

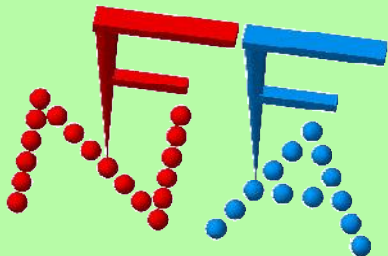
APE Beamline @ Elettra as the first demonstrator for the NFFA data repository

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Software engineer

**CNR - Istituto Officina dei Materiali,
APE BEAMLINe @ ELETTRA**

Area Science Park – Basovizza (TRIESTE)

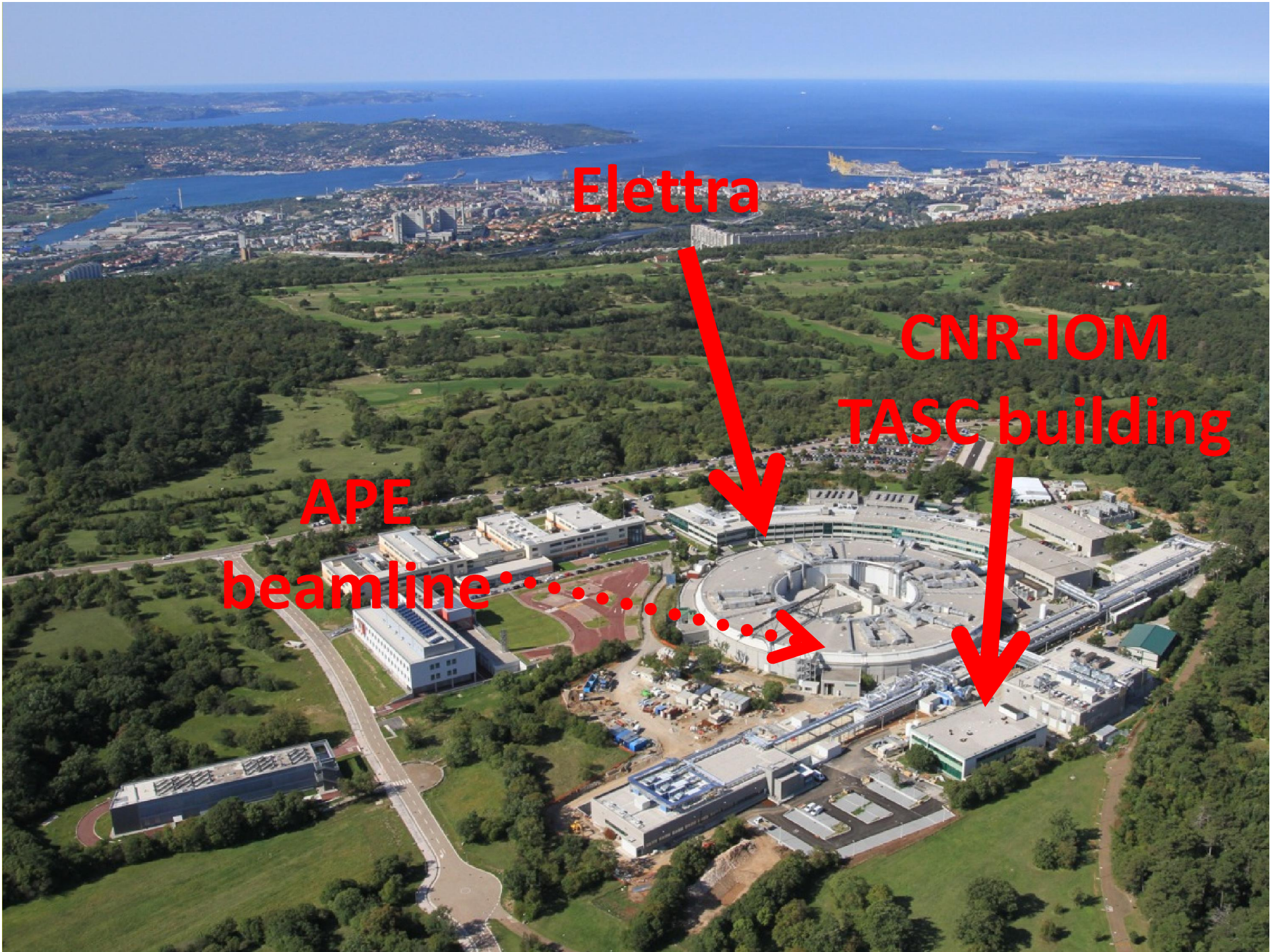


APE Beamline



Agenda

- Introducing the NFFA project
- The NFFA DATA repository
- Introducing the APE Beamline
- **APE Beamline as a demonstrator**
- FUTURE designs studies by NFFA staff



Elettra

**CNR-IOM
TASC building**

**APE
beamline**





The NFFA project

Nanoscience **F**oundries and **F**ine **A**nalysis

www.nffa.eu

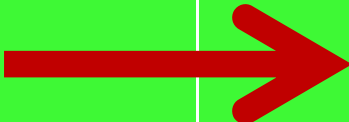
- An EU-funded design study (2008-2010) for a European Research infrastructure enabling access to nanoscience, atomic precision and fine analysis with a unified metrology.
- MIUR funding (2011-2013) for a demonstrating phase
- Led by **CNR-IOM** (Trieste). The project coordinator is prof. **Giorgio Rossi (Università degli studi di Milano)**.
- It involves many scientists and users, mainly experimentalists.

Design study Consortium

- **CNR-IOM (Coordinator)**
Consiglio Nazionale delle Ricerche
