PIC
port d'informació
científica

IFAE Institut de Física d'Altes Energies

GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

Scientific Computing and Applied AI at PIC

M.Eriksen, on behalf of the PIC and the applied AI group

Tsung-Dao Lee Institute visit, 18th May 2026

Unió Europea
Fons Europeu
Next Generation

GOBIERNO DE ESPAÑA

Plan de Recuperación, Transformación y Resiliencia

Next Generation Catalunya

Generalitat de Catalunya
Departament de Recerca i Universitats

PIC overview

Apr. 2026

Compute	Storage
CPU: 350 kHS23	Disk (dCache): 52 PB
+78 GPUs	Disk (Ceph): 4.2PB
	Usable space
	Tape: 120 PB

Spanish WLCG Tier-1 centre → **~80% of resources**

→ Provides ~5% of Tier1 data processing of CERN's LHC detectors ATLAS, CMS and LHCb

¼ of the Spanish ATLAS Tier-2 and **a Tier-3 ATLAS data analysis facility** → **~10% of resources**

LSST lite-Independent Data Access Center (lite-IDAC), **T2K** and **DUNE** [neutrinos], **MAGIC** and **CTA** [gamma-ray astronomy], **PAU** and **EUCLID** [cosmology], **VIP** [instrumentation], opportunistic access to **LIGO/VIRGO** [gravitational waves], among others...

Port d'Informació Científica (PIC)

Founded in 2003: collaboration between IFAE and CIEMAT, with support from UAB and Generalitat de Catalunya

Data center operations, software infrastructure for experiments, pay-per-use services, data-analysis methodologies

Mission: Participate at highest level in the LHC Computing and leverage experience to advance other scientific activities

→ Development and Operations
→ Cross-disciplinary collaboration across fundamental physics and other data-intensive domains
→ International scope
→ Societal impact

Applied AI group at PIC

Martin Eriksen (IFAE)

Jiefeng Chen (IFAE/CSC)

Guangzai Ye (IFAE/CSC)

Hanyue Guo (IFAE/CSC)

Antoni Alou
(CIEMAT/UAB)

