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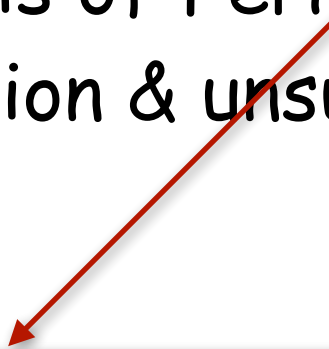
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- Exploiting the full information on DM signals contained in multi-wavelength and multi-messenger observations (Christoph&Nicolao)

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Slack: **#multiwavedm** (Nicolao), #1dimDM (Christoph)
+ bayesian point sources (Christoph)

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First talk today, joint data set

- Exploiting the full information on DM signals contained in multi-wavelength and multi-messenger observations (Christoph&Nicolao)

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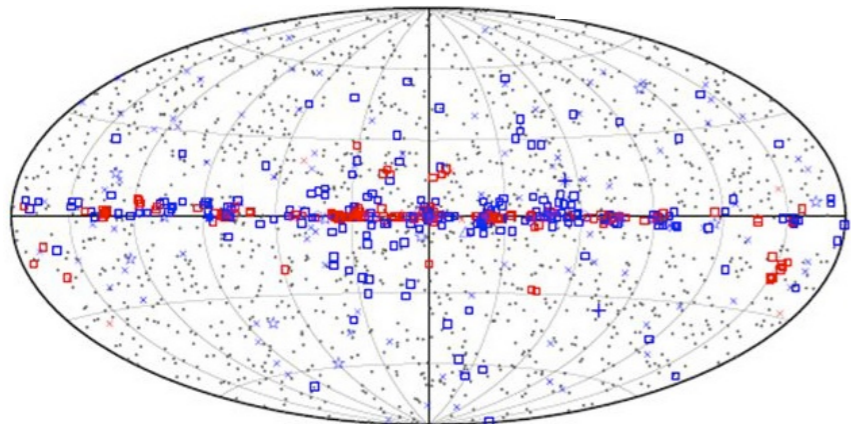+ bayesian point sources (Christoph)

