SOLVING SOURCE SEPARATION PROBLEM FOR LISA DATA ANALYSIS WITH AUTOENCODERS

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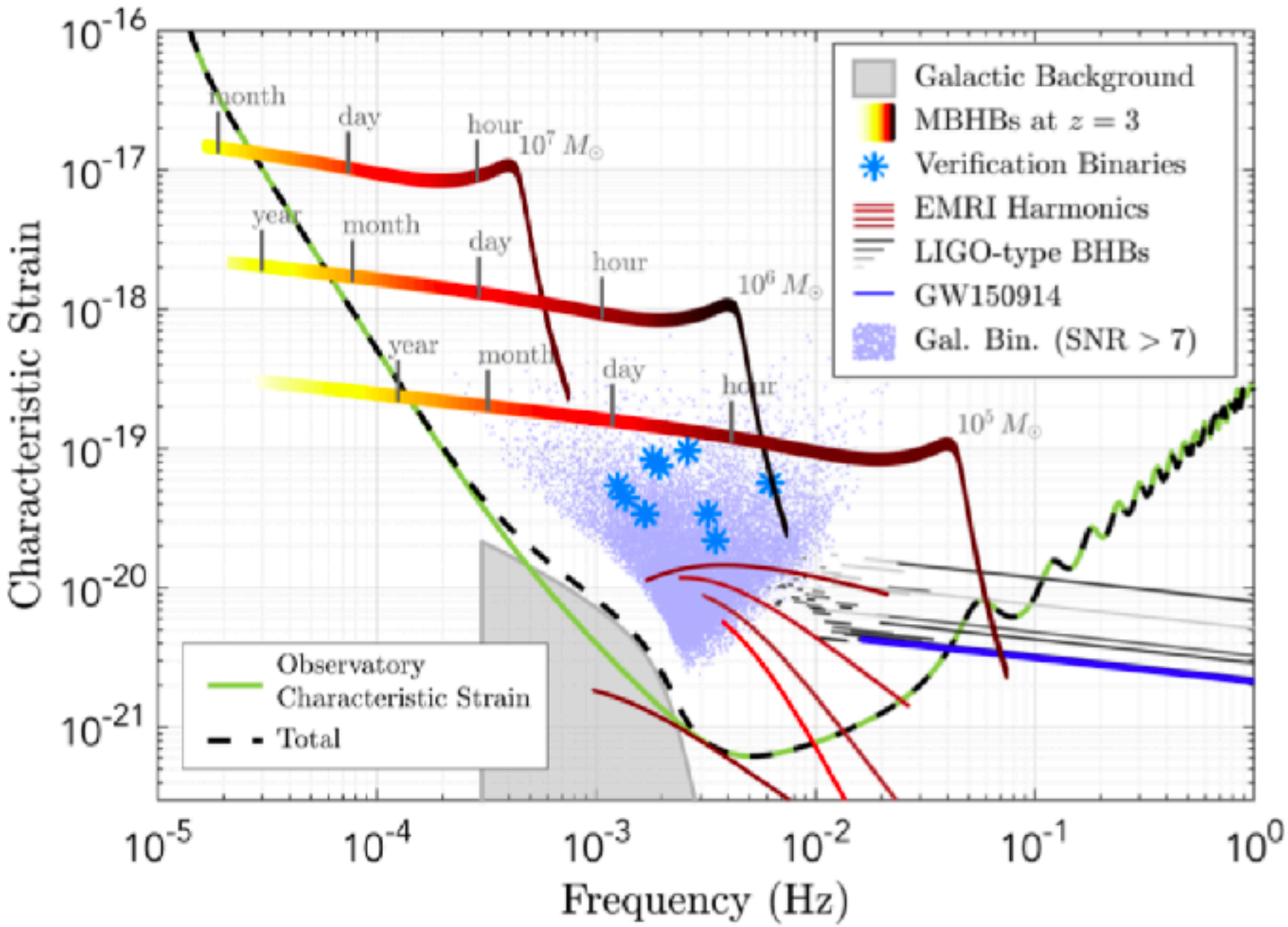
LISA SOURCES



