A Computer Cluster System for Pseudo-Parallel execution of

Geant4 serial applications

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Vulcano Workshop 2012 - Memmo Federici IAPS (INAF) Bruno Martino IASI (CNR)

Geant4

Applications

High energy and nuclear physics detectors
. ATLAS, CMS, HARP and LHCb at CERN and BaBar
   at SLAC
Accelerator and shielding
   . Linacs for medical use
Medicine
. Radiotherapy
   . photon, proton and light ion beams
   . brachytherapy
   . boron and gadolinium neutron capture therapy
. Simulation of scanners
   . PET & SPECT with GATE (Geant4 Application
      for Tomographic Emission)
Space
. Satellites
   . effect of space environment on components
      (especially electronics)
   . shielding of instruments
   . charging effects
. Space environment
   . cosmic ray cut-offs
. Astronauts
   . dose estimates

Simulation of s
PET scanner using G
(Courtesy o
OpenGATE collabora

Scenario

Main aim:

- making the execution of Monte Carlo simulations within affordable times and costs

The approach:

- *Minimizing the cost* of the computer systems

- Achieving *acceptable computation times*

- Intensive *reuse of serial* simulation software

This work:

shows that it is possible to *convert serial applications for Geant4 to be effectively executed in a "pseudo-parallel" mode* with performances comparable to that achievable by the corresponding native parallel applications

Parallel applications

Advantages:

- **parallel applications runs simultaneously on multiple processors, or cores inside the same processor, resulting in a significant increase in performance**

Drawbacks:

- **writing parallel applications generally implies a challenging design**

- **converting serial into parallel applications possibly requires a *complete rewrite* of the source code**

