

Belle II Computing

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INFN & University of Torino

Meeting with Referees 2015-09-07

Software/Computing Workshop

11-15 Maggio 2015

- Giornate intense piene di presentazioni e discussioni
- See:
<http://kds.kek.jp/conferenceDisplay.py?confId=17040>
- Progressi importanti, principale fattore limite e' la mancanza di manpower
 - Critica in Europa ed Italia

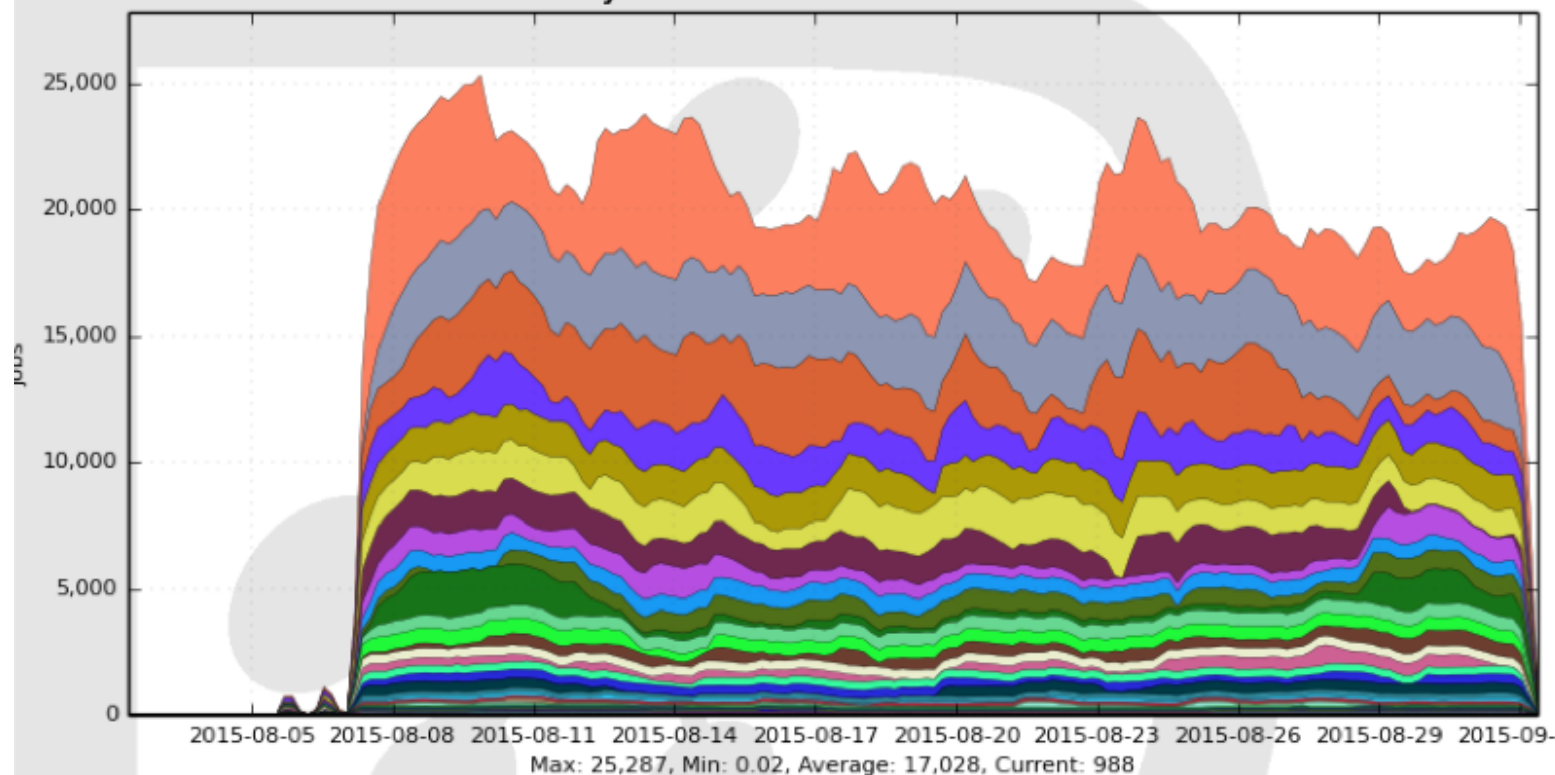
Attivita' in Italia

- Importanti contributi italiani allo sviluppo del software
 - Tracking, ECL, tools di analisi (Pisa, Perugia, Napoli, Frascati)
- Contributi al computing essenzialmente sotto forma di risorse di calcolo messe a disposizione e di studi sul networking (Napoli)
 - Dirac server a Napoli
 - CPU e storage pledged al CNAF ed a Napoli
 - VO Belle abilitata anche a Frascati, Pisa, Legnaro e Torino
- Responsabilita' ufficializzate a giugno 2015:
 - Co-Network Representative for Europe: Silvio Pardi (Napoli)
 - Chair of Computing Steering Group; FB
 - Regional coordinator for Europe: FB

