Extragalactic sources of high-energy cosmic neutrinos

Bl lac objects

Chiara Righi

Correlation F_gamma F_nu

$$\frac{F_\nu}{F_\gamma} = \frac{L_\nu}{L_\gamma} = \frac{\epsilon_p}{\epsilon_e}\frac{Q'_p}{Q'_e}$$

Ice Cube

Km3NeT

Righi et al. 2016

Results

Introduction:

- Ice Cube fi extrophysical neutrinos
- Extragalactic sources that could produce extrophysical neutrinos: AGN
- AGN subclass: Blazars
- Relation between Fgamma & F nu

Spine-layer MODEL

FSRQs

Conclusions:

- High-energy neutrino could be produced by extragalactic sources
- Bl Lac are good candidates to produce neutrino
- Future observation could confirm the production of neutrino by Bl Lac

Most galaxies harbors a supermassive BH
In about 1% of the galaxies the BH is active (AGN)
About 10% of AGN are radio loud: JETS

Blazars:

Spectral Energy Distribution (SED): dominated by the boosted non-thermal continuum emission of the jet.

Leptonic Model: Synchrotron and Inverse Compton
Hadronic Model: synchrotron or photo-meson emission

Blazars:

BL lac Objects: low power; look a' important thermal comp.
FSRQ Objects: high power; Thermal optical comp.

Blazars:

Bl lac | FSRQs

pp reaction pgamma reaction is likely to occur

In collaboration with F. Tavecchio (INAF-Brera), M. Landoni (Inaf-Brera), G. Ghisellini (INAF-Brera), D. Guetta (Inaf-Roma)

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NATIONAL INSTITUTE FOR ASTROPHYSICS

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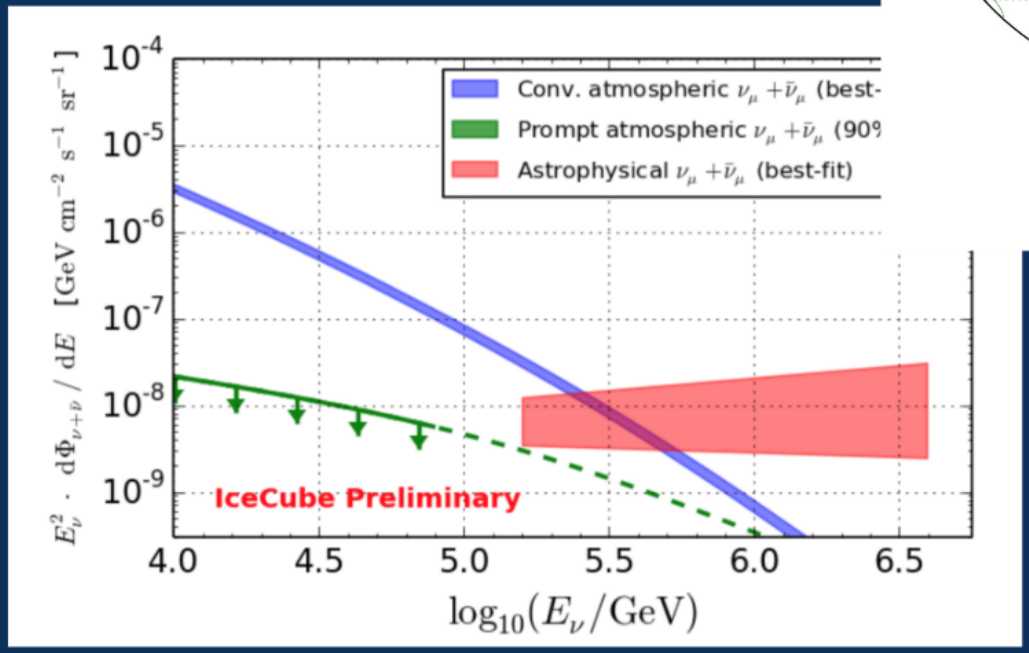
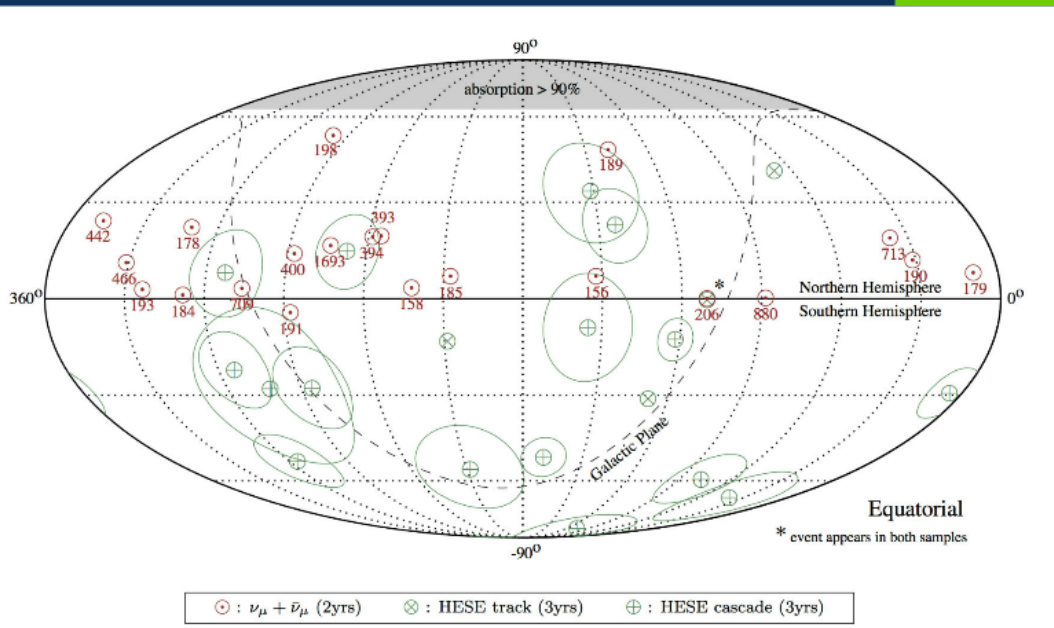
~50 high-energy neutrino events (up to 60TeV) from 2008 to 2015



