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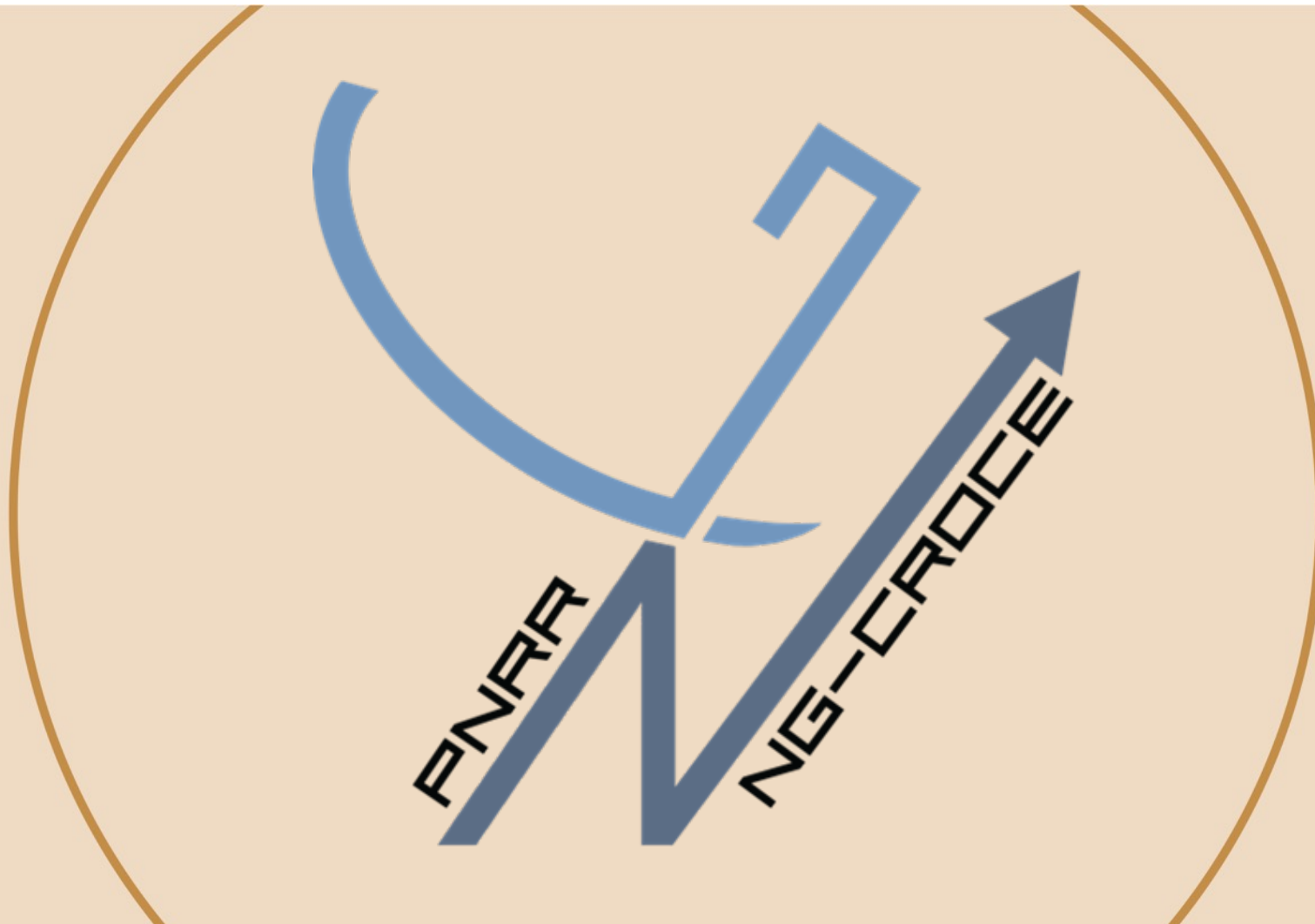
ML FRB-RFI Sifting 🤔

