Black hole candidates in the nearby universe

Speaker:
Laurentiu-Ioan Caramete

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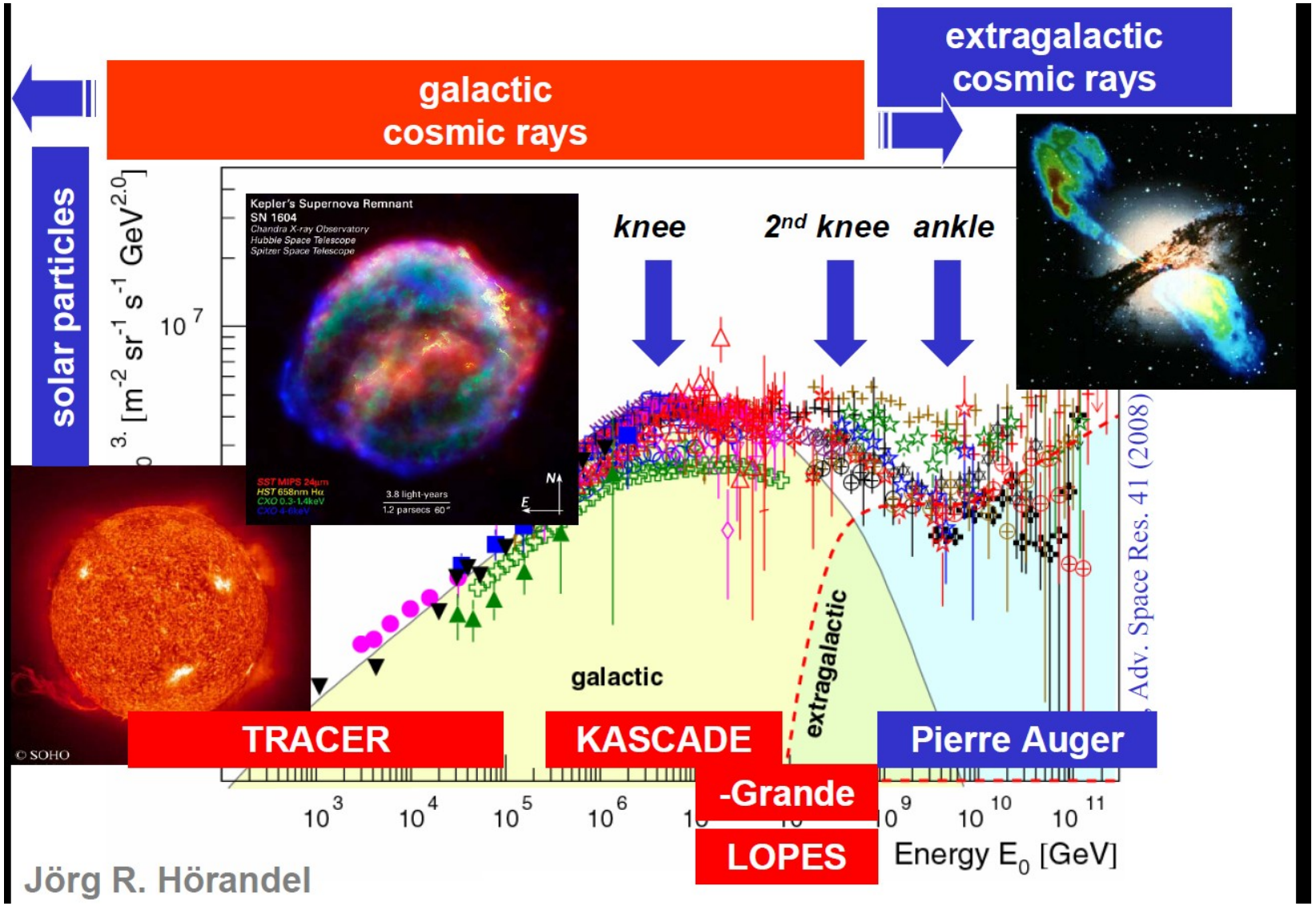
COST
WG 4 Supermassive Black Holes

