



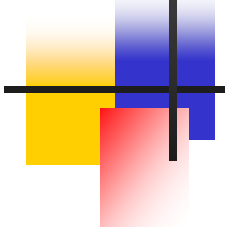
Interactivity on the Grid

ARDA workshop

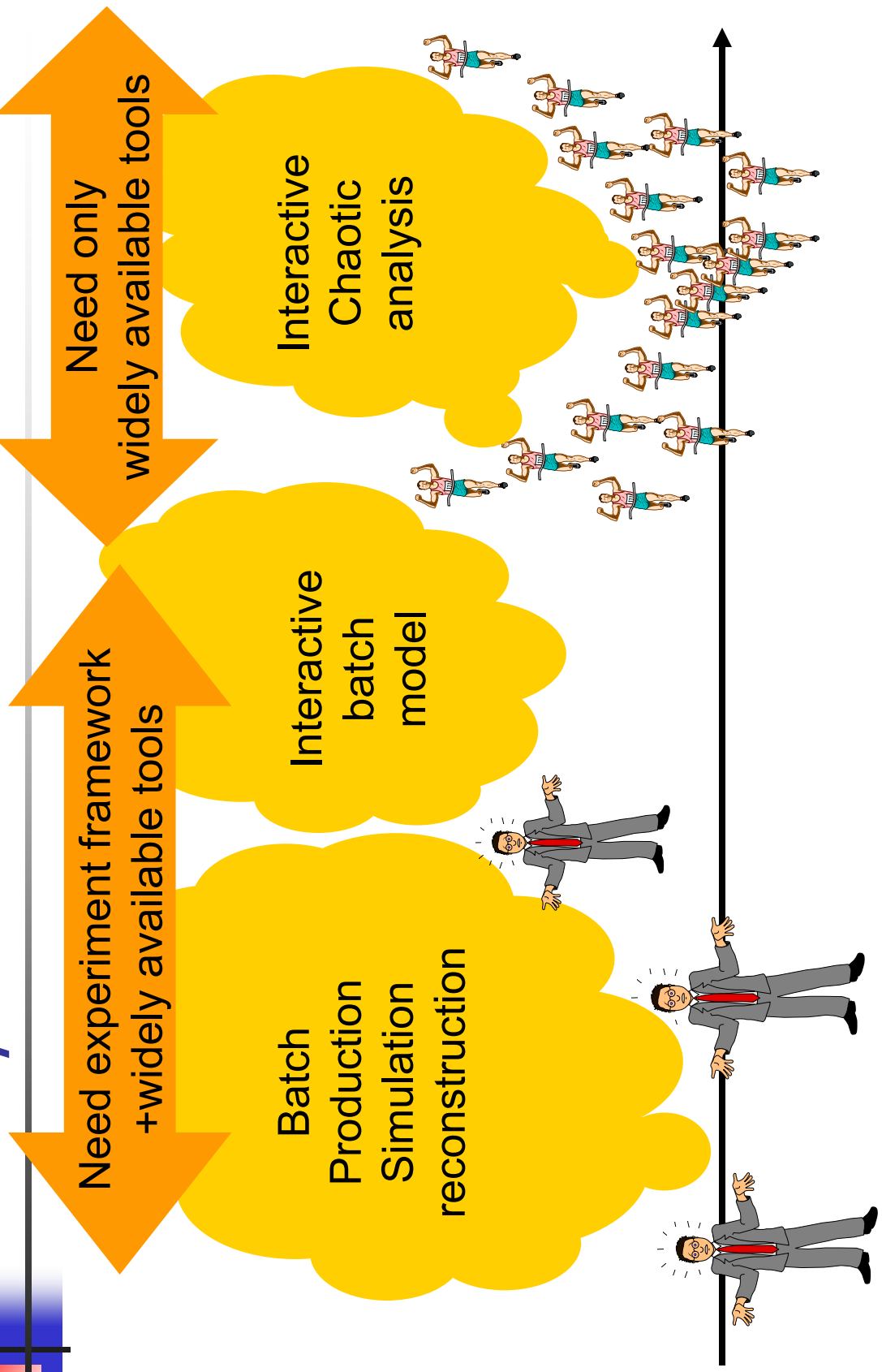
CERN 23 June 2004

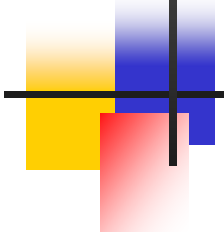
René Brun

CERN



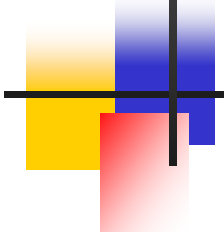
Batch/Interactive models





Batch-mode Local analysis

- Conventional model: The user has full control on the event loop.
- The program produces histograms, ntuples or trees.
- The selection is via user private code
- Histograms are then added (tool or in the interactive session)
- ntuples/trees are combined into a chain and analyzed interactively.

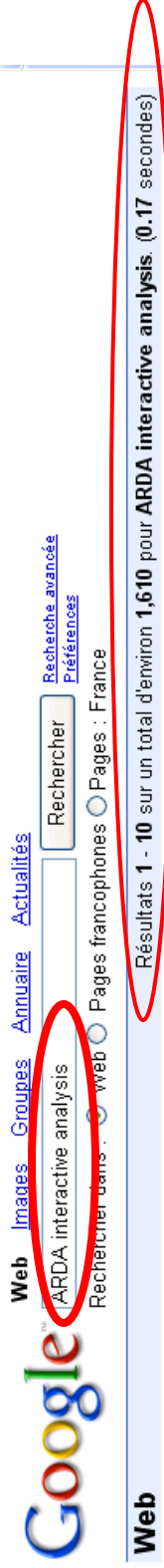


Batch Analysis on the GRID

- From a user viewpoint, a simple extrapolation of the local batch analysis.
- In practice, must involve all the GRID machinery: authentication, resource brokers, sandboxes.
- Viewing the current status (histograms) must be possible.
- Advantage: Stateless, can process large data volumes.

Google: a good model

Make it simple



[PDF](#) [The ALICE Analysis Approach ARDA](#)

Format de fichier: PDF/Adobe Acrobat - Version HTML

... Andreas J. Peters CERN/Geneva @ **ARDA** Workshop 21.12.2004 **Interactive Analysis** model with PROOF PROOF allows **interactive analysis** on local clusters with a ...

[agenda.cern.ch/askArchive.php?base=agenda&categ=a036745&id=a036745s11/transparencies](#) - [Pages similaires](#)

[PDF](#) [Microsoft PowerPoint - ArdaAppsJan04_gro.1074762582.ppt](#)

Format de fichier: PDF/Adobe Acrobat - Version HTML

... **ARDA** Workshop Jan 2004 Slide 7 Torre Wenaus, BNL/CERN **Interactive Analysis** Tools

Interfacing to tools supporting **interactive** (low-latency, rapid-response ...

[agenda.cern.ch/askArchive.php?base=agenda&categ=a036745&id=a036745s6t1%2Ftransparencies%2FArdaApp...](#) - [Pages similaires](#)

[[Autres résultats](#), [domaine agenda.cern.ch](#)]

[RTAG11 ARDA Documents](#) - [[Traduire cette page](#)]

... presentation to GpPhyN meeting [ppt, pdf], October 3, **ARDA** SC2 report ... Components and Services" [link] CS11 use cases for **interactive analysis** -> Grid services ...

