

## Selected 'radio blazars' as neutrino sources

# Radio Blazars & Neutrino

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First hints of correlations of IC events (public data)  
and radio blazars published by Plavin et al.

⇒ **Correlation with HE events**

**&&**

⇒ **Correlation with p-value skymap from 'old'  
point source analysis**

**ANTARES contacted Plavin for collaboration**

⇒ **First results shown yesterday  
at ANTARES physics telcon**

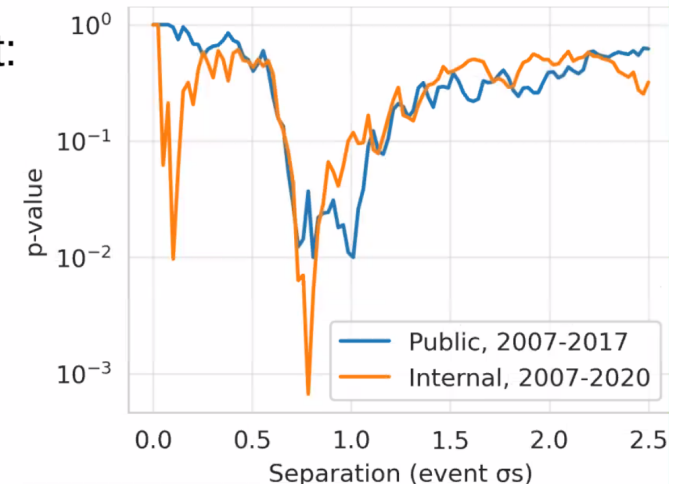
## Utilizing ANTARES observations

Looking for positional correlation between ANTARES detections  
and 3.5k radio blazars:

- Count number of blazar-neutrino pairs within errors
- Compare to randomized coordinates to obtain significance

Higher significance with internal dataset:  
post-trial  $p=1.5\%$  instead of 6%.

Due to reconstruction changes,  
not because of new events.



## Brief cross check of the findings (night-coding, errors not excluded!)

- 1) Check for each Radio blazar the amount of close neutrino events (using the 'best' match criterium of distance  $<0.8 \cdot \beta$ )

=> 1/2/3/4 matches: 340/33/3/1 => in total **419 matches**

*cross check with scrambled data:*

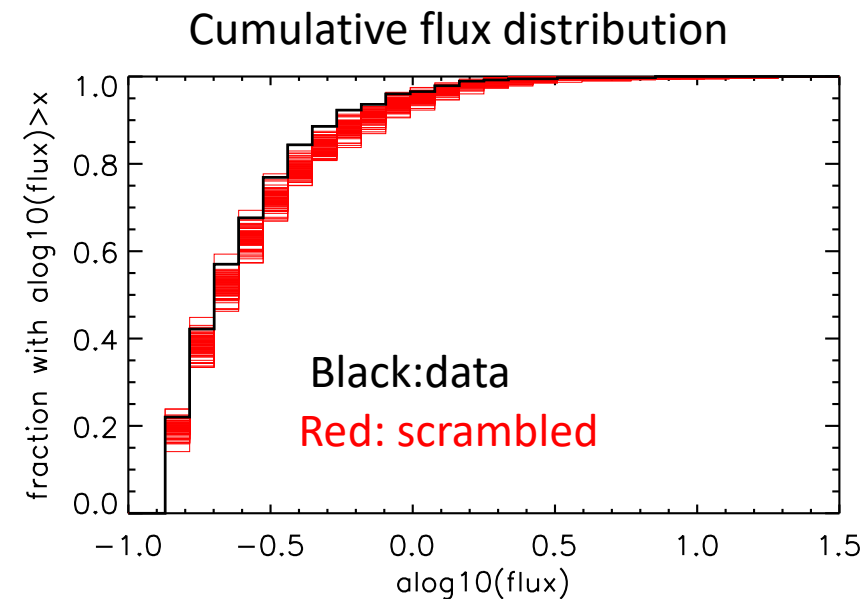
*scrambling 1: randomizing RA*

*scrambling 2: shifting by  $N \cdot 5\text{deg}$*

*=> both consistent*

*=> 1/2/3/4 matches on average 327/24/1.5/0 => in total **379 matches***

- 2) Check distribution of associated blazar VLBI fluxes



- ⇒ Can reproduce slightly enhanced blazar-neutrino correlation
- ⇒ Correlated blazars have lower VLBI fluxes than 'scrambled' sets

*=> to be cross checked on IC data*

## New 10-year public data set from IceCube available (26th January)

Choose IC-86-I, predefine cuts

\* Event number reduction for feasibility of this small study:

Select 2% highest energy events

*(leads to #amount of correlations comparable to ANTARES case)*

\* Declination  $> 0$  ,  $\beta < 1^\circ$

\* Association neutrino-blazar within  $3 \cdot \beta$  (accommodating systematics)

