

# What's new in L01?

French contribution to DDPC CU L01

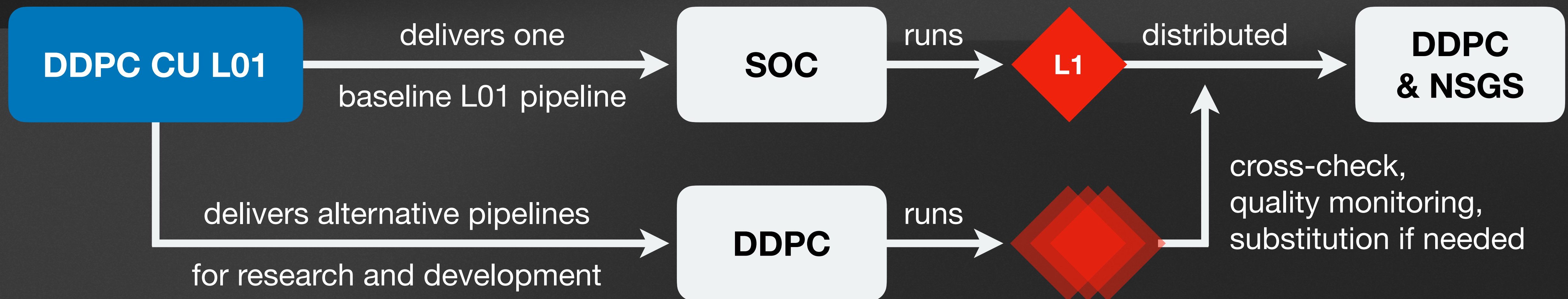
Jean-Baptiste Bayle, Aurélien Hees — Journées LISA France — Mai 2026 (IAP, Paris)

# Why? From L0 to L1 data

- **L0.5 data**
  - is downlinked from instrument with some unit conversion and coalesced packets
  - also contains ground-based observation, and orbit and clock fits
- **Unsuitable for scientific analysis** as some noises are much louder than signals and can be **mitigated by calibrating** / combining multiple measurement channels; such as
  - Laser noise
  - Clock noise
  - Tilt-to-length noise
- Also, data needs to be **transformed in an reference frame** suitable for astrophysics
- Also, need to **reconstruct essential information** (for noise suppression and calculation of the response function needed for the fits): arm lengths, clock deviation wrt. some global time frame, etc.
- **Produce L1 data** containing, among others,
  - TDI single-link  $\eta$  and XYZ
  - Light travel times and derivatives
  - Noise estimates
  - Orbit and clock estimates
  - Estimated TTL coefficients and noise

# What? Requirements on CU L01

- Current understanding of **DDPC CU L01** assignments
  - Official L01 pipeline is delivered by **CU L01** but run by **SOC**
  - Alternative pipeline are developed by **CU L01** and run at **DDPC**