[www.uscms.org/s&c/lcg/ARDA/docs.html](#) - [7k](#) - [En cache](#) - [Pages similaires](#)

[PDF](#) [www.uscms.org/s&c/lcg/ARDA/presentations/2003-09-18-ARDA-nwg.ppt](#)

Format de fichier: Microsoft Powerpoint 97 - Version HTML

... **ARDA** services present an API, called by applications like the experiments frameworks, **interactive analysis** packages, Grid portals, Grid shells, etc. ...

[Pages similaires](#)

[[Autres résultats](#), [domaine www.uscms.org](#)]

[PDF](#) [ADA: ATLAS Distributed Analysis](#)

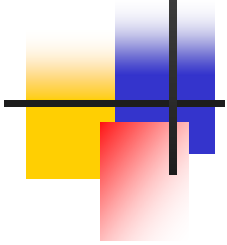
Format de fichier: Microsoft Powerpoint 97 - Version HTML

... Incorporate ideas from PPDG, **ARDA**, ... If available in time. ... 14. David Adams.

ATLAS. Deliverables for first release (cont). **Interactive analysis** service. ...

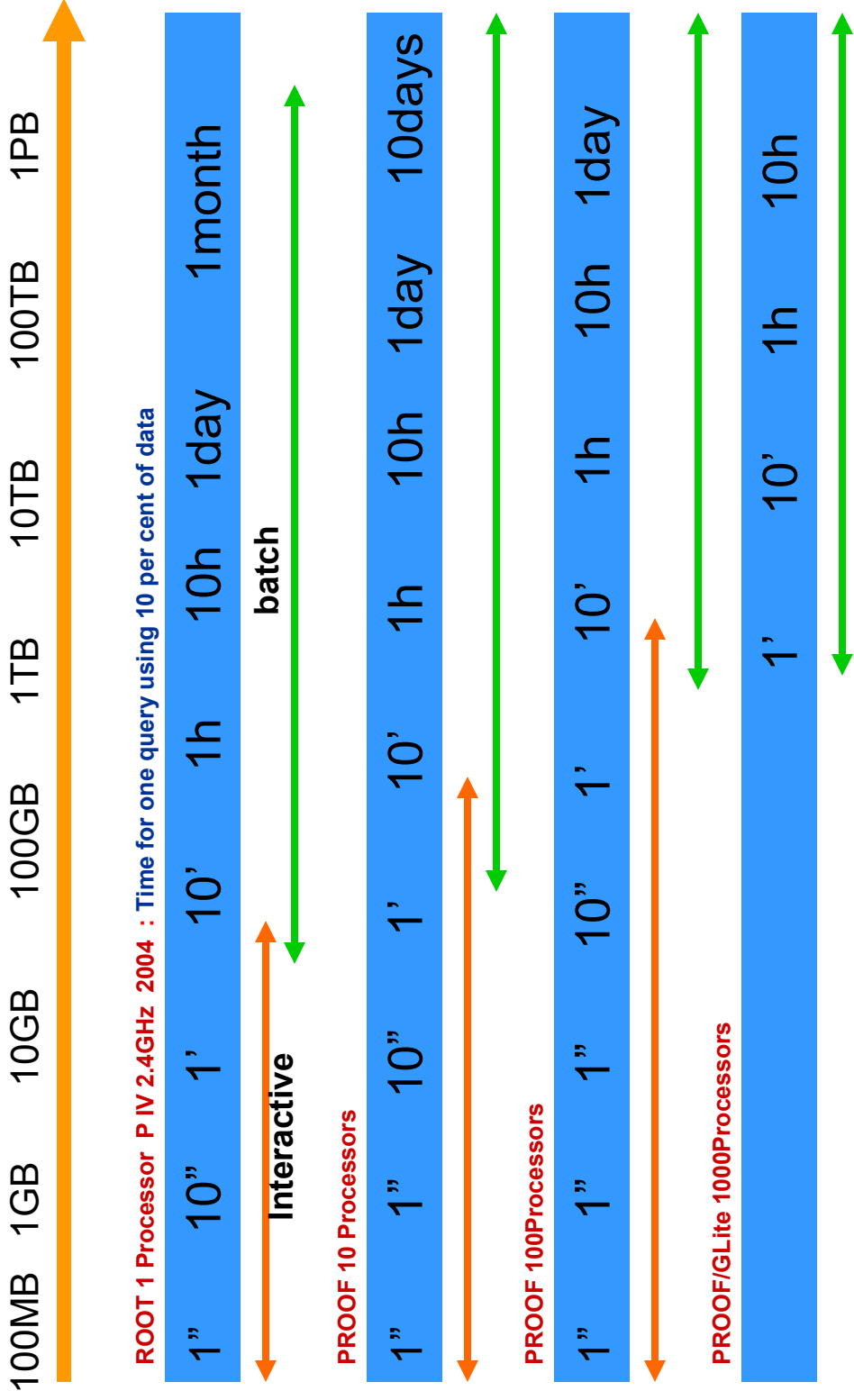
[www.usatlas.bnl.gov/ADAXtalks/031215_ada.ppt](#) - [Pages similaires](#)

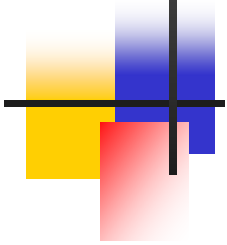
Simple interface
Available everywhere
Hidden Parallelism
Distributed DB
Don't know a priori
the data location
Fast