Rädel & Schoenen, 2015



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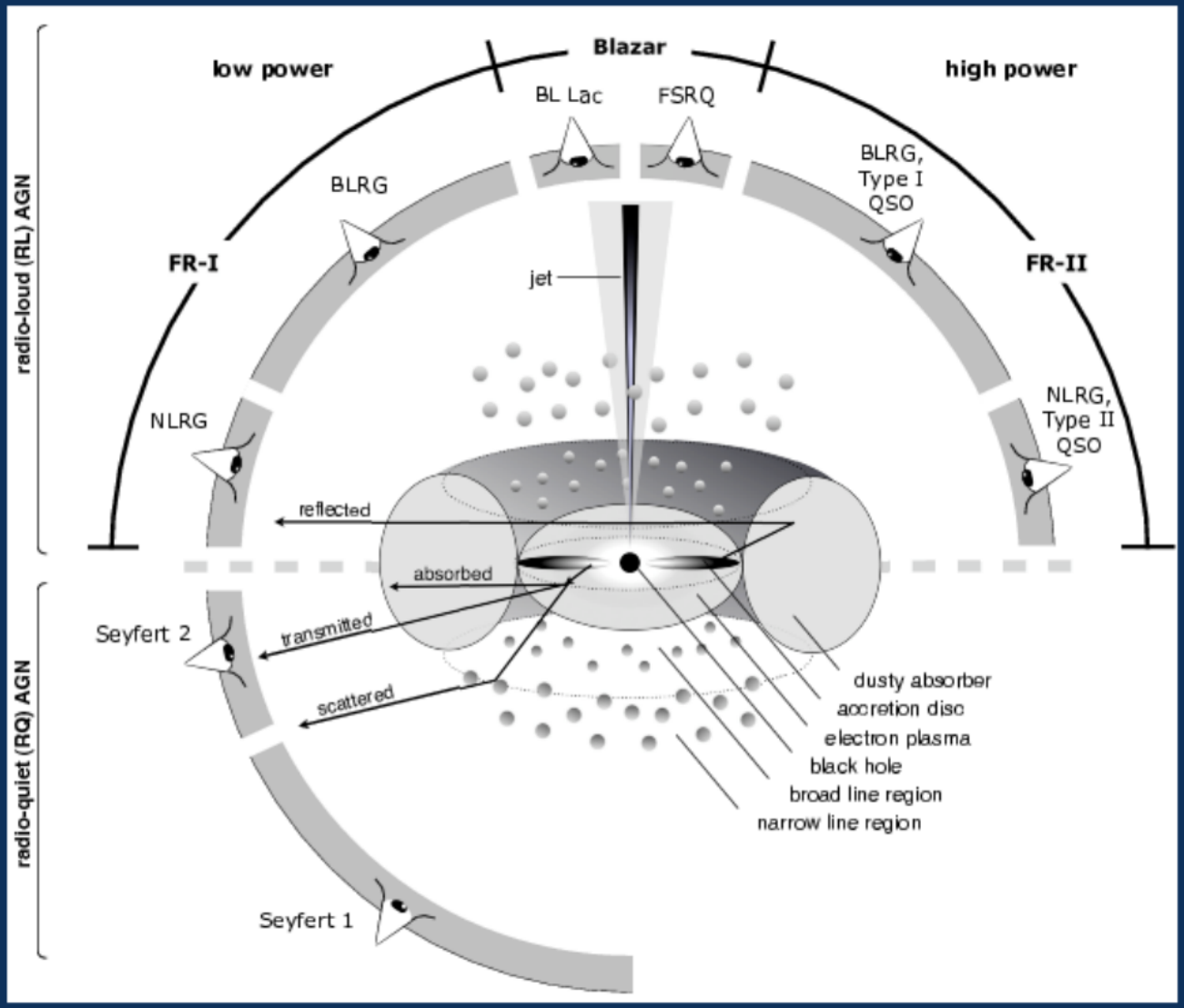

