Searches for IceCube Neutrinos from Seyfert galaxies

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IJCLab APHE Meeting.

June 17, 2025.

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High energy neutrinos (~100 TeV)

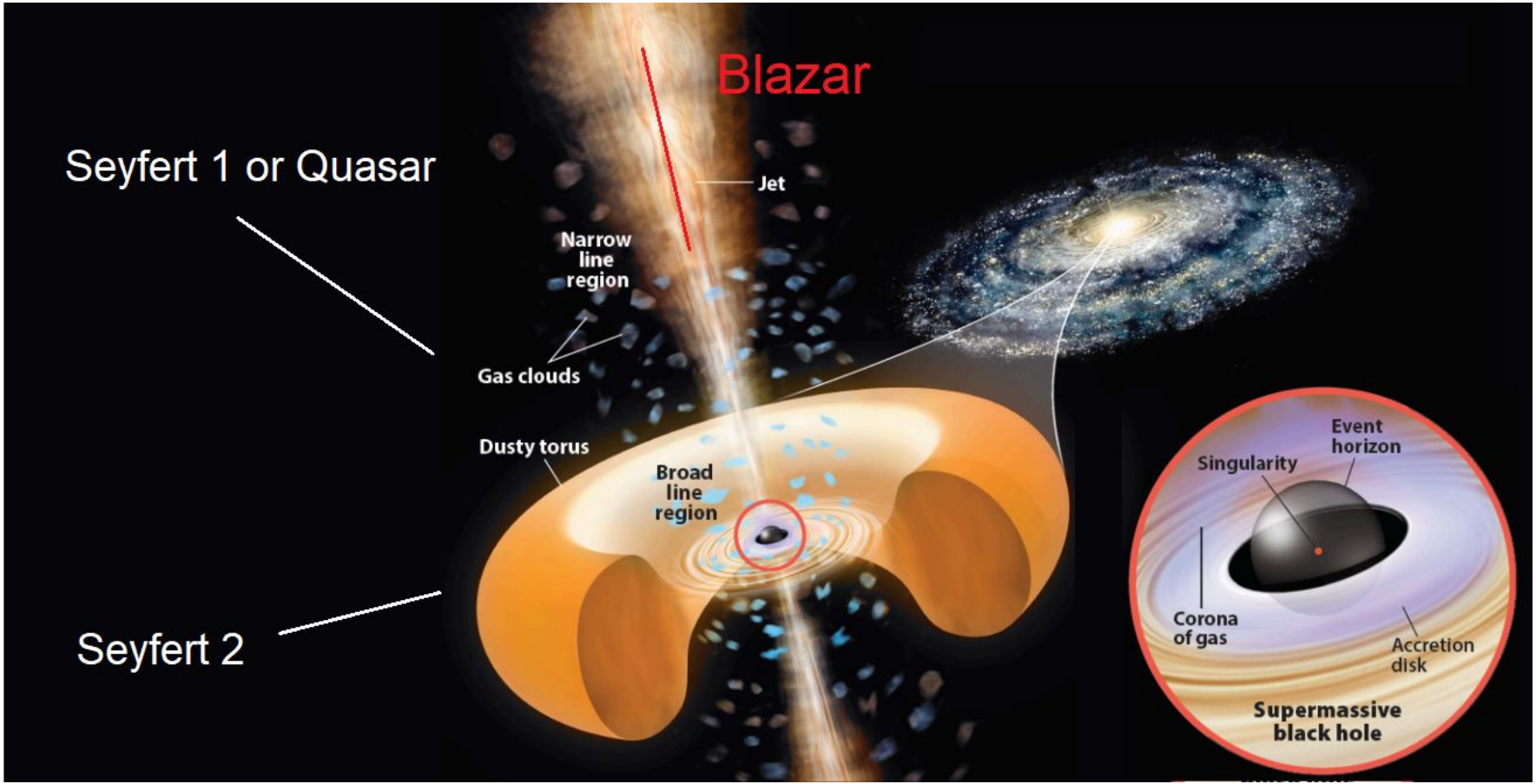
Possible origins?