Data Volume & Processing Time

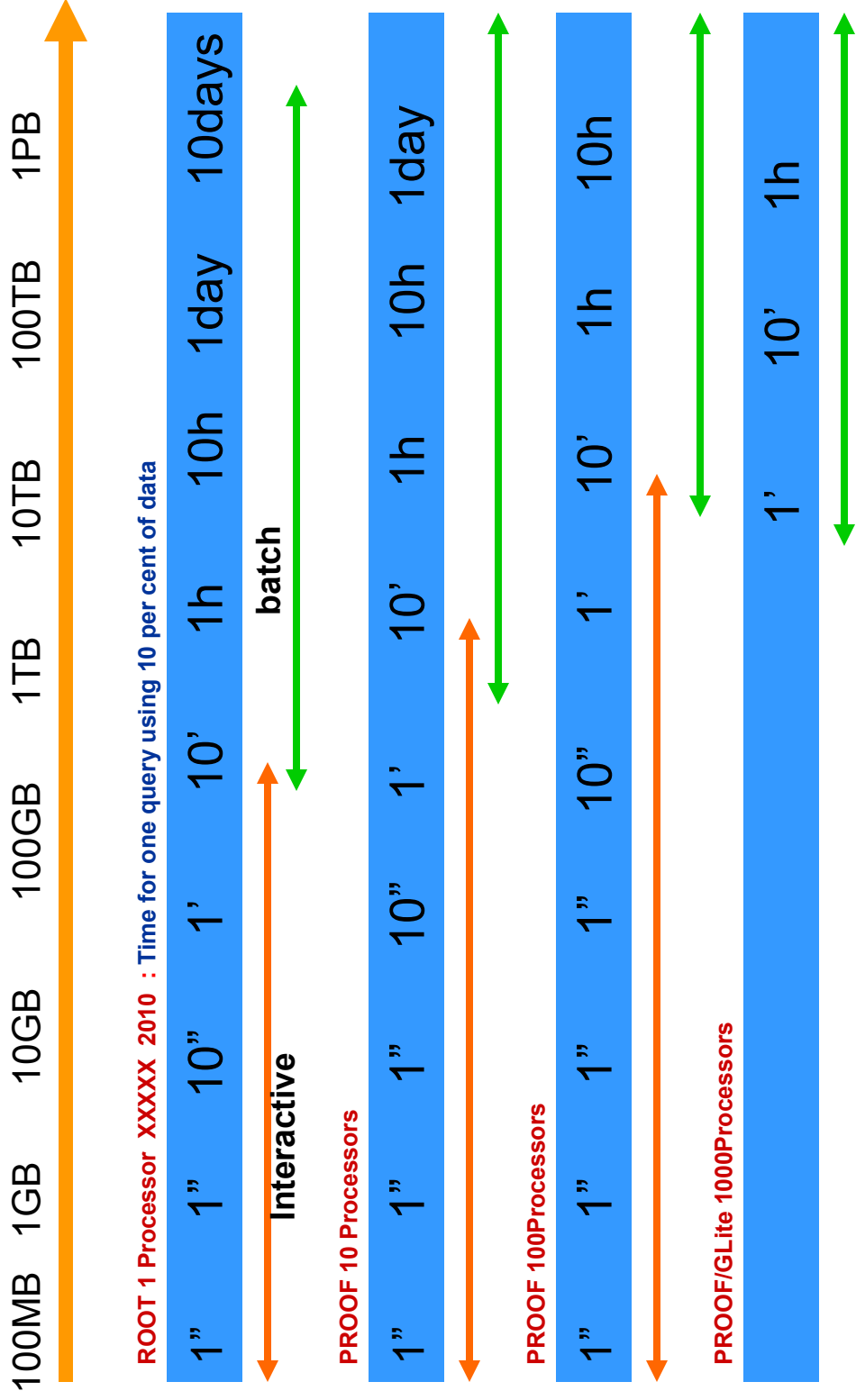
Using technology available in 2004



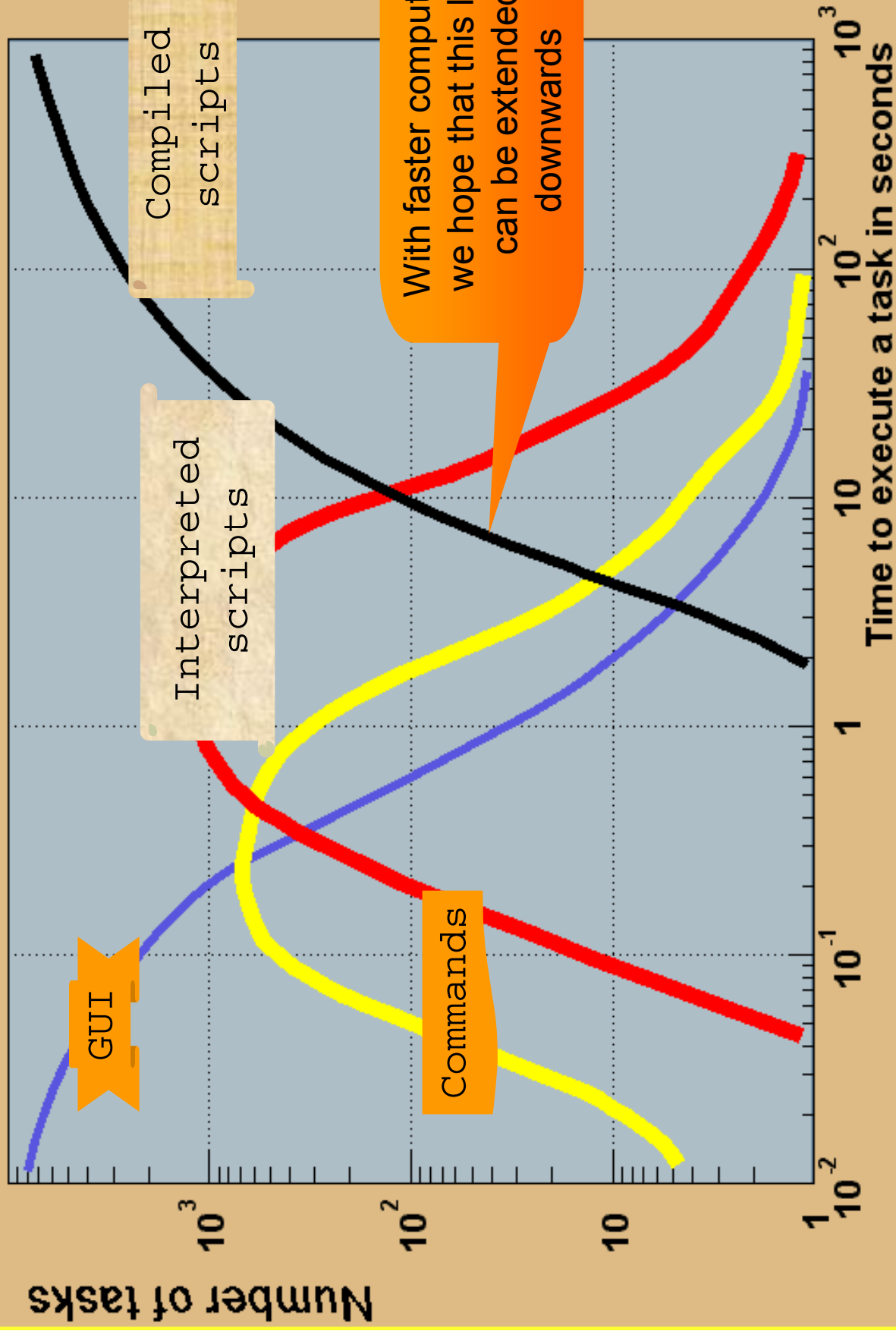


Data Volume & Processing Time

Using technology available in 2010



