

Particle Physics activities at the LNF
LNF Scientific Committee
20/11/2012

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Summary: Group1 activities @ LNF in 2012 fwd

Requests 2011, funding 2012, SJ 2012 at the level of 1 k€

Exp	Res	Tec	FTE	<FTE>	MI	ME	CON	APP	ALTRO	CAP					
ATLAS	15	5	15.6	0.78	15	8	221	106	38	24	113	109			
BABAR	7	0	3.3	0.47	5	2	21	15	6	4					
BESIII	4	0	2.0	0.50	4	3	56	35	15	7	6	0	6	0	INV
CDF2	5	0	2.3	0.46	3	2	75	19	4	3			8	2	INV
CMS	9	4	9.7	0.75	12	5	126	51	55	19			10	10	INV
KLOE	23	4	17.5	0.65	46	22	50	24	216	99	568	294	100	90	MAN
LHCb	10	2	8.2	0.68	16	4	112	60	35	22	165	85	5	5	INV
NA62	7	1	5.3	0.66	23	10	119	79	40	25	100	100	20	20	TRA
PSupB	7	4	4.0	0.36	25	7	47	12	40	34			5	5	TRA
Pmu2e	4	0	1.2	0.30	4	1	28	11	35	19			22	6	INV
UA9	6	2	2.1	0.27	3	1	20	14	6	5	25	5	34	28	INV
DTZ	97	22	71.2	0.60	37	18	68	37	74	30			73	33	INV

Activities in 2012: ATLAS @ LNF

Activities focused on analysis and computing:

Main focus $h \rightarrow ZZ \rightarrow 4l$,

$h \rightarrow WW \rightarrow \ell\nu\ell\nu$, h properties and related objects perf./reco.

$h \rightarrow ZZ \rightarrow 4l$:

Analysis optimization (2011+2012)

MVA analysis and 2d fit signal yield

conf. note editing (selection, MVA)

spin/parity convener

$h \rightarrow WW \rightarrow \ell\nu\ell\nu$:

MET reconstruction/systematics

Theoretical uncertainties

Editing of the MET conf. note from the JET/ETMISS group

h properties:

Group coordination

Tier-2 size:

5 full racks with CPU

- ATLAS Tier-2: 5808 HepSpec, 832 j.s. (+ 2477 HepSpec in installation)
- Tier-2: 6920 HepSpec, 1024 j.s.
- Additional ~1100 j.s. available for Tier-3

Storage : 380 TB

Network: funding requested for a 10Gb/s switch for direct connection of the Tier-2 to the WAN

• Activity:

- Superb VO integration (other LHC experiments ~ realized)
- Parallel Analysis on Grid with Proof on Demand

Activities in 2012: ATLAS @ LNF

FTK and new Small Wheels

4 activities coordinated by Frascati

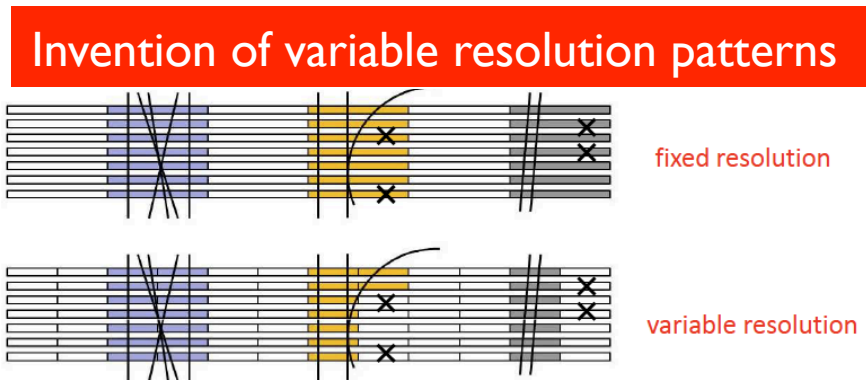
New Associative Memory ASIC 65nm.

Pattern density x20, speed x2.5

Similar power consumption!!

Vertical slice integration

FTK input & clustering



- Small Wheel upgrade (2018) just approved by ATLAS muon IB and ATLAS CB with several milestones for the end of 2012.
- Participation of several Italian groups: LNF, Rome I, Rome3, NA, CS, PV, LE for micromega (MM) detector (mainly for precision tracking)
- Central role of LNF: Italian site construction, FE electronics, mechanical quality control, mechanical structure.
- **LNF responsibility for the technological transfer from CERN to Italian company (ELTOS)**
- Novel front-end electronics for μ TPC reconstruction
- Several Test beams (one scheduled at BTF at the end of november) and Cosmic Ray studies ongoing
- An LNF technician should get expertise on PCB for micro-gap chambers from RD51 lab at CERN under Rui de Oliveira

Group composition in 2013: ATLAS

ATLAS LNF 2013: 15 researchers and 3 engineers for 16 FTE

- ▶ Undergraduate students: one working on FTK, one performing other HW studies, the other two analyzing ATLAS data set
- ▶ 6 Support technicians
- ▶ 3 Technicians for TIER-2 support

Requests for 2013 in CSN1: ATLAS

MI	Italian group meetings	15 kE	23 kE	17.5
	Technological transfer MM's toward ELTOS firm	8 kE		
ME	Responsibilities + shifts	12 mu	193 kE	86
	Physics meetings	9 mu		
	Detector maintainance (MDT, RPC, FTK), metabolism	24.2 mu		
	Technological transfer MM's at RD51 LAB	7 mu		
CON	Metabolism	16 kE	54kE	25
	Small buy at CERN	8 kE		
	Small buy local IT	5 kE		
	upgrade: test beam LNF + test stand CR	15 kE		
	Small buy cosmic-ray test with MM's	10 kE		
APP	TIER-2: Disc space 175 TB + network + server	71 kE	213 kE	103+7
	CPU TIER-2 - 1.5 kHS	22 kE		
	IP core for serialized I/O for AMchip+multipackaging	100 kE		
	New version of FTK_IM	20 kE		
INV	HV MM's + tooling assembly test	20 kE	20 kE	6

LNF support requests: I sem. 2013 ATLAS

Requests linked to upgrade (MM's) and trigger (mu = man-month)

Richieste I semestre 2013			
SEA	PCB design	2 mu	11 mu
	design of new AMchip version, even in case of success for the former version	6 mu	
	micromegas	3 mu	
SPCM	Metrology support: micromegas	2 mu	3 mu
	Mechanics (officina): micromegas	1 mu	
SSE/SPAS	micromegas design		6 mu
	Group technicians support: micromegas		8 mu