Self-supervised image denoising and photometry

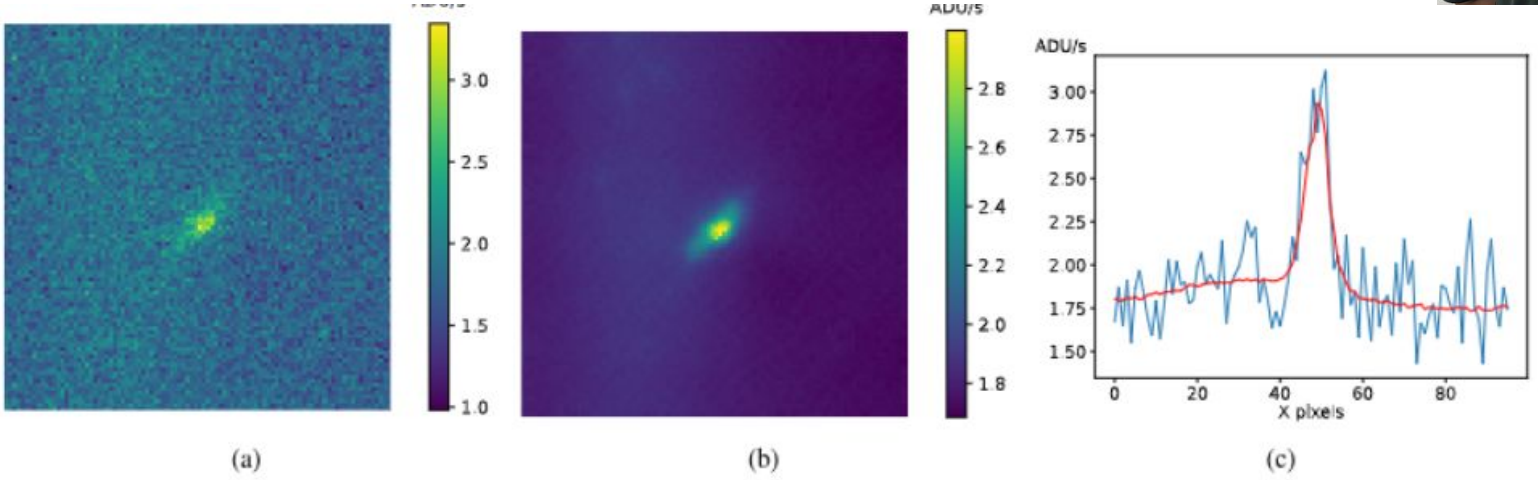
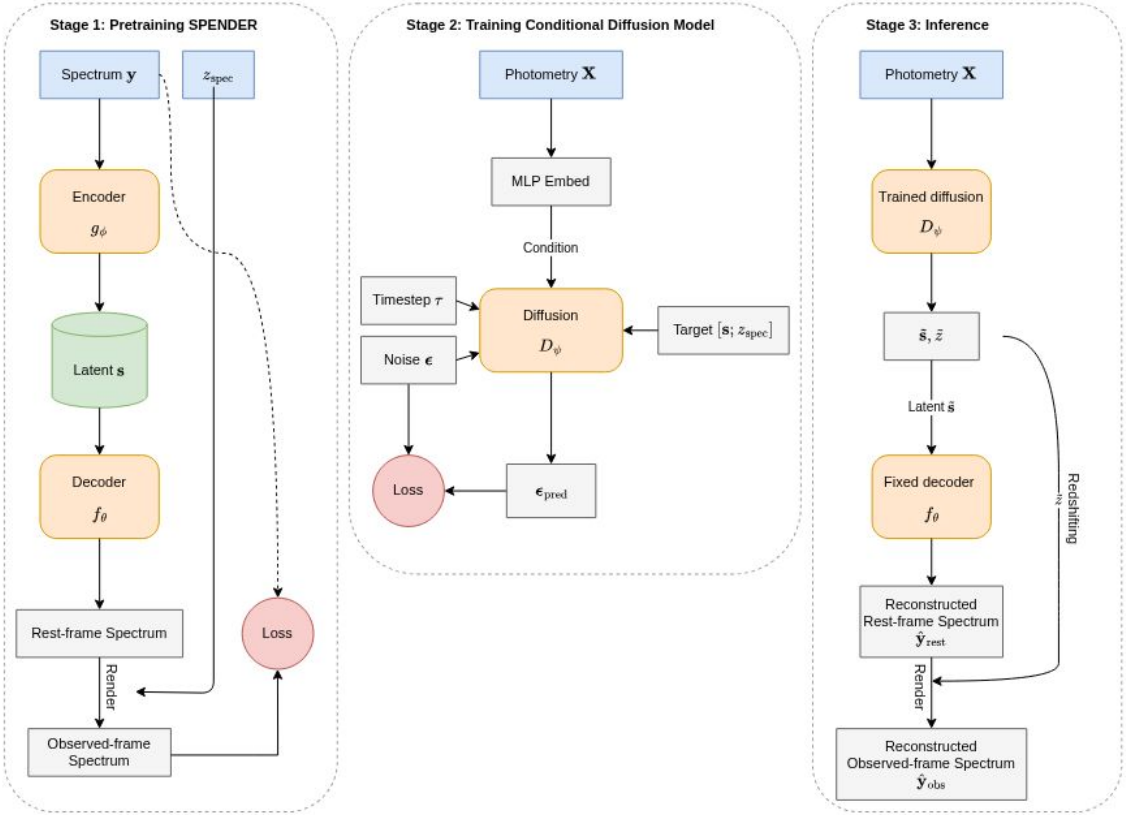


Fig. 6: Example of N2V denoising applied to a PAUS image. *Left*: Original noisy stamp. *Middle*: Denoised stamp. *Right*: One-dimensional intensity profile across the central galaxy in the noisy (red) and denoised (blue) PAUS images. Additional denoising examples for PAUS images are provided in Appendix A.

