Elettra Virtual Collaboratory: status and future developments

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Outline

- Introduction to collaboratories
- The status of Elettra Virtual Collaboratory
  - The portal application
  - The Collaboration Tools
  - The Architecture
  - Usage scenarios
- Connection with BIOXHIT / VCS
- Connection with IA-SFS / JRA1
- Connection with GRIDCC / MCE
- Connection with EUROTeV / MVL

What is a Collaboratory?

- The term *“collaboratory”* was coined by William Wulf by merging the words *collaboration* and *laboratory*, and defined as “... Center without walls, in which researchers can perform their research without regard to geographical location - interacting with colleagues, accessing instrumentation, sharing data and computational resource, and accessing information in digital libraries”.

Pros of Collaboratories

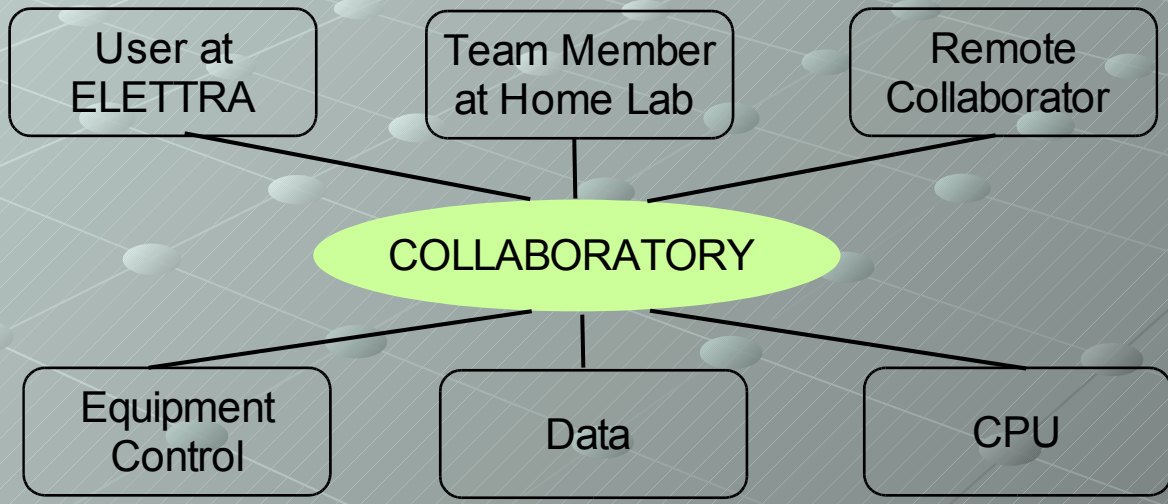
- Scientific collaborations currently rely on face-to-face interactions, group meetings, individual action, and hands-on experimentation. The creation and introduction of effective CSCW systems aims at bringing the following main advantages:
  - provide remote access to expensive and hard-to-duplicate equipment (and thus reduce travel costs of research groups)
  - increase the effectiveness of the experimental activity, since more experts can participate to experiments, give useful hints and solve problems
  - facilitate multi-institutional consortia collaborations on large-scale projects.

VC examples: features

- Provide Remote Access
  - instrumentation
  - data (visualisation)
  - computing power
- Telepresence
- Videoconference
- Notebooks
- Automation
- …

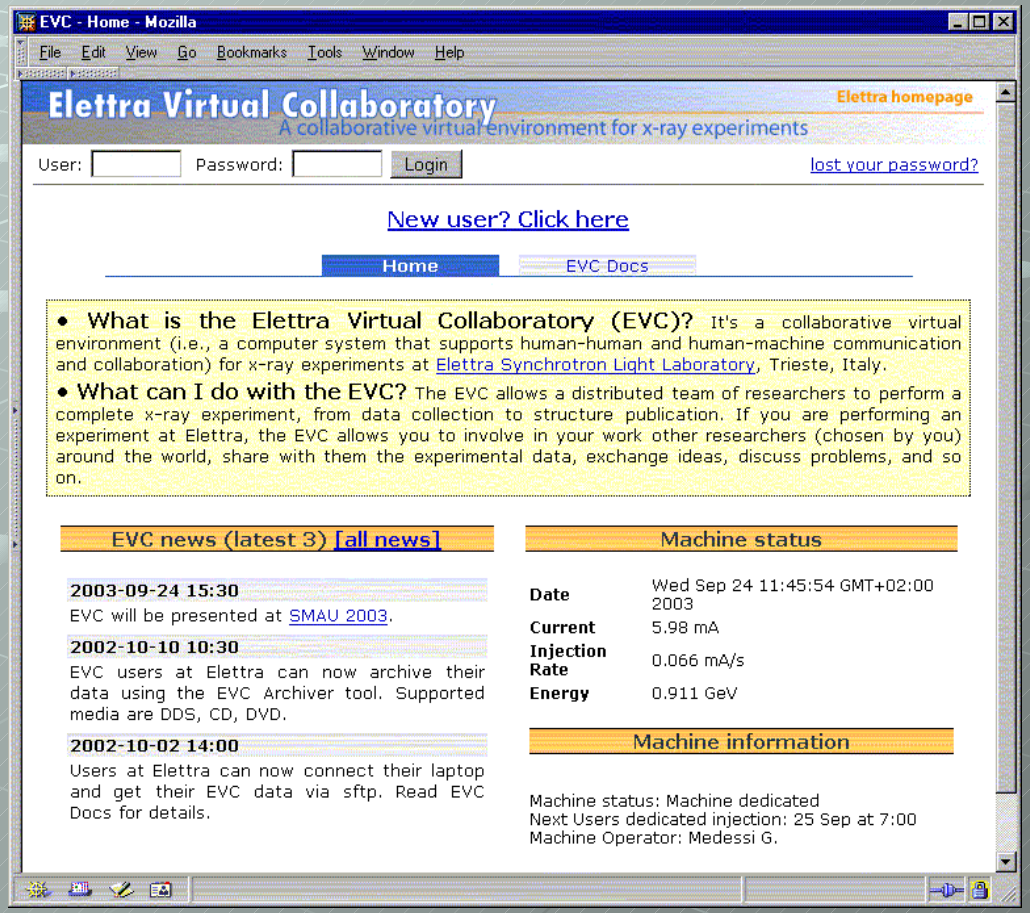
What is the Elettra Virtual Collaboratory (EVC)?

- EVC is an example of virtual laboratory, a system which allows a team of researchers distributed anywhere in the world to perform a complete experiment on the equipped beamlines and experimental stations of Elettra.