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Activities in 2012: LHCb

Group composition: 8 Res., 2 Eng. , 2 post-docs ~8 FTE, 5 technicians

1) Data taking:

- shift leader, online monitor, muon piquet
- μ detector maintenance : MWPC, GEM chambers, FEE electronics, ECS software

2) Muon detector performance studies

- MWPC/GEM hardware efficiency online monitoring
- offline μ identification algorithm: measurement of efficiency and misidentification probabilities for $\pi/K/p$ on data control samples, provide calibration for many LHCb analyses with μ 's in the final state

3) Data analysis

- strong contribution (wg convener from LNF) to $B_s \rightarrow \mu^+ \mu^-$ search, see following
- new channels: search for $B_s \rightarrow e\mu$ (LFV) and CP violation in $D^0 \rightarrow \phi\gamma$ decay

4) Muon detector upgrade

- design and development of new GEM detectors for central regions of M2/M3
- production of spare MWPC detectors (only site in Italy)
- FEE electronics to sustain a 40 MHz rate
- upgrade of ECS software

Activities in 2012: First evidence of $B^0_s \rightarrow \mu^+ \mu^-$

- ▶ Update on $B^0_{(s)} \rightarrow \mu^+ \mu^-$ search presented at HCP conference, with **1.0 fb⁻¹ at 7 TeV (2011)** + **1.1 fb⁻¹ at 8 TeV (2012)**
- ▶ Paper submitted to PRL on november 12, [arXiv:1211.2674](https://arxiv.org/abs/1211.2674)

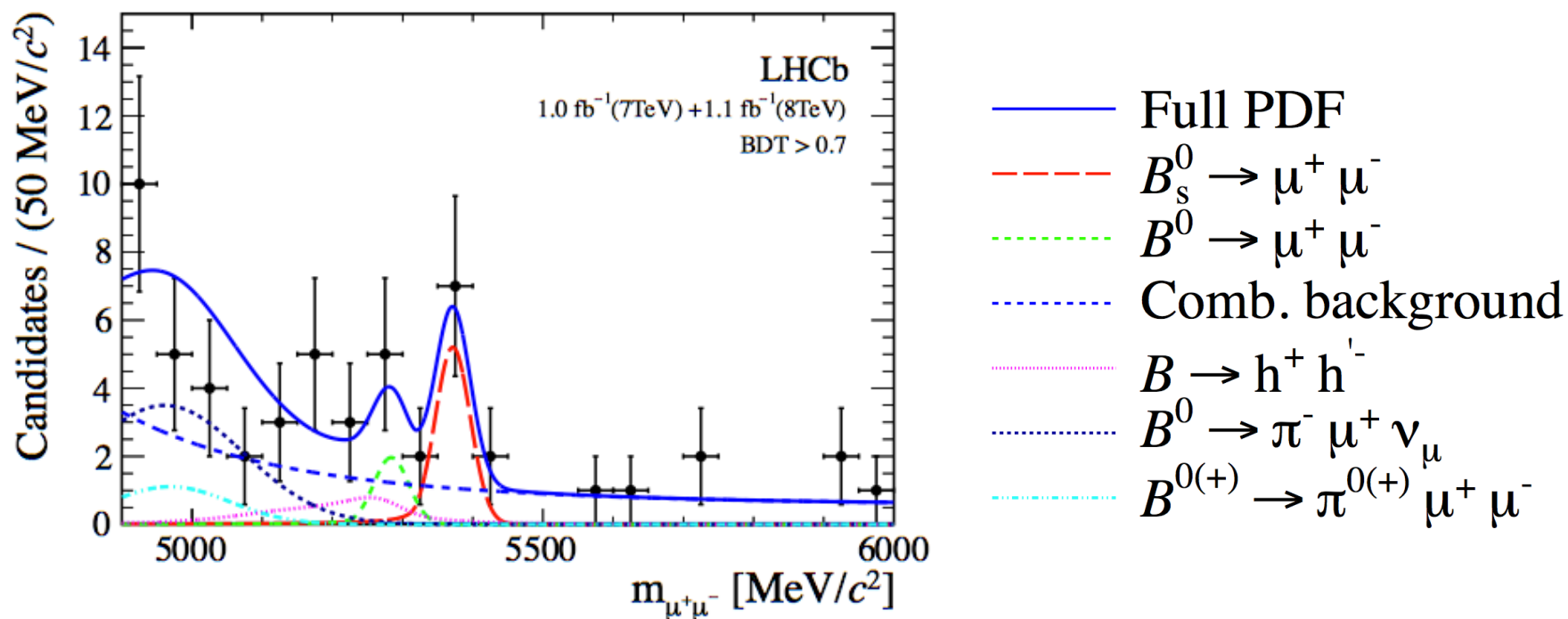
A search for the rare decays $B^0_s \rightarrow \mu^+ \mu^-$ and $B^0 \rightarrow \mu^+ \mu^-$ is performed using data collected in 2011 and 2012 with the LHCb experiment at the Large Hadron Collider. The data samples comprise 1.1 fb⁻¹ of proton-proton collisions at $\sqrt{s} = 8$ TeV and 1.0 fb⁻¹ at $\sqrt{s} = 7$ TeV. We observe an excess of $B^0_s \rightarrow \mu^+ \mu^-$ candidates with respect to the background expectation. The probability that the background could produce such an excess or larger is 5.3×10^{-4} corresponding to a signal significance of 3.5 standard deviations. A maximum-likelihood fit gives a branching fraction of $\mathcal{B}(B^0_s \rightarrow \mu^+ \mu^-) = (3.2^{+1.5}_{-1.2}) \times 10^{-9}$, where the statistical uncertainty is 95 % of the total uncertainty. This result is in agreement with the Standard Model expectation. The observed number of $B^0 \rightarrow \mu^+ \mu^-$ candidates is consistent with the background expectation, giving an upper limit of $\mathcal{B}(B^0 \rightarrow \mu^+ \mu^-) < 9.4 \times 10^{-10}$ at 95 % confidence level.

