

INFN-CNAF

And my activities there

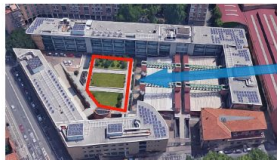
Stefano Dal Pra
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The INFN-CNAF

- INFN-CNAF: the national center of INFN (Italian Institute for Nuclear Physics) dedicated to Research and Development on Information and Communication Technologies

<https://www.cnaf.infn.it/en>

- CNAF hosts the Italian Tier-1 data center for the high-energy physics experiments at the Large Hadron Collider in Geneva
- CNAF is one of the most important centres for distributed computing in Italy
- It is currently located close to the Bologna city centre
- Co-located with the Physics department of the Bologna University



May 2023

CNAF: Born as “National Center for Framework Analysis” (1962) is the main data processing and computing technology research center of INFN

- ~ 80000 CPU cores (1.2M HEPSCORE)
- ~ 60 PB online disk
- ~ 130 PB tape

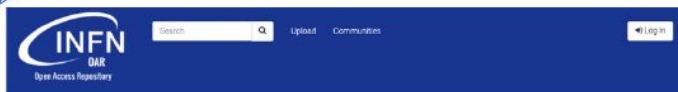
Several partnerships, BI-REX Competence Center among the relevant ones on Technology Transfer



May 2024

INFN Open Access Repository - OAR

<https://www.openaccessrepository.it/>



Latest entries

September 30, 2023 [PDF] Technical note Open Access

Top Quark Pair Production in Association with a Jet with NLO QCD Off-Shell Effects at the Large Hadron Collider

Bonifazi, G., J. Hachimi, H. B. Khaw, M. J. Worak, M.

We present a complete description of top quark pair production in association with a jet in the dijet channel. Our calculation is accurate to next-to-leading order in QCD (NLO) and includes all non-resonant diagrams, interferences and off-shell effects of the top quark. Moreover, non-resonant...

Uploaded on August 29, 2023

October 16, 2023 [PDF] Technical note Open Access

Breve storia della ricerca delle oscillazioni nei neutrini solari ed atmosferici fino al 1996, con particolare riguardo all'esperimento MACRO

Ronga, F.

Comunemente si tende a indicare il 1998 come anno della scoperta delle oscillazioni di neutrino. In realtà la storia è molto più complessa ed è durata circa 30 anni. Durante questi anni si è visto inoltre un dibattito spesso acceso sulla mancanza dei neutrini elettronici provenienti dal sole e...

Uploaded on August 29, 2023

October 07, 2023 [PDF] Technical note Open Access

Relatività Speciale: Esercizi e Complementi

Bonifazi, G.

Questa nota fa parte di una serie di dispense distribuite durante il corso "Incontri di Fisica Moderna", rivolto ai docenti di Matematica e Fisica dei Licei Scientifici. Il corso si è svolto, presso i Laboratori Nazionali di Frascati, nel periodo Novembre 2019 - Maggio 2020, ed è costituito da...

Uploaded on August 29, 2023

December 22, 2023 [PDF] Technical note Open Access

Fiber Bragg Grating (FBG) sensors as flatness and mechanical stretching sensors

Bonifazi, L. et al.

A novel approach which uses Fiber Bragg Grating (FBG) sensors has been utilized to assess and monitor the flatness of Gaseous Electron Multiplier (GEM) foils. The setup layout and preliminary results are presented.

Uploaded on August 29, 2023

January 16, 2024 [PDF] Technical note Open Access

La Realtà Quantistica

Bonifazi, G., Marzotto, M.

Questa nota fa parte di una serie di dispense distribuite durante il corso "Incontri di Fisica Moderna", rivolto ai docenti di Matematica e Fisica dei Licei Scientifici. Il corso si è svolto, presso i Laboratori Nazionali di Frascati, nel periodo Novembre 2019 - Maggio 2020, ed è costituito da...

