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SPECTRA-AI

Spectral Pattern Extraction for Classifying Transient Radiations in Astronomy with Artificial Intelligence

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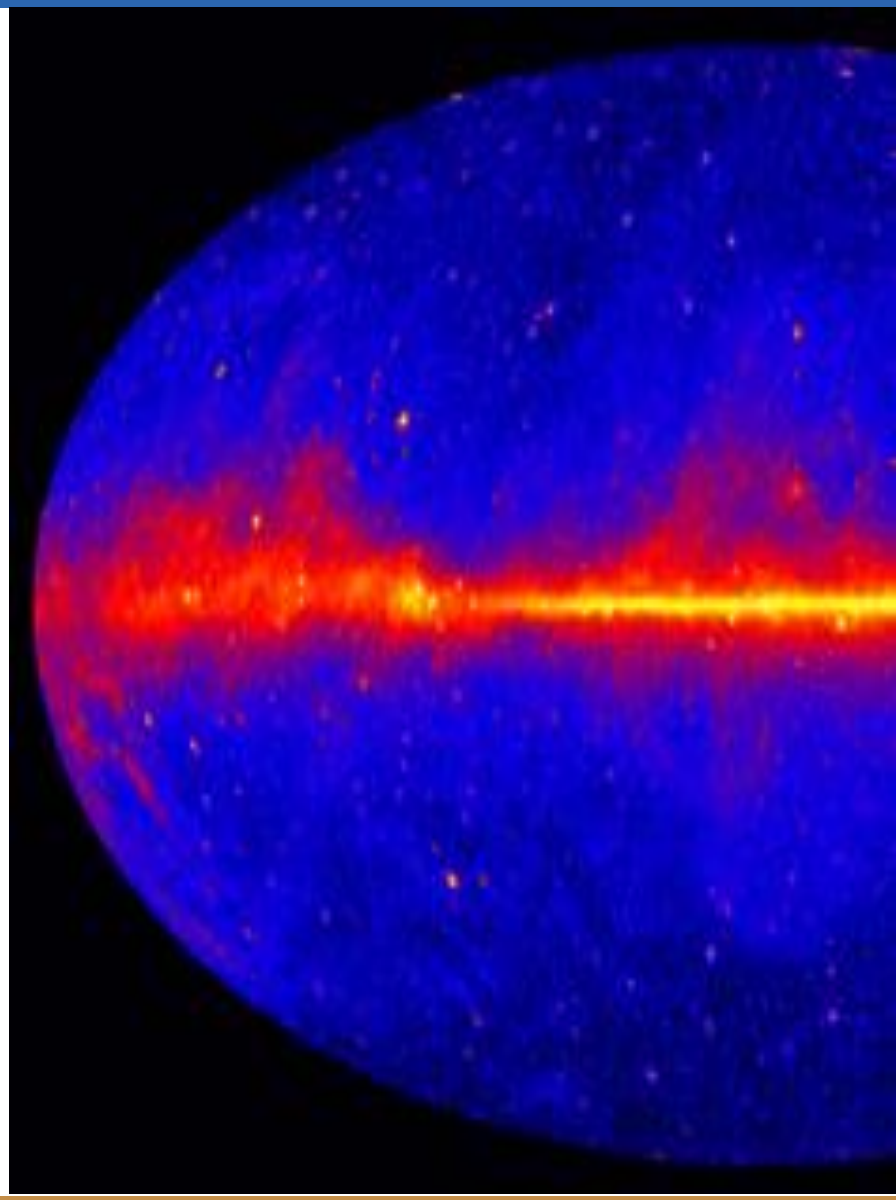
Project Overview

The **SPECTRA-AI** project aims to innovate astronomical observation by applying Artificial Intelligence (AI) techniques to identify and analyze transient astronomical sources using data from high-energy gamma-ray experiments.

This includes phenomena such as gamma-ray bursts, supernovae, and solar flares.