Current MC Campaign

Running jobs by Site

30 Days from 2015-08-02 to 2015-09-01



LCG.DESY.de	19.0%	LCG.MPPMU.de	3.0%	LCG.CYFRONET.pl	1.3%
DIRAC.PNNL.us	13.5%	LCG.Frascati.it	2.9%	LCG.Melbourne.au	0.9%
LCG.Pisa.it	11.2%	LCG.NCHC.tw	2.6%	LCG.ULAKBIM.tr	0.5%
LCG.KEK2.jp	6.9%	LCG.Cosenza.it	2.5%	DIRAC.CINVESTAV.mx	0.5%
DIRAC.UVic.ca	6.6%	DIRAC.BINP.ru	1.9%	CLOUD.CC1_Krakow.pl	0.3%
LCG.Napoli.it	6.5%	LCG.KMI.jp	1.8%	LCG.Legnaro.it	0.3%
LCG.HEPHY.at	5.5%	ARC.SIGNET.si	1.5%	DIRAC.TMU.jp	0.2%
LCG.KIT.de	3.2%	LCG.KISTI.kr	1.5%	DIRAC.Hokudai.jp	0.2%
LCG.CNAF.it	3.0%	LCG.CESNET.cz	1.4%	... plus 18 more	

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KEKCC

- Macchine e personale di una ditta esterna
 - Contratto di 4 anni, dopodichè si azzera tutto e si ricomincia
 - Importanti rigidità nel sistema, costi significativamente più alti dei nostri.
- Nuovo contratto nel 2016 con incremento di risorse (e di costi).
 - Possibile downtime di KEKCC fino a 2 mesi
 - Necessità di duplicare all'esterno di KEKCC i servizi essenziali al funzionamento del computing
 - Scelta strategica da fare comunque
- Stiamo facendo pressione su KEK per passare ad un modello di management di KEKCC più razionale
 - Dopo reazione iniziale negativa, ci sono ora segnali di apertura
 - Memo con confronto dei costi di gestione di KEKCC, CNAF, GridKa, PNNL in preparazione

Stima delle Risorse

- Sequenza:
 - Stima preparata e approvata dal CSG di Belle II
 - Review interna
 - Approvata dall'Exec Board
 - Approvata dal BPAC
 - Review esterna, G. Carlino per l'INFN
- A febbraio 2015 il BPAC ha fatto alcuni rilievi a cui e' stata data una risposta ufficiale in un memo solo a luglio.
 - I numeri che seguono sono stati approvati da CSG ed Exec Board
 - Sono stati inviati al BPAC a luglio, siamo in attesa di una risposta
- Di seguito mostro solo il risultato, i dettagli su come si e' pervenuti ad esso sono nelle slides di backup

Total Resources for 2016-2018

Year	CPU (kHEPSpec06)	Tape (TB)	Disk (TB)
2016	226	1039	4098
2017	310	3013	8476
2018	357	5373	9122

To be shared according to PhD count
Tape storage only at KEK and PNNL

Italian Share (12.5%) for 2016-2018

Year	CPU (kHEPSpec06)	Tape (TB)	Disk (TB)
2016	28		512
2017	39		1060
2018	45		1140

- Al CNAF abbiamo 5 kHEPSpec + 150 TB
- Nei siti ReCaS:
 - 13 kHEPSpec + 800 TB accesso esclusivo
 - Accesso ad altre 21 kHEPSpec accesso condiviso
- Non abbiamo bisogno di risorse aggiuntive per il 2016

Cost of Italian Share

	2016	2017	2018
CPU (kHEPSpec)	0	11	6
CPU (kEuro)	0	150	80
Disk (TB)	0	100	100
Disk (kEuro)	0	25	25
Total Cost	0	175	105

The CPU and disk amounts in the table are the ones that need to be added each year to the existing ones