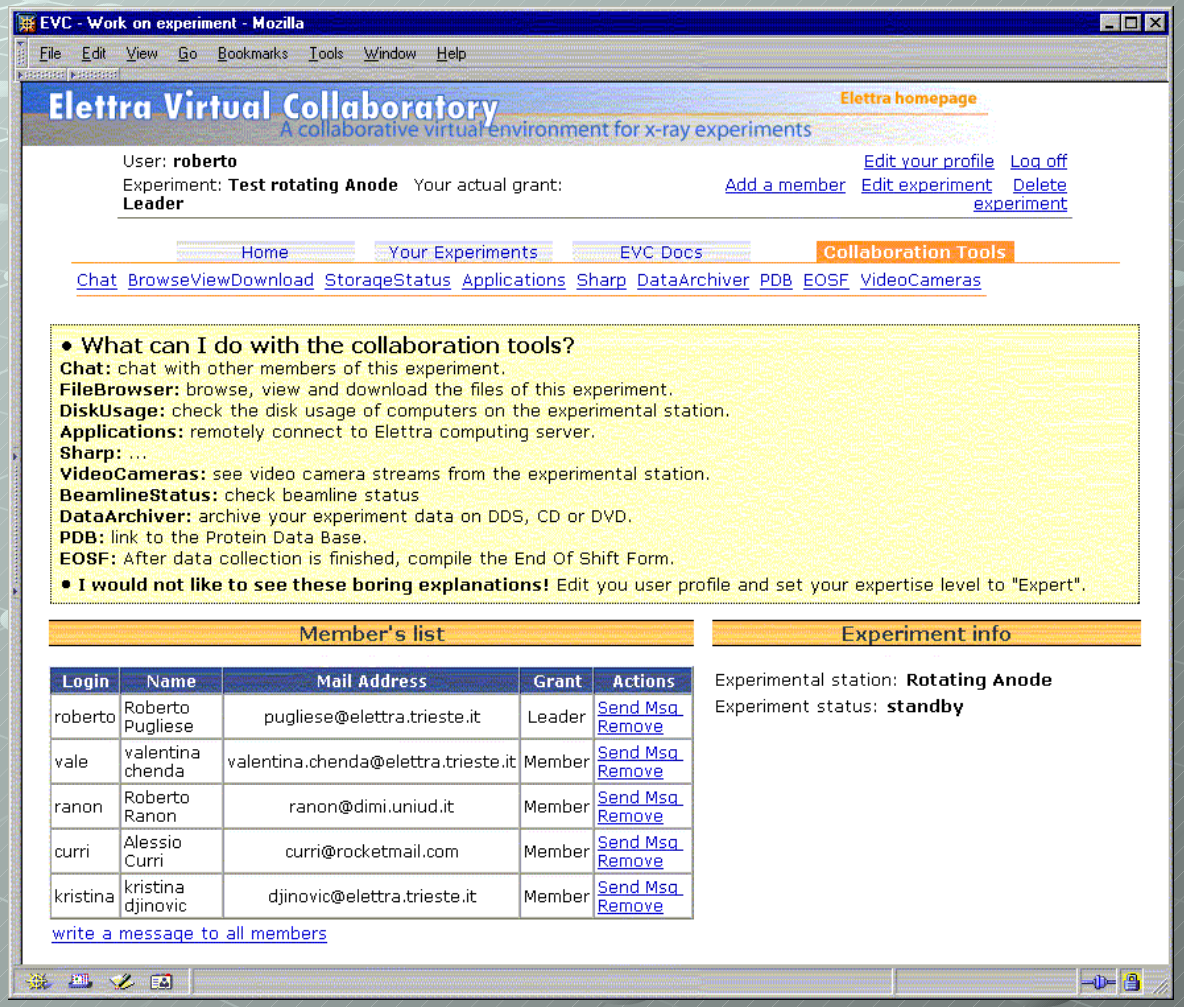
EVC in action: a web portal

- EVC is based on the “web portal” metaphor
- All you need is a browser
- EVC supports four different user categories:
  - Visitors
  - Normal users
  - Project leaders
  - Staff



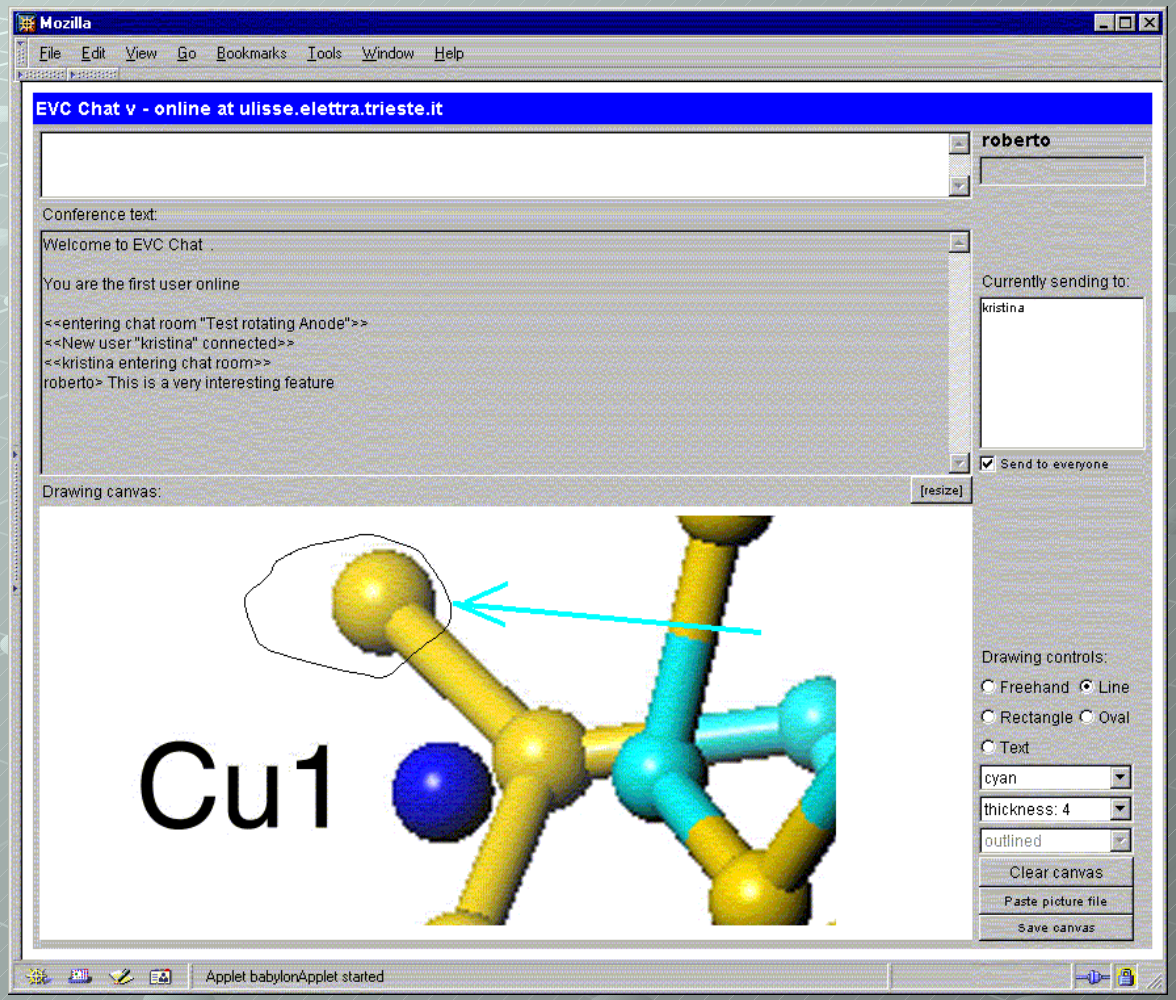
Collaborating to an EVC project

- Scientists working to an EVC project can use many project related collaboration tools
- EVC presents an adaptive interface changing to suite the category and expertise level of the user



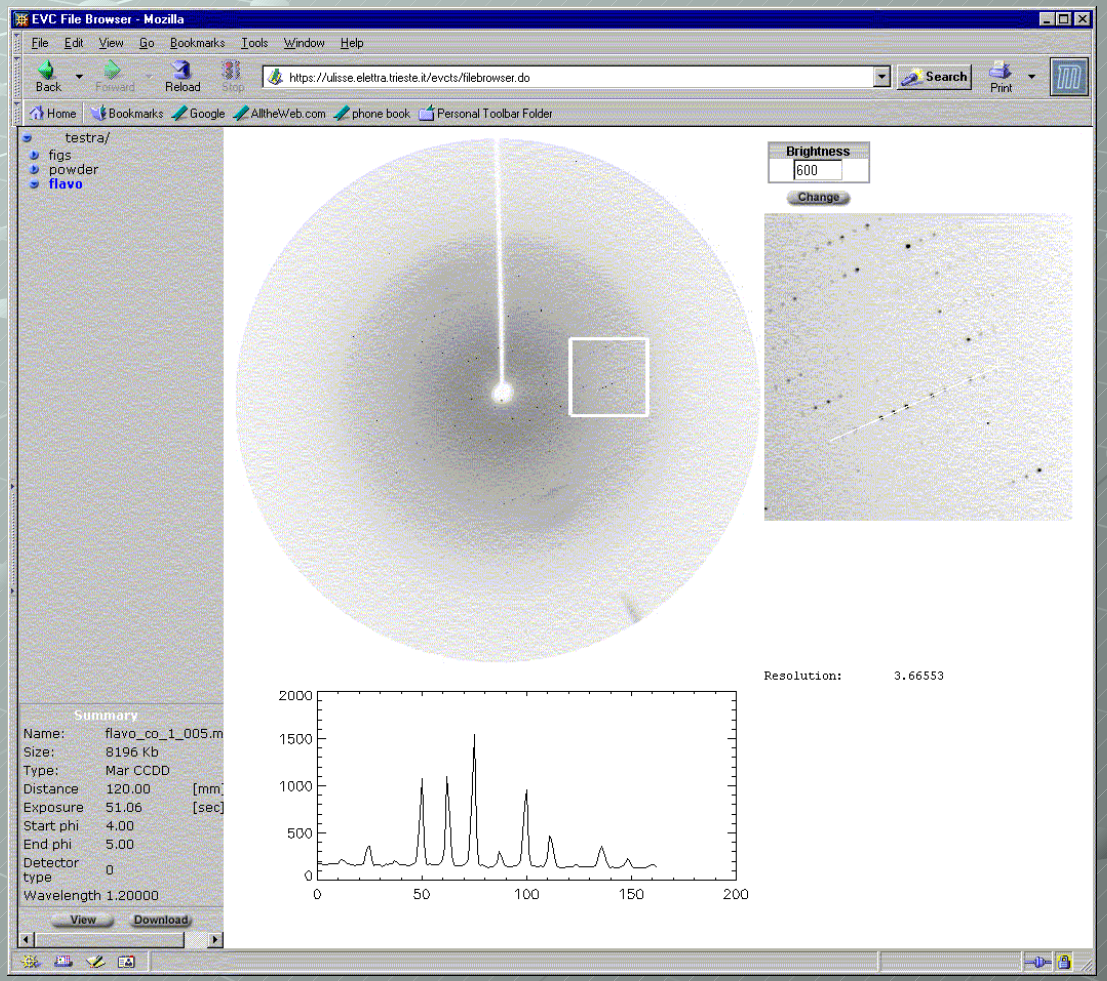
Collaboration Tools: EVC chat

- EVC chat is “project centered”: there is a different channel for each project
- Usual chat feature are extended in order to allow exchange of
  - Drawings
  - scientific images
  - graphical annotations