- ▶ see also CERN seminar:

<http://indico.cern.ch/conferenceDisplay.py?confId=216344>

Combined dataset, $\mathcal{B}(B^0_s \rightarrow \mu^+ \mu^-)$

- ▶ 7 TeV (1 fb⁻¹) + 8 TeV (1.1 fb⁻¹): $\mathcal{B}(B^0_s \rightarrow \mu^+ \mu^-) = (3.2^{+1.5}_{-1.2}) \times 10^{-9}$
- ▶ SM expectation: $(3.54 \pm 0.30) \times 10^{-9}$
- ▶ Bkg-only probability value: 5.3×10^{-4} (3.5 σ excess)



$B_s^0 \rightarrow \mu^+ \mu^-$: contribution from LNF

- ▶ Among the 23 analysis authors, 6 are from LNF, contributing to different aspects of the analysis:
- ▶ Data streaming and validation
- ▶ Muon identification efficiency
- ▶ pion/kaon/proton misidentification probabilities → peaking background determination ($B_s^0 \rightarrow h^+ h'^-$ with double misID)
- ▶ combinatorial background ($b\bar{b} \rightarrow \mu\mu X$) determination via interpolation of the dimuon mass sidebands
- ▶ Branching fraction fit
- ▶ Paper writing and submission

LHCb activity in 2012: toward the upgrade

- ▶ The higher rates in the upgraded conditions (x7.5 w.r.t. current LHCb running conditions) might create large dead-time with the current electronics, leading to important muon system inefficiencies in the inner region of M2
- ▶ We have started to study a solution to recover these inefficiencies by eventually upgrading the detectors located in the central regions of station M2, using **triple-GEM** detectors
- ▶ A new front-end and back-end electronics will also be required to readout these detectors, optimized for the operation in the new 40 MHz LHCb readout scheme
- ▶ R&D activity at LNF in 2013 already scheduled and funded by Gr I:
- ▶ Design and production of a real-size triple-GEM prototype for the inner region of M2, using the latest updates in the GEM assembly technique
- ▶ Study performance of triple-GEM detectors using MWPC gas mixture
- ▶ Start developing/testing of the new 40 MHz readout board (TELL40) in the upgraded muon detector configuration

Funding requests 2013 at CSN1: LHCb

Group composition in 2013, ~ the same: 10 Res. + 2 Eng., 7.6 FTE

Four support technicians

Requests CSN1 2013				
MI	algorithmic		9.5kE	7.5+1
ME	maintanance MWPC Muon system	1.5 mu	52 kE	30
	maintanance GEM+FEE Muon system	3 mu		
	LHCb weeks, meetings @ CERN, conferences	7.6 mu		
	Responsibility analysis $B_s \rightarrow \mu\mu$	2 mu		
CON	Metabolism + metabolism at CERN	19 kE	56	25.5
	Prototypes GEM in scale 1:1 (M2R1, M2R2)	12.5 kE		
	Setup TELL40 board: AMC + daughter boards	12 kE		
	FEE for GEM	6 kE		
	MWPC repairing, GEM assembly	6.5 kE		
APP	MOF-B contribution		85 kE	45

LNf support requests 2013, LHCb

Support request for 2013			
SEA	electronics maintainance (ODE/IB) Muon system	2 mu	16 mu
SEA	maintainance/update firmware ODE/ECS Muon system	9 mu	
SEA	upgrade: readout GEM design	1 mu	
SEA	upgrade: FEE GEM prototypes	1.5 mu	
SEA	upgrade: digital filter for new FE Mu system	2.5 mu	
SSE	upgrade muon detector – maintainance and developments of support and movement structures at CERN for Muon system – Legal documentation		4 mu
SSE/ SPAS	design of 2 prototypes scale 1:1 GEM detectors for upgrade M2 station		6 mu

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CMS-LNF: activity and responsibilities in 2012

Group composition: 3 phys., 6 eng., 1 undergraduate eng., 3 techn., for total of ~9 FTE

Activities and responsibilities 2012

- **Physics analysis (D.Piccolo) single-top**
 1. Measurement of the t-Channel Single Top Quark Production Cross Section in pp Collisions at root s=7 TeV, Chatrchyan (CMS Coll.) *PRL* 107 2011 doi: 10.1103/PhysRevLett.107.091802
 2. CMS Analysis Note AN-2012/273 D.Piccolo et al.
- **Gas Gain Monitoring system**
 1. A new approach in modeling the response of RPC detectors, L. Benussi et al., *NIM* A661 (2012)
 2. Performance of the GGM... S.Colafranceschi et al., <http://arXiv.org/abs/arXiv:1209.3893> accepted by JINST (2012)
- **Run Coordination LVL2 (L.Benussi)**
- **Deployment of CMS Centre at Frascati for remote RPC shifts**
- **Organization of Int. Conf. on RPC and related det., Frascati, 5 Feb 2012**

CMS-LNF: activity and responsibilities in 2012

Activities and responsibilities 2012

- **External resources attracted:**

1. **Completion of PRIN2008 Ministry grant (24 months)** *Optical sensors for contaminants of RPC gas mixture (Caponero Saviano Felli Parvis et al.)*

1. Patent deposited RM2011A000621
2. Study of gas purifiers for the CMS RPC detector. L. Benussi, et al., *NIM A661* (2012) S241-S244 arXiv:1012.5511
3. Modified POF Sensor for Gaseous Hydrogen Fluoride Monitoring in the Presence of Ionizing Radiations, S. Corbellini et al., *IEEE Tran. Nucl. Sci.* 61 1201-1208 (2012)
4. SiOx sensors for Gas contaminants, S. Grassini et al, accepted by JINST (2012)
5. A Novel Temperature Monitoring Sensor for Gas-Based Detectors in Large HEP Experiments L. Benussi et al., *Physics Procedia Volume 37, 2012, 483–490* (2012) <http://dx.doi.org/10.1016/j.phpro.2012.02.400>
6. A study of gas contaminants, S. Colafranceschi et al., *arXiv:1210.1819* accepted by JINST 2012

2. **First year of AIDA FP7 Capacities, Grant Agreement 262025 (48 months)**
WP 8.5.3 (environm. monitors)

CMS-LNF: activity and responsibilities in 2013

1. CMS RPC Italy responsible 2013-2014 (S.Bianco)

2. Data taking shifts (3 months)

3. Physics analysis single top

- No physicist PhD students, the 2-year “*assegno di ricerca*” contract asked to Lab is crucial to keep momentum after startup work (D.Piccolo)

4. RPC detector upgrades in Long Shutdown I (2013-2014)

5. R&D on Gas Electron Multiplier (GEM) muon detectors for hi-eta region in Long Shutdown 2 (2017-2018)

- Gas mixtures studies, mechanical assembly of GEM foils studies: CMS Trapezoidal GEM Foils Structural Analysis by G.Raffone (Frascati) LNF - 10 / 20(IR)