# Who? Teams involved in CU L01

## Official leadership



## French contributions



## International contributions

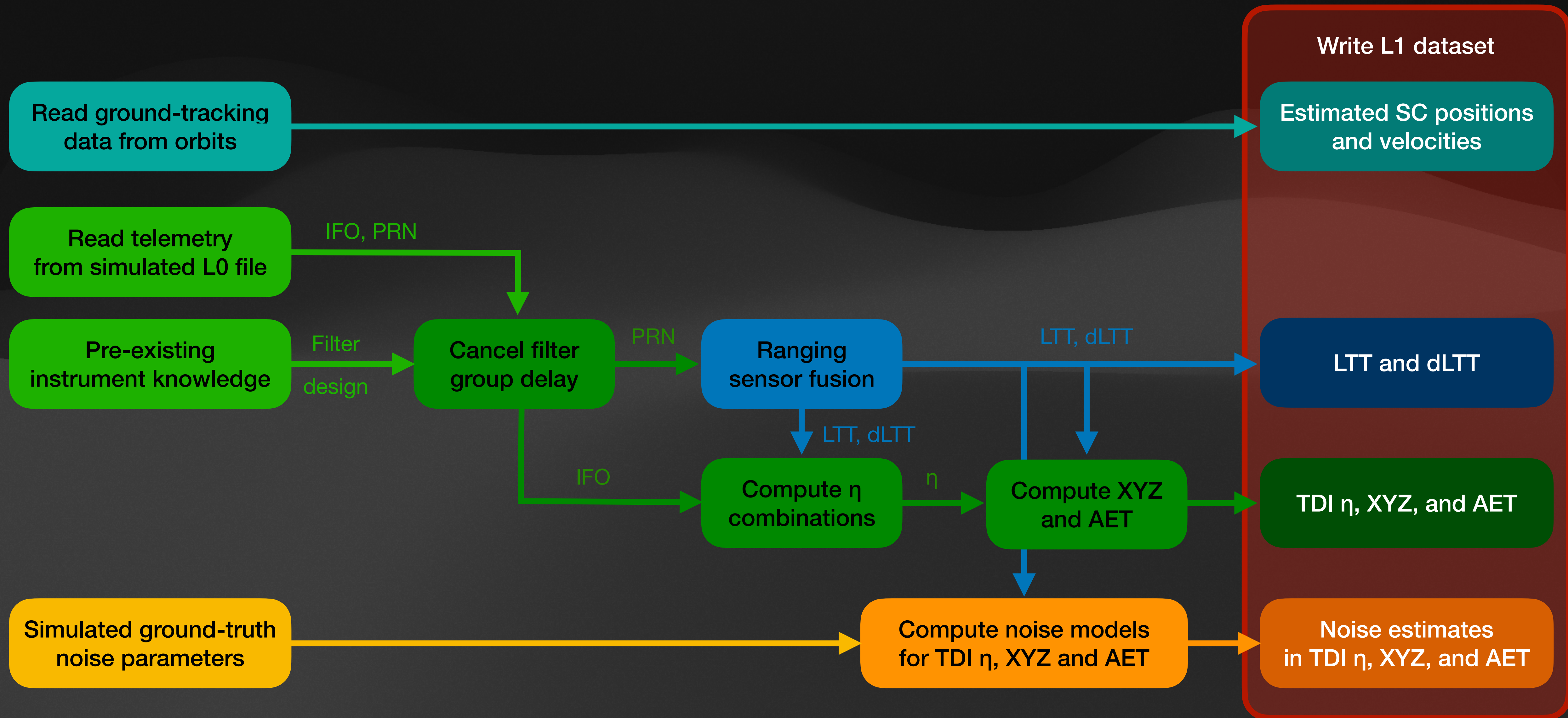


# How? Mojito light pipelines

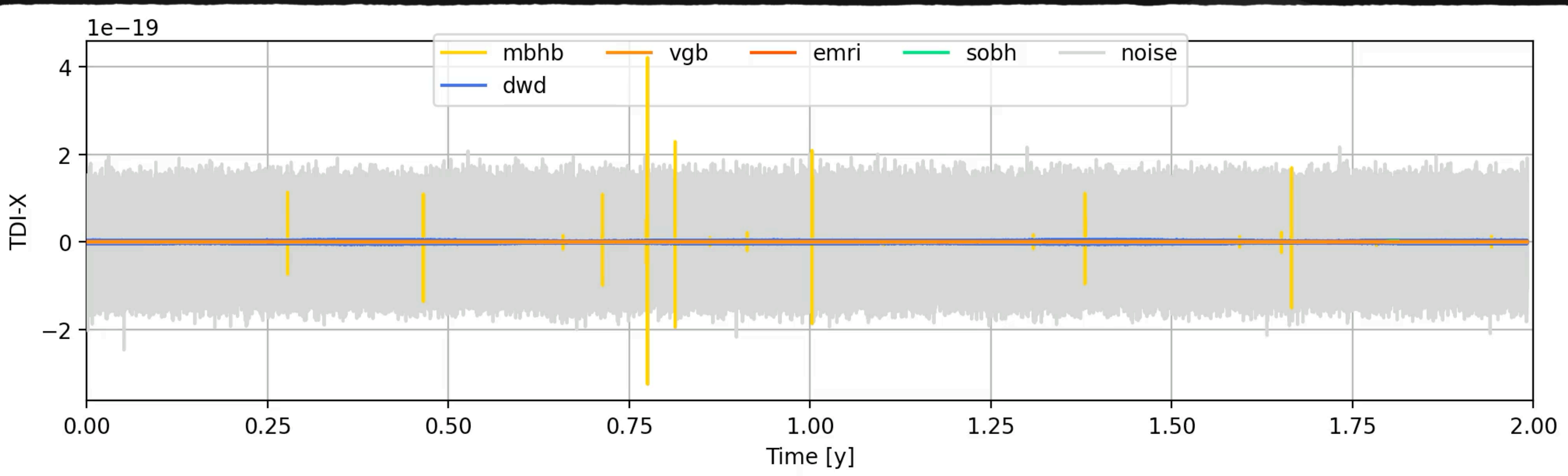
- 2 different Mojito light pipelines for **noise** and **signal**
  - These pipelines are run “in overlapping time chunks” for RAM optimization
  - Products can be combined under the assumption of linearity (good approx.)

	Signal pipeline	Noise pipeline
Frequency content	Fluctuations (in-band only)	Total frequency
Inputs	Link response directly (to optimize the simulation pipeline)	Simulated L0.5 (includes instrumental simulations)
Outputs	TDI observables, LTT and orbits estimates	Also includes noise covariance estimations