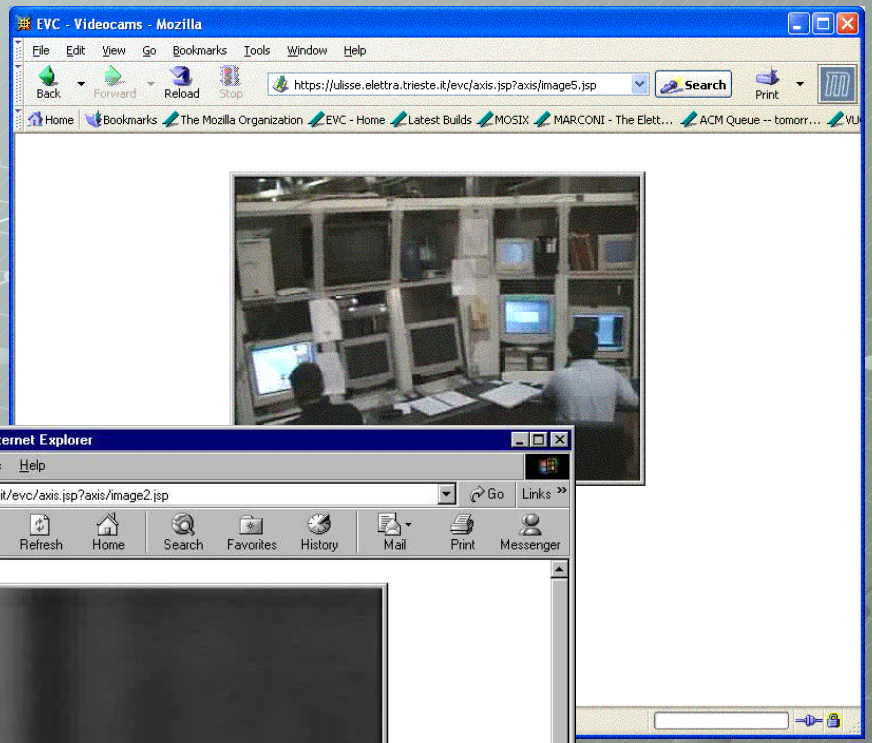
Collaboration tools: scientific visualisation

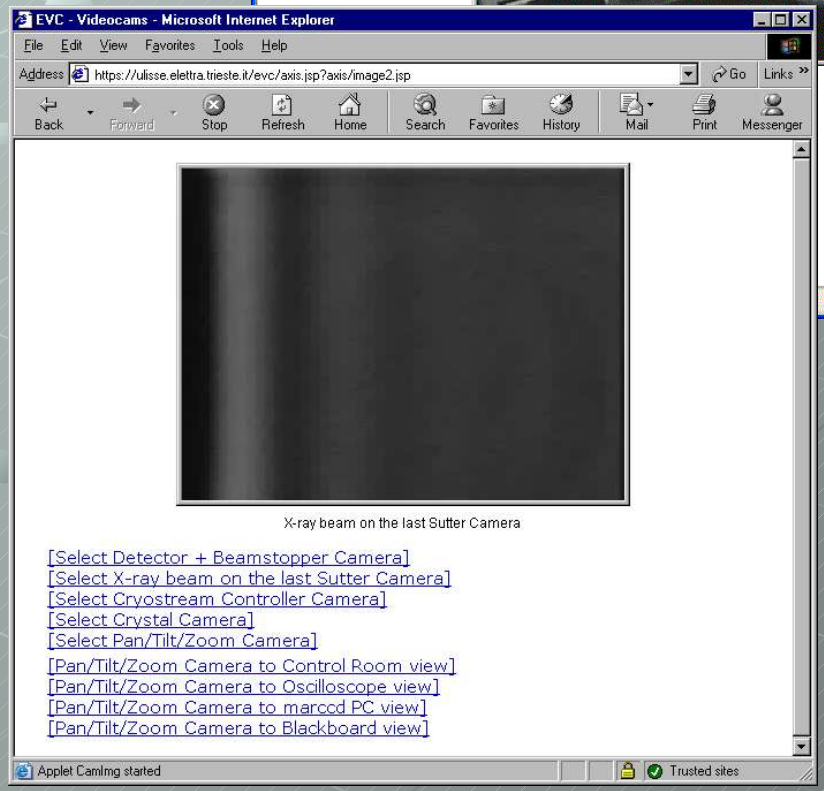
- Scientists can browse, visualise and process remotely scientific data in real-time as soon as the data is collected



Collaboration Tools: telepresence

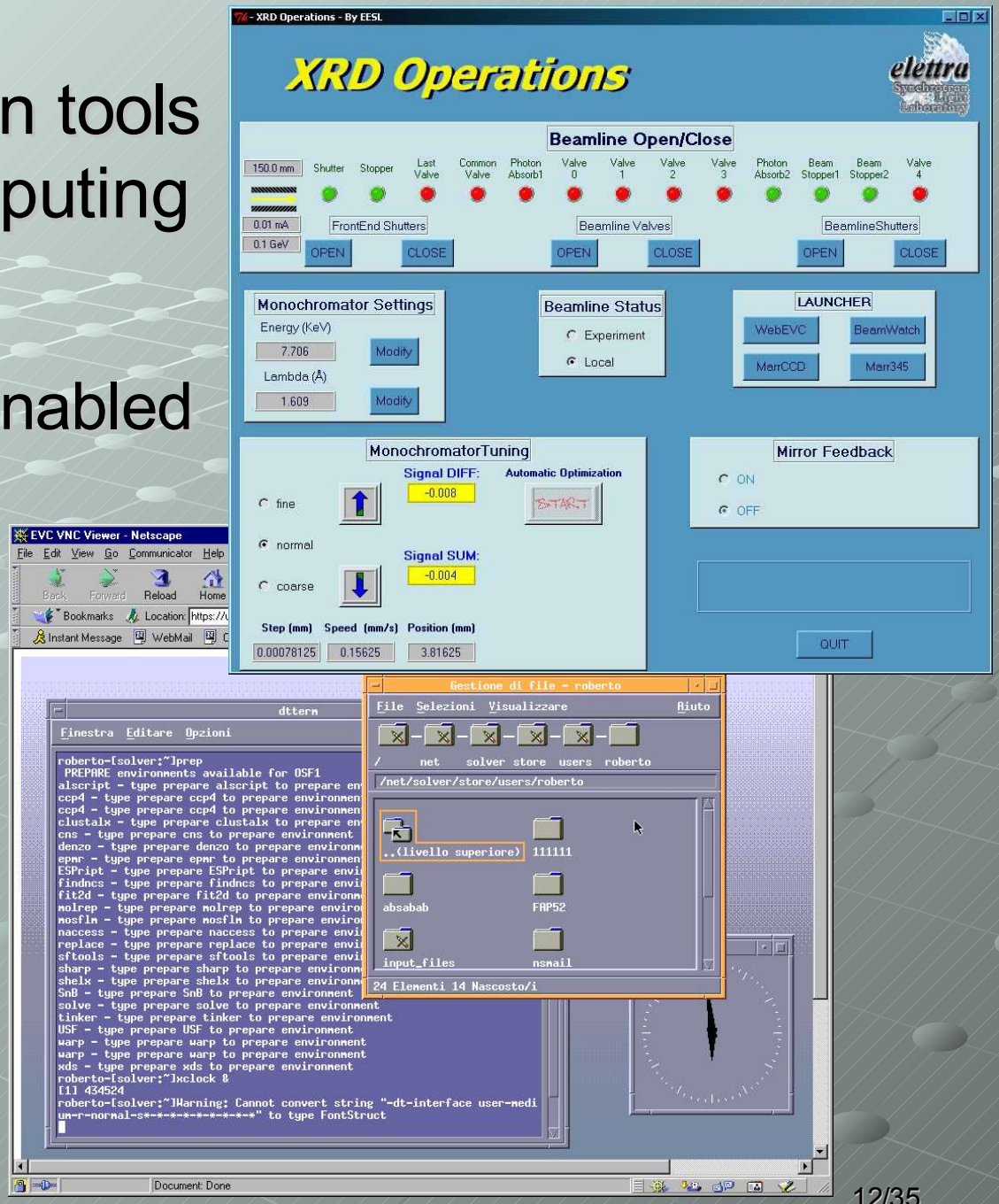
- The different video streams of the equipped experimental stations can be selected and viewed even through a slow connection
- Movable cameras can be controlled via web by the project leader