Talk by Christoph

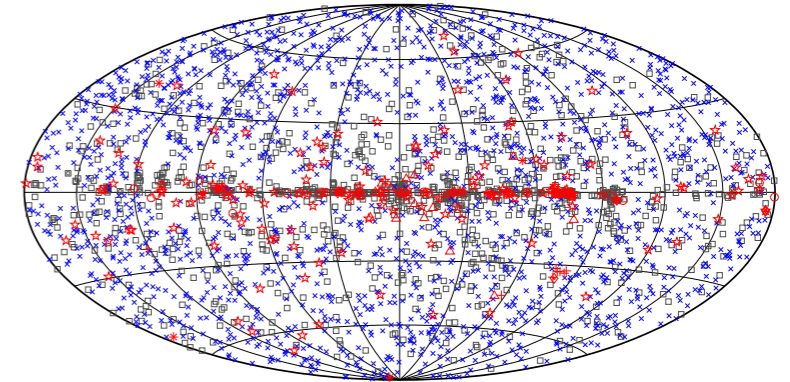# The science case/ motivation

Diffuse emission from our Galaxy
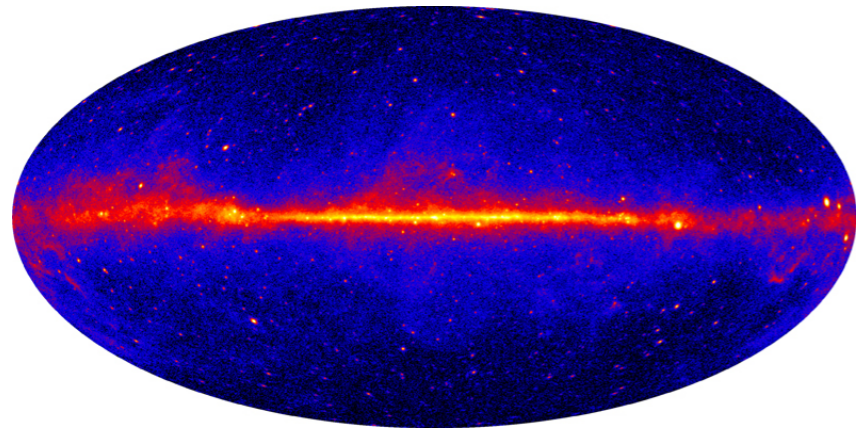
Point sources
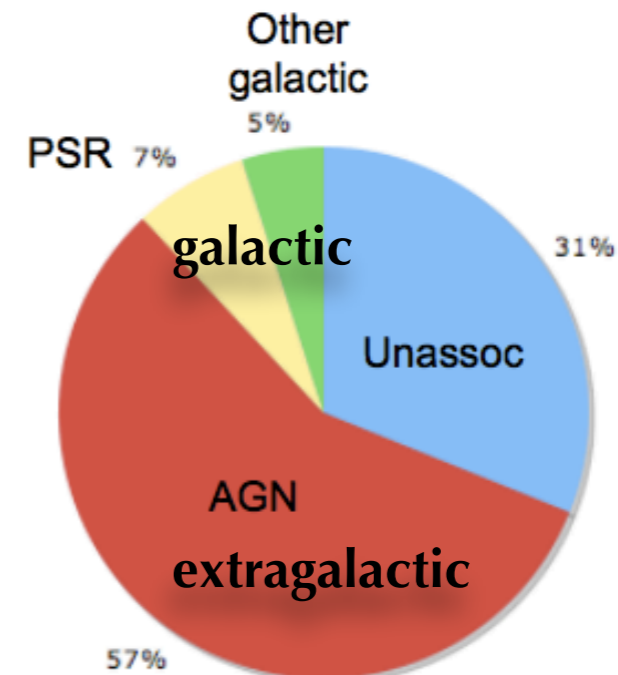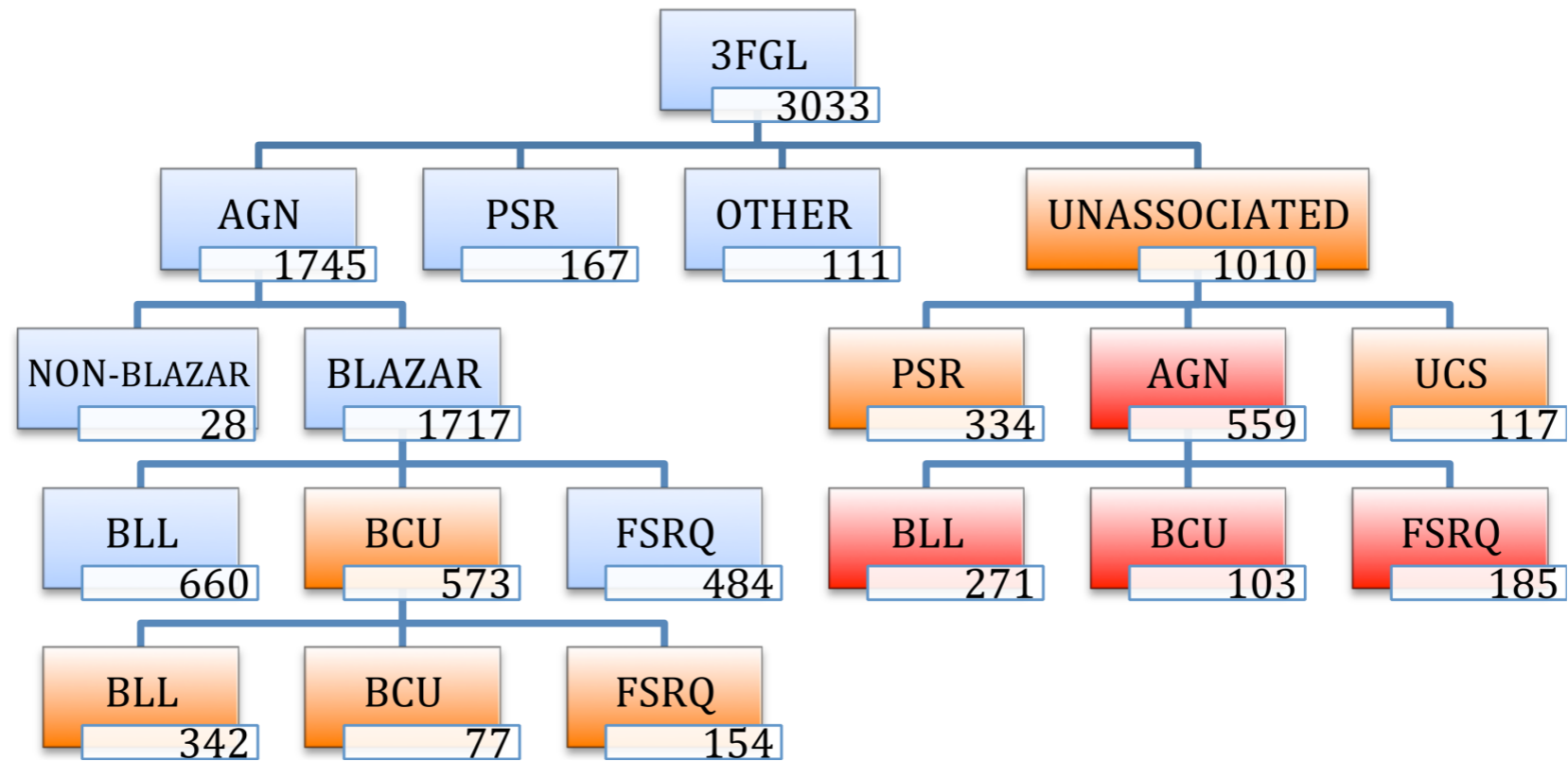

