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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA
ICSC Centro Nazionale di Ricerca in HPC, Big Data and Quantum Computing

Allucinating Molecular Cloud emission with Neural nets

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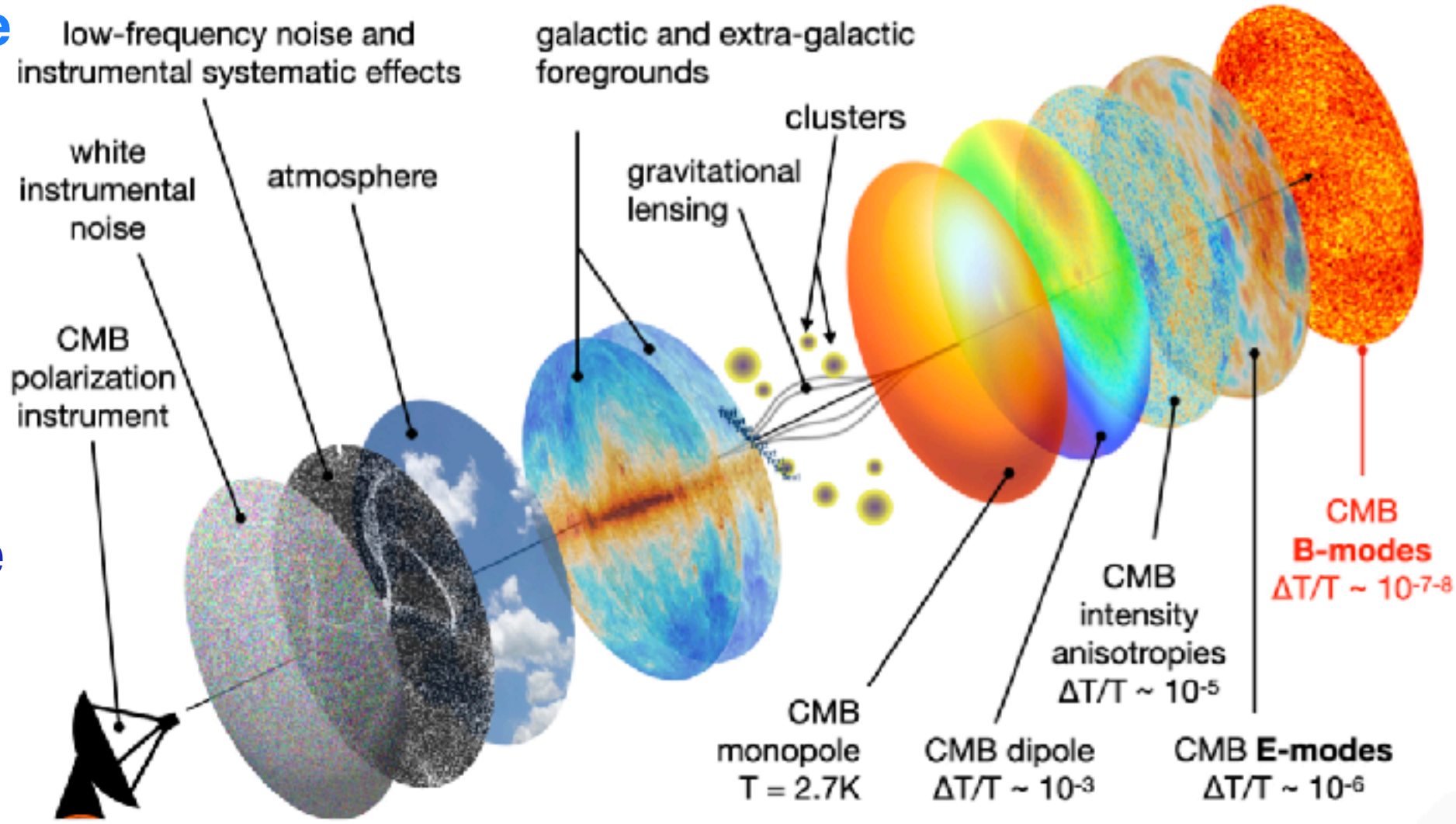
Scientific Rationale