SOURCE POPULATIONS

- *Massive Black Hole Binaries*
  — 10 to 100 sources / year [1]

- *Extreme Mass Ratio Inspirals*
  — 1 to 10000 [2]

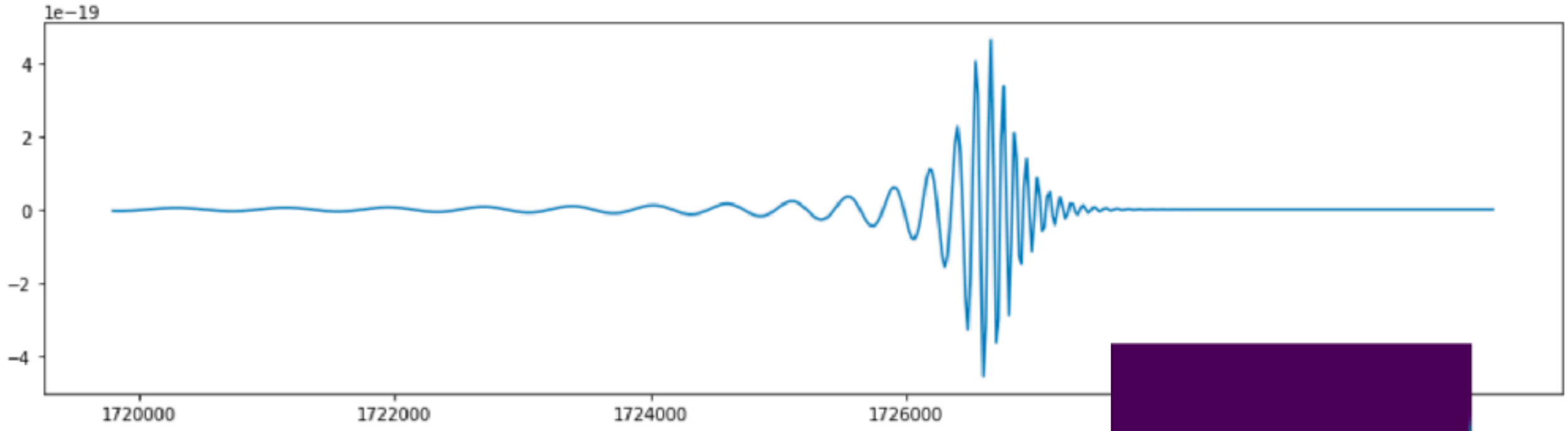
- *White Dwarf Binaries*
  — approx 25000 individual resolved galactic binaries [3]

- *etc*

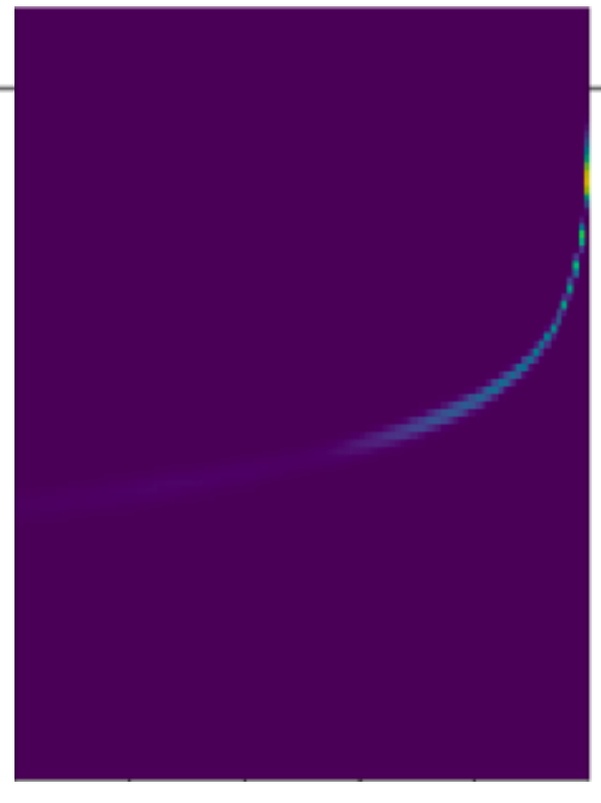
[1] Gair et al, Constraining properties of the black hole population using LISA, Class. Quantum Grav. for proceedings of 8th LISA Symposium, arxiv.org/abs/1009.6172
[2] Gair et al, Prospects for observing extreme-mass-ratio inspirals with LISA, Journal of Physics: Conference Series, Volume 840, conference 1, arxiv.org/abs/1704.00009
[3] Toonen et al, Supernova Type Ia progenitors from merging double white dwarfs: Using a new population synthesis model, A&A Volume 546, arxiv.org/abs/1208.6446

