

Artificial Intelligence at CERN in Research

Machine Learning has been used at CERN since the 1990s
Since early 2000s Deep Learning provides powerful techniques, applicable to a wide range of use cases

Data processing for LHC experiments :

- ⊙ Anomaly detection and real time data selection
- ⊙ Data analysis and pattern recognition
- ⊙ Synthetic data generation and simulation

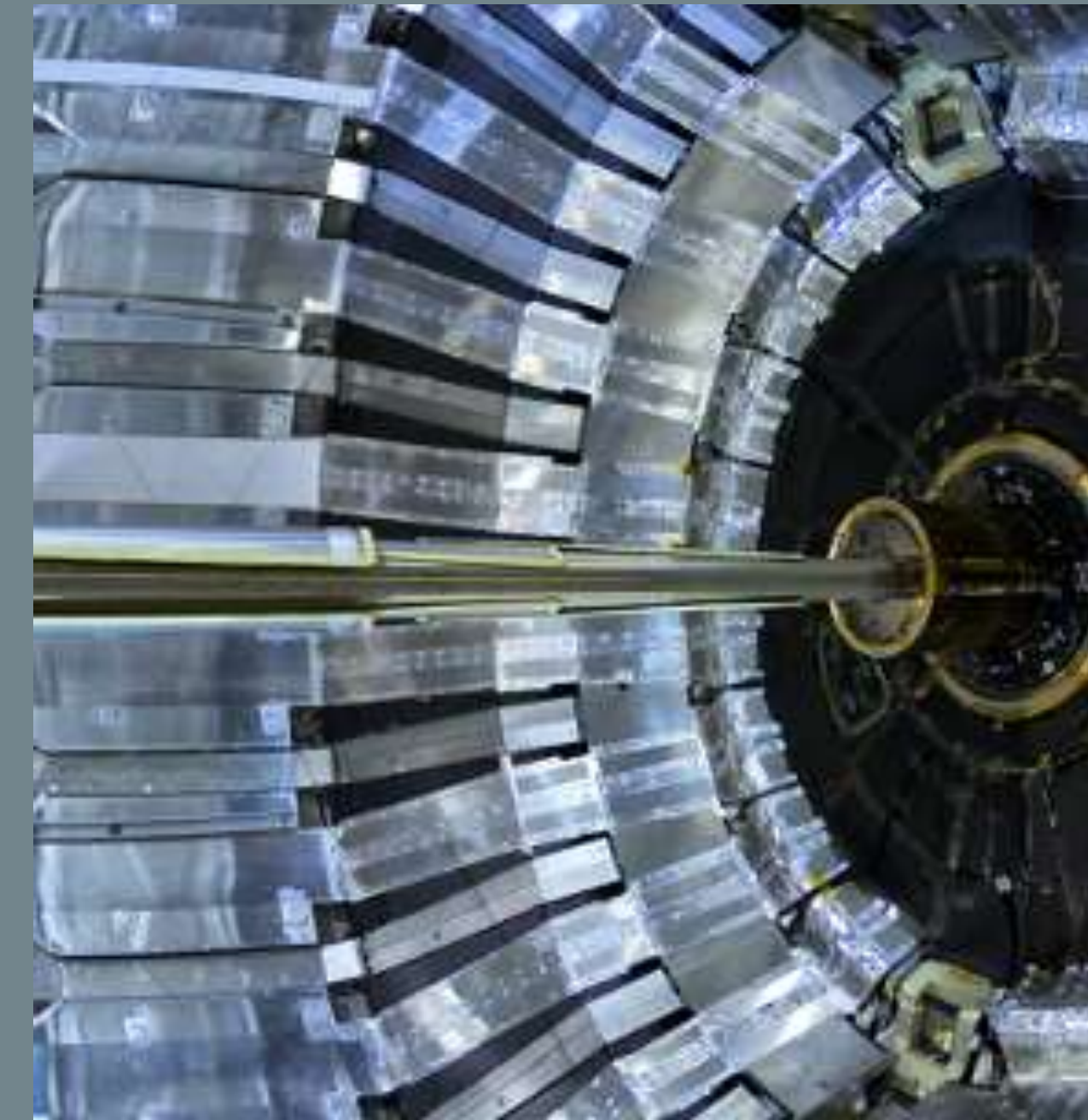
Operations and research in the field of particle accelerators

Engineering and Infrastructure

- ⊙ Robotics and computer vision

NB:

**None of the above applications triggers (Personal) Data
Protection issues**



AI-based real time data selection:

In just a few microseconds, the complex
system can determine whether the
information about a given collision event
is worth keeping or not.