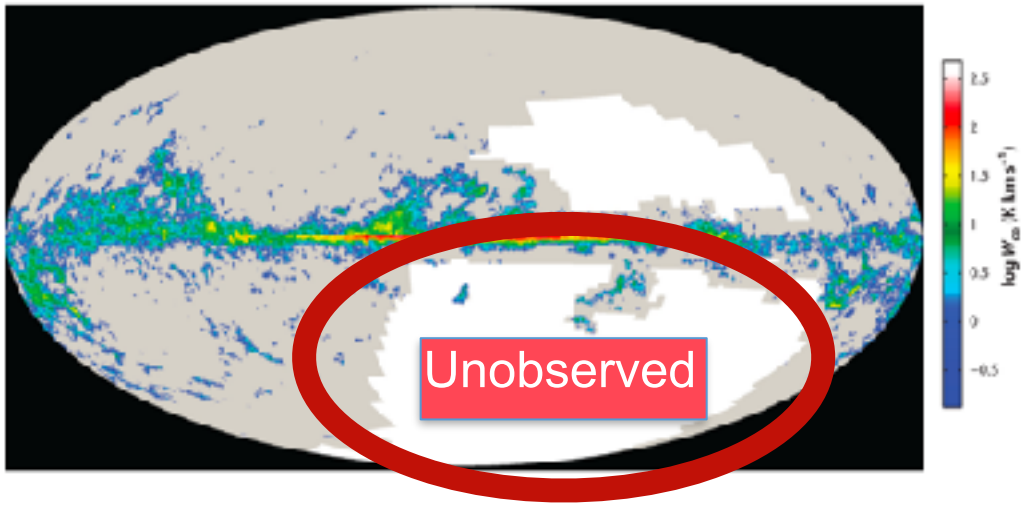
The Milky Way acts as a *foreground* wrt Cosmic Microwave Background (CMB)