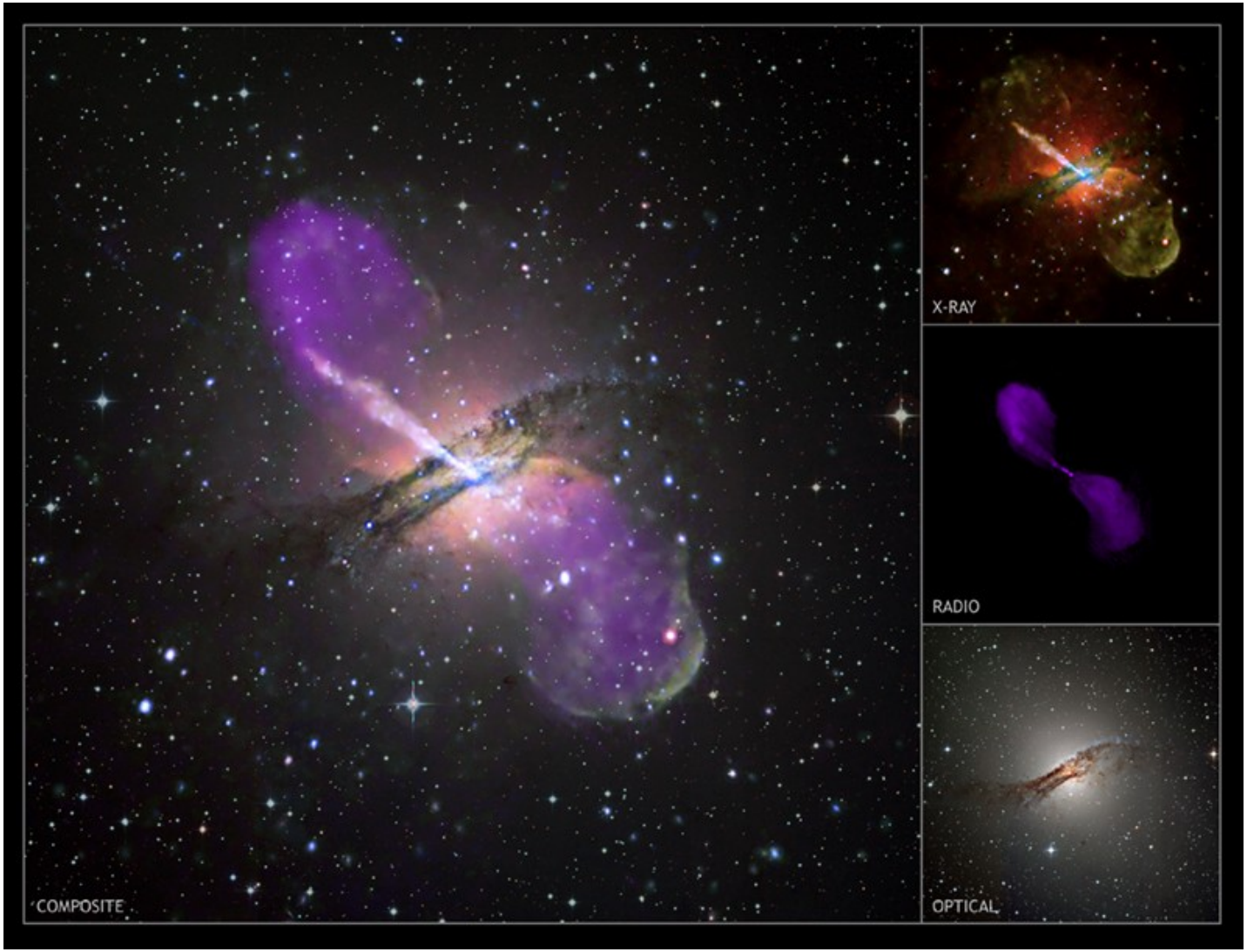
Contents

- From Cosmic Rays to Black Holes
- Massive Black Holes Catalog
- Characteristics of the catalog
- Monte-Carlo Distribution Simulation
- Conclusions&Discussions

• UHECR – Sources



• UHECR – Sources



Active Galaxy Centaurus A

Credit: X-ray - NASA, CXC, R.Kraft (CfA), et al.;

