FIU AMPATH Workshop - August 15-17, 2001

Parallel and Distributed Processing Group PDPG - UFRGS

Research's Projects

Prof. Dr. Cláudio Fernando Resin Geyer
geyer@inf.ufrgs.br

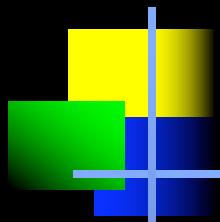
FEDERAL UNIVERSITY OF RIO GRANDE DO SUL
Porto Alegre - RS – Brazil

Professors Staff

- Alexandre Carissimi (Ph.D. - France)
- Cláudio F. Resin Geyer (Ph.D. - France)
- Fernando R. do Nascimento (Ph.D. - France)
- Philippe Olivier A. Navaux (Ph.D. - France)
- Simão Toscani (Ph.D. - Portugal)
- Tiarajú Asmuz Divério (Ph.D - Brazil)

Researchers Staff

- Graduated
  - o PHD Students: 12
  - o Ms.C. Students: 20
- Auxiliar Researcher: 2
- Undergraduated Students: 12



Current Goals

- Development of theoretical models for parallel processing driven for high performance applications;
- Proposal of theoretical models for distributed computing, including support for physical and logical mobilities;
- Development of tools for parallel and distributed computing: Visual Programming, Monitoring, Debbuging, Code Static Analysis, Scheduling Support, etc.

Current Projects

- APSE - *Superscalar Processor Architectures*
- DECK - *Distributed Execution and Communication Kernel*
- DPC++ - *Distributed Processing in C++*
- EXEHDA – *Execution Environment for High Distributed Applications*
- HetNOS - *Heterogeneous Network Operating System*
- HoloParadigm – *Multiparadigm Distributed Environment and Language*

Current Projects

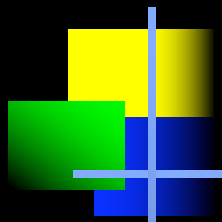
- ISAM – *Mobile Application Support Infrastructure*
- MultiCluster - *Support for Parallel Programming on Multiple Clusters*
- OPERA - *Implicit Parallel/Distributed Programming Environments*
- PADI - *PArallel Debugger Interface*
- SEGIME - *Medical Image Segmentation*
- SEMEAI - *Teaching-Learning Environment using Internet*

Computational Resources

- Sun Workstations (SunOs, Solaris)
- Dual Pentium Pro Clusters (Linux)
- Windows NT environment
- Cray T94 (2 x 1,8 Gflops)
- Array Processor with 144 processing elements

HPA Applications & Internet

- Cellular Growth Parallel Simulation
- Parallel Computational Model for 3D Hydrodynamics and Mass Transport
- Diffractive Physics – HEP



Cellular Growth Parallel Simulation

Cellular Growth Parallel Simulation

Motivation

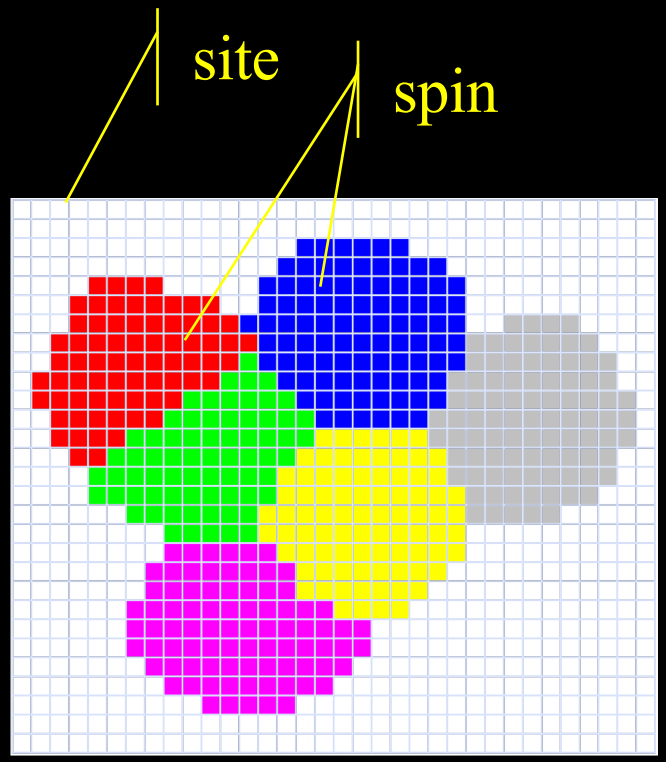
- To understand tumour growth by means of modeling evolutionary behavior of a cell:
  - cellular adhesion, mitose, defunctions…
- From Parallel Processing point of view:
  - High weight CPU-bound task;

    Use of parallel programming techniques aiming to achieve performance enhancements

Cellular Growth Parallel Simulation

Model

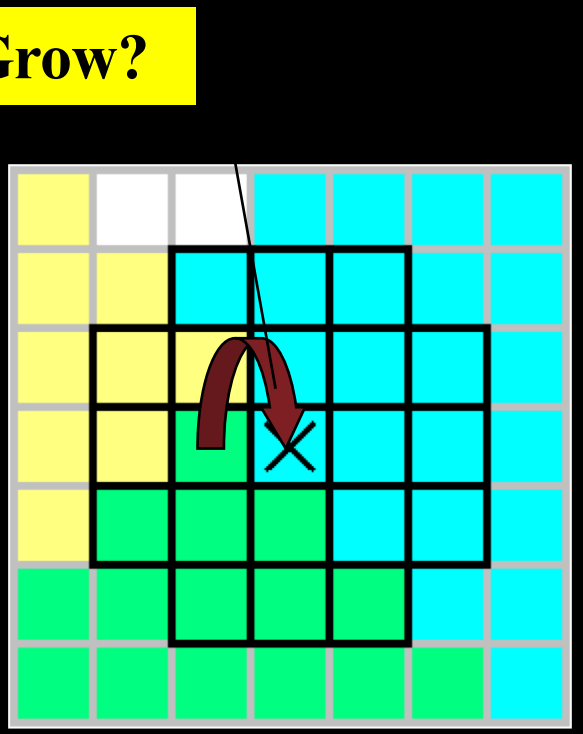
- Iterative process over a bidimensional (2D) matrix
  - Site (sítio): discretization unit
  - Spin: identifies to which cell a site belongs to.
- Two sub-steps: Monte Carlo and Mitose



