



ROOT Project Status

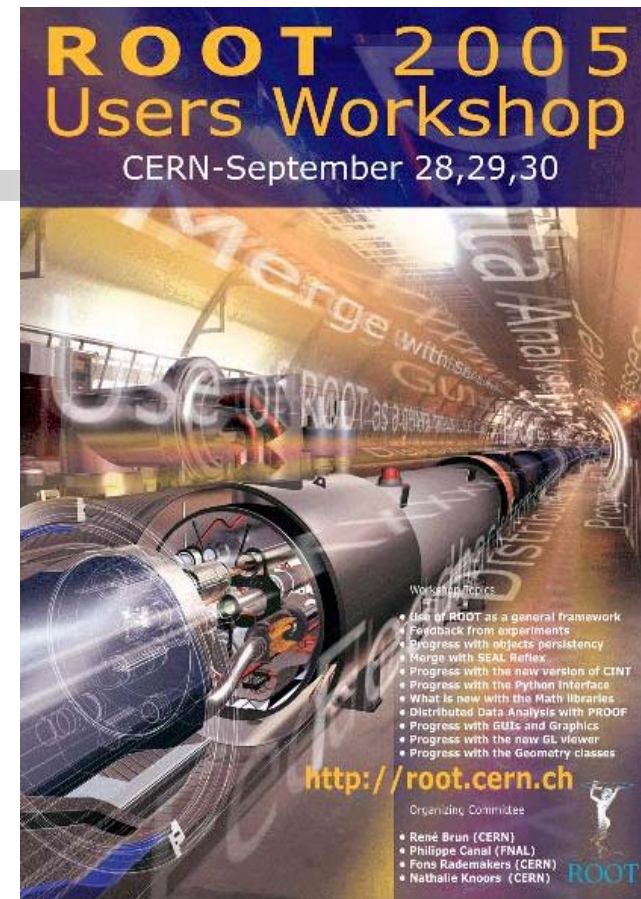
Major developments

Directions



ROOT Workshop 2005
28 September

René Brun
CERN





Plan of talk



- The LCG project and ROOT
- The new ROOT Team structure
- Summary of developments in versions 4 & 5
- Directions



Project History

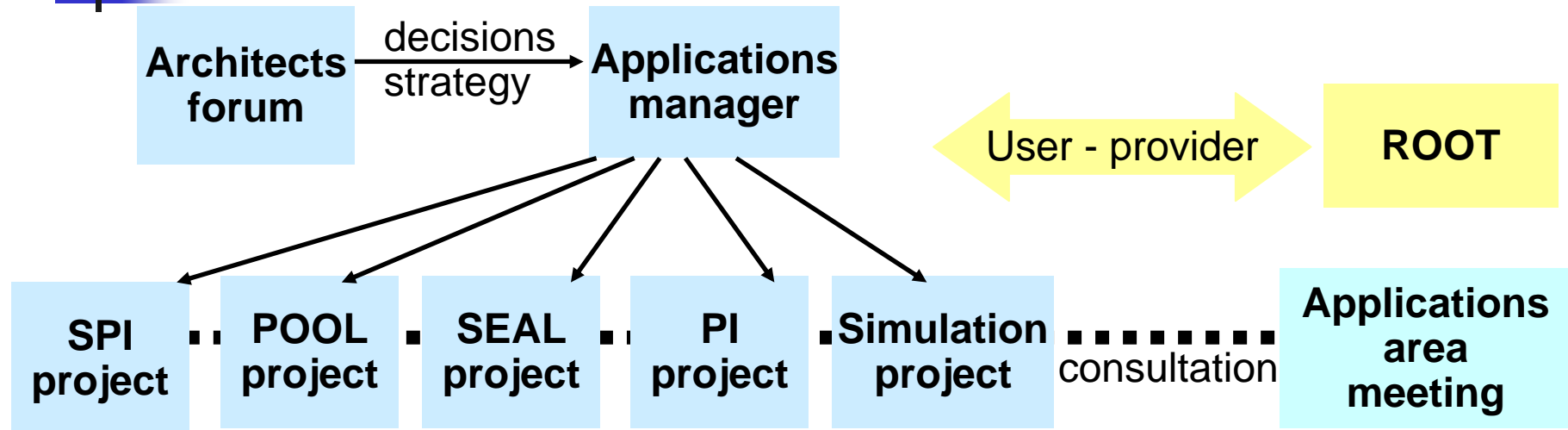


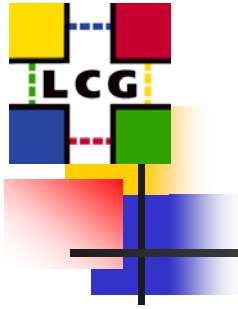
- Jan 95: Thinking/writing/rewriting/???
- 👉 ■ November 95: Public seminar, show Root 0.5
- 👉 ■ Spring 96: decision to use CINT
- Jan 97: Root version 1.0
- Jan 98: Root version 2.0
- 👉 ■ Mar 99: Root version 2.21/08 (1st Root workshop FNAL)
- Feb 00: Root version 2.23/12 (2nd Root workshop CERN)
- Jun 01: Root version 3.01/05 (3rd Root workshop FNAL)
- Oct 02: Root version 3.03/09 (4th Root workshop CERN)
- Feb 04: Root version 4.00/02 (5th Root workshop SLAC)
- May 05: Root version 4.04/02 (current pro release)
- 👉 ■ Sep 05: Towards version 5.0x (6th Root workshop CERN)

10 years !!



