Esigenze di Calcolo dei Futuri Esperimenti

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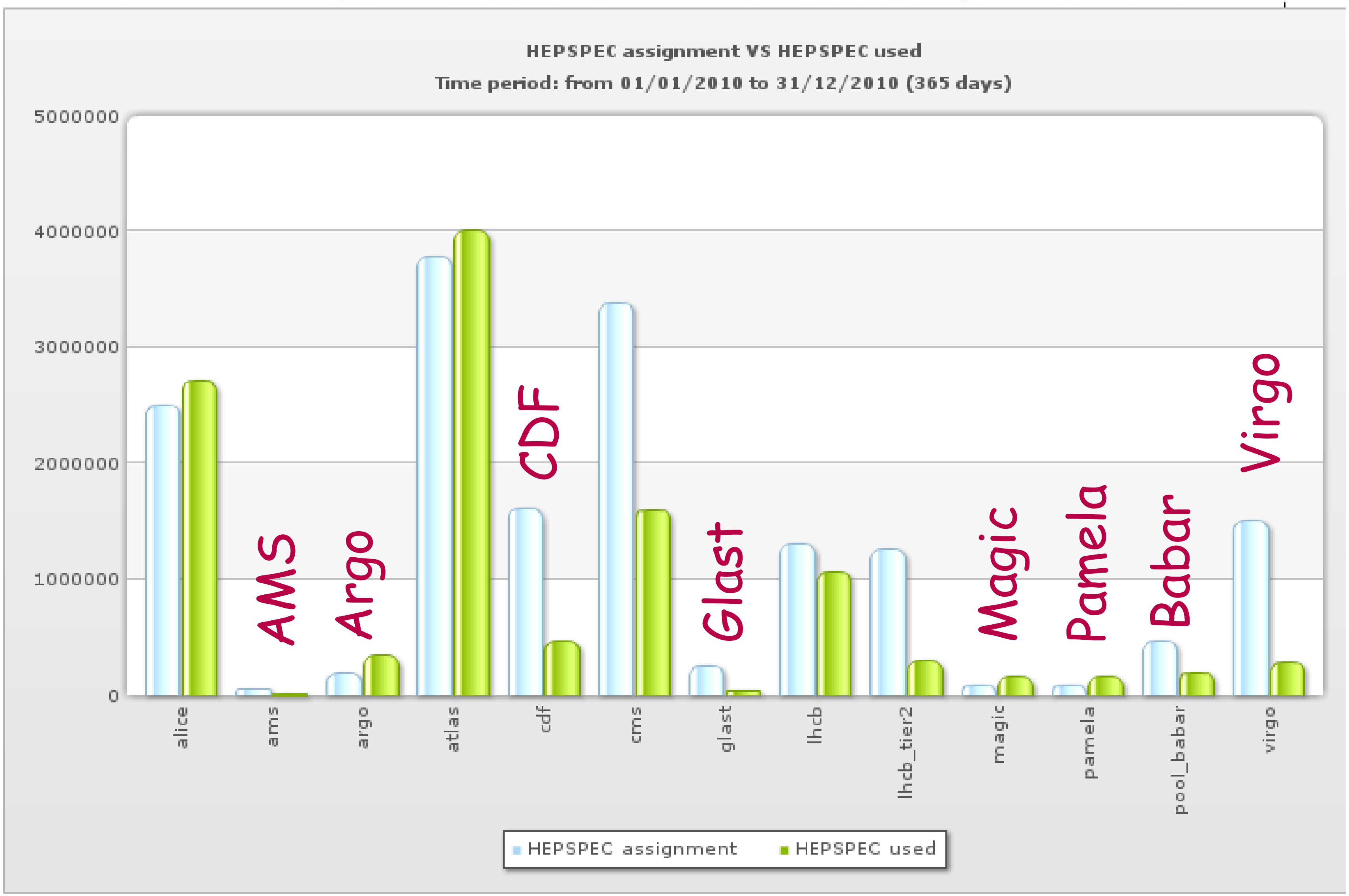
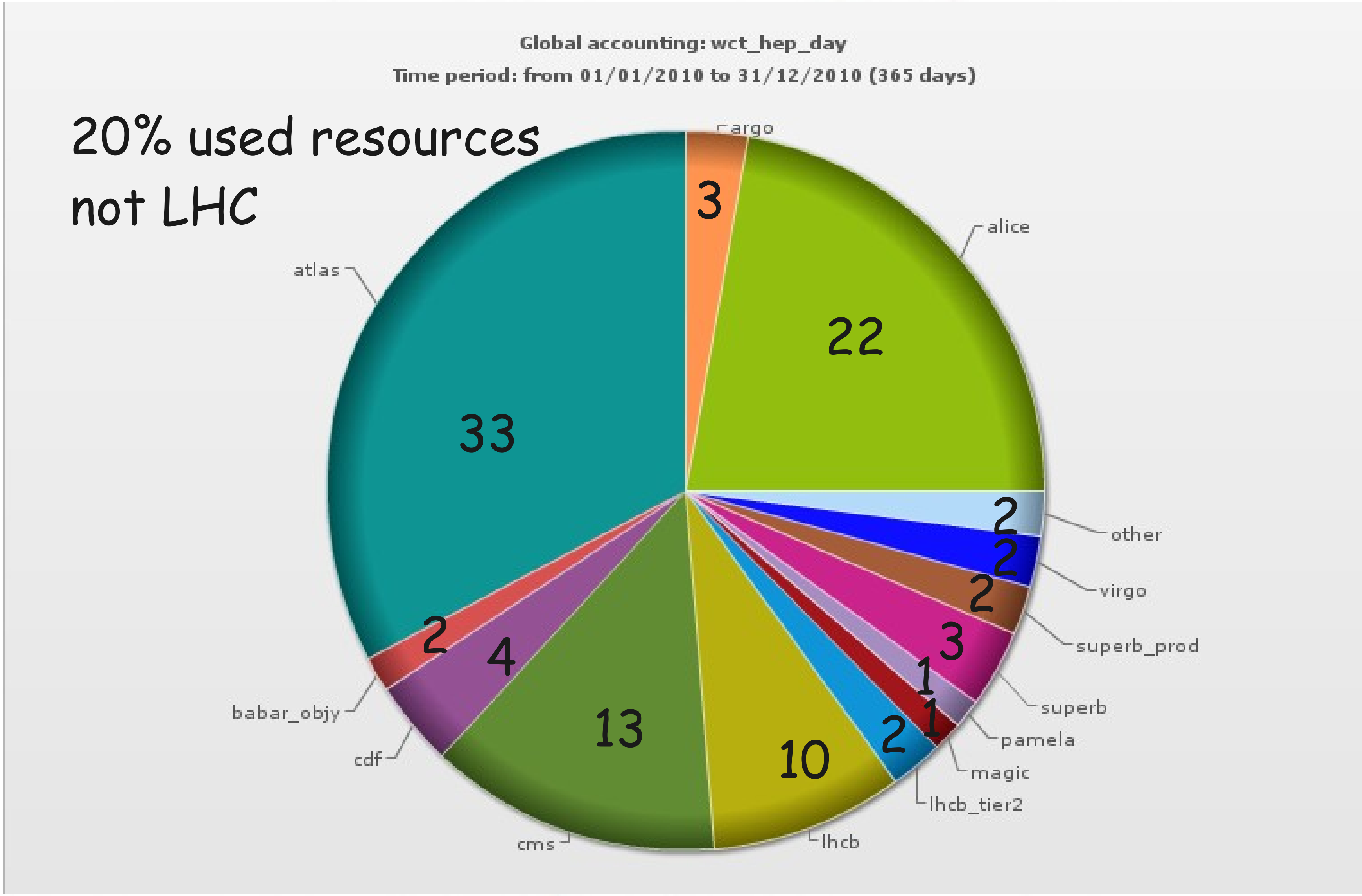
Universita' e INFN Padova

Workshop della Commissione Calcolo
Stato e Prospettive del Calcolo Scientifico
Legnaro 16-18 febbraio 2011

Tier 1 Computing Assigned/Used



Tier 1 Computing Usage 2010



New INFN Experiments that need Grid Computing

INFN provides computing not only for LHC and it will do in the future for experiments:
- Nuclear Physics: PANDA, AGATA
- Particle Physics without accelerators: AMS
- Particle Physics with accelerators: NA62, SuperB

I did my best to collect as many information as possible, if I miss something, my apologies.

Nuclear Physics Experiments: $\overline{\text{P}}$ANDA

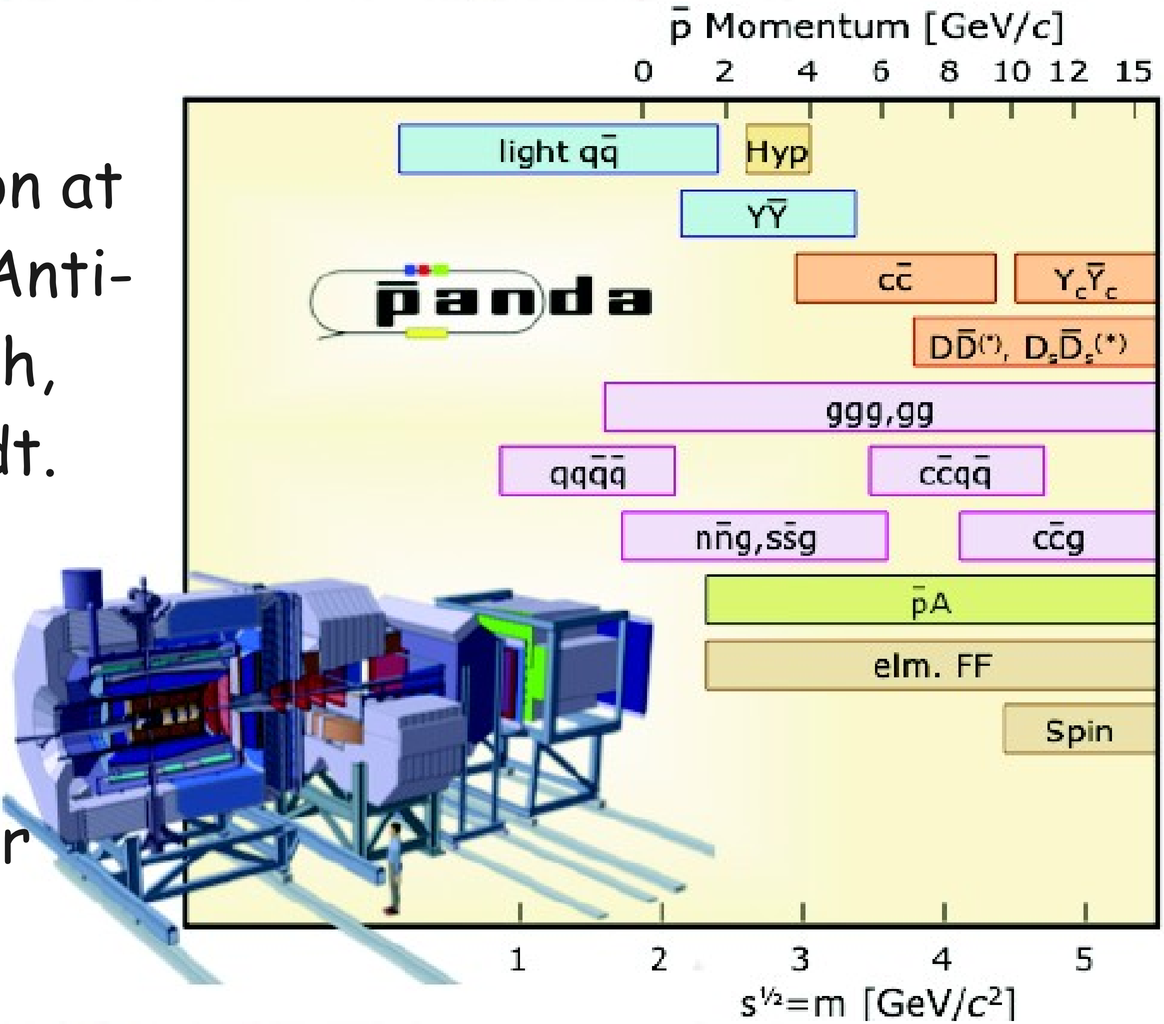
antiProton ANnihilations at DArmstadt

Study strong interaction at FAIR, the Facility for Anti-proton and Ion Research, laboratory of Darmstadt. Data taking in 2016.

