

High-energy astrophysics and axion-like particles

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Linked to the “Scheda INAF”: *Fundamental physics from astrophysical data (FUPA)*, PI: **Giorgio Galanti**, INAF – IASF-Milano

- Goals: (i) Possible explanation with axion-like particles (ALPs) of astrophysical phenomena
(ii) Confirm or disprove ALP existence

Milestones: status 2023

1. Assessment of the state-of-the-art literature about blazars (BL Lacs and FSRQs) and of the project complexity:
✓ **COMPLETED**
2. Realization of a simulation model about photon-ALP beam propagation for blazars for spectral and polarization studies:
➤ **IN PROGRESS**
3. Realization of a simulation model for poor galaxy clusters:
➤ **IN PROGRESS**
4. Assessment concerning pulsars:
✓ **COMPLETED**
5. Realization of a simulation model for pulsars:
➤ **IN PROGRESS**
6. Assessment concerning gamma-ray bursts (GRBs):
✓ **COMPLETED**
7. Realization of a simulation model for GRBs:
✓ **COMPLETED**

Activities and Results

ACTIVITIES:

1. 29 – 31 May: *Meeting AVENGe*, **invited review** about ALP (and Lorentz invariance violation, LIV) impact on astrophysical sources at very-high energy.
2. 3 – 7 July: *18th Patras Workshop on Axions, WIMPs and WISPs*, **invited talk**, presented results about ALP spectral and polarization effects in astrophysics and on GRB 221009A, in particular.
3. 22 – 24 September: *Trieste Next*, **invited dissemination conference** on fundamental physics studies (ALPs and LIV) with Fermi.
4. 19 – 20 October: *Meeting on Fermi mission advancement*, **talk**, presented results about ALP importance for GRB 221009A with strong indication of the ALP existence.

PUBLISHED OR ACCEPTED PAPERS:

1. **G. Galanti**, *Photon-ALP oscillations inducing modifications to photon polarization*, Phys. Rev. D 107, 043006 (2023), [doi: [10.1103/PhysRevD.107.043006](https://doi.org/10.1103/PhysRevD.107.043006)].
2. **G. Galanti**, M. Roncadelli, F. Tavecchio and E. Costa, *ALP induced polarization effects on photons from galaxy clusters*, Phys. Rev. D 107, 103007 (2023), [doi: [10.1103/PhysRevD.107.103007](https://doi.org/10.1103/PhysRevD.107.103007)].
3. **G. Galanti**, M. Roncadelli and F. Tavecchio, *ALP-induced polarization effects on photons from blazars*, Phys. Rev. D 108, 083017 (2023), [doi: [10.1103/PhysRevD.108.083017](https://doi.org/10.1103/PhysRevD.108.083017)].
4. **G. Galanti**, L. Nava, M. Roncadelli, F. Tavecchio and G. Bonnoli, *Observability of the Very-High-Energy Emission from GRB 221009A*, [accepted for publication by Phys. Rev. Lett.](#)