Next Steps

- Extend the resource estimate until 2024
 - Goal is to have it approved by February 2016 BPAC
- Prepare a multi-lateral MoU on computing resources
 - Goal is to have it signed by the end of 2016
- The INFN approves the model for the Belle II computing infrastructure in Italy
 - CNAF + Federation of Tier2 (Napoli-Recas, Pisa, Torino)
 - A memo has been circulated on July 2014, needs to be updated with the new resource estimates
 - Goal is to present the updated memo around March 2016 and have the approval by July 2016

Attività 2016

- Fornire il 12.5% delle risorse hardware necessarie alla collaborazione
- Produrre il 12.5% di eventi MC
- Aprire la Cloud di Torino a Belle II
 - Storicamente a Torino c'è una cloud di BES III
 - Resp. M. Maggiore che dal 2016 diventa anche membro di Belle II
 - Accesso opportunistico fino a quando non ci saranno risorse finanziate a Belle II
 - Evidente sinergia tra i due esperimenti
- Vorremmo coinvolgerci nello sviluppo del middleware dell'esperimento
 - Necessario identificare il manpower

Richieste 2016: Hardware

- Non e' necessario acquisire nuovo hardware per fornire la nostra quota di risorse per il 2016
- Pero' vorremmo esplorare la possibilita' di anticipare al 2016 alcune risorse che dovremo acquisire comunque nel 2017

Richieste 2016: anticipo dal 2017

- Con riferimento alla tabella di pag. 8, nel 2017 ci serviranno 11 kHEPSpec e 500 TB in piu' (in parte gia' disponibili)
 - Di questi vorremmo installare 6 kHEPSpec e 100 TB (non 200 TB come nei preventivi) a Torino
 - Per avere risorse "Belle II" nella cloud
 - Il resto pensiamo di chiederlo per il CNAF
- Proponiamo di anticipare al 2016: 6 kHEPSpec (80 kEuro) e 100 TB (25 kEuro) da installare a Torino
 - Da mettere nella tasca e valutare a luglio 2016
 - L'acquisto si farebbe a fine 2016, facendo un'unica gara con il potenziamento del Tier2 di Alice
 - Permetterebbe di avere la cloud di To in modalita' produzione da inizio 2017

Richieste 2016: missioni

- Coordinamento:
 - Responsabile Networking Europa (Pardi): 5 kEuro
 - Coordinamento Computing Italia, chair Computing Steering Group, Regional Coordinator for Europe (Bianchi): 10 kEuro
- Partecipazione workshop software/computing:
 - 1 WS di 5 gg a PNNL (costo stimato 2.7 kEuro) + 2 gg attaccati ad un collaboration meeting a KEK (0.3 kEuro), totale 3 kEuro
 - L'anno scorso non e' stato finanziato rendendo la partecipazione estremamente limitata
 - I workshop sono per il software/computing cio' che i test beam sono per i detector
- La richiesta e' di finanziare la partecipazione di 11 persone a questi workshop (suddivisione come da preventivi)
 - E' inclusa la partecipazione di persone attive nello sviluppo del software e dei tool di fisica
 - Non sono incluse le persone con ruoli di coordinamento.

Backup

SuperKEKB Schedule

- 2016:
 - Phase 1 commissioning of the machine (mid Jan to mid May)
 - Cosmic data taking (Sept to Nov)
- 2017:
 - Phase 2 commissioning of the machine with Beast detector (mid May to mid January 2018)
- 2018:
 - Cosmic data taking (mid Jul to mid Oct)
 - Physics data taking (mid Oct to mid Dec)

Assumptions

- Reconstruction 45 HEPSpec s/event
- Simulation (generation + reconstruction) 89 HEPSpec s/event
- Phase 1 Background Simulation 4.5 HEPSpec s/event
- Phase 1 Background Analysis 2.25 HEPSpec s/event
- Phase 2 Background Simulation 45 HEPSpec s/event
- Phase 2 Background Analysis 22.5 HEPSpec s/event
- Cosmic Processing: assume 10 kHEPSpec for 3.5 months
- Cosmic Analysis: assume 10 kHEPSpec for 3.5 months
- Phase 2 raw data simulation: 55 HEPSpec s/event
- Raw data size: 300 kB/event
- mDST size: 40 kB/event
- Skim size: 40 kB/event
- User data size: 4 kB/event
- 10 months/year of useful production
 - Site downtime, software bugs that require restart of production, operational mistakes, etc

Activities in 2016 (1)