Detector:

-Target spectrometer

-Forward spectrometer



PANDA Code Infrastructure

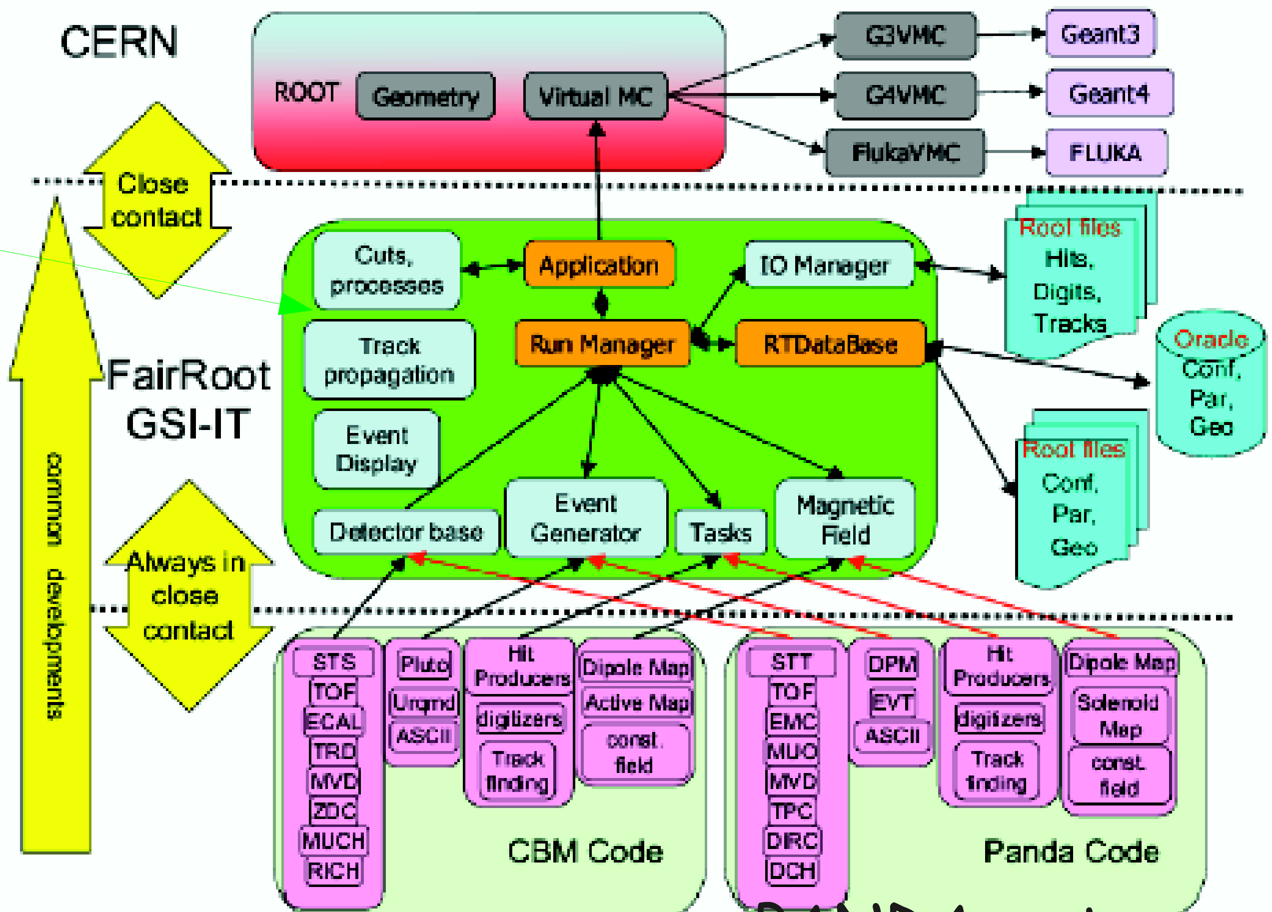
Software infrastructure, PANDAroot, based on FAIRroot

FAIRroot:

-inherit ROOT and MC functionalities

- used for detector simulation and offline analysis

Monitor tool based on MonALISA



PANDAroot

$\overline{\text{P}}$ANDA Computing Model

PANDAroot runs on several platforms → GRID

Currently expanding AliEN2 GRID network in collaboration with Alice

Complete simulation and analysis chain tested successfully on GRID, 10 sites at the moment, we can expect request in Italy.

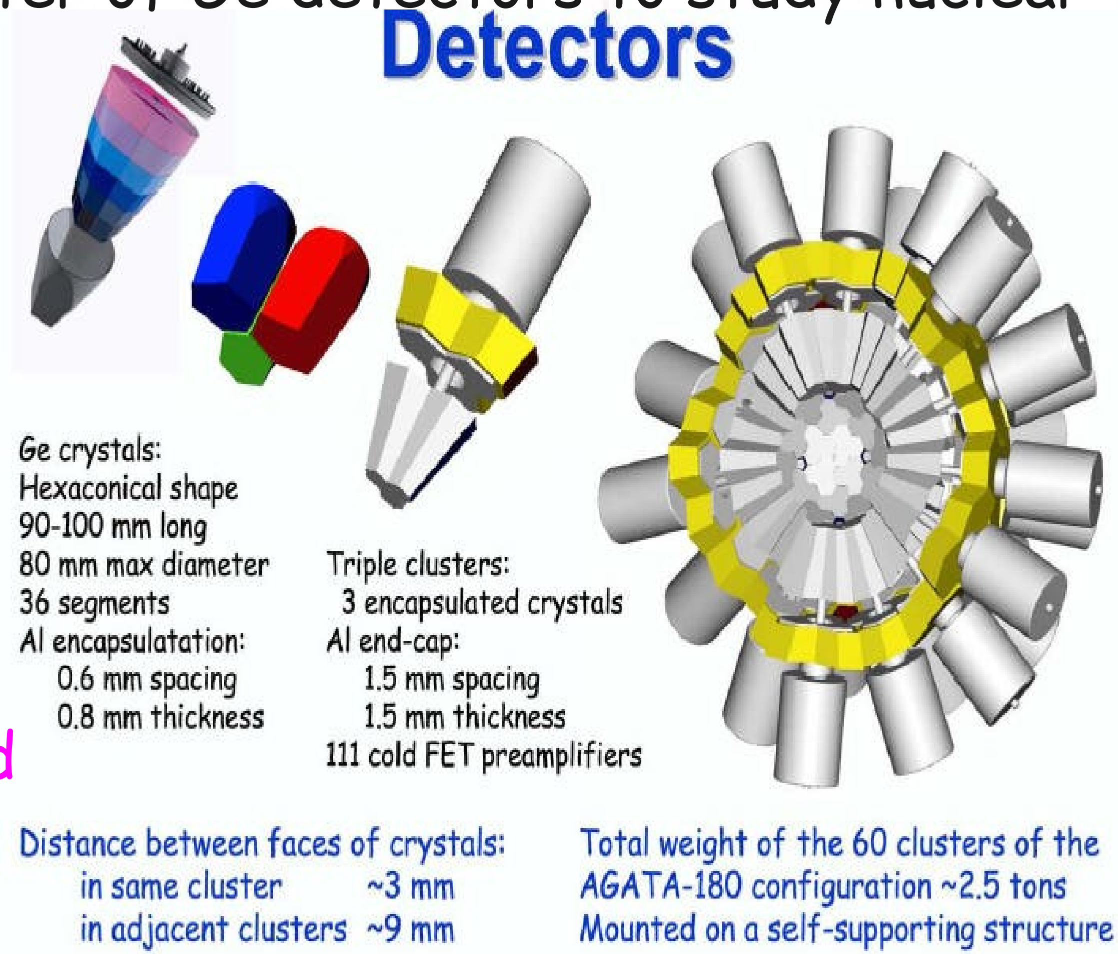
Nuclear Physics Experiments: AGATA

A 4π gamma spectrometer of Ge detectors to study nuclear structure.

Data analysis consists:
Pulse Shape Analysis to find gamma position in each detector

Real time analysis on Legnaro farm

Data saved at CNAF and Lyon and accessed by users for analysis



AGATA Data Flow

AGATA WEEK, INFN – LNL, 20-22 JANUARY 2010

DATA FROM COMMISSIONNING EXPERIMENT

Week-12 Experiment :

- Reaction 30Si (70MeV) + 12C
- 1 triple cluster (ATC1) used with complete electronic chain
- Original traces written on disk for off-line preprocessing, Pulse Shape Analysis and γ-ray Tracking
- Data transfered to Bologna CNAF-INFN-TIER1 Tape

Organization of the Data :

Dataset/ → subDataset-B/ → { DataFile-0, DataFile-1, ... , DataFile-n }
→ subDataset-G/ → { DataFile-0, DataFile-1, ... , DataFile-n }
→ subDataset-R/ → { DataFile-0, DataFile-1, ... , DataFile-n }

36 Datasets, 302 DataFiles of 14.336 GB each, per Crystal
30 DataFiles of 1.4336 BG each, per Crystal

Total amount of Data : 13 TB

Dino Bazzacco

PSA processing for One set of DataFiles with Narval emulator:

45 GB: DataFile-i-B, DataFile-i-G, DataFile-i-R → Narval Emulator

1 GB: BasisFile-B, BasisFile-G, BasisFile-R → Narval Emulator

Narval Emulator → Output Files

It tooks 68.5 minutes to run Narval Emulator (Pulse Shape Analysis and γ-ray Tracking) with this Data on a 2.8 GHz processor, 16 GB

It is expect about 2 weeks running 24 / 7 in order to process the 13 TB Data.