- **very expensive whenever excuted on high-end servers (machines with a large number of processor sockets, dozens, even hundreds, and a large amount of shared memory)**
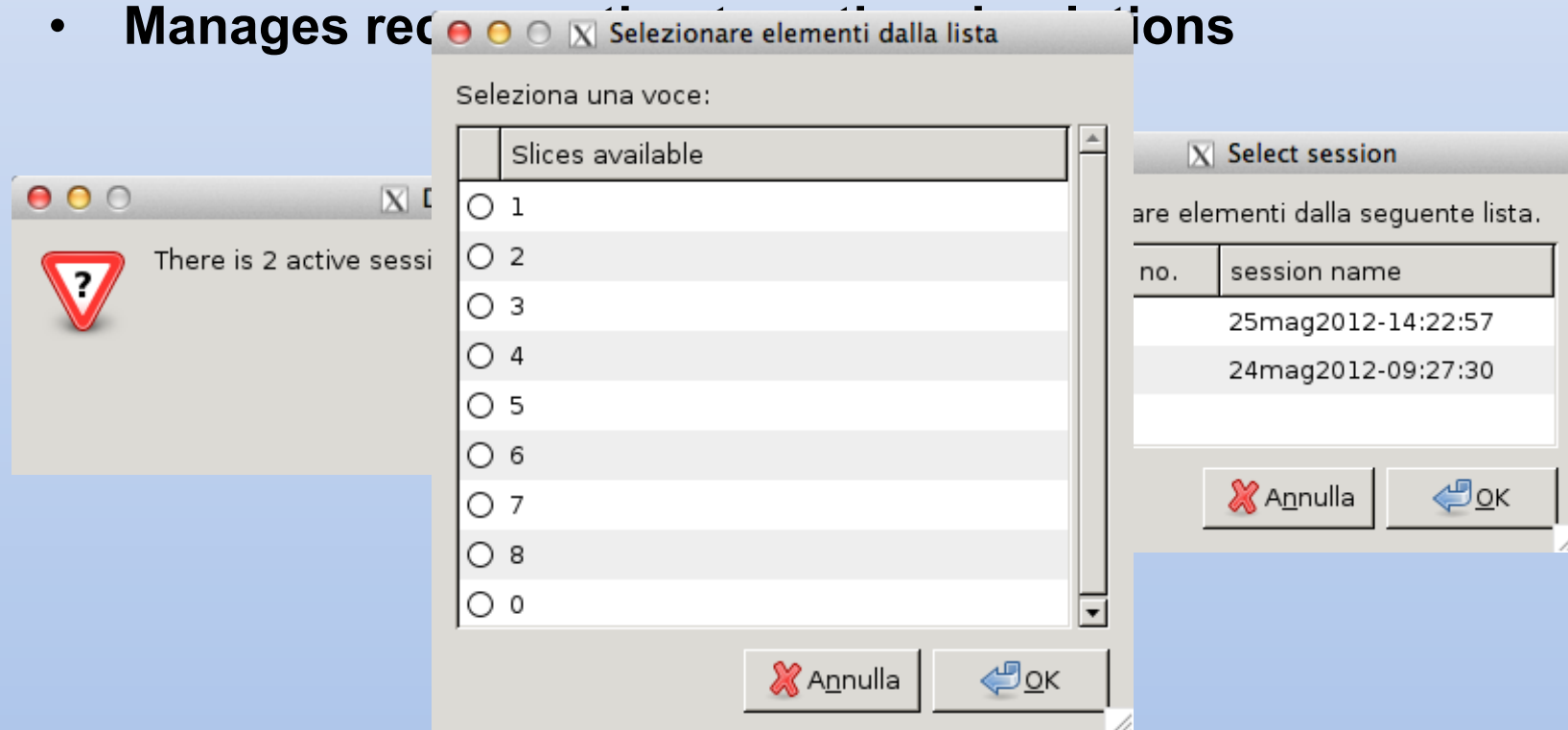