Istituto Officina dei Materiali
ITALY
- **STFC**
Science and Technology Facility Council
UNITED KINGDOM
- **CSIC-CNM**
Consejo Superior de Investigaciones Cientificas
Centro Nacional de Microelectronica
SPAIN
- **PSI**
Paul Scherrer Institute
Laboratory for Micro- and Nanotechnology
SWITZERLAND
- **OEAW**
Austrian Academy of Sciences
Institute of Biophysics and Nanosystems Research
AUSTRIA



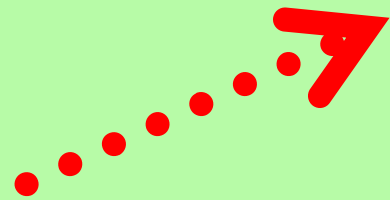
NFFA Data Repository (DR)

Work Package #	Work Package Title
WP1	Management of NFFA Design Study
WP2	Analysis of users and science program, development of NFFA roadmap
WP3	Design study of NFFA-RI Centres, technical layout of instrumentation and tools
WP4	Development of management structure and format of user access for NFFA-RI Centres.  <u>Design of NFFA Data Repository and its access criteria.</u>
WP5	Schemes of future dissemination activities

NFFA Data Repository goal

- NFFA has addressed the creation of the first Data Repository (**DR**) in nanoscience.
- Store all the data produced in the NFFA centres
- Less invasive as possible for the users: it doesn't change too much the user approach
- Make data accessible by appropriate search tools