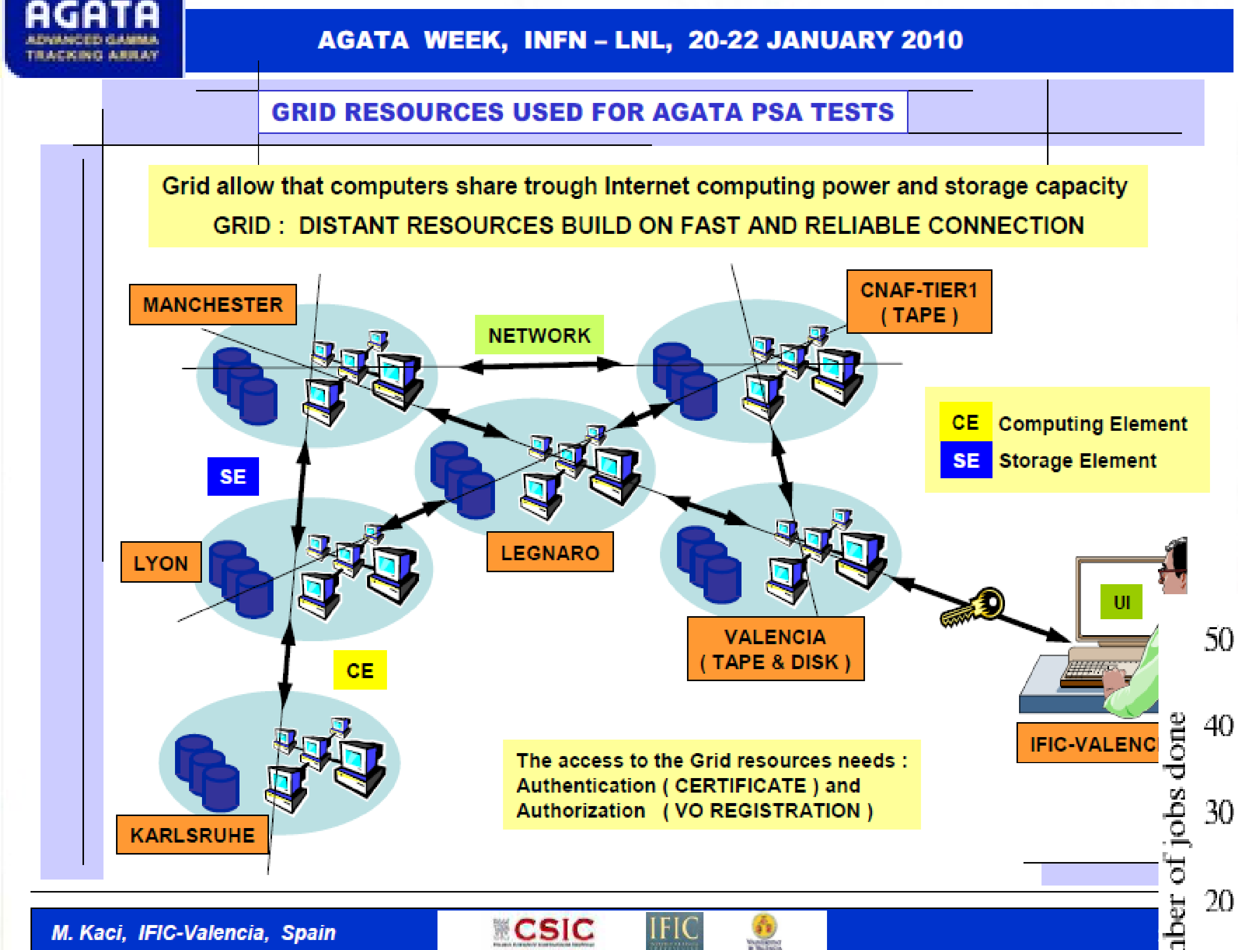
Tests using Grid...

M. Kaci, IFIC-Valencia, Spain

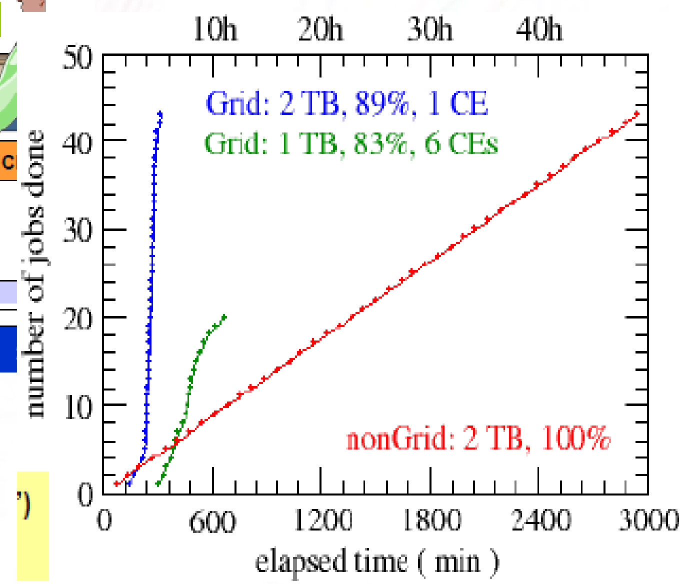
CSIC IFIC

1 / 7

AGATA Data Distribution



Dino Bazzacco

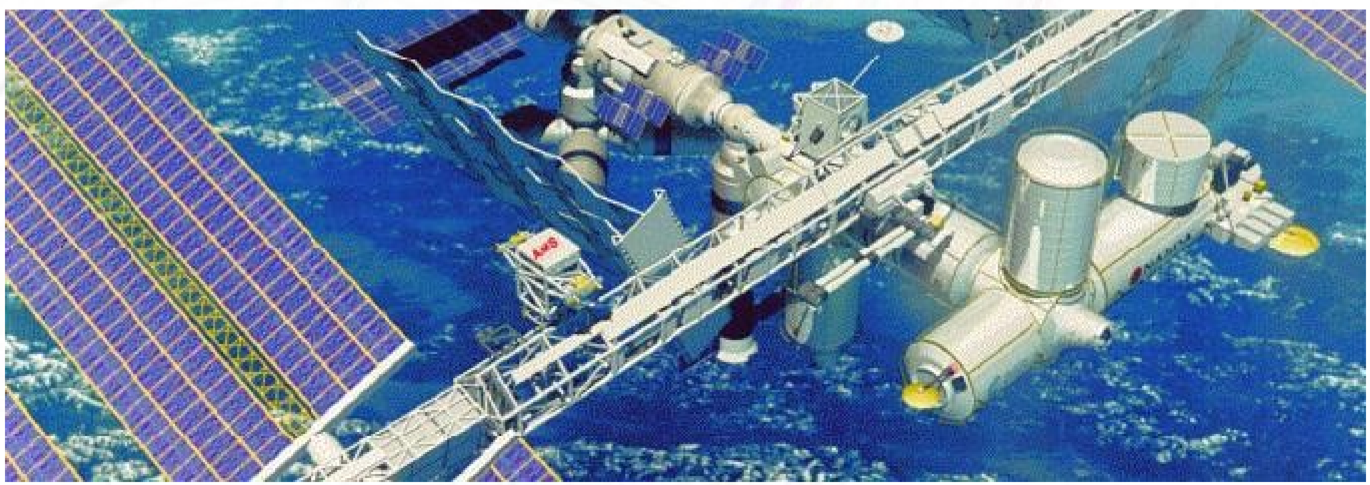


Additional tests in progress

Discussion on whether use Grid

Particle Physics experiments w/o accelerator: AMS-02

The Alpha Magnetic Spectrometer is a state-of-the-art particle physics detector designed to operate as an external module on the International Space Station for >10 yrs.



Bruna Bertucci

AMS-02

AMS conceived to search for primordial anti-matter (antinuclei), indirect signal of dark matter (positrons, anti-protons, gammas) and precision measurements of cosmic radiations.

- ✓ Detector integration ended in Jul.2010
- ✓ Current activities : integration with the shuttle/ISS HW interfaces and end-to-end tests to verify shuttle/ISS data/electrical interfaces
- ✓Expected launch date **April 19,2011**STS134 shuttle flight.

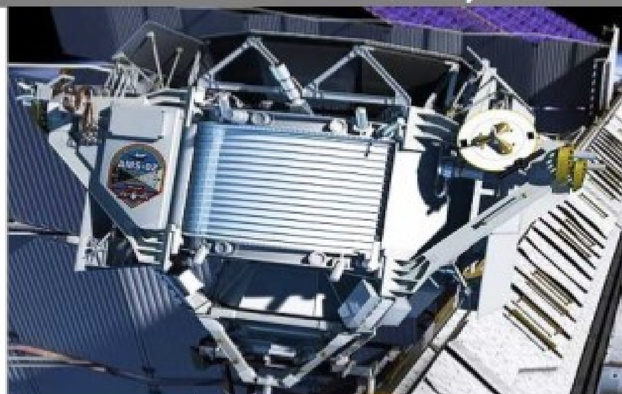
Italy in AMS-02: 25% of the international collaboration co-piship, responsibility of 4 (TRACKER, TOF, ECAL, RICH) out of 6 sub-detectors (ACC,TRD)

AMS-02 Italy & Computing : CNAF as regional center

AMS SCIENCE DATA DATA FLOW

Orbit of planet Earth (now simulated at KSC, FL)

AMS DDRS Laptop



NASA channels

6 mbits/s
≈ 20 TB/year of RAW DATA

POCC network (KSC only)

KSC, FL
Current AMS POCC
Payload Operation Control Center

JSC, TX
AMS POCC Training centre, redundant POCC

MSFC HOSC, Huntsville AL
AMS GSC Centre
Ground Support Computer

BBFTP over Internet

CERN, CH-FR
AMS POCC
Main operations centre

Regional Centres
Ciemat, Lyon, NLAA, SEU
CNAF

↔

CERN, CH-FR
AMS SOC
Science Operations centre

≈ 60 TB/year reconstructed DATA

AMS-SOC @ CERN

Bruna Bertucci

1) Raw data reconstruction (and future Re-processings)
2) Science Data Quality Monitor
3) Data Analysis
4) MC production

Regional Centers

1) MC production
2) Data Analysis
3) Support in Re-processings

at CNAF : also MASTER COPY of RAW Data

Science Operations Center

Current Status : Farm in B892 @ CERN

Bruna Bertucci

- ~100 Intel 2GHz cores;
- ~300 TB of disk arrays;
- Direct data access protocols (~1GByte/s);