Training Meeting NG-Croce

Lunedì 12 Maggio - Giovedì 15 Maggio

Radiotelescopi di Medicina

IRA - Bologna



Martin Topinka OACa INAF



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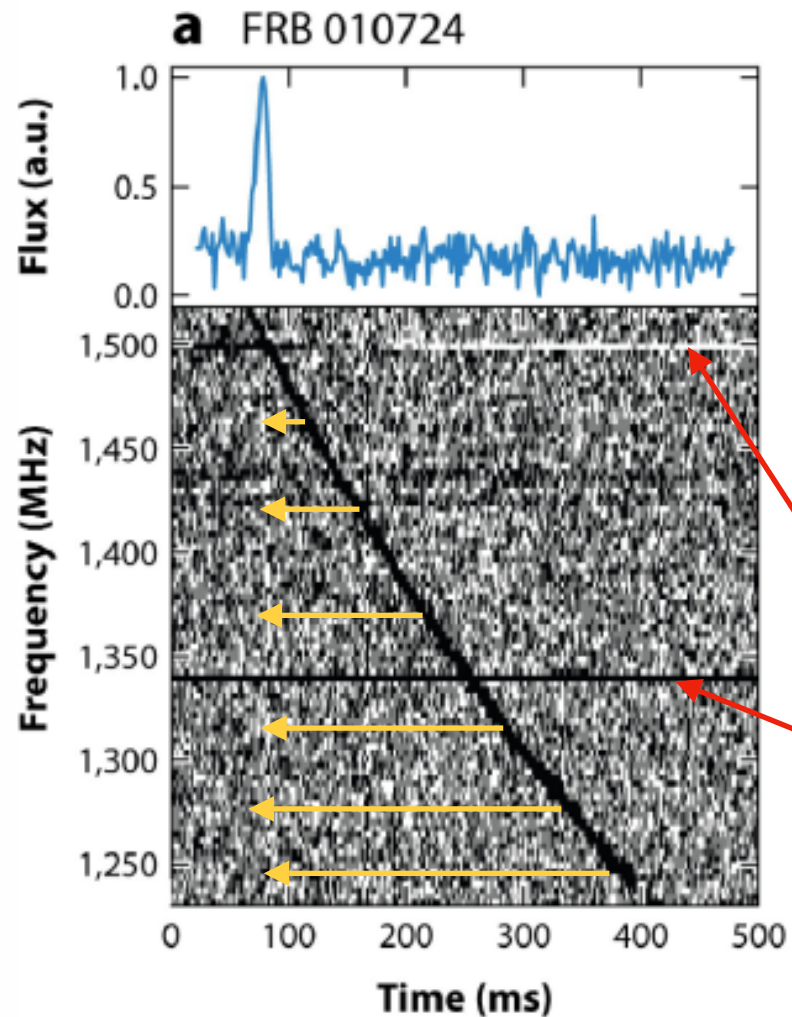
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Radio
Frequency
Interference

Dispersion measure

$$DM \sim \nu^{-2} = \int n_e(z) dz$$





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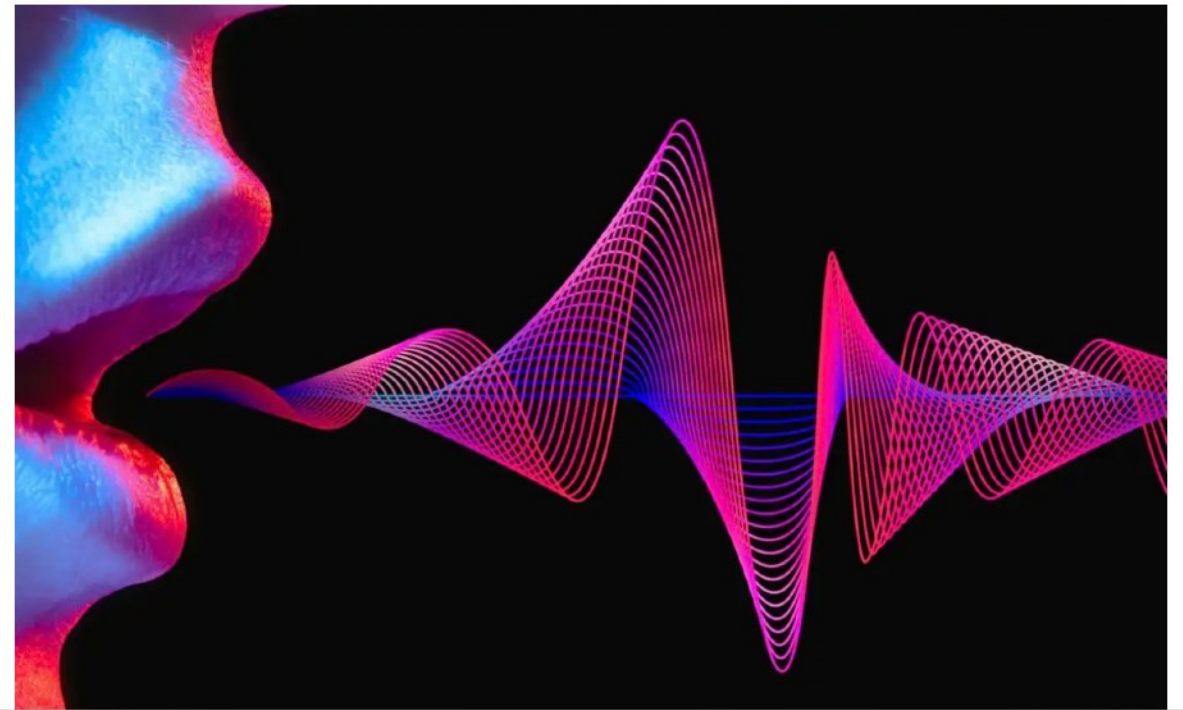
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Parkinson's disease could be detected by listening to someone's voice

The pitch and hoarseness of a person's voice often changes if they have Parkinson's disease, suggesting there could be a non-invasive way of screening for the condition

By [Clarissa Brincat](#)