6. Request from CMS for a TOSCA simulation code expert

- Needed to fill a vacant senior position in the CMS Solenoid working group for the mapping of B field. Candidates in the Frascati Accelerator Division, exploring availability with AD Director and LNF Director

- **A high-quality programme well-linked to group size in progress, from physics analysis to detector development and technological applications**
- **External funds attracted**
- **High-level responsibilities in the next 2-3 years**
- **Funding received is critical, as well as resources from Lab.**

CMS-LNF: request and funding INFN 2013

Requests to the CSN1 for 2013				
MI	7.1 FTE x 1 kE/FTE		7 kE	8
ME	3.7 kE/m.u. x 36.2 m.u.		120 kE	58
CON	Metabolism 1.5 kE/FTE x 7.1 FTE	9 kE	21 kE	7
	CERN car	4 kE		
	Spare RPC gaps for GGM (5 gap)	5 kE		
	GEM R&D gas studies	3 kE		

- Only 50% requests granted overall
- No funding for GEM R&D granted

CMS-LNF: manpower request for 2013

Requests I e II semester 2013			
Electro nic Techni cians Div Ric	Maintenance on RPC gas system for leaking	12 mu	31 mu
	Maintenance of Gas Gain Monitoring System	4 mu	
	Test and QC of linkboard trigger RPC	4 mu	
	Installation of T sensors based on FBG on new endcap chambers	4 mu	
	p,T,H sensors in GIF++/AIDA EC FP7 Capacities Grant 262025	4 mu	
	R&D GEM	3 mu	
SPCM	Mechanical parts in Lab workshop	0.5 mu	
SPAS	Design of gas distribution system end-user facility GIF++/ AIDA EC FP7 Capacities Grant 262025	1 mu	

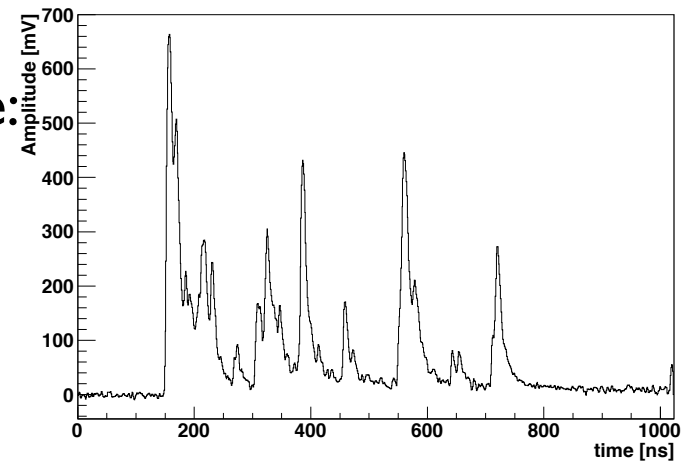
Space in the ASTRA laboratory for testing spare chambers of the GGM system
 6-month usage of 1/2 of the ASTRA clean room to test mechanics of GEM chambers

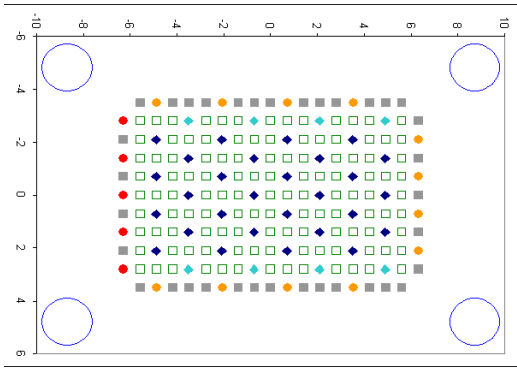
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2012 activity: pSuperB

R&D activities for drift chamber with cluster counting readout

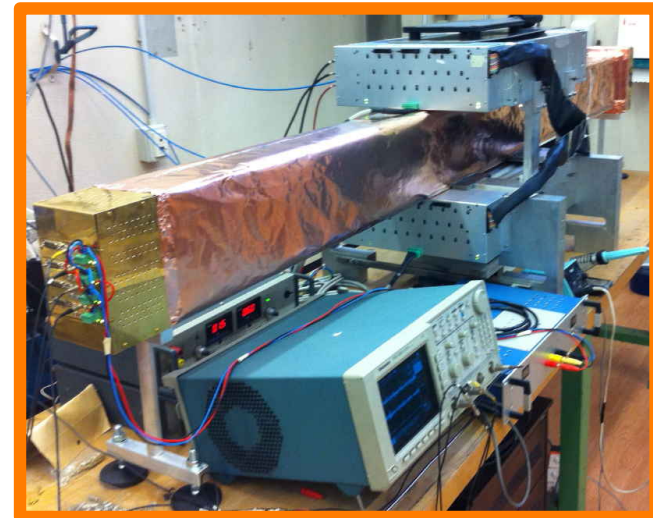
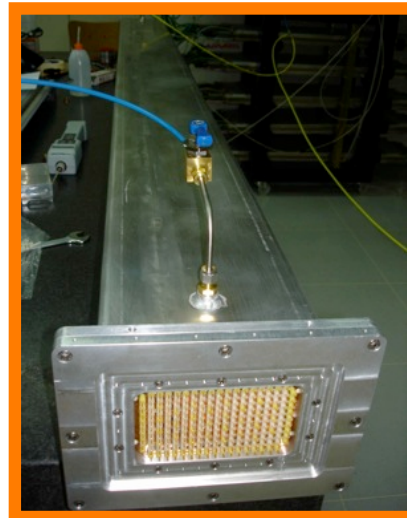
- ▶ Prototype build, for cluster counting studies in realistic conditions (discrete cathod cells, dimension L=2.5m)
 - ▶ 28 squared cells with side=14mm, Rfs=3:1 on 8 layers (3-4-3-4-3-4-3-4)
- ▶ 10 samples for cosmic-ray tracks with gas mixture 90%He-10% iC_4H_{10} :
 - ▶ Truncated mean at 70%: $\sigma_{dE/dx}/\langle dE/dx \rangle = 13.3\%$
 - ▶ Average number of clusters: $\sigma_N/\langle N \rangle = 8.8\%$
- ▶ Need a test at TRIUMF to prove the capability to achieve π/K separation
 - ▶ Ongoing, e/ π/μ beam until 3rd of Dec.
- ▶ Trigger studies with the new prototype:
 - ▶ Time jitter under analysis
 - ▶ Rate test at 25 Hz