Sufficient capacity to process AMS data for the first 6 months of operations

- ➢ Reduced capacity for analysis
- ➢ No capacity for MC production after launch

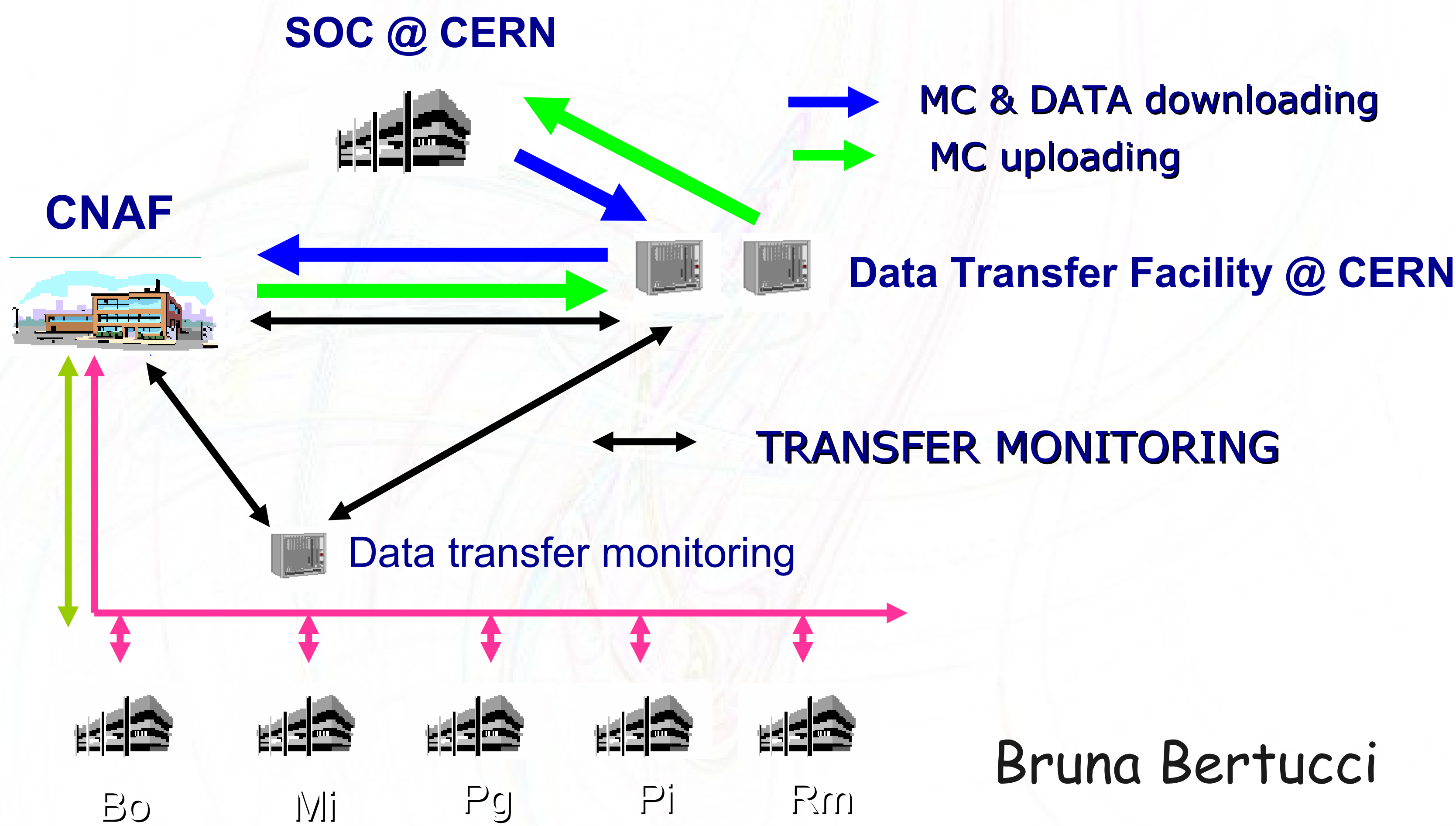
Significant upgrade foreseen in 06/2011: SOC in CERN computing centre.

- → 1000 Intel 2GHz cores
- → 1PB of disk arrays

Ongoing work on test-bench to integrate production in the new environment.

DATA FLOW @CNAF

Obiettivi di AMS@CNAF:
- → Copia integrale dei dati RAW (MASTER COPY)
- → Copia integrale dei dati ricostruiti / MC
- → Analysis facility
- → Produzione MC



Current Status @CNAF

Bruna Bertucci

Activities at CNAF started in 2003:

- few resources : mainly for MC production and to be prepared to operate in the CNAF environment

✓ Data transfer : ok – tested

✓ Storage : ok

Raw data copy : 50 TB of tape allocated and infrastructure tested.

Reconstructed data : 93 TB disk allocated for 2011, infrastructure tested

CPU: 432 HS06 allocated for 2011

→ Environment : ok , AMS-SW running.

→ queues and their priorities to be optimized

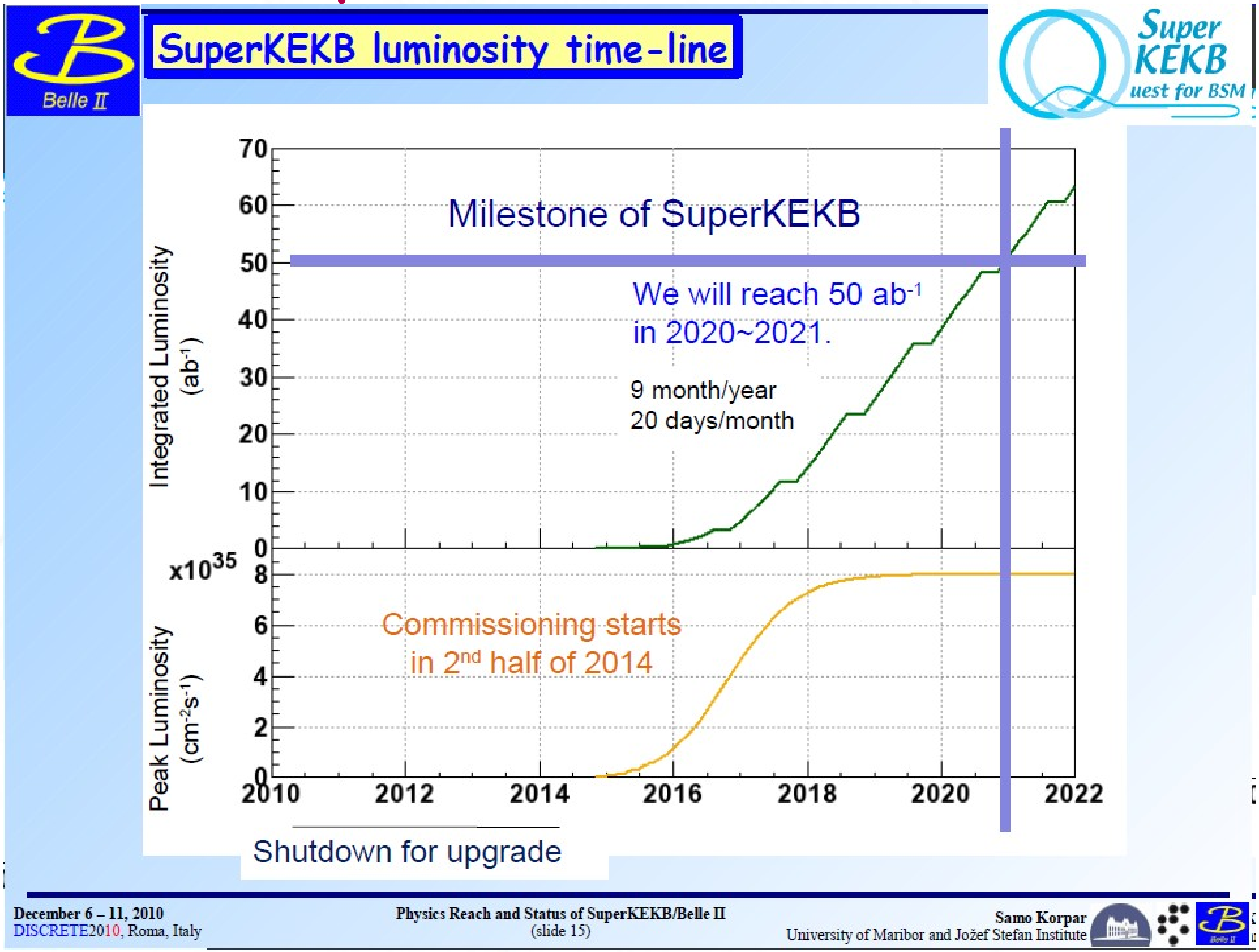
→ more resources needed (? most probably): depending on the SOC functionality and availability of NLAA / SEU regional centers for MC production.

Particle Physics experiments with accelerator: SuperB

- B-factories improved Standard Model testing:
  high precision determination of Cabibbo-Kobayashi-Maskawa
- Further constrains on Standard Model in this sector need factor 50-100 more data respect to B-factories (50-75 ab^{-1})
- This can be achieved with a very high luminosity machine:
  $L \geq 10^{36} cm^{-2} s^{-1}$ energy E= $\Upsilon(4s)$-$\Upsilon(5s)$

- Two machines:
  - SuperKEKB in Japan, no Italian collaborations
  - SuperB in Italy

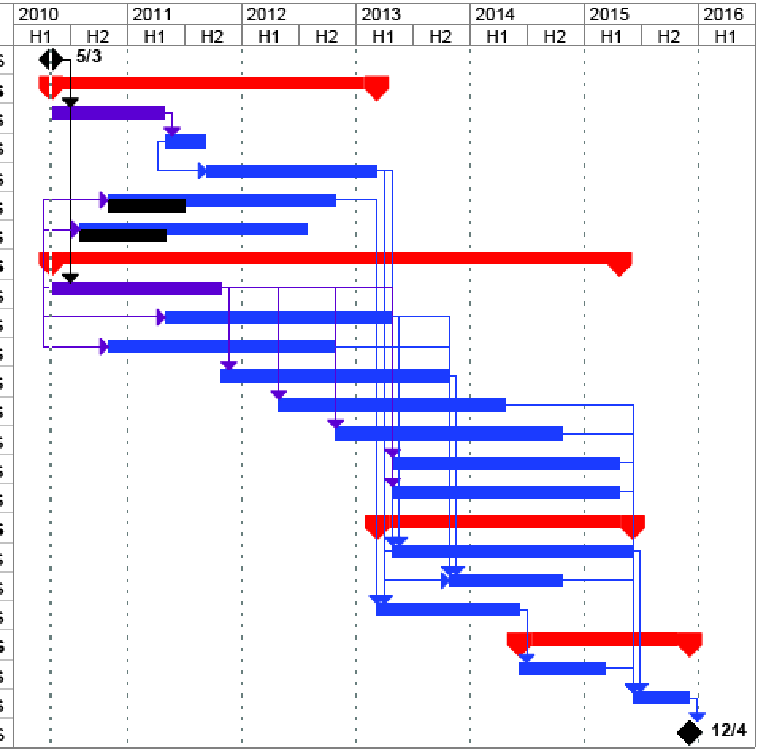
SuperKEKB schedule



SuperB accelerator schedule

Accelerator Schedule Piano Triennale

ID	Task Name	Duration
1	Approvazione	0 wks
2	**Infrastrutture**	**149 wks**
3	Progettazione edilizia civile	52 wks
4	Gara edilizia civile	19 wks
5	Costruzione Tunnel, Edifici, e Sala sperim.	78 wks
6	Progetto/gara Linac, DR, & BTL	104 wks
7	Progetto e gara Elettr., Raffredd., Cryo.	104 wks
8	**Progetto & Costruzione Acceleratore**	**260 wks**
9	Progettazione acceleratore	78 wks
10	Costruzione magneti	104 wks
11	Costruzione sistema vuoto	104 wks
12	Costruzione supporti	104 wks
13	Costruzione utilities	104 wks
14	Costruzione controlli	104 wks
15	Costruzione RF	104 wks
16	Costruzione alimentatori	104 wks
17	**Installazione Acceleratore**	**117 wks**
18	Installazione nel tunnel	110 wks
19	Installazione Zona Interazione	52 wks
20	Installazione Linac, DR, & BTL	65 wks
21	**Commissioning Acceleratore**	**78 wks**
22	Commissioning Linac	39 wks
23	Commissioning Fasci	26 wks
24	Prime collisioni	0 wks



Search site committee formed

SuperB Computing: data model

Computing Model in preparation, information from arXiv:1007.4241v1 [physics.ins-det]

Data format:

1. Raw data
2. Full reconstructed data
3. Mini recons. data: compact form with noise suppression
4. Micro recons. data: only information useful for analysis

Computing resources needed

Parameter	typical Year
Luminosity (ab^{-1})	15
Storage (PB)	
Tape	113
Disk	52
CPU (KHep-Spec06)	
Event data reconstruction	210
Skimming	250
Monte Carlo	670
Physics analysis	570
Total	1700

For comparison CMS in 2011:

550 Kheps-Spec06

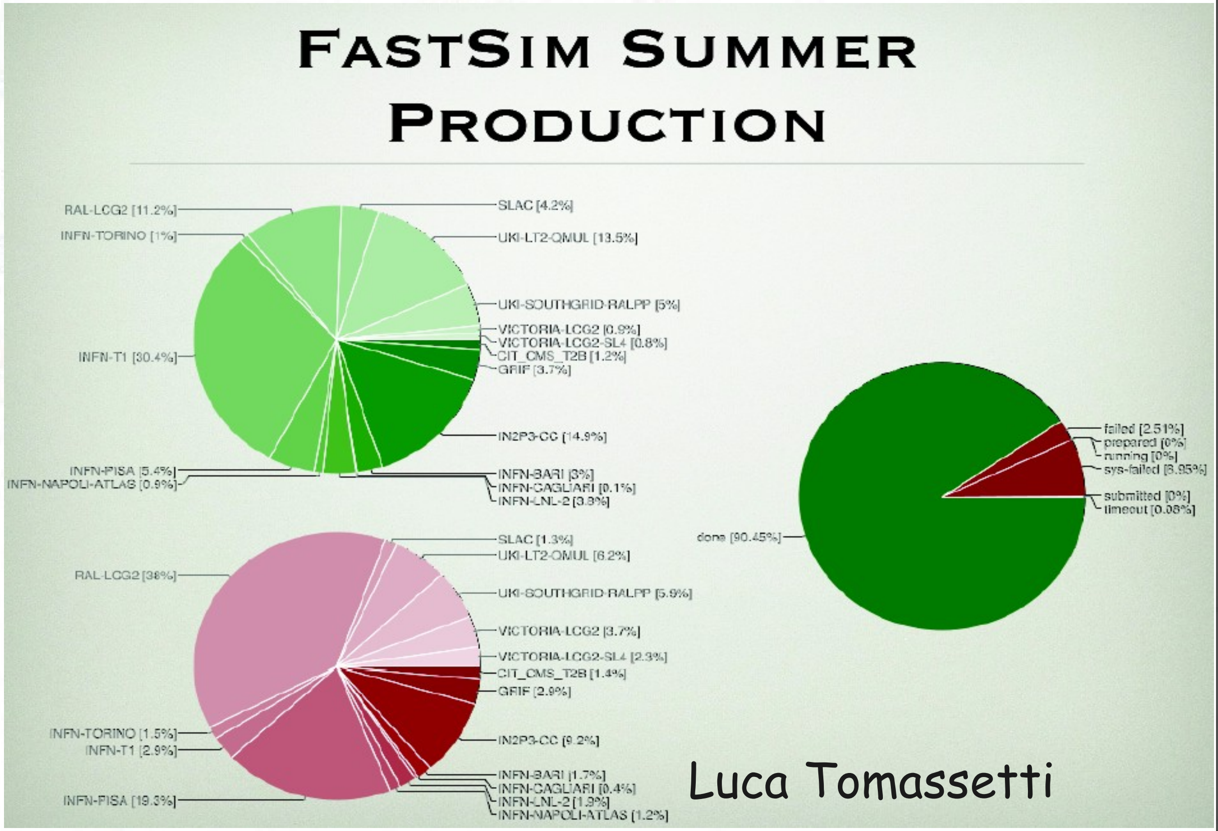
112 PB

SuperB: Site Usage

Big effort on simulation:

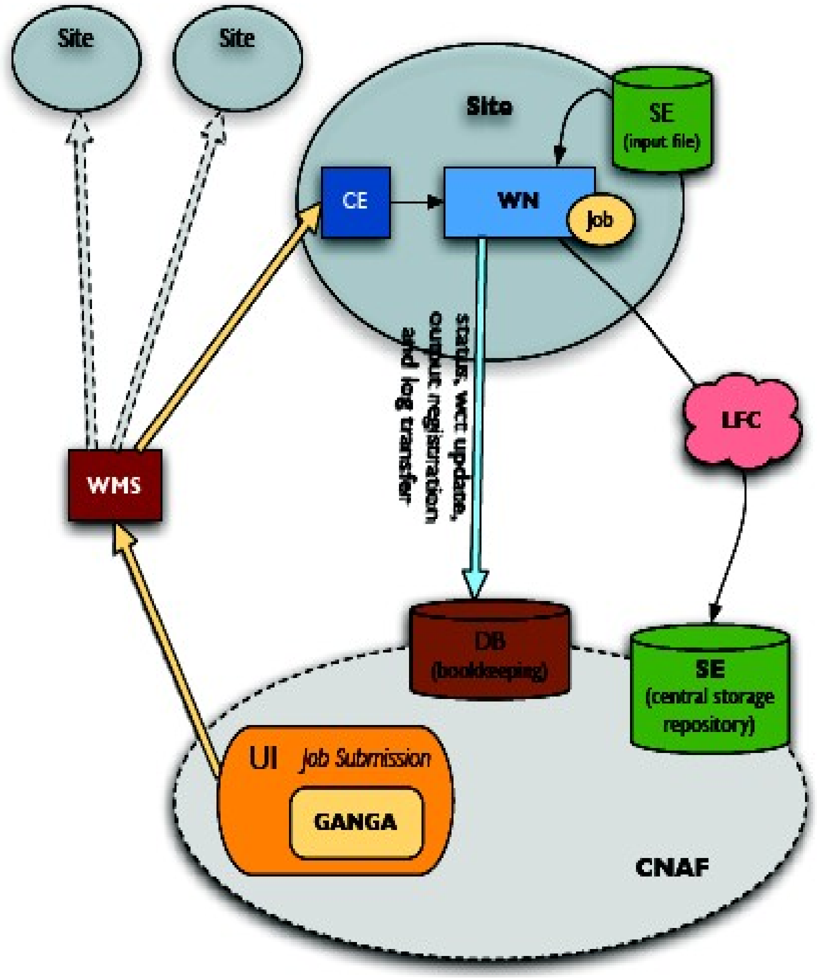
- Fast simulation: simplified detector models and parametric resolution function
- Full simulation: detailed detector simulation based on GEANT4

Site name	Grid flavor
CNAF Tier1, Bologna, Italy	EGEE/gLite
Caltech, California, USA	OSG/Condor
SLAC, California, USA	OSG/Condor
Queen Mary, London, UK	EGEE/gLite
RALPP, Manchester, UK	EGEE/gLite
GRIF, Paris/Orsay, France	EGEE/gLite
IN2P3, Lyon, France	EGEE/gLite
INFN-LNL, Legnaro, Italy	EGEE/gLite
INFN-Pisa, Pisa, Italy	EGEE/gLite
INFN-Bari, Bari, Italy	EGEE/gLite
INFN-Napoli, Napoli, Italy	EGEE/gLite



SuperB: distributed production

Simulation production work-flow



1. input file to remote SE Distribution
2. job submission via GANGA
3. output stage out to CNAF repository

SuperB: Toward the Computing Model

List from Fabrizio Bianchi superB workshop Caltech

- Efficient use of multi-core architectures
- Distributed storage
- Job management
- Metadata management
- Event store
- Framework
- Digitization code
- Reconstruction code

Computing funding is part of the project funding

Data

Measurement of the very rare $K^+ \to \pi^+ \nu\bar{\nu}$ decay ($\sim 10^{-11}$) to determine with 10% precision $|V_{td}|$

Data format:

Raw data: from detector

Calib data: calibration

Reco data: output of reconstruction

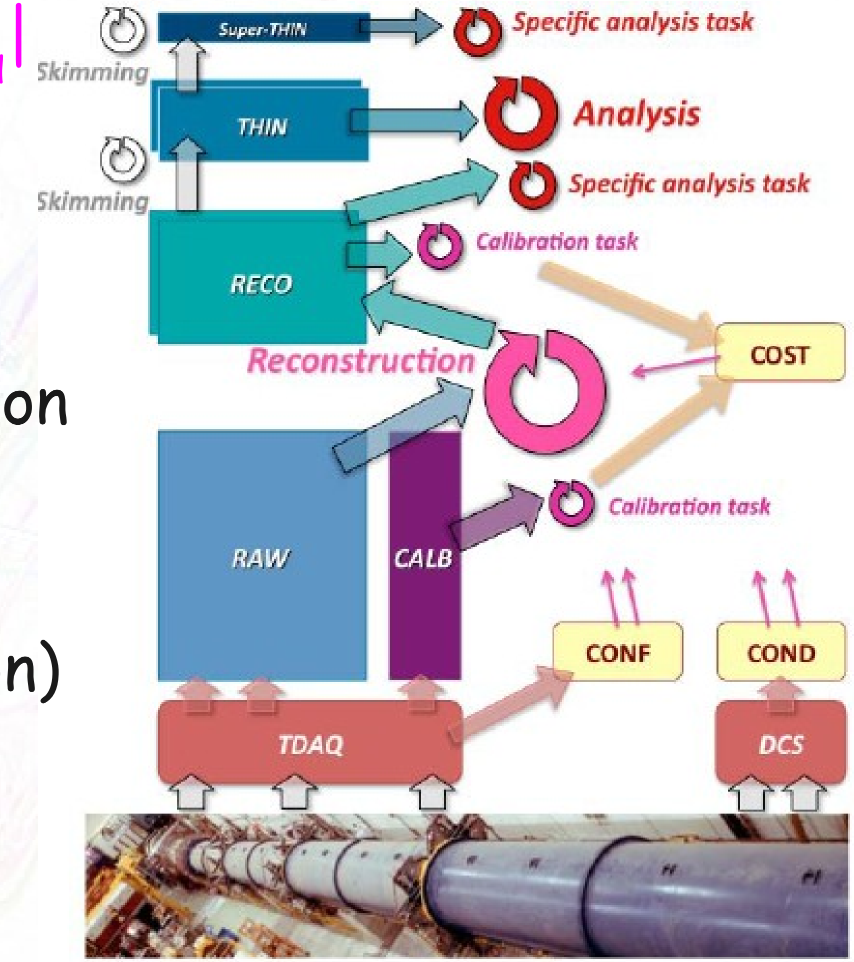
Thin data: skimmed events

Super-thin data: more skimmed

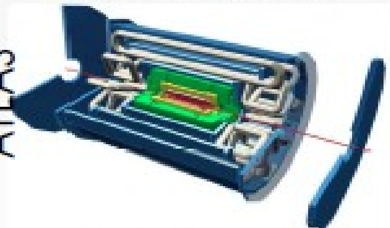
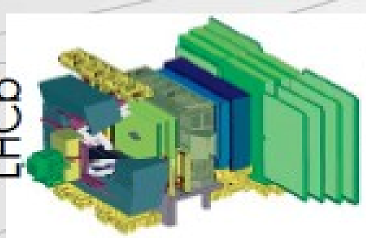
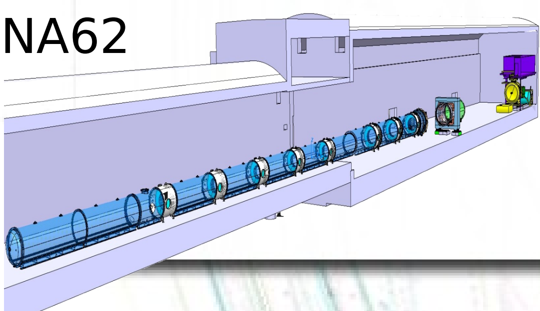
Meta data: Conf (run configuration)