- Requested by Physics Groups:
 - 5 ab^{-1} generic MC production (+ skimming + analysis)
 - ~ 5 times integrated luminosity of first year of data taking
 - BaBar final MC sample is 10 times integrated luminosity
 - 20 ab^{-1} -equivalent B Rare Decay MC
 - Decay with missing energy sensitive to New Physics
 - 20 ab^{-1} -equivalent Btag-skim (skim at generator level + processing)
 - For studies of modes with missing energy on the recoil of a fully reconstruct B
 - 0.3 ab^{-1} scan & non 4S
 - Quarkonia studies and search for dark sector particles
 - 0.1 ab^{-1} $ee(\gamma)$, $eeee$, $ee\mu\mu$
 - Important for calibrations and physics background studies

Activities in 2016 (2)

- Requested by Background Group (~60 s of bkg data):
 - 2.4×10^{10} Phase 1 background events (MC prod + analysis)
 - 2.4×10^{10} Phase 2 (Beast) background events (MC prod + analysis)
- Cosmic Data (processing + analysis)
 - 3 month at 100 Hz trigger rate: 7.8×10^8 events
- 0.5 ab^{-1} Phase 2 (Beast) raw data simulation (to be processed in early 2017 to test processing of Phase 2 detector data)

Resource Estimate 2016 (1)

Data Sample	Events ($\times 10^9$)	CPU (KHEPSpec06)	Tape (TB)	Disk (TB)
5 ab^{-1} generic MC Production	28.50	98.00		1087.19
20 ab^{-1} rare B decay	0.33	1.15		12.58
0.3 ab^{-1} scan & non 4S	1.71	5.90		65.23
0.1 ab^{-1} $ee(\gamma)$, $eeee$, $ee\mu\mu$	2.00	6.90		76.29
20 ab^{-1} B tag skim (generator level) MC	2.31	7.95		88.12
5 ab^{-1} generic skimming	28.50	24.50		1087.19
5 ab^{-1} generic analysis	28.50	24.60		108.72

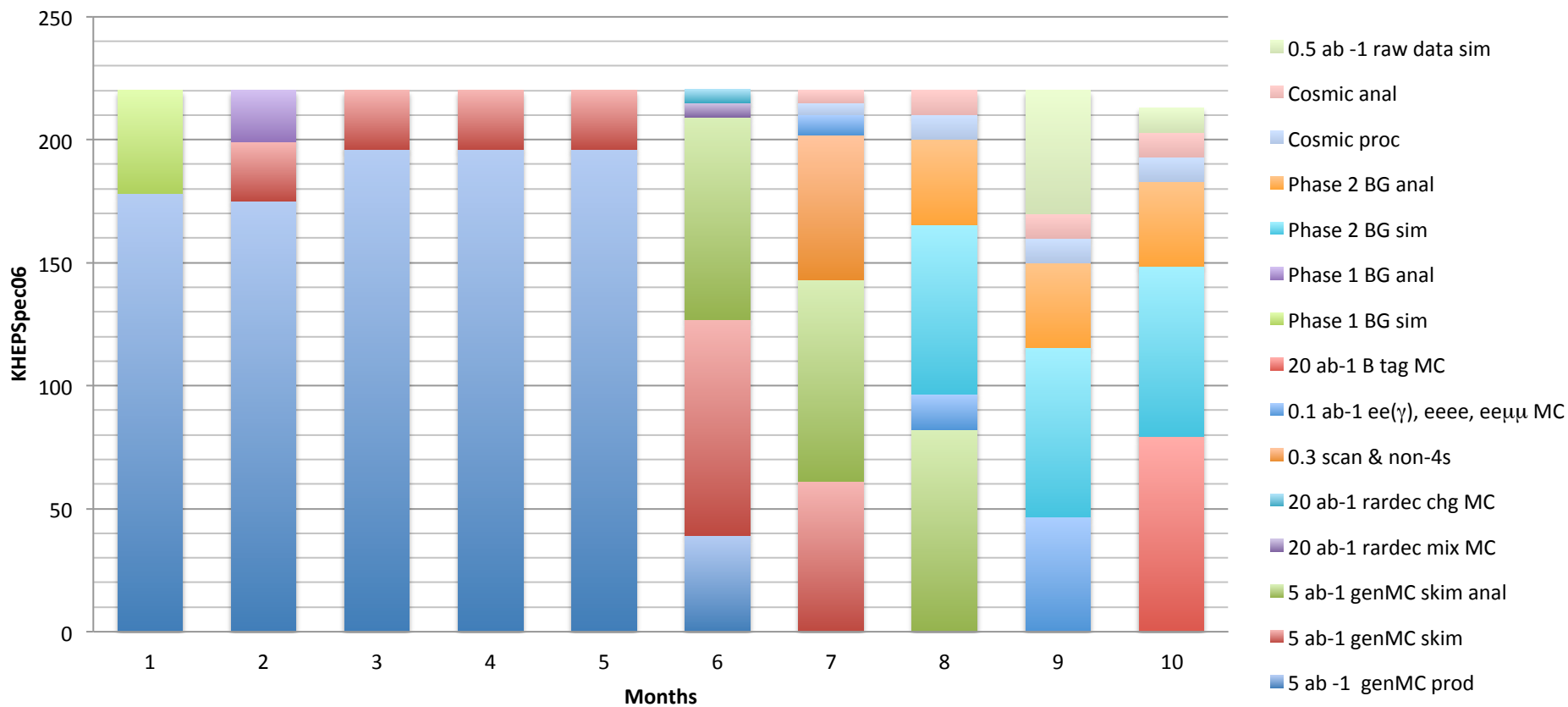
Resource Estimate 2016 (2)