# How? Mojito light noise pipeline

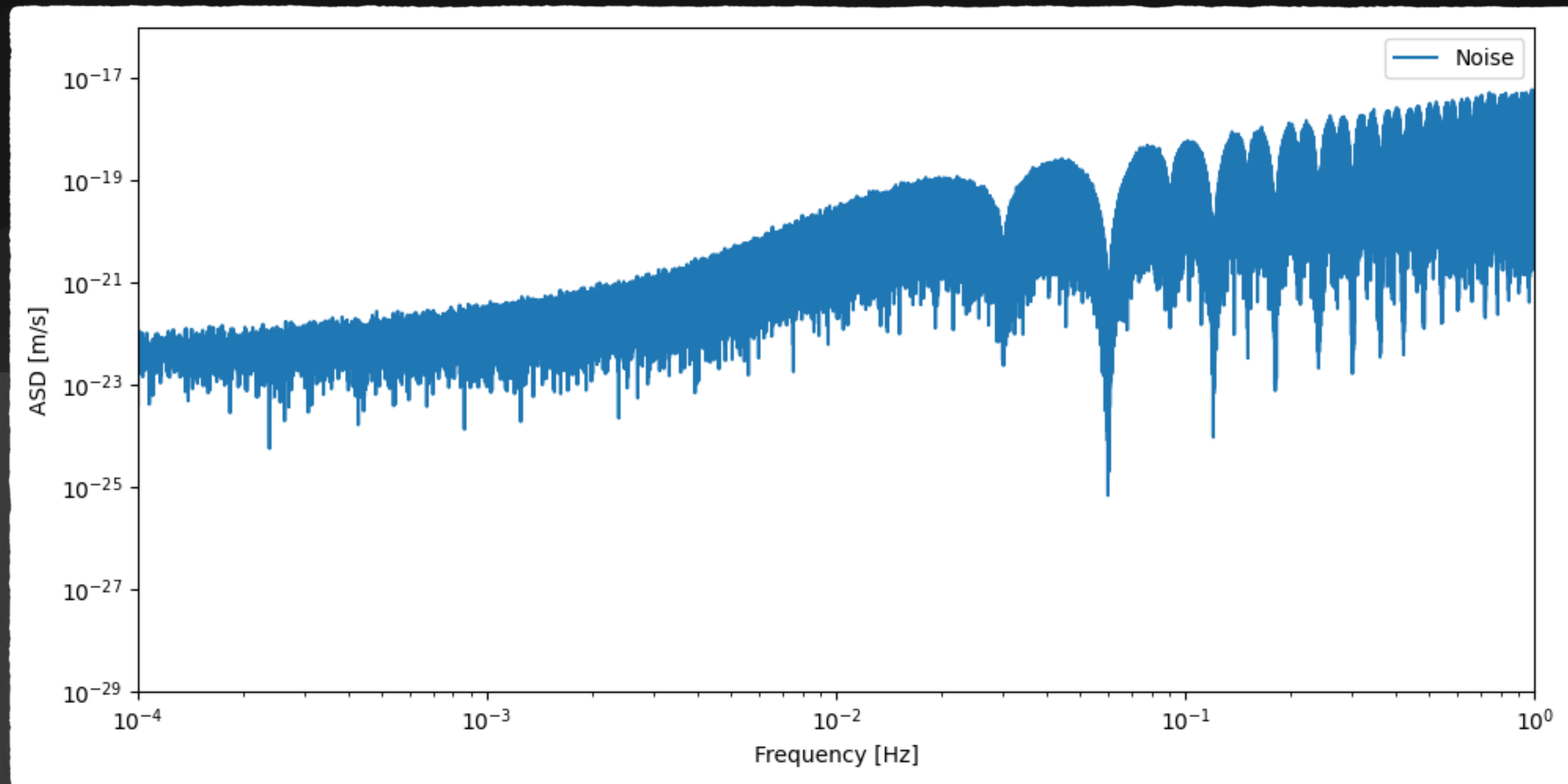


# Results Eyes and ears on L1 TDI X time series

