

# The ALICE Off-line Framework

a successful migration to OO

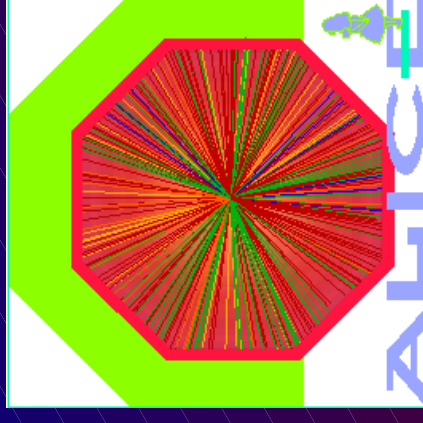


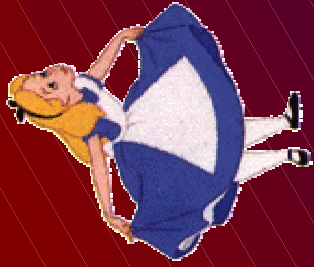
Federico Carminati

CERN - ALICE

CHEP 2000

February 7, 2000

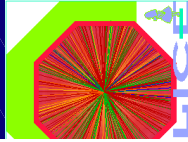




# ALICE beg '98



- 😊 **Small(er) collaboration**
  - **Cannot afford several development lines**
  - **Must reuse code**
- 😊 **Software and Physics one single group**
  - **Use programs available and working**
  - **Minimise the legacy-code-to-be**
- 😞 **IT/LCB/R&D official line not ready**
  - **Working framework based on FORTRAN + ZEBRA + PAW**
- 😞 **Users were not (yet all) speaking OO**
  - **Split into “dinosaurs”, “prophets” and “lost users”**





# The LHC Computing Challenge



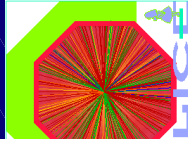
Design the Detectors and Prepare the Code Now

and

Design the New Software Framework

and

Train and Involve the User Community



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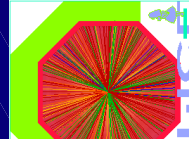
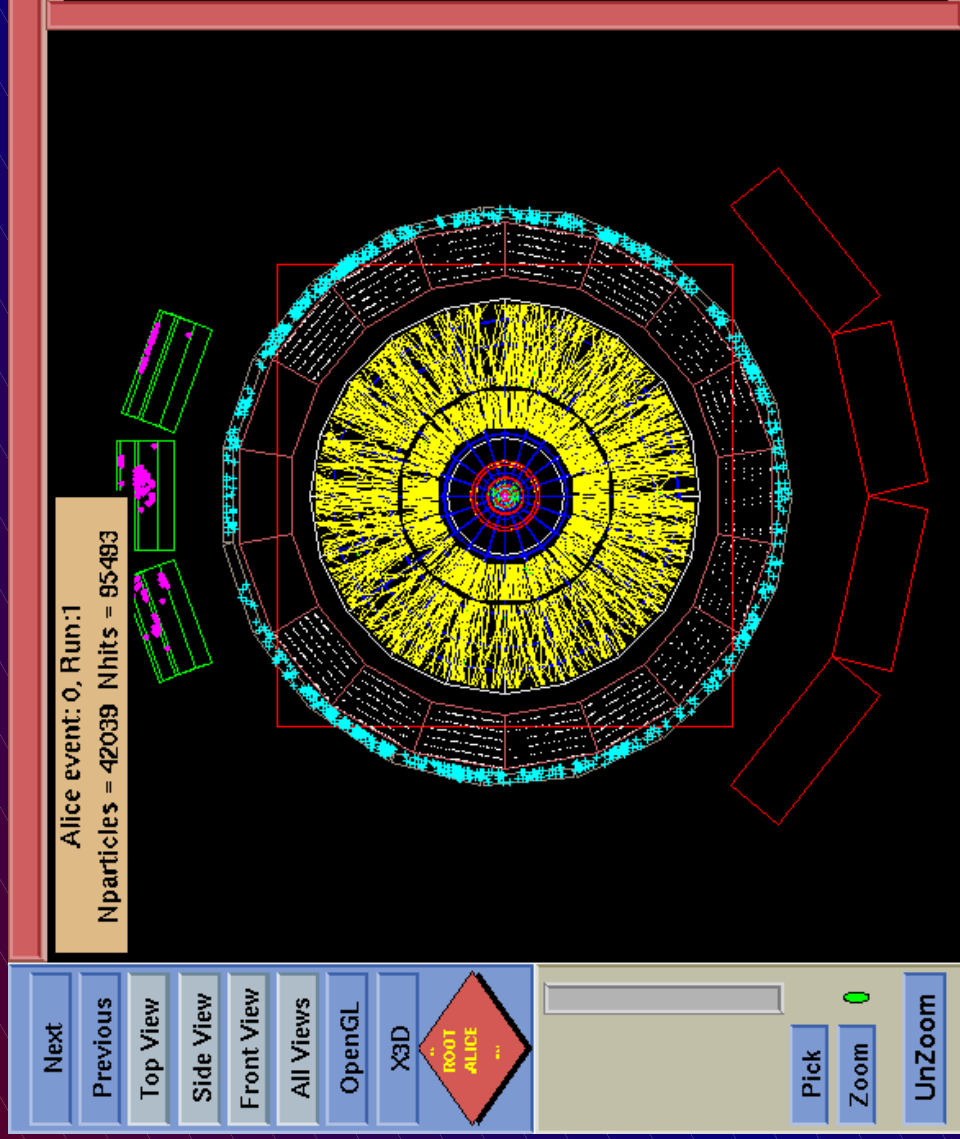
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# ALICE event/100