DATA REPRESENTATION

- *Example of a time series of the MBHB around coalescence (no detector noise)*

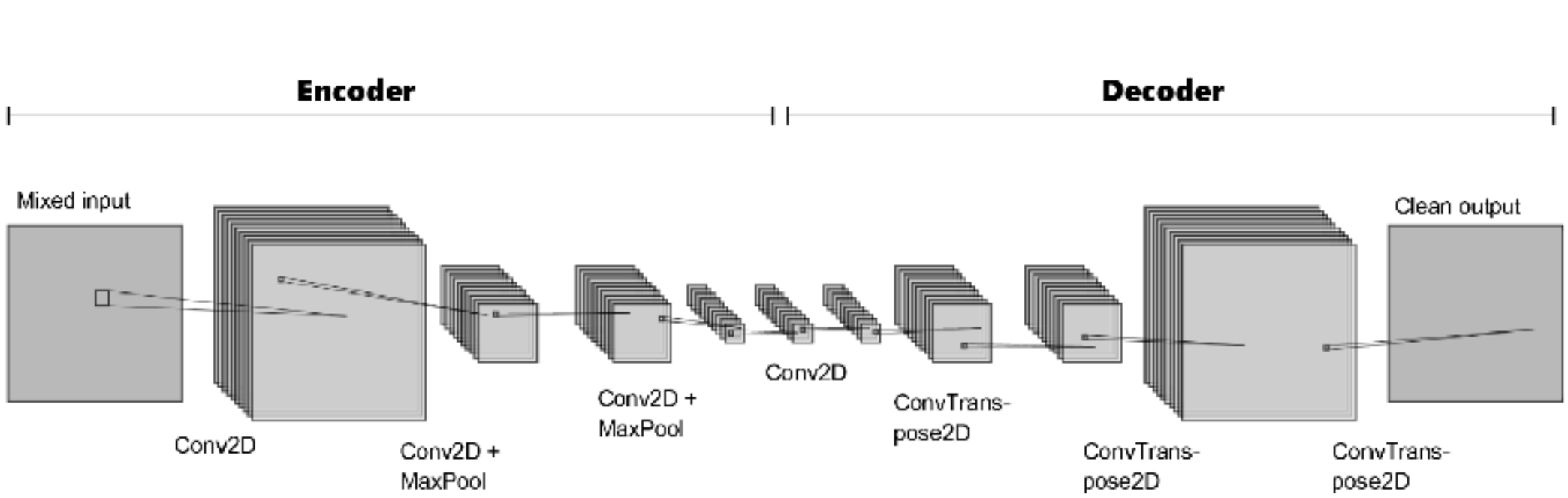


- *Spectrum of the MBHB around coalescence (no noise)*