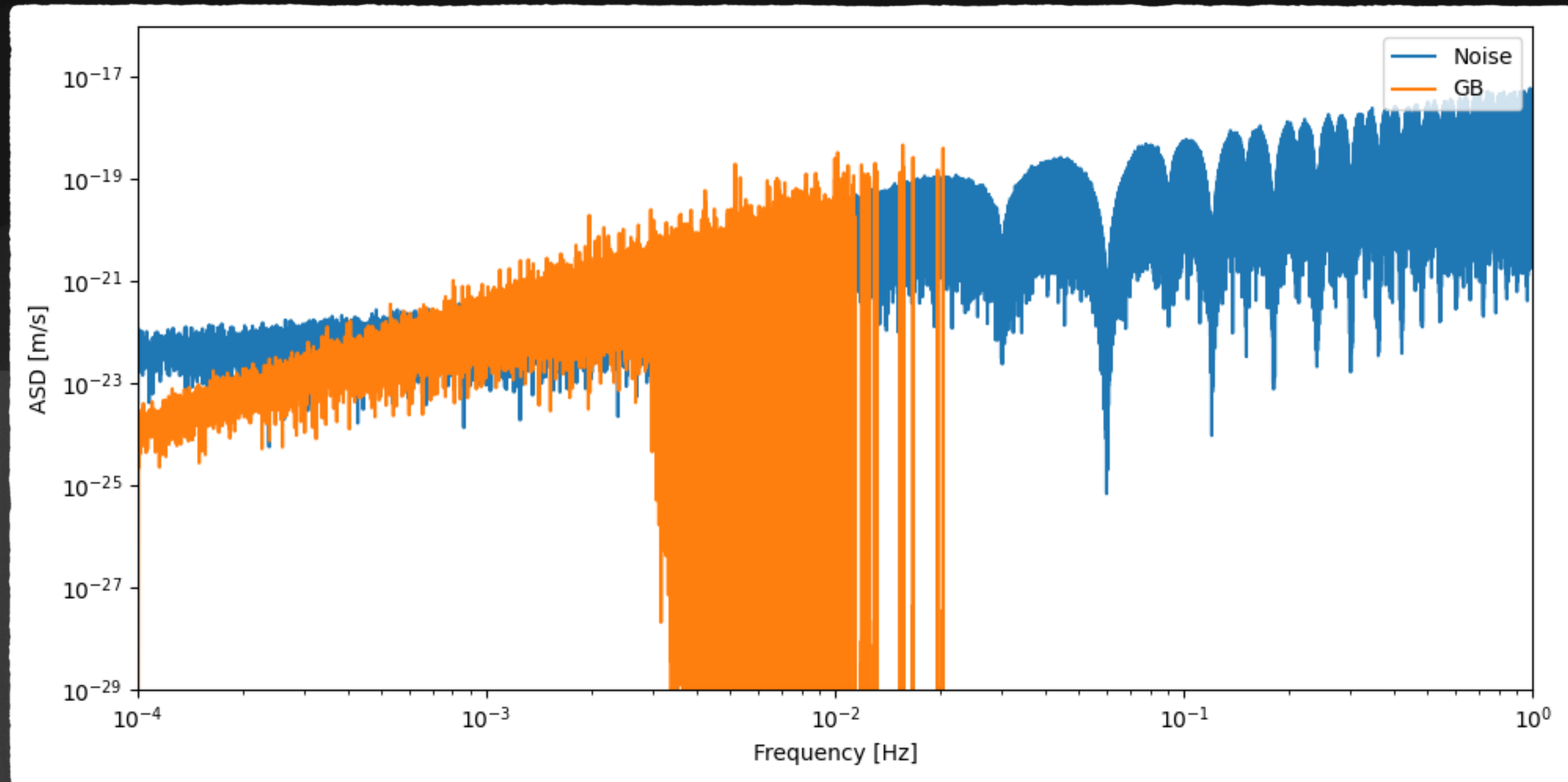


Courtesy of H. Inchauspé

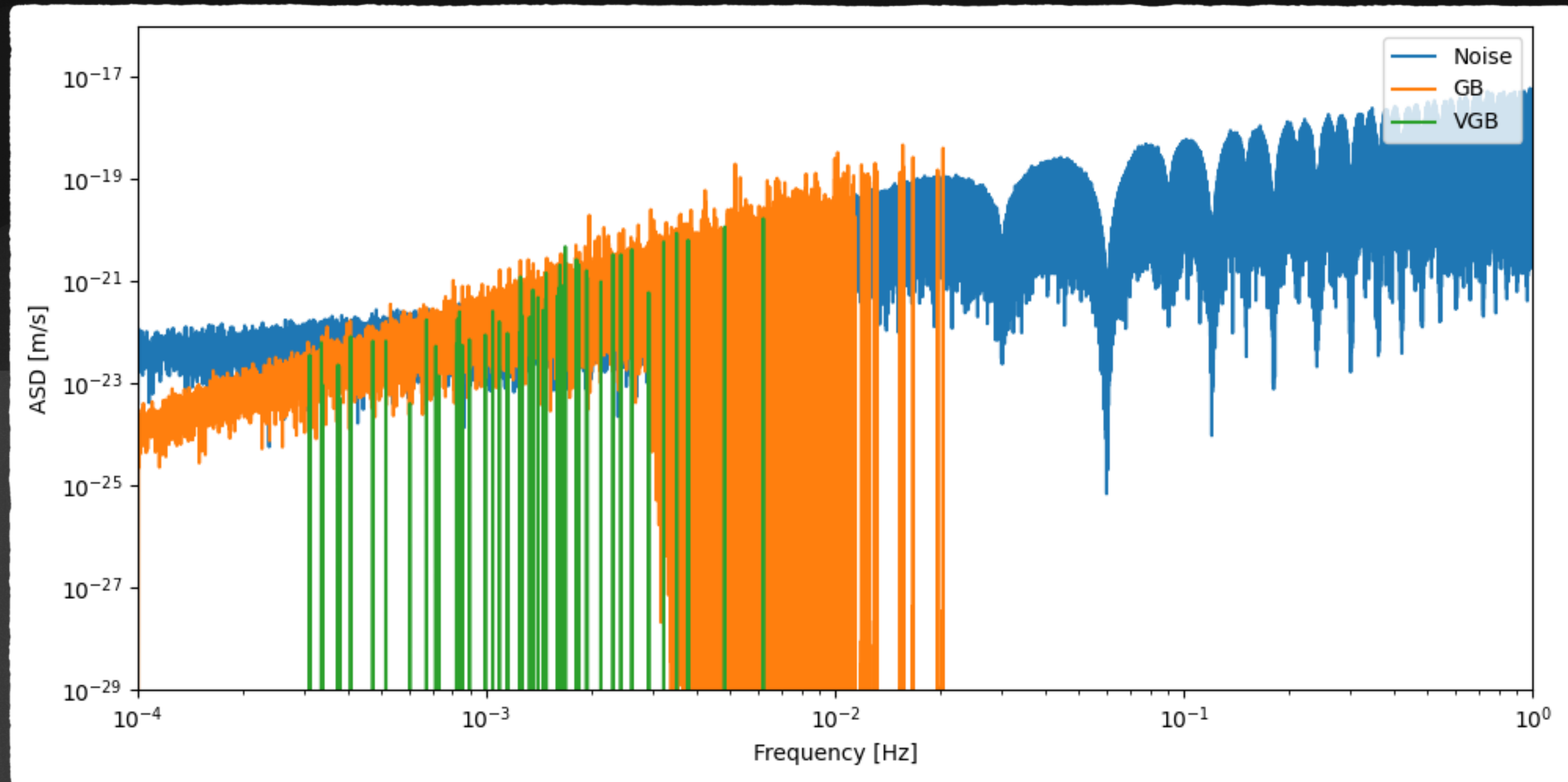
# Results L1 TDI X periodograms