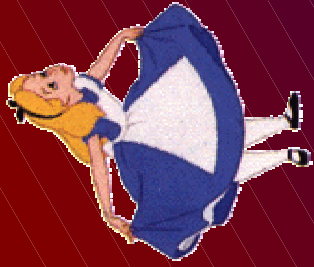


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# Are we in trouble with Simulation?



*Simulation is vital, but*

☹ Using GEANT 3.21

- Stay with FORTRAN, shaky physics and geometry

☹ Using GEANT 4

- *Fresh from the oven: can we trust it yet?*

☹ Using FLUKA

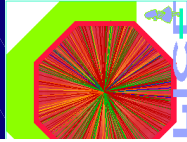
- Difficult to use, limited geometry

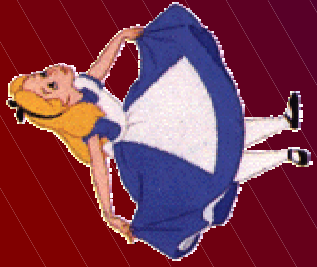
# Yes, we are in trouble!

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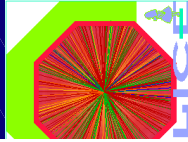




# Alice's choice



- Migrate immediately to C++
  - Immediately abandon PAW
  - But accept GEANT3.21 (initially)
- Adopt the ROOT framework
  - Not worried of being dependent on ROOT
  - Much more worried being dependent on G4, Objy.....
- Allow use of FORTRAN and C++
  - Allow to start with *wrapping and bad design*
- **Impose a single framework**
  - Provide central support, documentation and distribution
  - Train users in the framework

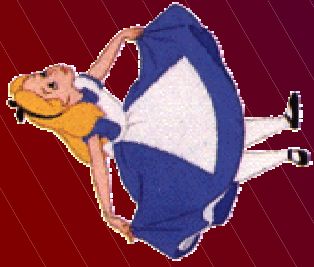


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# The AliRoot System



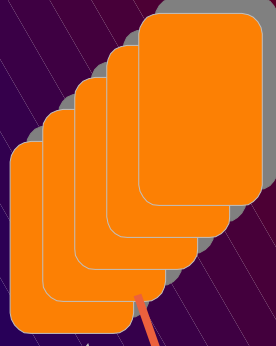
Run Control

Generators

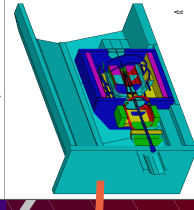
New Transport Engine

Virtual MC

Root hits structures



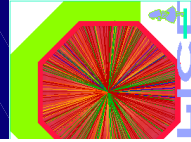
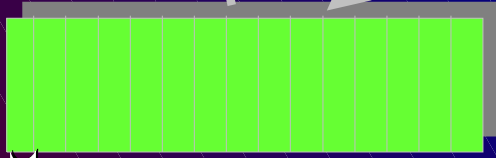
Geometry Database