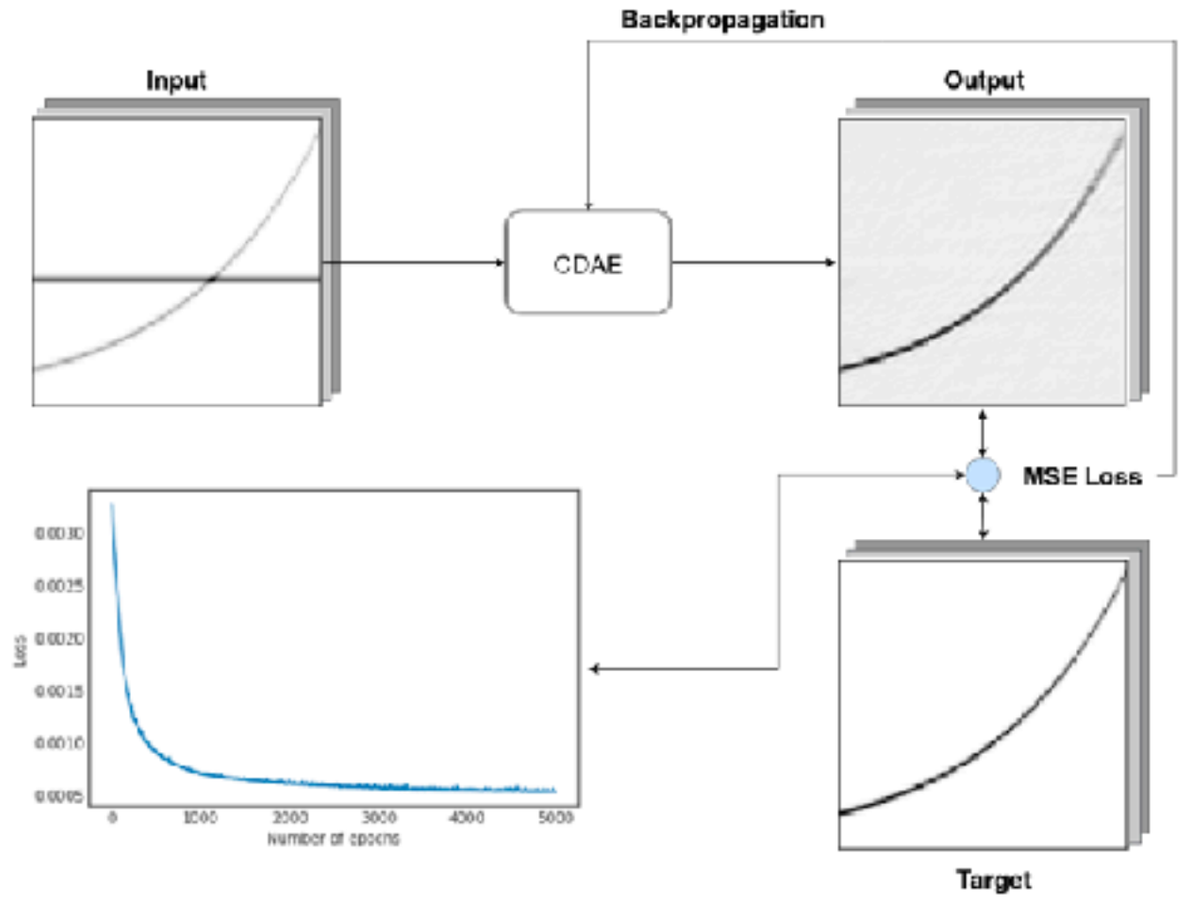
DENOISING CONVOLUTIONAL AUTOENCODERS

- *Inspired by the paper Single Channel Audio Source Separation using Convolutional Denoising Autoencoders by Emad M. Grais and Mark D. Plumbley (GlobalSIP 2017)*