Applications Area Organization in LCG Phase I





Applications Area Organization in LCG Phase II



Same organization as in Phase I.

ROOT and SEAL projects merge

**SPI
project**

**POOL
project**

**ROOT +SEAL
project**

**Simulation
project**

consultation

**Applications
area
meeting**



ROOT project structured in work-packages



Thanks to ..



- We would like to thank many people who have contributed to setup the current organization and trust the new team for merging people and ideas.
 - Les, Torre, Pere, John, J.J, Dieter
 - The LHC exp. Management & Computing coordinators
- ROOT has grown from a micro (2-3) to a large team (see later). This is a challenge. We have no other choice but to produce a good system, **simple to use** and **ready for the LHC** start in 2007.



New ROOT team structure



The work-packages

SEAL

Lorenzo Moneta

DICT

Philippe Canal

BASE

Fons Rademakers

MATH

Lorenzo Moneta

I/O & Trees

Philippe Canal

2-D/3D graphics

Olivier Couet

GEOM/VMC

Andrei Gheata

PROOF

Fons Rademakers

GUI

Ilka Antcheva



CINT/Reflex workshop



- A very important workshop took place at CERN (May 2->7) to discuss the integration of Reflex and CINT.
 - Fons, Markus, Masa, Philippe, Rene, Stefan
- We converged on a C++ DS taking advantage of Reflex and the current redesign of CINT by Masa.
- See more about **Reflex** and new **CINT** in the talks by **Stefan** and **Philippe**



BASE work-package



- Fons Rademakers
- Ilka Antcheva (doc) (LCG1, new LCG2)
- Bertrand Bellenot (new LCG2 since 8/05)
- Philippe Canal (FNAL)
- Axel Naumann (html/doc) (new LCG2 11/05)

`CVS, DOC, Install, Releases, QA, Mailing lists`

`ACLIC`

`System classes, Collection classes`

`Network, plug-in manager`



DICT work-package

- Philippe Canal (FNAL)
- Markus Frank (LHCb)
- Masa Goto (Agilent)
- Wim Lavrijsen (PyRoot) (LBL/Atlas)
- Axel Naumann (Cint->Reflex)
- Stefan Roiser (Reflex) LCG1, new LCG2

`CINT, Reflex, ROOT meta classes`

`Rootcint, gccxml`

`Pyroot`



IO & Trees work-package



- Philippe Canal
- Markus Frank
- Paul Russo (FNAL)

Basic I/O, Auto schema evolution

CINT/rootcint/reflex interfaces

Trees, TreeSQL, Tree queries

Bitmap indices



MATH work-package



- Lorenzo Moneta
- Eddy Offermann (Rentec)
- Anna Kreshuk --.....---
- Andras Zsenei (end now)

`MathCore, MathMore, TMath, TF1, TH1`

`TMinuit, TFumili, new Minuit, roofit, TVirtualFitter`

`Stats classes, Linear Algebra`



GUI work-package



- Ilka Antcheva
- Bertrand Bellenot
- Fons Rademakers
- Valeri Fine (Qt) BNL/STAR
- Valeriy Onuchin (finished in July)

`Low-level GUI widgets (TVirtualX implementations)`

`High level widgets (Editors, browsers)`

`GUI builder`



Graphics work-package



- Olivier Couet (2-D graphics)
- Andrei Gheata (geometry) /ALICE
- Richard Maunder (GL)
- Timur Pocheptsov (GL) JINR/Dubna

2-D graphics, histpainter, graphs, TLatex

3-D graphics

X3D & GL viewers

Image processing classes



GEOM work-package



- Andrei Gheata
- Mihaela Gheata /ALICE

Detector Geometry (modeling & navigation)

Interfaces with Geant3, Geant4 and Fluka (VMC)

Graphics interface



PROOF work-package



- Fons Rademakers
- Maarten Ballantijn (MIT/Phobos/CMS)
- Bertrand Bellenot (GUI)
- Marek Biskup (TS, end now)
- Gerri Ganis (LCG1, new LCG2)
- Guenter Kickingler (DS/ALICE)\
- Derek Feichtinger (ARDA project)/CMS
- Andreas Peters (ARDA project)/ALICE

PROOF development

PROOF test bed

Help LHC experiments to start with PROOF



SEAL work-package



- Lorenzo Moneta
- Stefan Roiser

Maintenance of existing SEAL libraries

In a medium/long term keep:

Foundation classes; SealBase, SealUtil

SealKernel, SealServices



ROOT version 5



- pro release 4.04/02 3 May (new Users Guide)
- 1st dev release 5.02 28 June
- 2nd dev release 5.04 20 September
- 3rd dev release 5.06 25 October or 2 Nov
- Pro release 5.08 15 December