Computing environment
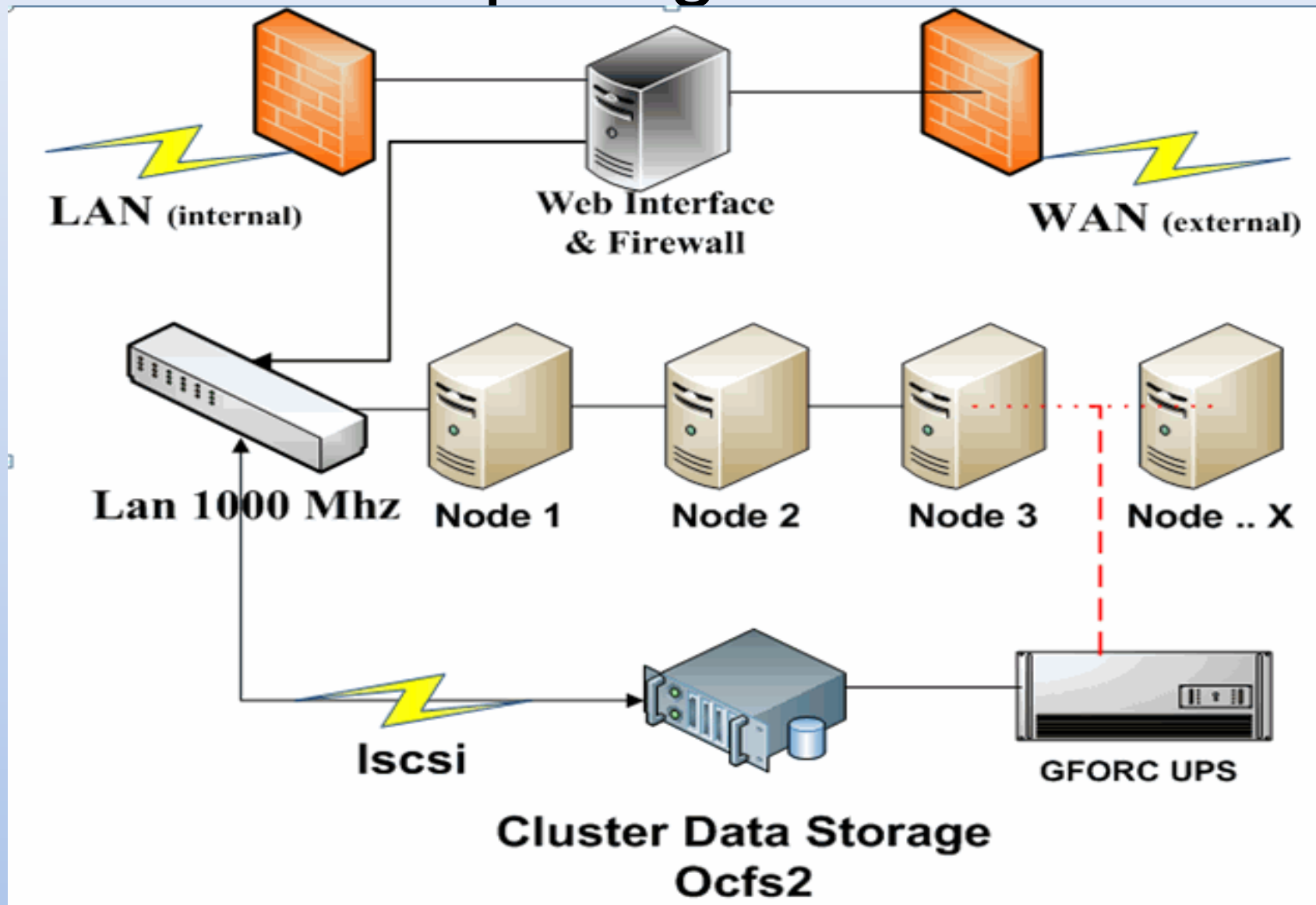
How to run simulations
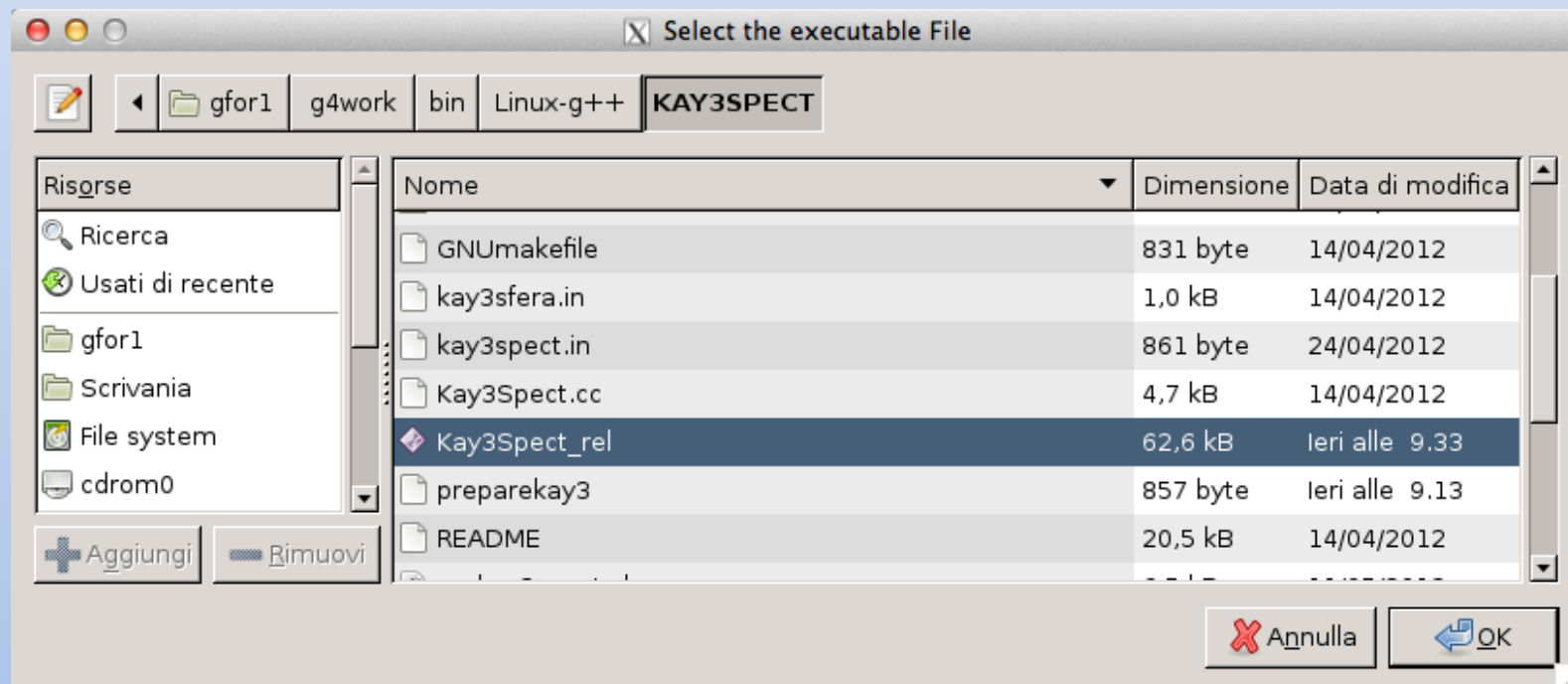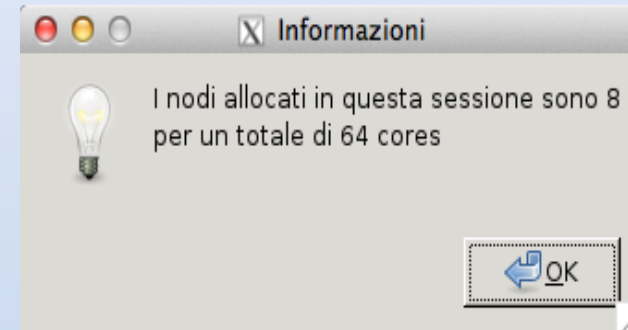
At login time the user profile script:

- **Sets the execution environment**

- **Makes it possible for the user to select the number of nodes devoted to the simulation**

- **Manages rec** ··· **tions**

How to run simulations

At run time a script:

•**Make it possible for the user to select the application to be run and generate the corresponding configuration files (one for each instance of the process)**
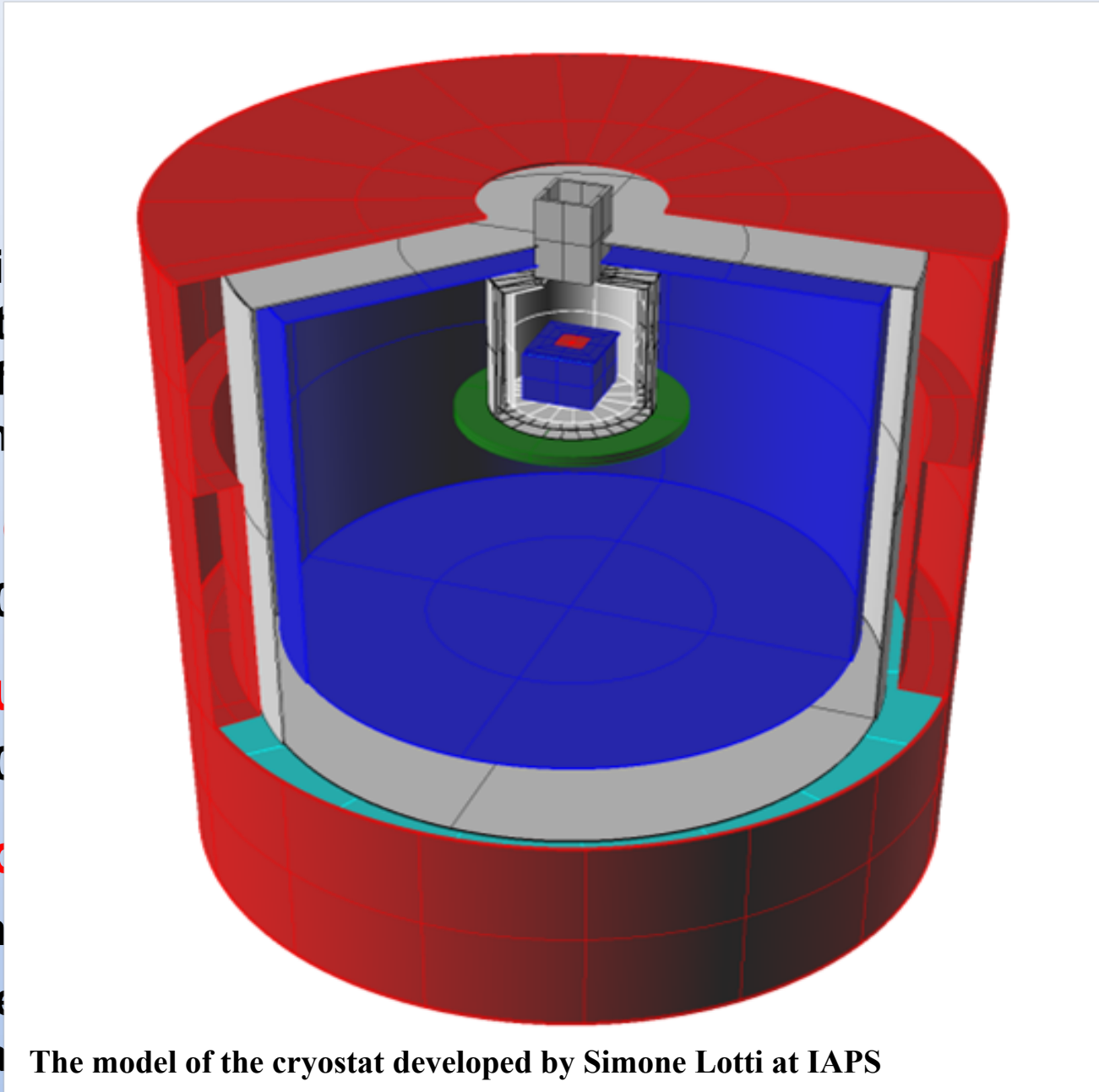