Interpreter to Compiler

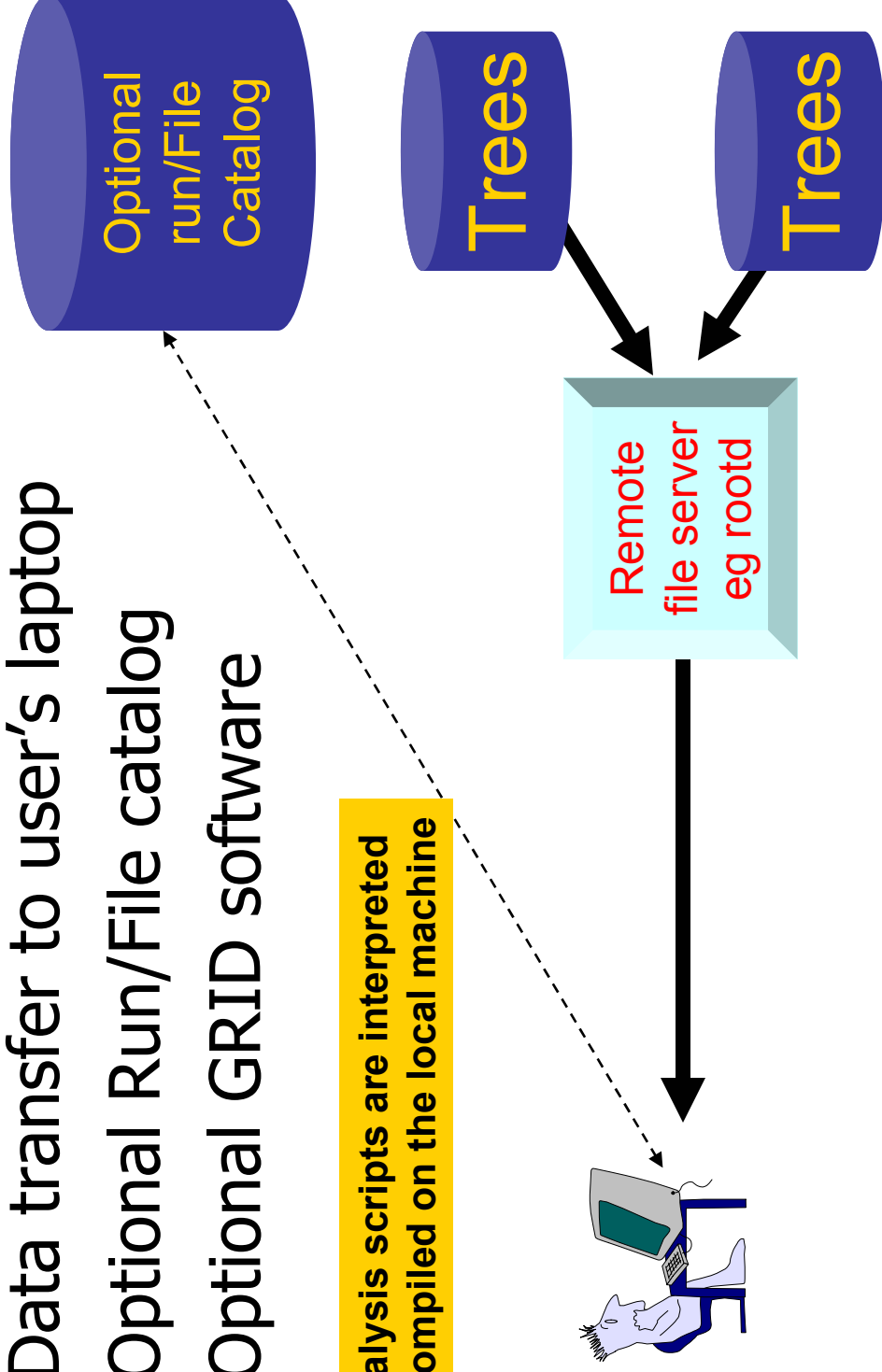


GRID: Interactive Analysis

Case 1

- Data transfer to user's laptop
- Optional Run/File catalog
- Optional GRID software