The 2nd pSuperB DCH prototype

- Prototype for cluster-counting studies in realistic conditions (discrete cathode cells, $L=2.5\text{m}$)
 - 28 squared cells with side=14mm, Rfs=3:1 on 8 layers (3-4-3-4-3-4-3-4)



- Read-out boards with independent analog readout for triggering, 4-fold grouping of the 8 layers, will study trigger time jitter

Funding requests in 2013 at CSN1: pSuperB

▶ **pSuperB in 2013: 6 Res., 5 Eng.: 4.6 FTE**

▶ Requests of funding to exploit at best prototype in length scale 1:l

Richieste CSN1 2013				
MI	contacts with firms + responsibilities + meeting with Lecce	7		
ME	beam test at TRIUMF: PID with Proto2	19	49+19	15+13
	responsibilities + collab. meetings + integration meeting at SLAC	34		
	Metabolism	8		
CON	2 Gandalf modules, 8 ch's FADC + FPGA, SJ	21	49+21	36+20
	new FE boards to compare different options for cluster counting	5		
	performance test with 28, 10-m long cables as in nominal design	2		
	carbon-fiber test, tools for test modification with holes	15		
	Gas	12		
	build a new telescope	15		

Support requests I sem. 2013 pSuperB

Requests I sem. 2013			
SEA	Setup new boards FADC GANDALF for cluster counting (s.j. to positive performance in the 2002 test)	2 mu	4 mu
	Laboratory activities and beam test	2 mu	
SPAS	Tooling test for carbon fiber and test inner DCH vessel	4 mu*	6 mu
	Laboratory activity	2 mu	

* To be re-discussed

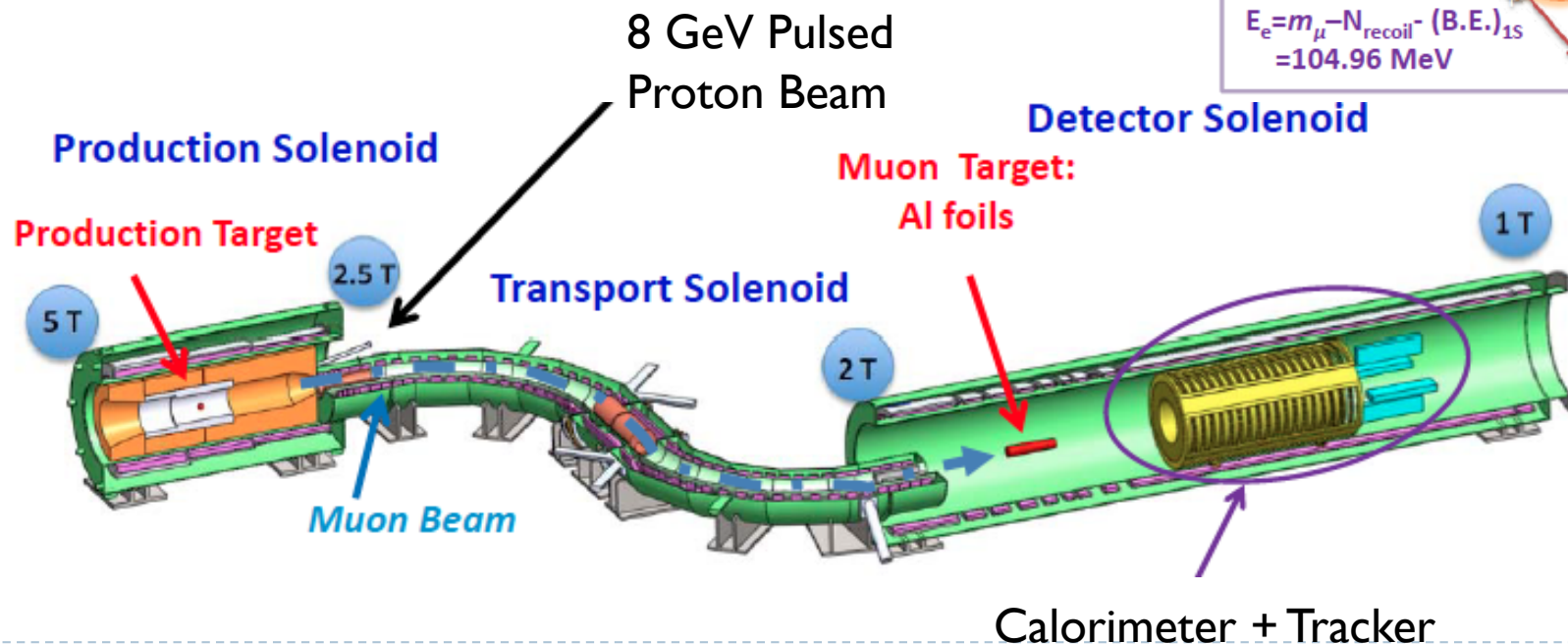
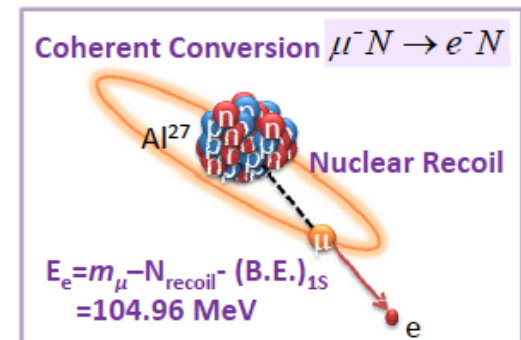
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Mu2e experiment @ FNAL

- ✧ Search for the CLFV process $\mu^- + N \rightarrow e^- + N$, i.e. the conversion of a muon to an electron in the field of a nucleus. Signal is a mono-energetic electron of 105 MeV.
- ✧ In the SM, $BR(\mu \rightarrow e\gamma) \sim 10^{-53} \rightarrow$ any signal is a compelling evidence of new physics.

➤ **Current limits** (SINDRUM II at PSI) : $R_{\mu e} < 4.3 \times 10^{-12}$ (Ti), $R_{\mu e} < 7 \times 10^{-13}$ (Au)

➤ **MU2E Goal** $R_{\mu e} = \frac{\mu^- Al \rightarrow e^- Al}{\mu^- Al \rightarrow capture} < 6 \times 10^{-17}$ (90% C.L.)