Root output file

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Root particle stack

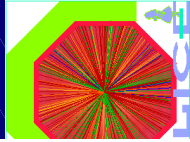
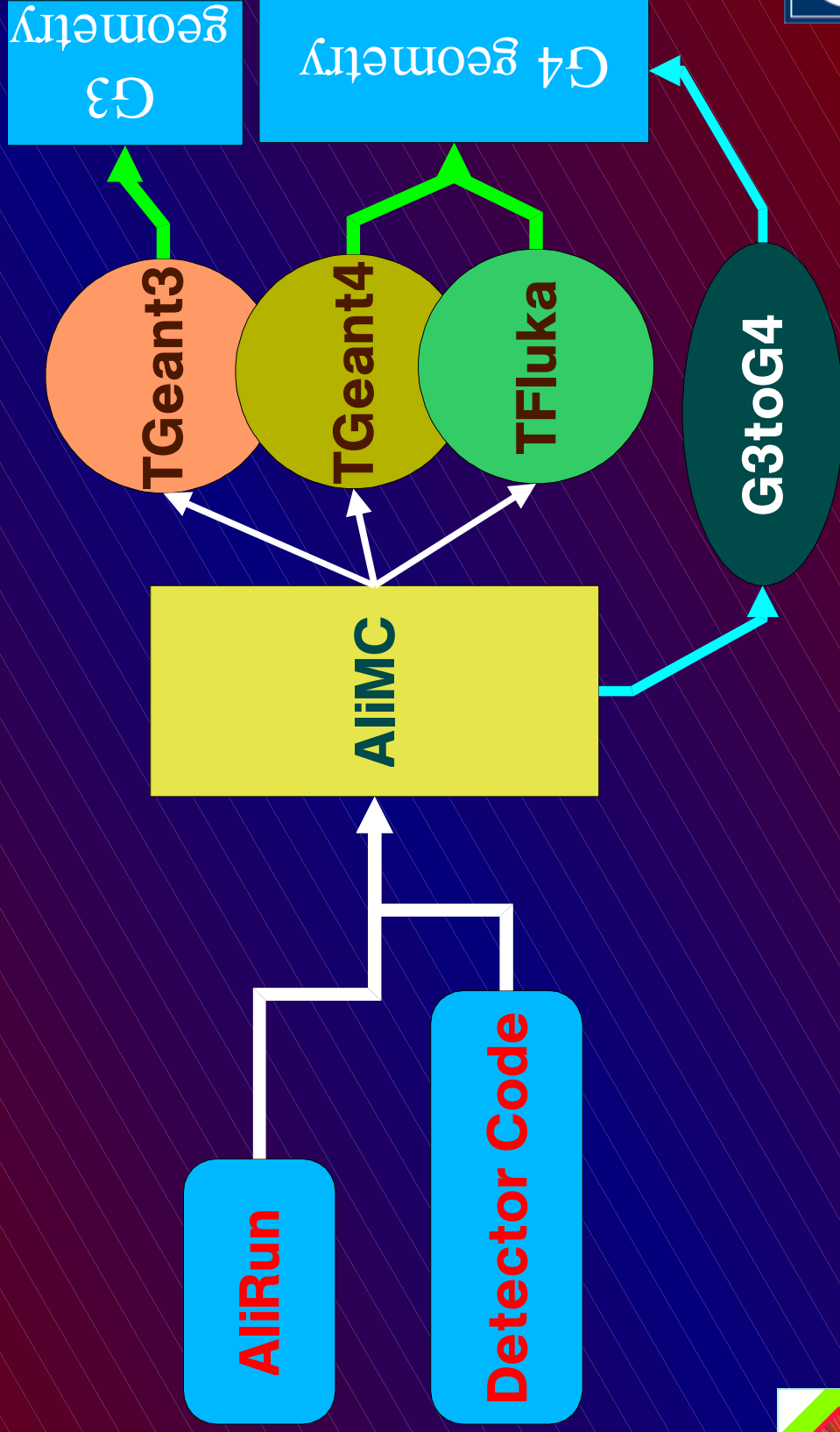
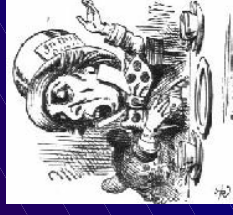


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# The Virtual MC



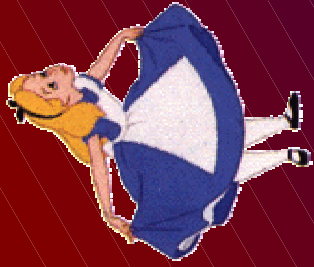
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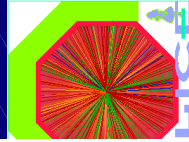


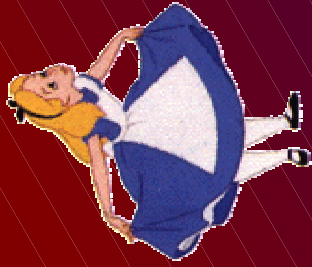


# Comparison new/old



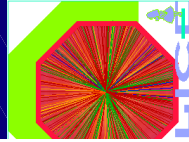
- **Time per event**
  - **Old** link: >40" run: 710'/event (=11h:50m)
  - **New** link: <1" run: 435'/event (=7h:15m)
- **Space**
  - **Old** galint executable 11MB
  - **New** AliRoot executable 438kB
- **Documentation**
  - **Old** Web page (by hand!)
  - **New** in the code and automatically extracted





# FLUKA

- ☺ CERN wants to support FLUKA
  - ♥ A minority (man-power) and independent line
  - ♥ Possible collaboration with GEANT4 in areas of complementarity ?
  - ♥ Source release in some time from now
- G3, G4 & FLUKA: the same input/output
  - Only way to compare results and models
  - G3toG4 (ALICE) and FLUGG (ATLAS/INFN-Milano)
  - Access to FLUKA via ALICE Virtual MonteCarlo
  - Output via the same stepping routines