📅 13 May 2025





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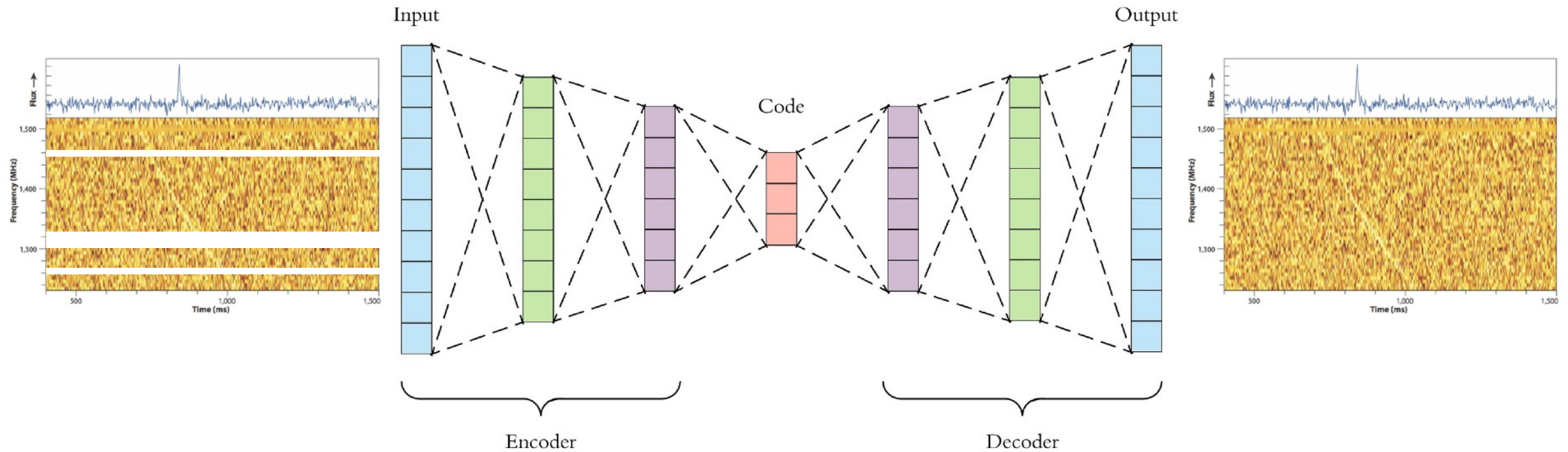


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RFI removal





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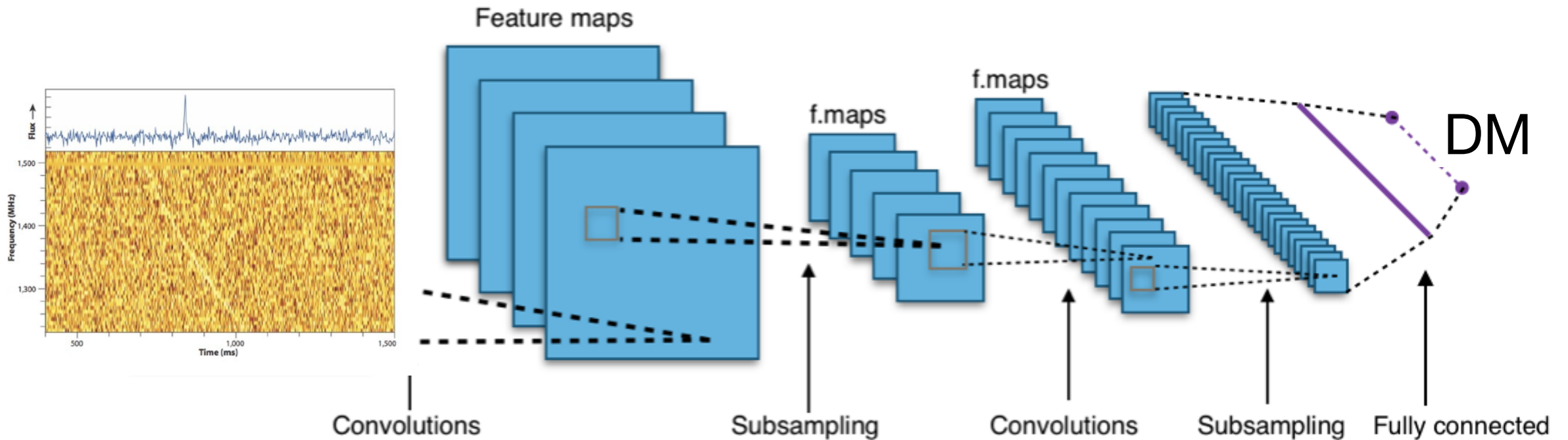


