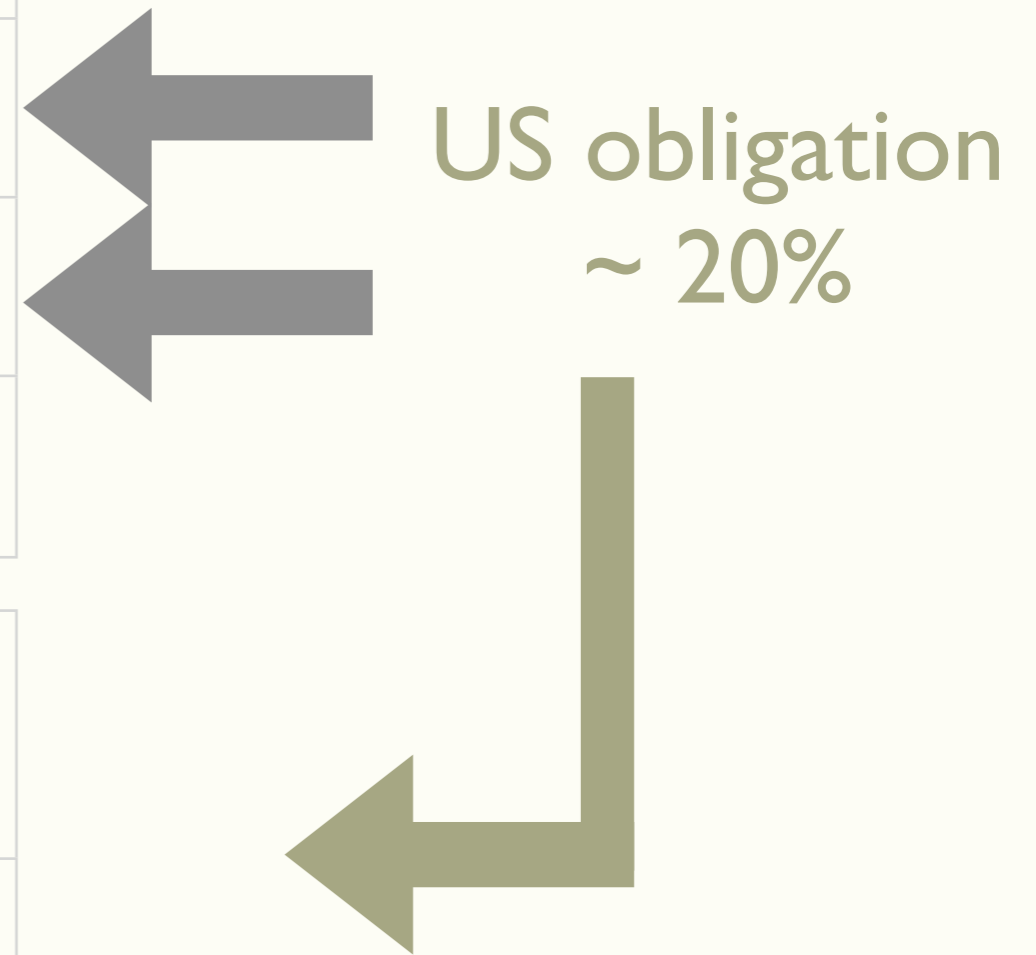
ESnet 2010 Lambda Infrastructure



Required Capacity, e.g. 2008

	cpu MSI2k	disk PB	tape PB
CERN Tier 0	4.1	0.4	5.7
CERN AF	2.7	1.9	0.5
Sum Tier 1's	24.0	14.4	9.0
Sum Tier 2's	19.9	8.7	0
TOTAL	50.7	25.4	15.2

US Tier 1	4.8	2.9	1.8
Each US Tier 2	0.8	0.12	0



Atlas T2 Status, 2006

Five Tier 2 U.S. sites are required

3 have been approved:

Boston University & Harvard University

University of Texas, Arlington, University of Oklahoma, Hampton University, & University of New Mexico

University of Chicago & Indiana University

Call for proposals

2 more sites, 5y proposals due to US Atlas by May 15

Award: \$600k/year for the "life of the research program" ≥ 10 years

MSU-UM Proposal

Four distinct components:

cpu availability
RAID storage
network capability
technical personnel

From 3 defined sources:

university-dedicated
university-shared
project funds

UM original proposal to us:

university dedicated resources:

UM: \$1M

MSU: \$0.5M

award sharing:

UM: \$400k/year

MSU: \$200k/year

This has changed:

university dedicated resources:

UM: \$2.5M against \$375k/year

MSU: \geq \$0.5M against \$225k/year

our goal

to be

as significant a partner with the University of Michigan

as we are accustomed to being in the HEP community

we bring now

considerable expertise

high-density commodity Linux cluster development

real-time coding/scripting

physics simulation, electronic trigger design, and detector
construction/calibration

large project management

considerable group resources

HEP FTE commitment

name	position	source of support	Project year				
			1	2	3	4	5
Abolins	faculty		0.5	0.5	0.5	0.5	0.5
Brock	faculty		0.3	0.3	0.5	0.5	0.5
Linnemann	faculty		0	0.1	0.1	0.25	0.25
Pope	faculty		0.4	0.5	0.5	0.5	0.5
Schwienhorst	faculty		0.3	0.3	0.5	0.5	0.5
Hauser	Sr. RA	50% NSF; 50% Atlas M&O	0.5	0.5	0.5	1	1
post doc		NSF	0.2	0.2	1	1	1
DiMattia	temp RA	Atlas M&O	1				
post doc		NSF	1	1	1	1	1
Ermoline	engineer (@CERN)	Atlas M&O	1				
Laurens	engineer	currently, DØ project	0.7	0.7	0.8	1	1
Rockwell	comp tech	50% NSF	0.5	0.5	0.5	0.5	0.5
Nila	comp tech	Dept	0.5	0.5	0.5	0.5	0.5
post doc		NSF				1	1
graduate students		NSF	0	2	3	4	4

we require:

1. cold, powered, 10Gbs capable housing for our clusters
2. arrangement for 10Gbs connectivity through MiLR
3. 10Gbs connectivity from ComArts to BPS(?)
4. possibly home for T2 tape backup
5. \$ in order to leverage our cpu resources w/ RAID storage
6. support for 1.5 technical FTEs

rack housing

HEP has 1 rack of 27 nodes in the Computer Center

PA has a commitment to another rack in startup package

HEP has funds for ~1 more rack

estimate in hand for BPS 1221 AC renovation

obviously, we go nowhere without a resolution to this problem

multiple groups in PA, Bio, chemistry are in a serious difficulty

MiLR access

UM has been using MiLR in “data challenges”

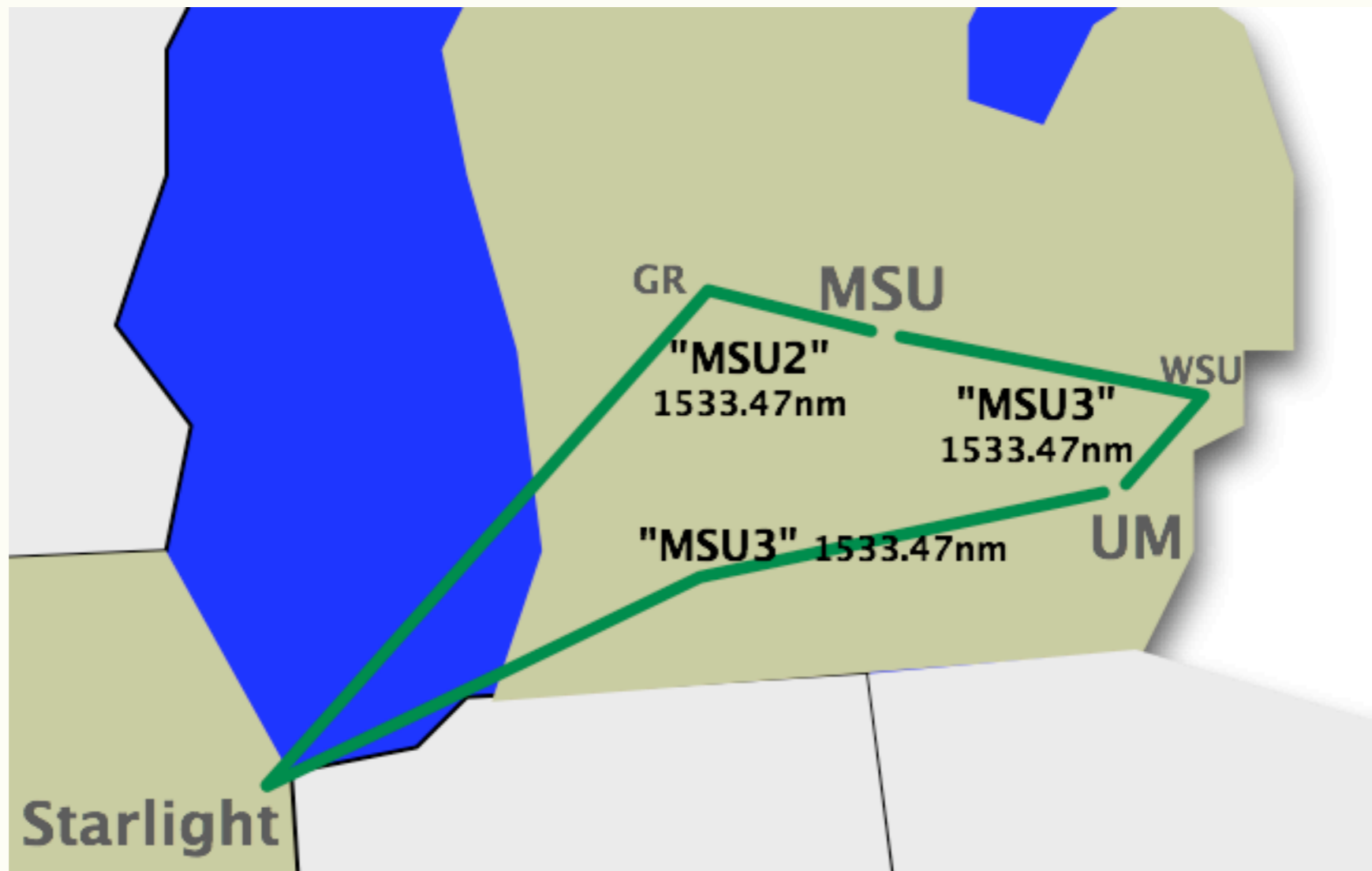
stressing the high-throughput connectivity to BNL/CERN