See detailed Release Notes

<http://root.cern.ch/root/Version50400.news.html>

See presentations at this workshop



ROOT License



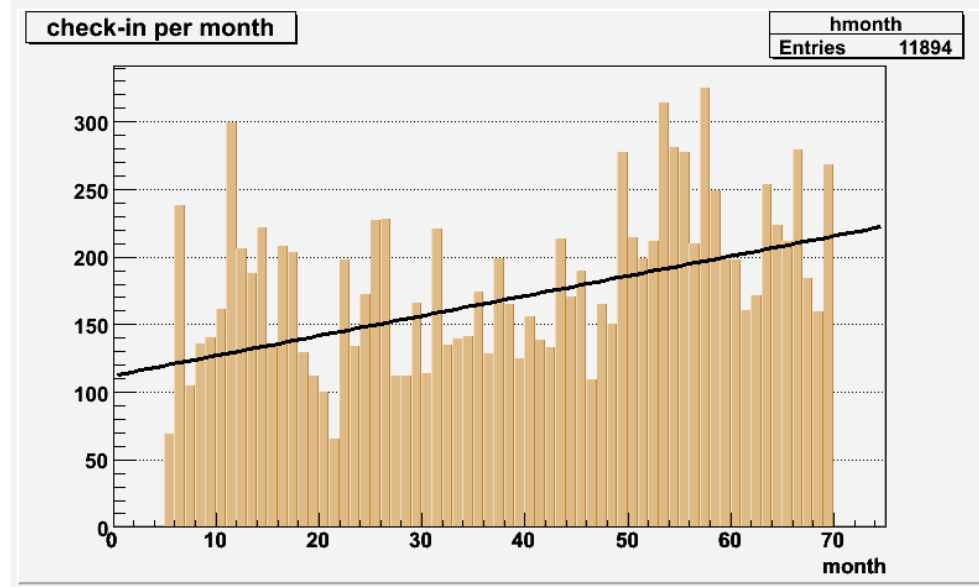
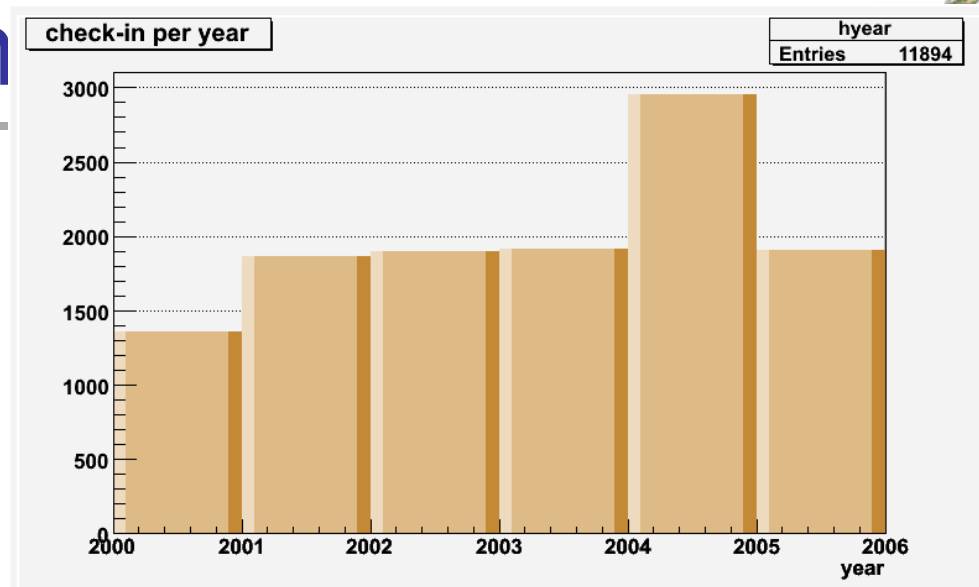
- With version 5.04 we have changed the license to **LGPL**.
- With this change ROOT can be distributed with systems like **Debian**.



CVS check-in



Still no signs of stagnation
We are at a rate of 200 CVS
check-in per month





BASE work-package : Plan



- plug-in manager extensions
- port to new platforms
- I/O thread safe
- New THtml & Help/Doc system
- See talks by [Fons](#) and [Axel](#)



