Gravitational Waves Group @ Aristotle University of Thessaloniki

NIKOLAOS STERGIOULAS

DEPARTMENT OF PHYSICS

ARISTOTLE UNIVERSITY OF THESSALONIKI

ΛISA in Greece, 23/2/2022

GROUP MEMBERS

LISA Consortium (since 2018)

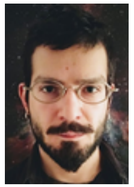

Stergioulas


Pappas


Karnesis


Sasli


Oikonomou


Souvaitzis


Kugiumtzis

(Department of Physics)

(Department of Electrical and Computer Engineering)

Virgo Collaboration (since 2020)

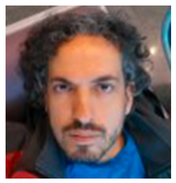

Stergioulas


Pappas


Karnesis


Pesios


Sasli


Tefas


Passalis


Nousi

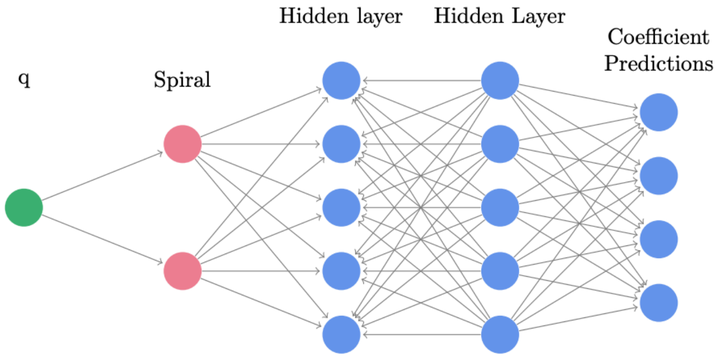
(Department of Physics)

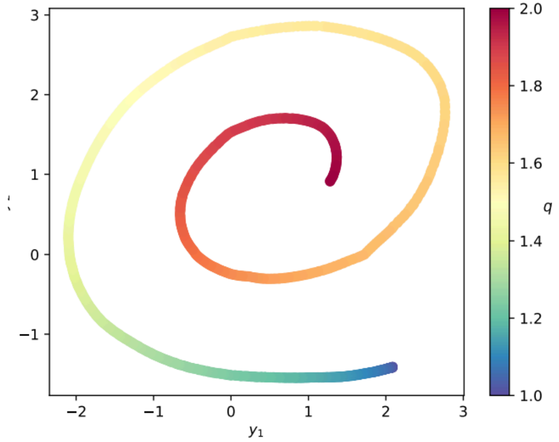
(Department of Informatics)

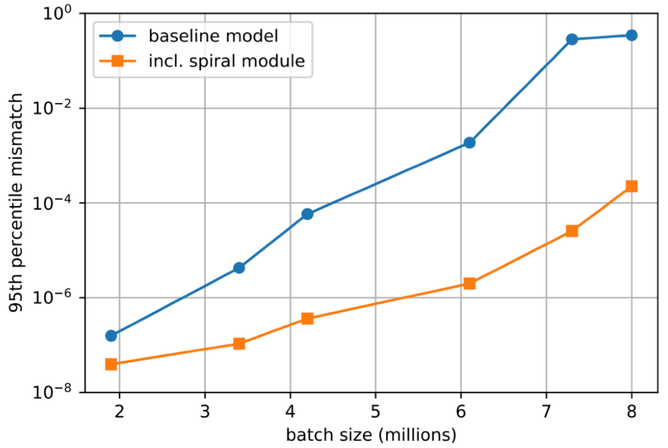
MACHINE–LEARNING APPLICATIONS TO GW ASTRONOMY

"Autoencoder-driven Spiral Representation Learning for Gravitational Wave Surrogate Modelling"