Cellular Growth Parallel Simulation

Monte Carlo Phase

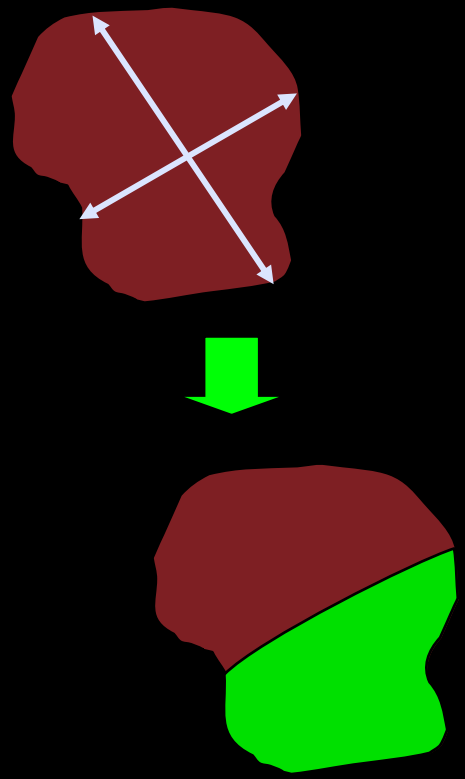
- Variation in cell's area:
  - Simulation of thermal fluctuations by a random lottery approach over the matrix sites + neighborhood and area analysis
  - CPU cost of this phase is constant (fixed number of iterations)



Cellular Growth Parallel Simulation

Mitose Phase

- Cell partition when its distortion reaches a parameterized threshold
  - Distortion: ratio between the larger and smaller cell diameters
  - CPU cost vary (proportional to the number of cells in a given moment)



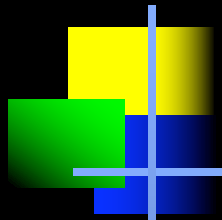
Cellular Growth Parallel Simulation

Monte Carlo Parallelization

- Two approaches:
  - Threads + shared memory:

    Specific target (SUN Workstation)
  - Processes + message passing:

    Specific target: LAN (the current implementation uses a standard UNIX socket library) + Myrinet



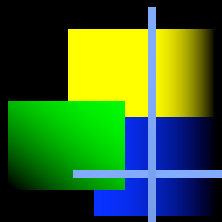
Parallel Computational Model for 3D Hydrodynamics and Mass Transport

3D Hydrodynamics

- Parallel computational model for 3D hydrodynamics and mass transport : Conservative and high quality numerical schemes for simulation of hydrodynamic behavior and mass transport in water bodies.
- Parallel solution: the high computational performance is obtained with the parallelization of the solvers (data decomposition) and/or the decomposition of the problem in subproblems (domain decomposition);
- Solution methods for the systems of equations: the local and global solution methods are Krylov subspace and Cholesky;