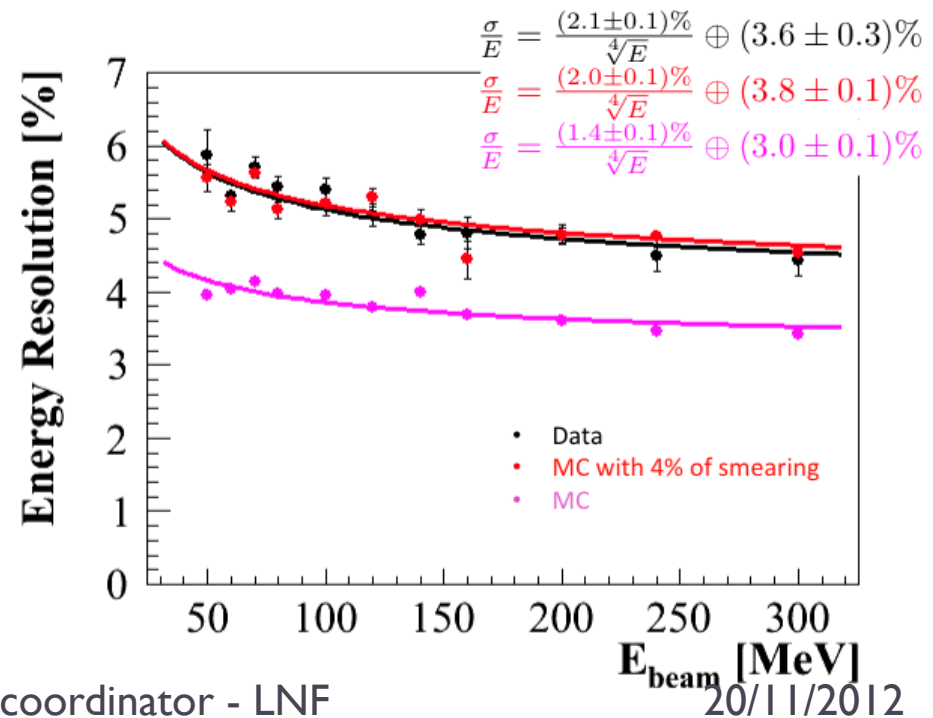


P-Mu2e activity 2011-2012

- ❖ Experiment in phase of approval @ Fermilab (USA)
CDI granted July 2012. CD2 expected in 1.5 years.
- ❖ Overall schedule aims to experiment starts @ beginning of 2019
- ❖ Italian collaboration (P-Mu2e) concentrated on detector effort
 - LNF+INFN PI/Ud work on EMC R&D & design (LYSO crystals) → 16 staff (5 FTE)
 - INFN Lecce working on alternative to the proposed tracker system
 - P.Fabbricatore (INFN Genova) now working for the Magnet system.

❑ LNF plays a leading role in EMC (S.Miscetti L2 manager of the system)

- Synergy with the KLOE-2 experiment to develop and test prototypes.
- Successful test beam @ MaMi (Mainz Microtron) in March 2011
- development of QC stations
- Characterization of photo-sensors
- Development of Laser calibration
- Overall calorimeter design

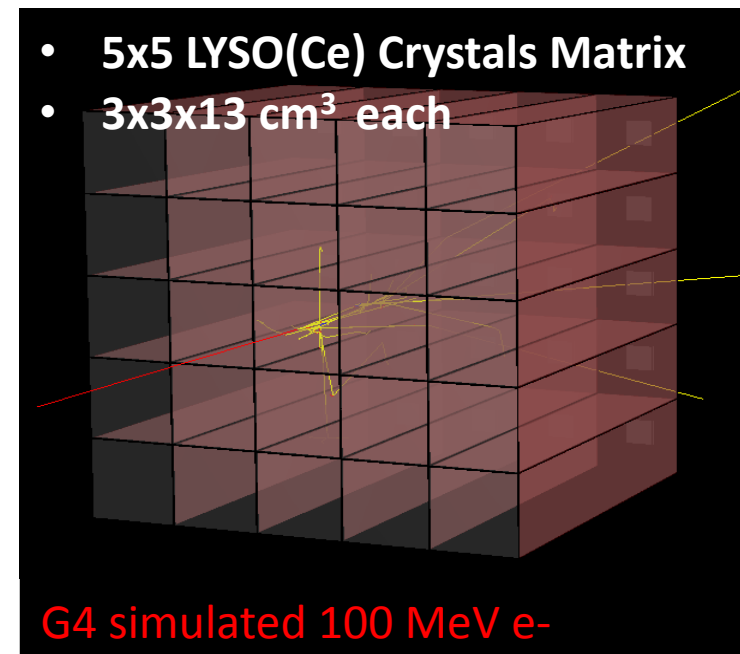
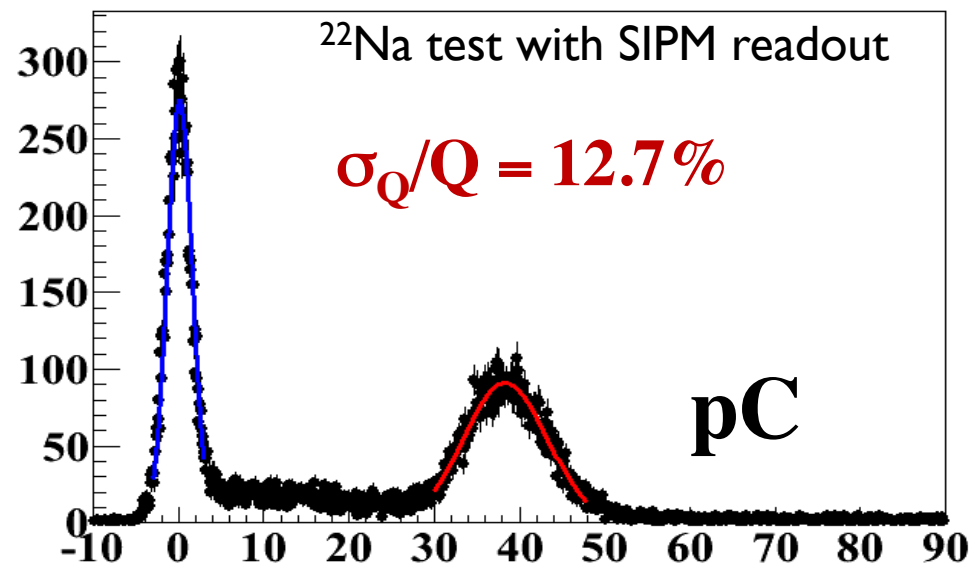


