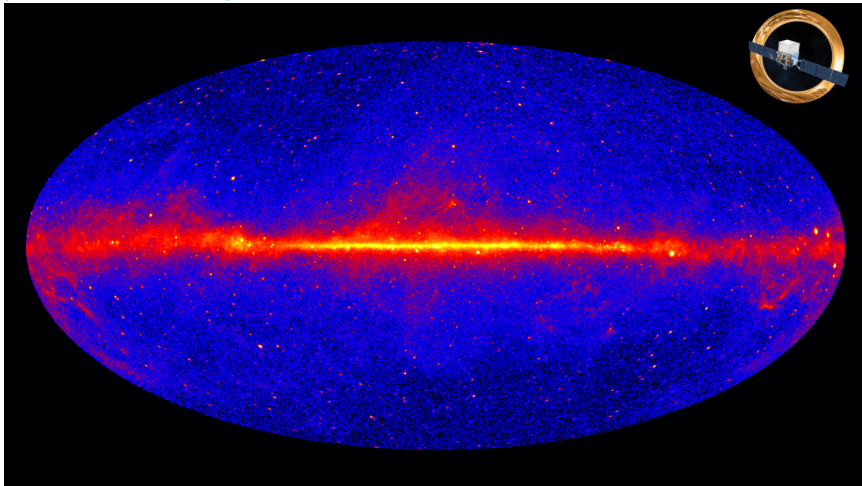# Classification of Fermi-LAT sources with deep learning

S.Manconi (RWTH) , with A.Butter, T.Finke, F.Keil, M.Krämer

[Fermi-LAT 5 years, energy > 1 GeV]
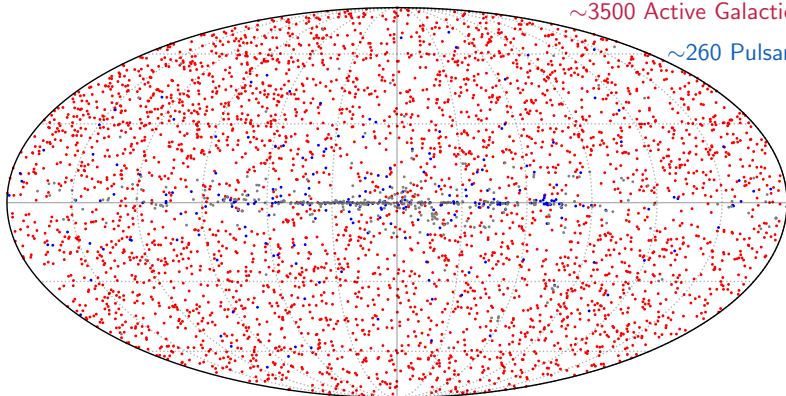
Classification of Fermi-LAT sources with deep learning

S.Manconi (RWTH) , with A.Butter, T.Finke, F.Keil, M.Krämer

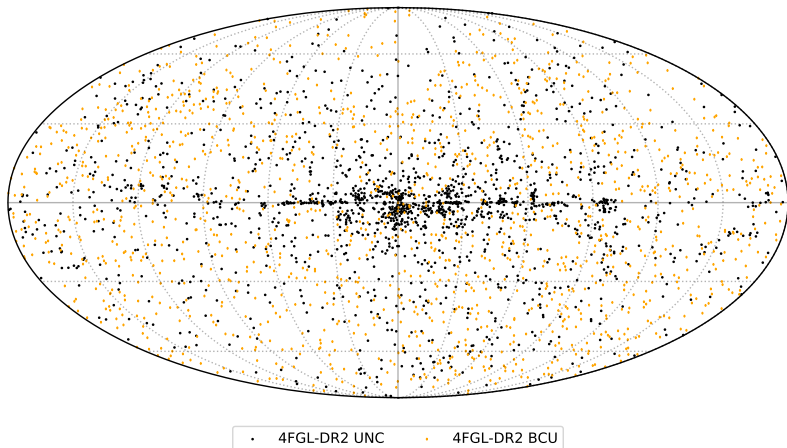**Fermi-LAT catalog: ∼5800 detected sources**