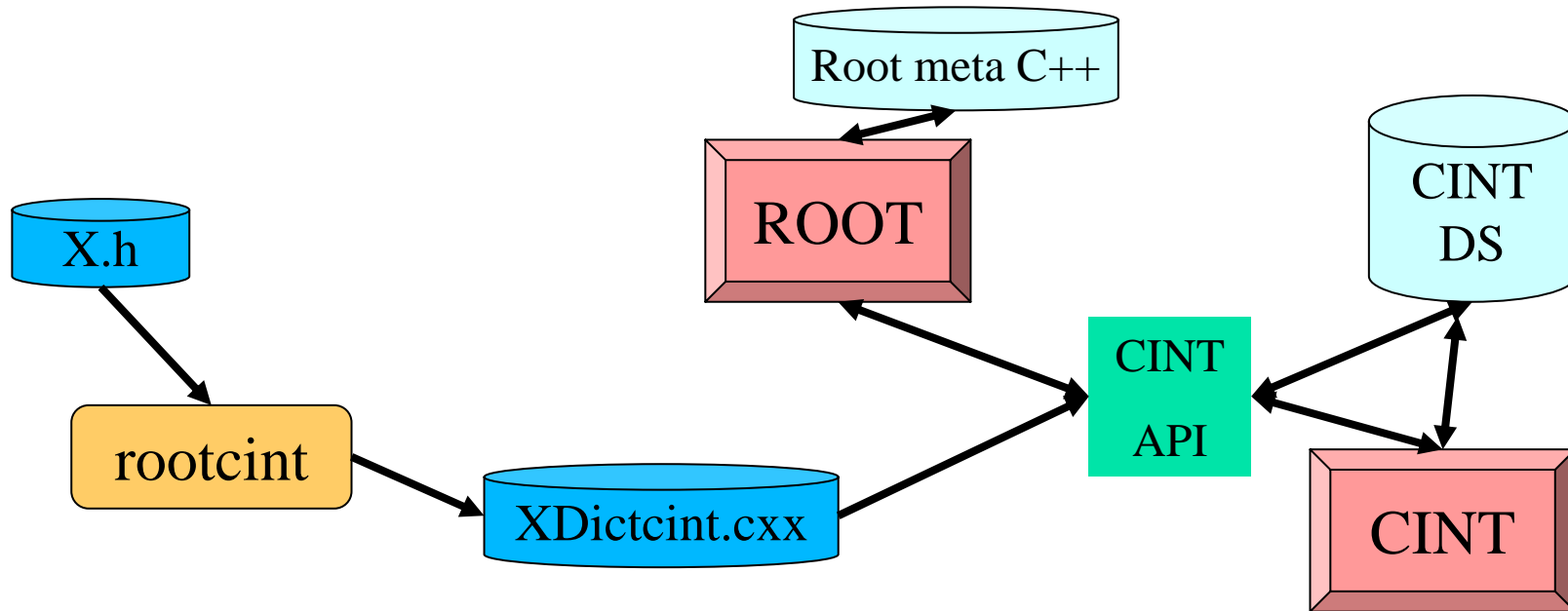
DICT work-package : Plan



- New version of **Reflex**
- New version of **rootcint**
- rootcint → CINT
- rootcint -> Reflex -> Cintex -> CINT
- rootcint -> gccxml -> Reflex -> CINT
- Adapt **PyRoot** to Reflex
- Adapt CINT to Reflex
- See talks by **Stefan** , **Philippe** and **Wim**