Advanced Photoemission Experiment



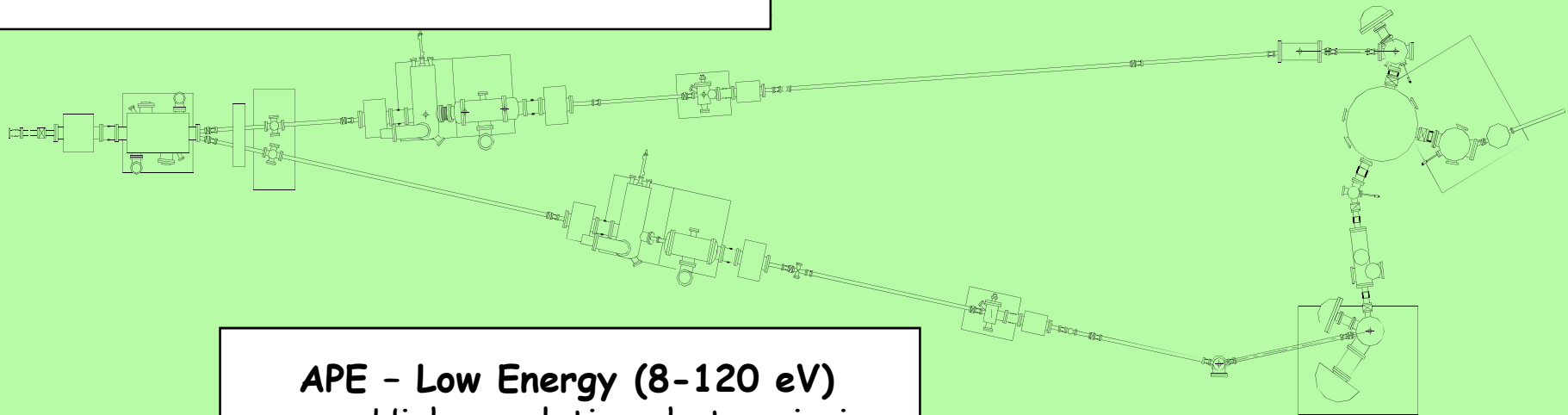
beamline @ Elettra

APE - High Energy (150-1600 eV)

- Spectro(micro)scopy
- Magnetic microscopy
- X-ray absorption

APE - Laboratory

- Kerr effect
- LEED/Auger
- Sample preparation
- STM




APE - Low Energy (8-120 eV)

- High-resolution photoemission
- Electronic band structure
- Fermi surface mapping

APE beamline as a demonstrator

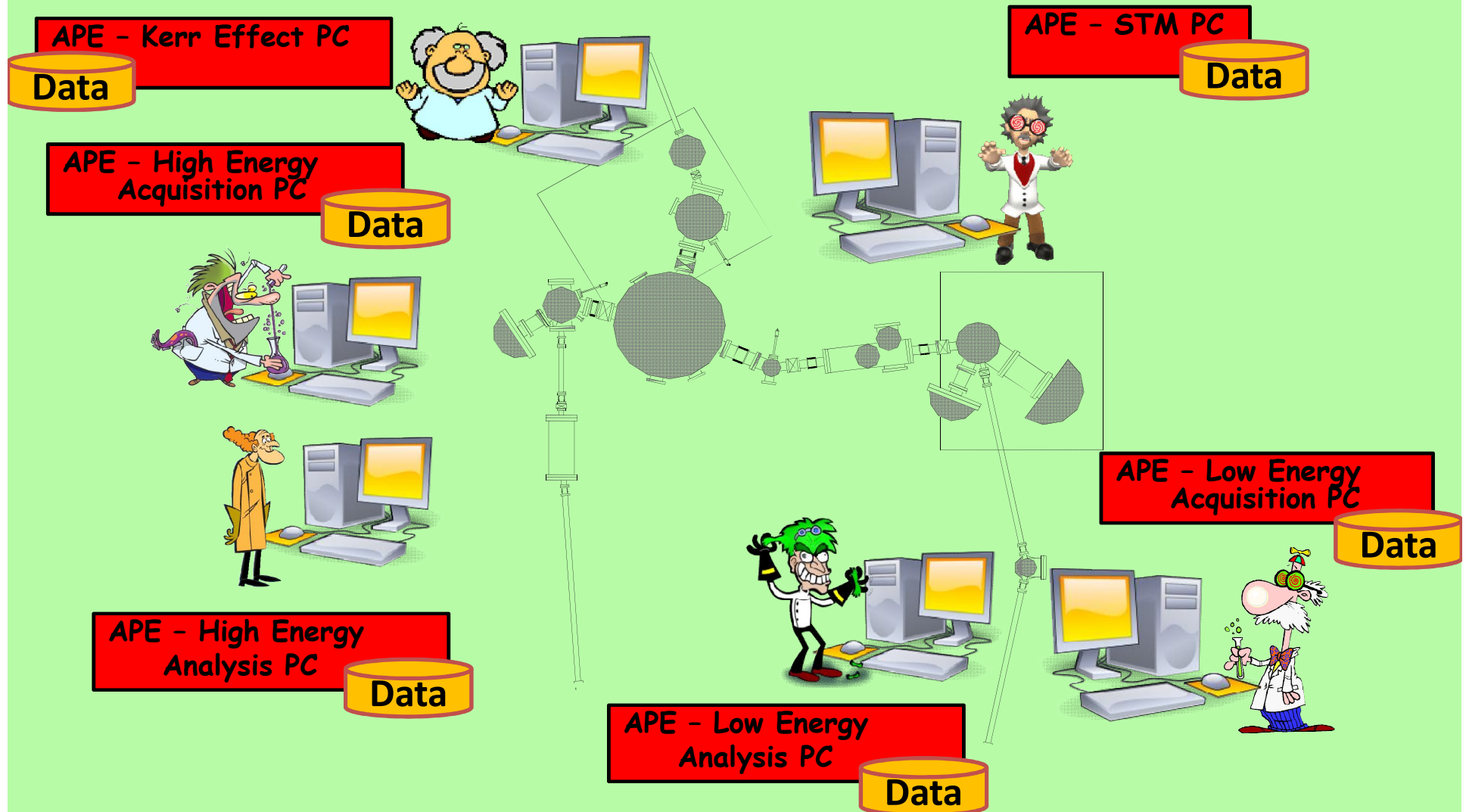
APE Existing scenario:

- The data acquisition occurs in **Labview** in **Windows** environment accessing a set of heterogeneous instruments
- The (row)data (*) and metadata (**) reside in text files within a folder structure organized by user and date (no binary home-made files, no third parties binary files, no HDF!)
- Data analysis tools are mostly these commercial products: **Igor Pro by Wavemetrics** and **Origin by Originlab**.
- Data exchange between users occurs mostly via network and USB sticks 

(*) we mean: “data from the machine”

(**) from Wikipedia: “refers to data about data”

Data acquisition PCs and data analysis PCs @ APE Beamline



A typical rowdata(set)

```
[Info 1]
Region Name=Overview_86eV
Excitation Energy=86
Energy Scale=Kinetic
Acquisition Mode=Swept
Center Energy=51
Low Energy=20
High Energy=82
Energy Step=0.05
Step Time=133
Detector First X-Channel=71
Detector Last X-Channel=992
Detector First Y-Channel=284
Detector Last Y-Channel=691
Number of Slices=204
Lens Mode=Angular
Pass Energy=10
Number of Sweeps=1
File=D:\Data\Marangolo2013\1S1132M
Sequence=D:\Ses-1.2.2-r5_101U\data\Seq
Spectrum Name=Overview_86eV006
Instrument=SES 2002-101U
Location=APE
User=Marangolo
Sample=32M0139B3
Comments=32M0139B3 overview 86 eV
Date=7/20/2013
Time=3:25:11 PM
Time per Spectrum Channel=1.862
[...]
```

```
[User Interface Information 1]
Sample temperature [° K] = +77.300
```

```
[Data 1]
2.000000000000000E+0001 6.030000000000000E+0002 5.660000000000000E+0002
3.880000000000000E+0002 6.040000000000000E+0002 3.340000000000000E+0002
5.480000000000000E+0002 6.450000000000000E+0002 4.390000000000000E+0002
2.850000000000000E+0002 2.780000000000000E+0002 3.890000000000000E+0002
5.830000000000000E+0002 7.580000000000000E+0002 2.730000000000000E+0002
3.760000000000000E+0002 5.250000000000000E+0002 2.730000000000000E+0002
3.470000000000000E+0002 3.140000000000000E+0002 2.730000000000000E+0002
3.960000000000000E+0002 3.590000000000000E+0002 2.730000000000000E+0002
5.920000000000000E+0002 6.410000000000000E+0002 5.180000000000000E+0002
3.700000000000000E+0002 4.210000000000000E+0002 3.490000000000000E+0002
```

...

(SINGLE) FILE SIZE:

Typically: < 1MB

NUMBER OF FILES

/ 1 week-beamtime / 1 APE branch :
1000-5000!!!

Header

- It contains metadata about the experiment for future reproducibility
- Sometimes resides in a separate files
- Typically scalars:
- It resembles Windows ini file:
MagnitudeName = MagnitudeValue (MagnitudeUnit)

Data

- Numbers formatted in text format
- Typically:
 - One or more columns
 - Matrices

Dealing with many files and many users

Questions ?!?