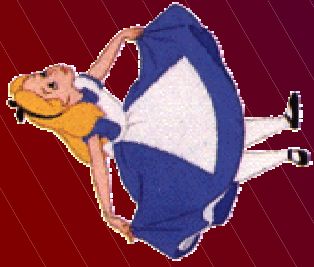


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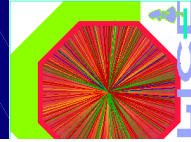
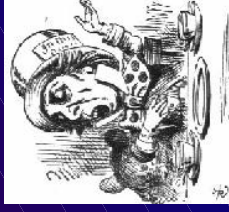
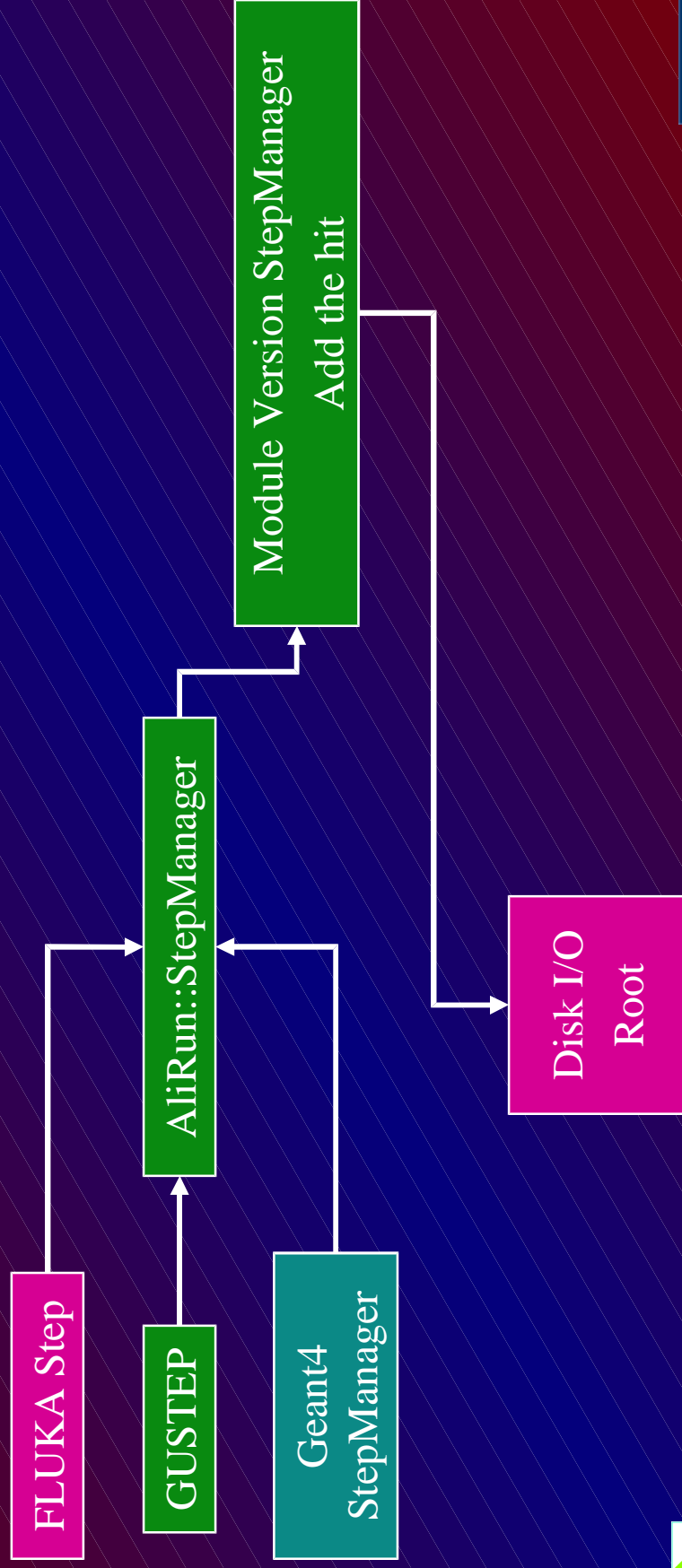
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# Tracking schema



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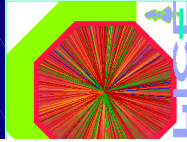




# ALICE's policy



- We follow a *minimum resistance path*
  - Use ROOT containers
  - Forbid the use of templates and STL (for the moment?)
  - Completely rely on CINT (I/O, script interpreter)
  - Do not use CLHEP, LHC++ or *alternative* components
- Not worried by all-out modularity
- Official request to CERN management
  - Support for ROOT
  - Consider it for the choice of a common LHC solution
  - Consider it in the development of new solutions