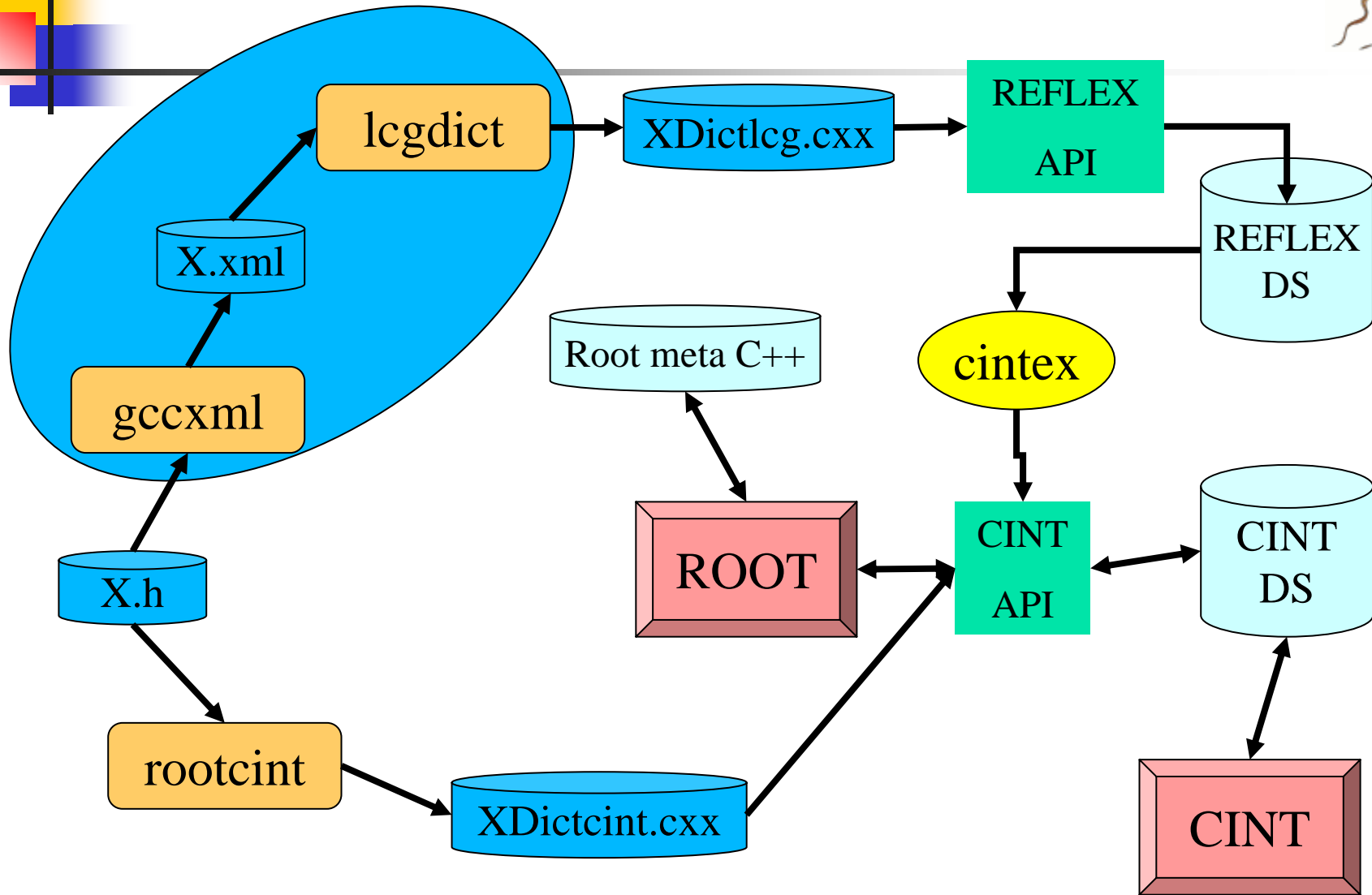


Dictionaries : root only



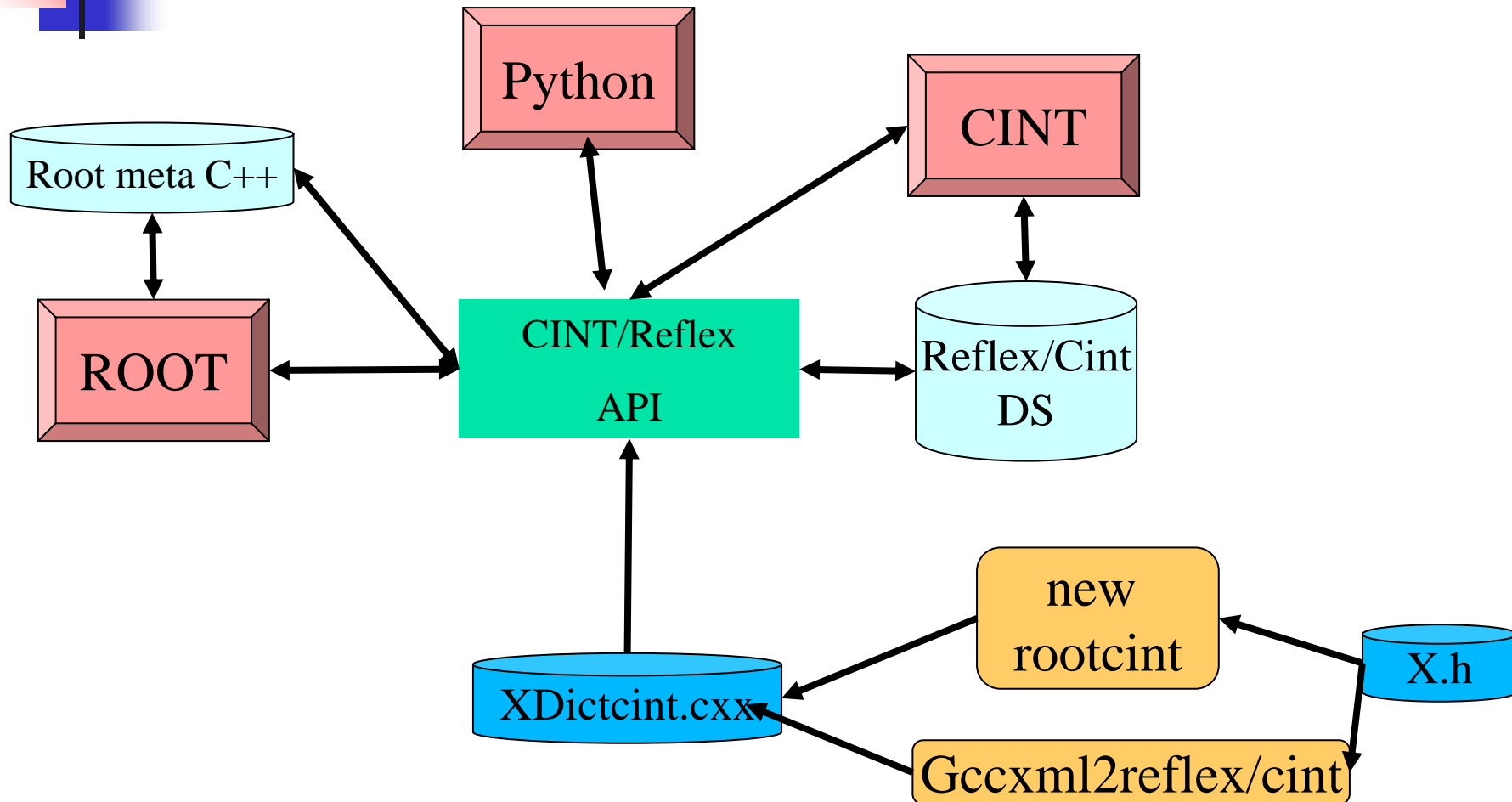


Dictionaries : situation today





Dictionaries : situation in the future





IO work-package : Plan



- Consolidation, Consolidation, Consolidation
- More cases in **auto schema evolution**
- Better support for **references**
- **read ahead** with **large caches**
- **TreeSQL**
- See talks by **Markus** and **Philippe**



MATH work-package : Plan

- Adapt ROOT classes to **MathCore**
- TF1,2,3, Fitting
- Virtual Fitter extensions
 - corresponding changes in ROOT fitting and roofit
- Fitting GUI
- Box plots, qqplots
- Many new tools required for LHC Physics analysis
- See talks by [Lorenzo](#), [Andras](#) and [Anna](#)(Friday)



Graphics work-package : Plan



- zillions of micro/mini features
 - (see Olivier url)
http://couet.home.cern.ch/couet/POW_files/frame.htm
- reimplement (TGaxis)
- GL with new GUI
- GL for dynamic tracks
- Event Display infrastructure
- See talk by **Richard** and demos this afternoon.