Data Sample	Events ($\times 10^9$)	CPU (KHEPSpec06)	Tape (TB)	Disk (TB)
Phase 1 BG simulation	24.00	4.20		915.33
Phase 1 BG analysis	24.00	2.10		91.5
Phase 2 (Beast) BG simulation	12.00	20.70		457.76
Phase 2 (Beast) BG analysis	12.00	10.35		45.78
Cosmic data	0.78		223.16	
Cosmic Processing		3.50		29.75
Cosmic MC		3.50		29.75
Cosmic analysis		7.00		2.98
0.5 ab-1 (Beast) Raw Data Simulation	2.85	6.00	815.39	

Resource Estimate 2016

- Gran Total:
 - CPU: 226.35 kHEPSpec to be used for 10 months
 - Tape storage: 1038.55 TB
 - Disk Storage: 4098.17 TB

Time Profile of CPU Usage 2016



Activities in 2017

- Recreate the MC sample requested by Physics Groups for 2016:
 - Improved software.
 - Keep 2016 sample for comparison.
- 0.5 ab⁻¹ Phase 2 (Beast) raw data processing (simulated at the end of 2016)
- Requested by Background Group (~60 s of bkg data):
 - 2.4x10¹⁰ Phase 2 (Beast) background events (MC prod + analysis) with detector constant from Phase 2 data taking
 - Keep 2016 BG simulation data for comparison
- Phase 2 (Beast) data:
 - Process + reprocess + skim + analyze detector data
 - Produce + skim + analyze MC data (4 x Det Data)
- 1 ab⁻¹ raw data processing rehearsal for 2018 Physics Run data
 - get raw data from 5 ab⁻¹ generic MC production
 - Process and reprocess the data sample

Resource Estimate 2017 (1)

Data Sample	Events ($\times 10^9$)	CPU (KHEPSpec06)	Tape (TB)	Disk (TB)
5 ab^{-1} generic MC Production	28.50	98.00		1087.19
20 ab^{-1} rare B decay	0.33	1.15		12.58
0.3 ab^{-1} scan & non 4S	1.71	5.90		65.23
0.1 ab^{-1} $ee(\gamma)$, $eeee$, $ee\mu\mu$	2.00	6.90		76.29
20 ab^{-1} B tag skim (generator level) MC	2.31	7.95		88.12
5 ab^{-1} generic skimming	28.50	24.50		1087.19
5 ab^{-1} generic analysis	28.50	24.60		108.72

Resource Estimate 2017 (2)

Data Sample	Events ($\times 10^9$)	CPU (KHEPSpec06)	Tape (TB)	Disk (TB)
Phase 2 (Beast) BG simulation	24.00	41.40		915.33
Phase 2 BG (Beast) analysis	24.00	20.70		91.50
0.5 ab^{-1} Phase 2 MC raw data processing	2.85	5.00		108.72
1 ab^{-1} generic MC raw data storage (Phys Run rehearsal)	5.7		1630.78	
1 ab^{-1} generic MC raw data process + reproces (Phys Run rehearsal)	5.7	39.60		434.88