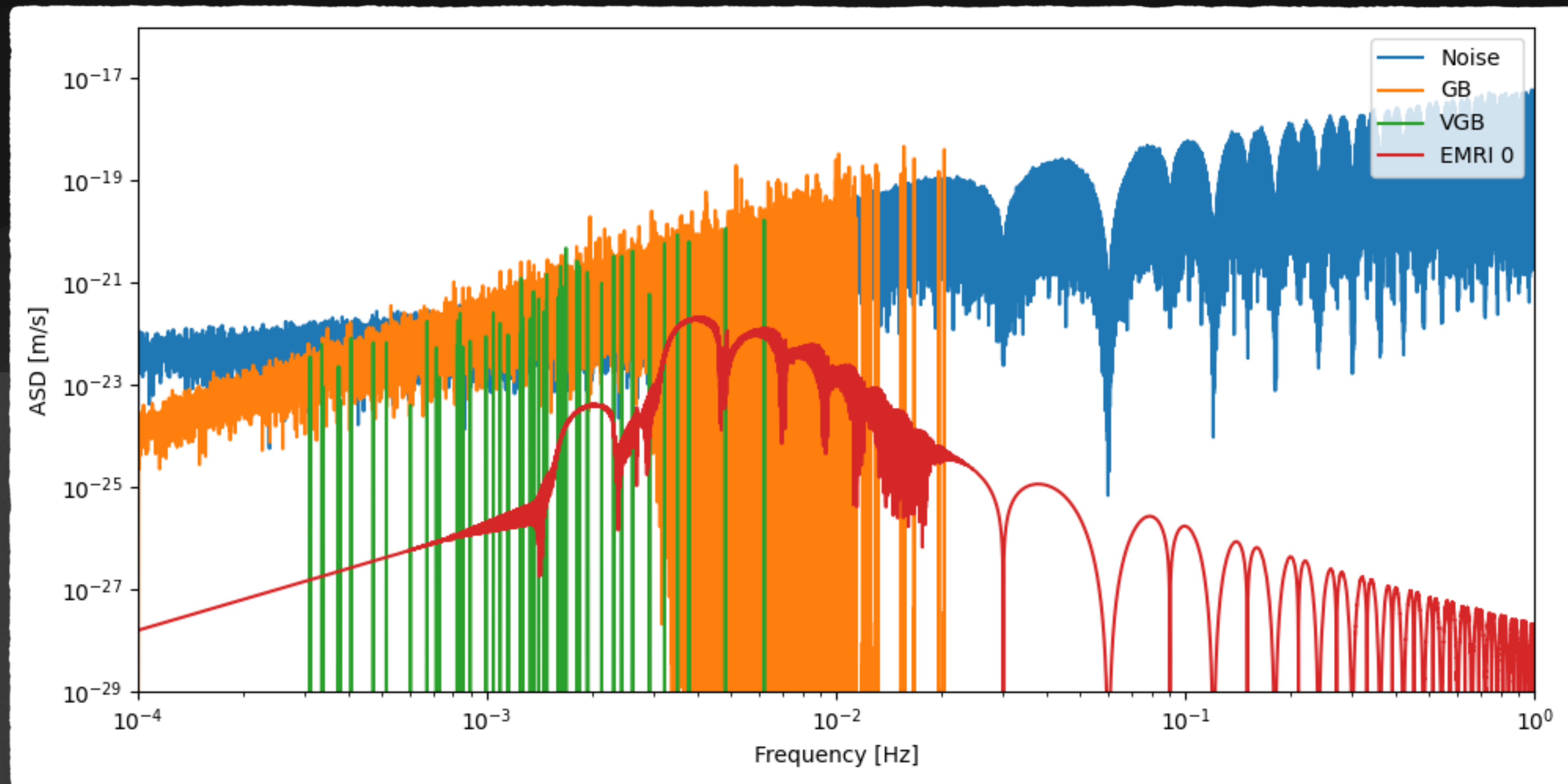
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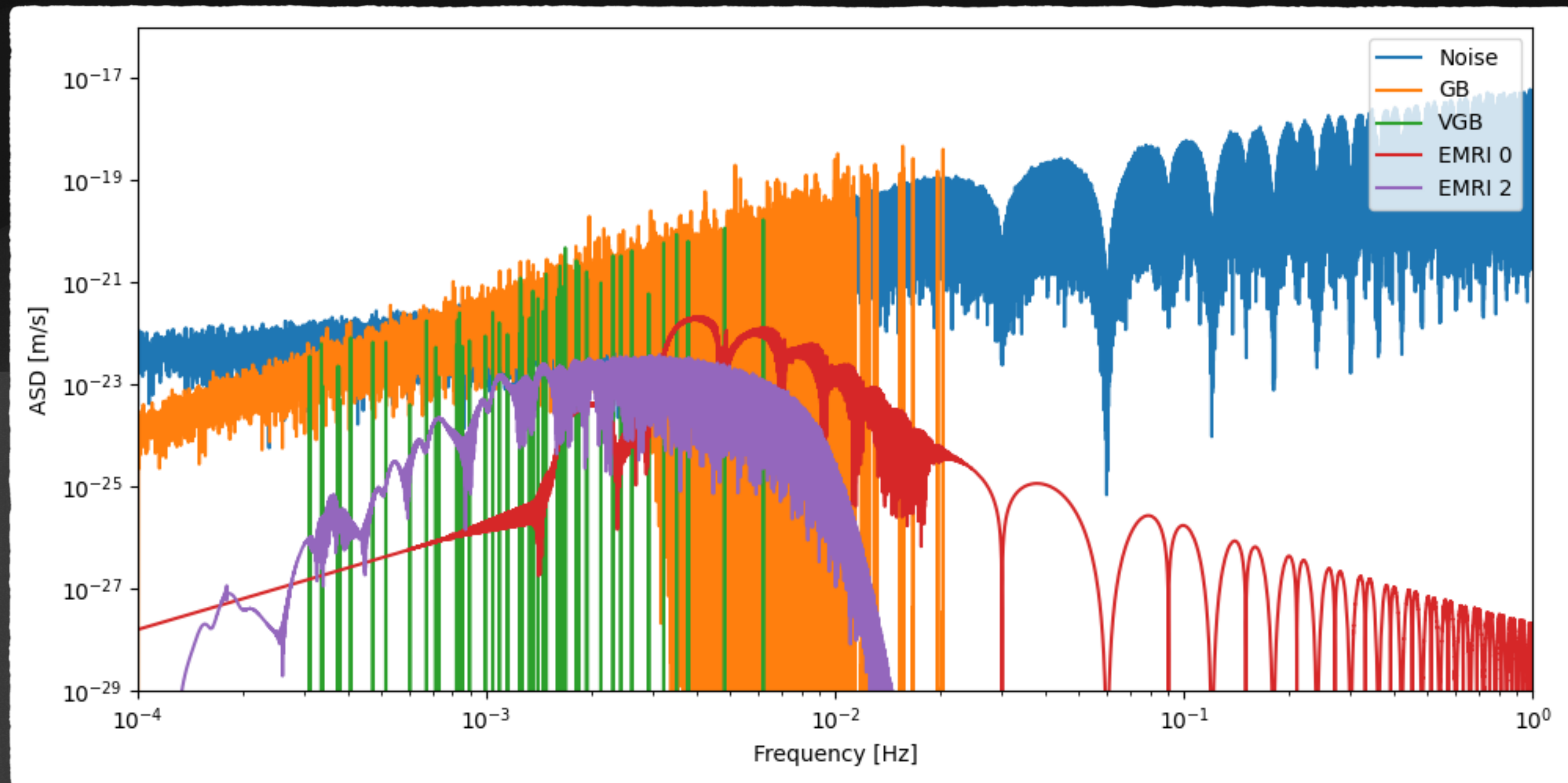
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