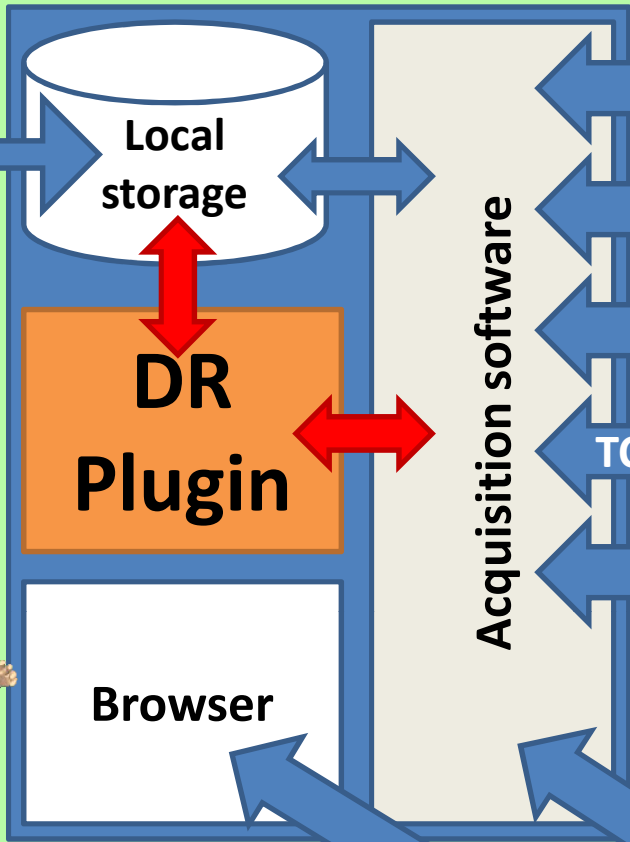
- How to organize users and files?
- How to find a document of interest?
- How to design a system expandable to other NFFA laboratories / instruments

APE Future scenario (under development)

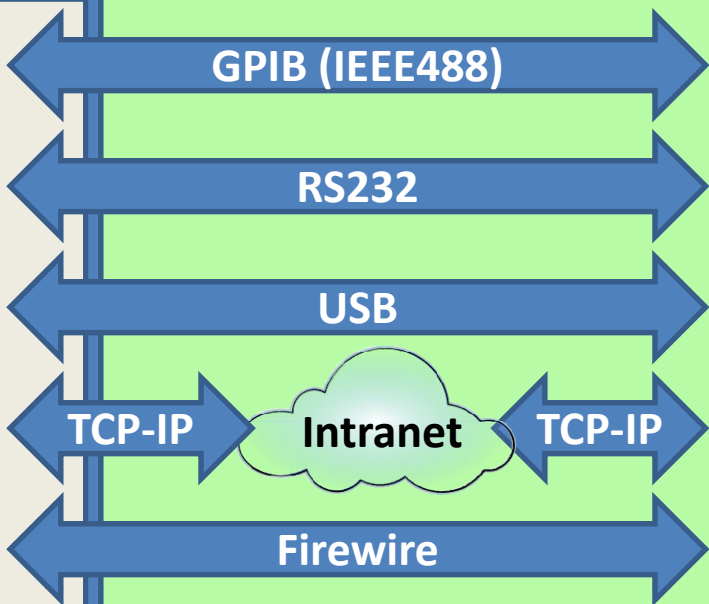
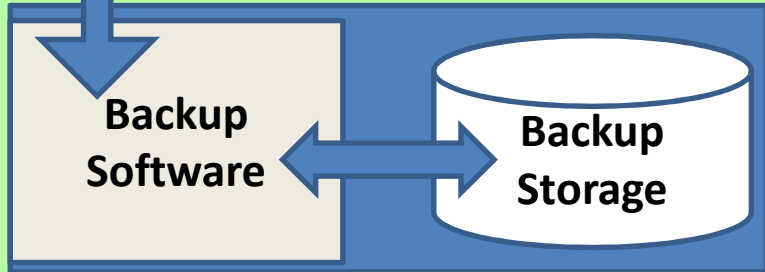
- The **data** and **metadata** are automatically uploaded into the database from an acquisition PC located at the experimental station via a DR Plug-In
(*a minimal interaction with user is required!*)
- The database features a flexible architecture that can be adapted to different research facilities
- Users download the (row)data by accessing the DR for (subsequent) analysis
- Users then upload the analyzed data to be accessible for other participants