Analysis scripts are interpreted or compiled on the local machine

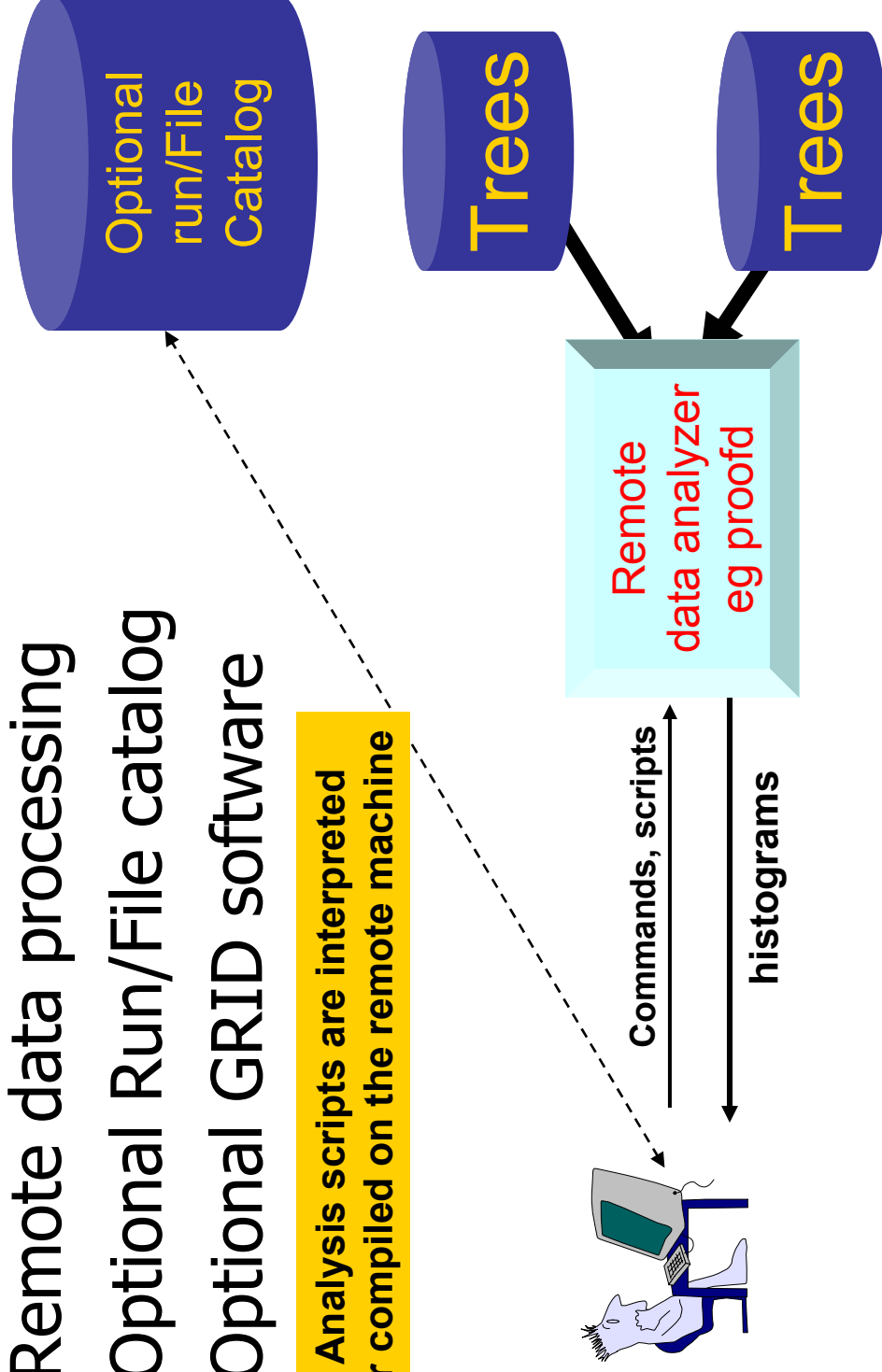


GRID: Interactive Analysis

Case 2

- Remote data processing
- Optional Run/File catalog
- Optional GRID software

Analysis scripts are interpreted or compiled on the remote machine

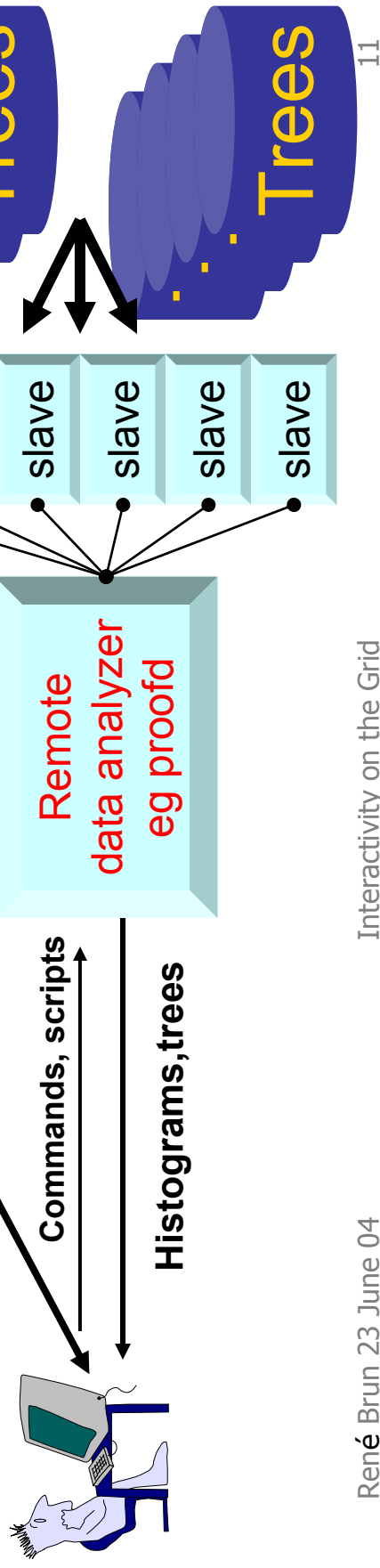


GRID: Interactive Analysis

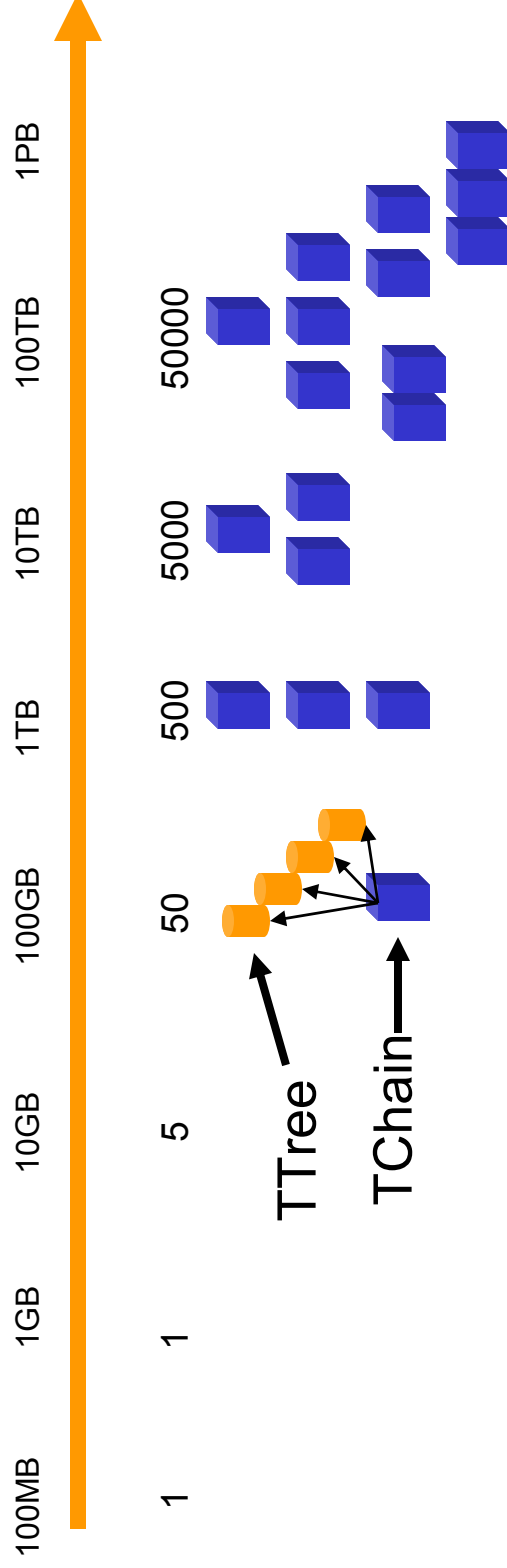
Case 3

- Remote data processing
- Run/File catalog
- Full GRID software

Analysis scripts are interpreted or compiled on the remote master(s)



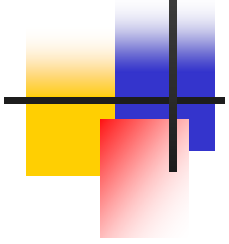
Data Volume & Organisation



A TFile typically contains 1 TTree (or a few)