AGNs?

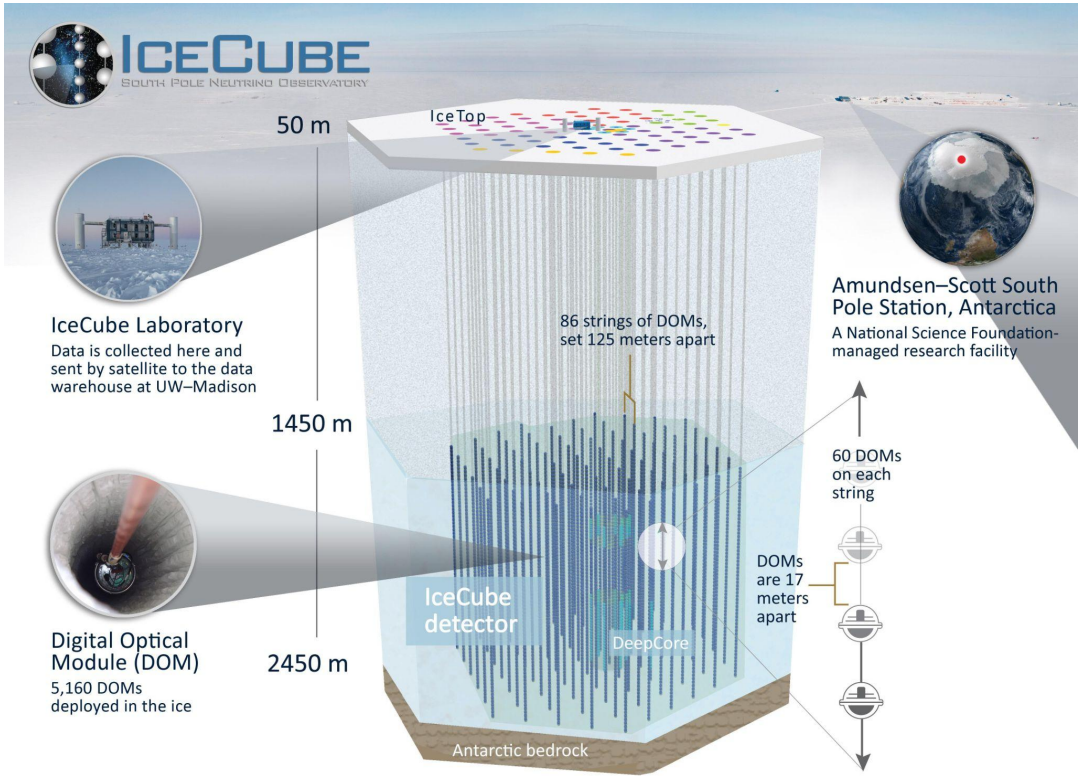
Blazar TXS 0506+056, Seyfert NGC 1068

Blazars don’t contribute much to diffuse neutrino flux

Seyferts?