Radio - NSF, VLA, M.Hardcastle (U Hertfordshire) et al.;

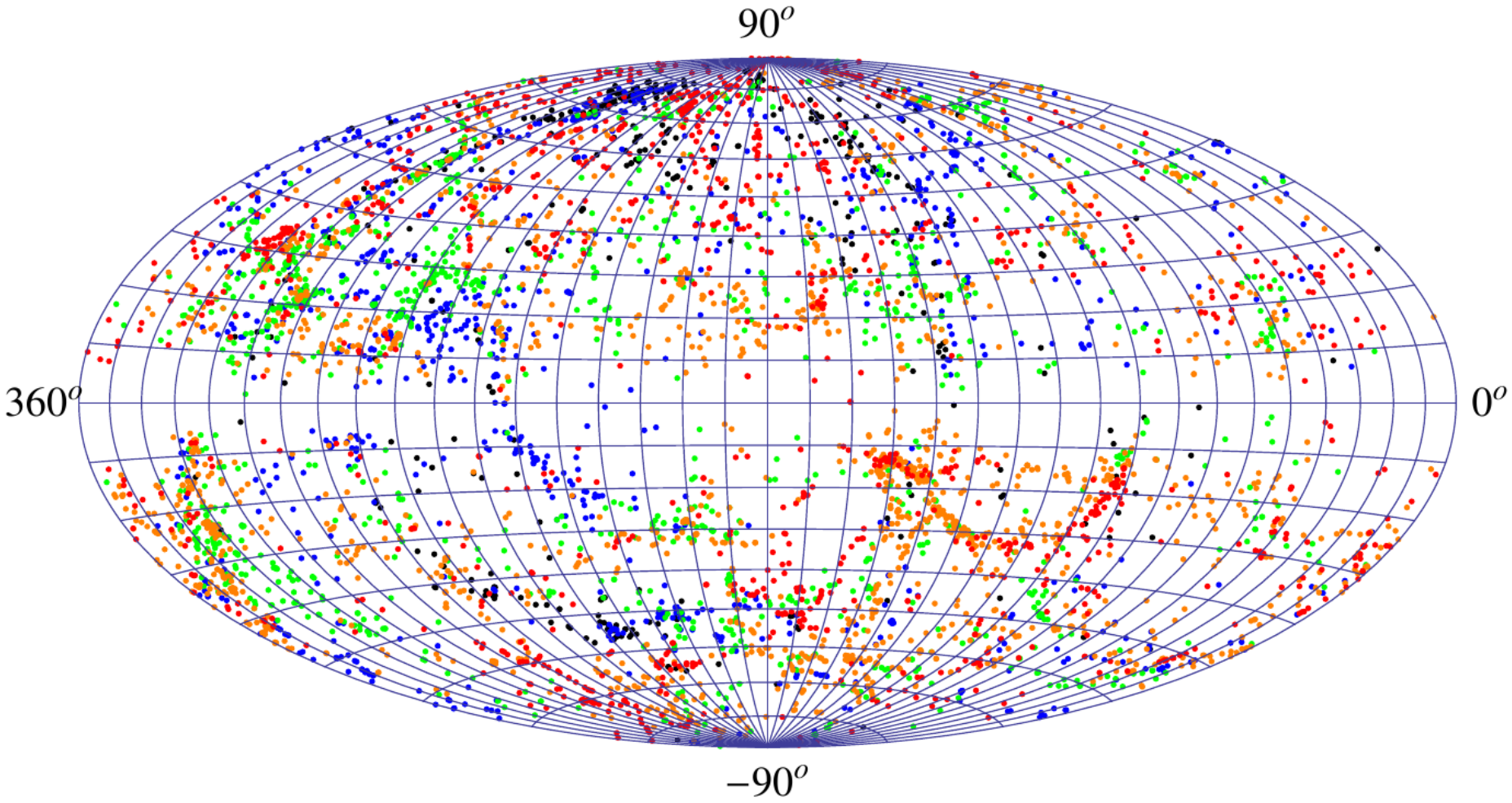
Optical - ESO, M.Rejkuba (ESO-Garching) et al.