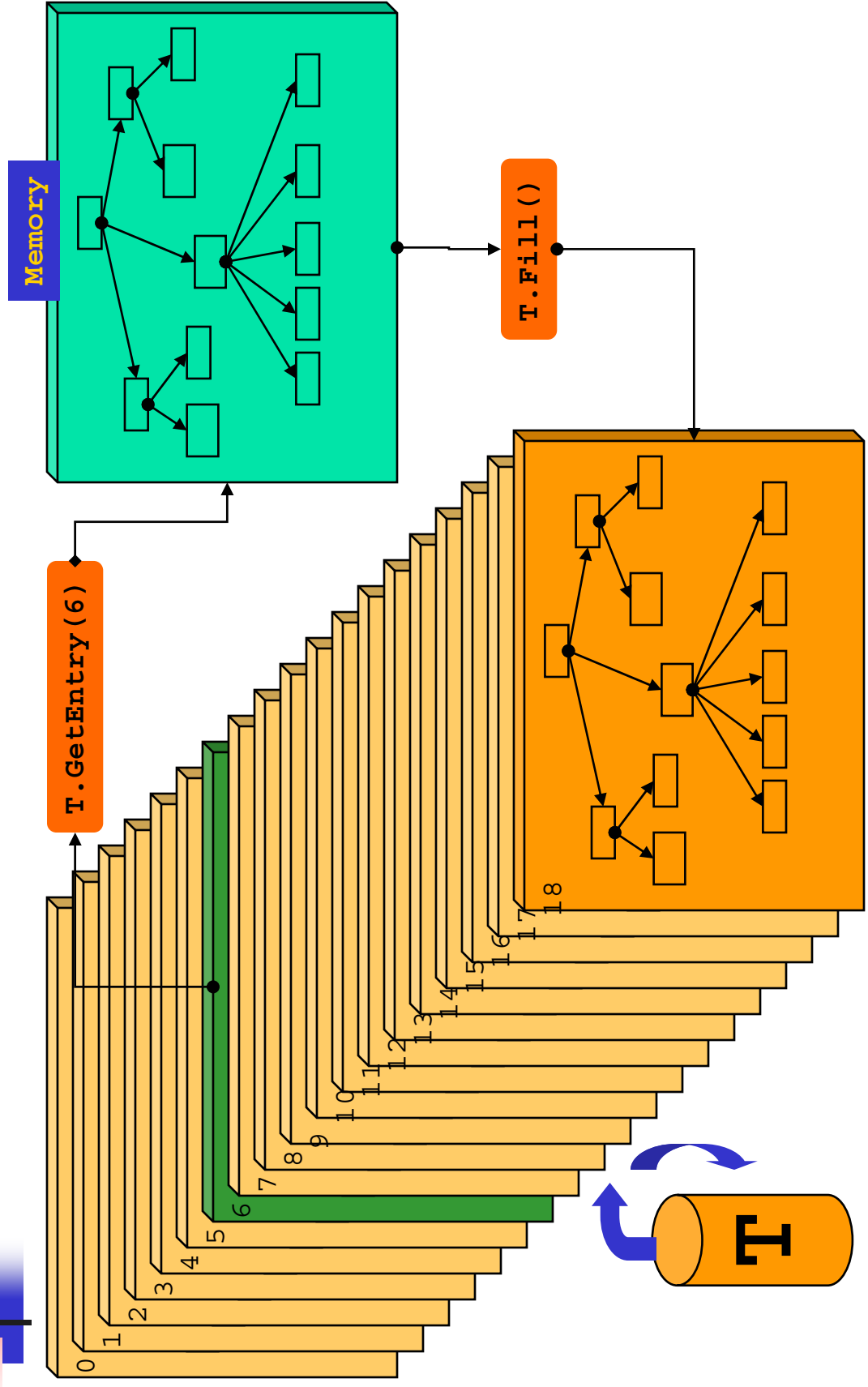
A TChain is a collection of TTrees or/and TChains

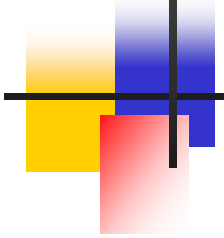
A TChain is typically the result of a query to the file catalogue



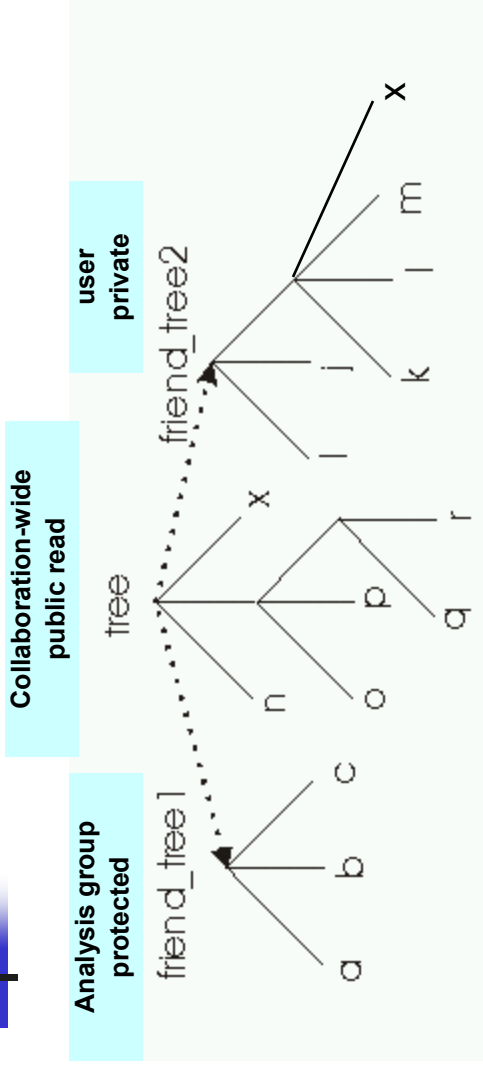
Memory \leftrightarrow Tree

Each Node is a branch in the Tree





Tree Friends



Processing time independent of the number of friends unlike table joins in RDBMS

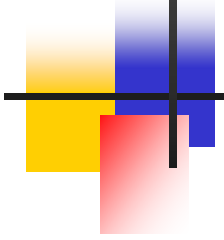
```
Root > TFile f1("tree1.root");
Root > tree.AddFriend("tree2", "tree2.root")
Root > tree.AddFriend("tree3", "tree3.root");
Root > tree.Draw("x:a", "k<c");
Root > tree.Draw("x:tree2.x", "sqrt(p)<b");
```



Chains of Trees

- A TChain is a collection of Trees.
- Same semantics for TChains and TTrees
 - **root > .x h1chain.C**
 - **root > chain.Process("h1analysis.C")**

```
{  
    //creates a TChain to be used by the h1analysis.C class  
    //the symbol H1 must point to a directory where the H1 data sets  
    //have been installed  
  
    TChain chain("h42");  
    chain.Add("$H1/dstarpb.root");  
    chain.Add("$H1/dstarp1a.root");  
    chain.Add("$H1/dstarp1b.root");  
    chain.Add("$H1/dstarp2.root");  
}
```



TSelector – The Algorithms

- Basic ROOT TSelector

```
// Abbreviated version
class TSelector : public TObject {
Protected:
    TList *fInput;
    TList *fOutput;
public
    void Init(TTree*);
    void Begin(TTree*);
    void SlaveBegin(TTree *);
    Bool_t Process(int entry);
    void SlaveTerminate();
    void Terminate();
};
```

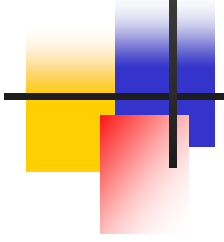
A skeleton selector
Is automatically
generated
By
TTree::MakeSelector



Selectors

- A Selector script can be run
 - In batch
 - Interactive ROOT
 - Interactive ROOT + PROOF
 - Interactive or batch ROOT + PROOF + GLITE
- A Selector script can be
 - Interpreted `tree.Process("myselector.C")`
 - Or compiled `tree.Process("myselector.C++")`