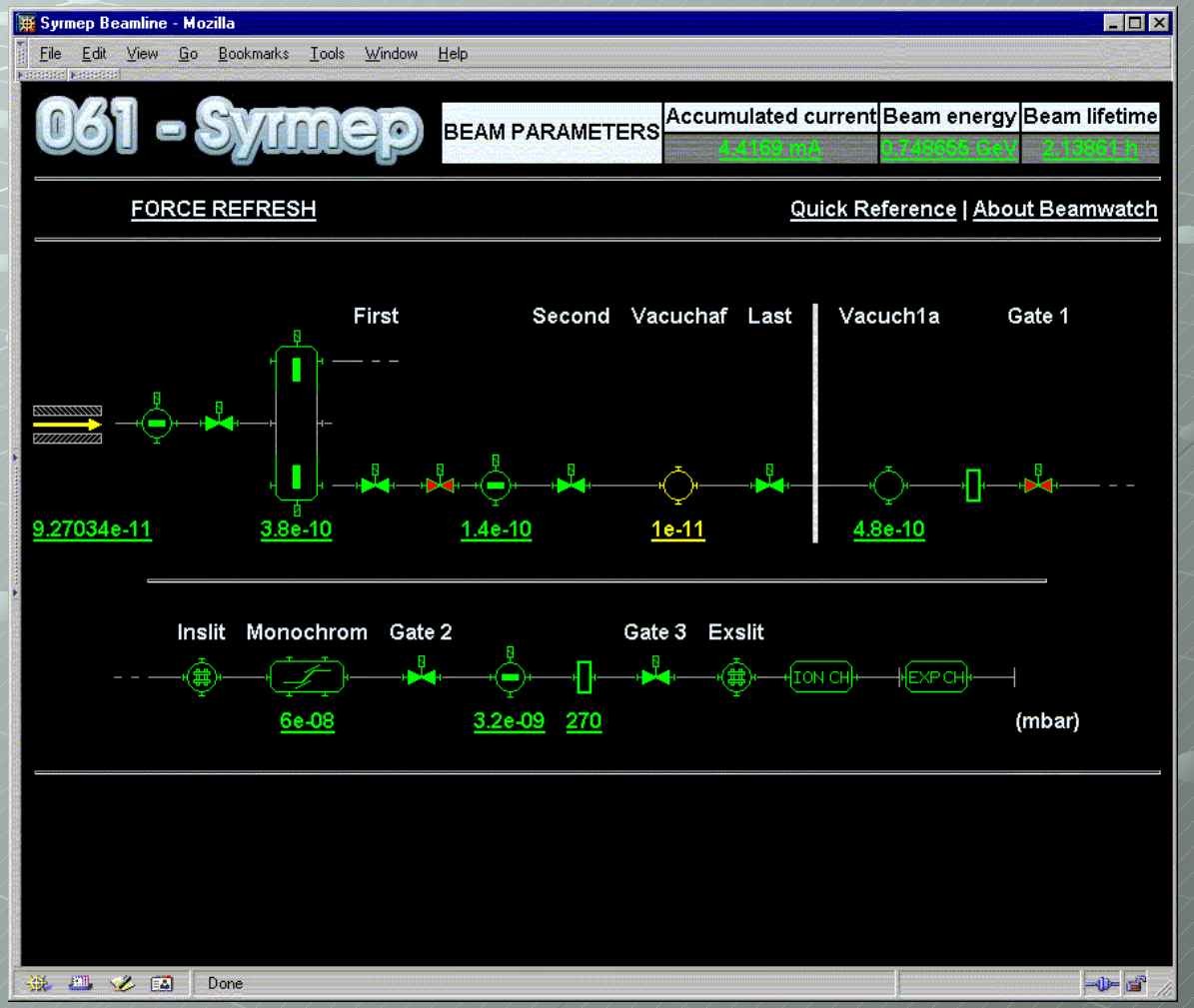
Collaboration tools remote computing

- Legacy software is normally not web enabled
- EVC uses VNC to web enable legacy apps.
  - It is small and simple, sharable and open
  - Can be tunnelled via ssh
- VNC can be used as a fast integration tool



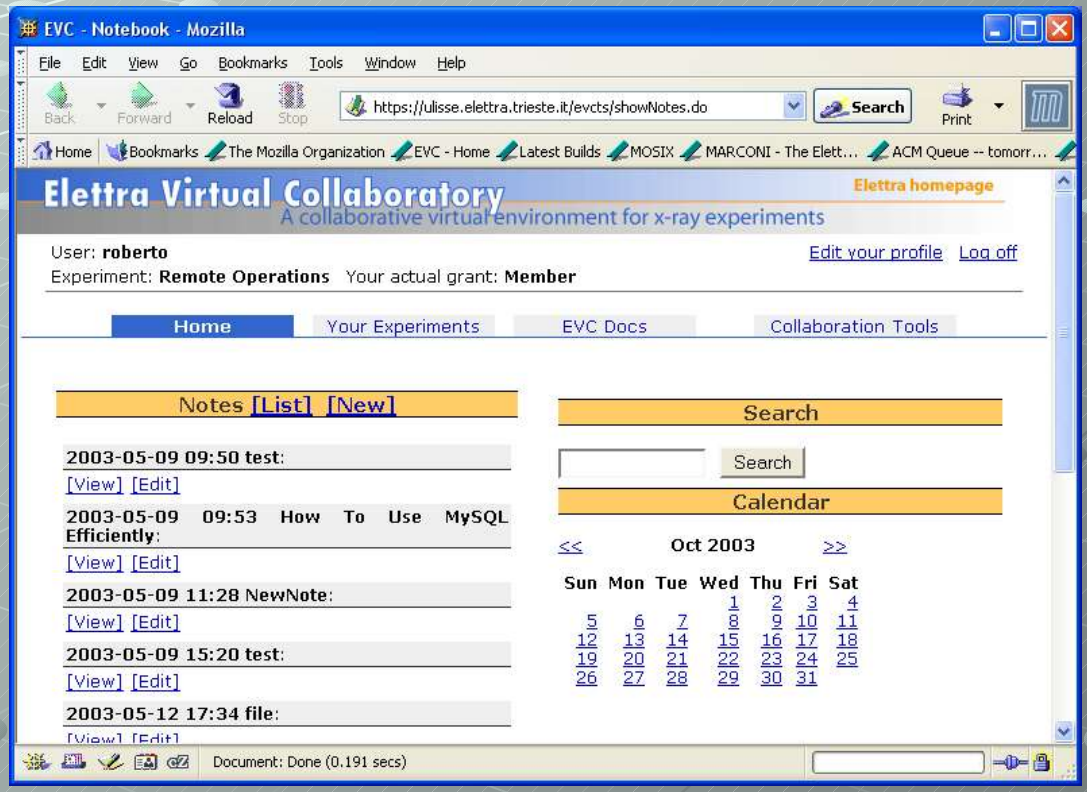
Collaboration Tools: Remote Beamline Control and Supervision

- Beamwatch presents a synoptic view of the beamlines
- Autorised people can thus operate remotely on the beamline intrumentation