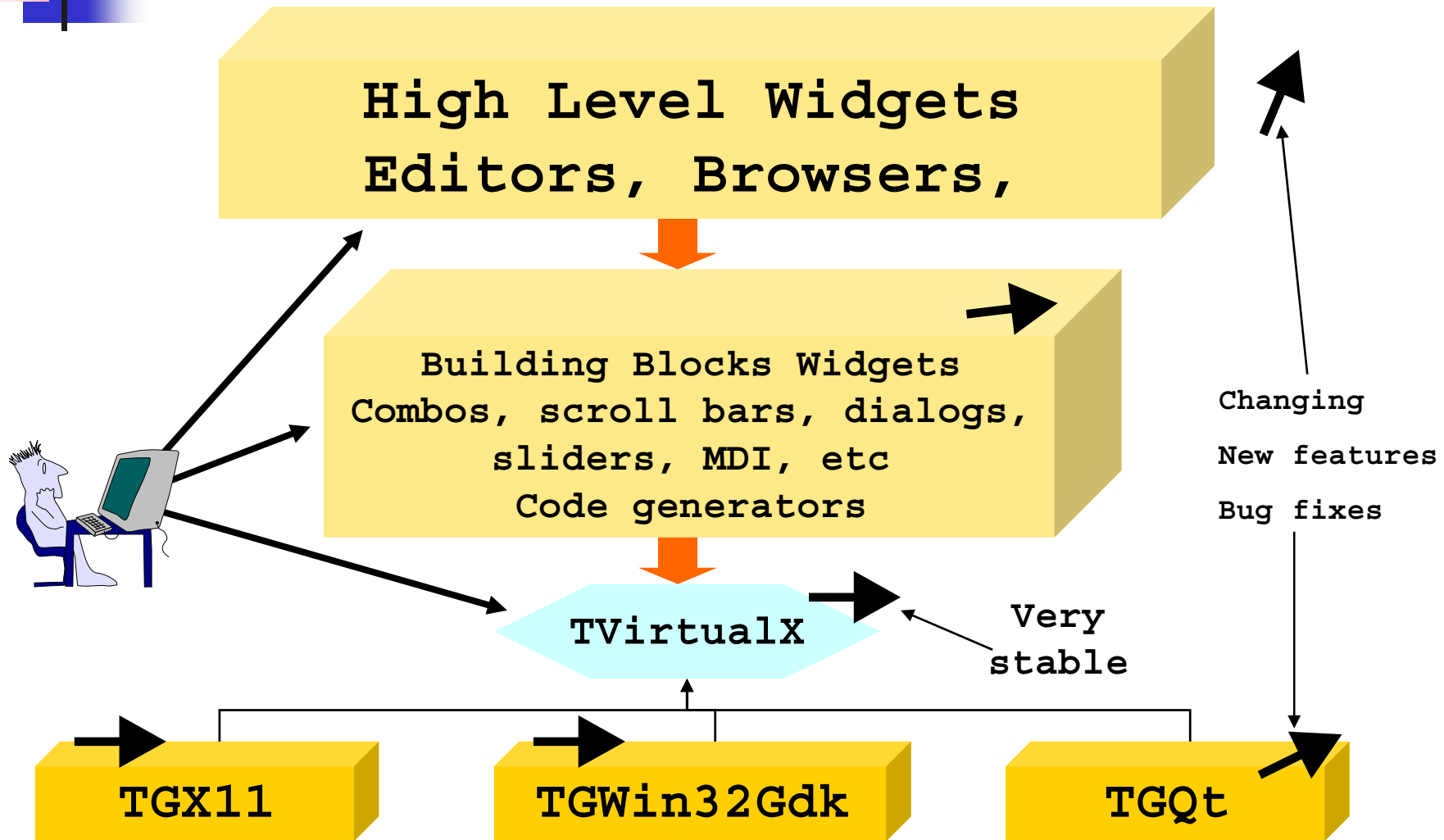
GUI work-package : Plan



- zillions of micro/mini features
 - (see Ilka url)
 - <http://antcheva.home.cern.ch/antcheva/>
- GUI Builder completion
- New Editor Widgets
- Fit Panel widget
- See talk and demos by [Ilka](#), [Bertrand](#)



GUI work-package : Plan





GEOM work-package : Plan



- Support for parameterized shapes. This will reduce the geometry size in memory for certain geometries defined in G3 style.
- CAD geometry import
- Geometry builder GUI
- See talk by [Andrei](#)



PROOF work-package : Plan



- Build a test bed
- Get Users (help with selectors)
- Interfaces with data management services
- Provide the full ROOT service in PROOF mode
- exploit possible large memory caches,
 - eg 20 Tera on local farm



PROOF and XROOTD



- **XROOTD** is already playing a very important role in PROOF. It will continue to play a growing role.
- The **PROOF** and **XROOTD** teams are cooperating to get even more from XROOTD: caching, read ahead, new XROOTD services.
- Still a lot to do to have a good integration of XROOTD with other services like **CASTOR**.
- Do not miss **Andy's** talk tomorrow afternoon.