### 1) Check associations blazar-neutrino

=> 1/2/3/4 matches: 401/64/5/0 => in total **544 matches**

*cross check with scrambled data:*

*scrambling 1: randomizing RA*

*scrambling 2: shifting by  $N \cdot 5^\circ$*

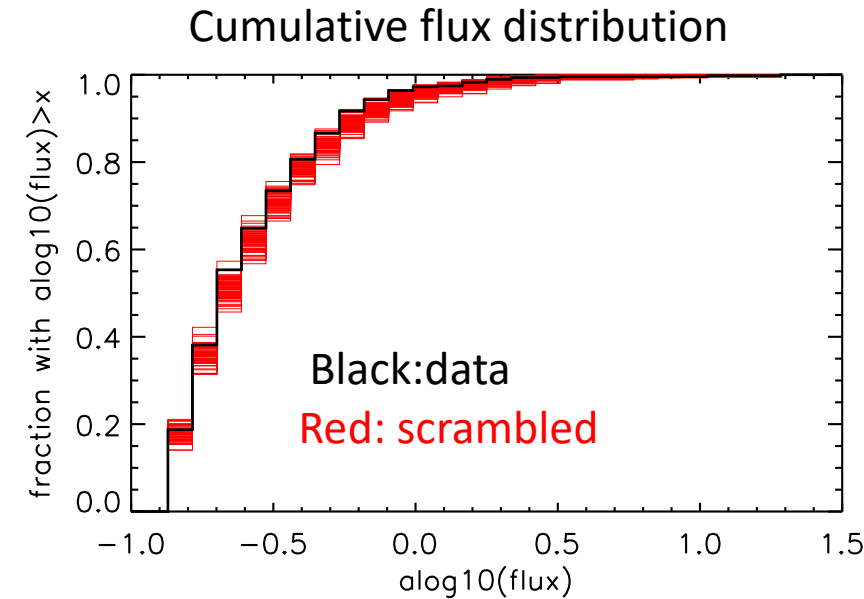
*=> both consistent*

*=> 1/2/3/4 matches on average 355/47/4.6/0.5 => in total **464 matches***

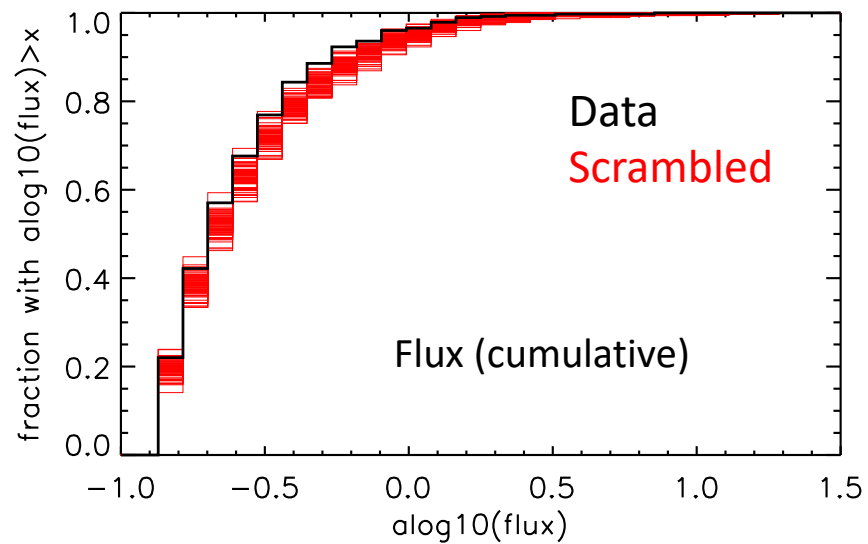
### 2) Check distribution of associated blazar VLBI fluxes