Informazioni

I nodi allocati in questa sessione sono 8 per un totale di 64 cores

OK

Select the executable File

gfor1 | g4work | bin | Linux-g++ | **KAY3SPECT**

Nome	Dimensione	Data di modifica
GNUmakefile	831 byte	14/04/2012
kay3sfera.in	1,0 kB	14/04/2012
kay3spect.in	861 byte	24/04/2012
Kay3Spect.cc	4,7 kB	14/04/2012
Kay3Spect_rel	62,6 kB	Ieri alle 9.33
preparekay3	857 byte	Ieri alle 9.13
README	20,5 kB	14/04/2012

Risorse
- Ricerca
- Usati di recente
- gfor1
- Scrivania
- File system
- cdrom0

Aggiungi   Rimuovi

Annulla   OK

Aim:

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The model of the cryostat developed by Simone Lotti at IAPS

Simulation champaigns

Aim:
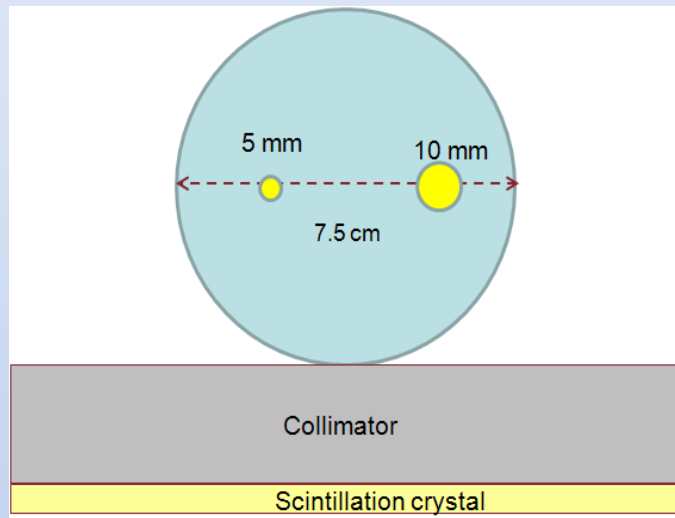
SPECT with small Gamma Camera
based on $LaBr_3:Ce$ continuous crystal

Practical advantages :

- makes the design of the detector more effective (the impact evaluation of design changes is easily evaluated)
- performances are increased by a factor of 60, costs by a factor of 7

Conclusions
The cluster:

▪ **has been optimized for GEANT4 use**

▪ **improves by a factor from 40 to 60 the speed for simulations that require large computational resources (compared with a single PC of the same category)**

▪ **drastically decreases the probability of failure thanks his great speed**

▪ **it's cheap: it currently consists of 8 commercial PC for a total of 64 cores**

▪ **it's modular: easily expandable without substantial changes**

▪ **can be easily reused on other projects!**

Future developments:

- Porting of Monte Carlo code to NVIDIA GPU multicore architecture

- Use a distributed Parallel File Systems

Thanks to:

Pietro Ubertini
Lorenzo Natalucci
Simone Lotti
Maria Nerina Cinti
Fabio Guglietta