P. Nousi, N. Passalis, P. Iosif, Th. Apostolatos, G. Pappas, N. Stergioulas, A. Tefas, arXiv:2107.04312 (2021)

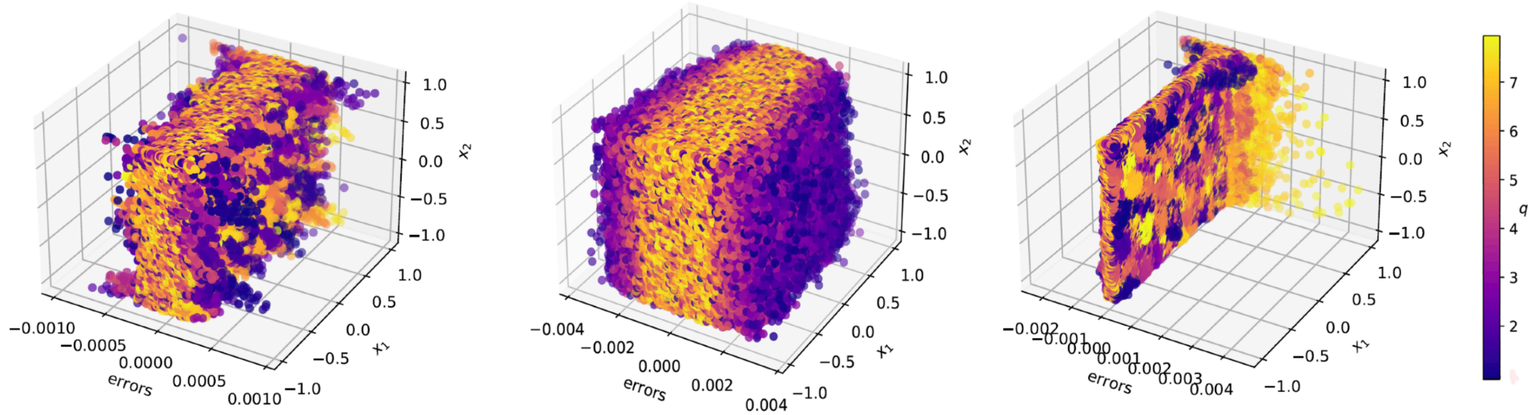


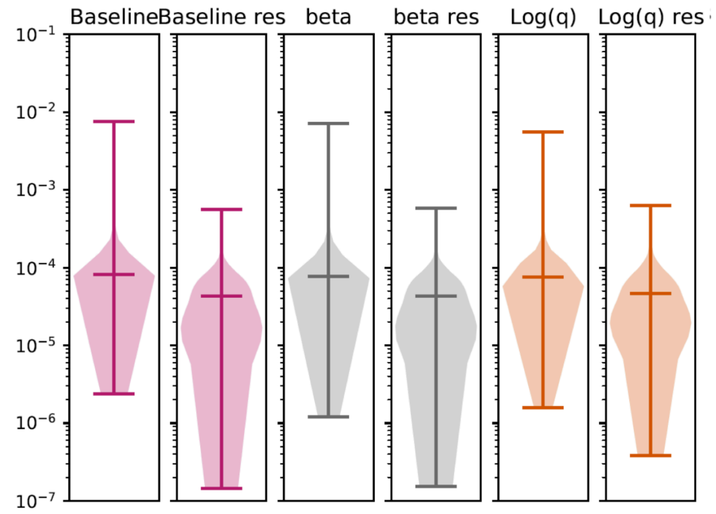




"Deep Residual Error and Bag-of-Tricks Learning for Gravitational Wave Surrogate Modeling"

S. Fragkouli, P. Nousi, N. Passalis, P. Iosif, N. Stergioulas, A. Tefas, in preparation





GENERIC ORBITS IN GENERALIZED SPACETIMES

"Generic Orbits around rotating Black Holes and non-Kerr compact objects with Gravitational Wave applications for LISA"

L. Souvaitzis (MSc Thesis), supervisors: G. Pappas, N. Stergioulas (2021)

General form of metric for a rotating black hole $ds^2 = g_{tt}dt^2 + 2g_{t\phi}dtd\phi + g_{rr}dr^2 + g_{\theta\theta}d\theta^2 + g_{\phi\phi}d\phi^2$

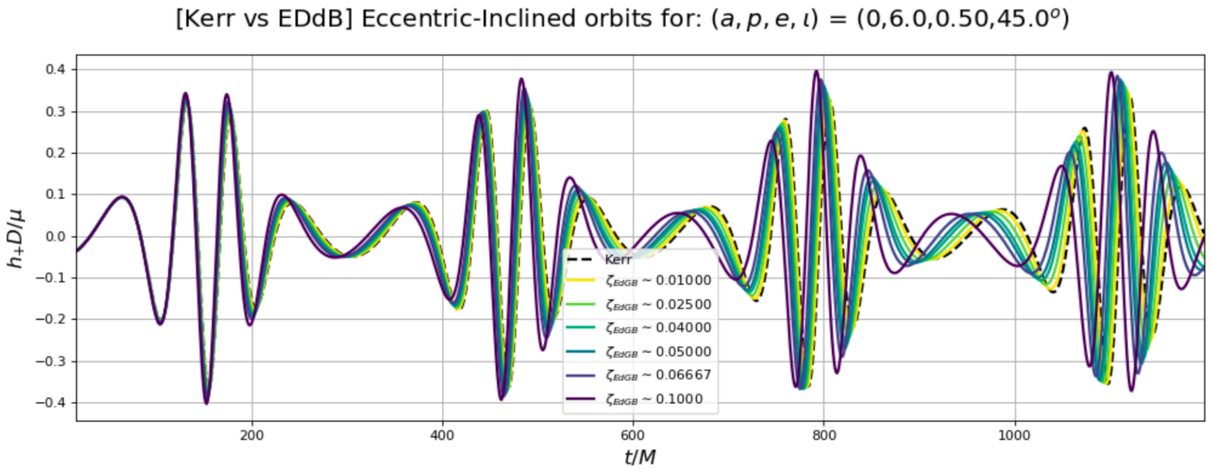
Hamiltonian formalism for orbits $\mathcal{H} = \frac{1}{m}\sum p_a \dot{x}^a - \mathcal{L} = -E\dot{t} + L\dot{\phi} + g_{rr}\dot{r}^2 + g_{\theta\theta}\dot{\theta}^2 - \mathcal{L}$