Ex. Generative Models in HEP

Generative AI today «translates to LLMs» but it is actually a much broader class:

Boltzmann Machines exist since the 1980s

and in HEP we have used them since 2014!


Ex. CaloGAN (2017), 3DGAN (2017)...

PHYSICAL REVIEW D **97**, 014021 (2018)

CALOGAN: Simulating 3D high energy particle showers in multilayer electromagnetic calorimeters with generative adversarial networks

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IOP Conf. Series: Journal of Physics: Conf. Series **1085** (2018) 022005 doi:10.1088/1742-6596/1085/2/022005

Generative models for fast simulation

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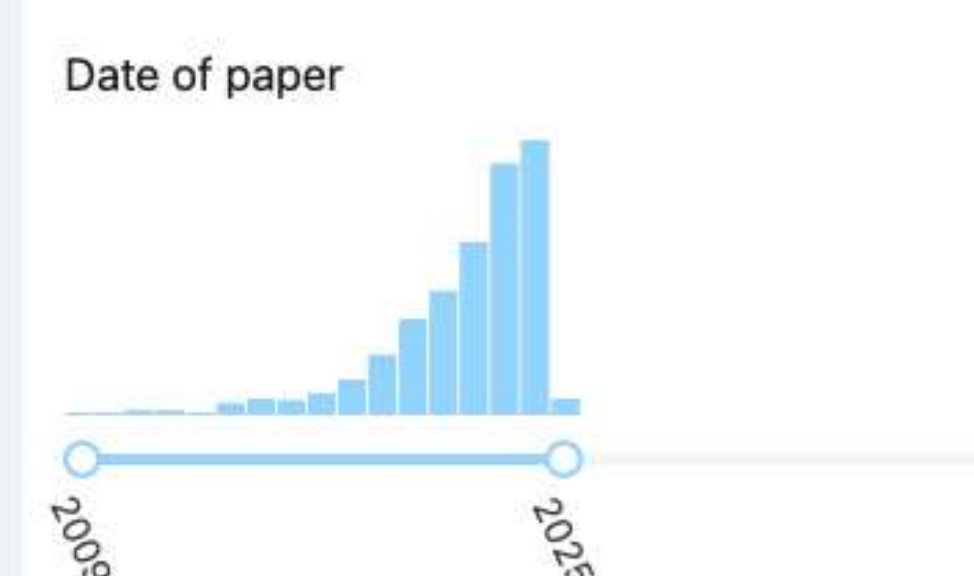


literature

generative models

Literature

Date of paper



Number of authors

☐ Single author

103

☐ 10 authors or less

690

Exclude RPP

☐ Exclude Review of Particle Physics

738

Document Type

☐ article

532

☐ published ⓘ

296

☐ conference paper

146

☐ thesis

58

☐ review

6

☐ book

2☐ introductory

Author

☐ Gregor Kasieczka

24

☐ Sofia Vallecora

23☐ Benjamin P. Nachman

738 results |  cite all

On the Use of WGANs for Su

John Brennan, Balu Sreedhar, John

e-Print: 2501.13056 [astro-ph.GA]

 pdf  cite  claim

Renormalization group flow, c

Artan Sheshmani, Yi-Zhuang You, B

Published in: Phys.Rev.E 111 (2025)

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GenSC-6G: A Prototype Test

Brian E. Arfeto, Shehbaz Tariq, Uma

e-Print: 2501.09918 [cs.AI]

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Simulating the Hubbard Mod

Dominic Schuh (Tata Inst. and Bonn

Virgin Islands, St Thomas), Lena Fur

(Jan 13, 2025)

Contribution to: Lattice 2024 • e-Pr

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OmniJet- α_C : Learning point

Joschka Birk (Hamburg U.), Frank G

et al. (Jan 9, 2025)

e-Print: 2501.05534 [hep-ph]

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Diffusion-Enhanced Optimiza

Shikun Zhang (Beihang U.), Zheng C

9, 2025)