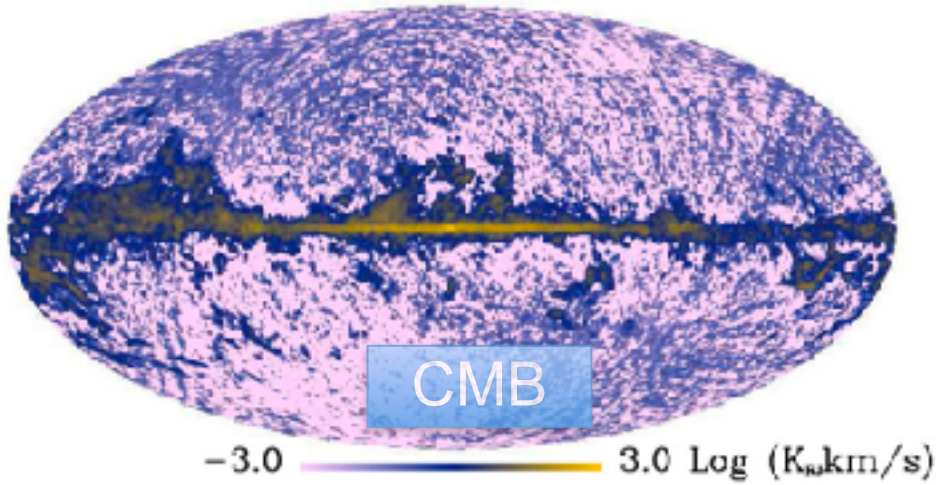


Credit: J. Errard

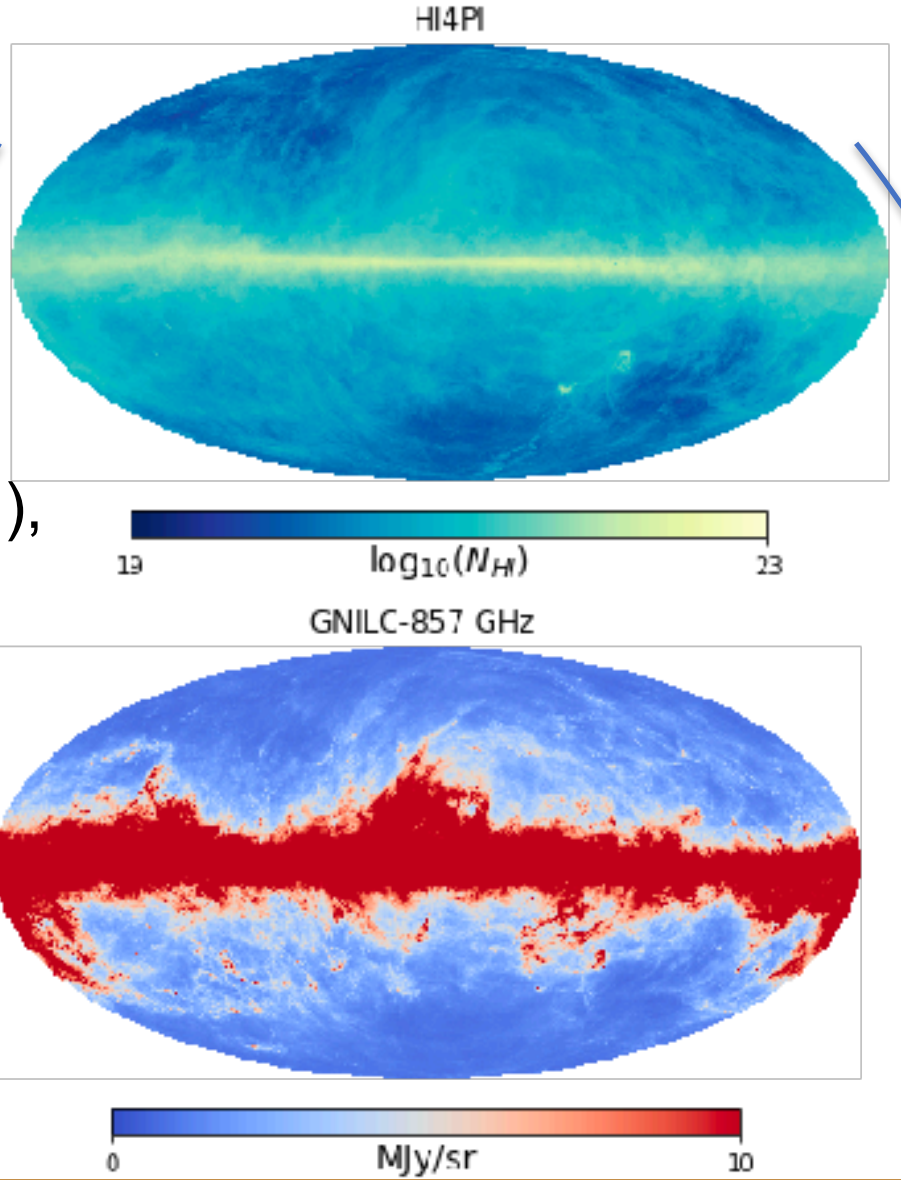
Scientific Rationale

- Full sky maps of Galactic emissions are needed for cosmological observations.
- There are regions that are not observed … yet
- In the same area, CMB ground telescopes are observing…
- *Planck* data observed full sky,BUT also full of noise