Joint probabilistic inference of galaxy redshifts and rest-frame spectra from photometric fluxes with latent diffusion

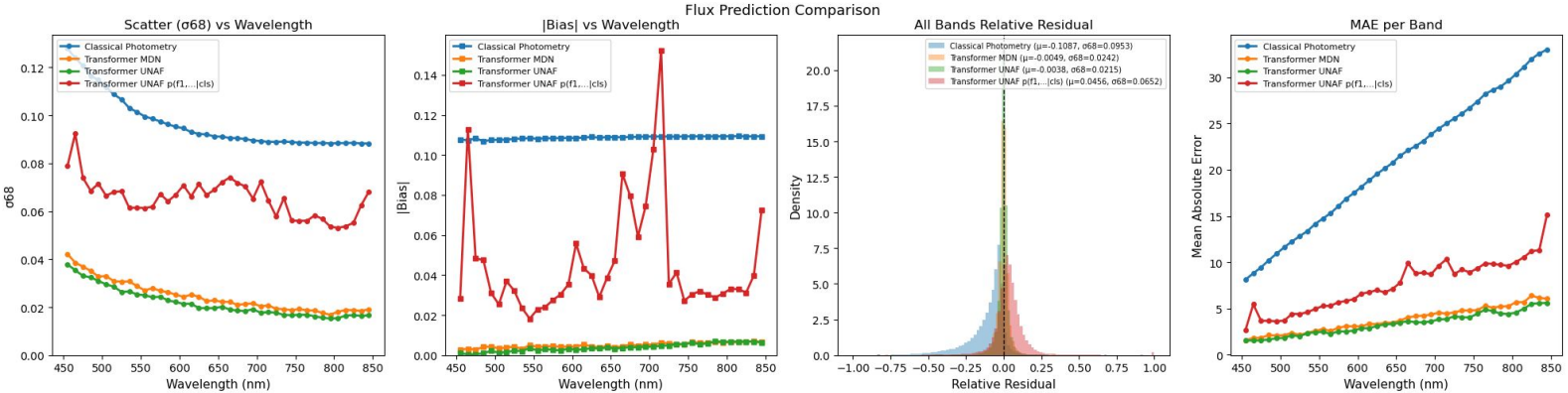


Trained Spender auto-encoder on 5 million galaxies.