- Constructing the catalog

• Sample at 2 micron (Two Micron All Sky Survey - 2MASS, Skrutskie et al., 2006): all galaxies dominated by an **old stellar population** emit strongly at **2micron** (van der Wel et al. 2006), and the spheroidal component of the **older stellar population** correlates well with **supermassive black holes** (e.g., Faber et al. 1997, Wang & Biermann 1998, Haering & Rix 2004)

• Using Hubble type → • Scaling Relation → • Catalog

- Sky plot color coded in Redshift



Aitoff projection in galactic coordinates of 5,895 NED candidate sources in the case of a complete sub sample. The choice was made from a complete sample of 10284 candidate brighter than 0.03Jy and selected at z< 0.025 and 2 micron. The color code is Black, Blue, Green, Orange, Red corresponding to redshifts between 0, 0.005, 0.01, 0.015, 0.02, 0.025

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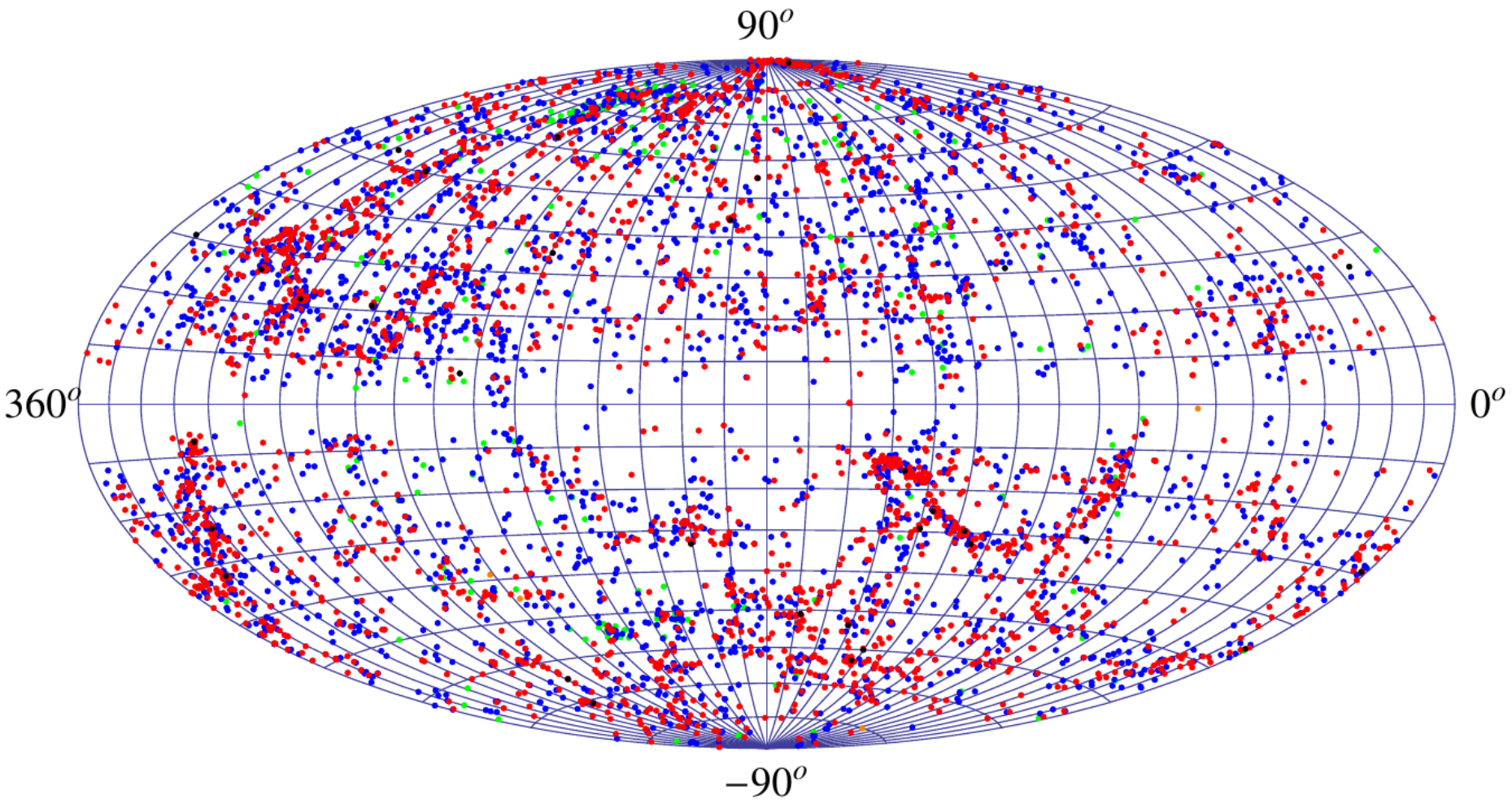
- Sky plot color coded in Black Holes Mass