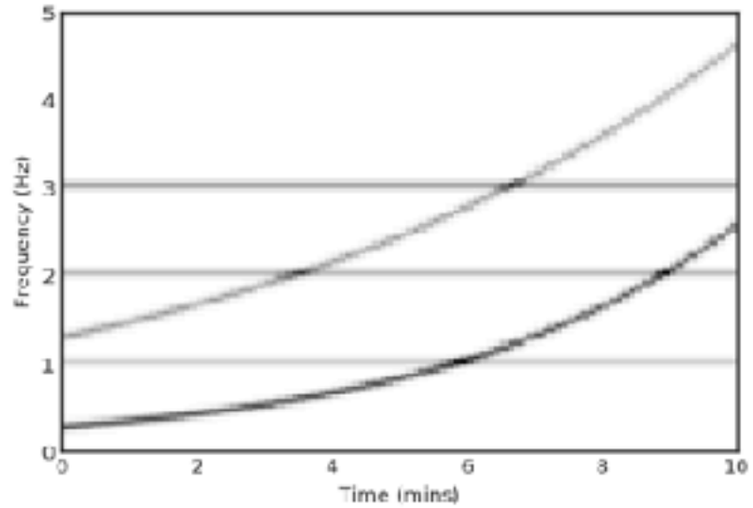


TOY PROBLEM

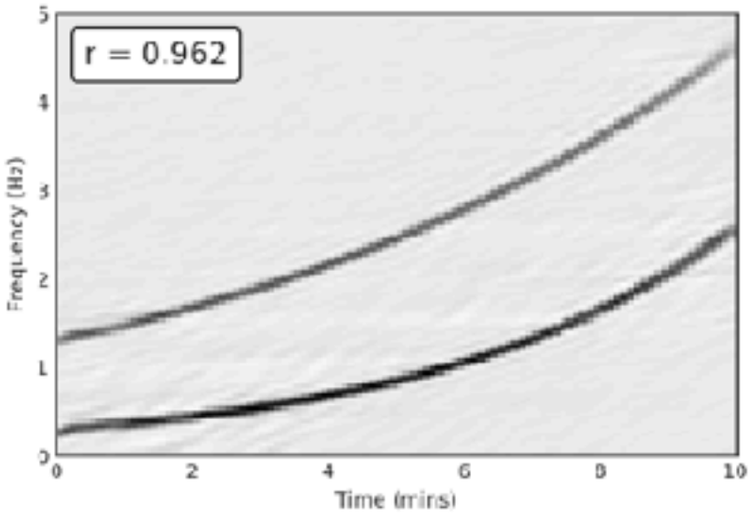
- *Chirp*
- *Sine spectrum*



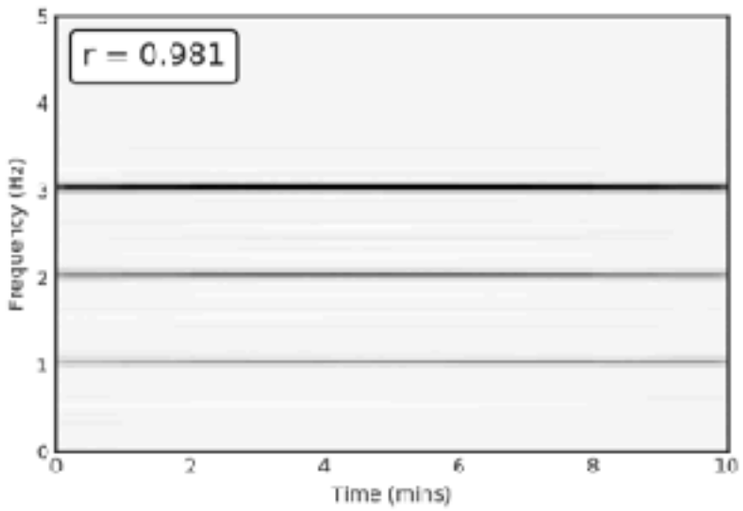
PERFORMANCE ON THE TOY PROBLEM



(a)