anticipate a steady-state ~2-3Gbs rate, bursting to 10Gbs

dedicated MSU-UM wavelength for all research?

doable with negotiated use of either regeneration point

L3 switch at both ends?

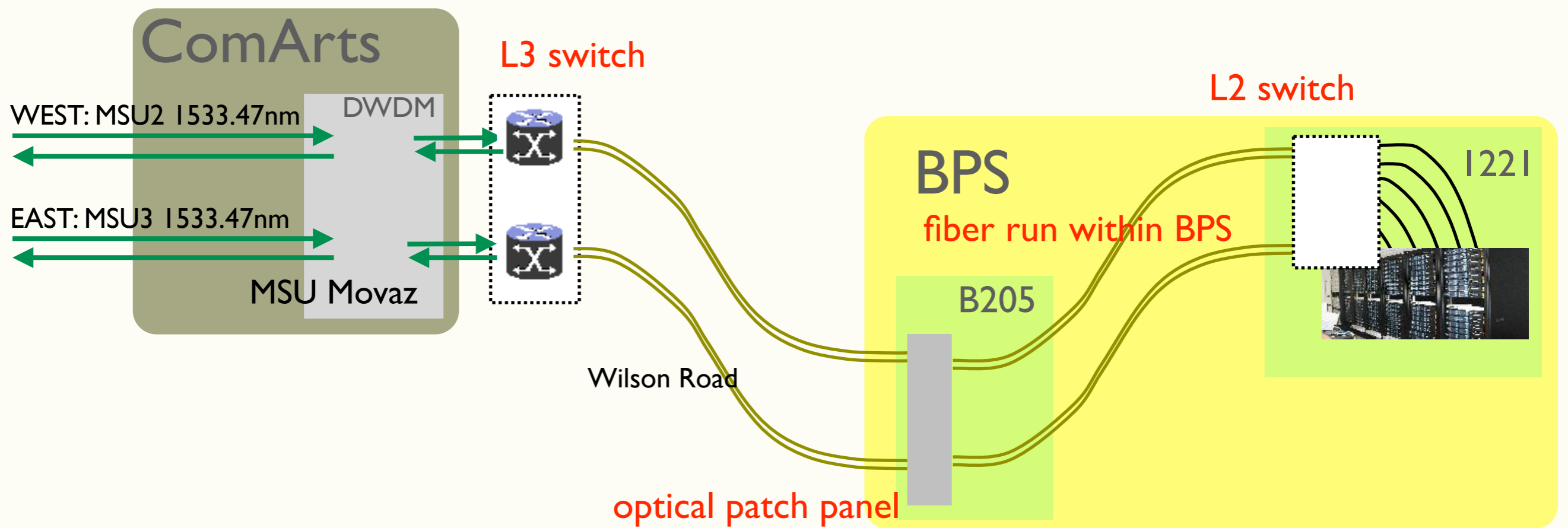


either MSU would break its regenerated pass-through in AA
or
UM would break its regenerated pass-through in EL

Campus 10Gbs connectivity

no routing, no new Movaz chassis or OAD blades

items in **red** are required



tape archival backup

we have been asked to provide archival backup

MSU/UM T2 systems, home directories, configurations

suggesting tape, HP MSL 6060 30 slot silo

suggestions here? is tape the right medium? is there Computer Center personnel/equipment that could be shared?

financial resources

(see spreadsheet)

- **RAID storage**

we would be front-loading cpu purchases

we need: RAID storage of about

cpu(kSI2k)/1.3 in TB...

eg, a rack of 150 kSI2k requires about 115 TB

- **campus 10Gbs equipment & help with monthly charges**

- **support for 1.5 technical personnel**

one of whom is an existing electrical engineer