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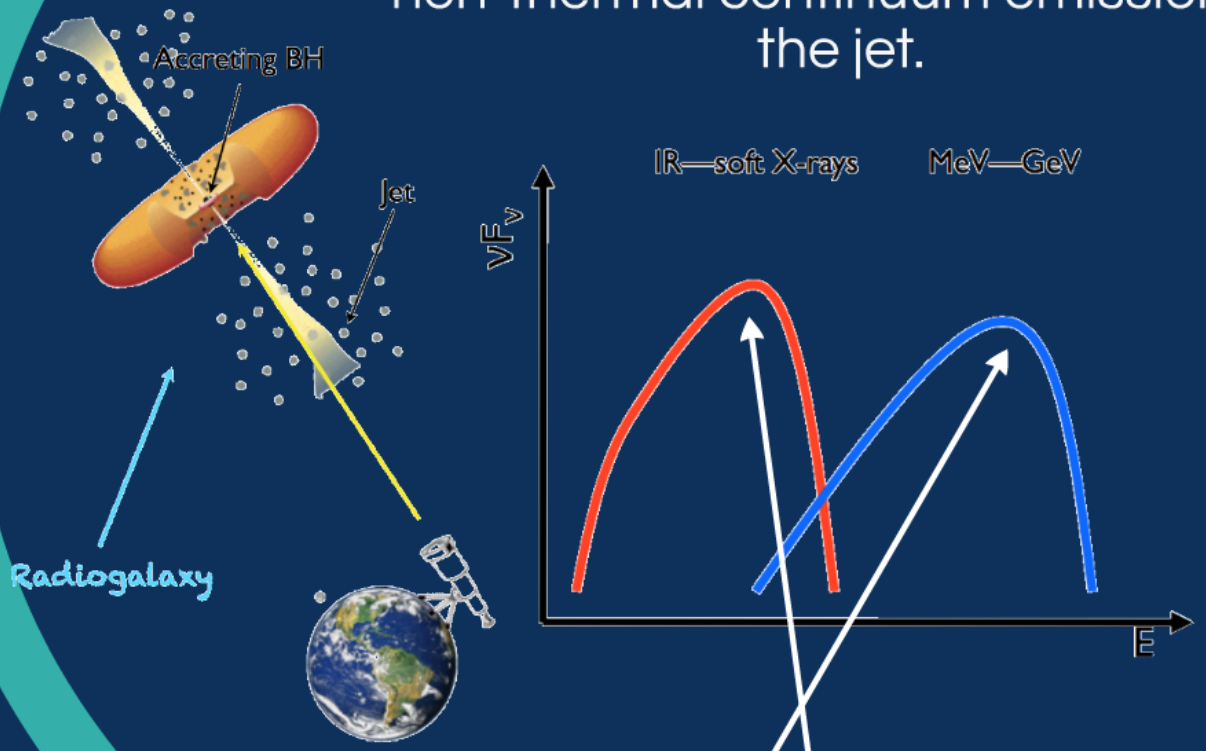

