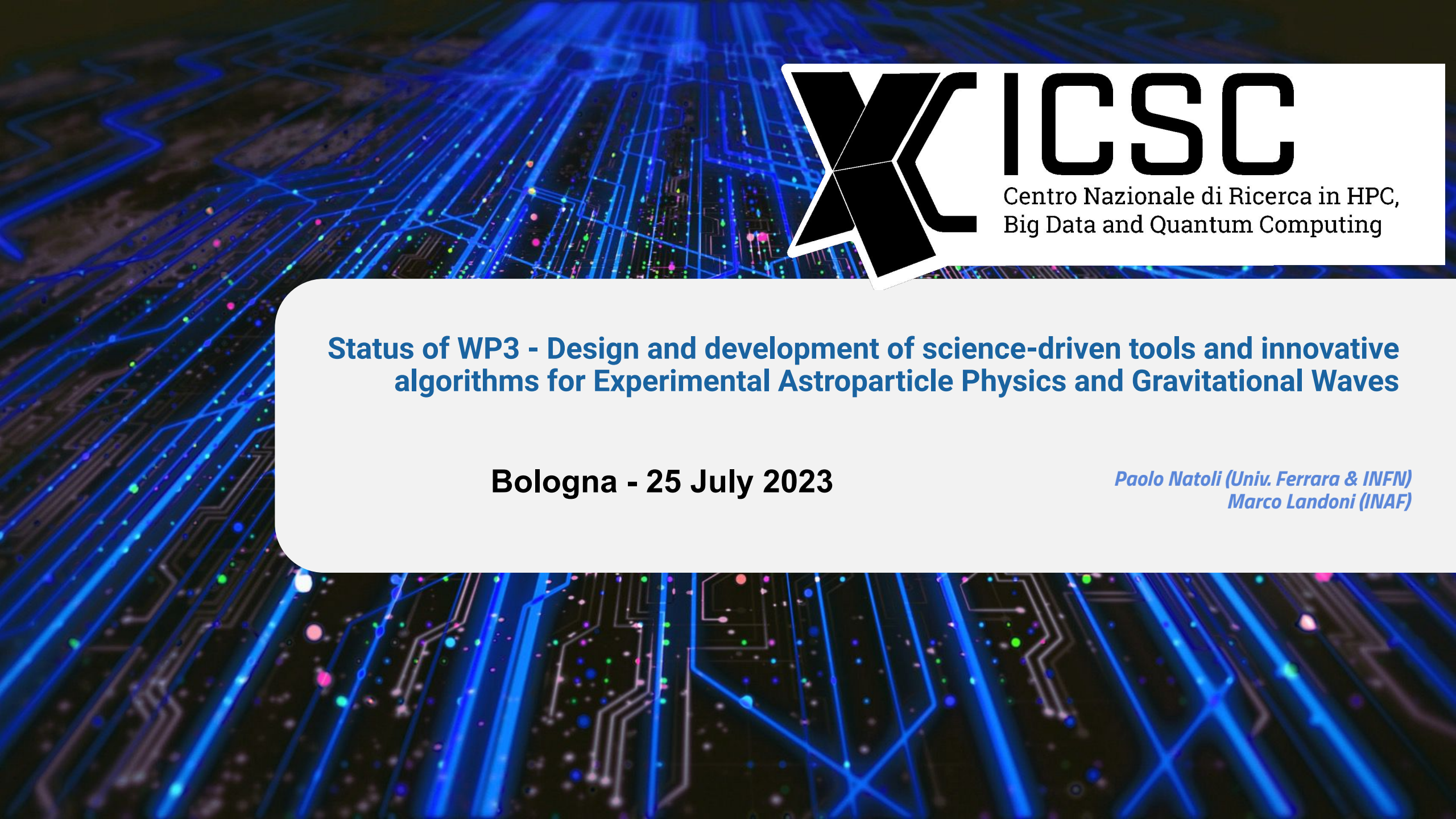

ICSC
Centro Nazionale di Ricerca in HPC,
Big Data and Quantum Computing

Status of WP3 - Design and development of science-driven tools and innovative algorithms for Experimental Astroparticle Physics and Gravitational Waves

Bologna - 25 July 2023

Paolo Natoli (Univ. Ferrara & INFN)
Marco Landoni (INAF)

Use cases statistics - Received up to now

We currently have 32 use cases received so far and 7 flagship UC

- Univ. Salento: 4
- UniCal: 3
- INFN: 4
- INAF: 7
- Federico II: 2
- UniMiB: 1
- UniBo: 2 (+1 announced)
- Univ. Firenze: 2
- Univ. Ferrara: 2
- Sapienza: 1
- Univ. Trieste: 1
- UniNa 1
- UniPd 1
- UniBa/PoliBa 1
- UniCT 1

No affiliate is now missing!

1. **Boosting the analysis of GW signals.**

Pia Astone - INFN Roma 1 - LIGO/VIRGO

Riccardo Buscicchio - MiB - LISA

Fabio Garufi - UniNa — GW+GRB

Edoardo Milotti - UniTS - VIRGO

Massimo Lenti - UNiFi (+UniUrb) VIRGO + ET

Francesco Pannarale - Sapienza - LIGO/VIRGO

Lorenzo Natalucci - INAF - GW transients and KN afterglow

Michele Moresco - UniBO - GW as dark sirens to estimate cosmological and population parameters

2. Analysis techniques for astroparticles and high energy photons

Alessio Tiberio - UniFi - GAPS / HERD
Antonio Pagliaro - INAF IASF Palermo - ASTRI/ JEM-EUSO
Lorenzo Perrone - UniSalento + INFN - Pierre Auger
Francesco Visconti - INAF OAR - IACT
Ciro Birongiari - INAF OAR - IACT
Francesco De Palma - UniSalento/INFN Le - DAMPE / HERD

Luca Zampieri - INAF OAPD - Interferometria Ottica con ASTRI/CTA

Elisabetta Bissaldi/Silvia Rainò/Nicola Fulvio Calabria - UniBa/Poliba - techniques for multimessenger and multiwavelength astrophysics

Gioacchino Anastasi + … - UniCT - ML techniques for event reconstruction in astroparticle experiments (Auger, Darkside,...)