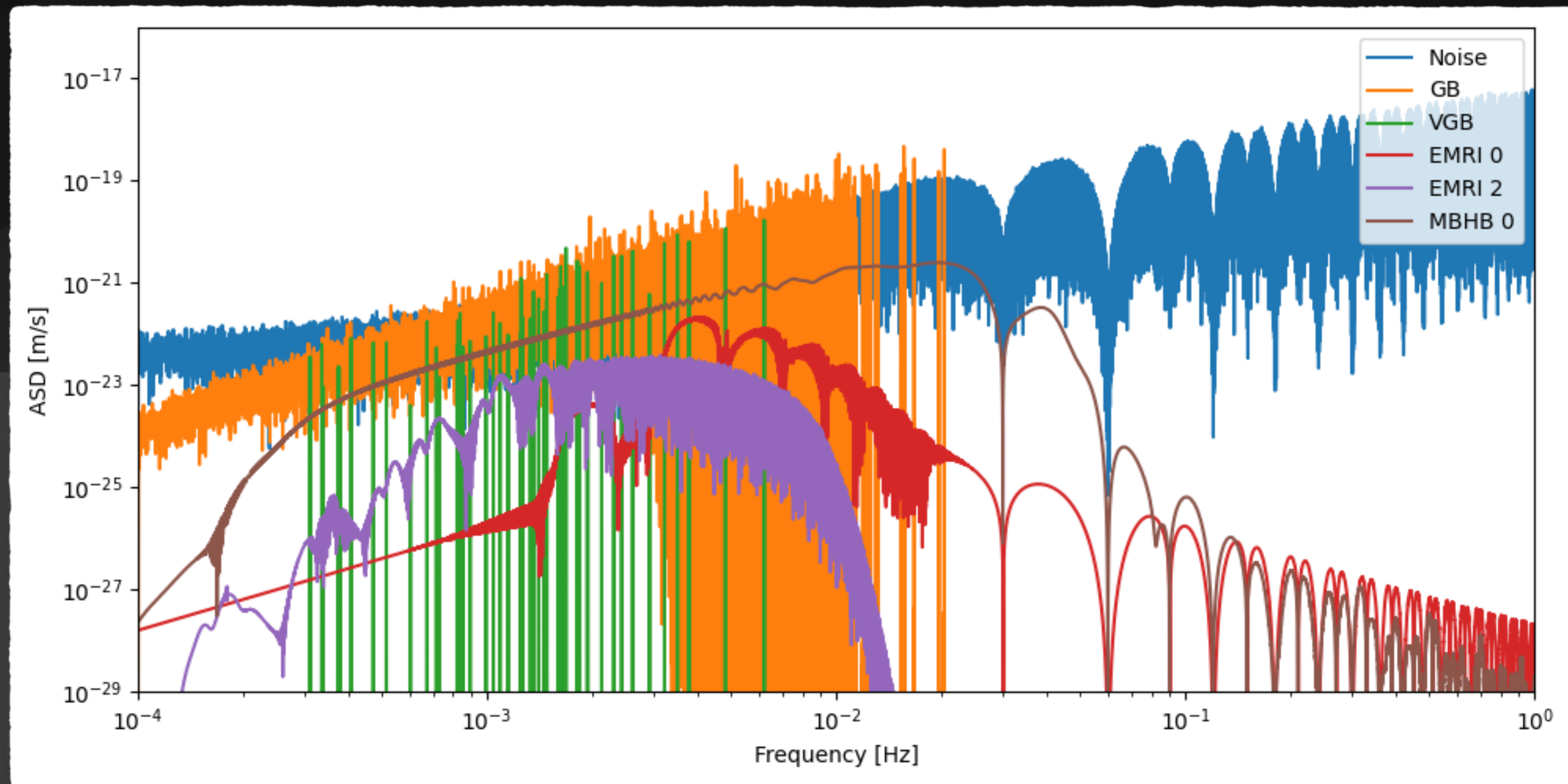
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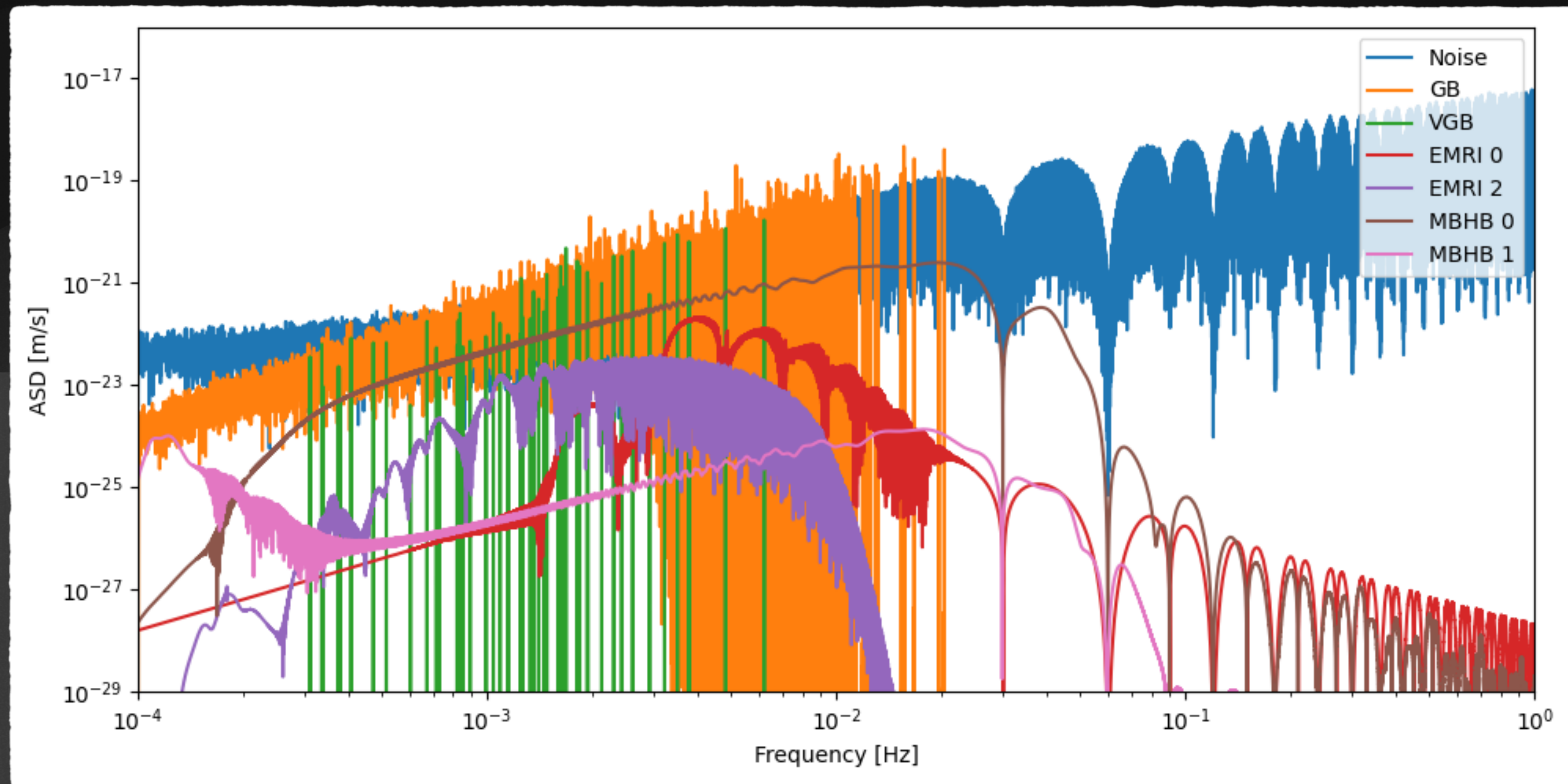