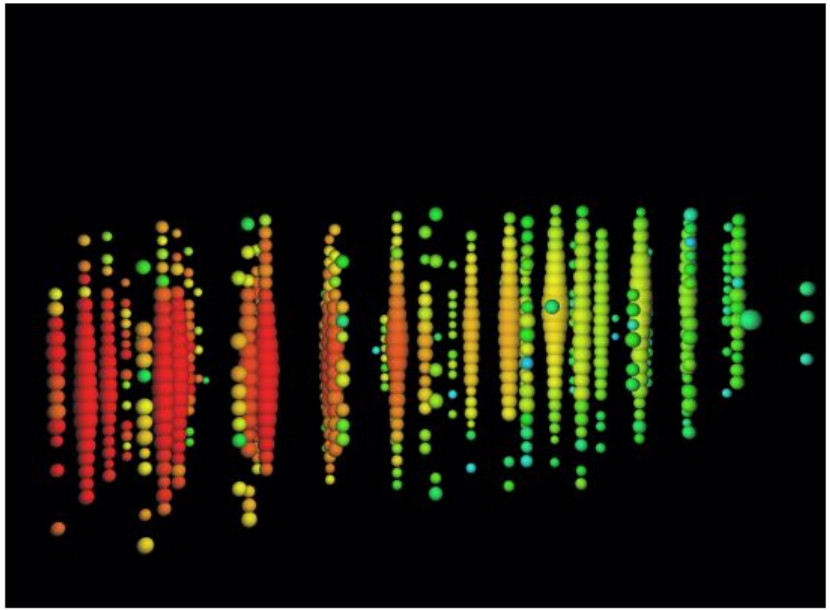

Blazar
Seyfert 1 or Quasar
Jet
Narrow line region
Gas clouds
Dusty torus
Broad line region
Seyfert 2
Event horizon
Singularity
Corona of gas
Accretion disk
Supermassive black hole