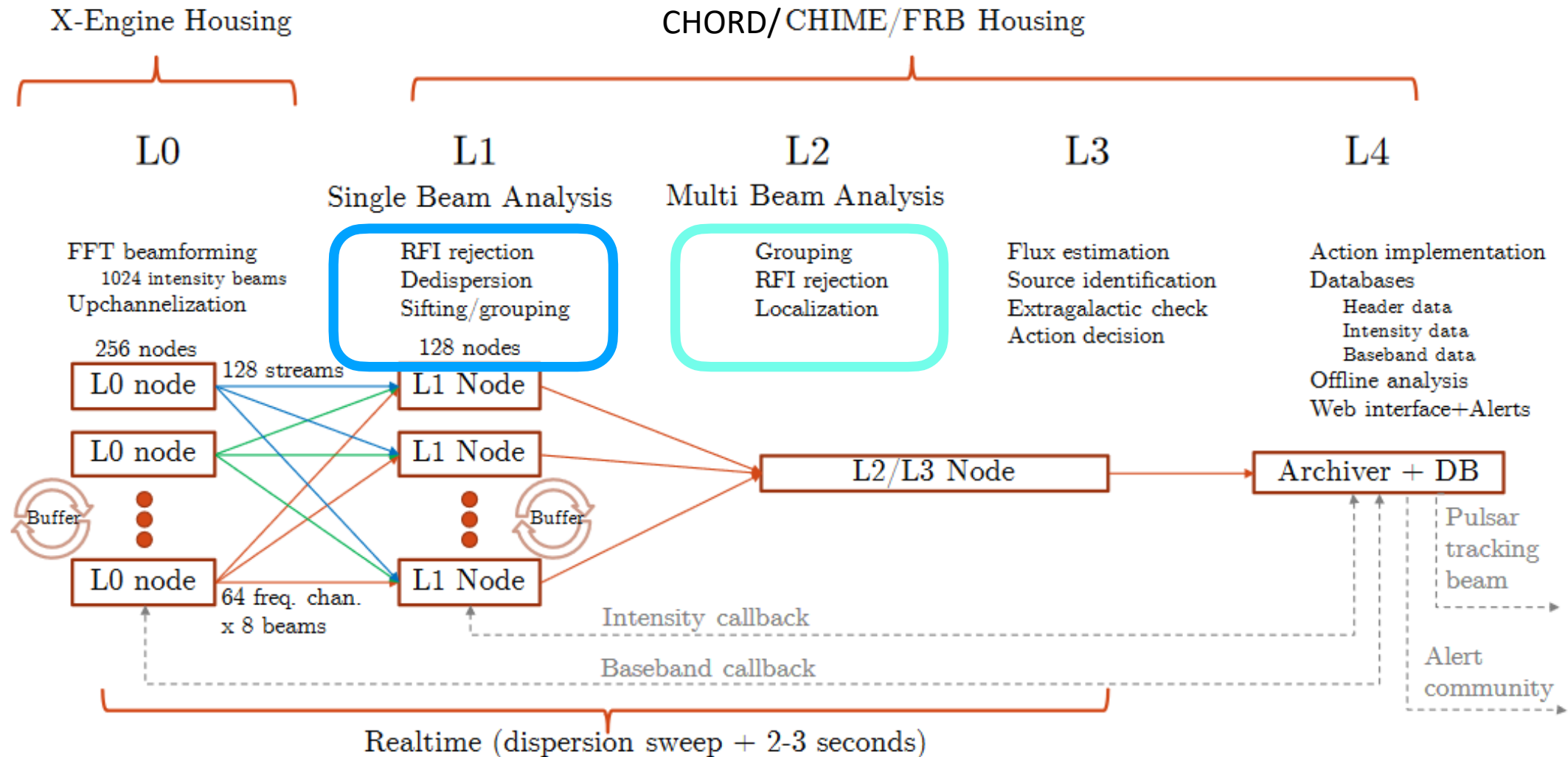
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DM direct estimate







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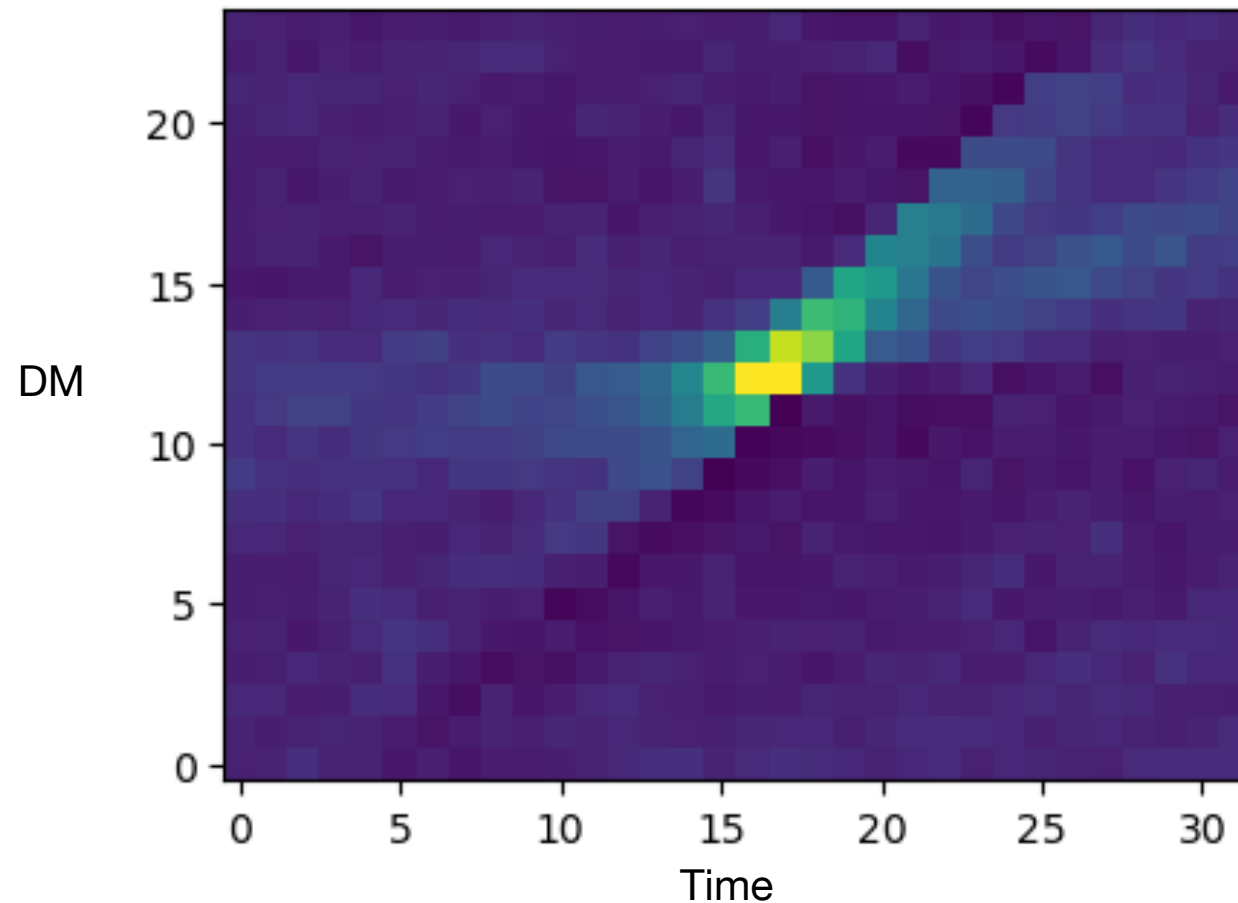


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DM-t plane sifter: Astro vs RFI ?