Cond (run condition)

Cost (calibration)

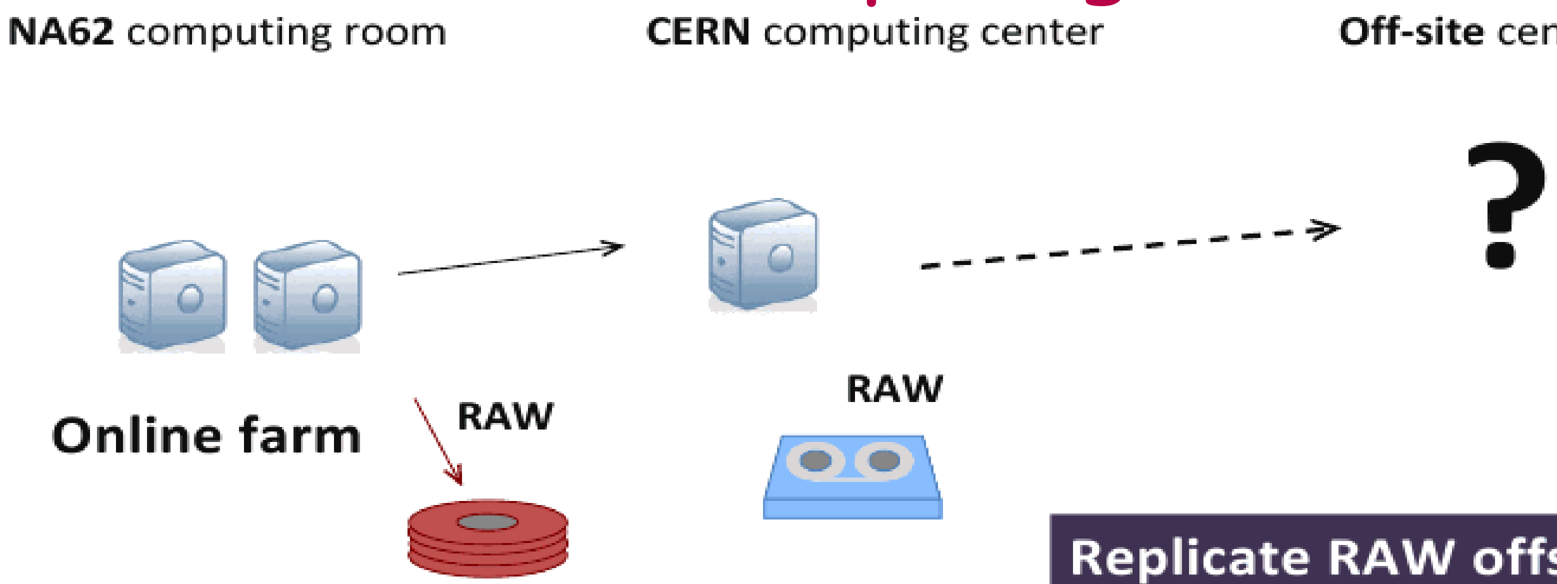


Trigger/DAQ parameters

	No.Levels Trigger	Level-0,1,2 Rate (Hz)	Event Size (Byte)	Readout Bandw.(GB/s)	HLT Out MB/s (Event/s)
ALICE 	4	Pb-Pb 500 p-p 10^3	5×10^7 2×10^6	25	1250 (10^2) 200 (10^2)
ATLAS 	3	LV-1 10^5 LV-2 3×10^3	1.5×10^6	4.5	300 (2×10^2)
CMS 	2	LV-1 10^5	10^6	100	~1000 (10^2)
LHCb 	2	LV-0 10^6	3.5×10^4	35	70 (2×10^3)
NA62 	3	**LV-0 10^6** **LV-1 10^5** **LV-2 10^4?** **5×10^4 new tape**	**2.2×10^5** Reduced zero suppression	**5** (without LKr)	**220** (103 ?)

P. Valente

NA62 Computing Model



Replicate RAW offsite?

If the answer is **"Yes"**

A. RAW need to be transferred if one wants to make use of off-site computing power not only for analysis purposes

If instead the answer is: "**No**", the question is:

How to handle (re-)processing?

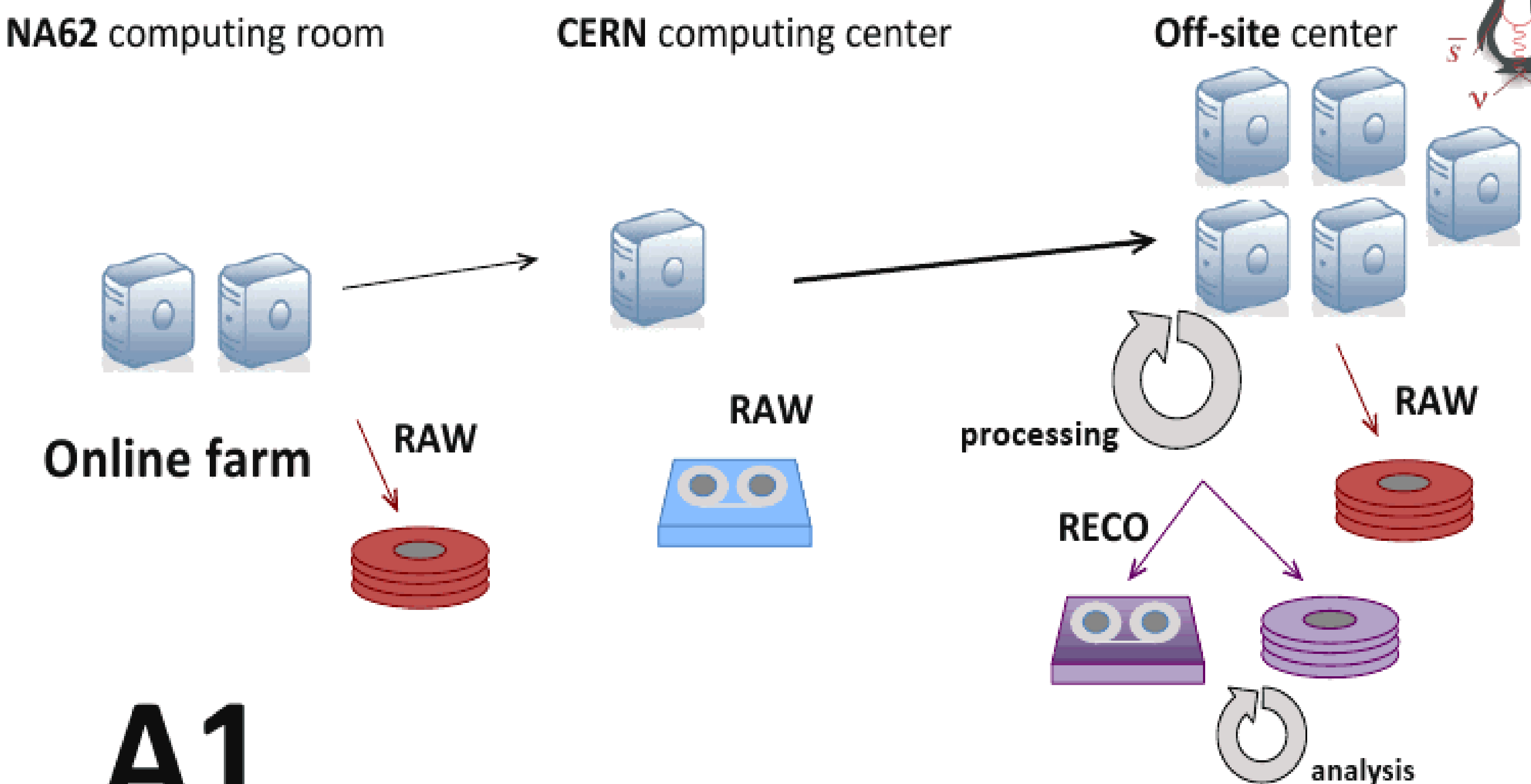
If RAW are recorded on disk&tape at CERN computing center:

B. the (re-)processing should run there

RAW storage

P. Valente

Computing Model: Answer N° 1

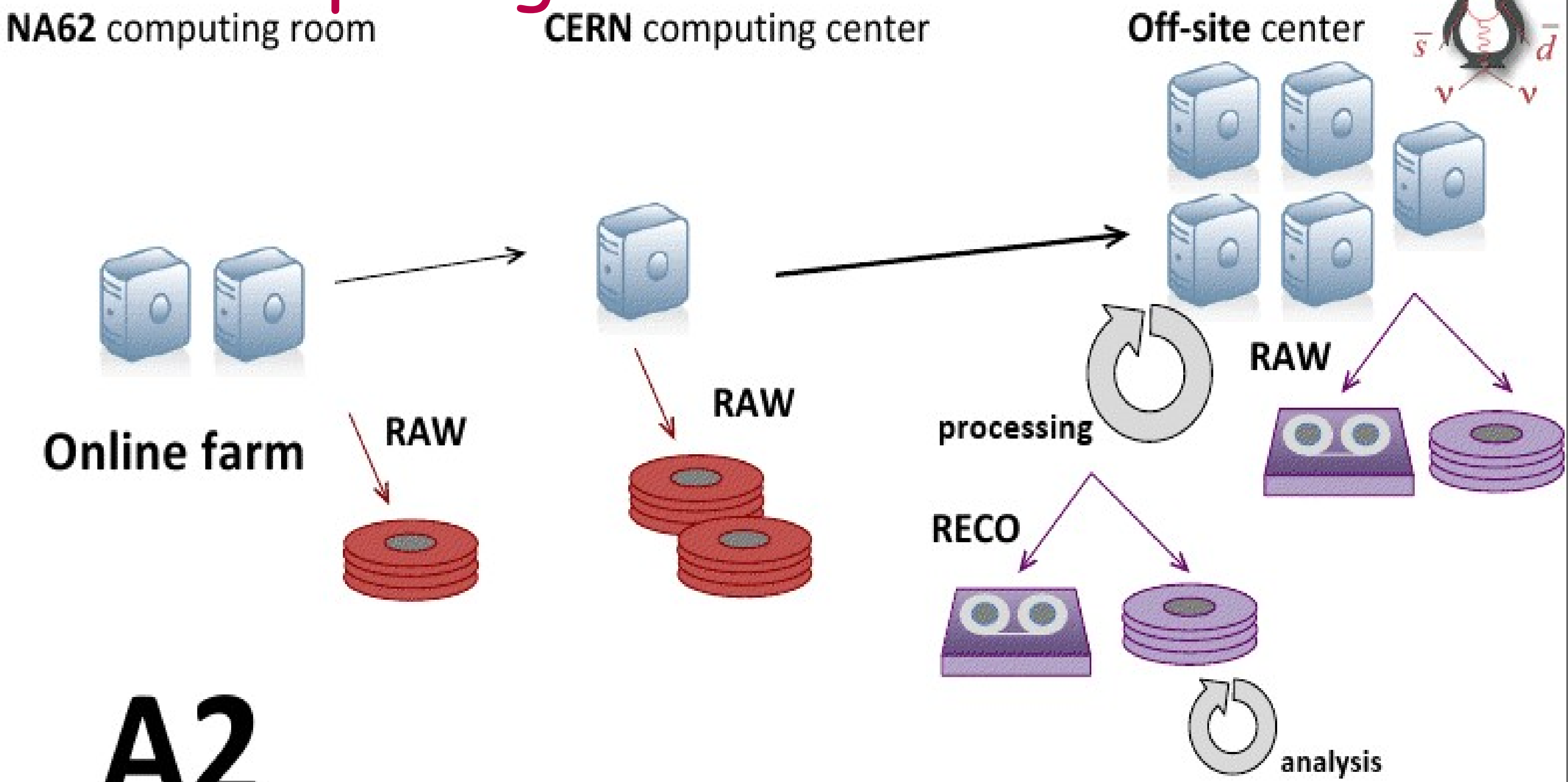


A1

Off-site processing

P. Valente

Computing Model: Answer N° 2



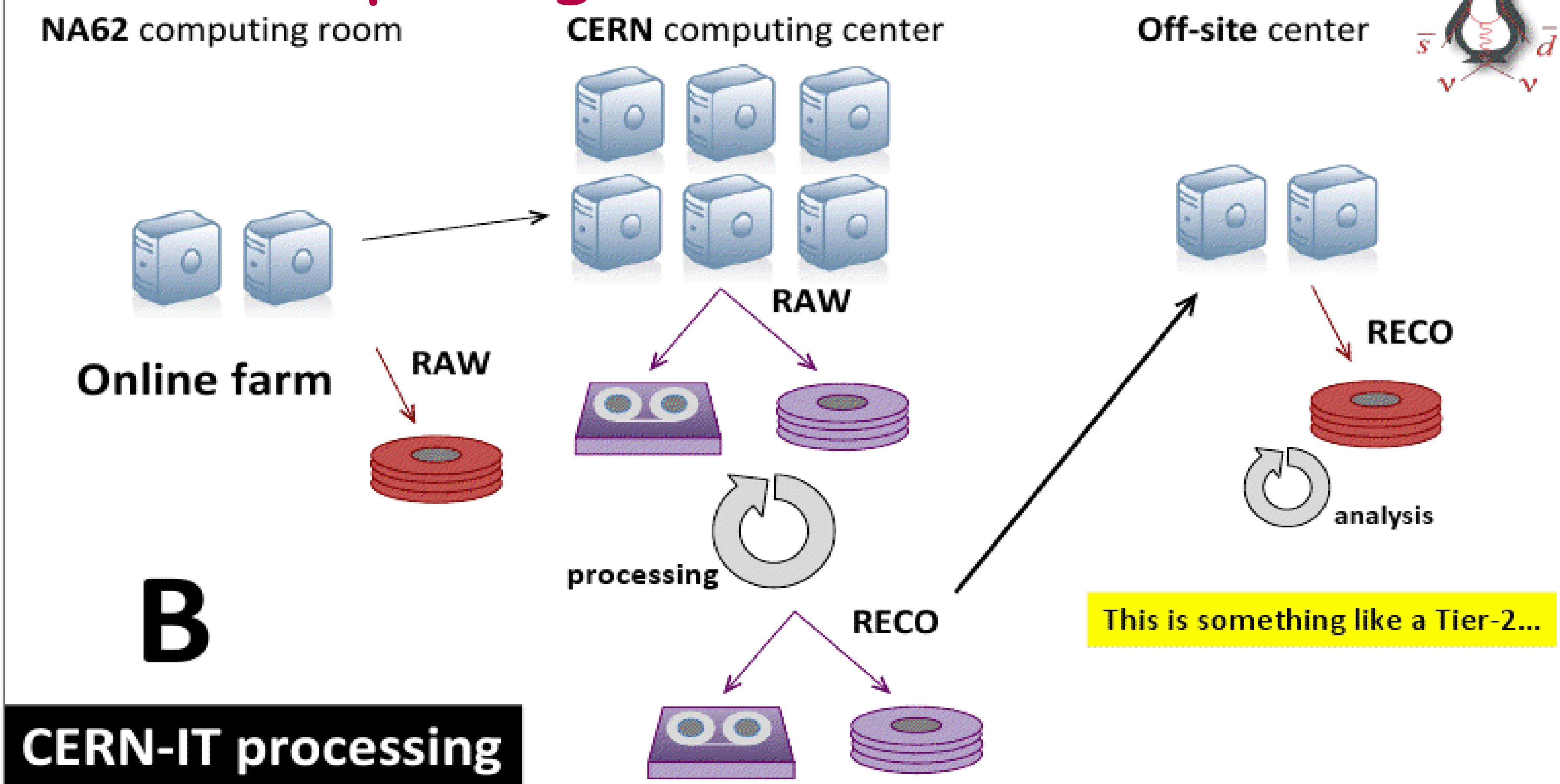
A2

Off-site processing

P. Valente

This is more a Tier-1...

Computing Model: Answer N° 3

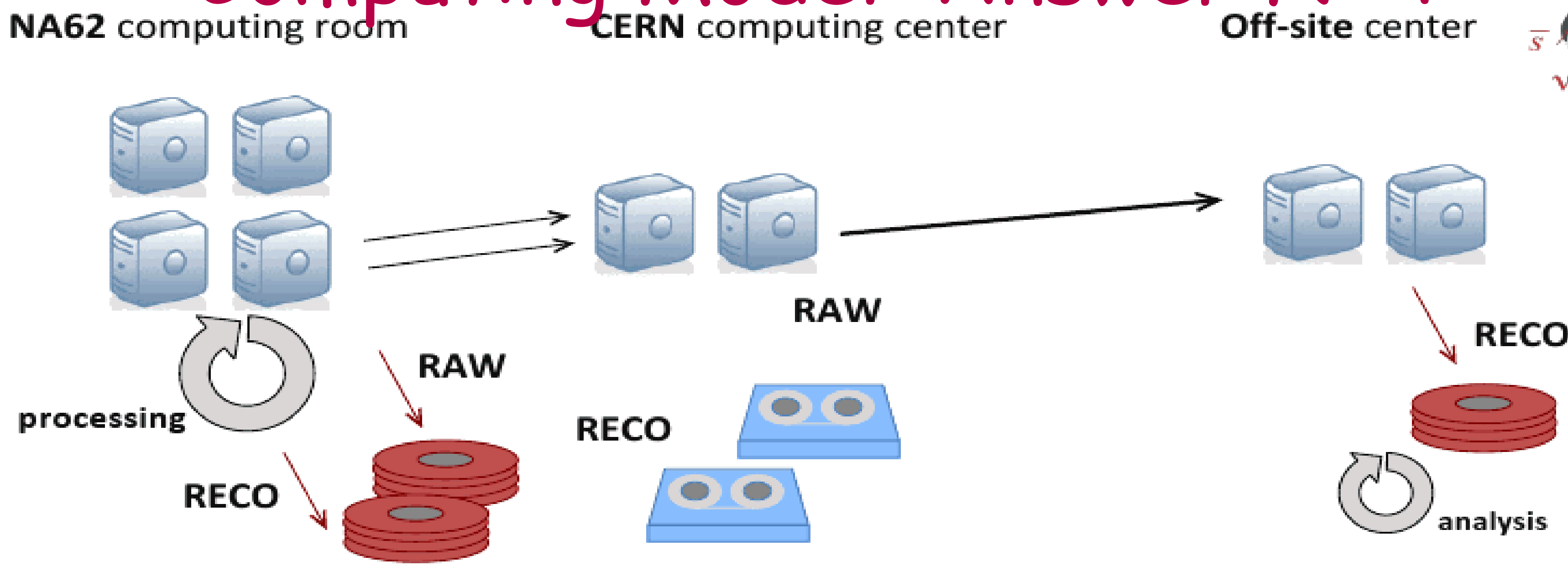


P. Valente

If data are processed at CERN-IT center, only RECO are replicated off-site in order to run analysis jobs

This is a Tier-0/Tier-1

Computing Model: Answer N° 4



C

NA62 farm Processing

An **alternative** is to have a **enough computing power** (and **disk buffer**) in the NA62 farm to **run (re-)processing from disk**

How much computing power?
How much disk-space?

Again, RECO **only** are replicated off-site in order to run analysis jobs

Italy plays a big role in construction, it should do it also in analysis

P. Valente

Summary

Several new experiments of nuclear physics, astro-particle physics and particle physics have a computing model compliant with the Italian infrastructure, some of them will have GRID-based infrastructure, others will use the resources in a simplified way.
All of them will need support for computing.

Dino Bazzacco, Bruna Bertucci,
Fabrizio Bianchi, Giuseppe Cardella
Paola Gianotti, Patrizia Rossi,
Paolo Valente

BACKUP

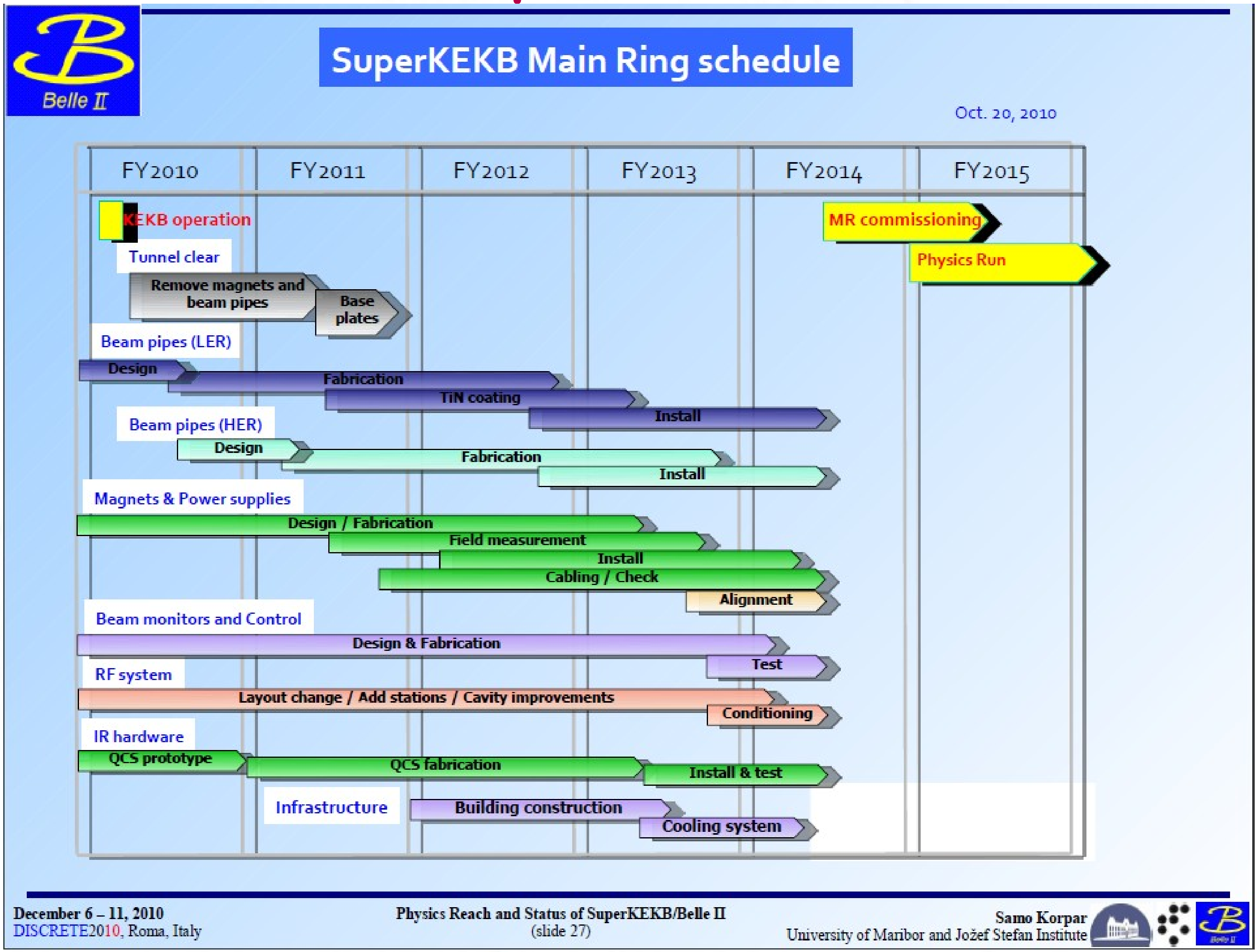
Nuclear Physics: New Experiments

New activities at JLAB: upgrade computing facility at the Laboratory, everything done on local farm.