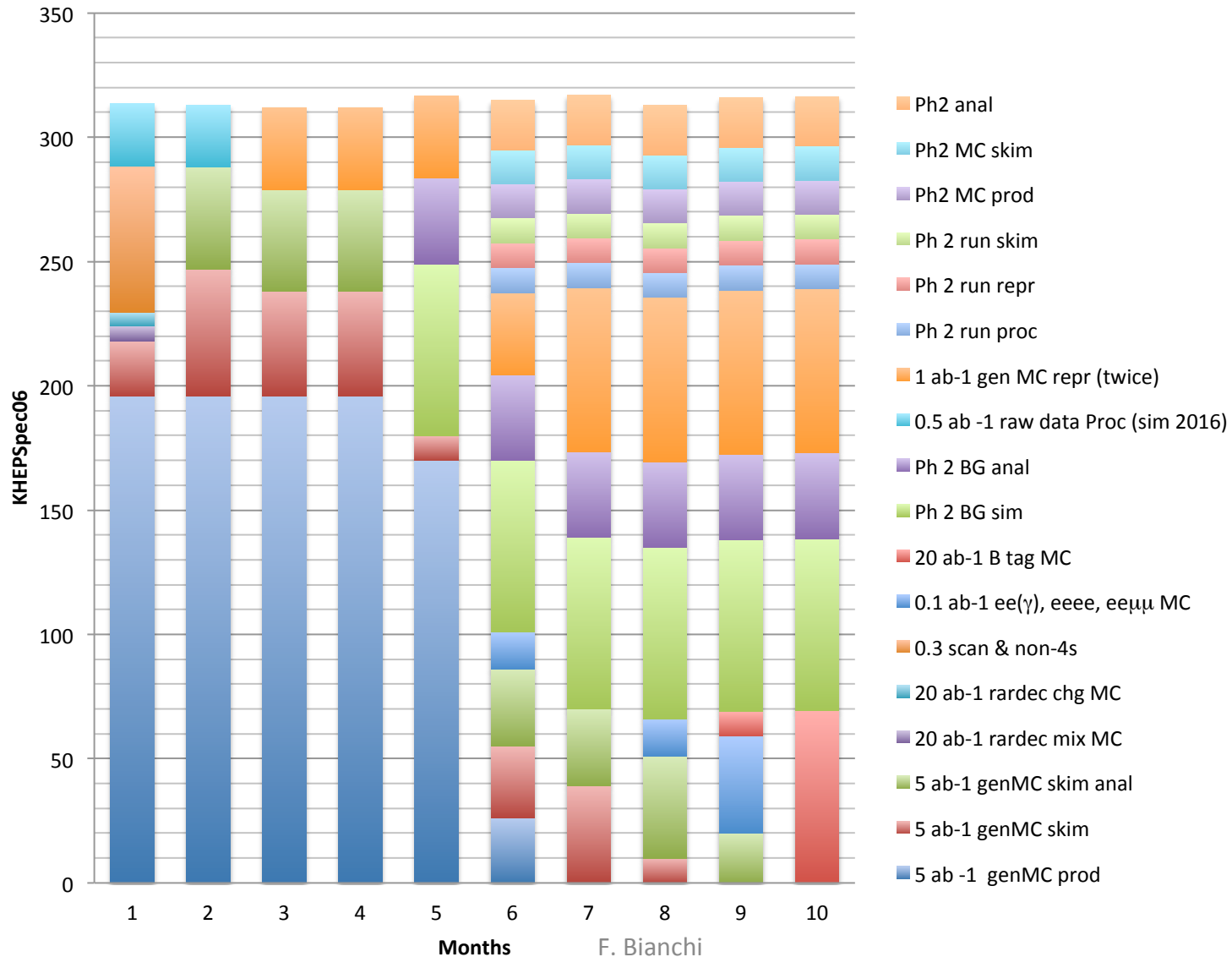
Resource Estimate 2017 (3)

Data Sample	Events ($\times 10^9$)	CPU (KHEPSpec06)	Tape (TB)	Disk (TB)
Phase 2 (Beast) run raw data storage	1.20		343.32	
Phase 2 (Beast) run Raw data processing	1.20	5.00		45.78
Phase 2 (Beast) run Raw data reprocessing	1.20	5.00		45.78
Phase 2 (Beast) run Detect data skim	1.20	5.00		45.78
Phase 2 (Beast) run MC production	2.00	6.85		76.28
Phase 2 (Beast) run MC skim	2.00	6.85		76.28
Phase 2 (Beast) run (Det + MC) analysis	3.20	6.00		12.21

