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PRISME-21 dataset

Public Reference for Interferometric Simulations for Foreground Mitigation in the Epoch of Reionization 21-cm signal

SKACH Winter Meeting 2026 – Emmanuel de Salis

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The team behind this dataset

- This dataset is the result of a collaboration to tackle the SKAO Science Data Challenge 3a (SDC3a) ‘Foregrounds’, by the SKACH team.
- The SKACH team is composed of experts from astrophysics and data science

  ➥ *Disclaimer : I am from the Data Science side.*

SDC3a Foregrounds

- The 'Foregrounds' challenge goal is to remove obscuring sources of emission which prevent analysis of the underlying hydrogen-21cm signal from the Epoch of Reionisation (EoR).
- Participants are asked to extract the cylindrically-averaged power spectrum of the EoR signal, clean from foregrounds contamination.
- To do so, we were expected to simulate our own dataset for the creation and training of our models.
- This resulted of a lot of work to be able to simulate coherent, rich and relevant data.
- After the challenge, various colleagues and researchers expressed their interest in this dataset, which lead to an effort to make it available to the community.

Creating data

A Challenge by itself

- Creating an artificial dataset raise multiple challenges, especially with data representing real physical elements:
  - From a physics perspective: the dataset should align with real data, with similar behavior. It should "feel" and "act" as real data, to make analysis based on this data credible.
  - From a Machine Learning (ML) perspective : the underlying method for generating the data should be complex and hidden enough so that the ML models, that relies on statistical patterns, cannot catch the generation method.
- Dataset was created in Python, using *21cmFast*, that allows simulating both the cosmic structure formation and ionization of the intergalactic medium. The total size of this dataset is around 7Tb.
- Full details about data generation can be found in Bianco et al. (2024)[1]

1 : Bianco, M., Giri, S. K., Sharma, R., Chen, T., Krishna, S. P., Finlay, C., Nistane, V., Denzel, P., De Santis, M. & Ghorbel, H. (2025). Deep learning approach for identification of Hii regions during reionization in 21-cm observations–III. image recovery. *Monthly Notices of the Royal Astronomical Society*, staf973.

Accessing the data

Also a challenge by itself

- Hosting 7Tb of data in open access and according to the FAIR guidelines rules out many open science platforms, which have a limit of 50Go per dataset usually.
- Fortunately, a long-term solution was found thanks to the CSCS.
- Dataset :
  - Hosted on : https://rgw.cscs.ch/ska:sdc3-simdata
  - Walkthrough access : https://github.com/Emmanuel-desalis/sdc3-simdata
  - DOI and citation : https://zenodo.org/records/18326619

- ***No account needed to download the data***
- ***Only requirement : Python 3.9+***
- ***You can visualize the dataset, and download only subset of the data if you want***

Usage of the data

- Creating new foregrounds mitigation method → *I am currently doing this*
- Benchmarking existing foregrounds mitigation techniques.
- Assess your own foregrounds mitigation method on another dataset than the one you used to create it.
- But also :
  - Use it as a training dataset for your students
  - Use it as a starting point for your PhD research
  - *… and probably many other use-cases.*

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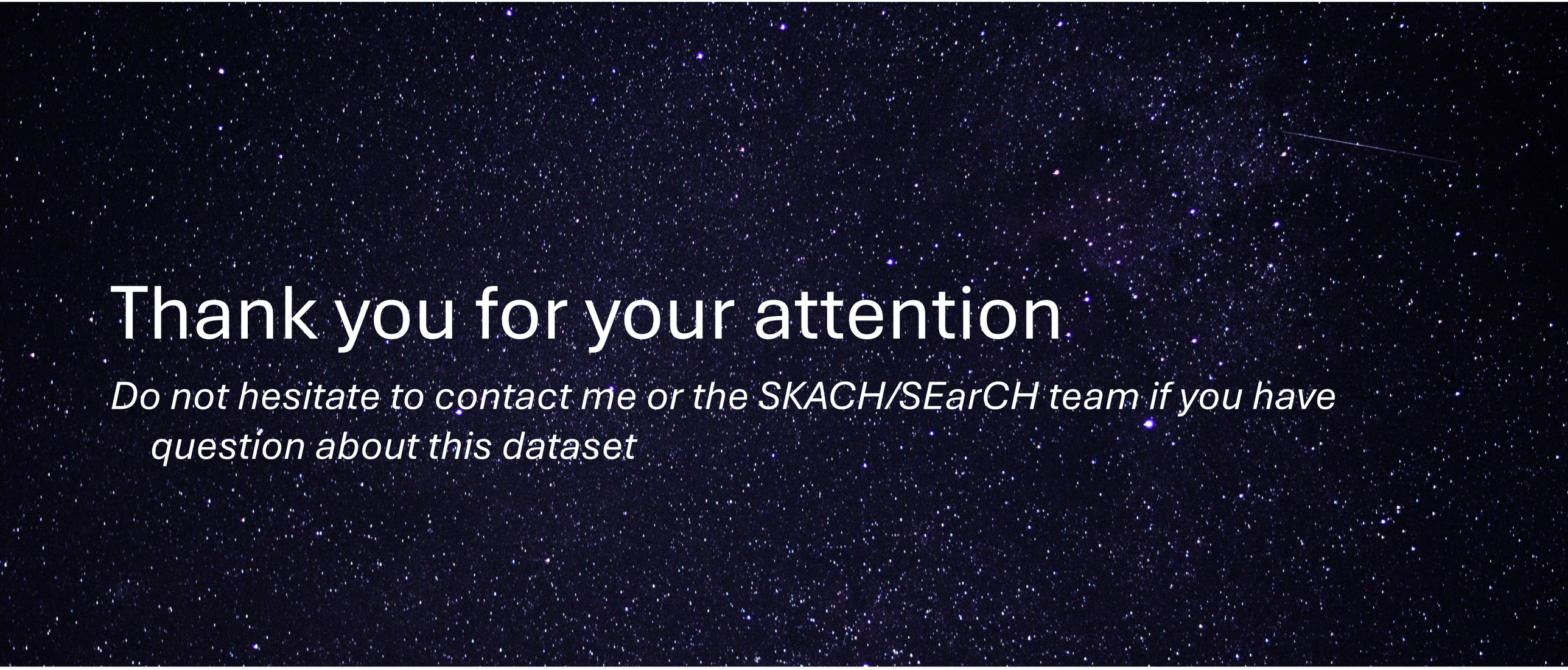

Thank you for your attention

Do not hesitate to contact me or the SKACH/SEarCH team if you have question about this dataset