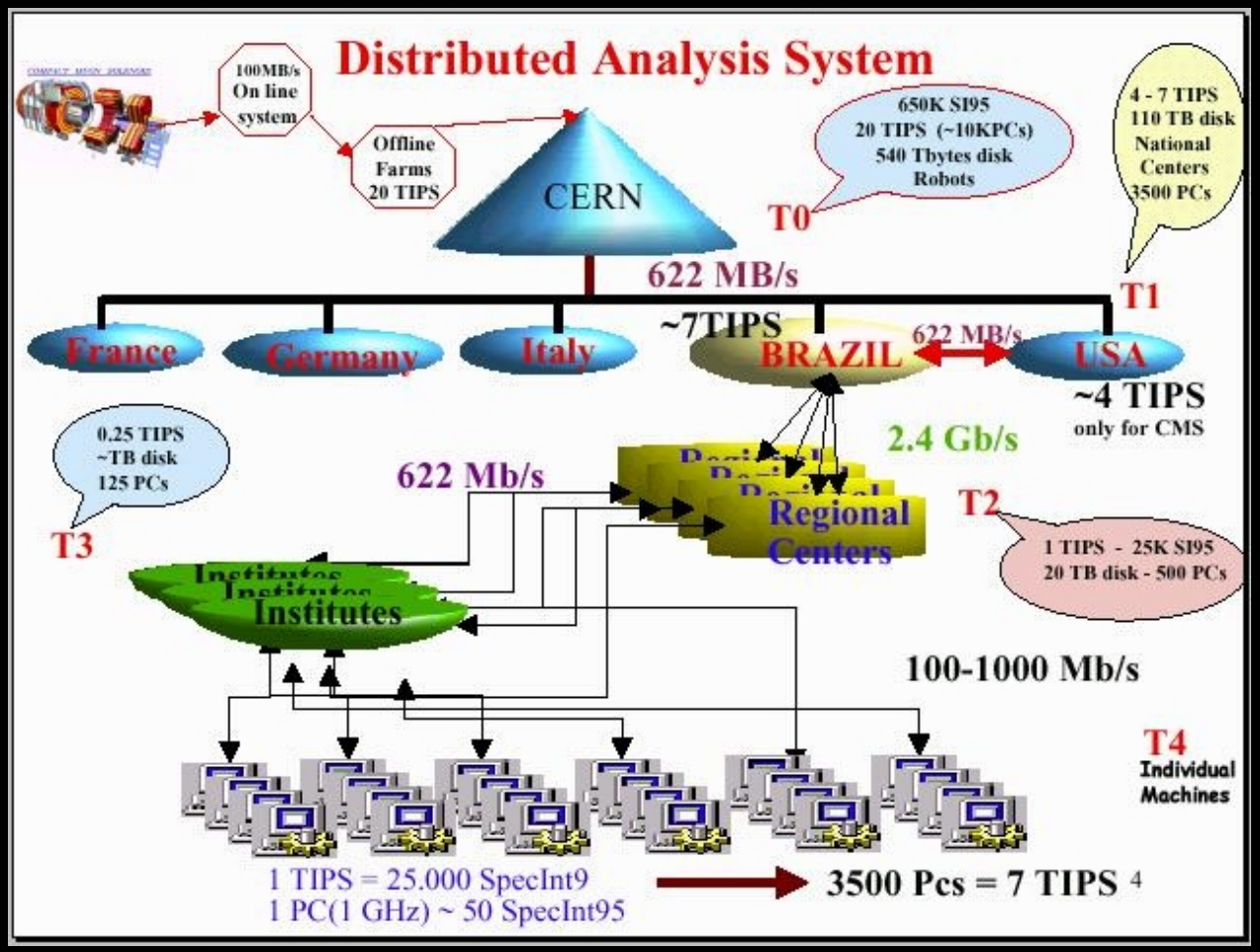
3D Hydrodynamics

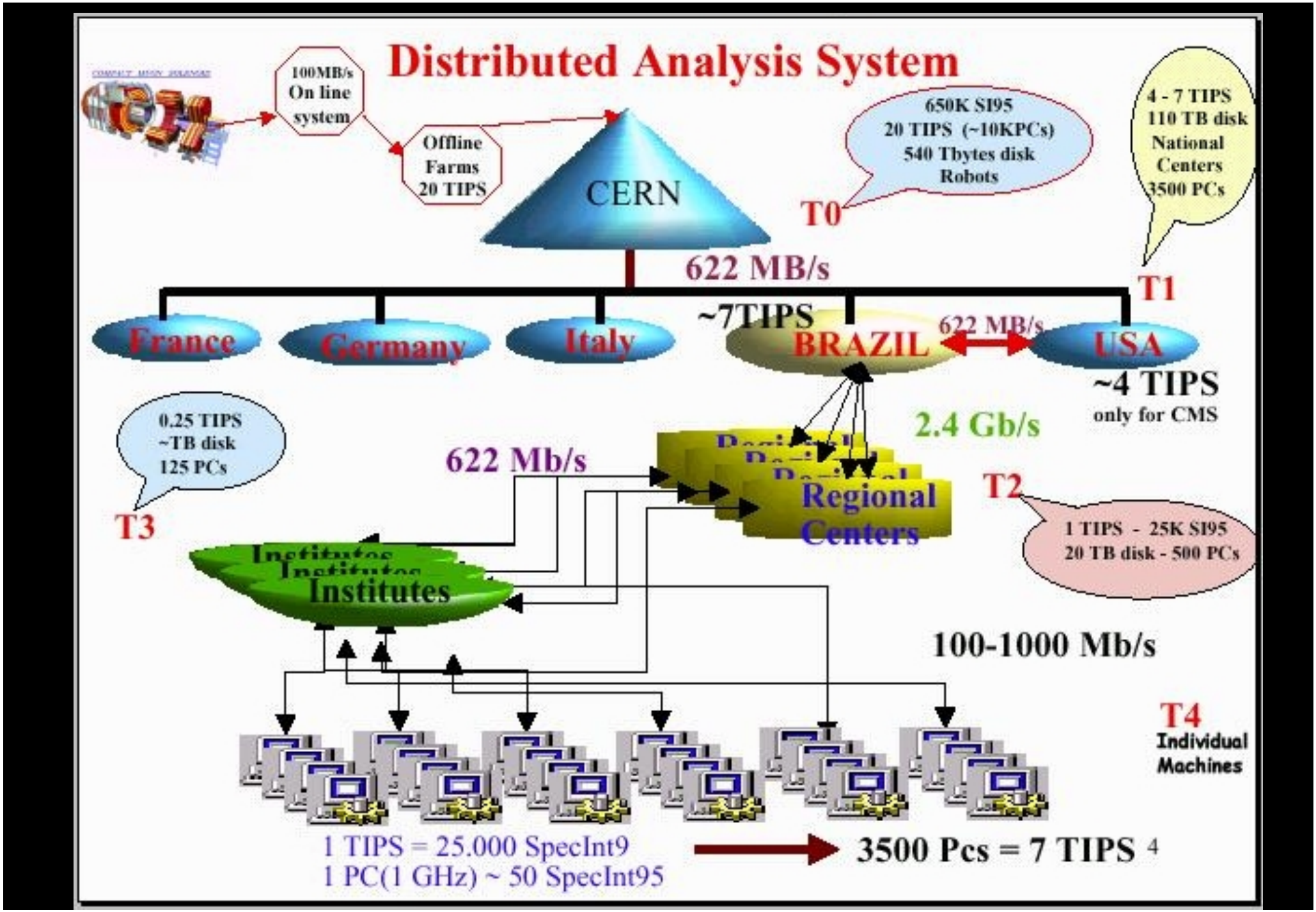
- Local refinement: necessary to capture the details of transport and control the numerical oscilations;
- Domain partitioning: building irregular subdomains which allow domain partitioning between the processors such to obtain an optimal balancing;
- Multiphase problem: hydrodynamics and mass transport constitute a problem which must be solved in different time steps;
- Dynamic load balancing: uses diffusion algorithms to transfer, during execution, the load from the heavily loaded nodes to the neighbour nodes;