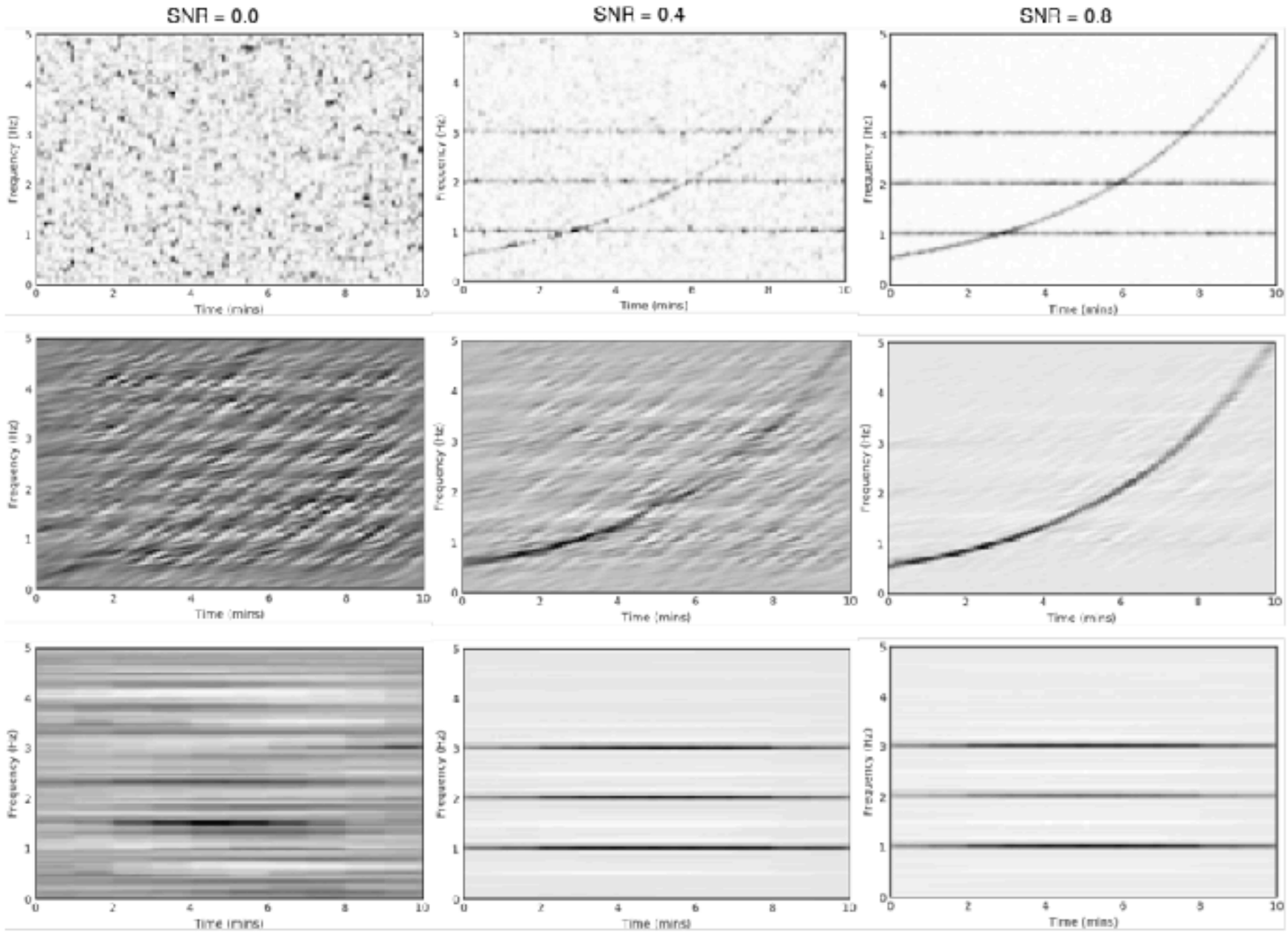


(b)



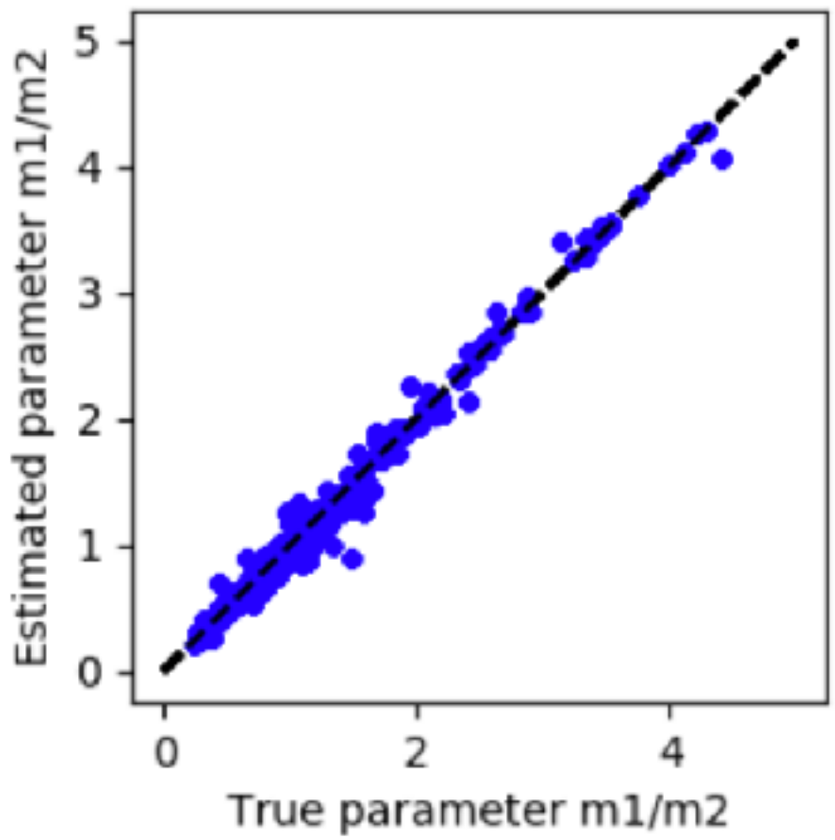
(c)