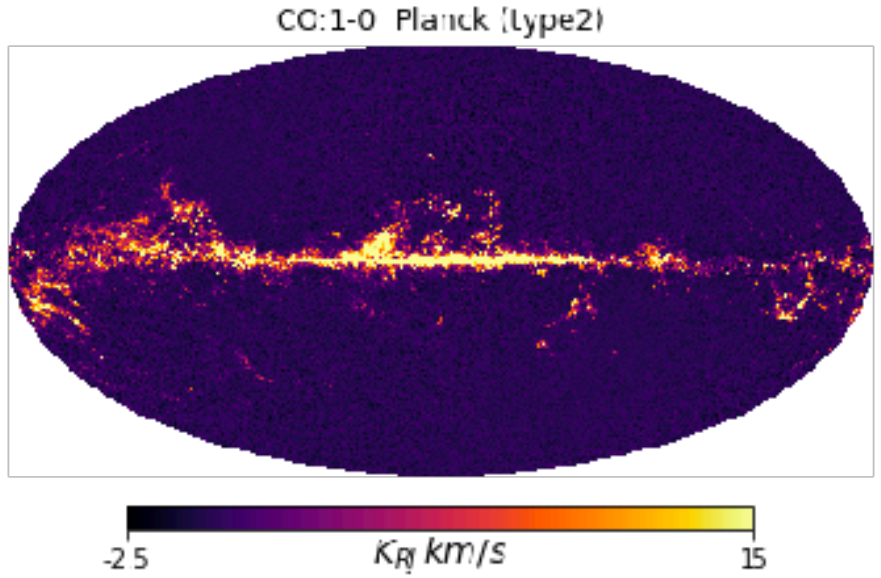




X: N(HI), IR dust

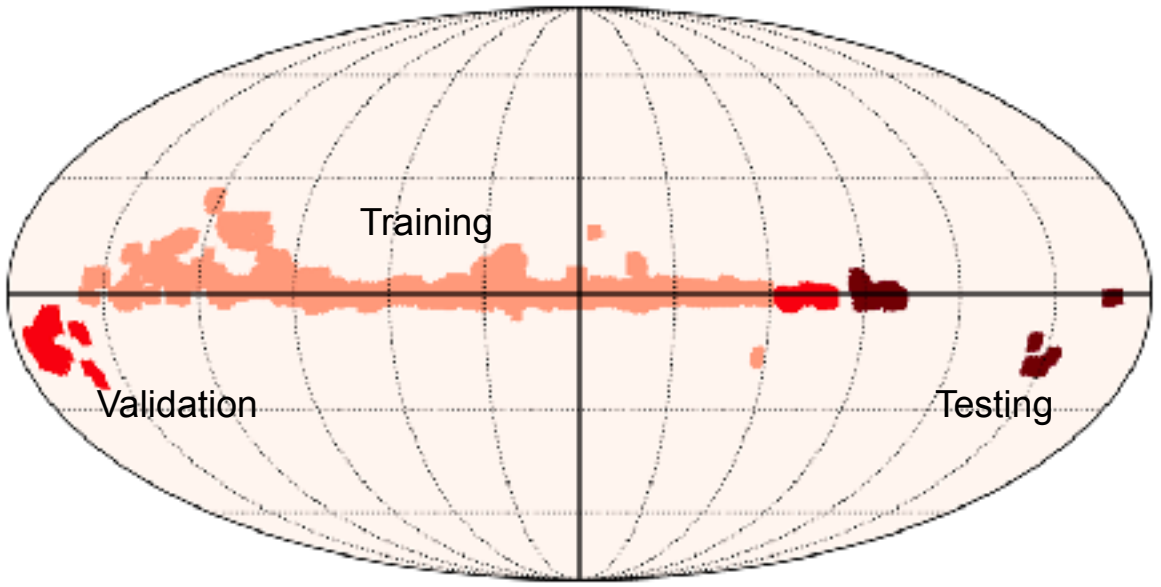


Y: CO map



Technical Objectives, Methodologies and Solutions

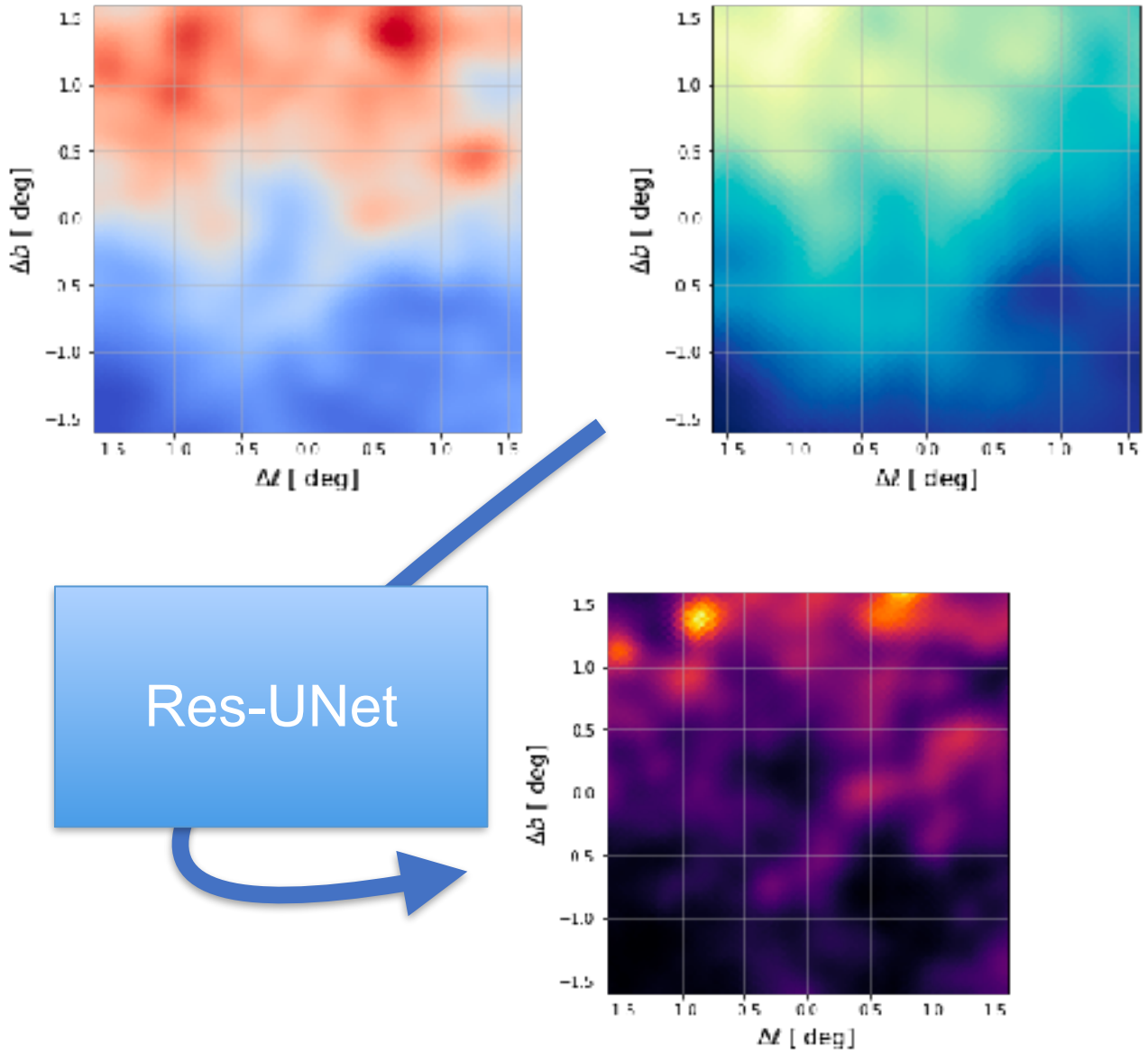
- Build training set from available data (*Planck, HI4Pi)*
- Identify Galactic regions of bright emission, low noise contribution,-> high SNR >8