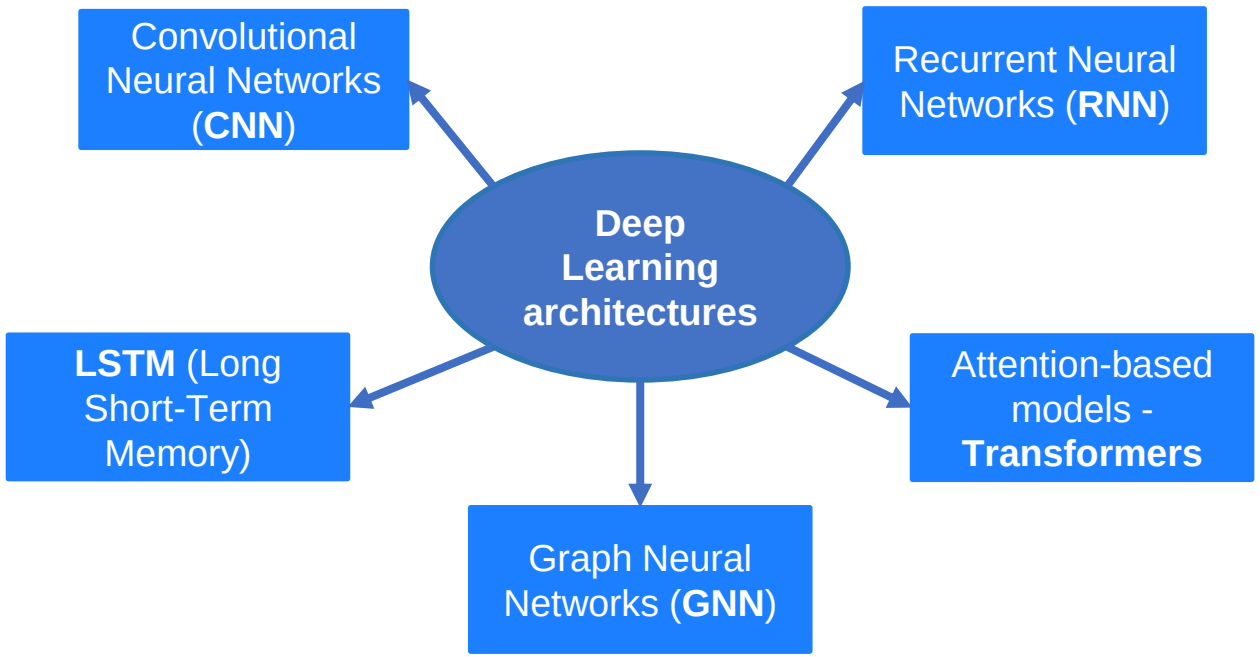
The project's main focus is on using deep learning to improve the accuracy of identifying these fleeting and complex events in space, which is crucial for better understanding the high-energy universe.



Technical Objectives, Methodologies and Solutions

- Innovative **machine learning techniques** will be developed with the aim of searching for astronomical sources in high-energy gamma ray experiments.
- Big data processing and visualization, via adopting innovative approaches for the **analysis of large and complex data volumes** and for their exploration.

Deep Learning algorithms to process and analyze spatial, temporal and energetic data from telescopes and satellites.



Technical Objectives, Methodologies and Solutions

Achieve a more comprehensive and accurate understanding of gamma-ray events, it is essential to **simultaneously** consider all these aspects.

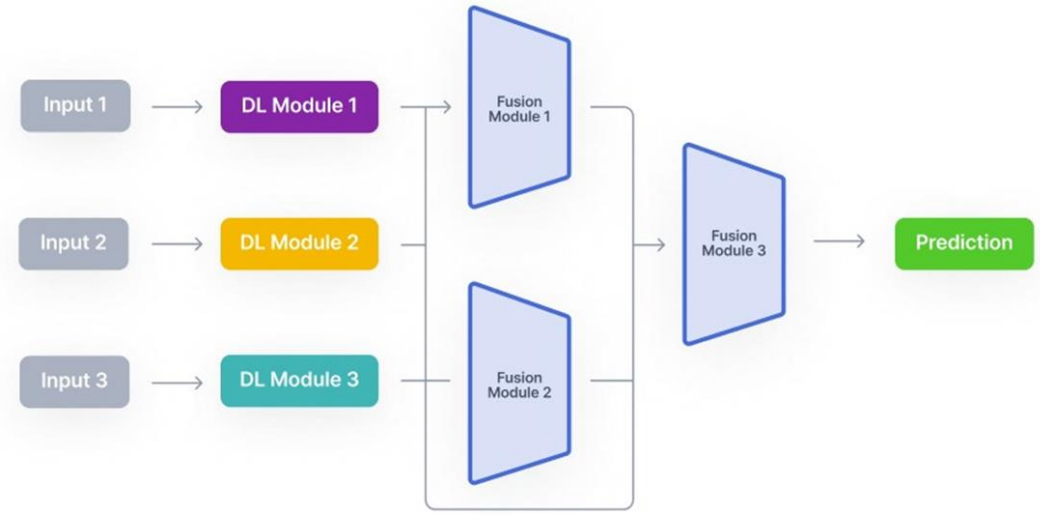
Multimodal Deep Learning Architectures

Designed to handle multiple types of data simultaneously, each representing a specific aspect (spatial, temporal, spectral/energetic).

- Recurrent Neural Networks (**RNNs**) or **LSTMs** for the Temporal Axis.
- Convolutional Neural Networks (**CNNs**) for the Spatial Axis.
- **Networks** for the Spectral/Energetic Axis.