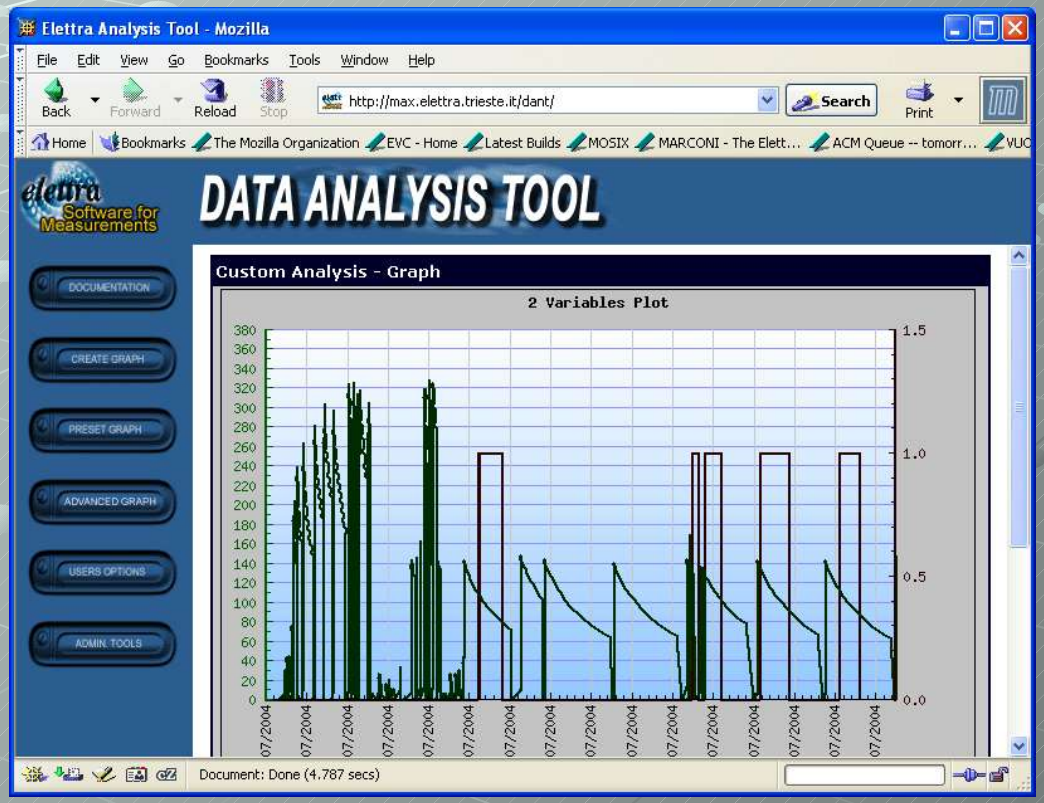
Collaboration Tools: Electronic Notebook

- Web application which substitutes the Beamline LogBook registering meaningful beamline events using a wiki-weblog methaphor
- Events can be entered manually or automatically by a program
- Texts and images are automatically indexed and hence easily searchable and browsable



Collaboration tools: Advanced LogAnalizer

- Advanced LogAnalizer is a web application which allows to select variables from the logfiles produced by different control and supervision systems, and to plot them in a user specified temporal interval



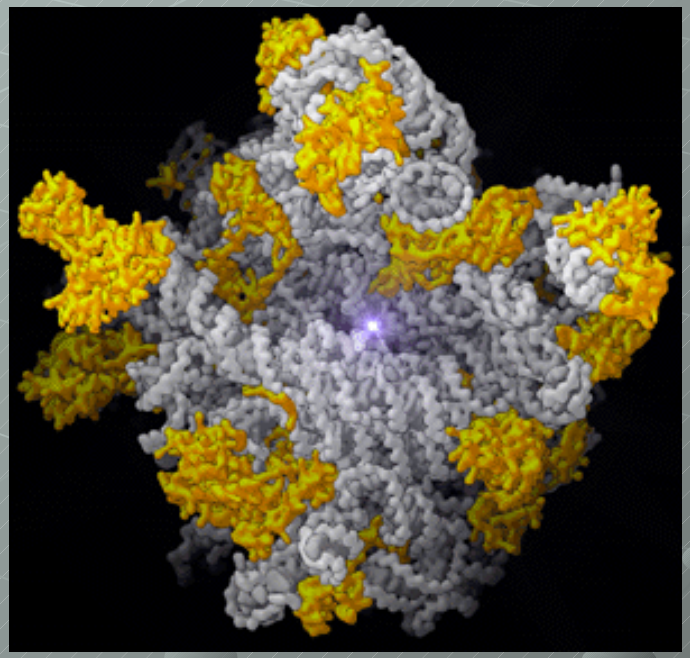
- Advanced LogAnalizer is technically a data webhouse, modular both considering the data loading and the data visualisation (Visual Data-Mining)

EVC usage scenarios: Cristallography “by mail”

- In a typical EVC operating scenario it is sufficient that a single person operates in the Elettra experimental hall while all the other team members collaborate operating remotely, by providing hints and suggestions, by helping to solve ordinary or accidental problems, analysing acquired data, etc.
- In the case of fully particulary automatized experimental stations the presence of people operating at the beamline can be even considered not necessary.

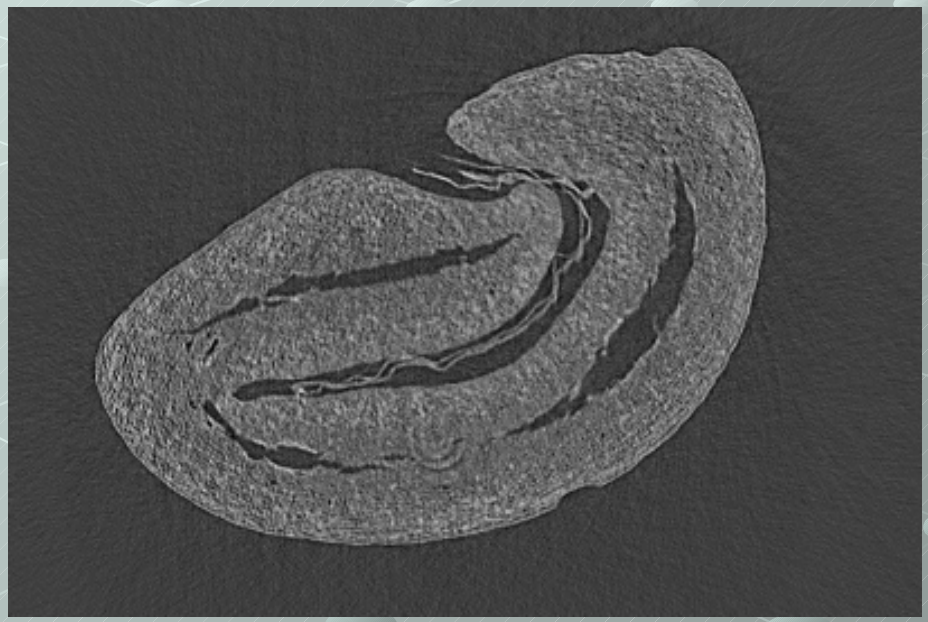
EVC usage scenarios: Cristallography “by mail”

- EVC allows biologists to send by mail protein crystals which will be ananlized at the Xray Diffraction beamline by the beamline staff.
- Collected data and results are accessible via EVC and results can be downloaded as soon they are available.



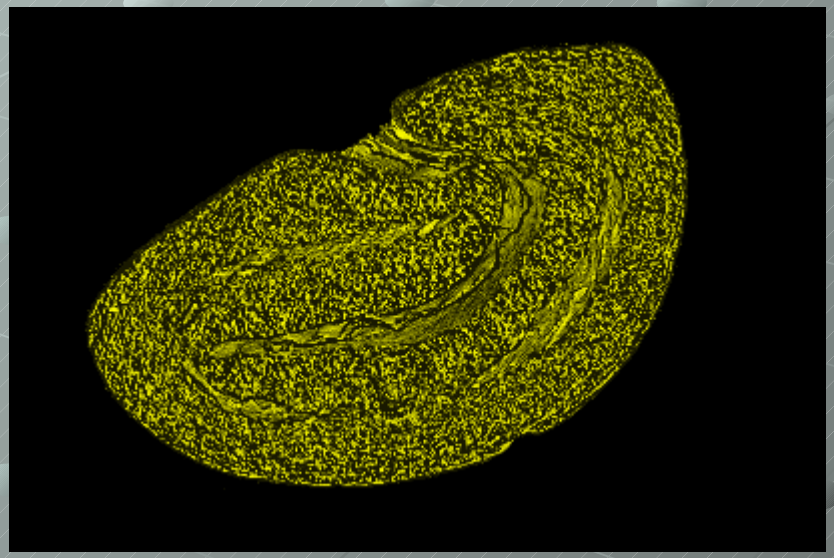
EVC usage scenarios: real time micro-tomographic reconstructions

- EVC will be used to allow real-time micro-tomographic reconstructions on SYRMEP beamline, as soon as data is collected