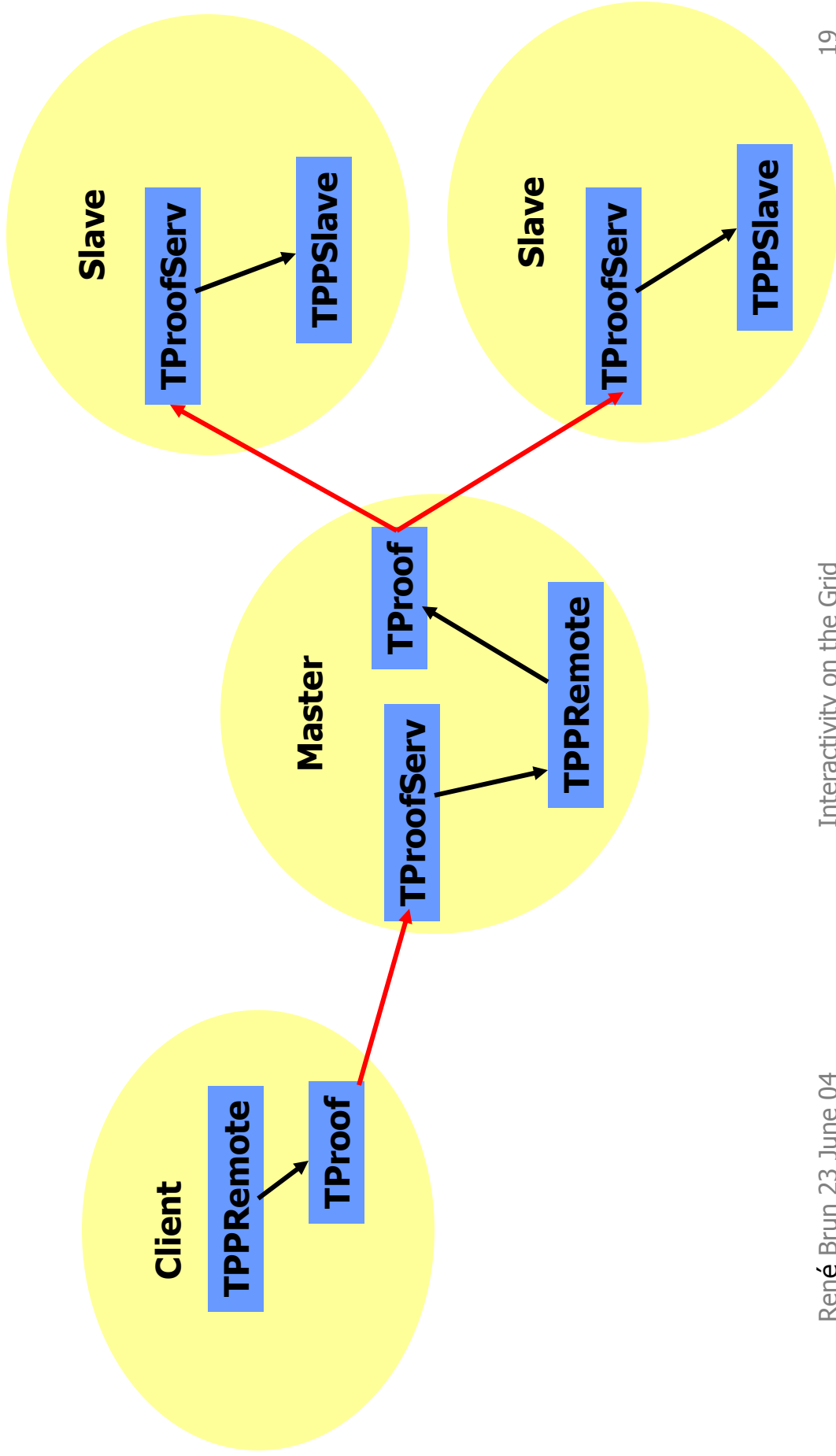
Smooth transition between batch and interactive sessions

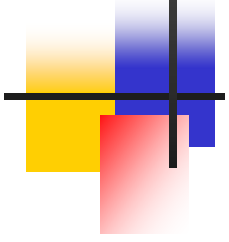


Parallel ROOT Facility

- The PROOF system allows:
 - Parallel analysis of trees in a set of files
 - Parallel analysis of objects in a set of files
 - Parallel execution of scriptson clusters of heterogeneous machines
- Its design goals are:
 - Transparency, scalability, adaptability

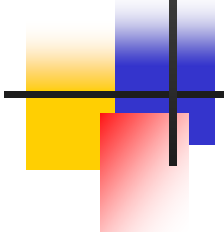
TProofPlayer





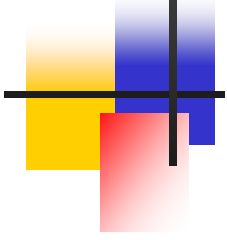
Dynamic Histogram Binning

- Implemented using THLimitsFinder class
- Avoid synchronization between slaves
- Keep score-board in master
 - Use histogram name as key
 - First slave posts limits
 - Master determines best bin size
 - Others use these values



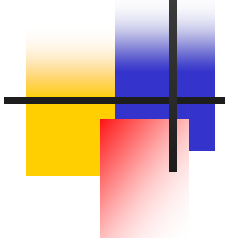
Merge API

- Collect output lists in master server
- Objects are identified by name
- Combine partial results
- Member function: Merge(TCollection *)
 - Executed via CINT, no inheritance required
- Standard implementation for histograms and (in memory) trees
- Otherwise return the individual objects



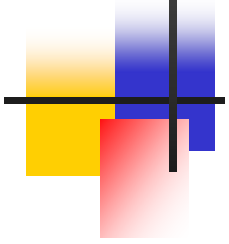
PROOF Authentication

- PROOF supports secure and un-secure authentication mechanisms
- Same as for rootd
 - UsrPwd
 - SRP
 - Kerberos
 - Globus
 - SSH
 - UidGid



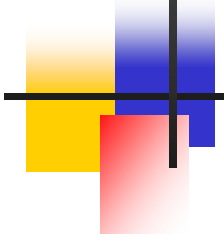
PROOF Error Handling

- Handling death of PROOF servers
 - Death of master
 - Fatal, need to reconnect
 - Death of slave
 - Master can resubmit packets of death slave to other slaves
- Handling of ctrl-c
 - OOB message is send to master, and forwarded to slaves, causing soft/hard interrupt



Sandbox – The Environment

- Each slave runs in its own sandbox
 - Identical, but independent
- Multiple file spaces in a PROOF setup
 - Shared via NFS, AFS, shared nothing
- File transfers are minimized
 - Cache
 - Packages