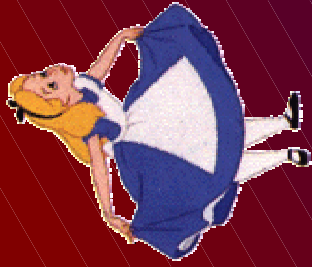
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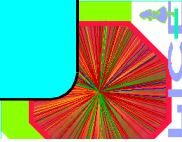
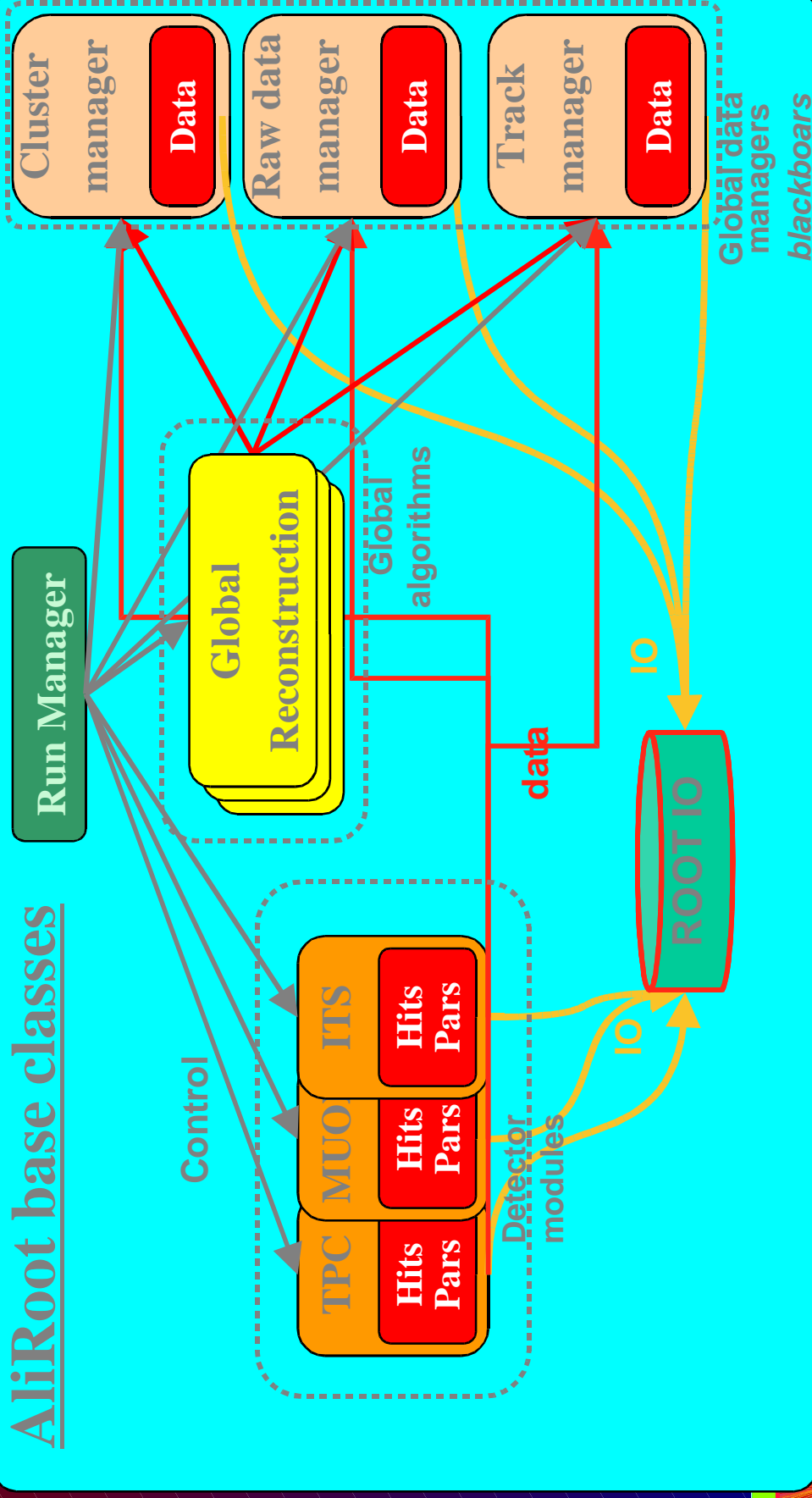


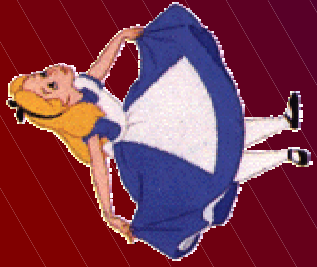


# The AliRoot architecture



## AliRoot base classes

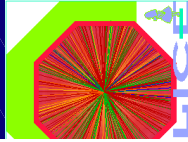




# The AliRoot framework



- Dependency on CERNLIB minimised
  - We need only GEANT 3.21 (ZEBRA-MQ)
  - All libraries are shared
- Detector versions from virtual detectors
  - AliDetector->AliTPC->AliTPCv0
  - The **right** version will be in the output file
- Reconstruction/Analysis are naturally developing in the same framework
  - Supported on Linux, HP-UX, Solaris, Compaq



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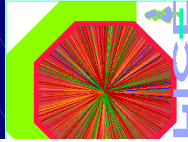




# AliRoot Modules



- Modularity of AliRoot reflected in the physical structure of the shared libraries
- ```
graph TD; MCs[MC's] --> STEER[STEER]; Generators[Generators] --> STEER; TPC[TPC] --> STEER; RICH[RICH] --> STEER; TOF[TOF] --> STEER;
```
- Complete framework: 6 months x 2 people