Background – IceCube Neutrinos from Seyferts



Background – IceCube Neutrinos from Seyferts

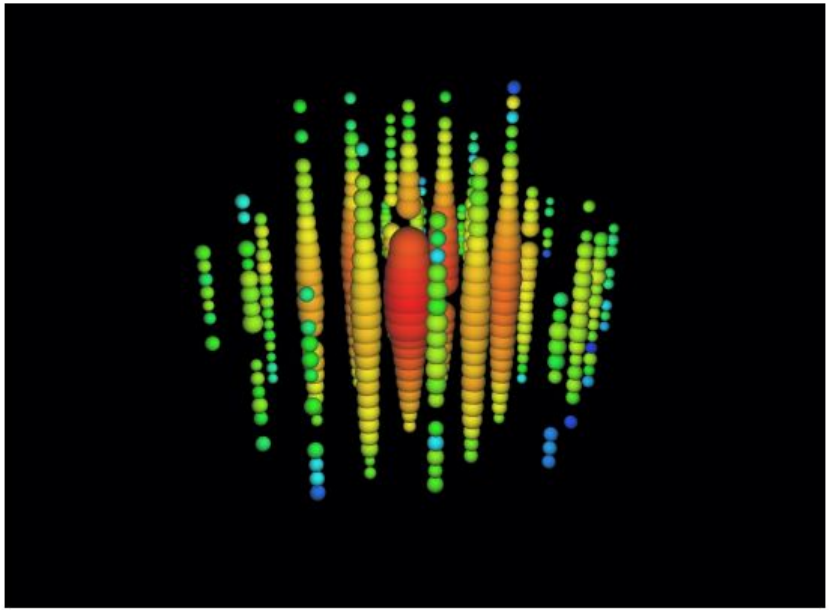
Tracks



$$\nu_\mu + N \rightarrow \mu + X$$

Good angular resolution 0.1-1 deg

Cascades



$$\nu_X + N \rightarrow \nu_X + X, \quad \nu_e + N \rightarrow e + X$$

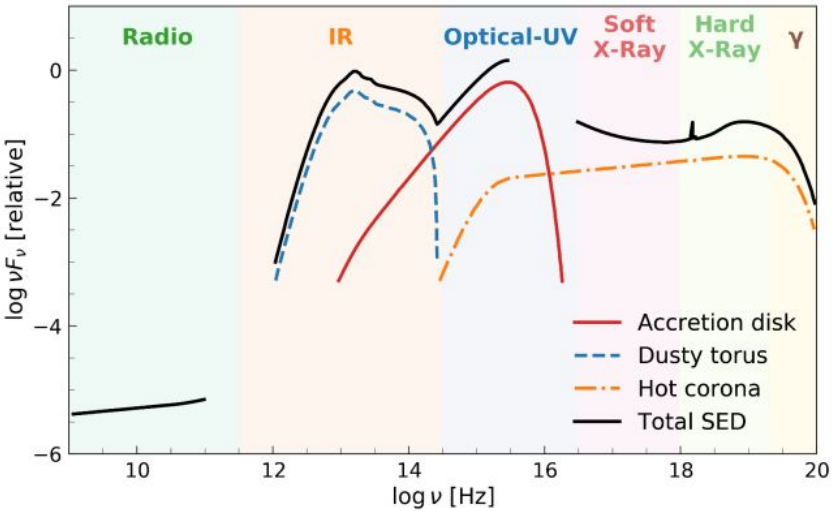
Fully active calorimeter

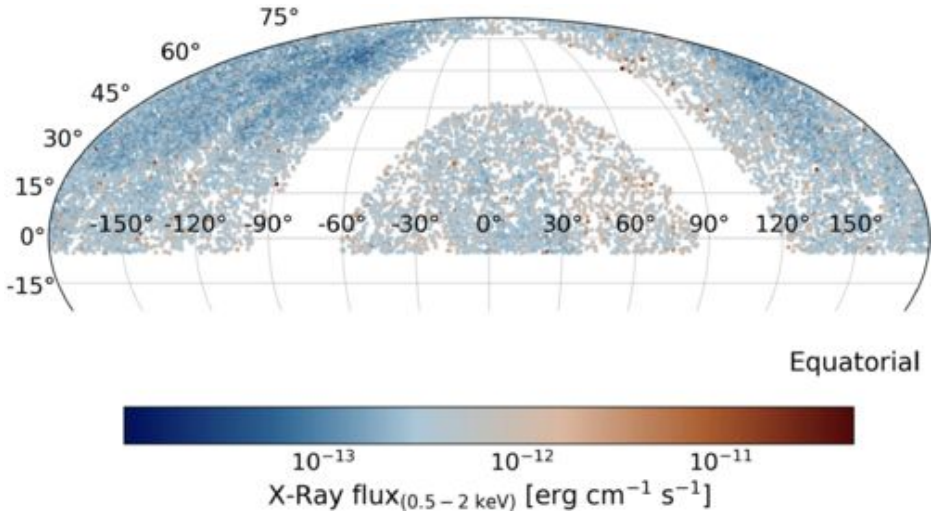
Background – IceCube Neutrinos from Seyferts

Abbasi et al. (2024) *Search for neutrino emission from core of active galactic nuclei*

8-year IceCube neutrino events from Northern sky

PLUS X-ray sources from XMM-XLS2 against MIR AllWISE for Seyferts





Background – IceCube Neutrinos from Seyferts

Correlation between diffused neutrino and X-ray fluxes of Seyfert AGNs

$$\mathcal{L}(n_s, \gamma) = \sum_i^N \left[\frac{n_s}{N} S(x_i, \gamma) + \left(1 - \frac{n_s}{N}\right) B(x_i) \right]$$