PROOF test facility



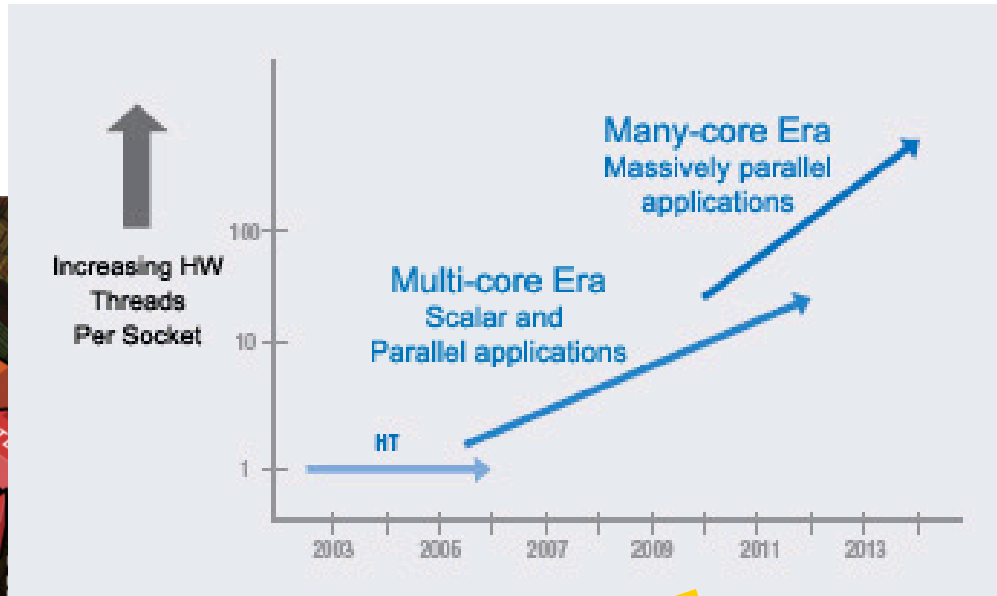
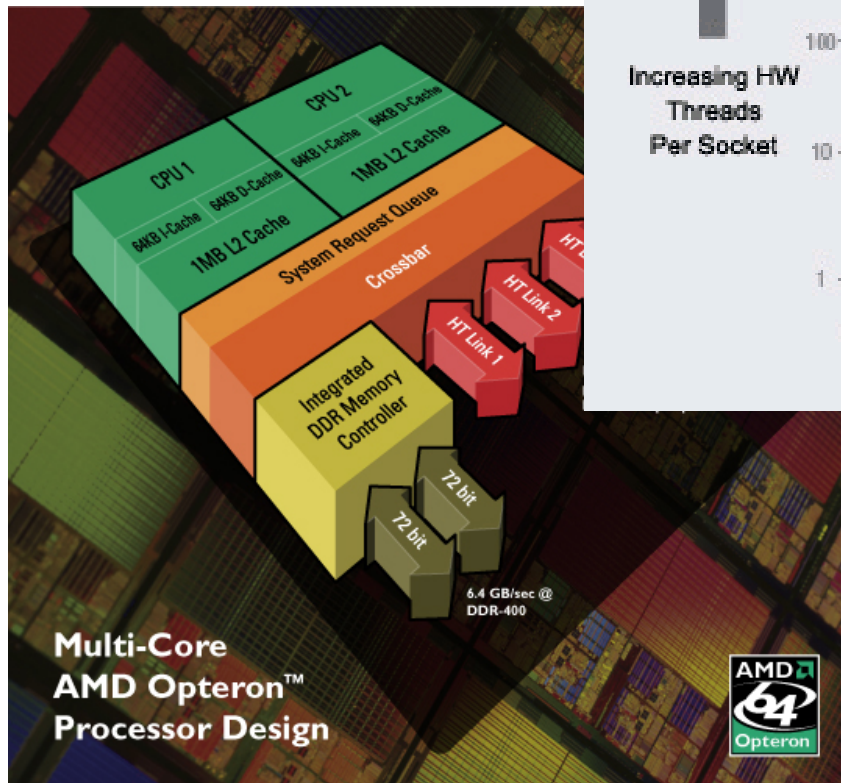
- Since a few weeks we have access to a dedicated farm (thanks [Jamie Shiers](#)) with 32 dual processor nodes. We will use it for the PROOF demo tomorrow morning.
- The nodes are slow machines (800 MHz), but are extremely useful (vital) to test our PROOF prototypes ([Alice](#), [CMS](#), [Phobos](#)).
- We expect to have many more (100) and faster machines this fall. These machines are intended for testing, not production.
- We assume that the LHC collaborations will have their own analysis facility, but the collaborations can test their analysis code on the test bed if they like.