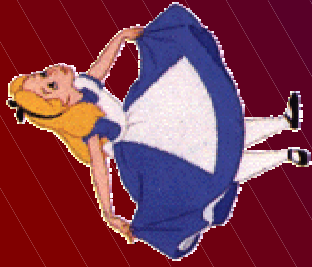


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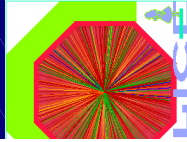
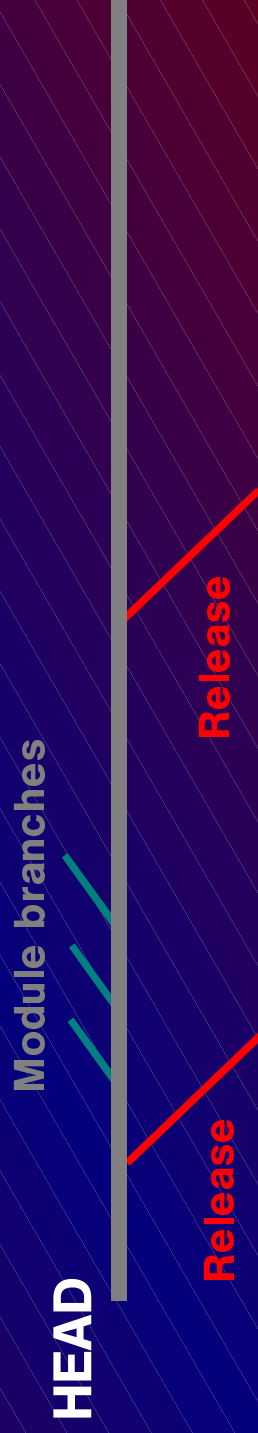




# Code development



- Central cvs database divided in modules
  - Hand-added access control by module
  - No configuration tools for the moment
- Custom coding convention checking tool
  - RuleChecker developed with IRST Trento
  - Cjj project (see talk from P.Tonella et al.)



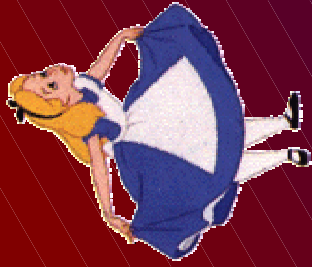
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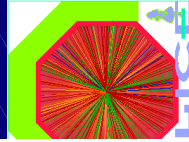




# Cathedrals and Bazaars



- **Definitely a Bazaar model**
  - **Rapid prototyping, rapid response to user feed-back**
- **Use extensively prototyping**
  - **Existing technology**
  - **Production code**
- **Design only what you can prototype**
  - **do not hope in technological miracle**
- **Development based on**
  - **micro cycles**
  - **macro-cycles**

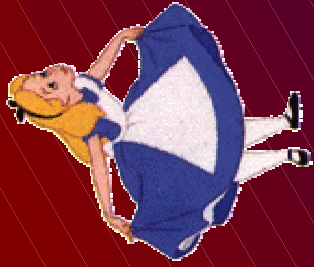


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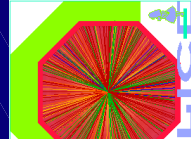
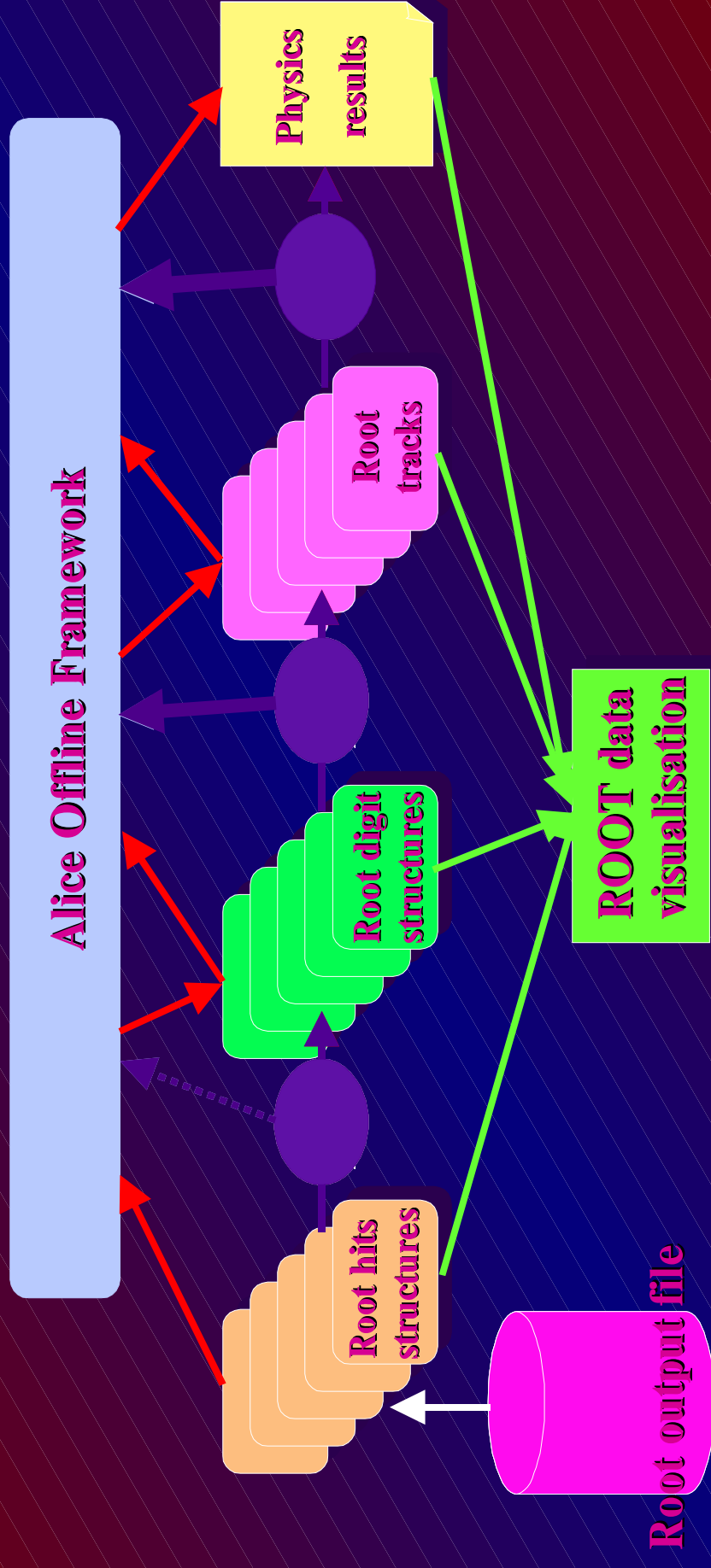
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# AliRoot evolution schema