P-Mu2e plans 2013-2014

- **Complete R&D (good support from CSNI)**

- Engineering of QC stations
- Test Beam with a full size 5x5 crystal matrix to reach/ test limits in energy resolution O(2 %) and make a final choice of photo-sensors
- Carry out radiation hardness tests

- From LNF: **keep support provided by 1 mech. Engineer and two Technicians. Usage of 3+3 months of electronic department and similar amount of mech. shop for prototype assembly.**



Requests 2013 pMu2e, LNF

Group composition LNF 2013: 4 + 2 Res., 2.0 FTE

- ▶ Undergraduate students: A.Luca' (thesis on ECAL requirements march 2011, 110/110 *cum laude*), V.Stomaci (WF digitizer), L.Bianchi (mu rejection and QC)
- ▶ KLOE-2/Research division: A.Sarra (joint work CCALT) and 3 technicians

Requests CSN1 2013				
MI	meeting with firms and meeting in Italy		3 kE	1+1
ME	beam test at MAMI, conferences, etc.		23 kE	12+2
CON	Step-by-step motor, mechanics, polaroid, source	8 kE	29 kE	19
	LASER mechanics, optical fiber, mixer, table	4 kE		
	Proto 5x5 matrix: Preamps + HV + APD holder	17 kE		
INV	Chiller, Tungsten lamp, PC for DAQ	4 kE	19 kE	11
	LASER head + driver	10 kE		
	Proto 5x5 matrix FEE: 1 VME board	5 kE		

LNf requests support pMu2e

Requests for 2013 for 5x5 matrix prototype

- ▶ Keep support from the three technicians already involved in this R&D for test beam and QC

Support Requests 2013			
SEA	FEE development	1.5 mu	3.5 mu
	QC station controls	2 mu	
SPCM	Building of a new 5x5 prototype		3 mu
SSE	Mechanical design of prototype		2 mu

New activity *in fieri*: g-2 @ FNAL

New activity coalescing: the experiment g-2 a FermiLab, aka E-989

- ▶ The goal: measurement of a_μ @ 0.14 ppm, improve on E821 by a factor of 4
- ▶ Statistical improvement by a factor of 20 in 2 years of data taking
- ▶ Systematic error improvement by a factor of 3, installing the storage ring from BNL to FNAL + detector upgrade and more precise measurement of magnetic field and beam parameters
- ▶ Proposal submitted at FNAL in January 2009:
 - ▶ F. Happacher, G. Venanzoni (LNF) among the 66 signatures
- ▶ Stage-I approval at January 2010
- ▶ Proposal for DOE at April 2010, 83 physicists, among which:
 - ▶ F. Happacher, G. Venanzoni and M. Martini (LNF), D. Moricciani (Roma2)
- ▶ DOE approval August 2010 and first money flowing (dismantling and transport ring from BNL)

- ▶ INFN item: the electromagnetic calorimeter
 - readout gain monitoring, 0.12 ppm @ E821 → 0.02 (largest systematic error for E821)
 - pile up 0.08 ppm @ E821 → 0.04, by using a calorimeter with higher granularity
- ▶ **Total cost of \$40M, of which \$ 0.2-0.3 M for new detectors non from DOE**
- ▶ **Tight and aggressive timescale: R&D non-DOE until 2013, start in 2016**
- ▶ Quick approval phase: CD-0 this summer, CD-1 end 2012/beginning 2013.
- ▶ Beam synergy with mu2e at FNAL: “Muon Campus”

New activity *in fieri*: g-2 @ FNAL

Italian proto-collaboration in development:

- ▶ At the moment: LNF, PI, UD, RM2
- ▶ Synergy with P-Mu2e at LNF (common R&D for calibration)
- ▶ **Any decision for official activity opening postponed to 2013**
- ▶ Focus of INFN activity: e.m. calorimeter PbF2, with online, LASER-based calibration system of the gain (in the inter-spill)
 - Studies of performance and reproducibility and light transmission linked to Mu2e calibration system
 - Common R&D for at least 1 year
- ▶ **Informal discussions within CSNI, a first presentation of the physics case and of the INFN interest at last september meeting**
- ▶ **In 2012, the local coordinator helped for mission to FNAL connected with g-2**

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Activity in 2012, experiment CDF2

- I. time-integrated mixing probability of the b -flavored hadron mixture
 - derived from the ratio of SS to OS dimuons due to b - $b\bar{b}$ production and direct decay
 - Without mixing, SS di-muons arise from processes such as $b \rightarrow c \rightarrow \mu$ or $b \rightarrow c$ $c\bar{b}$ with c or $c\bar{b} \rightarrow \mu$. Once removed these contributions, the ratio $R = SS/OS$ yields $\chi = f_d \chi_d + f_s \chi_s$
 - Since the mixing probability of bu and bs hadrons are now well measured, χ provides info about f_s and f_d
 - We exploit ghost hypothesis by re-measuring R with muons originating within 10 cm, first ignoring the existence of ghost events and then accounting for them using the data
 - $\chi = 0.127 \pm 0.008$ in agreement with LEP
2. Measurement of A_{sl}^b : CP violation measured with fully reconstructed B decays [low stats] and inclusive modes - muons from B decays (D0) - [high stats but large dilution from CP conserving modes]
 - ▶ CDF result $A_{sl}^b = 0.0115 \pm 0.004$ (stat) ± 0.0074 (syst)
 - ▶ D0 final $A_{sl}^b = -0.00957 \pm 0.0025$ (stat) ± 0.00146 (syst) [D0 systematic uncertainty needs to be re-assessed as well as the central value of the asymmetry]
 - ▶ A good guess is that the systematic errors have to be comparable
 - ▶ Based on stat errors only, the D0 and CDF measurements differ by 4.5σ

Requests to CSN1 2013, CDF2

In 2013: 3 res., 0.9 FTE

- ▶ 2013 devoted to completion of ongoing analyses

Requests for CSN1 in 2013			
MI	Meetings in Italy	1 kE	1
ME	3+2 trips to FNAL analysis/meeting 1 trip to FNAL for hardware maintainance	16 kE	5.5
CON	Metabolism at LNF and at FNAL	1 kE	1
INV	IT	8 kE	0

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Activity in 2012, BABAR experiment

After the end of data taking (April 2008) all of the events reprocessed with up-to-date version of reconstruction software and needed MC samples have been generated

Analysis activity ongoing in various institutions and will go on on a wide spectrum of physics items. Many analyses updated using complete data set, many more in development. Total number of accepted papers exceeds 500!