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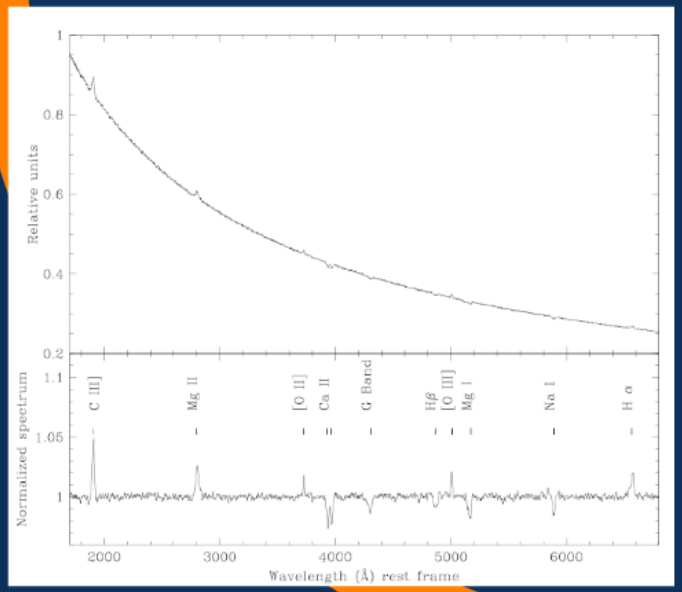
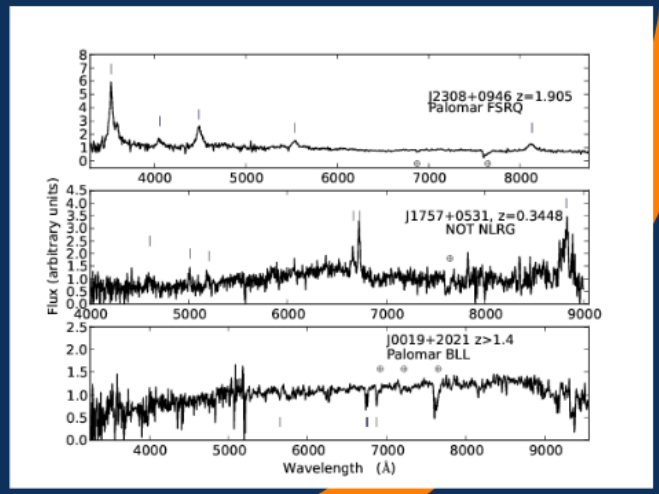
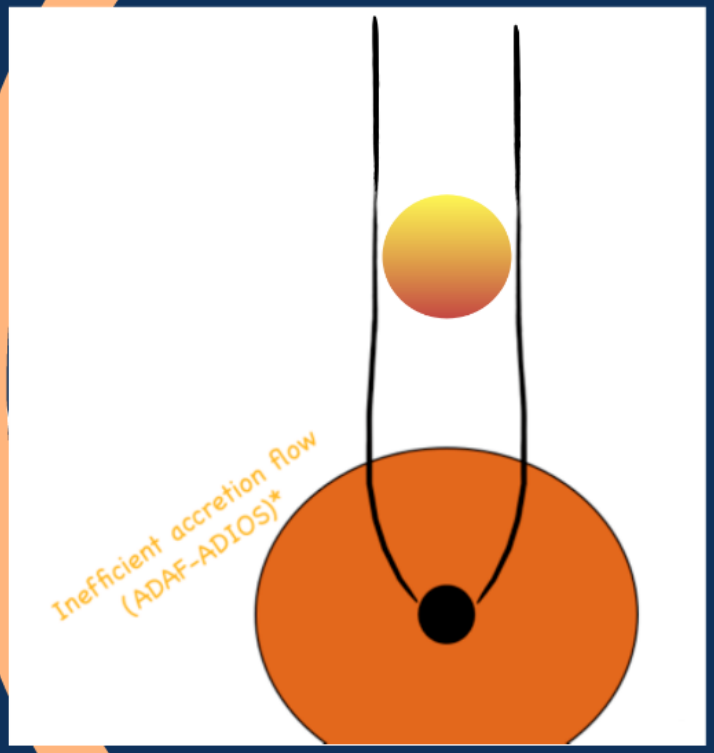