3. Numerical Modelling for Earth and Space

Leonardo Primavera - UniCal - Turbulence in geophysics and heliosphere

Sergio Servidio - UniCal - Numerical GW and BH

Francesco Valentini - UniCal - Turbulence in space plasma

4. Pipeline optimization for space and ground based experiments

Roberto Peron - INAF - Pipelines for space gravity missions

Giuseppe Andronico - INFN CT - Pipeline for JUNO and similar experiments

Giovanni Mazzitelli - INFN LNF - Pipeline per CYGNO and similar experiments in CSN2

Valentina Fioretti - INAF - Simulation pipeline for GEANT4 with NASA COSI as a test bed

5. Optimization techniques in Astrophysics and Cosmology

Achille Nucita - UniSalento - EUCLID (LLO and SSO)

Maurizio Paolillo - UniNa - AGN from VST, LSST e/o JWST

Luca Pagano - UniFe - LiteBIRD Map Making

Luca Pagano/Thejs Brinckmann - UniFe - CMB Likelihood

Lorenzo Natalucci - INAF - Real time monitoring: LSST and HE streams

Giulia Despali - UniBo - Impact of warm and self-interacting dark matter on lensing and galaxy properties through Euclid, VLBI, ALMA, adaptive optics, ELT

Alvise Raccanelli - UniPD - N point correlation functions for cosmological datasets

Summary of proposed flagship UC (link to repo)

1. Group 1 GW - Frequency Hough (FH) Transform analysis on GW continuous sources, resp. P. Astone / M. Serra (INFN Roma 1)
2. Group 1 GW - Inference of cosmological and astrophysical population properties from GW observations with and without electromagnetic counterparts. M. Moresco / F. Pannarale (Unibo / Uniroma1 / …)
3. Group 2 AP - Development of innovative analysis techniques using realistic simulations of the upgraded Auger Observatory within the context of a machine learning environment. L. Perrone et al. (INFN / Unisalento / …)
4. Group 4 PIPE - Pipeline optimization for space and ground based experiments. G. Mazzitelli, V. Fioretti et al. (INFN/INAF)
5. Group 5 ASTRO - Efficient use of machine learning and GPUs in cosmological data analysis: from theory to likelihood to statistical inference - Thejs Brinckmann / L. Pagano (UNIFE)
6. Group 5 ASTRO - Detection and classification of SSO in Euclid Simulated data - A. Nucita (UniSalento)
7. Group 5 ASTRO - Hydrodynamical simulations to test the nature of dark matter - G. Despali et al. (UniBO)

1. Group 1 GW - Frequency Hough (FH) Transform analysis on GW continuous sources,

- P. Astone / M. Serra (INFN Roma 1)
- Link (not yet on common repository)
- Status: advanced
- Four KPIs, Oct 2023 to June 2025
- Risk analysis: complete
- Human resources: 12+4 m/yr + 2 ext coll.
- Computing resources: defined

Group 1 GW - Inference of cosmological and astrophysical population properties from GW observations with and without electromagnetic counterparts

- M. Moresco (lead, Unibo) / F. Pannarale (Uniroma1)
- Link
- Status: advanced
- Four KIPs
- Risk analysis: OK
- Human resources: 16.5 m/yr + ext coll.
- Computing resources: defined

1. Group 2 AP - Development of innovative analysis techniques using realistic simulations of the upgraded Auger Observatory within the context of a machine learning environment.

- L. Perrone (lead), F. de Palma, V. Scherini (INFN / Unisalento)
- Link
- Satus: science part advanced, the rest much less advanced
- KPIs: not defined
- Risk analysis: not defined
- Human resources: TBU
- Computing resources: not defined

1. Group 4 PIPE - Pipeline optimization for space and ground based experiments.

- G. Mazzitelli (INFN), V. Fioretti (INAF), C. Magnafico (INAF), R. Peron (INAF), G. Andronico (INFN) - No leader proposed
- Link
- Status: advanced
- KPIs: 6
- Risk analysis: OK
- Human resources: 24m/yr
- Computing resources: defined
-

Group 5 ASTRO - Efficient use of machine learning and GPUs in cosmological data analysis: from theory to likelihood to statistical inference

- T. Brinckmann / L. Pagano (UNIFE)
- Link
- Status: advanced/intermediate
- KPIs: 5
- Risk analysis: OK
- Human resources: TBD, reasonably 15 m/yr
- Computing resources: TBD
-

Group 5 ASTRO - Detection and classification of SSO in Euclid Simulated data

- A. Nucita (lead, UniSalento), F. de Paolis, A. Strafella, …
- Link
- Status: advanced/
- KPIs: 4
- Risk analysis: OK
- Human resources: 7 m/yr
- Computing resources: defined

Group 5 ASTRO - Detection and classification of SSO in Euclid Simulated dataHydrodynamical simulations to test the nature of dark matter

- G. Despali (lead), M. Baldi, F. Marinacci (Unibo)
- Link
- Status: advanced
- KPIs: 7
- Risk analysis: OK
- Human resources: 10.5 m/yr
- Computing resources: defined

Status of landscape document

- 70% complete
- Participation from all groups
- Abstract/intro/conclusions to be written (by WP conveners)
- Link