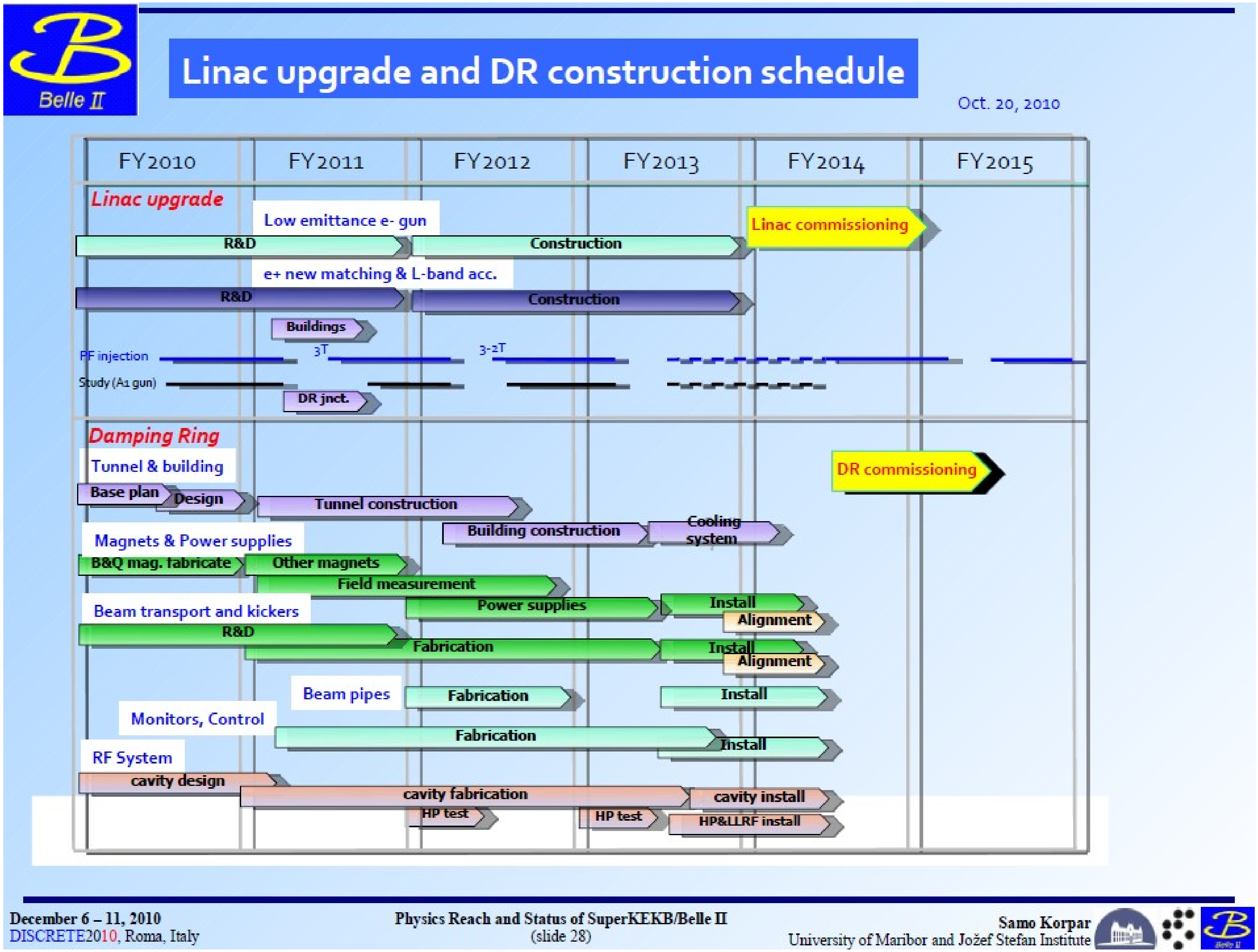
Proposed a new experiment:
FARCOS: Femtoscope ARray for COrrelation and Spettroscopy

Computing model to be done, probably they will use local farm

SuperKEKB


Belle II
SuperKEKB Main Ring schedule
Oct. 20, 2010
FY2010
FY2011
FY2012
FY2013
FY2014
FY2015
KEKB operation
MR commissioning
Physics Run
Tunnel clear
Remove magnets and beam pipes
Base plates
Beam pipes (LER)
Design
Fabrication
TiN coating
Install
Beam pipes (HER)
Design
Fabrication
Install
Magnets & Power supplies
Design / Fabrication
Field measurement
Install
Cabling / Check
Alignment
Beam monitors and Control
Design & Fabrication
Test
RF system
Layout change / Add stations / Cavity improvements
Conditioning
IR hardware
QCS prototype
QCS fabrication
Install & test
Infrastructure
Building construction
Cooling system
December 6 – 11, 2010
DISCRETE2010, Roma, Italy
Physics Reach and Status of SuperKEKB/Belle II
(slide 27)
Samo Korpar
University of Maribor and Jožef Stefan Institute

SuperKEKB

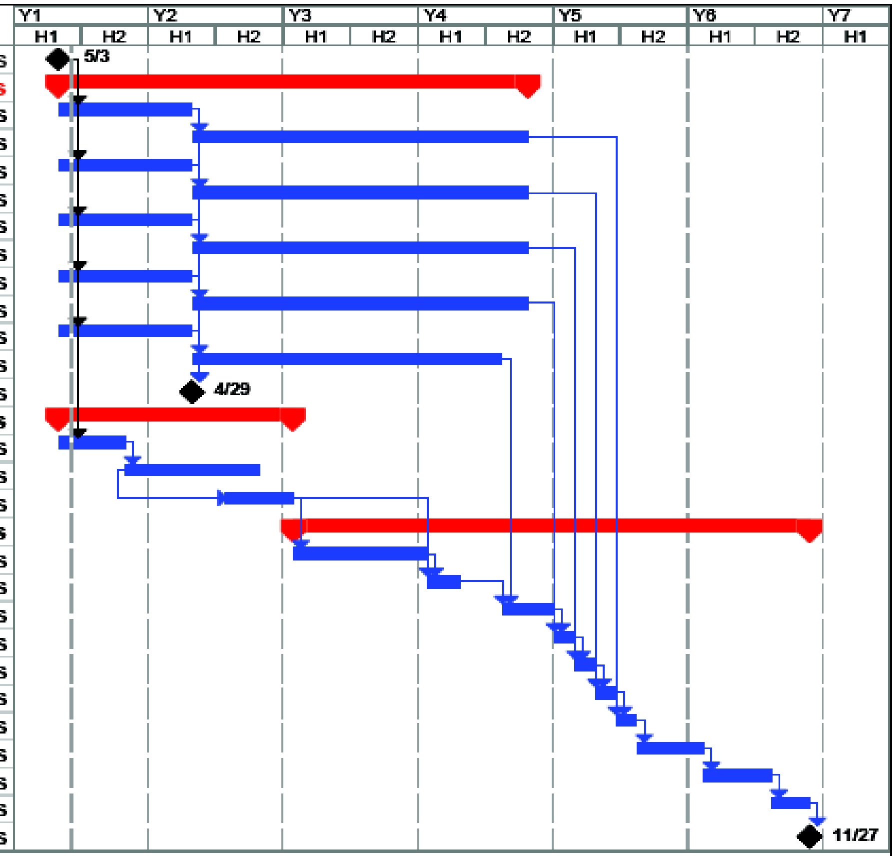


Belle II
Linac upgrade and DR construction schedule
Oct. 20, 2010
FY2010
FY2011
FY2012
FY2013
FY2014
FY2015
Linac upgrade
Low emittance e- gun
R&D
Construction
Linac commissioning
e+ new matching & L-band acc.
R&D
Construction
Buildings
PF injection
3T
3-2T
Study (A1 gun)
DR jnct.
Damping Ring
Tunnel & building
DR commissioning
Base plan
Design
Tunnel construction
Building construction
Cooling system
Magnets & Power supplies
B&Q mag. fabricate
Other magnets
Field measurement
Power supplies
Install
Alignment
Beam transport and kickers
R&D
Fabrication
Install
Alignment
Beam pipes
Fabrication
Install
Monitors, Control
Fabrication
Install
RF System
cavity design
cavity fabrication
cavity install
HP test
HP test
HP&LLRF install
December 6 – 11, 2010
DISCRETE2010, Roma, Italy
Physics Reach and Status of SuperKEKB/Belle II
(slide 28)
Samo Korpar
University of Maribor and Jožef Stefan Institute

SuperB Detector schedule

Detector Schedule Piano Triennale

ID	Task Name	Duration
1	Approval	0 wks
2	Detector Design & Construction	182 wks
3	Design SVT	52 wks
4	Construct SVT	130 wks
5	Design DCH	52 wks
6	Construct DCH	130 wks
7	Design PID	52 wks
8	Construct PID	130 wks
9	Design forward EMC	52 wks
10	Construct forward EMC	130 wks
11	Design IFR	52 wks
12	Construct IFR	120 wks
13	Detector Technical Design Report	0 wks
14	Dismantle & Move Babar	91 wks
15	Design Tooling	26 wks
16	Dismantle Babar	52 wks
17	Component transportation	26 wks
18	Detector Installation & Commissioning	200 wks
19	Installation steel	52 wks
20	Installation magnet	13 wks
21	Installation IFR	20 wks
22	Installation EMC	8 wks
23	Installation PID	8 wks
24	Installation DCH	8 wks
25	Installation SVT	8 wks
26	Commissioning	26 wks
27	Cosmic Ray test	26 wks
28	Commissioning on beam	15 wks
29	Detector ready for collision	0 wks



Project: SBF_schedule_v1.2
Date: Fri 6/4/10

Task | Split | Milestone | Summary | External Tasks | External Milestone