$$\dot{x}^a = \frac{\partial \mathcal{H}}{\partial p_a}$$

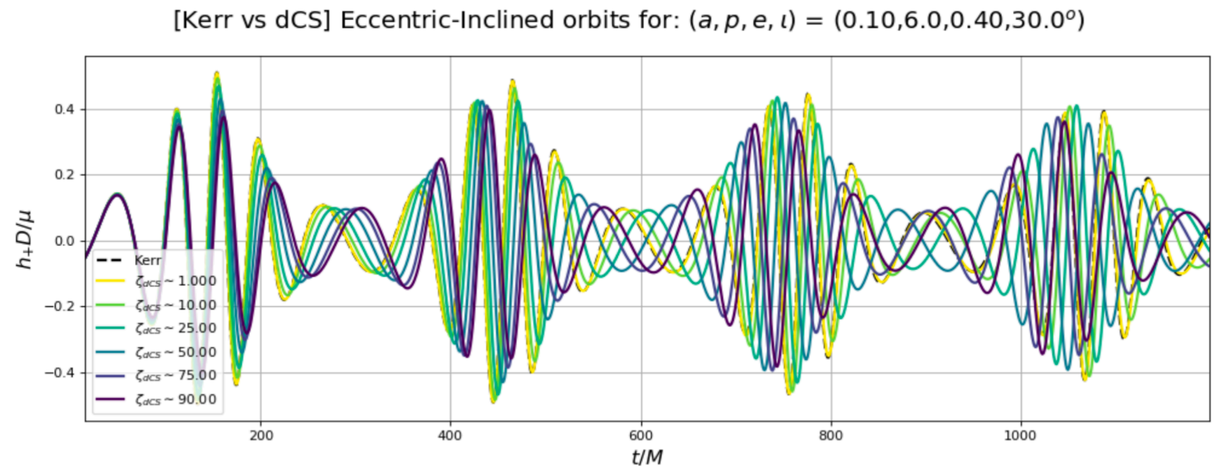
$$\dot{p}_a = -\frac{\partial \mathcal{H}}{\partial x^a}$$

Examples:

Einstein-dilaton-Gauss-Bonet



dynamical Chern-Simons



ESA PRODEX FUNDING

prodex

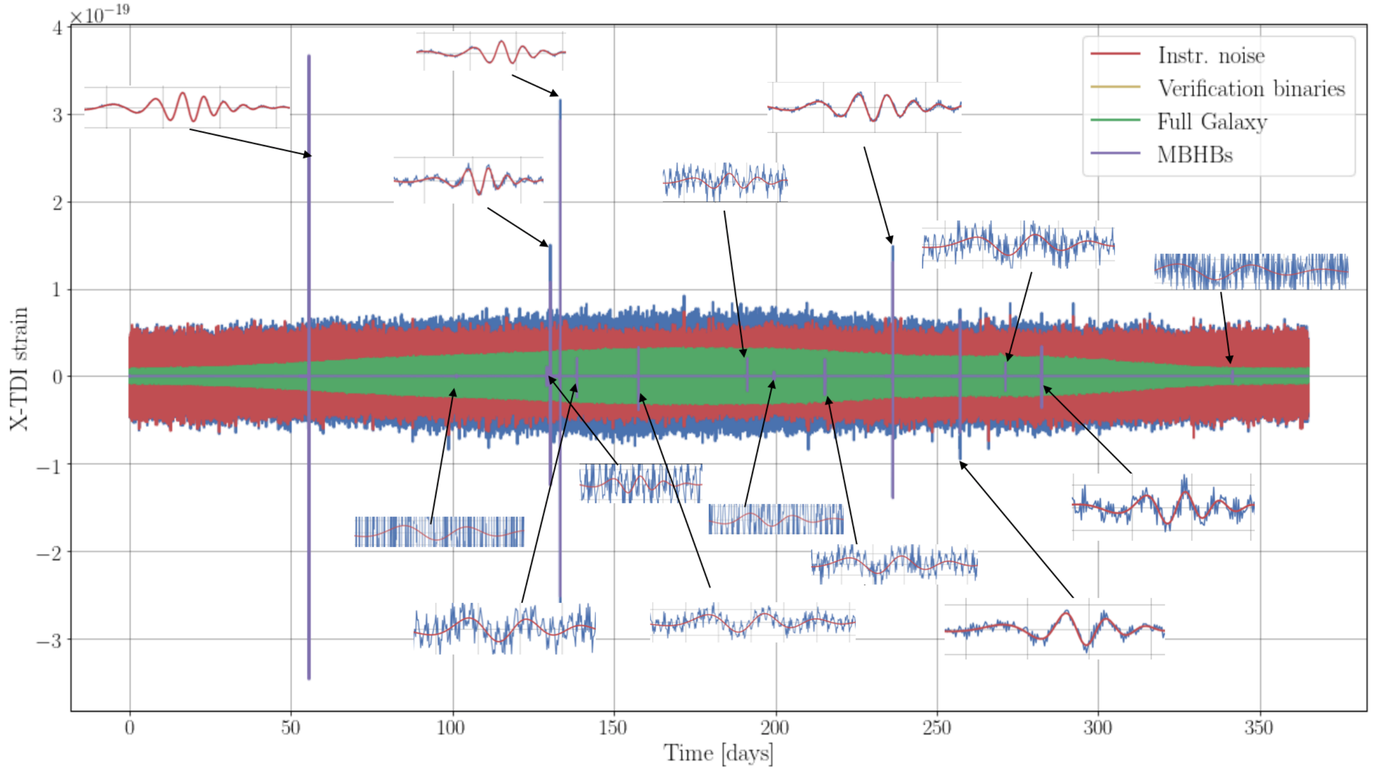
esa

PRODEX Experiment Arrangement No. 4000132310
Oct. 2020 - Sept. 2022
P.I. N. Stergioulas + 1 senior post-doc (N. Karnesis)

LISAπ

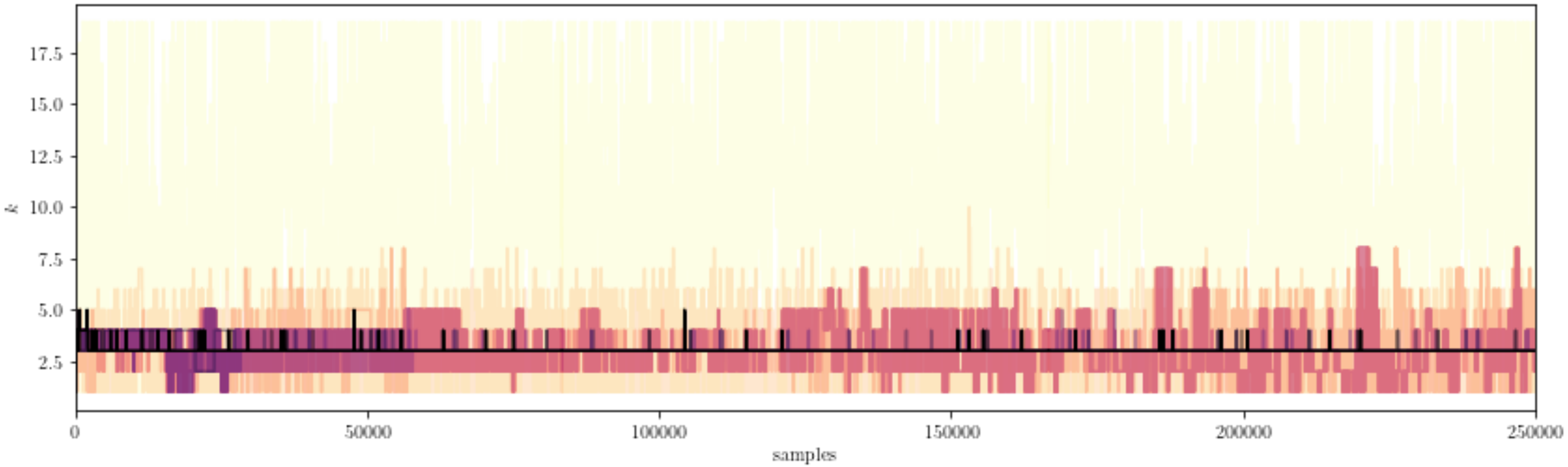
LISA Stochastic Signals Analysis Pipeline / LISA-Pi