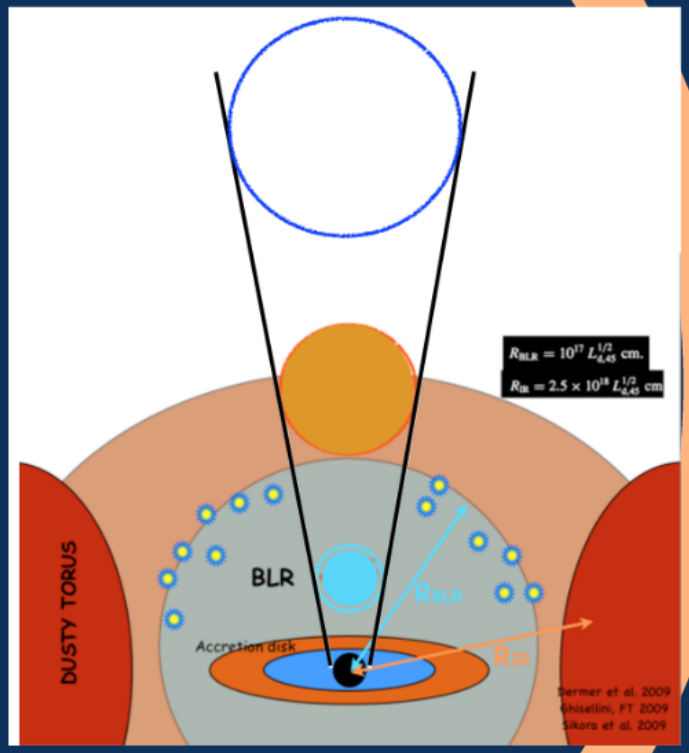


Blazars:

Bl lac



FSRQs



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pgamma reaction is likely
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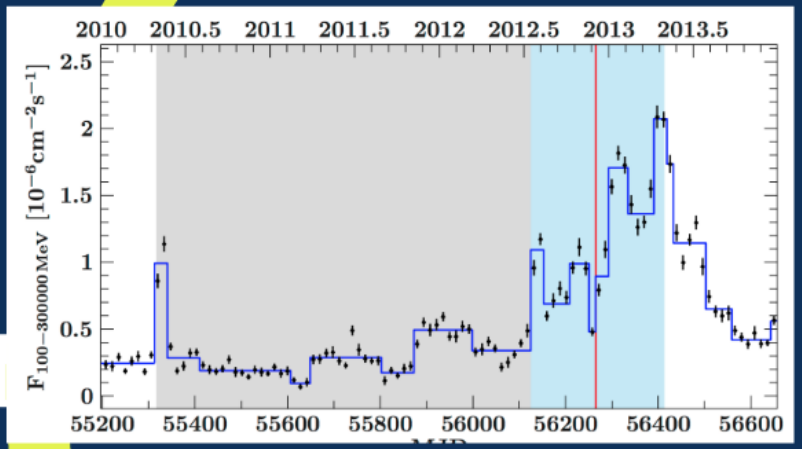
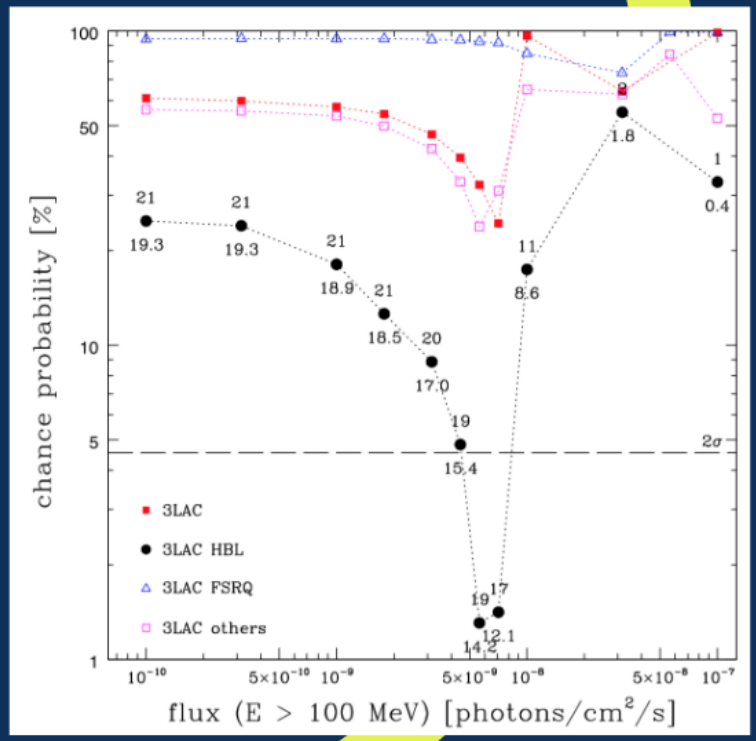
FSRQs ?