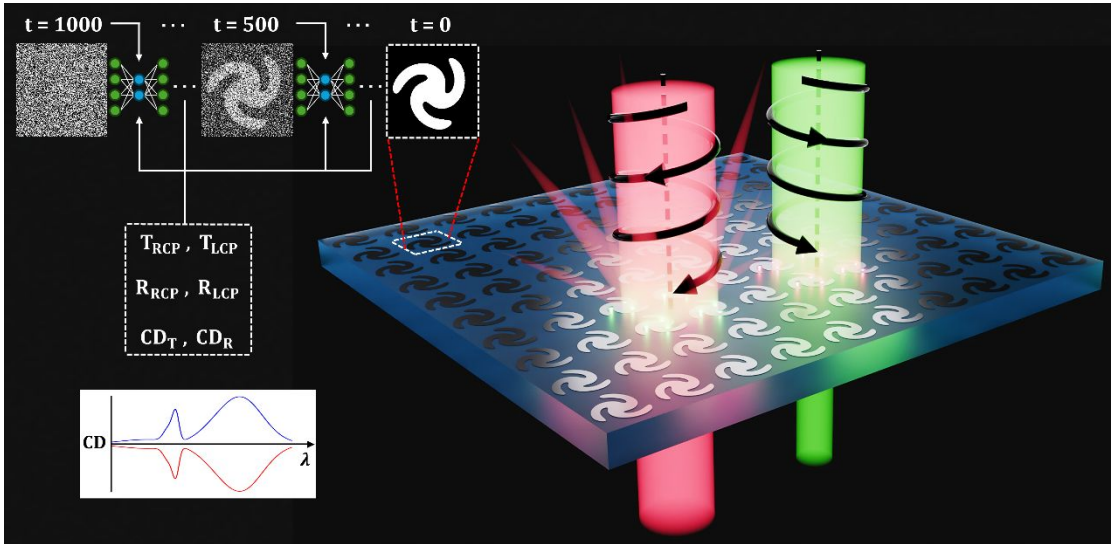
http://arxiv.org/abs/2605.10753

Multi-band photometry and photo-z

Uses a transformer architecture on tokenized images from an auto-encoder to make joint predictions of photometry and photo-z from individual exposures.



Denoising diffusion probabilistic model for the inverse design of plasmonic chiral metasurfaces with on-demand optical properties



Collaboration with ICMM in Madrid.

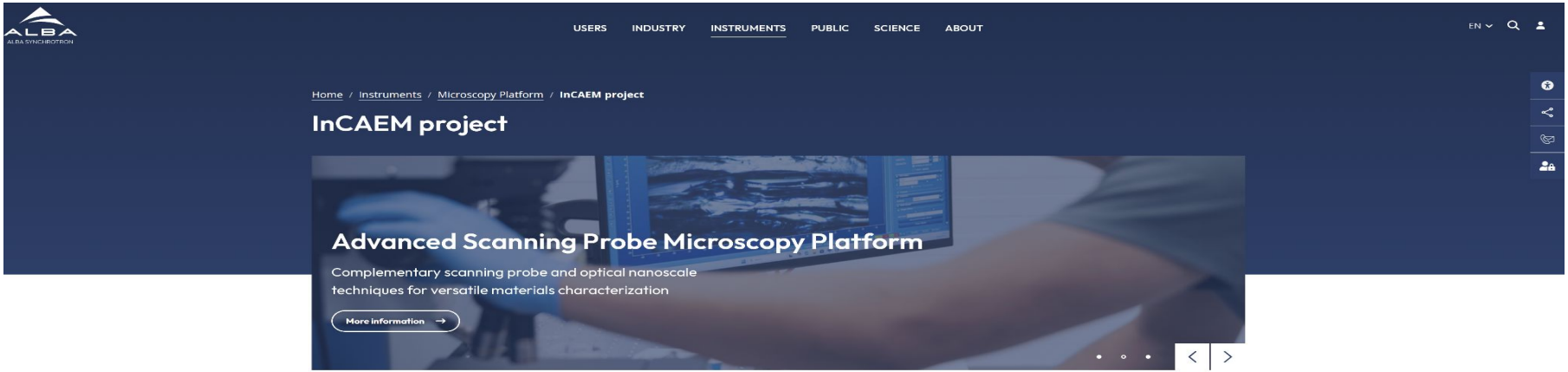
Electron microscopy for materials science

InCAEM project: ALBA, ICN2, ICMAB, PIC/IFAE

A multimodal approach with different instruments is essential in many technologies in the energy and environmental sector, including catalyst development

Data represents a challenge: volume, speed, variety

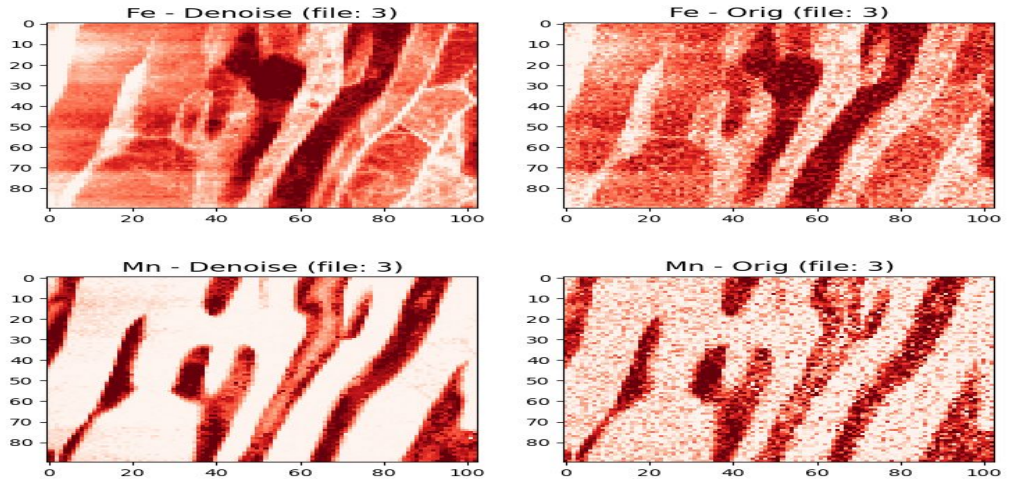
PIC collaborates with ALBA (synchroton facility) to build and operate the computer system to analyze the data of this new research infrastructure