Signal PDF ~ Power law

$$\lambda = -2 \log \frac{\mathcal{L}(n_s = 0)}{\mathcal{L}(n_s, \gamma)}$$

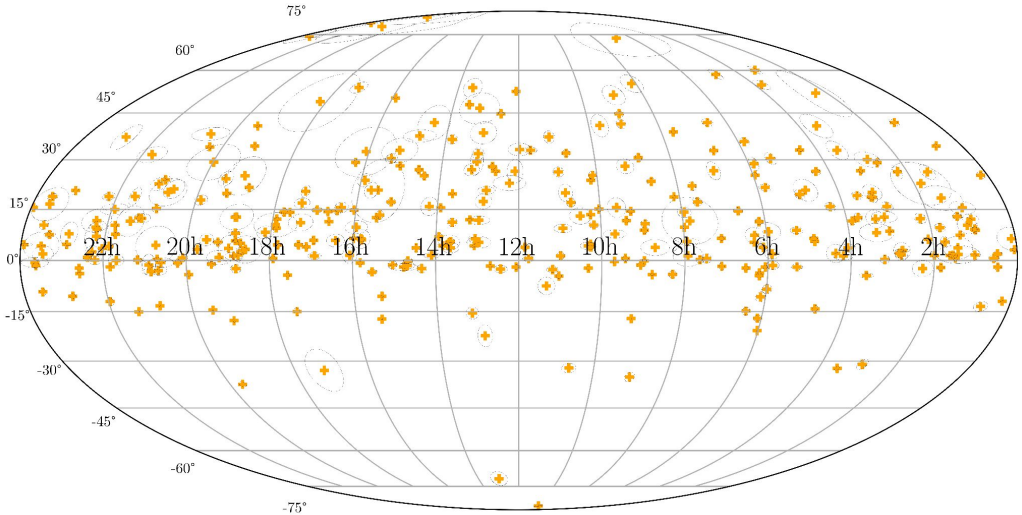
Test statistic

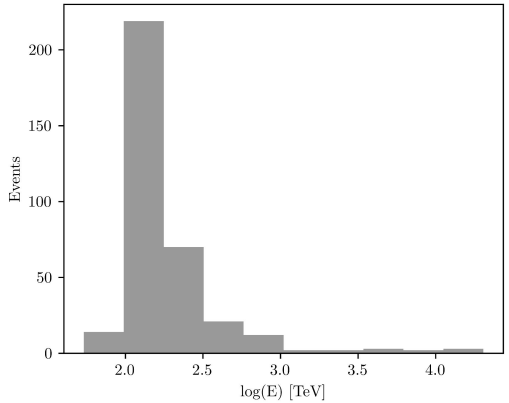
Seyfert galaxies explain 51% of the neutrino flux

IceCube Neutrinos from Seyferts

Extend it with **eROSITA** sources (5” mean positional error)

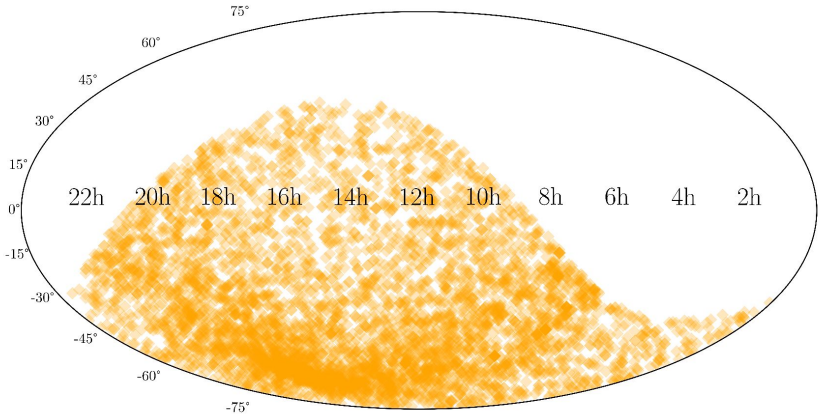
Test case: IceCat-I Alerts Catalog

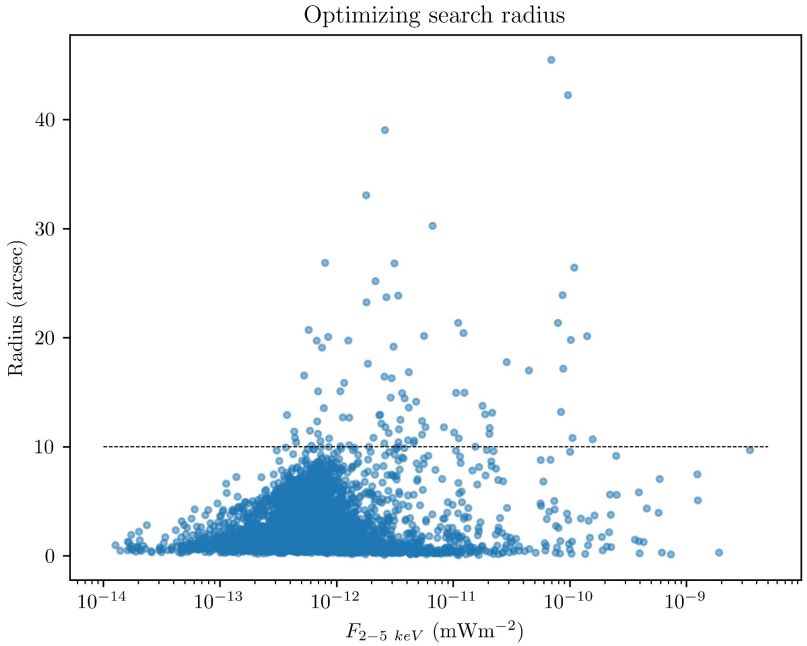




IceCube Neutrinos from Seyferts

eROSITA eRASS1 Source Catalog (Hard band)