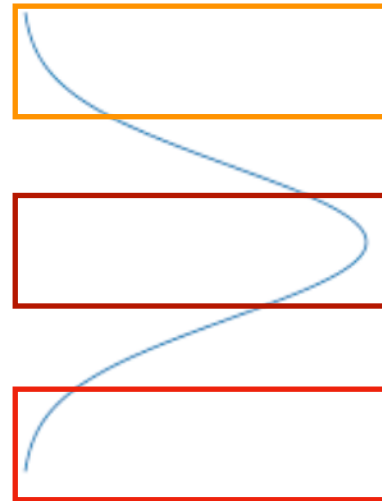
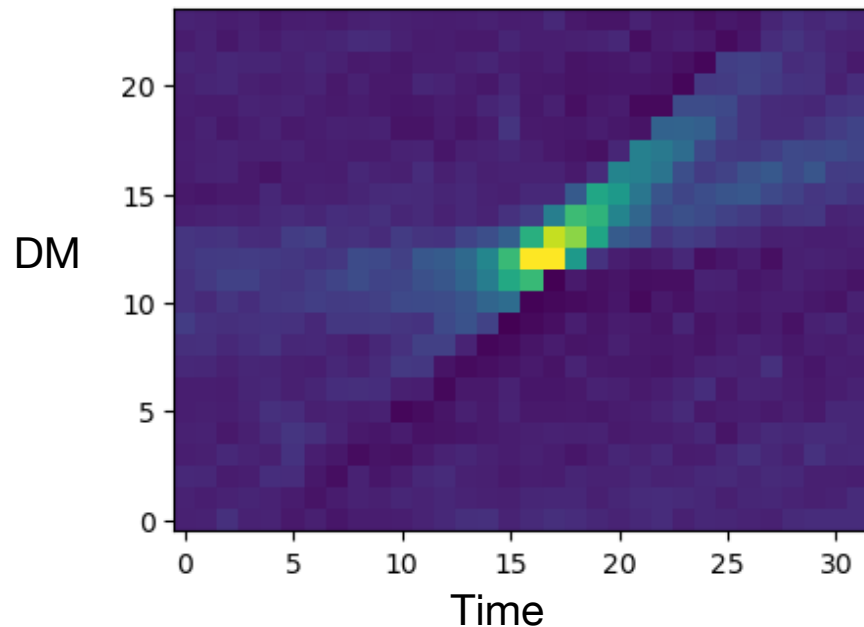


- **CHIME strategy:**

1) DM-t plane marginalised over t $\rightarrow$ DM profile

FRB $\sim$ Gaussian

left|right tail to centre ratio $\rightarrow$ (linear) classifier SVM with RBF kernel



2) Beam illumination pattern + DM-profile score classification



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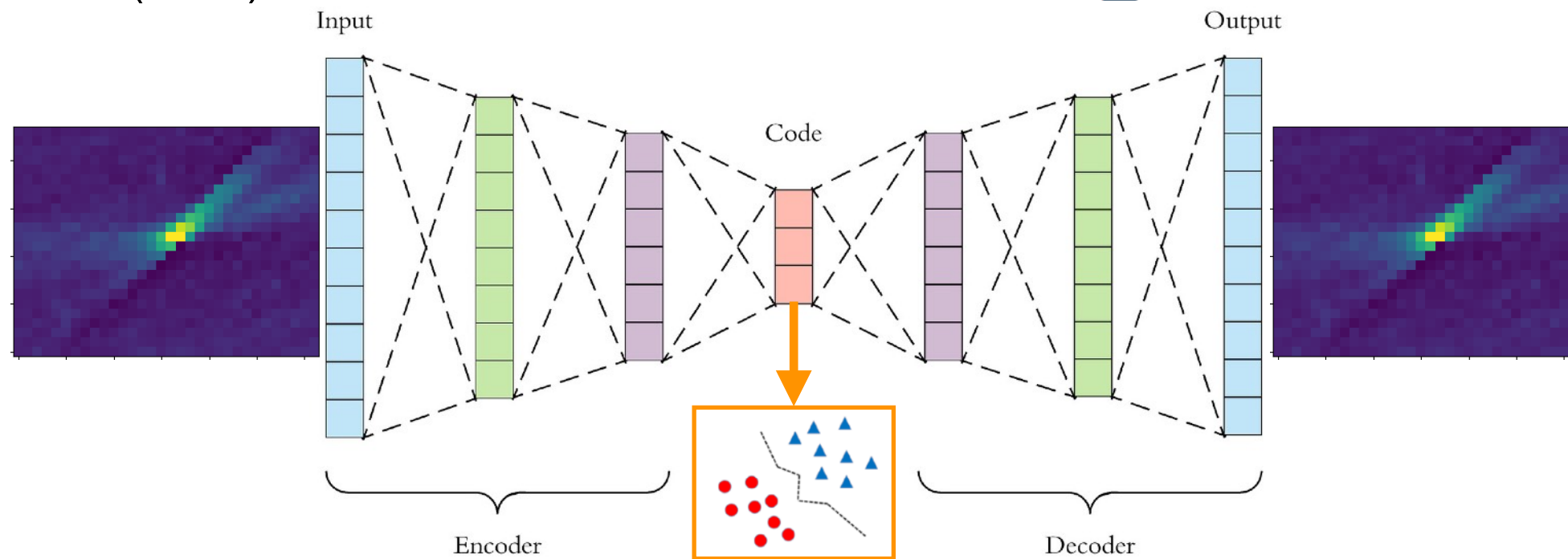