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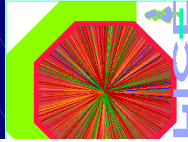




# The ALICE Mass Storage Project



- **Close collaboration with CERN/IT**
  - **Assess our computing model in realistic conditions**
  - **Develop integration DAQ and Off-line and event model**
  - **Provide a framework to assess new technologies**
- **MSS situation confused**
  - **Enstore, CASTOR, HPSS IBM, Eurostore I**
- **Participation into Eurostore II**
  - **EU financing, proposal submitted to Jan 15 call**
  - **CERN, DESY, QSW, Tera**
- **We will interface ROOT with Eurostore II**



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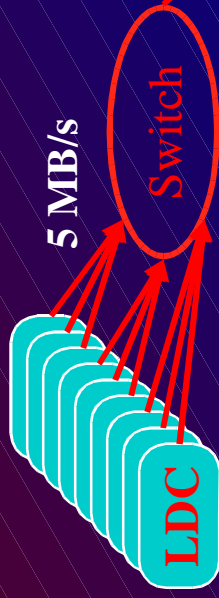


# ALICE DC II



NA 57 data source

9 PowerPC AIX

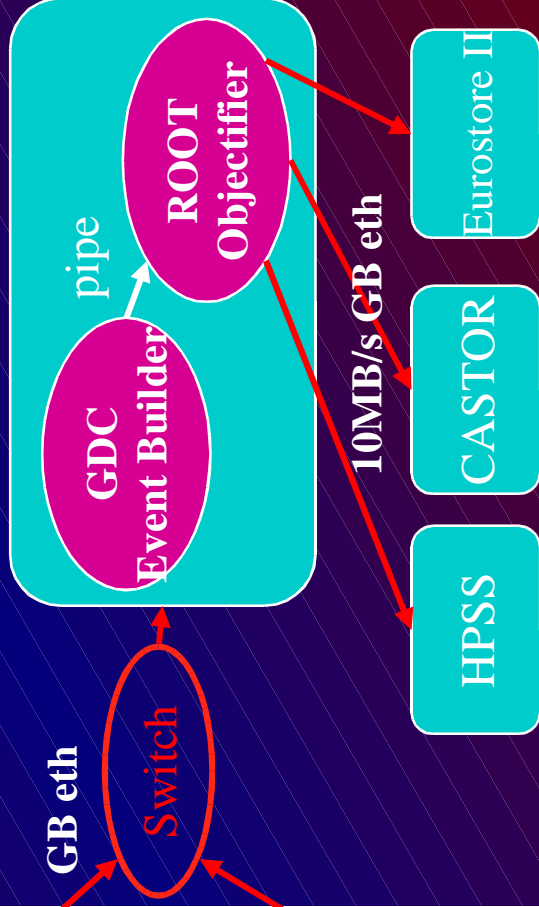


Intel/PC Linux + PowerPC /AIX +Sun

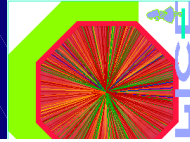


Computer Centre

Intel/Linux PC Cluster 10/15 nodes



ALICE DAQ data source



DATE=GDC+LDC

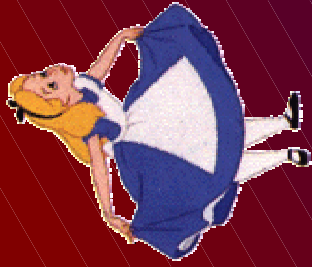
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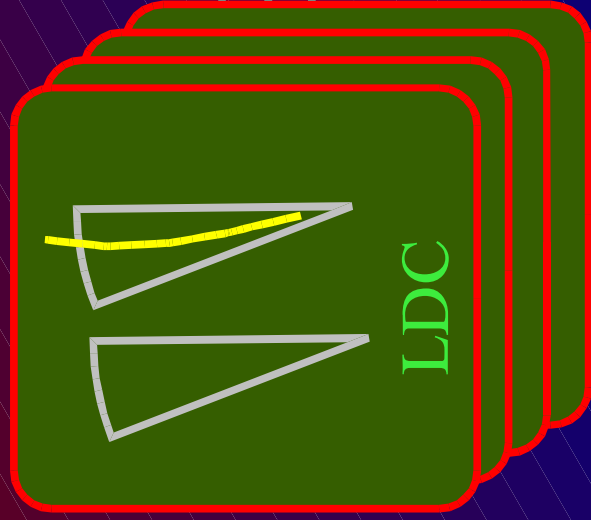
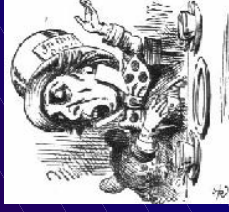
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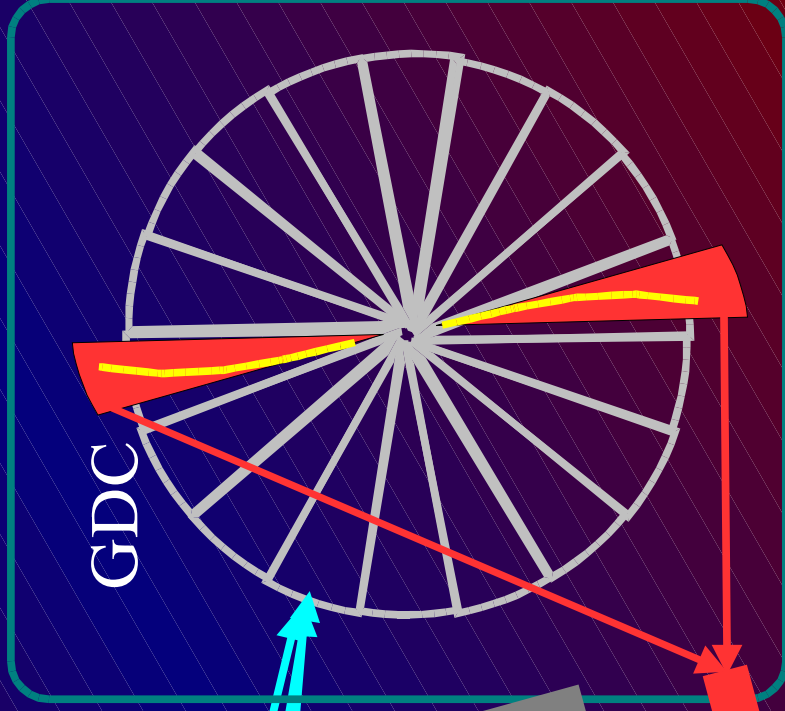




# ALICE L3 EFF

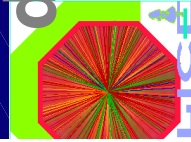


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100MB/s  
raw TPC

data

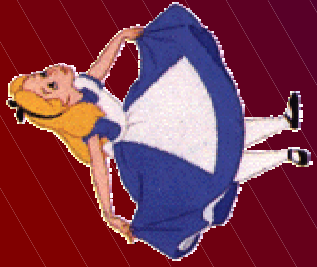


*Roads*  