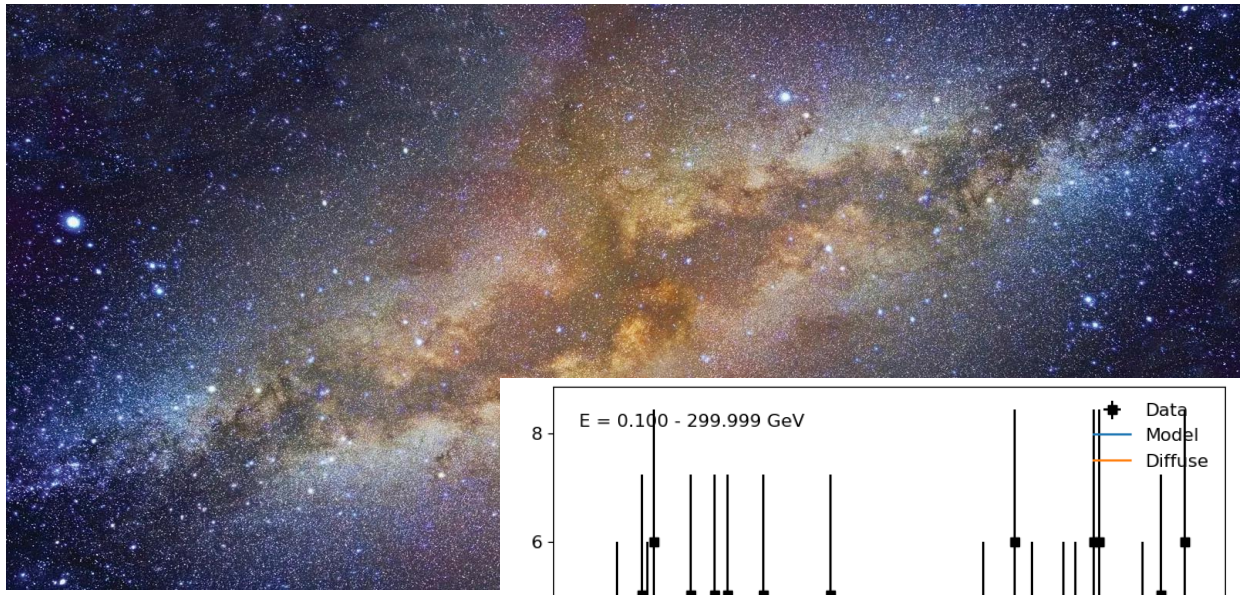
Data Fusion: information is fused in one or more subsequent layers of the network for more accurate classification or detection.

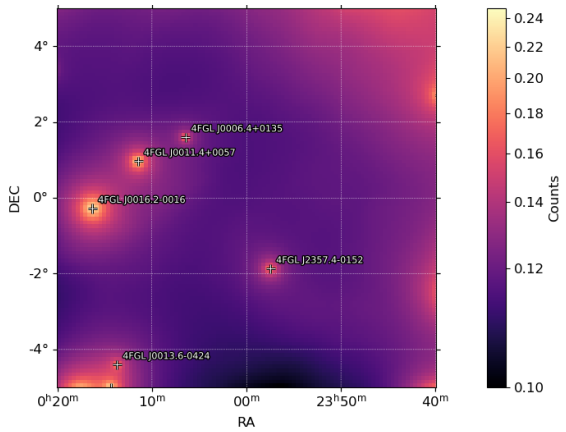
These architectures can be divided into **different branches**, each specialized in processing a particular type of data, and then combine the information at a subsequent layer.

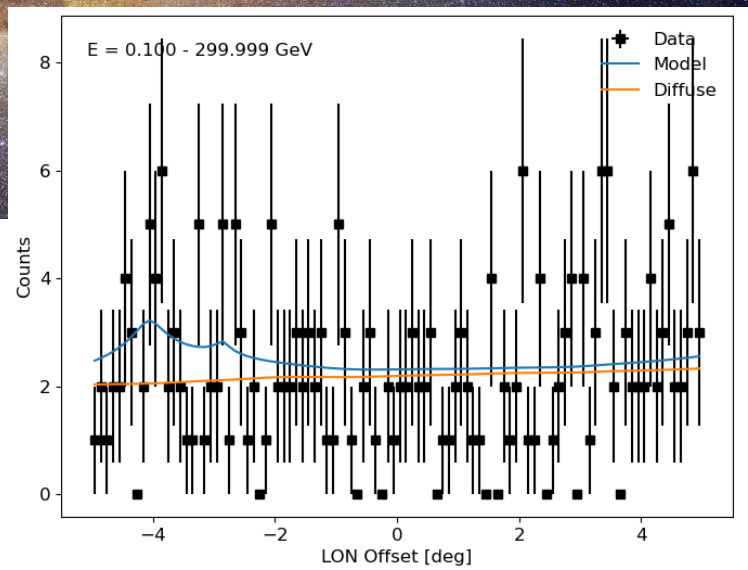


Analysis System Development

- Study and implementation of **Fermipy package** for Gamma Ray analysis
- Multi-analysis and grid-search
- Architecture development for **Time Binned Analysis**
- Training of **LSTM Autoencoder** for **anomaly detection**







Thanks!