Kadler et al. 2016



Murase, Inoue & Dermer 2014
Murase & Waxmann 2016

LOW SOURCE DENSITY-->
Strong correlation expected!

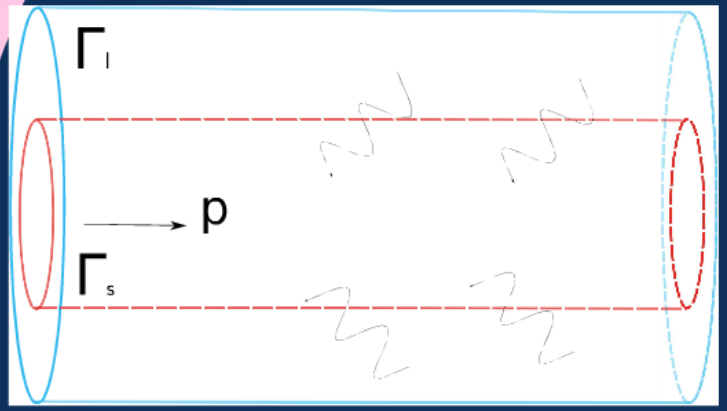


Padovani & Resconi 2014 Padovani et al. 2016

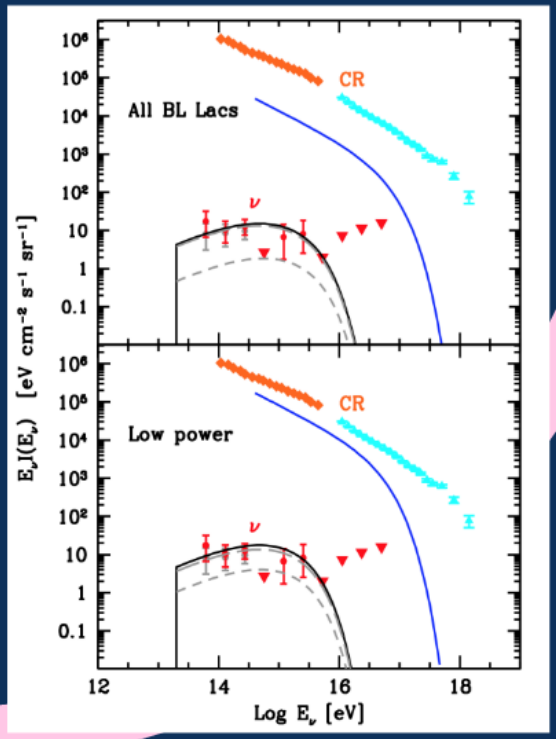
But if we considered a structured jet?!?!

Spine-layer MODEL

The spine sees an enhanced Urad coming from the layer



p-gamma reaction is likely to occur!