Fermi catalog 3000 sources!

Now 5000 sources!

3FGL [Fermi LAT coll. 1501.02003]

Other galactic 5%

PSR 7%

galactic

31%

Unassoc

AGN

extragalactic

57%

Analysis challenges:
- **'find'** PS in the bright diffuse background
- **associate** them to one of the source classes (AGNs, Pulsars…)
- **Discover NEW source classes** (Dark Matter?)

Previous attempts to use ML with Fermi LAT PSs

Machine-learning algorithms used for screening and classification of unassociated sources based on γ-ray data only.

1— Mirabal+ (2016): to pinpoint potentially novel source classes
2— Saz Parkinson+ (2016): to classify UnA as likely AGN or PSR (including the likely type of pulsar) using **timing and spectral information**
3— Salvetti+ (2017, 3FGLZoo): classification UnA likely AGN as likely BLL or FSRQ, using **timing** information

Initial ideas for data challenge   #fermi-point-sources

In general:

V01 Fermi LAT data only

V02 add **multi-wavelength info**

V03 add timing information?

Initial ideas for data challenge

V01 Fermi LAT data only

Step1:
- Start with only two very distinguishable sources classes (**pulsars and AGNs**), with **NO diffuse emission**
- Generate **training data**: Pulsar and AGN sources, generated based on their spectral properties and distribution on the sky (isotropic vs Galactic plane). **labeled whole sky images**
- Generate test data: MIXed maps of two source classes sources (unlabeled), use for **testing** — how well is algorithm capable of telling them apart

Step2:
1. add the **fictive source class**
2. see if fictive sources are clustered separately (unsupervised or semi-supervised)
3. Move on to all source classes with the unassociated one, remove the fictive source class (this would hopefully give an interesting result)

Step3:
4. add diffuse emission, and train for source localization/finding -> Christoph?

Training data

German&Christopher

Step1:
- Monte Carlo generation of PS based on the distribution of the sky positions and spectra (not yet implemented) -> xml
- Use gtmodel etc to simulate Fermi LAT response functions
- Format: healpix + layer of labels

Should be available within few weeks (almost there…)

How to communicate?

Slack channel(s)!

We will post:
- Links where to download the data
- Some links to ML algorithms and strategies
- Do not be shy to ask questions on slack — as a group we should collaborate and help each other!

Plan on having **monthly meetings** to discuss progress and strategies.
Ideally the challenge should end up with a **publication** summarising what was learned.

Thoughts/comments?
We are flexible, let us know what would be

the most useful approach in your view!