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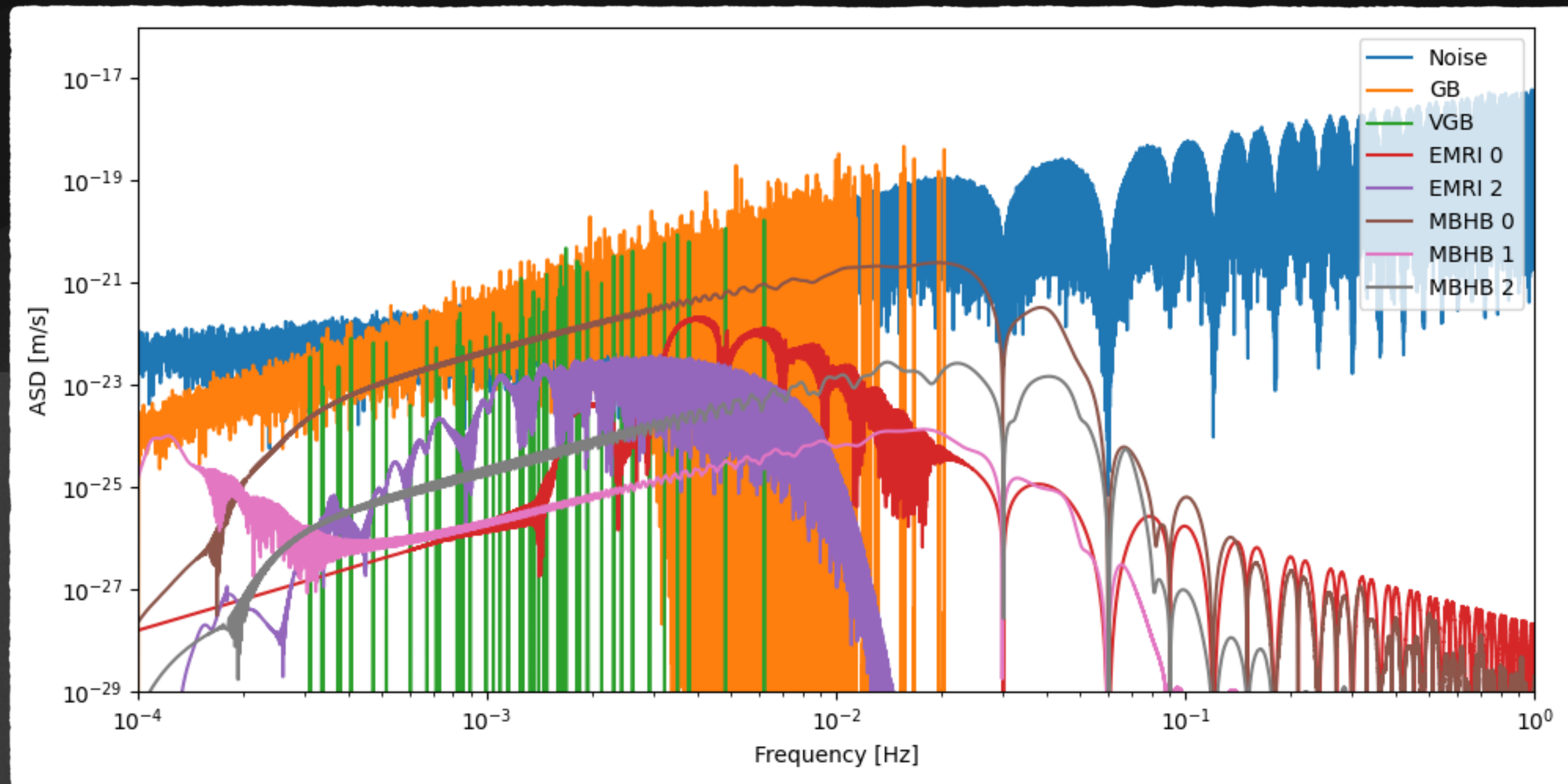
# Results L1 TDI X periodograms