- Create the training set from those areas
- 3x3 deg2 maps (128x128)
- ~3210 square patches
- With augmentation patch
- 5650(training), 930(validat.) , 2790 (test.)



Methodologies

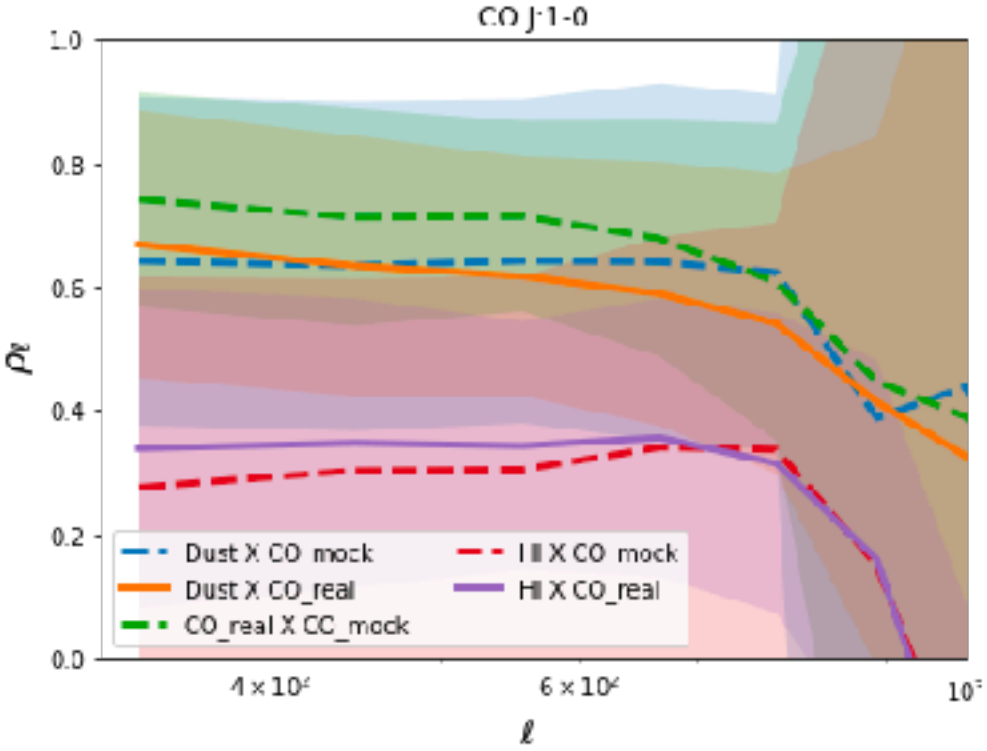
Training Res-UNet (Diakogiannis+2019, Guzman+ 2019)