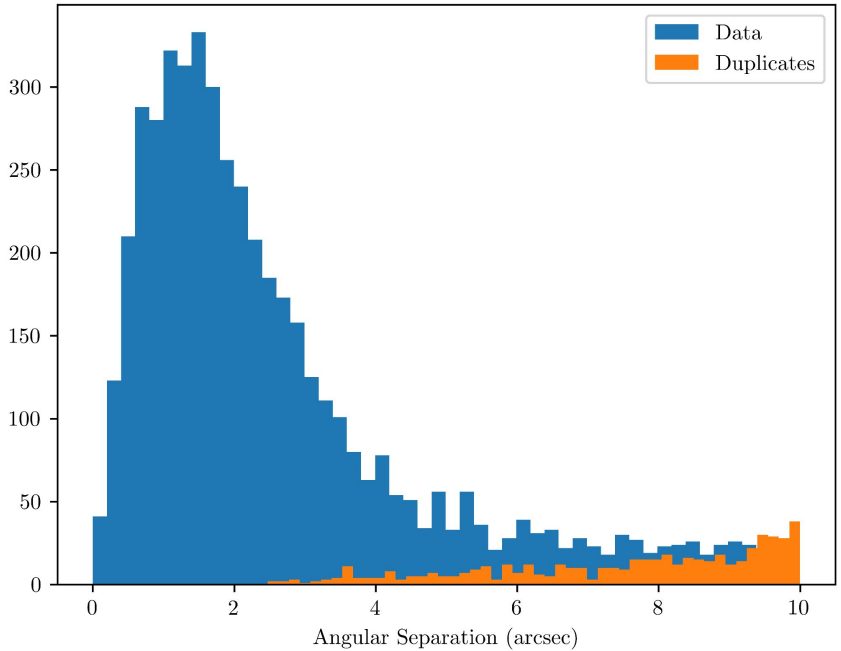




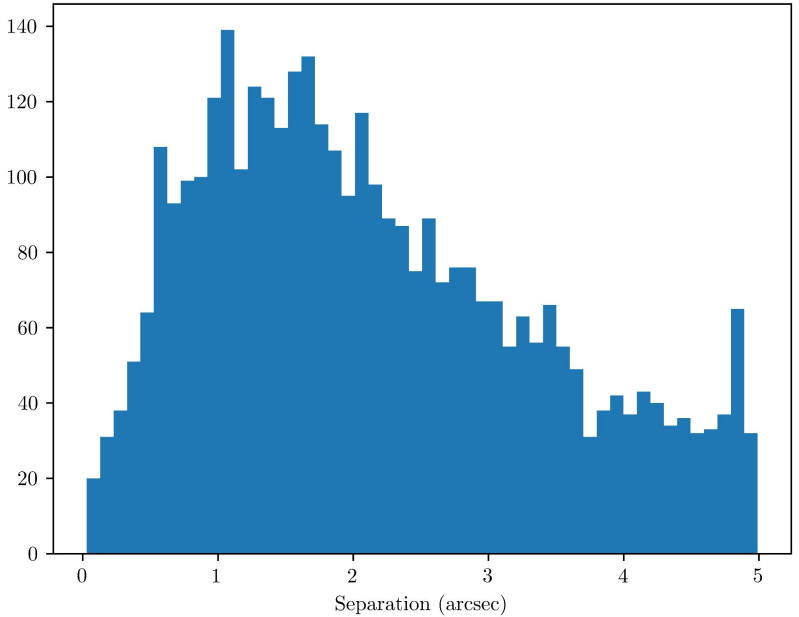
IceCube Neutrinos from Seyferts

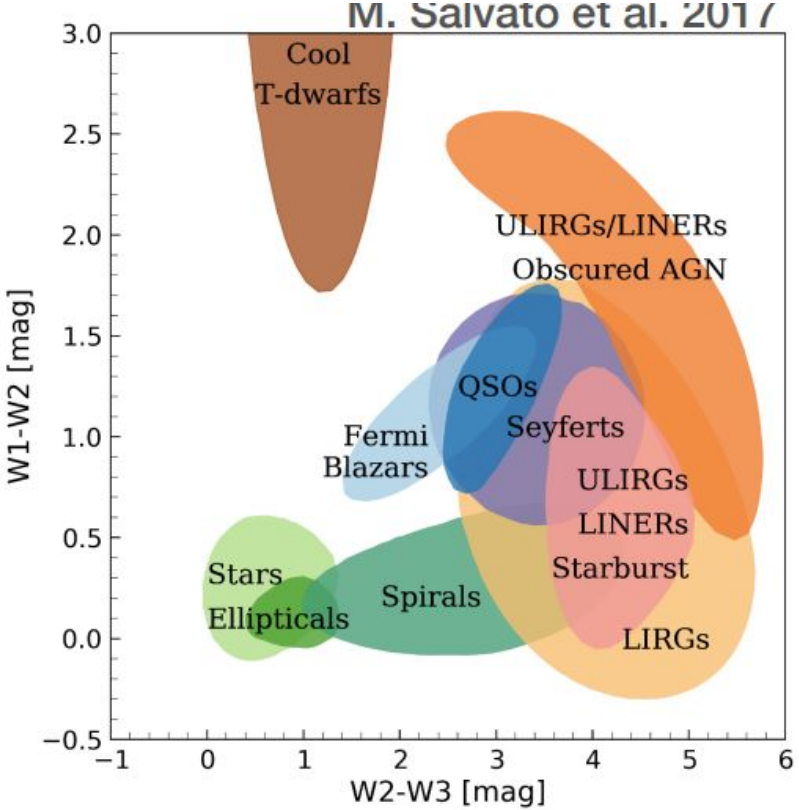