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- CHORD strategy:**

DM-t plane → CNN auto-encoder transformer

encode(DM-t) + estimated DM + reconstruction error → NN classifier





- **Collect CHIME candidates:**

- Simulate FRBs $nu-t$ in simpulse
- Inject into CHIME node and let bonsai work
- Retrieve $DM-t$ planes of triggers (mixed FRB and RFIs)
- identify injected FRBs, all the rest is RFIs
- only 1 tree (resolution)
- DM-t windows 32x32 cuts

2 inject runs:

- on parameter grid (~100 FRBs)
- more in number (~1000 FRBs) & more random

- **imbalanced dataset 1:50**

- **Add FRB DM-t planes:**

Simulate FRB $nu-t$ + noise $\rightarrow DM-t$

Gaussian pulse light curve (width), power-law spectrum, applied naive dispersion DM and tail scattering (from CHIME distribution), primitive de-dispersion

3 training options:

- train on FRBs only
- train on RFIs only
- train on FRBs + RFIs

[fluence/peak flux, DM, pulse width, mean freq., PL spec. index, scattering time]



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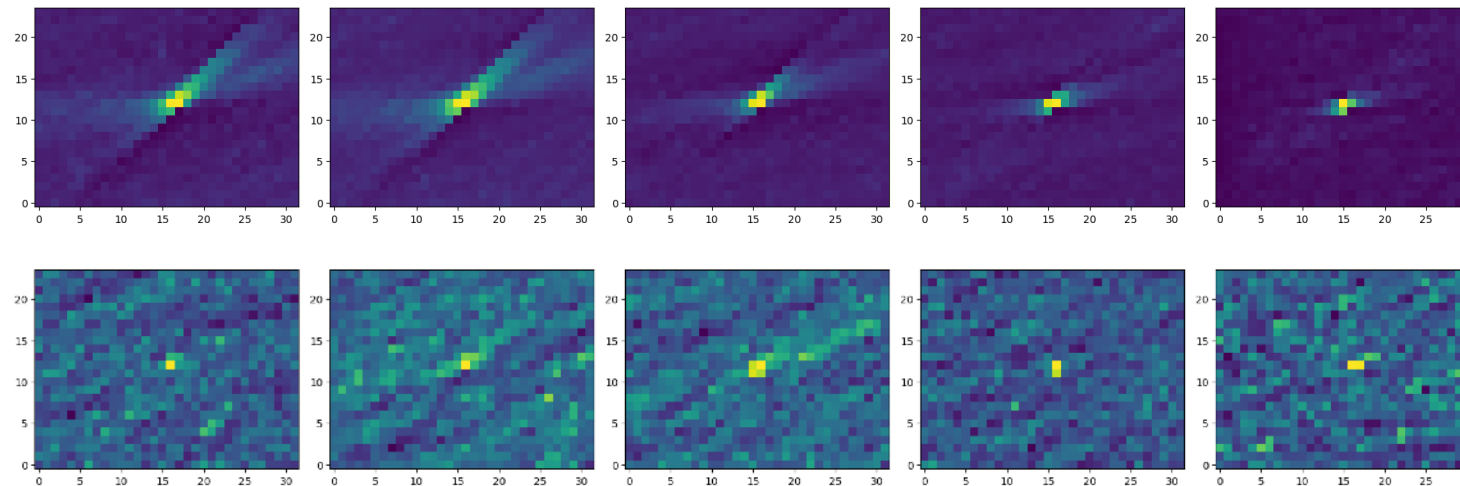
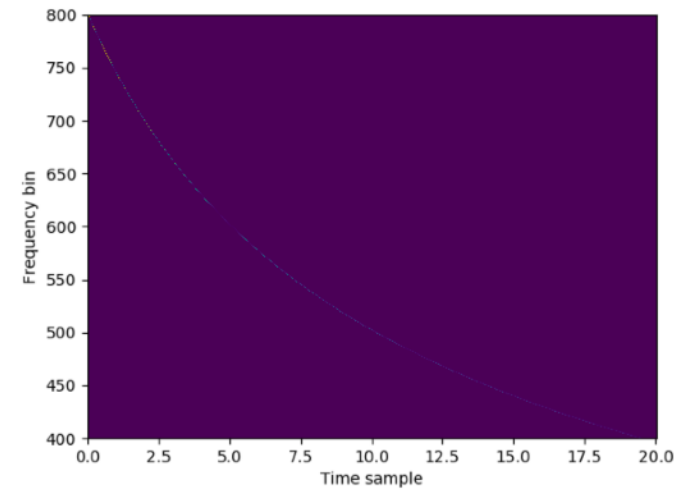
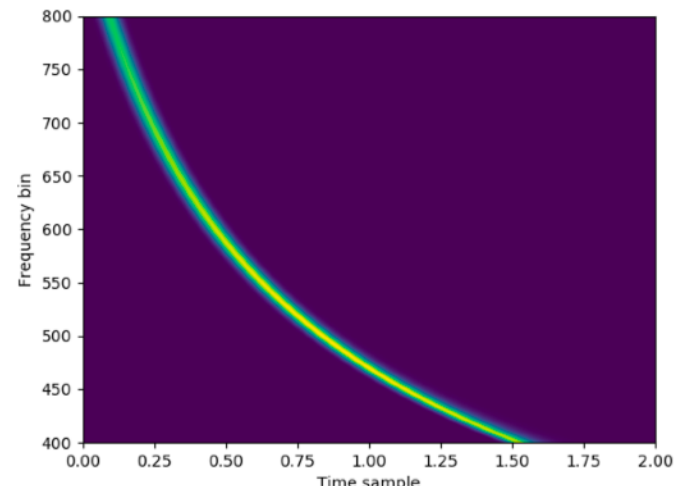
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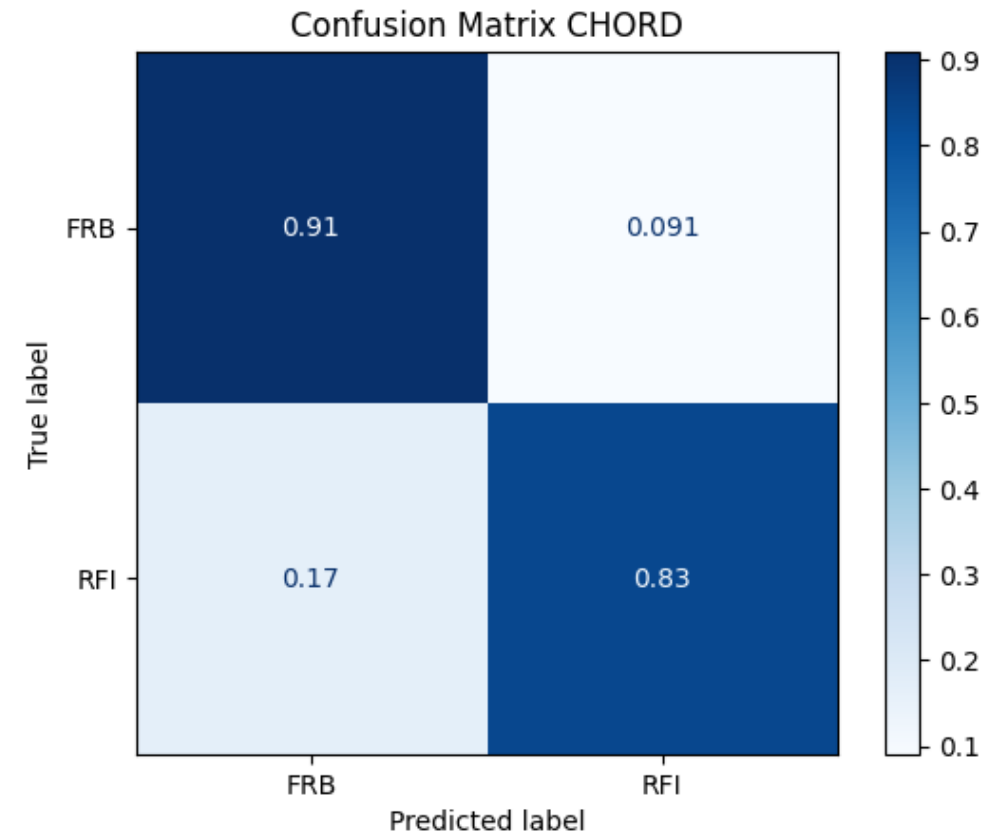
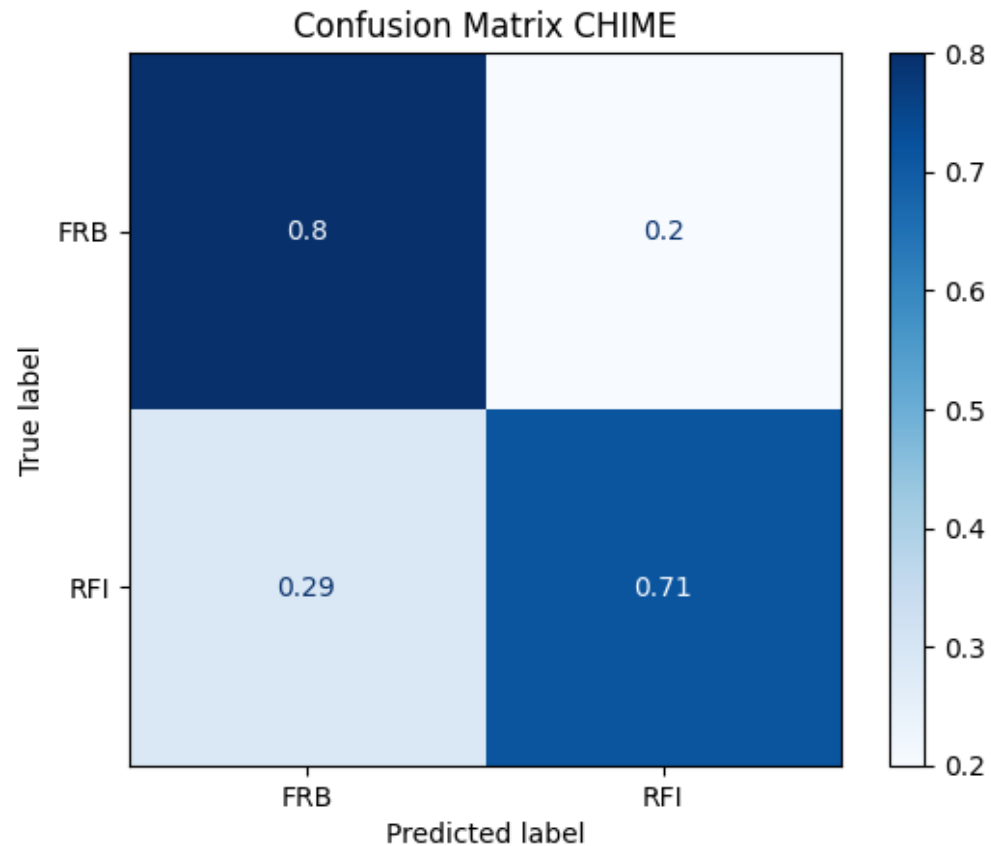
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L1b outperforms my naive CHIME implementation by 10%