Uploaded on August 29, 2023

INFN Open Access Repository at a glance

- **Research, Shared.** — all research outputs from across all domains of INFN research are welcome
- **Flexible, Citable, Discoverable.** — each upload gets a Digital Object Identifier (DOI) to make it easily and uniquely citable. You can (automatically) link your research outputs to your ORCID profile
- **Communities.** — create and curate your own community for a workshop, project, Division, Laboratory, service, journal, etc. into which you can accept incoming uploads
- **Funding.** — you can associate an upload to the grant that has funded the work
- **Flexible licensing.** — you can choose among several licenses. You can also upload closed or embargoed research outputs

Tweets from @INFN_

Torna l'appuntamento con il @SciMatInItaly. Per l'occasione domani alle 19:00 l'INFN sarà in diretta su YouTube con un contest in cui quattro candidati di materia oscura si sfideranno e il pubblico voterà quale tra questi è il più affascinante. youtu.be/pjyCeb75ue0

Per l'occasione domani alle 19:00 l'INFN sarà in diretta su YouTube con un contest in cui quattro candidati di materia oscura si sfideranno e il pubblico voterà quale tra questi è il più affascinante. youtu.be/pjyCeb75ue0



WHAT IS

Based on Zenodo and Invenio, open source software developed by CERN



WHO USES IT

INFN researchers and staff, other agencies (ISPRa, AISA, CoPER, etc.)

WHAT YOU CAN DEPOSIT

All file formats (publications, data, software, images, etc.)

OAR migration to InvenioRDM

**CURRENT VERSION: INVENIO
FRAMEWORK V3**



**ONGOING MIGRATION TO
INVENIO RDM V11 BY CNAF**

(released in January
2023) where it will become
national service

Update: RDM V12

Slide credits: Irene Piergentili, GLOS Group

Invenio RDM - News

CONTROLLED VOCABULARIES

Allow auto-completion of the fields

- **Affiliations** (entity name)
- **Names** (authors)
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- **Users** (verification and approval of user profiles)

ROR (RESEARCH ORGANIZATION REGISTRY)

Unique identifier for institutions, under the
funders.identifiers field in the institutions vocabulary

METADATA ONLY RECORDS

COMMUNITIES MANAGING

Community curators can also **edit records** (since v9)

Published May 6, 2024 | Version v1

Enabling INFN–T1 to support heterogeneous computing architectures

Dal Pra, Stefano¹  ·
 Spiga, Daniele²  ·
 Boccali, Tommaso³  ·
 Chierici, Andrea¹  ·
 Morganti, Lucia¹  ·
 Sapunenko, Vladimir¹  ·
 Cesini, Daniele¹  ·
 Rinaldi, Lorenzo⁴  ·
 Gregori, Daniele⁵  ·
 Cicala, Marco⁵ 

Hide affiliations

-  National Center for Frame Analysis
-  INFN Sezione di Perugia
-  INFN Sezione di Pisa
-  INFN Sezione di Bologna
- E4 Computer Engineering SPA

Citation

Style APA ▾

Dal Pra, S., Spiga, D., Boccali, T., Chierici, A., Morganti, L., Sapunenko, V., Cesini, D., Rinaldi, L., Gregori, D., & Cicala, M. (2024).
 Enabling INFN–T1 to support heterogeneous computing architectures.

Description

The INFN–CNAF Tier-1 located in Bologna (Italy) is a center of the WLCG e-Infrastructure providing computing power to the four major LHC collaborations and also supports the computing needs of about fifty more groups - also from non HEP research domains. The CNAF Tier1 center has been historically very active putting effort in the integration of computing resources, proposing and prototyping solutions both for extension through Cloud resources, public and private, and with remotely owned sites, as well as developing an integrated HTC+HPC system with the PRACE CINECA supercomputer center located 8Km far from the CNAF Tier-1 located in Bologna. In order to meet the requirements for the new Tecnopolo center, where the CNAF Tier-1 will be hosted, the resource integration activities keep progressing. In particular, this contribution will detail the challenges that have recently been addressed, providing opportunistic access to non standard CPU architectures, such as PowerPC and hardware accelerators (GPUs). We explain the approach adopted to both transparently provision x86_64, ppc64le and NVIDIA V100 GPUs from the Marconi 100 HPC cluster managed by CINECA and to access data from the Tier1 storage system at CNAF. The solution adopted is general enough to enable seamless integration of other computing architectures at the same time from different providers, such as ARM CPUs from the TEXTAROSSA project, and we report about the integration of these within the computing model of the CMS experiment. Finally we will discuss the results of the early experience.