⇒ Seemingly also here slightly enhanced correlation

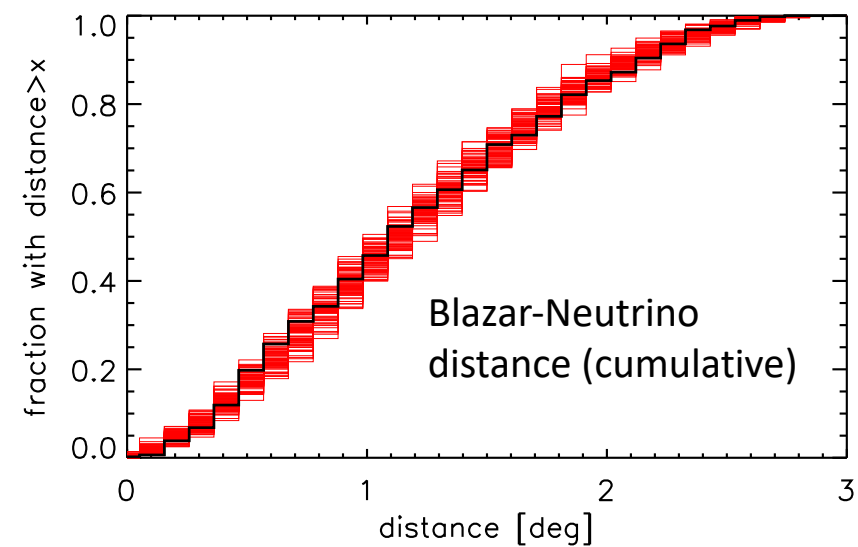
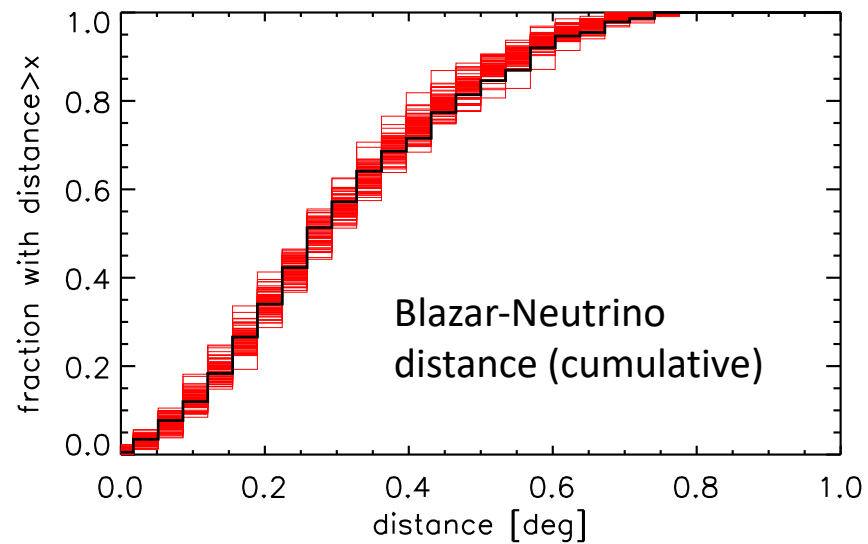
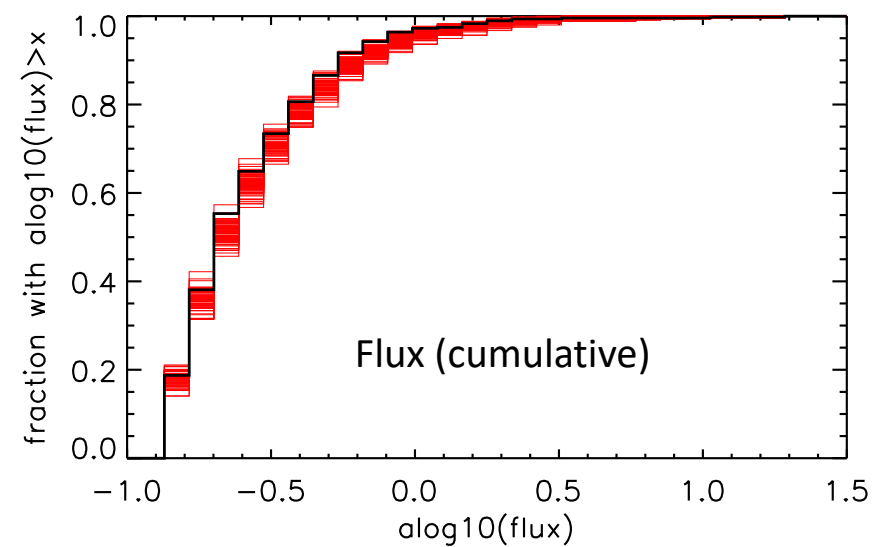
⇒ Correlated blazars have lower VLBI fluxes than 'scrambled' sets



**ANTARES 2007-2020**



**IceCube 86-I (1 year)**



## Hints for correlation in both ANTARES/IC

Are those real? Significance here not probed (requires proper pseudo-experiments), explorations of trends

- Could be artefact of chosen cuts (some arbitrariness in cut values, but not finetuned, results robust to some variations)
- Could be still bugs in my code

BUT

- Correlation been seen before with these blazars by Plavin et al. (with different IC samples)
- Hard to get via neutrino cuts a selection bias of low blazar fluxes

Note: In the public IC data IC-86-II – IC-86-VII the correlation is not directly obvious with these cuts,

HOWEVER:

Reconstruction & Calibration differs for those years from IC-86-I (in newer data BDTs and different calibration used), so not directly comparable data samples