Application of ML based denoise algorithm to the EELS data of the 3rd generation Medium Mn Steel

The Electron Energy Loss Spectroscopy (EELS) of materials materials are noisy, which impacts downstream analysis. In this work, we implement and test denoising auto-encoders on samples of 3d generation medium Mn steel.

Each point on the plot on the right corresponds to a spectra



In collaboration with ALBA and Eurecat

Thanks for your attention. Questions?

Financed by:

Application of ML based denoise algorithm to the EELS data of the 3rd generation Medium Mn Steel

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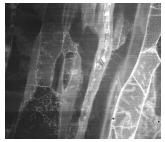
Motivation

The Electron Energy Loss Spectroscopy (EELS) of materials materials are noisy, which impacts downstream analysis. In this work, we implement and test denoising auto-encoders on samples of 3d generation medium Mn steel.

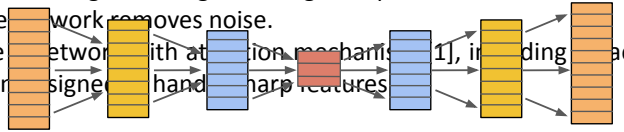
Data

Sample of 3rd generation medium manganese steel was cut with focused Ion beam and probed with transmission electron microscope SPECTRA 300 at ALBA, utilizing High-Angle Annular Dark field (HAADF) technique (right) for and EELS for element analysis.



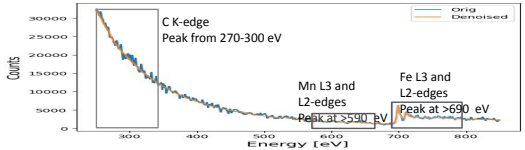
Neural network

- Unsupervised denoising can remove noise without knowing the ground truth.
- We tested denoising 2D images, but the best result was using an 1D auto-encoder for each pixel.
- An auto-encoded neural network consists of two parts, an encoder and a decoder. Through learning encoding the spectra on fewer features (here 10), the network removes noise.
- We use network with attention mechanism [1], including activation function designed to handle sharp features.

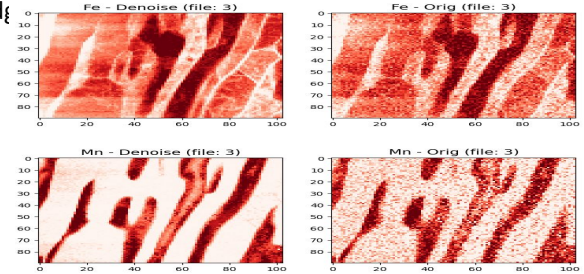


Encoder Decoder

Results



The original and denoised signal. For each pixel, we normalize using the pre and post-edg



The edge jump for Mn L3 (bottom) and Fe L3-edges (top) comparison with and without denoising algorithm applied.

Conclusions

Denoising makes earlier undetected features visible, allowing us to study Mn and Fe distribution in details. It is clear that the dominant Mn content

Acknowledgements

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[1] P. Melchior, Y. Liang, C. Hahn and A. Goulding, 'Autoencoding galaxy spectra. i. architecture,' The Astronomical Journal, vol. 166, no. 2, 2023