Files

epjconf_chep2024_11006.pdf

Page: 1 of 9

Automatic Zoom

EPJ Web of Conferences **295**, 11006 (2024)

https://doi.org/10.1051/epjconf/202429511006

CHEP 2023

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Versions

Version v1

May 6, 2024

Details

Resource type

Journal article

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JSON

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Metadata enrichment:

- add ORCID when possible,
- normalize affiliations
- add ROR



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10

10 result(s) found

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Draft

January 31, 2022 (v1)

Dataset


Metadata-only


Edit

CovidStat project data

Menasce, Dario ; Mezzetto, Mauro; Pedrini, Daniele 

This record contains the daily updated data of the CovidStat project. CovidStat is a project carried out by the CovidStat Working Group at INFN, whose creation was promoted within the Italian National Institute of Nuclear Physics with the aim of making a statistical analysis of the data provided daily by the Civil Protection on the spread of the...

Uploaded on May 17, 2024

3


Draft

November 12, 1985 (v1)

Technical note


Metadata-only


Edit

Ottimizzazione della risoluzione energetica per un fascio γ di backscattering di luce laser da un fascio di elettroni

Preger, M.

La distribuzione energetica di un fascio di fotoni di alta energia ottenuti dallo scattering a $\sim 180^\circ$ di fotoni laser su di un fascio di elettroni di un anello dipende essenzialmente: 1) dall'angolo solido definito dal collimatore sul fascio γ ; 2) dalla distribuzione in energia degli elettroni; 3) dalla distribuzione degli angoli delle traiettor...

Uploaded on May 17, 2024

**Astrophysical sources emitting GW signals detectable by LIGO and Virgo
(10-2000 Hz)**

**CBC: Coalescence of binary
system of neutron stars and/or stellar-mass
black-hole**



Matched-filter
Modeled searches

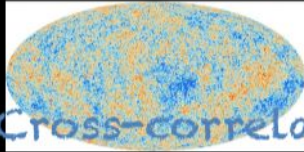


**Burst: Core-collapse of
massive stars**



Unmodeled searches

CW: Isolated or binary neutron-star



Cross-correlations

Stochastic Background



FFT based and hierarchical searches



Slide credits: Pia Astone,
INFN-Roma1

FRAMEWORK

Frequency-Hough (FH) analysis is an all-sky search for continuous-wave signals, developed by the Virgo Rome group. For the O3 run, INFN-CNAF infrastructures were used in order to carry out the analysis. Starting with O4a, the computing workflow has been adapted to integrate with the IGWN community computing centers. Detectors data are stored in the Band-Sampled Data (**BSD**) database, and analyzed through a **MATLAB** software.

8 input parameters for each job:

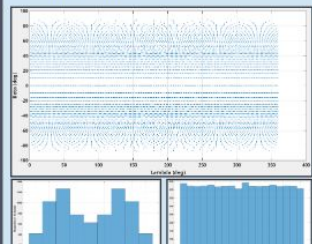
- Frequency interval (f , Δf)
- Sky section ($\lambda_{\min}$, $\lambda_{\max}$, $\beta_{\min}$, $\beta_{\max}$)
- Spin-down (SD) interval ($SD_{\min}$, $SD_{\max}$)

For a fixed sky section, each job has a number of **skypoints** to analyze. Each job produces in output a **candidates** file, which will undergo the coincidences veto and further analysis and follow-up.