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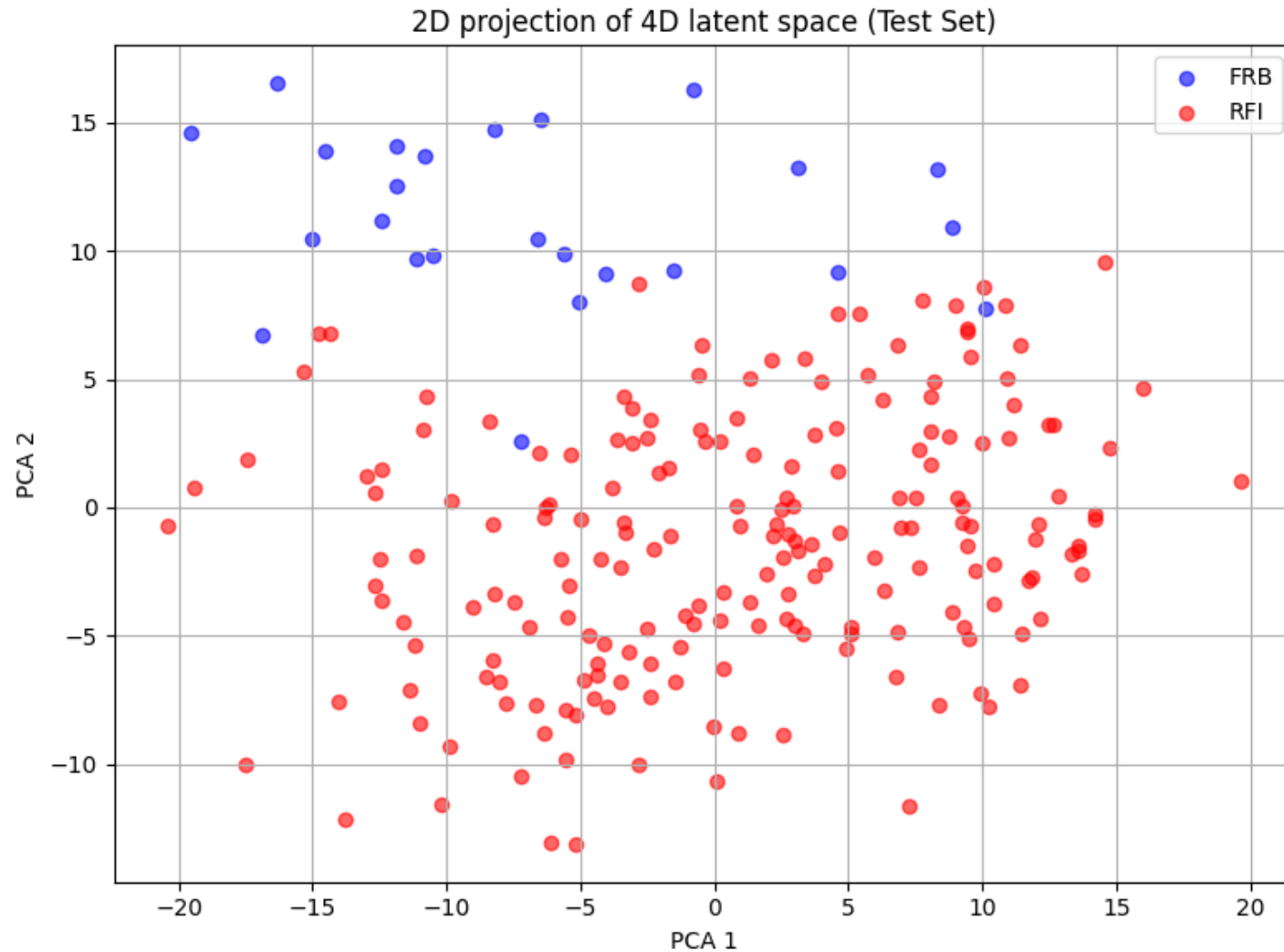
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Random Notes

- 5% of FRBs not triggered, 15% hard to identify (triggered at shifted time) in the DM-t plane
- CNN are translation invariant but not rotation invariant. Large range of DMs. Polar coordinates transformation?
- Training is slow, transfer to a better machine (TensorFlow + simpulse installed)
- Classification after being trained is very fast
- All this is for 1 channel, 1 beam (before beam grouping), trained on CHIME (transfer learning to CHORD needed).

What about **L2: sub-banding** and **beam illumination pattern** (impossible to train now)

- CHIME bonsai uses 1 spectral index
- Interpretability is limited
- More injected FRBs would help (1 more run of ~ 1000 FRBs ?)
- How will it look on CHORD?