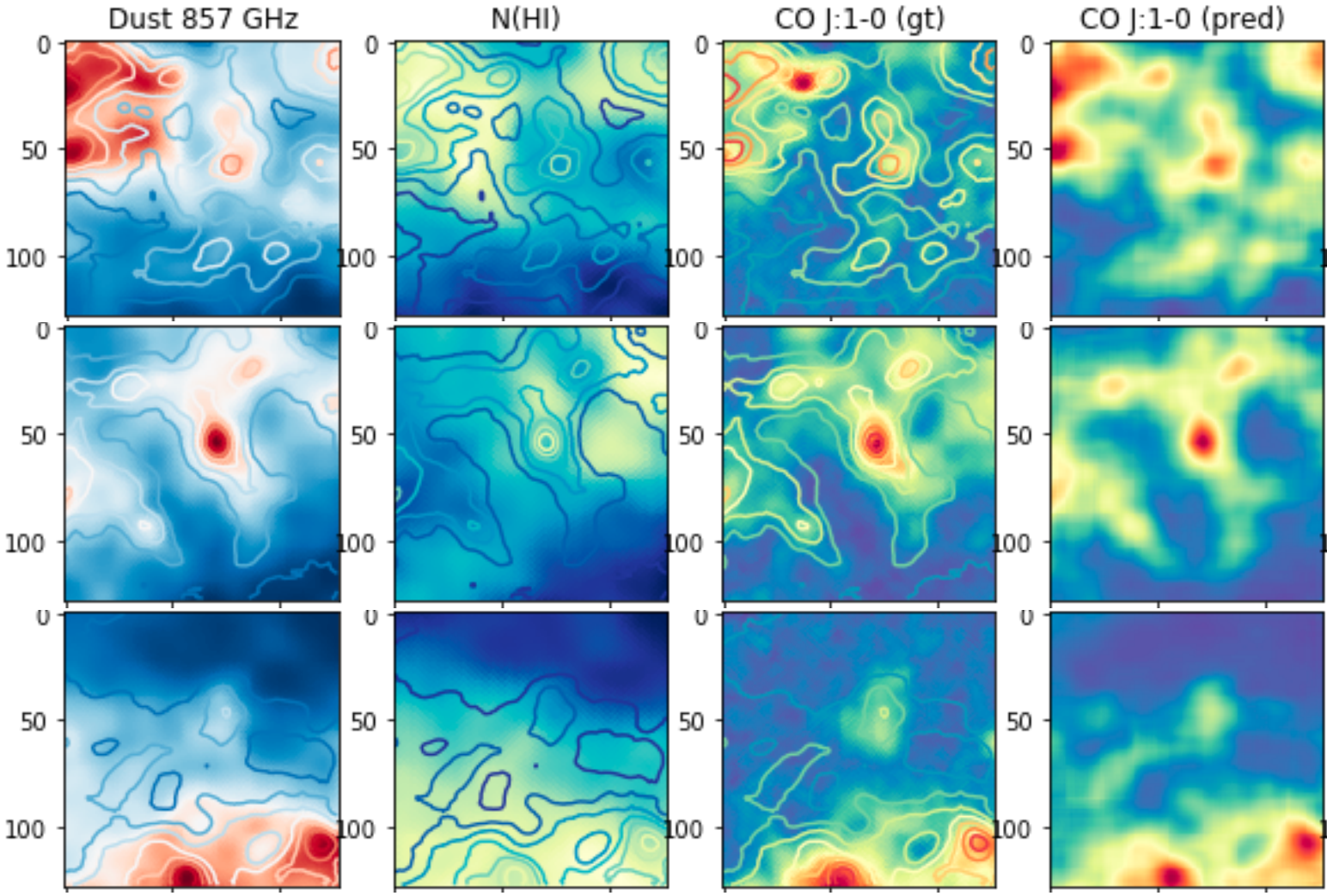
- batch size= 64
- training time performed @ NERSC on NVIDIA A100
- 20,000 epochs