PARAMETERS SPACE SPLIT

Sky section:

Skypoints are evenly distributed in λ (longitude) but not in β (latitude); β is split into 9 intervals of 20 degrees each, while λ is split in such a way that a job must contain roughly **2000 skypoints**, in order to have a fixed duration for each job.



PROBLEMS TO FACE

The adaptation of the workflow to launch jobs on **IGWN sites** requires some changes:

- **Runtime**: up to 12 days for CNAF, while for IGWN it can be at **most 3 days**. It is unknown *a priori* and it linearly depends on the number of skypoints ($\sim \mathcal{O}(10^6)$ total) and on the WN where the job will run. We deployed a linear skypoints estimator depending on frequency and sky section to have jobs of similar duration (~ 2 days on slowest WNs).
- **BSD files & MATLAB Runtime Library**: at CNAF, directly accessed via local shared filesystem (GPFS) $\rightarrow$ for IGWN, accessed via **CVMFS**.
- **Output file**: saved on local storage for CNAF $\rightarrow$ for IGWN, transferred to CNAF storage via **gfal-copy**.

IGWN COMPUTING CAMPAIGN

The IGWN campaign started at full capacity from August 2024; we report the results obtained in the last month (12/08 – 11/09).



- **Computed skypoints**: $\sim 5.5 \times 10^8$. In the upper panel, we report the mean speed of each site (without distinction on their own machines), expressed in skypoints per hour.
- **Completed jobs**: $\sim 370,000$. In the middle panel, we report the number of completed jobs for each IGWN site.
- **Runtime**: a total of $\sim 10^6$ core hours for completed jobs, with a percentage of $\sim 93\%$ with respect to the total runtime including failed jobs. In the lower panel, we report the efficiency of each site.

JOBS DATABASE

Jobs to be submitted are fetched from a PostgreSQL table consisting of roughly 3.2 millions of tuple. Jobs are submitted automatically through a script both on CNAF and IGWN sites and repeated for both the detectors (LL and LH). *Args* attribute encodes the 8 input parameters. Attributes *status* and *statush* worth 100 for completed jobs, 10 for submitted jobs and 0 for still unlaunched jobs. When the expected output file is present, the database is updated accordingly.

id	args	numtry	status	statush	statush
781696	886 1 -4e-09 -1e-09 -18 115 119	2	0	100	100
781703	886 1 -4e-09 -1e-09 -19 143 147	2	0	100	100
781713	886 1 -4e-09 -1e-09 -19 184 188	2	0	100	100
781695	886 1 -4e-09 -1e-09 -18 110 115	2	0	100	100
781731	886 1 -4e-09 -1e-09 -19 258 262	2	0	100	100

Jobs are launched in order of ascending frequency; up to now, jobs up to **840 Hz** have been completed.

- Redesign and generalize the computing workflow
- make job runtime predictable
- job failure resilient
- Automated job campaign execution