- LISA will be a signal dominated observatory
  - SuperMassive Black Hole Binaries (SMBHBs)
  - Compact Galactic Binaries (GBs)
  - Stellar Origin Black Hole Binaries (SOBBHs)
  - Extreme Mass Ratio Inspirals (EMRIs)
  - Stochastic signals from Cosmological sources
- Signals overlapping in time and frequency.
- In addition: confusion signal in certain frequency bands (.i.e the GBs case).
- Construct a key component of the **global fit** pipeline to detect and characterize the *Stochastic GW Background*!



COLLABORATIONS

- Planning and collaborations for LISAπ
  - N Korsakova (APC)
    - Make use of Neural Networks in order to improve efficiency of the sampler.
  - M. Katz (AEI Potsdam)
    - Accelerate the code with GPU interface.
  - LISAπ is going to be part of the analysis of the second LISA Data Challenge (LDC2).
    - The aim is to propose a solution to the LDC2 - a collaboration of several institutes (AEI, AUTh, APC).



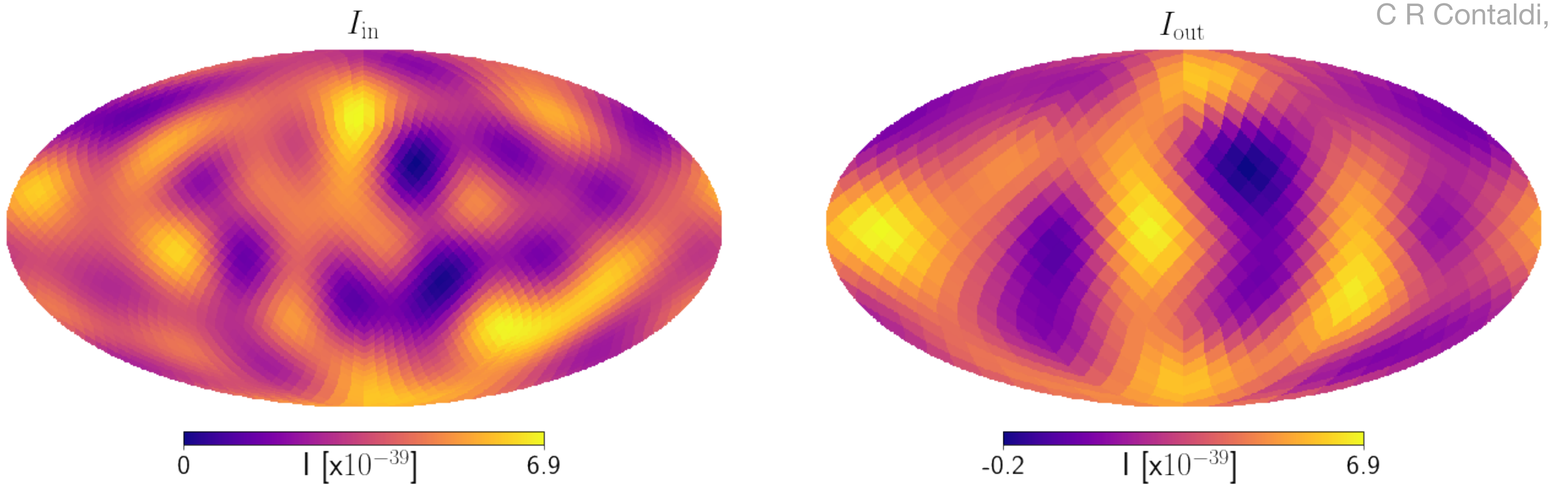
H.F.R.I. (ΕΛΙΔΕΚ) FUNDING

H.F.R.I. Research Grant 0048
Summer 2022 - Summer 2025

P.I. N. Karnesis (1 post-doc + 1 PhD student)

H.F.R.I.
Hellenic Foundation for Research & Innovation

- **SpaceSHEL: Space Stochastic Gravitational Wave Hunt Employing LISA**
  - Search for stochastic Gravitational-Wave signals of Cosmological & Astrophysical origin in the LISA data
  - Build GW-intensity sky maps to probe anisotropies of the stochastic GW background signals
  - Accelerate computations using Machine Learning
  - Second phase of LISAπ!



C R Contaldi, *et al*, Phys. Rev. D **102**, 043502