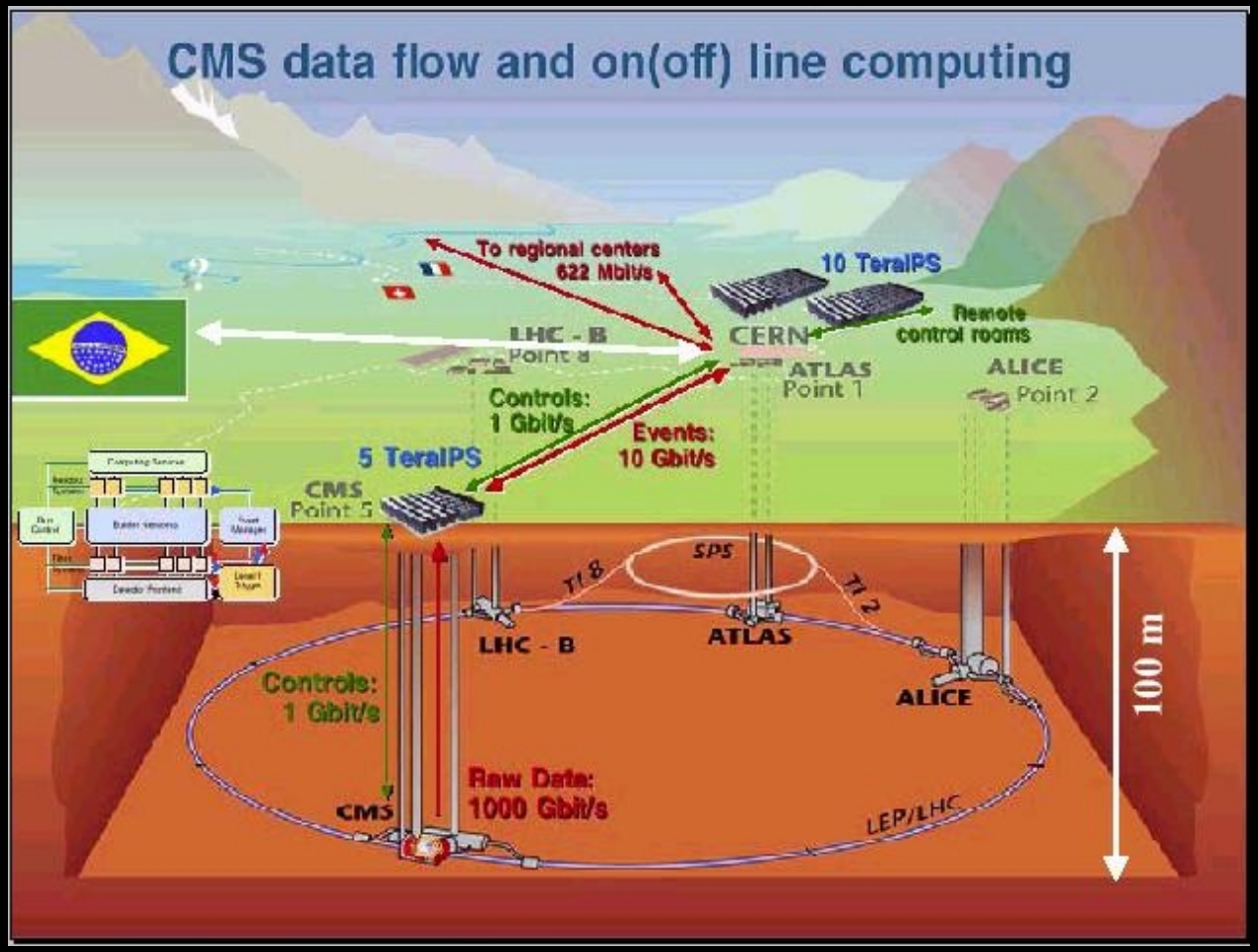
Diffractive Physics - HEP

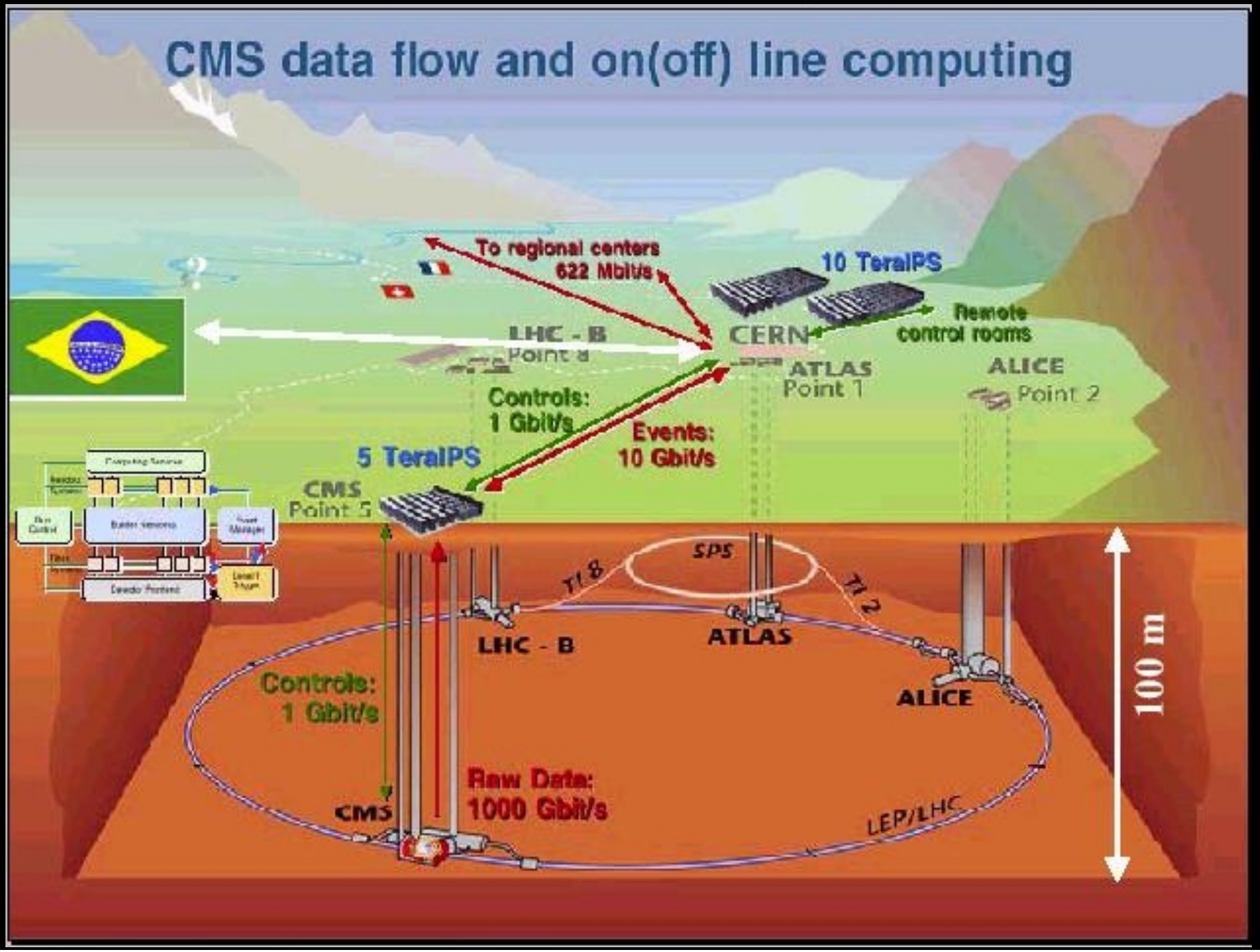
Diffractive Physics - HEP



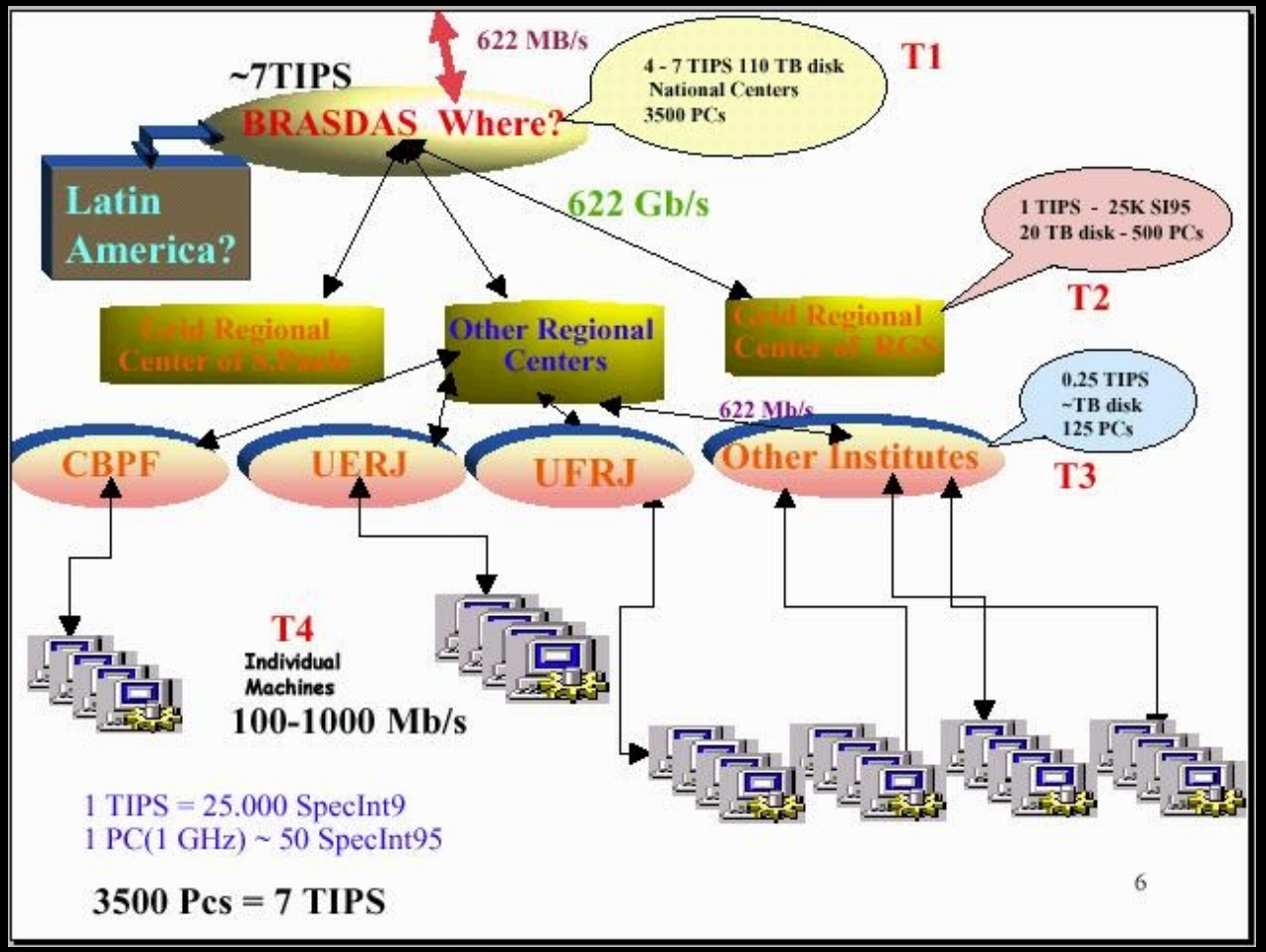

Distributed Analysis System
100MB/s
On line
system
Offline
Farms
20 TIPS
CERN
650K SI95
20 TIPS (~10KPCs)
540 Tbytes disk
Robots
T0
4 - 7 TIPS
110 TB disk
National
Centers
3500 PCs
T1
622 MB/s
~7TIPS
France
Germany
Italy
BRAZIL
622 MB/s
USA
~4 TIPS
only for CMS
2.4 Gb/s
0.25 TIPS
~TB disk
125 PCs
T3
622 Mb/s
Regional
Centers
T2
1 TIPS - 25K SI95
20 TB disk - 500 PCs
Institutes
100-1000 Mb/s
T4
Individual
Machines
1 TIPS = 25.000 SpecInt9
1 PC(1 GHz) ~ 50 SpecInt95
3500 Pcs = 7 TIPS