LNF analyses:

- ▶ $\sin 2\beta$ in $B^0 \rightarrow D^{*+}D^{*-}$, completed this year, submitted to PRD
- ▶ New phd student at Frascati (S. Martellotti), with **thesis on τ EDM measurement**
- ▶ Contribution to the “Babar-Belle legacy book project” (M. Rama)
- ▶ Two LNF members of the collaboration Council (R. de Sangro, I. Peruzzi)

Requests in 2013 at CSN1, BABAR

Group composition in 2013: 7 res., 4.3 FTE

Requests for CSN1 2013			
MI	Meetings in Italy	6 kE	2.5
ME	Meetings, workshops, conferences	23 kE	20
CON	Metabolism at LNF and at SLAC	6.5 kE	2

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Activity in 2012, UA9 experiment

- Two beam tests with protons: at CERN H8 (channeling measurements and definition of crystals to be installed in UA9 for LHC)
 - Measurement of Parametric X Radiation **PXR** (channeling monitoring on crystal)
 - Commissioning of crystal characterization system@ XLAB – Frascati
- **3 SPS Machine Development** for proton beam collimation:
 - implementation of the tracking system **medipix** in the SPS in 3 Roman Pots
 - development of a scintillating-fiber monitor to be installed in the roman pot for ion beams
 - installation of two GEM monitors for background measurement around the SPS beam pipe
 - maintenance and upgrade of UA9 detectors: GEM, medipix, and scintillators.
- Analysis of UA9 MD data
- Simulation of channeling on crystal for relativistic particles;
- Simulation of channeling radiation on several crystal structures
- Simulation of SPS collimation

2013 requests at CSN1, exp UA9













Group in 2013: 6 researchers, 1.8 FTE

Requests to CSN1 in 2013				
MI	Collaboration meetings		1 kE	2
ME	Meetings, test beam and MD (SJ) shifts		10 kE 2 kE	7+2
CO N	FEE design for diamond detectors	5 kE	21 kE	10
	Diamond detectors	3 kE		
	Gas for GEM detectors at LNF	3 kE		
	Control system for crystal test	10 kE		
INV	Power supply for diamond BLM for LHC		10 kE	0
APP	Prototype of beam loss monitor for LHC, diamond based		8 kE	0

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Summary: Group1 activities @ LNF in 2013 [back](#)

Requests 2012, funding 2013, SJ 2013 (at the level of 1 kE)

Sigla	Ric	Tec	FTE	<FTE>	MI	ME	CON	APP	OTHER
ATLAS 	15	3	15.7	0.87	23 18	193 86	54 25	213 110	20 6 INV
BABAR 	8	0	4.3	0.53	6 2	23 20	6.5 2		
BESIII 	5	1	3.0	0.50	6 4	43+8 34	9 7		5 5 INV
CDF2 	3	0	0.9	0.30	1 1	16 5	1 1		8 0 INV
CMS 	9	3	8.3	0.69	7 8	120 58	21 7		
KLOE 	19	5	15.8	0.66	18 18	30 15 15	115 28 46	85 77 70 78	100 35 MAN
LHCb 	9	2	7.5	0.68	10 8	52 30	56 26	85 45	
NA62 	8	1	6.3	0.70	16 8	132 84	45 27	65 65	15 15 TRA
PSupB 	6	4	4.6	0.46	30 15	19 13	49 36 21 20		15 INV
Pmu2e 	6	0	2	0.33	3 2	23 14	29 19		19 11 INV
UA9 	4	2	1.8	0.30	1 2	12 9	21 10	8 0	10 0 INV
DTZ 	92	22	70.2	0.62	29 17	29 23	39 31		51 33 INV

Support requests LNF 2012/2013

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Requests support LNF II sem. 2012 (mu)										
	ATLAS	BES-III	CMS	KLOE	LHCb	NA62	SupB	Mu2e	UA9	TOT
SEA	9.5	3		22.5	8	11	8.5			62.5
SPCM	4	0.5		12		7				23.5
SPAS	2	3		5	1.5	9	2			22.5
Tecn	6	3	18	30	10.5	34	12	3		116.5

Requests support LNF I semester 2013 (mu)										
	ATLAS	BES-III	CMS	KLOE	LHCb	NA62	SupB	Mu2e	UA9	TOT
SEA	11	3		9.5	8	11	4	3.5		50
SPCM	3	0.5	0.5	8	2	7		3		24
SPAS	6	3	1	4	3	9	6	2		34
Tecn	8	3	31	30	10.5	34	12	3		131.5

Conclusions

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Group I activity in 2012-3 showing a general positive versatility:

- ▶ Important analysis activity
- ▶ R&D activity very intense (upgrade of LHC experiments, pSuperB, etc.)
- ▶ Building of new detectors (KLOE, NA62, etc.)
- ▶ Request of support from the Lab still growing... facing spending and personnel cuts... will try to optimize to match with changing conditions
- ▶ Some positive synergy among groups has been pursued, e.g:
 - ▶ cosmic ray stand at the GS building (SuperB, ATLAS, LHCb, DTZ)
 - ▶ Other expts within the ATLAS TIER-2 (ATLAS, NA62, CMS, LHCb, DTZ)
 - ▶ building of common tools, such as a scintillator-WLS fiber tracker (BES-III, SuperB, LHCb, DTZ)
- ▶ Some difficulty to allow young researchers, especially undergraduates and PhD's, even if with some effort and success we are inverting the trend
- ▶ New activity *in fieri*: g-2 @ FNAL, reasonable scale in terms of costs/benefits. Synergy with pMu2e has to be assessed

Support requests LNF 2012/2013

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Requests support LNF II sem. 2012 (mu)										
	ATLAS	BES-III	CMS	KLOE	LHCb	NA62	SupB	Mu2e	TOT	Avail
SEA	9.5	3		22.5	8	11	8.5		62.5	75
SPCM	4	0.5		12		7			23.5	55
SPAS	2	3		5	1.5	9	2		22.5	27
Tecn	6	3	18	30	10.5	34	12	3	116.5	

Requests support LNF I semester 2013 (mu)										
	ATLAS	BES-III	CMS	KLOE	LHCb	NA62	SupB	Mu2e	UA9	TOT
SEA	11	3		9.5	8	11	4	3.5		50
SPCM	3	0.5	0.5	8	2	7		3		24
SPAS	6	3	1	4	3	9	6	2		34
Tecn	8	3	31	30	10.5	34	12	3		131.5