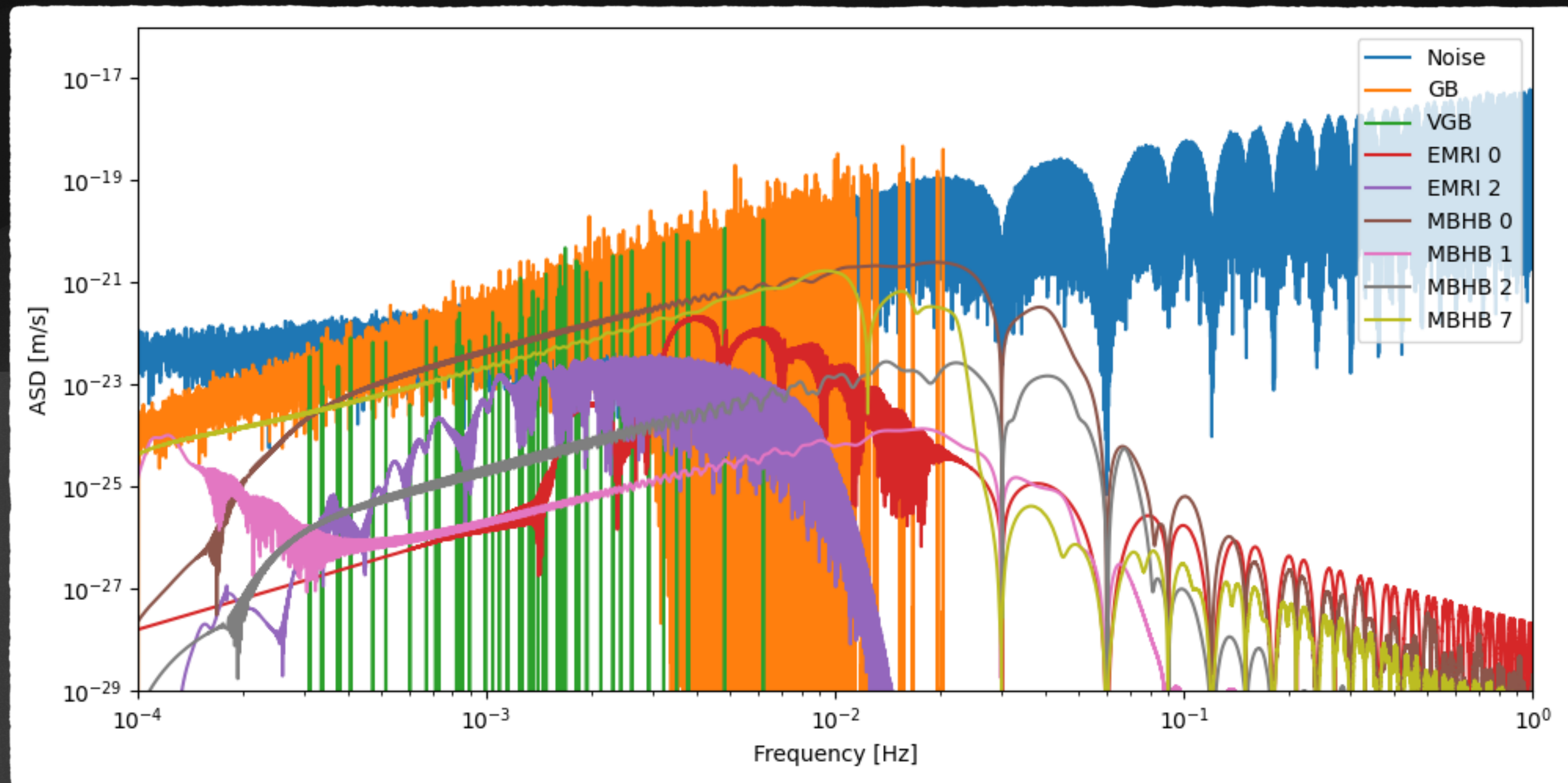
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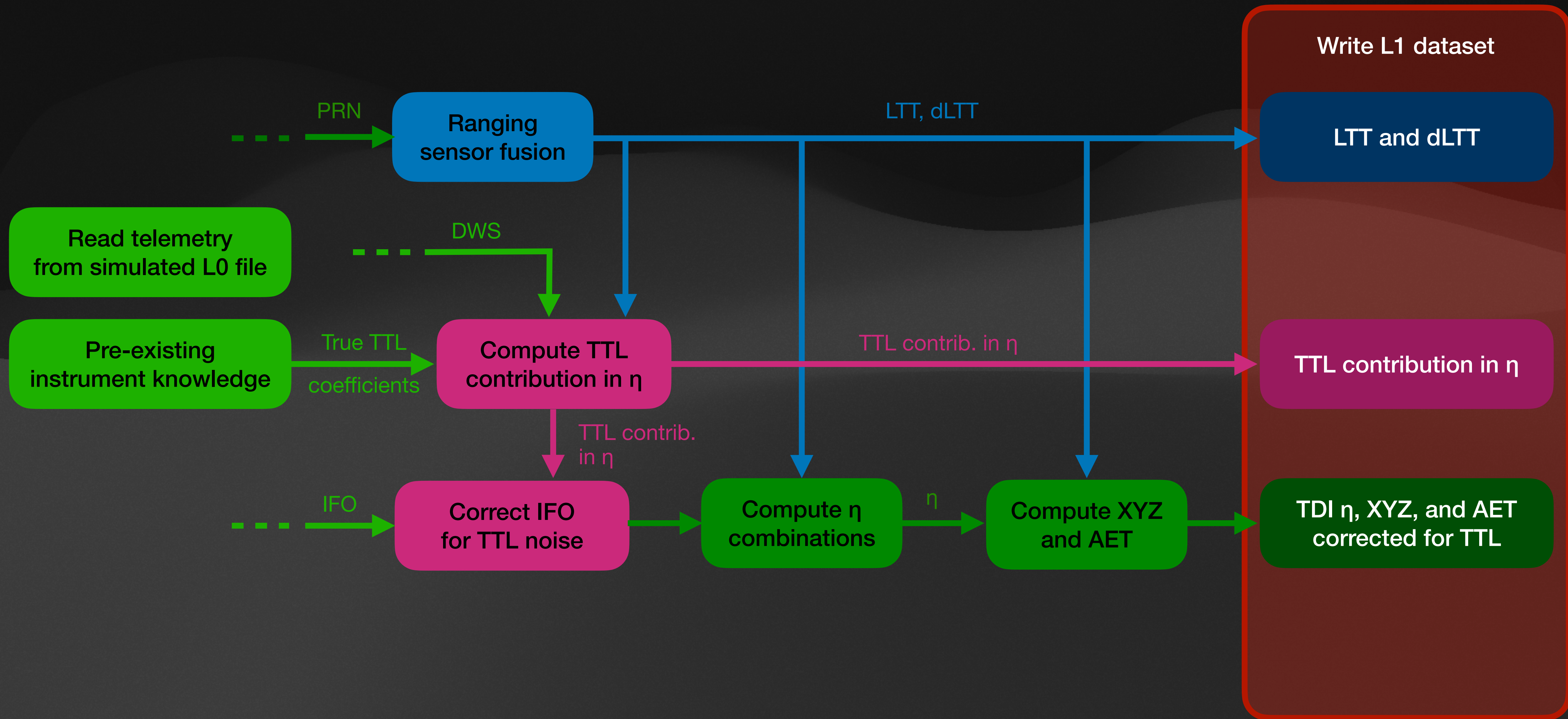
# Results L1 TDI X periodograms



# How? Mojito heavy pipelines

- 4 different Mojito heavy pipelines for **noise**, **signal**, **gaps**, and **glitches**
- **Noise pipeline** now includes
  - TTL correction, assuming perfect knowledge of time-varying coefficients
  - Improved noise modeling (laser noise residuals, TTL noise residuals, backlink noise, nonstationary test-mass noise, etc).
- **Gap pipeline** assumes we look all IFO data on a given schedule and propagate data gaps through the L01 noise pipeline
- **Glitch pipeline** propagates instrument glitches from L0 to L1, nearly identical to noise pipeline

# How? Mojito heavy noise pipeline



# How? Other activities

- Implementation of TTL coefficient estimation and mitigation using these imperfect estimates
- Improved ranging estimation using Kalman filters, comparison with current method
- Study of numerical precision and modeling of numerical errors
- Improvement of pipeline robustness against gaps and glitches
- Better validation of L01 pipelines
- Noise estimation and quality flagging
- Orbits reconstruction
- Implementation and study of TDI-free methods (PCI & TDI infinity)
- Fast L1 production for L2A (thinking about data ingestion and “re-regeneration” of L1)