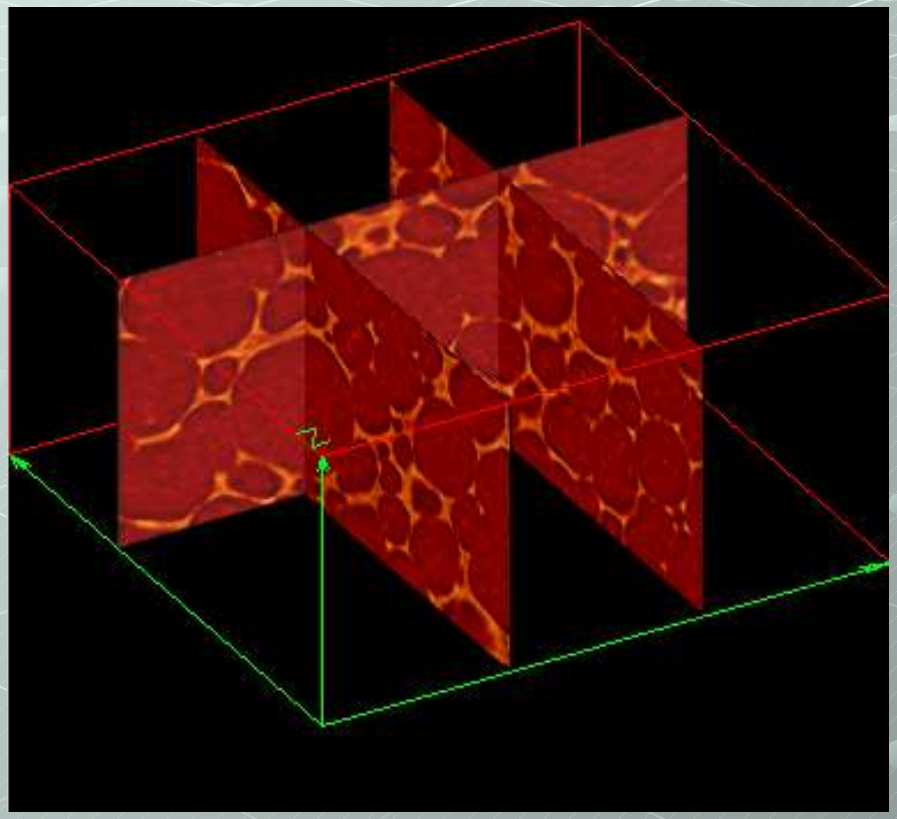
Reconstructed stack of 279 slices

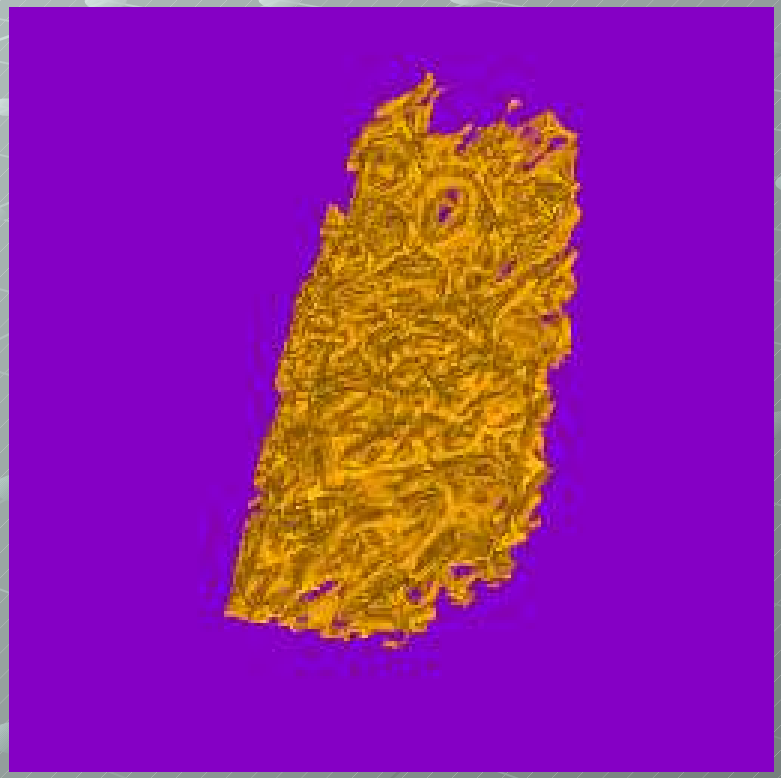
2 mm



Volume rendering

EVC usage scenario: real time micro-tomographic reconstructions





Virtual cut of the sample

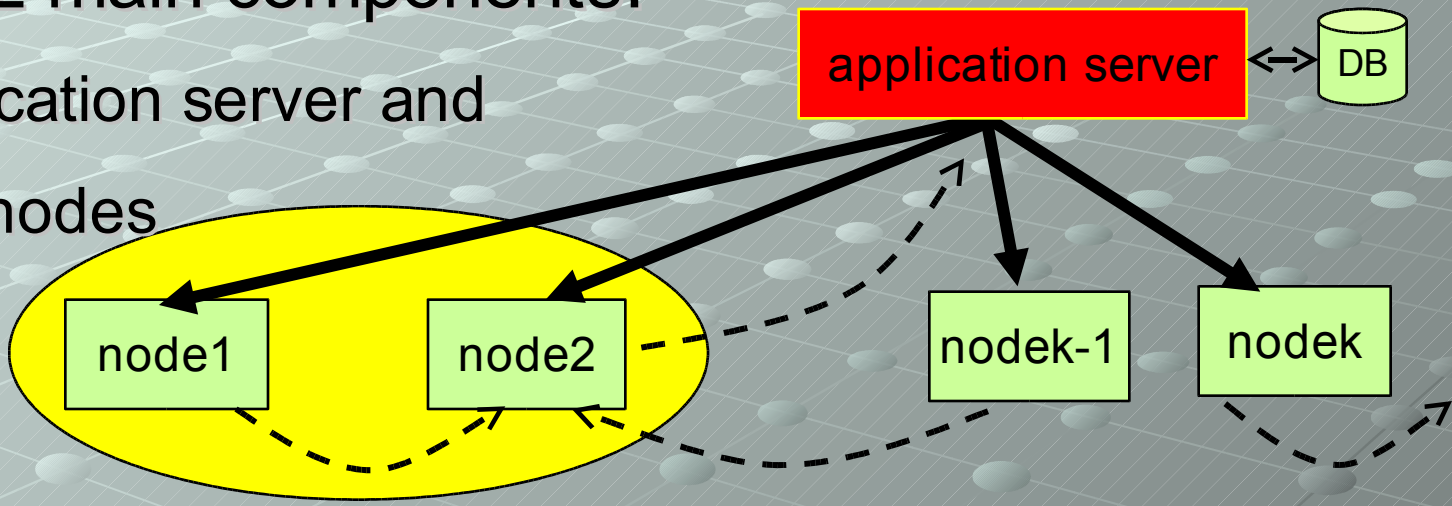
(3.2 x 3.0 x 1.4) mm³

EVC Architecture

- EVC has 2 main components:

  the application server and

  a set of nodes



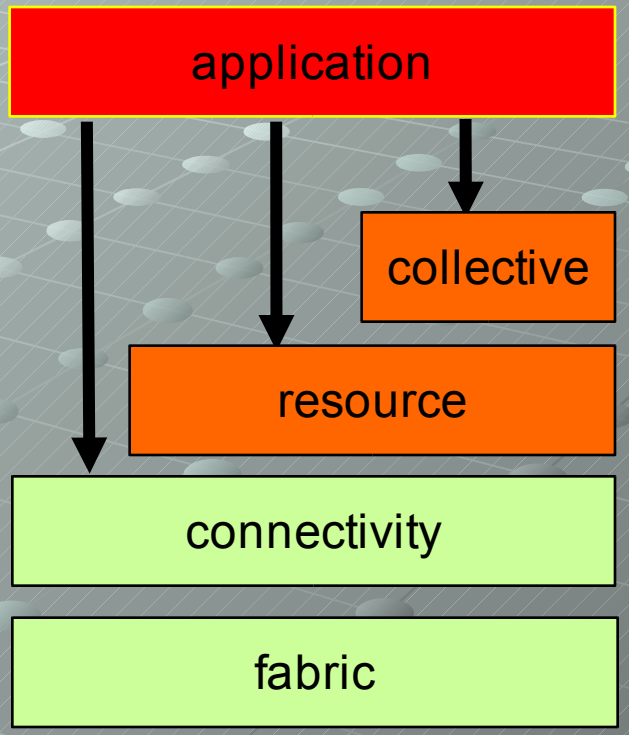
- The application server is running the portal application, the user and project database; the application server activates actions implemented by agents running in the nodes or requests services to external systems (e.g. VUO)