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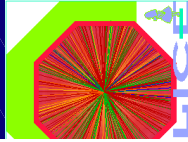




# Future milestones



- LHC main choices to be made by 2001
- Computing review started by H.Hoffman
  - Launched in Marseille to be concluded in < year
- We hope that
  - ROOT's position will be recognised at CERN too
  - Proper support provided
- Virtual ALICE run from Jun 00 to Jun 01
  - We are trying to meet the deadline!
  - Real life test of our framework
- WA data challenges (with Monarc)



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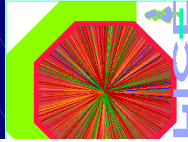




# Lesson (re)Learnt



- Users are ready to move to OO if there is
  - A clear framework and a path to it
  - Support and consultancy for new users
  - Training targeting the framework
  - Some flexibility toward FORTRAN inclusion
- People are afraid to be unproductive for a long time or to waste their work
  - Many *old* FORTRAN users provide their contributions
  - Remote users contribute once a framework is decided
- A *mutual trust* relationship has to be built





# Conclusions

- ☹️ C++ is a **VERY** complex language
  - Nobody understands it all (Stroustrup)
  - The code produced can be very obscure
- ☺️ FORTRAN lasted more than 20 y in HEP
  - It could bring us through LHC
- Migrating to a new environment makes sense only if it is better **AND** simpler
  - **ROOT** seems the right tool to achieve this goal  
<http://alisoft.cern.ch/offline>