Resource Estimate 2017

- Gran Total:
 - CPU: 310.4 kHEPSpec to be used for 10 months
 - Tape storage: 1974.10 TB (2017) + 1038.55 TB (to be kept from 2016) = 3012.65
 - Disk Storage: 4377.85 TB (2017) + 4098.17 TB (to be kept from 2016) = 8476.02 TB

Time Profile of CPU Usage 2017



Activities in 2018 (1)

- Recreate the MC sample requested by Physics Groups for 2016 and 2017:
 - Improved software.
 - Keep 2017 sample for comparison. Delete 2016 sample
- Requested by Background Group (~60 s of bkg data):
 - 2.4×10^{10} Phase 2 (Beast) background events (MC prod + analysis) with detector constant from Phase 2 data taking
 - Keep 2017 BG simulation data for comparison. Delete 2016 sample
- Phase 2 (Beast) data:
 - Reprocess + skim + analyze detector data with improved software and constants
 - Re-produce + skim + analyze MC data with improved software and constants
 - Keep 2017 data for comparison
- 1.5 ab^{-1} raw data processing rehearsal for 2018 Physics Run data
 - get raw data from 5 ab^{-1} generic MC production
 - Process and reprocess the data sample

Activities in 2018 (2)

- Cosmic Data (processing + analysis)
 - 3 month at 100 Hz trigger rate: 7.8×10^8 events
- Physic run data:
 - Process + reprocess + skim + analyze detector data
 - Produce + skim + analyze MC data (4 x detector data)

Resource Estimate 2018 (1)

Data Sample	Events ($\times 10^9$)	CPU (KHEPSpec06)	Tape (TB)	Disk (TB)
5 ab^{-1} generic MC Production	28.50	98.00		1087.19
20 ab^{-1} rare B decay	0.33	1.15		12.58
0.3 ab^{-1} scan & non 4S	1.71	5.90		65.23
0.1 ab^{-1} $ee(\gamma)$, $eeee$, $ee\mu\mu$	2.00	6.90		76.29
20 ab^{-1} B tag skim (generator level) MC	2.31	7.95		88.12
5 ab^{-1} generic skimming	28.50	24.50		1087.19
5 ab^{-1} generic analysis	28.50	24.60		108.72

Resource Estimate 2018 (2)

Data Sample	Events ($\times 10^9$)	CPU (KHEPSpec06)	Tape (TB)	Disk (TB)
Phase 2 (Beast) BG MC analysis	24	21.20		91.5
1.5 ab^{-1} generic MC raw data storage (Phys Run rehearsal)	8.55		2446.17	
1.5 ab^{-1} generic MC raw data process + reprocess (Phys Run rehearsal)	8.55	29.60		652.30
3 ab^{-1} MC challenge in parallel with reprocessing rehearsal	17.10	58.80		652.30
Cosmic Run Processing		3.50	223.16	29.75
Cosmic Run MC		3.50		29.75
Cosmic Run Analysis		7.00		5.90

Resource Estimate 2018 (3)

Data Sample	Events ($\times 10^9$)	CPU (KHEPSpec06)	Tape (TB)	Disk (TB)
Phase 2 (Beast) run Raw data reprocessing	1.20	3.00		45.78
Phase 2 (Beast) run Detect data skim	1.20	2.00		45.78
Phase 2 (Beast) run MC production	2.00	6.85		76.28
Phase 2 (Beast) run MC skim	2.00	3.44		76.28
Phase 2 (Beast) run (Det + MC) analysis	3.20	12.00		12.21