EVC Architecture (cont…)

There are many categories of nodes according to their function:

- data collection nodes,
- data storage nodes,
- computing nodes,
- data backup nodes

new categories can be also created



- a single host can act as one or more nodes
- an experimental station is associated with a group of nodes
- Comunications between the application server and the nodes agents is via a sort of rudimentary web service (httpunit, webmin, ssh,..)
- The agents in turn communicate with the application server via database

EVC status and future developments

- EVC project started on June 2001 and finished on June 2003. The first prototype was installed on the Xray Diffraction beamline of Elettra on June 2002
- EVC is now operating on 5 beamlines and experimental stations and will be extended to all the experimental station in the first half of the year.
- EVC was presented at SMAU2002, NOBUGS2002 and SMAU2003, HCI2003
- EVC development staff is partecipating in many EU projects submitted under FP6 (*BIOXHIT, IA-SFS/JRA1, GRIDCC, EuroTEV/GAN)*

BIOXHIT / Virtual Collaboratory System

- *…Virtual Collaboratory System* …to allow remote control of the diffraction and fluorescence experiment by being interfaced to beamline control and data collection software
- … VCS will be developed adopting a development technique …eXtreme programming and … open source web technologies
- …attention will be paid to the maximum portability of the system, in order to allow for implementation at other facilities.
- …VCS will be linked to the user database (Virtual User Office) and could be equally linked to the central project-tracking database, allowing easier administration both for synchrotron staff as well as for the users.

VCS implementation proposal

- Complex problems like “High-Throughput” Protein Crystallography involve in fact coordinating and sharing computing, application, data, storage, or network resources across dynamic and geographically dispersed organizations (Webservices/GRID?)
- Refactor the EVC by substituting the communication mechanism with webservices both from the application server to the agents and the way back
- Collect new requirements by the participating partners and implement the new kind of experimental stations (e.g. crystallisation station), nodes, agents, and collaboration tools involved
- A first possible application scenario is the implementation of a single application server and have only the nodes distributed among the participating facilities
- The final scenario involves the distribution of application servers (one for facility) and a communication collaboration mechanism between the application servers

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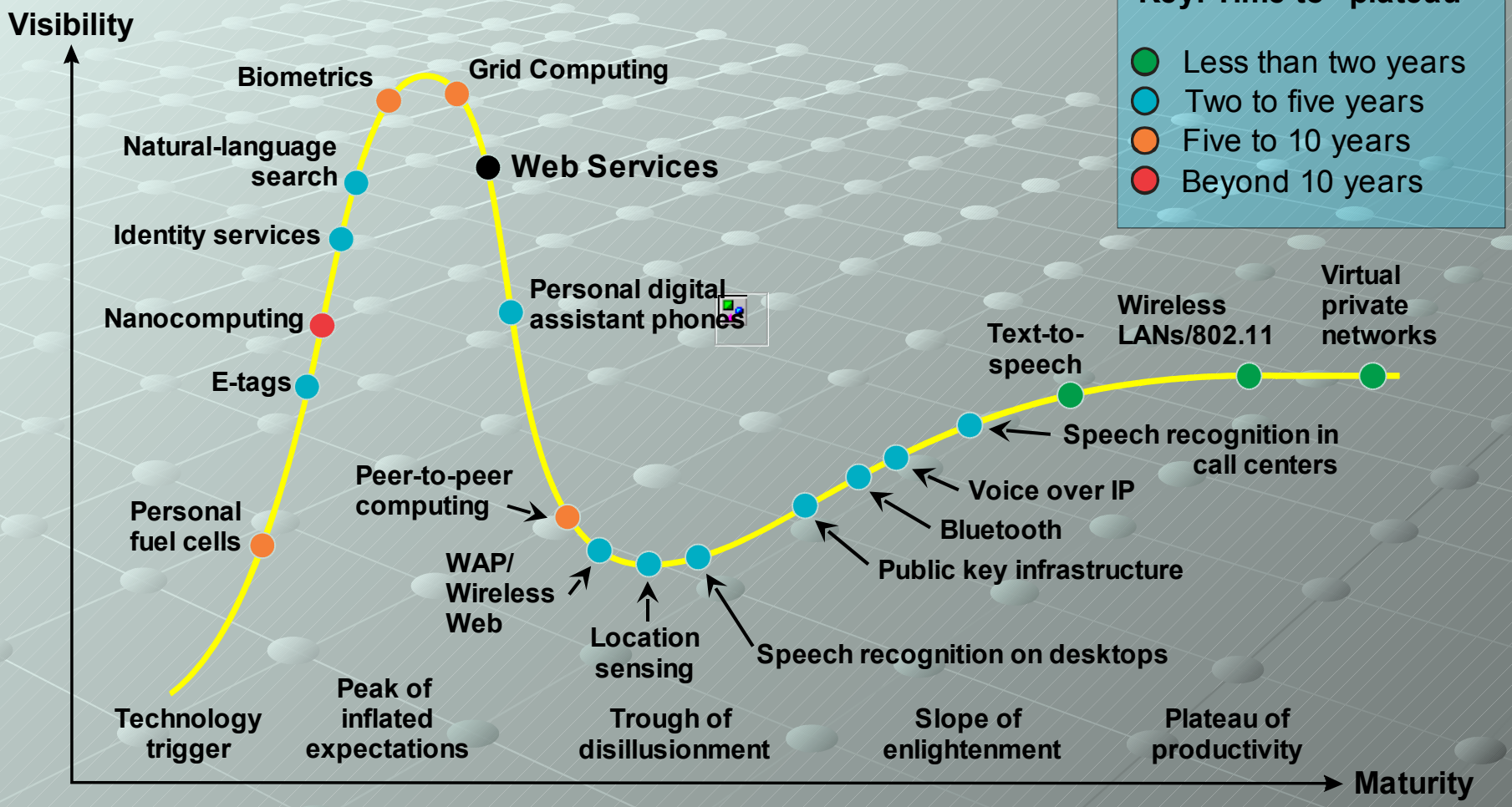
Why Web Services?

"The Web can grow significantly in power and scope if it is extended to support communication between applications, from one program to another."

- From the W3C XML Protocol Working Group Charter

Gartner's 'Hype' Curve



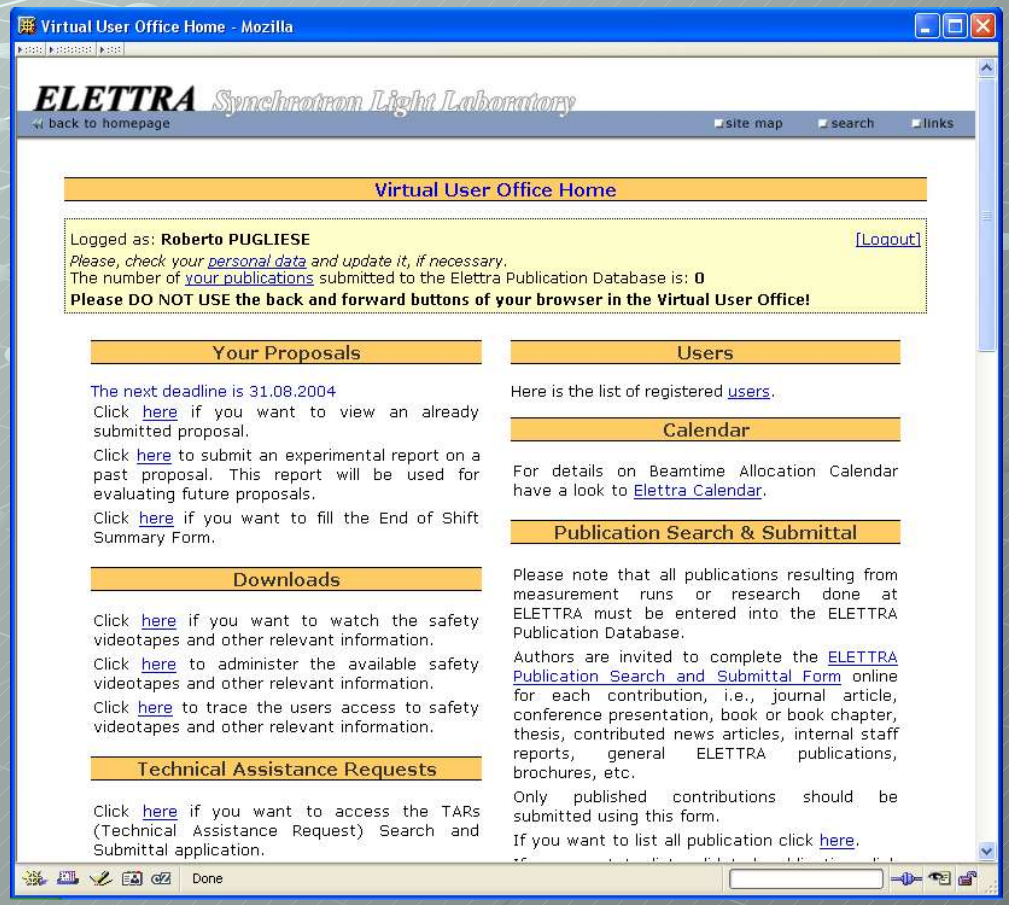
Source: Gartner Group June 2002

IA-SFS/JRA1-WP1 Rationale

- The generic nature of the experiments performed means that users can (and do) apply to more than one site for a particular project.
  - This may be because specific beam-lines are more suitable to some aspects of the experiment
  - may simply reflect the immediacy of demand, the difficulty of the project
  - travel and budgetary considerations
- The provision of a common application platform would enhance the efficiency of the application procedure *for the users,* and, if correctly implemented, might lead to a Europe-wide clearing-house for applications in this area in the mid-term (>5 years) future.