Developing Artificial Intelligence in the Cloud: The AI_INFN platform



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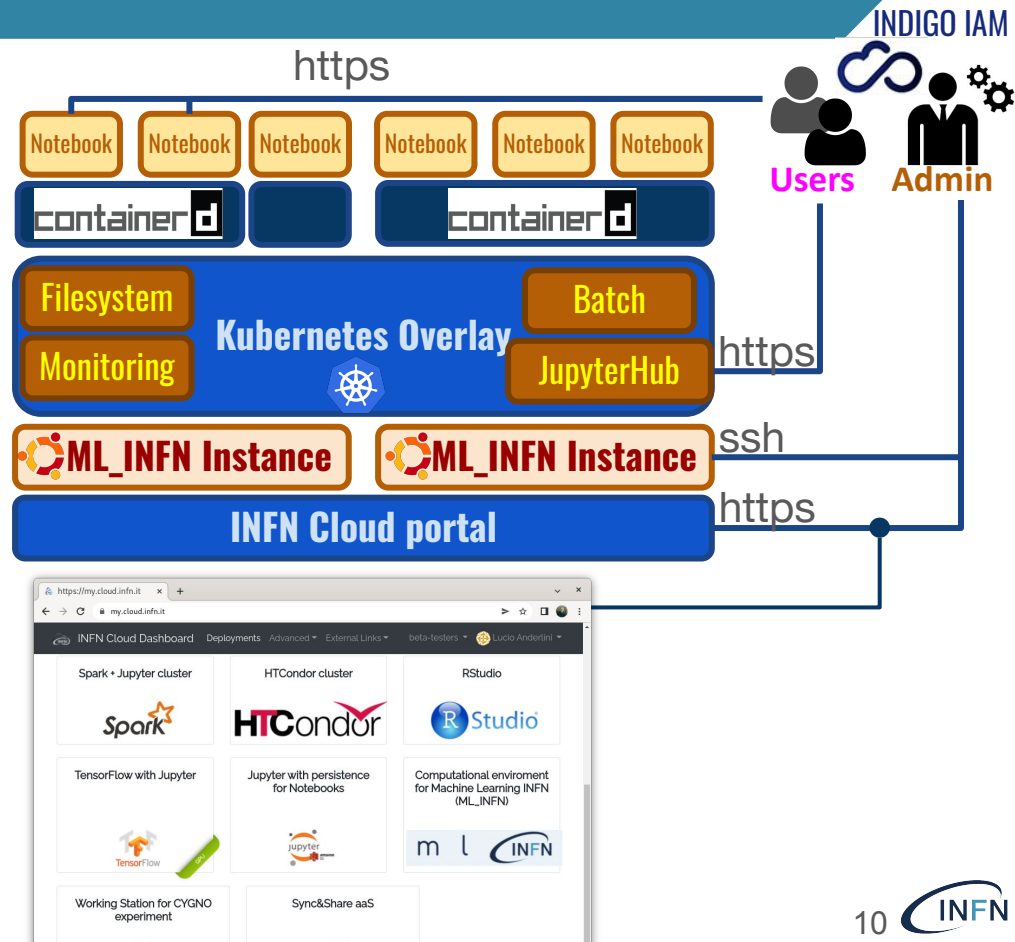
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INFN Cloud Resources: Architecture

- The ML_INFN outcome: **“sharing precious GPUs through the Cloud is feasible and effective!”**
- With **AI_INFN**, we improved on sharing by **decoupling data from computing resources**, with a **filesystem shared** across the VMs
- An additional abstract, elastic overlay is added on top of multiple VMs
Kubernetes Overlay:
 - login via AAI → **INDIGO IAM**
 - Monitoring & Accounting
 - Managed software environments for ML
- Adding and removing VMs enables manual horizontal scaling



WP3 - Community building and user support

First edition of the **AI-INFN User Forum**:

- <https://agenda.infn.it/event/40489>
- two-day event (11-12 June 2024) organized by CNAF
- 12 contributions, +30 participants

Agenda shaped by a **bottom-up approach**:

- INFN services enhancing: LLMs and other DL methods
- image segmentation (in medicine and muography)
- image analysis, processing for cultural heritage
- transformers for classification and analysis
- quantum machine learning
- FPGA benchmarking

New!!! First Advanced Hackathon, Nov 26-28, Padova

- <https://agenda.infn.it/event/43129/>

INFN has an active and collaborative AI community

1st AI-INFN User Forum

11-12 Jun 2024
Plesso Bert Pichat
Europe/Rome time zone

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Overview
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ai_infn_ws@lists.cnaif.in...



Welcome to the first edition of the **AI-INFN User Forum**, a two-day event (11-12 June 2024) to be held in Bologna, and aimed to collect and discuss scientific use cases involving machine learning techniques and hardware accelerator technologies (e.g., FPGAs, Quantum Computers) for INFN applications.

Take-home message

- similar use-cases in different domains
→ room for common toolkits
- great benefits from participation to [ML|AI]-INFN hackathons ([4th](#), [5th](#)).
- Need for renewing/expanding the [documentation](#)