Ghisellini, Tavecchio & Chieberge 2005
Tavecchio et al. 2014, 2015

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Ice Cube

Km3NeT

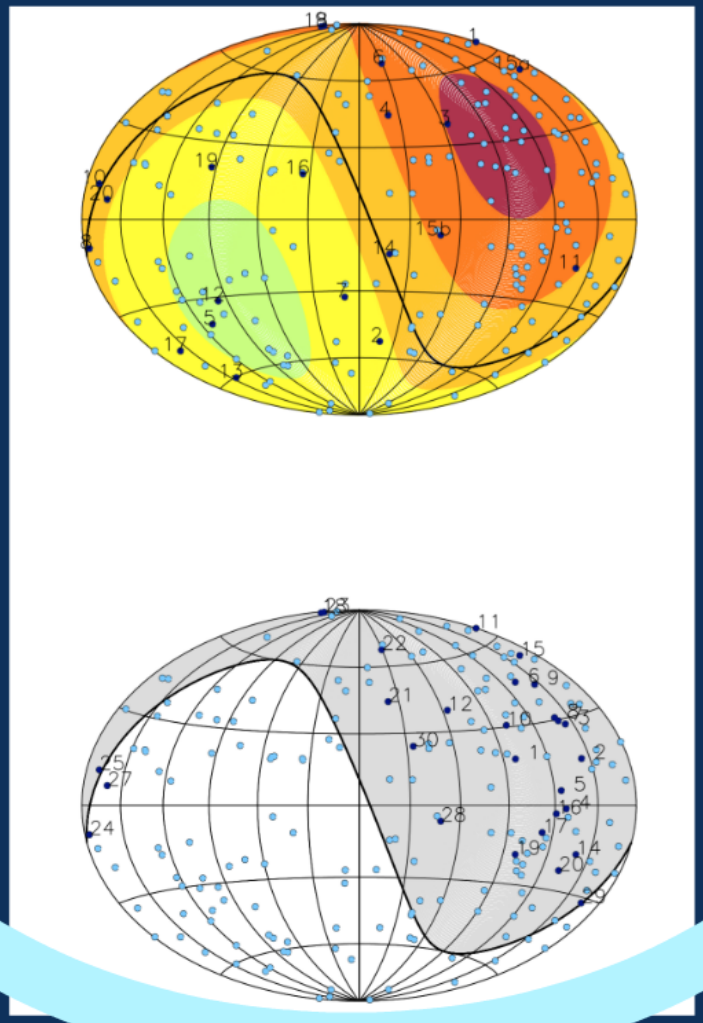
	Name	F_ν	R_ν
	$60° < \delta < 90°$		
1	1ES1959+650	1.38	0.27
2	1ES0502+675	1.14	0.22
3	S50716+71	0.44	0.08
4	1RXSJ013106.4+61203	0.25	0.05
5	4C+67.04	0.25	0.05
6	Mkn180	0.24	0.05
7	MS0737.9+7441	0.13	0.02
8	RXJ0805.4+7534	0.08	0.02
9	S40954+65	0.07	0.01
10	S41749+70	0.07	0.01
	$30° < \delta < 60°$		
11	Mkn421	8.77	4.89
12	Mkn501	3.41	1.90
13	PG1218+304	0.92	0.52
14	3C66A	0.87	0.49
15	1H1013+498	0.87	0.49
16	1ES0033+595	0.82	0.46
17	1ES2344+514	0.69	0.39
18	1ES1215+303	0.52	0.29
19	B32247+381	0.37	0.21
20	B30133+388	0.35	0.19
	$0° < \delta < 30°$		
21	PG1553+113	1.89	2.47
22	PKS1424+240	1.00	1.30
23	PG1218+304	0.92	1.20
24	TXS0518+211	0.87	1.14
25	1ES0647+250	0.75	0.99
26	1ES1215+303	0.52	0.69
27	RXJ0648.7+1516	0.45	0.59
28	1RXSJ194246.3+10333	0.41	0.54
29	RBS0413	0.32	0.42
30	1H1720+117	0.25	0.33

Righi et al. 2016

	Name	F_ν	R_ν	Visibility at horizon	R_ν	Visibility at 10°
1	Mkn421	8.77	4.59	0.30	5.80	0.39
2	PKS2155-304	2.15	2.23	0.60	2.53	0.69
3	Mkn501	3.41	1.65	0.28	2.26	0.39
4	PG1553+113	1.89	1.42	0.44	1.66	0.51
5	PKS0447-439	0.76	0.87	0.67	1.02	0.79
6	PKS1424+240	1.00	0.67	0.39	0.79	0.46
7	PKS2005-489	0.51	0.63	0.72	0.75	0.86
8	TXS0518+211	0.87	0.59	0.39	0.72	0.48
9	PG1218+304	0.92	0.55	0.34	0.69	0.44
10	1ES0647+250	0.75	0.47	0.36	0.60	0.46
11	3C66A	0.87	0.38	0.25	0.54	0.36
12	1RXSJ054357.3-55320	0.30	0.40	0.78	0.52	1.00
13	PKS0301-243	0.43	0.44	0.59	0.49	0.66
14	1H1914-194	0.45	0.44	0.57	0.49	0.63
15[a]	1H1013+498	0.87	-	-	0.48	0.32
15[b]	1RXSJ194246.3+10333	0.41	0.32	0.45	-	-
16	PKS1440-389	0.36	0.41	0.66	0.47	0.76
17	1ES0347-121	0.39	0.35	0.53	0.40	0.60
18	1ES1215+303	0.52	0.31	0.34	0.39	0.44
19	1RXSJ101015.9-31190	0.32	0.34	0.60	0.39	0.69
20	RXJ0648.7+1516	0.45	0.33	0.42	0.38	0.49

Results

KM3NeT



Ice Cube

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