∼3500 Active Galactic Nuclei

∼260 Pulsars

· 4FGL-DR2 AGN   · 4FGL-DR2 PSR   · 4FGL-DR2 other

Classification of Fermi-LAT sources with deep learning

S.Manconi (RWTH) , with A.Butter, T.Finke, F.Keil, M.Krämer

$\sim 30\%$ **of detected sources in last Fermi-LAT catalog (4FGL-DR2) are of uncertain type**

· 4FGL-DR2 UNC   · 4FGL-DR2 BCU

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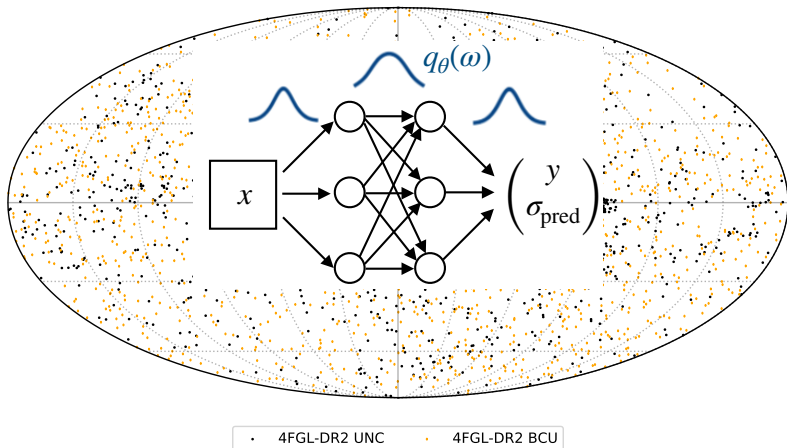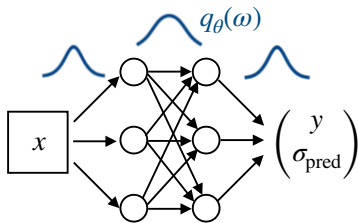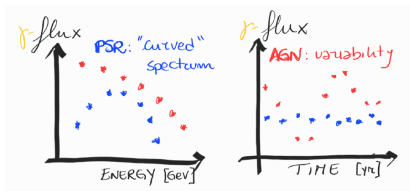S.Manconi (RWTH) , with A.Butter, T.Finke, F.Keil, M.Krämer

→ We perform **classification of uncertain 4FGL-DR2 sources using deep learning** techniques:

- Input data: energy and time γ-ray spectra *only*, instead of derived features: full information from measurements, w/o bias from feature selection

- *Dense* and *recurrent* networks: catch correlations in sequential data

- *Bayesian networks* : estimate uncertainties on predicted source class

Classification of Fermi-LAT sources with deep learning

S.Manconi (RWTH) , with A.Butter, T.Finke, F.Keil, M.Krämer

- Deep/recurrent networks extract relevant features from energy and time spectra
- Accuracy > 90%; Candidate sources follow expected sky/feature distributions
- Bayesian networks robust estimate of classification uncertainty

· 4FGL-DR2 UNC   AGN candidates   ■ YNG candidates   ♦ MSP candidates
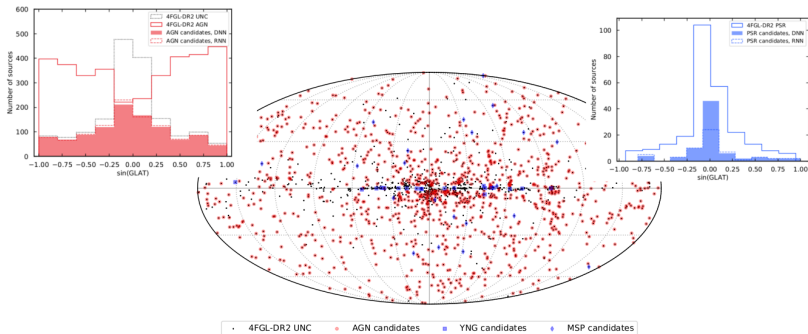
Full list of deep learning predictions available *here*

→ **Complement population studies and stimulate multi-wavelength follow ups**