AllWISE (Cutri+ 2013) x eROSITA

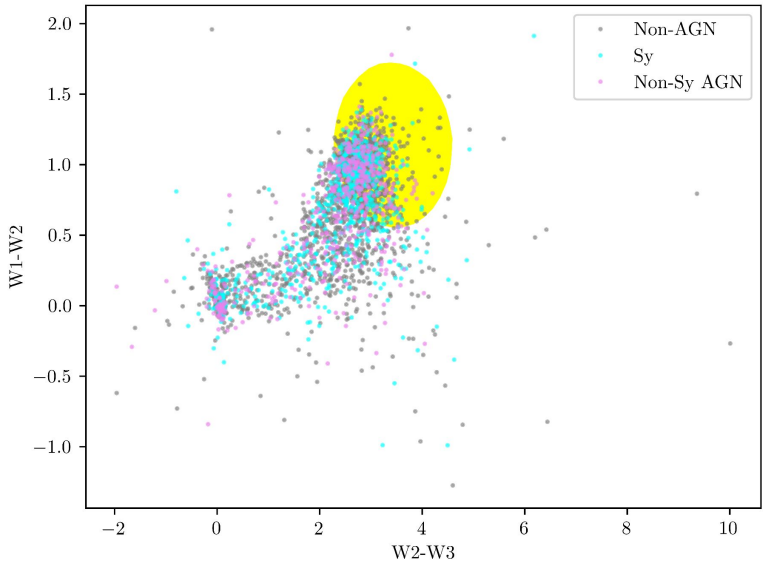
Bands [Vega]: W1 (3.4μm) W2 (4.6μm) W3 (12μm)