An Acquisition PC

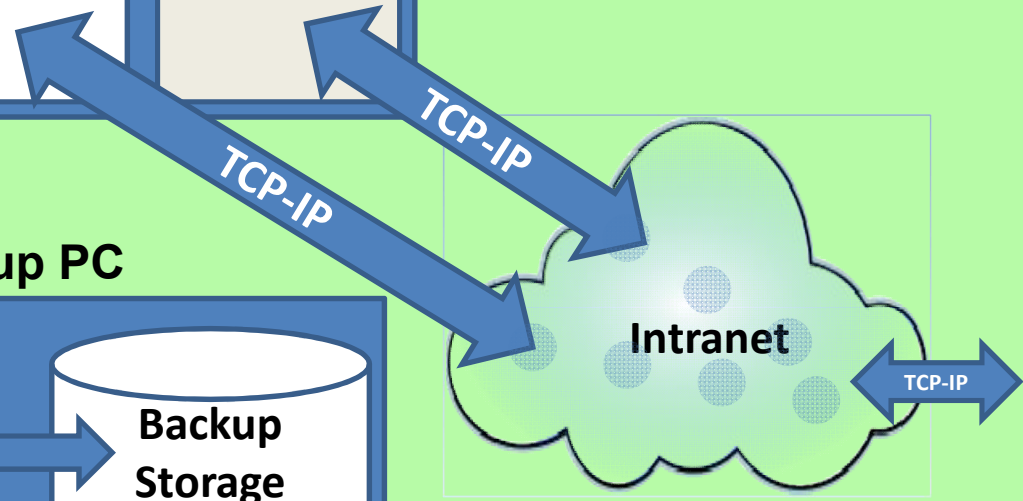


Backup PC



Beamline Instruments:

Electron analyzers,
Electrometers,
Motors, etc

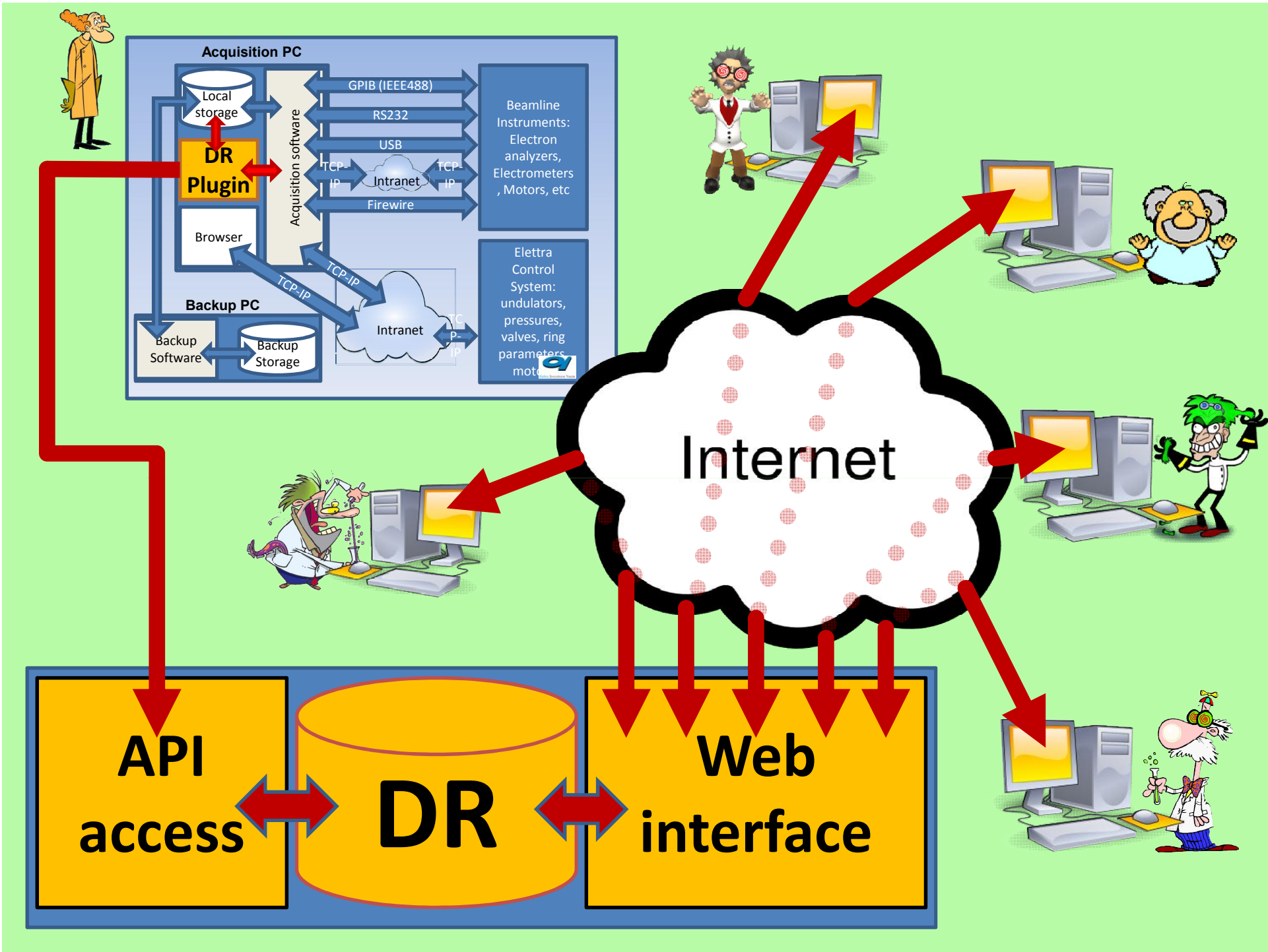


Elettra Control System:

light energy
and other ring
parameters



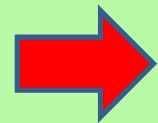
Elettra Sincrotrone Trieste



Ingredients for the DR (1)



- User name: (e.g. John Doe)
- Group name:(e.g XY university)
- Experimental Facility name: (e.g. Ape Beamline)
- Experimental Station name: (e.g. APE High energy experimental chamber)
- Description (e.g. topological insulators)
- Measurement technique
(e.g. **X**-ray **M**agnetic **C**ircular **D**ichroism)



Ingredients for the DR (2)



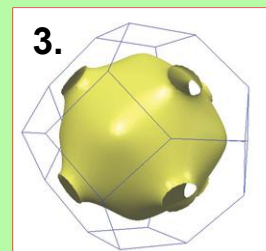
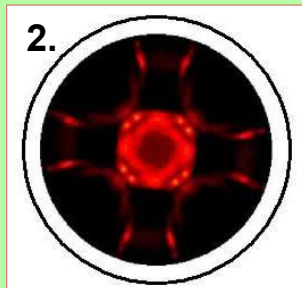
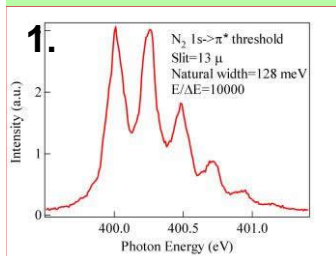
- Dataset (for a measurement)
 - Metadata and Rowdata (one or more text files)
 - “Data Analysis **blog**”. It contains:
 - data analysis tools project files (e.g. **.pxp** files (Igor), **.opj** files (Origin)) sorted by date and user intervention.
 - Data preview possibility on the web interface :

1. DR standard xy graphs

3. DR standard voxels

2. DR standard images

4. DR Animated data show



FUTURE design studies by NFFA stuff

Integrate into the demonstrator these
experimental stations:

- The **S**canning **E**lectron **M**icroscope instrument at CNR-IOM TASC laboratory
- The open package for first principle quantum simulation (Quantum Espresso) at CNR-IOM-Democritos.

THANK YOU!