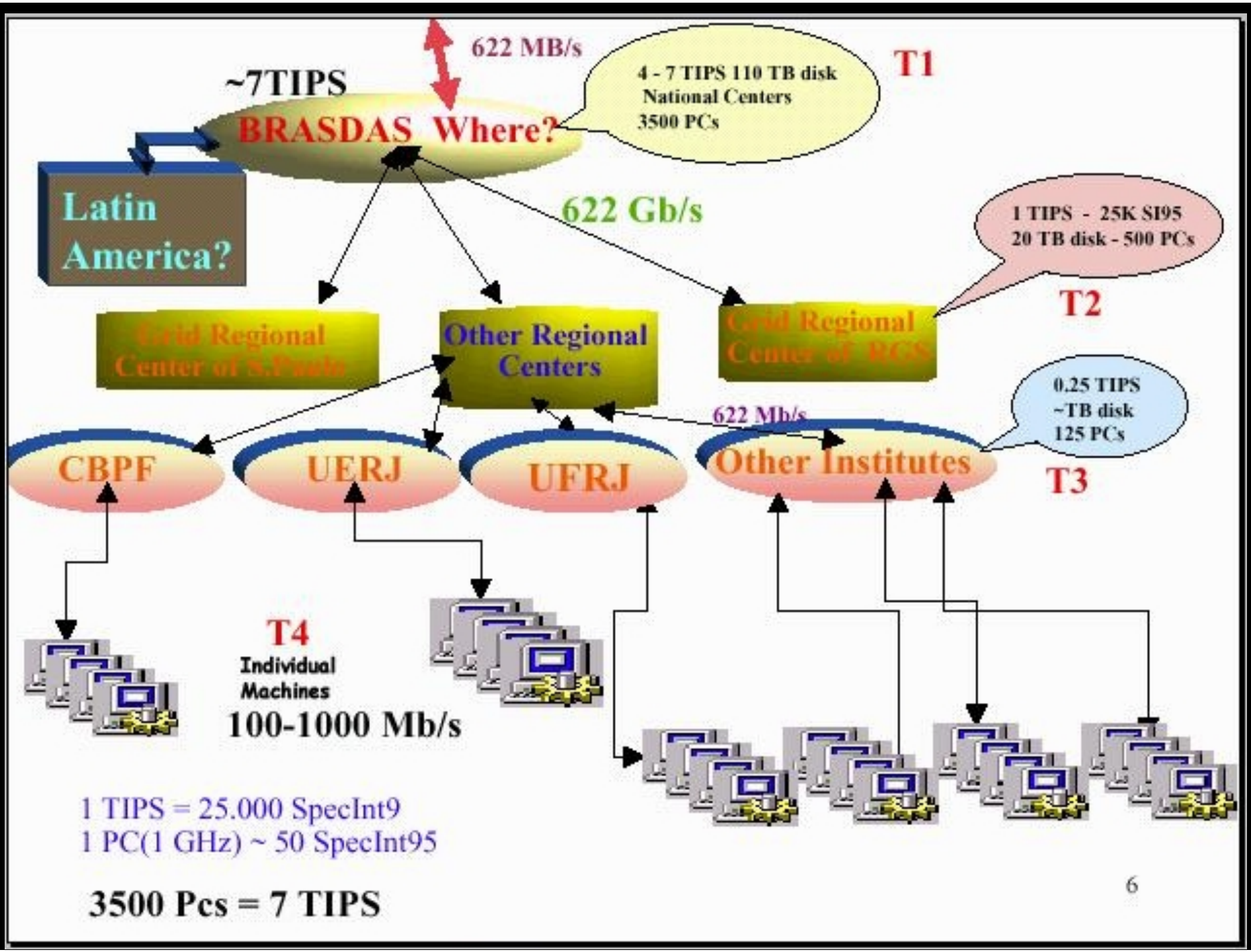
Diffractive Physics - HEP



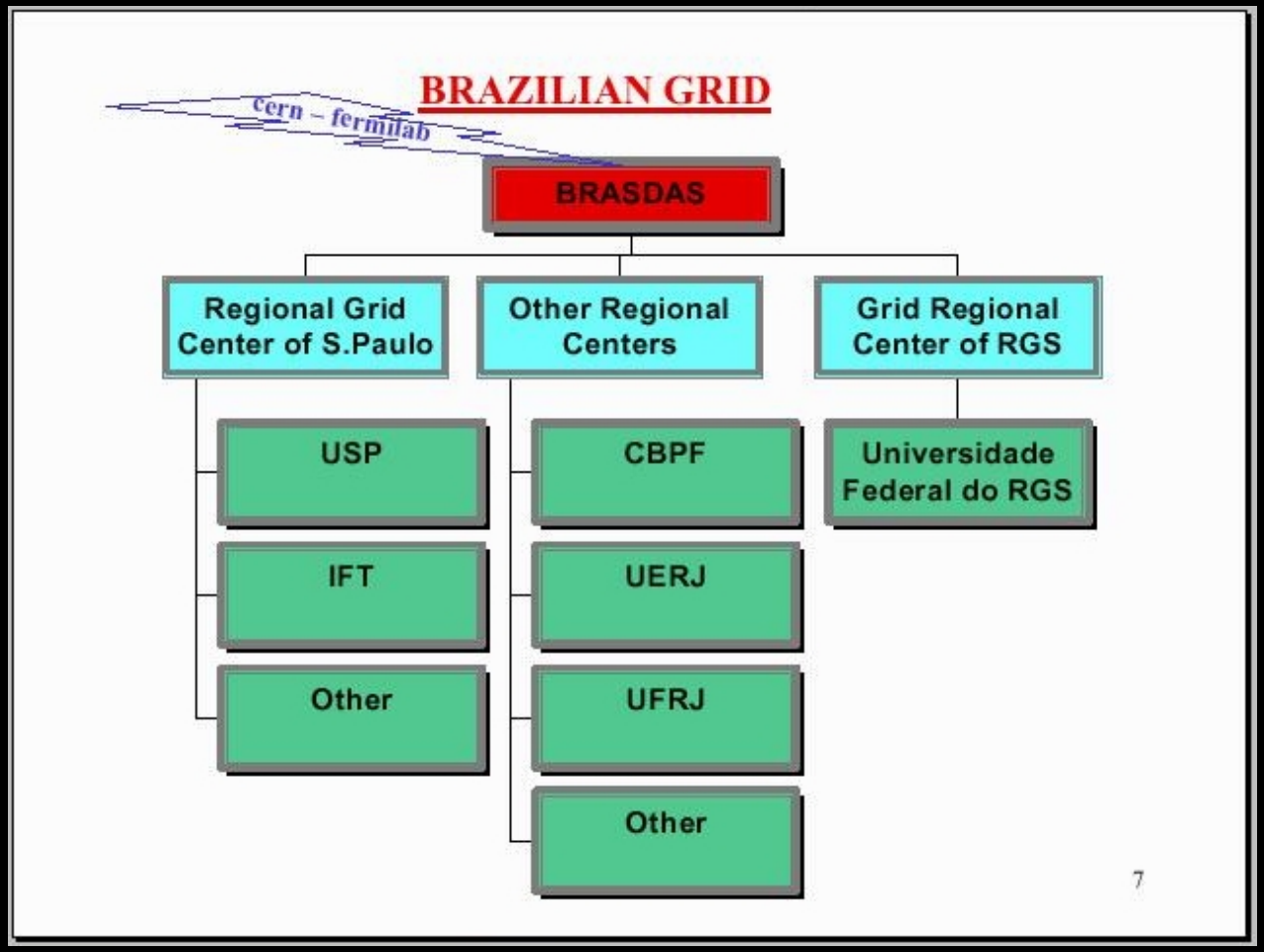

CMS data flow and on(off) line computing
To regional centers
622 Mbit/s
10 TeraIPS
Remote
control rooms
LHC - B
Point 8
CERN
ATLAS
Point 1
ALICE
Point 2
Controls:
1 Gbit/s
Events:
10 Gbit/s
5 TeraIPS
CMS
Point 5
SPS
TI 8
TI 2
LHC - B
ATLAS
ALICE
Controls:
1 Gbit/s
Raw Data:
1000 Gbit/s
CMS
LEP/LHC
100 m