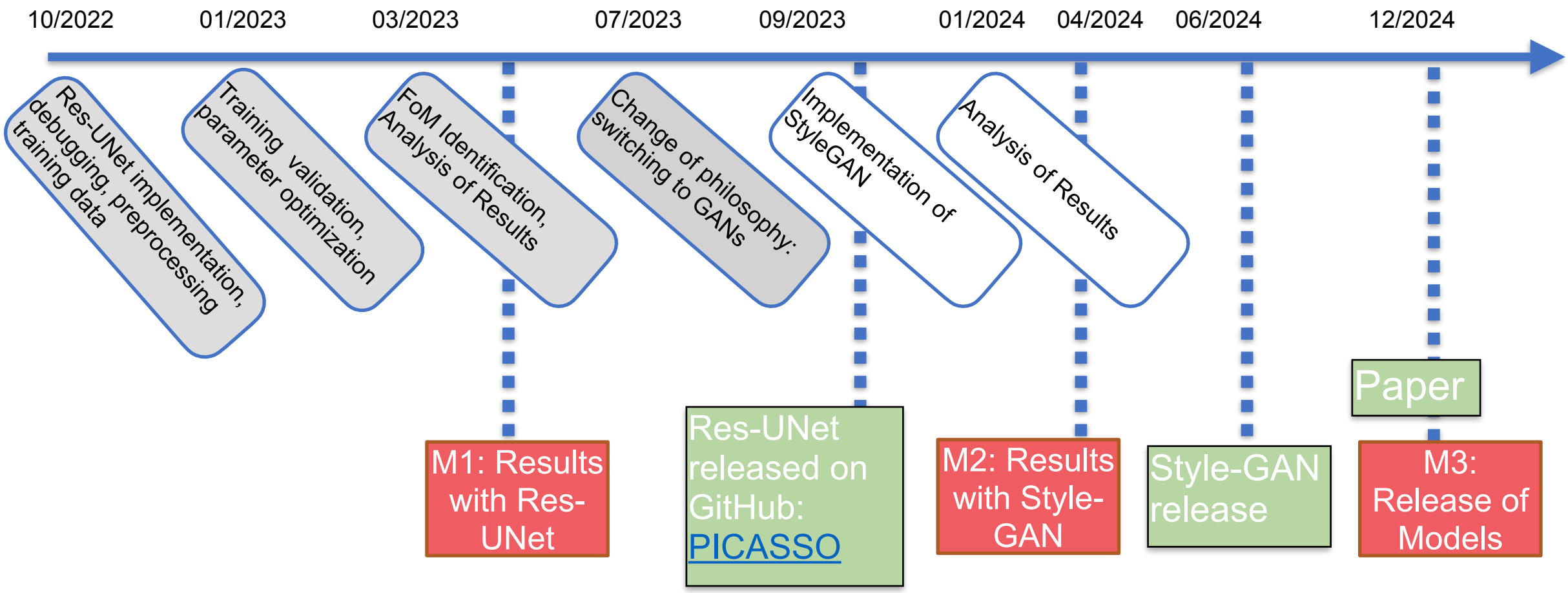
Accomplished Work, Results

- Training seems to be effective
- /!\ Output Features strongly correlated with dust more than HI





Timescale, Milestones and KPIs



Next Steps and Expected Results (by next checkpoint: April 2024)

- Reached a saturation in training phase with Res-UNet, mainly due to limited training dataset (<10,000)
- Need to explore the latent space feature, latent variables can be used to generate new data, as knobs to steer samples, -> styleGANs
- Jan 2024: trained data and first results from test-set
- Apr 2024: present stable results