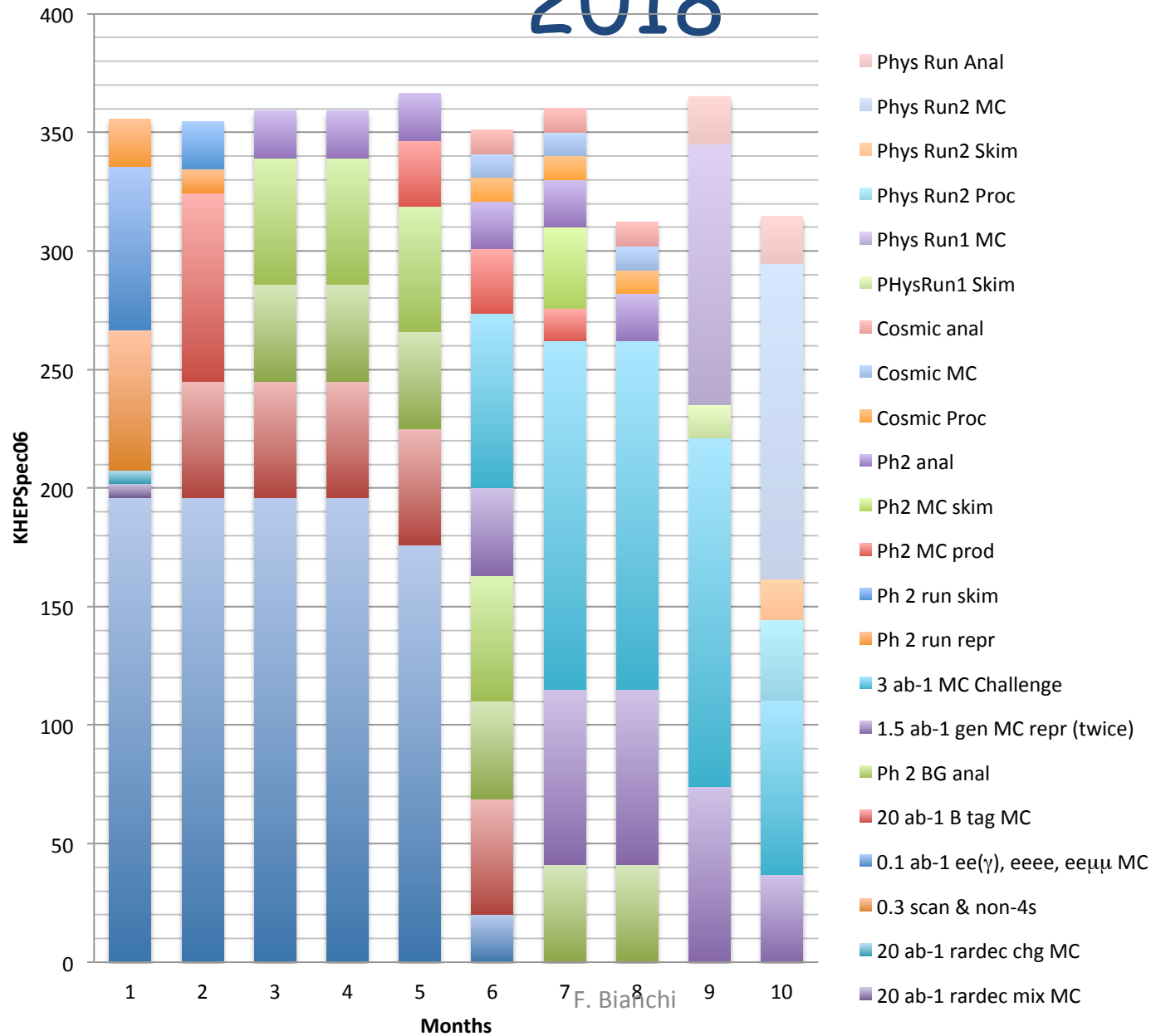
Resource Estimate 2018 (4)

Data Sample	Events ($\times 10^9$)	CPU (KHEPSpec06)	Tape (TB)	Disk (TB)
Phys Run Month 1 processing	0.80	2.80		30.52
Phys Run Month 1 skimming	0.80	1.40		30.52
Phys Run Month 1 MC	3.20	11.00		122.07
Phys Run Month 2 processing	0.97	3.40		37.00
Phys Run Month 2 Skimming	0.97	1.70		37.00
Phys Run Month 2 MC	3.88	13.00		148.01
Phys Run Raw Data Storage	1.77		506.40	
Phys Run Analysis (Data and MC)	8.85	4.00		33.76

Resource Estimate 2018

- Gran Total:
 - CPU: 357.19 kHEPSpec to be used for 10 months
 - Tape storage: 3175.73 TB (2018) + 1974.10 TB (to be kept from 2017) + 223.16 TB (cosmic data of 2016) = 5372.99 TB
 - Disk Storage: 4682.03 TB (2018) + 4377.85 TB (to be kept from 2017) + 62.48 TB (cosmic data of 2016) = 9122.36 TB

Time Profile of CPU Usage 2018



Sharing between Countries

Country	fraction 2016 (%)
Australia	2.91
Canada	2.91
Poland	2.03
Germany	13.01
India	3.20
Russia	8.14
China	2.62
Taiwan	2.91
KEK	22.31
Korea	4.94
Italy	12.43
Czech	1.16
Slovenia	2.33
Turkey	0.58
Ukraine	0.58
USA	14.46
Austria	1.74
Mexico	1.74
Total	100.00