Diffractive Physics - HEP

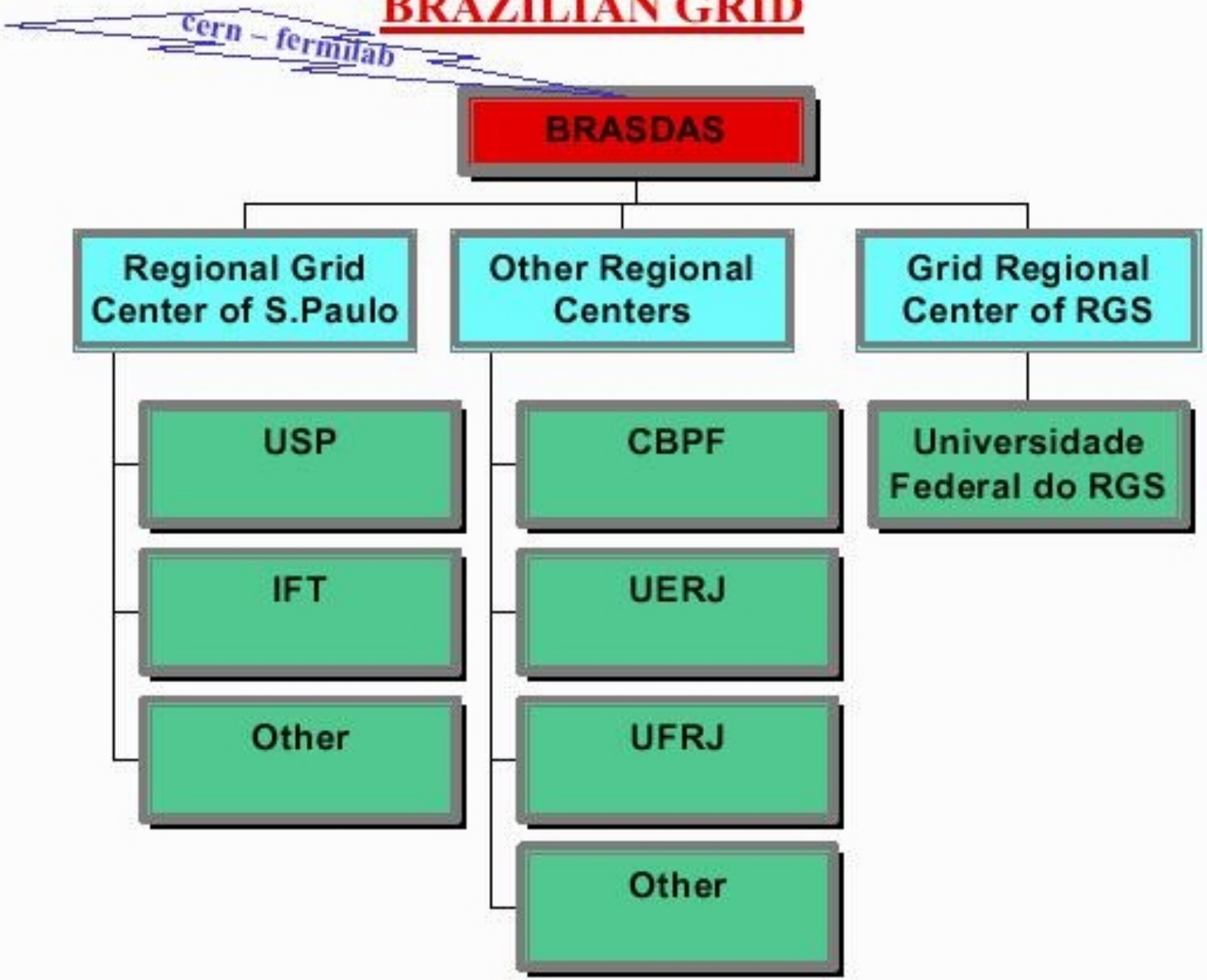



622 MB/s
~7TIPS
BRASDAS Where?
4 - 7 TIPS 110 TB disk
National Centers
3500 PCs
T1
Latin America?
622 Gb/s
1 TIPS - 25K SI95
20 TB disk - 500 PCs
T2
Grid Regional Center of S.Paulo
Other Regional Centers
Grid Regional Center of RGS
622 Mb/s
0.25 TIPS
~TB disk
125 PCs
CBPF
UERJ
UFRJ
Other Institutes
T3
T4
Individual Machines
100-1000 Mb/s
1 TIPS = 25.000 SpecInt9
1 PC(1 GHz) ~ 50 SpecInt95
3500 Pcs = 7 TIPS

Diffractive Physics - HEP



BRAZILIAN GRID



Cooperation projects

- Hep - BRASDAS-Brazilian Distribution Analysis System
  - Alberto Franco de Sá Santoro: brazilian physicist
  - Partners

    LNCC, UFRGS, Femilab, CERN, other brazilian universities

    Dzero X Fermilab,

    CMS-Compact Muon Solenoid X CERN

    Great number of brazilian phyisicists and engineers
  - Needs

    600 Mbs

Cooperation projects

- High Performance Constraint Logic Programming Systems
  - CNPq-NSF
  - in progress
  - Partners:

    UDallas, NMSU, SUNY, Bell Labs,UFRJ, UFRGS and UCPel
  - Needs

    Use of USA parallel machines

Cooperation projects

- High Performance Inductive Logic Programming for Biochemical applications
  - Partners

    Wisconsin, Prof. C. David Page, UFRJ, UFRGS
  - Starting
  - Needs

    Use of USA parallel machines

Cooperation projects

- Access Grid
  - Hw (environment) and sw for video conferences and scientific meetings
  - Needs
    - 20 Mbs
  - First event
    - Global Super Computing 2001
  - URL of Access Grid: http://www.accessgrid.org/
  - URL of SC01: http://www.sc2001.org/
  - Partners
    - UFRGS, Argonne, others

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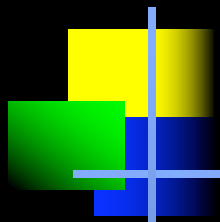
Computer Architecture and Operating Systems Group
Systems Engineering and Computer Science Department
COPPE/UFRJ
Research Projects

http://www.cos.ufrj.br

FEDERAL UNIVERSITY OF RIO DE JANEIRO
Rio de Janeiro – RJ – Brazil



Staff

- Cláudio Amorim (Ph.D. - England)
- Edil S. T. Fernandes (Ph.D. - England)