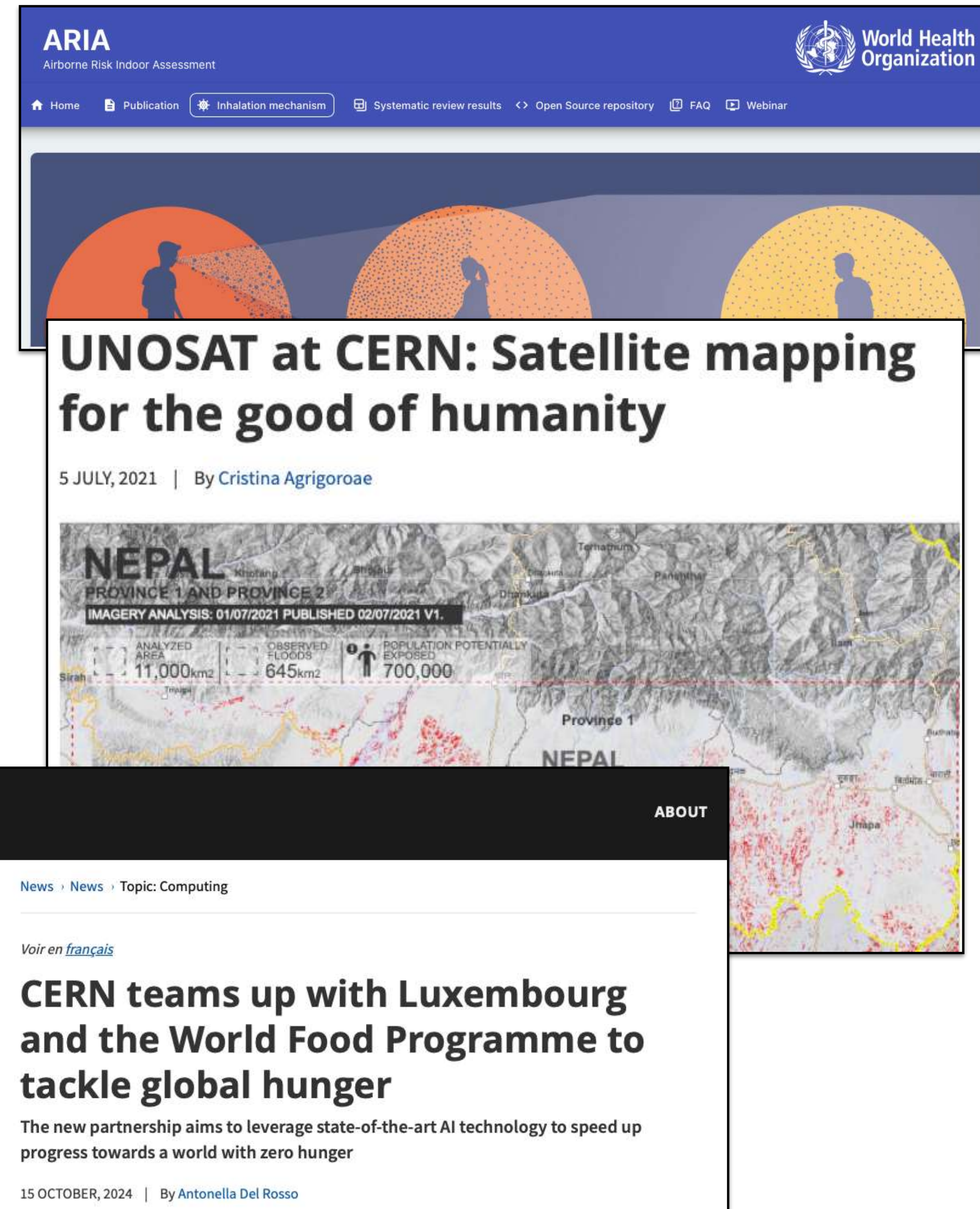
AI for humanity at CERN

“Unite people from all over the world to push the frontiers of science and technology, for the benefit of all”

from the CERN mission statement

CERN builds collaboration with humanitarian agencies and takes concrete actions to support human rights

- ⦿ ARIA project with WHO
- ⦿ AI-based satellite image analysis with UNOSAT (UNITAR)
- ⦿ Most recently, new collaboration with Luxembourg, LIST and WFP on a series of AI based tools to help improving WFP operations



AI strategy at CERN



Setup an AI Initiative coordinating different issues related to scientific AI applications development and AI use for productivity & efficiency

In particular addressing the need for policies, strategy and data privacy risks

Scientific applications at CERN do not suffer from the same kind of risks limiting application in other domains (e.g. AI for Human Right report)

Biases, performance and systematic errors are fully evaluated and characterized during the R&D process by design

Introduction of AI-based assistants to improve productivity at different levels for non-scientific tasks require addressing risks as in any other organisation