PERFORMANCE ON THE TOY PROBLEM



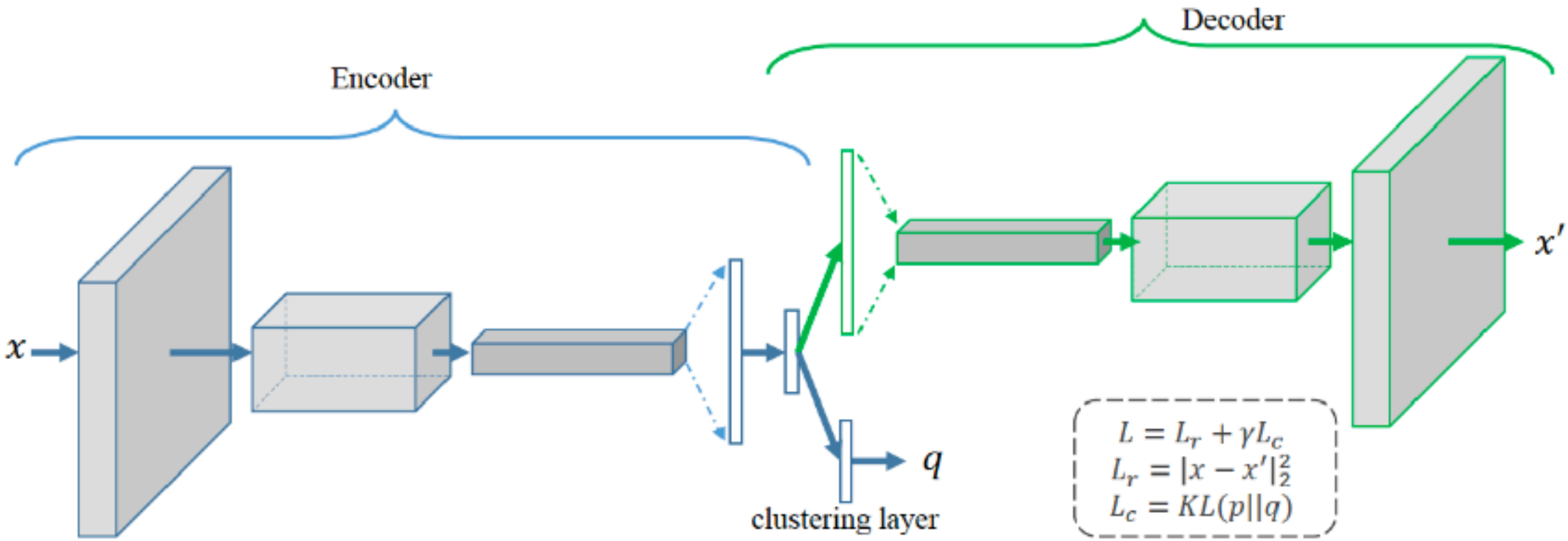
POINT PARAMETER ESTIMATION

- *Mass ratio parameter estimation for MBHBs*



FUTURE DIRECTION

- *Combine*



- *Deep Clustering with Convolutional Autoencoders, Xifeng Guo, Xinwang LiuEn Zhu, Jianping Yin, ICONIP 2017*

CONCLUSIONS AND FUTURE DIRECTION

- *Demonstrated on the toy model performance of one network*
- *Demonstrated the performance of parameter estimation network*
- *Now we need to combine them*
- *This network will provide the point estimated of the parameters for the mixed signals*