- Eliseu M. Chaves Filho (D.Sc. - Brazil)
- Felipe M. G. França (Ph.D. - England)
- Inês de Castro Dutra (Ph.D. - England)
- Ricardo Bianchini (Ph.D. – USA)
- Valmir Carneiro Barbosa (Ph.D. - USA)
- Vítor Santos Costa (Ph.D. - England)

{amorim,edil,eliseu,felipe,ines,ricardo,valmir,vitor}@cos.ufrj.br

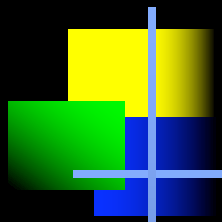
Students

Total of active students in the Department:

- 160 M.Sc.
- 120 D.Sc

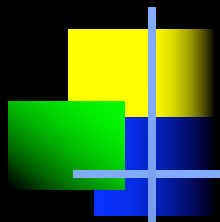
ASO students:

- D.Sc. Students: 9
- Ms.C. Students: 20



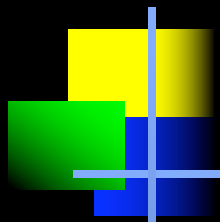
Current Projects

- Theory of Parallel and Distributed Computing
- Applications of Parallelism to Complex Systems
- Parallel and Distributed Algorithms



Current Projects

- Java for high performance network-based computing
- Scalable and interactive VoD servers
- Scalable servers for E-commerce
- Parallel applications in engineering
- Software and hardware tools for performance debugging and monitoring of parallel applications



Current Projects

- High Performance Symbolic Computing
- High Performance Biocomputing
- Parallel Applications in Artificial Intelligence
- Memory Management and Performance Evaluation of Parallel Application

Links

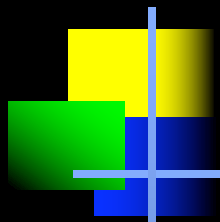
http://www.cos.ufrj.br/~amorim
http://www.cos.ufrj.br/~edil
http://www.cos.ufrj.br/~eliseu
http://www.cos.ufrj.br/~felipe
http://www.cos.ufrj.br/~ines
http://www.cos.ufrj.br/~ricardo
http://www.cos.ufrj.br/~valmir
http://www.cos.ufrj.br/~vitor

Computational Resources

- Sun Workstations (Solaris 2.x)
- Dual Pentium Pro Clusters (Linux)
- Windows 98 network
- Cray J90
- Myrinet
- Fast Ethernet
- Giganet

Cesup

- National centers for high-performance computing
- Several centers located at
  - Porto Alegre
  - Sao Paulo
  - Rio de Janeiro
  - Fortaleza
  - others



Cesup

- Used by multi-domain applications
- Physics, chemistry, mathematics, engineering, …
- Porto Alegre, UFRGS
  - Cray T94 (2 x 1,8 Gflops)
  - Sillicon Graphycs stations

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