Multi Core CPUs



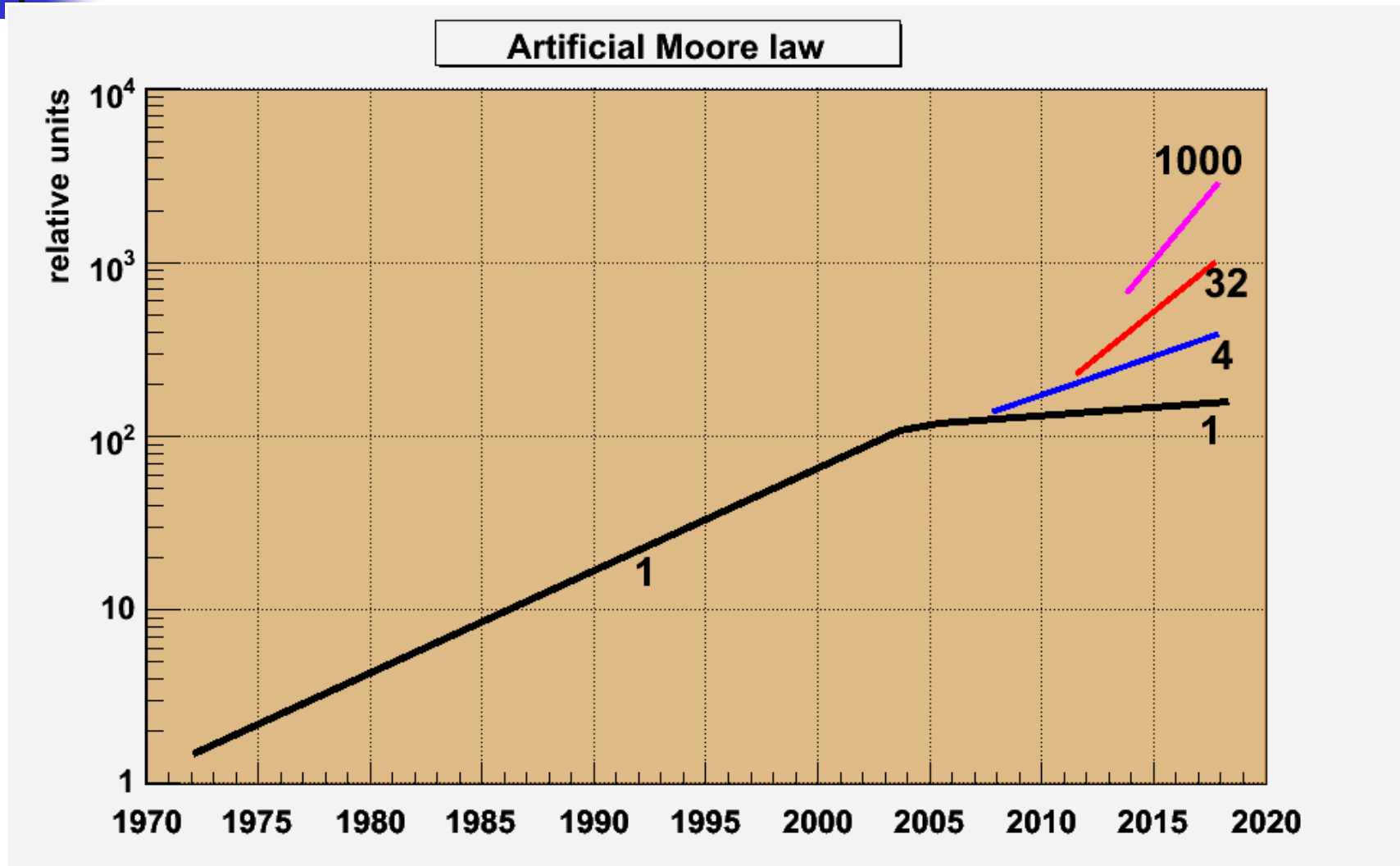
<http://www.intel.com/technology/computing/archinnov/platform2015/>



This is going to affect the evolution of ROOT in many areas



Moore's law revisited

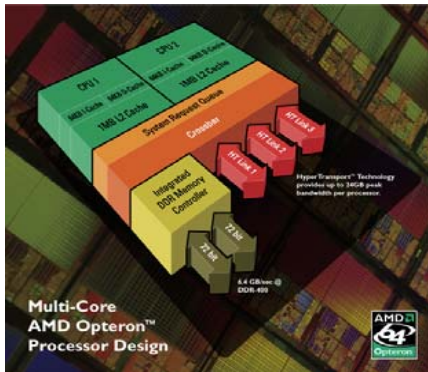




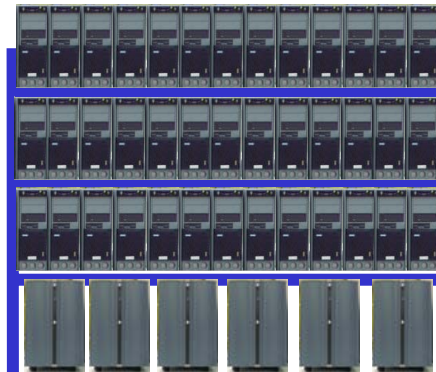
CPU/Node hierarchy



Laptop node
1->32->??N cpus



Local cluster
1000xN cpus



GRID(s)
100x1000 nodes



latency 100 nanos

100 micros

100 millis

Disk
2005
100 Giga

100 Tera

10 Peta

Disk
2012
> 1 Tera

> 1 Peta

> 100 Peta



Many implications for ROOT

- More and more multi-threaded applications
- Will have to make many classes thread aware
- ACLIC compilation in parallel
- GL viewer could take advantage of multi cpus
- Fitting too
- I/O with threads for
 - Read ahead
 - Unzipping
- And obviously TTree queries and PROOF



Implications for LHC data analysis

- Building a parallel or/and multithreaded software is a non trivial exercise.
- A model with a script looping on a collection of events will hit soon a big wall.
- We encourage ROOT users to base their analysis code on the selector (**TSelector**) interface, such that running in sequential or parallel mode will be transparent.



PROOF work-package : Remarks

- data rate at the LHC will be low for the first 2 years
- running time will be low (4 months/year?)
- we will have enough resources to analyze all data interactively
- meanwhile multi-core CPUs will be expanding
- large memory caches will become available
 - will require simple extensions of xrootd (may be already there)
 - exploit large caches on client too
- true parallelism (with communication for histogramming) will be a must.
- Currently GRID systems (batch-oriented) do not make a difference between local CPUs, local farms and distributed CPUs on the GRID.
- Will the GRID be used for data analysis? Or will the combination “my laptop” and “local farm” be sufficient?



This Workshop



- The real bread is in the coming talks.
- Many thanks to all my team colleagues who have been under pressure to produce nice posters and talks.
- Many thanks to all speakers. We have a lot of talks. We should have booked one more day.
- Many thanks to [Nathalie](#).
- This workshop (every 18 months) is meant to:
 - Inform you about the new developments and directions.
 - Collect your feedback. Do not hesitate to express your views, in particular during the two discussion sessions.
- **Enjoy the workshop and ...**
- **Please come to the reception Thursday evening at 18h15 at the main cafeteria.**