The User Perspective

- The VUO1.4 provides community services, beamtime application, beamtime calendar, access application, publication and experimental reports submission, on-line training (W3C/SLIM) ...
- Big efforts were made towards usability via user centered design



OpenUserOffice a testbed for IA-SFS/JRA1-WP1

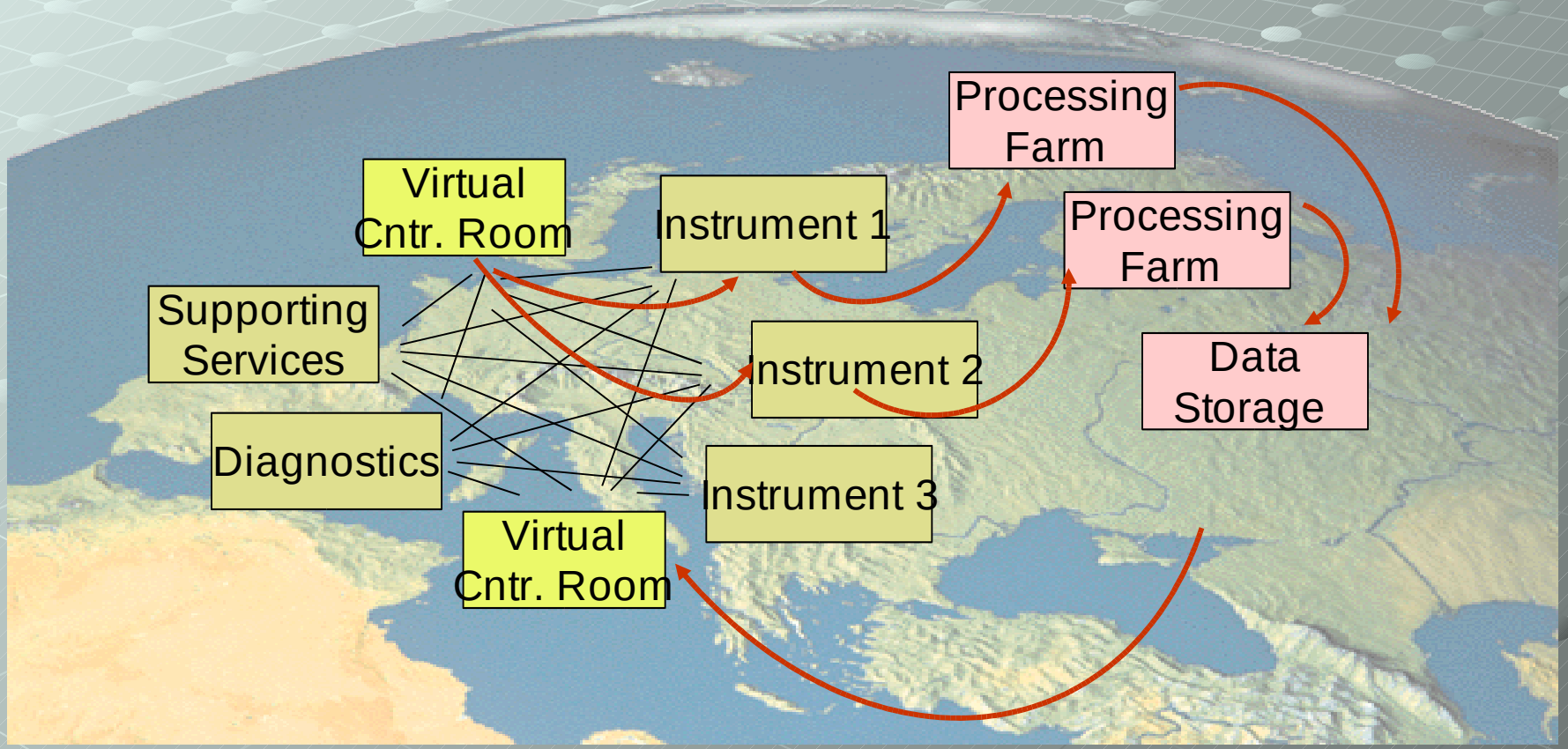
- The VUO application which have been operating for more than 6 years has now reached his maturity.
- The VUO application will be transformed in a Open Source project taking into account any requirement from the participating partners
  - this will allow the facilities which does not have this kind of application to have one at a very low cost
  - there is a very low possibility that a facility with an already operating VUO like application will use the OpenUserOffice, which means that we have to find a way out
- The OpenUserOffice will become a testbed of the WP1
- Using webservices technology, facilities with an already working application need only to implement a set of webservices for compatibility

GRIDCC

- ... the GRIDCC project extends the state of the art of computing Grid technologies, by introducing the handling of real-time constraints and interactive response into the existing Grid middleware
- Our goal is to build a widely distributed system that is able to remotely control and monitor complex instrumentation …These new applications introduce requirements for real-time and highly interactive operation of GRID resources.
- One of the main objectives of the project is to verify the feasibility of a Grid-based remote control of systems requiring real-time response with real applications running on existing Grid test beds over both national and international network infrastructures (e.g. GEANT).
- GRIDCC integrates a “grid of instrumentation” into existing Grid infrastructures that provide the computational power and storage needed for the applications ….

.... the GRIDCC project

Use of the Grid technology, as extension of the Web Service Technologies, to develop a widley distributed control system with access to grid enabled computing and data storage facilities



AccessGRID@ELETTRA

- Setup of an AccessGRID node at Elettra
- It means the implementation of a collaborative environment to support group to group interactions using AccessGRID technology
- Partners:
  - Elettra,
  - INFN,
  - CINECA,
  - ICTP

EUROTeV/GANMVL

Multipurpose Virtual Laboratory

- If the linear collider is to be build in a collaboration between the large HEP laboratories and contributions from smaller institutions, a dense network of inter-laboratory taskforces needs to be managed and supported.
  - Prototypes will be developed in one institution and tested with beam in another laboratory
  - Equipment will be built and delivered by one partner and needs to be integrated into the accelerator complex by another partner
  - Whole parts of the facility will be provided by a remote partner and need to be commissioned and possibly operated with the experts at their remote home institutions
  - In situ trouble shooting and repairs needs to be performed with the support of off-site experts
- The needs of the worldwide accelerator community to operate in this mode on a routine base in an efficient manner are by no means obvious. It will be a new way executing a large accelerator project. The laboratories will have to learn how to deal with it.
- **The Accelerator community has started to prepare itself for the new mode of collaboration**
- **The GANMVL project understands itself as part of the worldwide effort.**

GANMVL Project Goals

- Integrate
  - state of the art audio- and video communications technology
  - virtual instruments
  - and accelerator controls
- into an all round communications tool implemented as a compact and transportable hardware set-up containing
  - 3D-video screens,
  - audio devices, video capturing devices,
  - computer terminal,
  - sockets for connecting network, instruments

Conclusions

- The Elettra Virtual Collaboratory have now been operating for more than 3 years.
- We have described the results of this experience and presented the future developments relatate to EU and International initiatives and based on new emerging tecnologies like GRID and webservices.
- We are now ready to update EVC using webservices and GRID technologies in the framework of the FP6 EU projects in which our group is involved.
- These projects allows our group to participate in the grand challenging research and technological projects of this century.
- Acknoledgements: HCI Lab (UNIUD), BIOLAB (CNR, ELETTRA), …