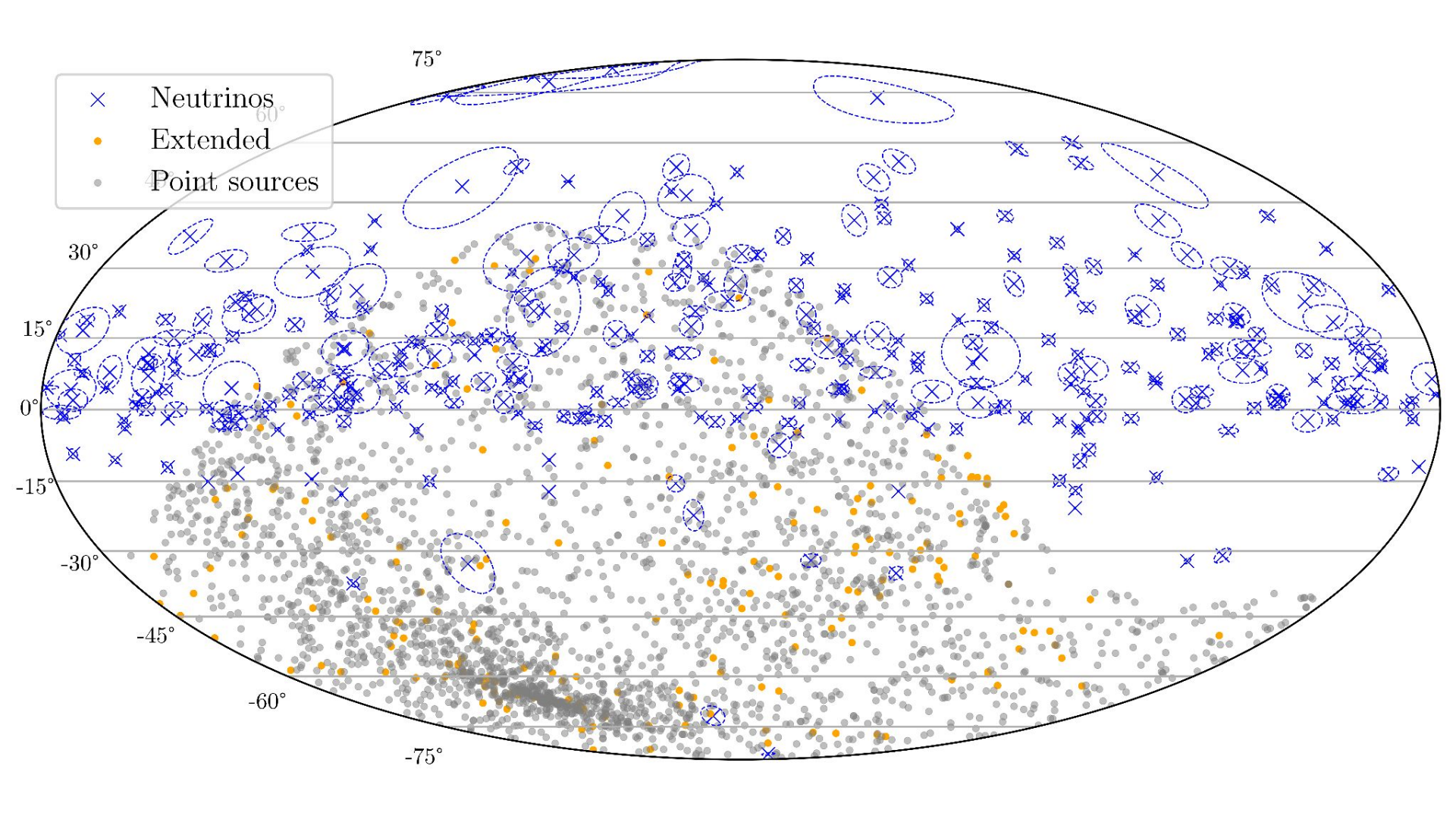


SIMBAD




M. Salvato et al. 2017
Cool
T-dwarfs
ULIRGs/LINERs
Obscured AGN
QSOs
Seyferts
Fermi
Blazars
ULIRGs
LINERs
Starburst
Stars
Ellipticals
Spirals
LIRGs
W1-W2 [mag]
W2-W3 [mag]


Non-AGN
Sy
Non-Sy AGN
W1-W2
W2-W3


Neutrinos
Extended
Point sources
75°
60°
30°
15°
0°
-15°
-30°
-45°
-60°
-75°