Running PROOF Using Alien

```
TGrid *alien = TGrid::Connect("alien");

TGridResult *res;
res = alien->Query("\lfn://alice/simulation/2001-04/V0.6*.root");

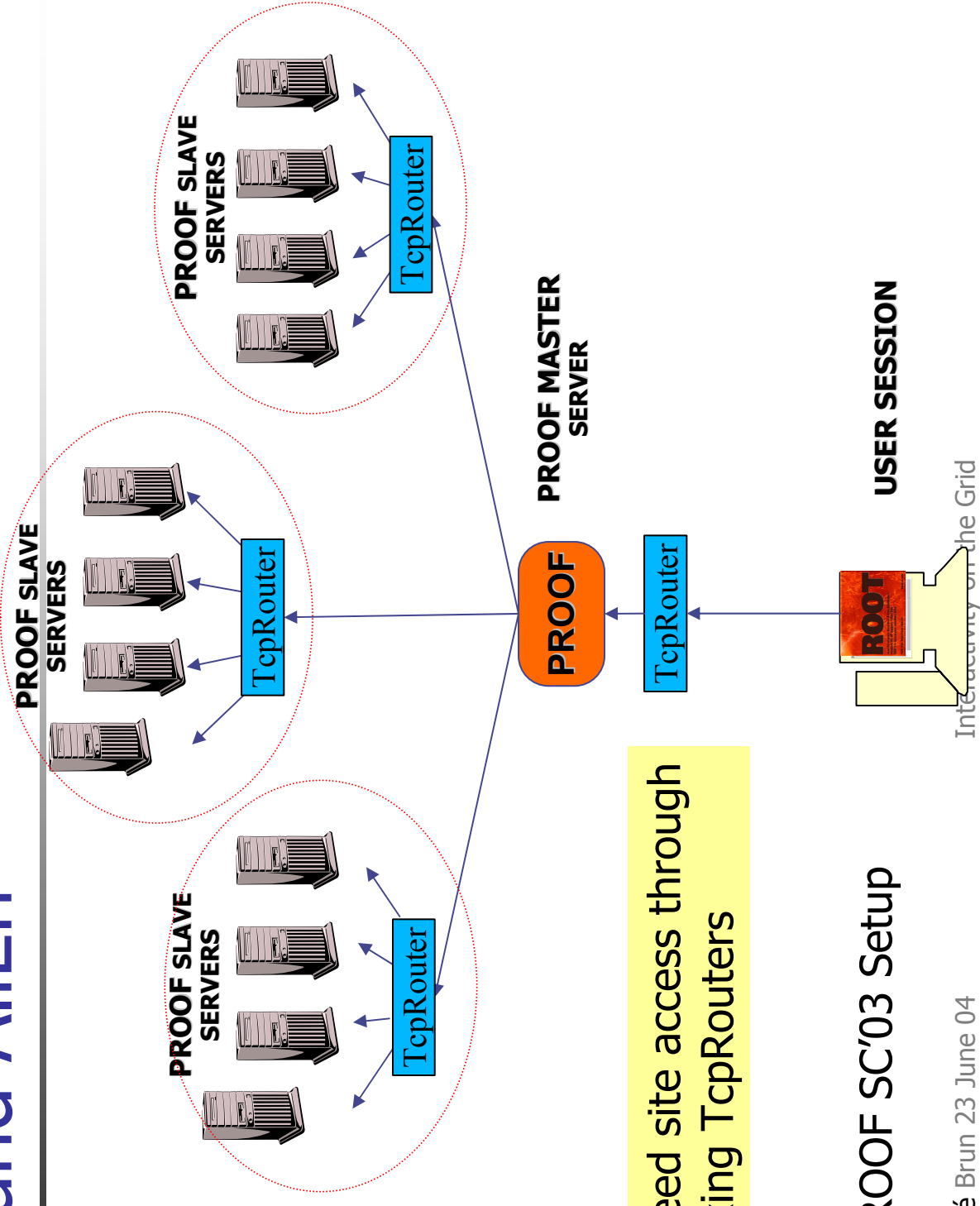
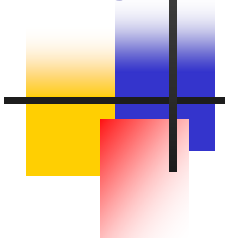
TDSet *treetset = new TDSet("TTree", "AOD");
treetset->Add(res);

gROOT->Proof(res); // use files in result set to find remote nodes
treetset->Process("myselector.C");

// plot/save objects produced in myselector.C
. . .
```

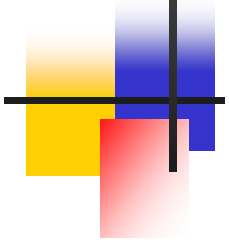
This scenario was demonstrated by ALICE at SC'03 in Phoenix

Interactive Analysis with PROOF and AliEn

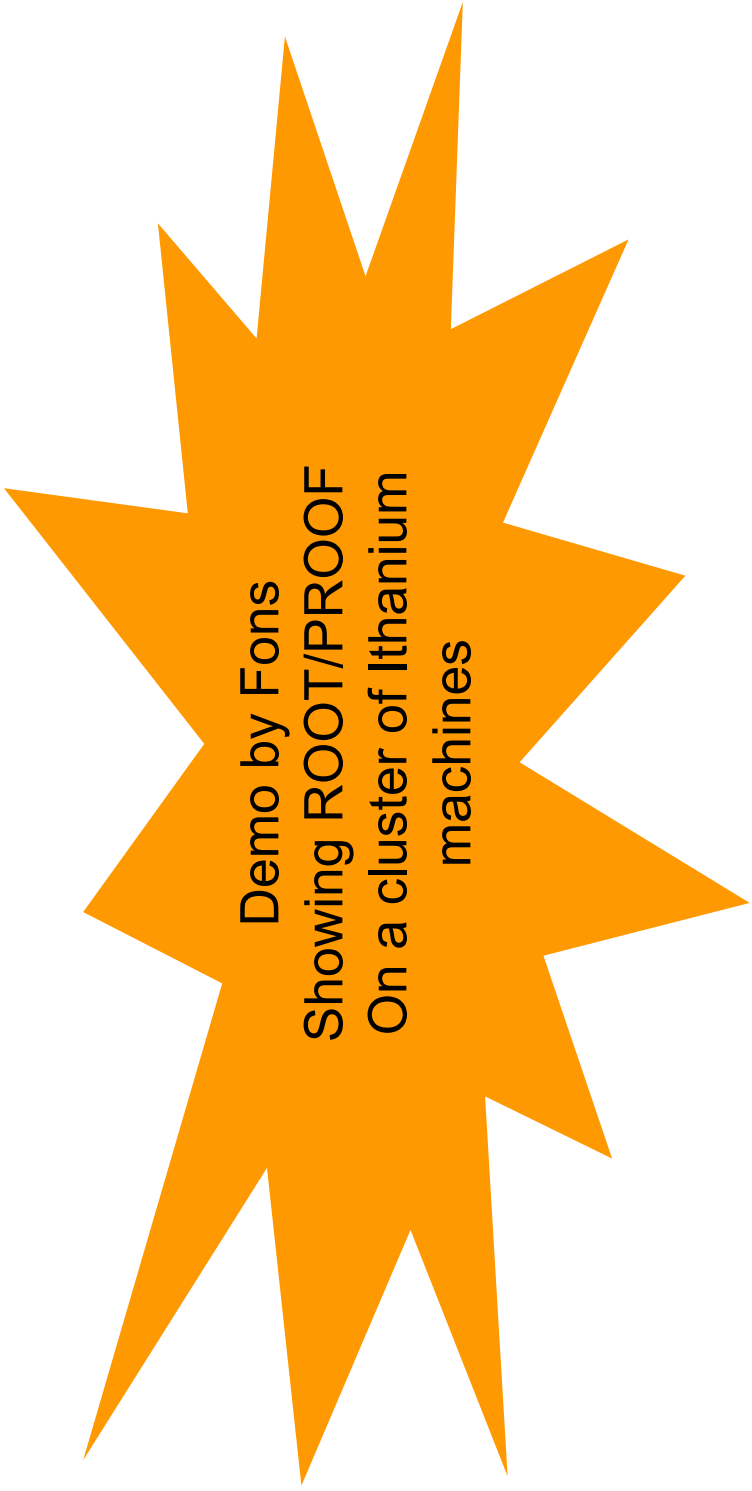


Guaranteed site access through Multiplexing TcpRouters

AliEn/PROOF SC'03 Setup



Interactive Demo



Demo by Fons
Showing ROOT/PROOF
On a cluster of Ithanium
machines