Aitoff projection in galactic coordinates of 5,895 NED candidate sources. The color code is Brown, Orange, Green, Blue, Red, Black corresponding to black hole masses between 10^5 Msol , 10^6 Msol , 10^7 Msol , 10^8 Msol , 10^9 Msol .

• Example of black holes list

Name	l Deg	b Deg	z	Morphological type	Distance Mpc	Estimated M_{BH} $10^8 M_\odot$	B-V	FIR/Radio ratio
NGC 5332	0.16	72.678	0.02241	S0-	92.0	3.75±1.88	0.94	
NGC 6500	43.763	20.233	0.01001	SAab LINER	41.1	1.41±0.704		3.6±0.1
NGC 6849	0.329	-30.818	0.02014	SB0-	82.7	4.49±2.24	0.8	
NGC 5311	83.759	72.474	0.009	S0/a	36.9	1.04±0.521		9.4±0.9
NGC 5845	0.338	48.904	0.00483	E	24.1	0.50±0.25	0.97	<0.17
NGC 5850	0.516	48.636	0.00852	SB(r)b	35.0	2.68±1.34	0.72	<0.819
NGC 7469	83.099	-45.467	0.01631	(R')SAB(rs)a Sy1.2	67.0	4.96±2.48	0.55	384.9±57.1
NGC 5846	0.426	48.797	0.00571	E0-1;LINER HII	29.1	5.37±2.69	0.96	>181.8
ESO 338- G 009	0.445	-23.401	0.01857	Sa-b	76.2	1.16±0.582		
NGC 5838	0.729	49.319	0.00453	SA0-LINER	18.6	1.23±0.614	0.94	<0.73
MESSIER 094	123.363	76.007	0.001027	(R)SA(r)ab;Sy2 LINER	4.6	0.752±0.376	0.72	601.1±75.06
UGC 00542	123.457	-33.599	0.015044	Sb	61.7	1.32±0.661	13.18	<0.22
NGC 4648	123.818	42.691	0.004717	E3	19.3	0.413±0.207	0.89	
UGC 00555	123.823	-33.999	0.022699	S0/a	93.2	2.67±1.34		
UGC 01039	123.896	22.220	0.017616	Sab	72.3	1.41±0.706		<0.43
UGC 00567	123.897	-31.115	0.020291	S0	83.3	1.69±0.844		
UGC 00670	123.913	12.758	0.015948	SBb?	65.4	2.33±1.17		<0.73
NGC 0317A	124.118	-19.057	0.017656	S0	72.5	2.09±1.04		<6.45
UGC 00600	124.118	-14.194	0.022726	SAB(s)b	93.3	2.06±1.03		<0.84
NGC 4589	124.235	42.901	0.006605	E2 LINER	20.4	1.25±0.627	0.93	7.1±0.42

Example of the data included in the massive black hole catalog, these 20 galaxies illustrate some of the different parameters that are available. We mention here that we used compiled distances as noted before where available and for all distances similar or less than the Virgo cluster the distances are corrected.

- Hubble types

Type	5894 selection	2928 selection	Rejected list
E	783	765	-
S0	2626	1771	-
Sa	879	184	-
Sb	1052	128	-
Sab	554	80	-
Sc	-	-	1941
Irr	-	-	14
Sy	-	-	128
No type	-	-	867
Sbrst	-	-	421
Unknown type	-	-	1019

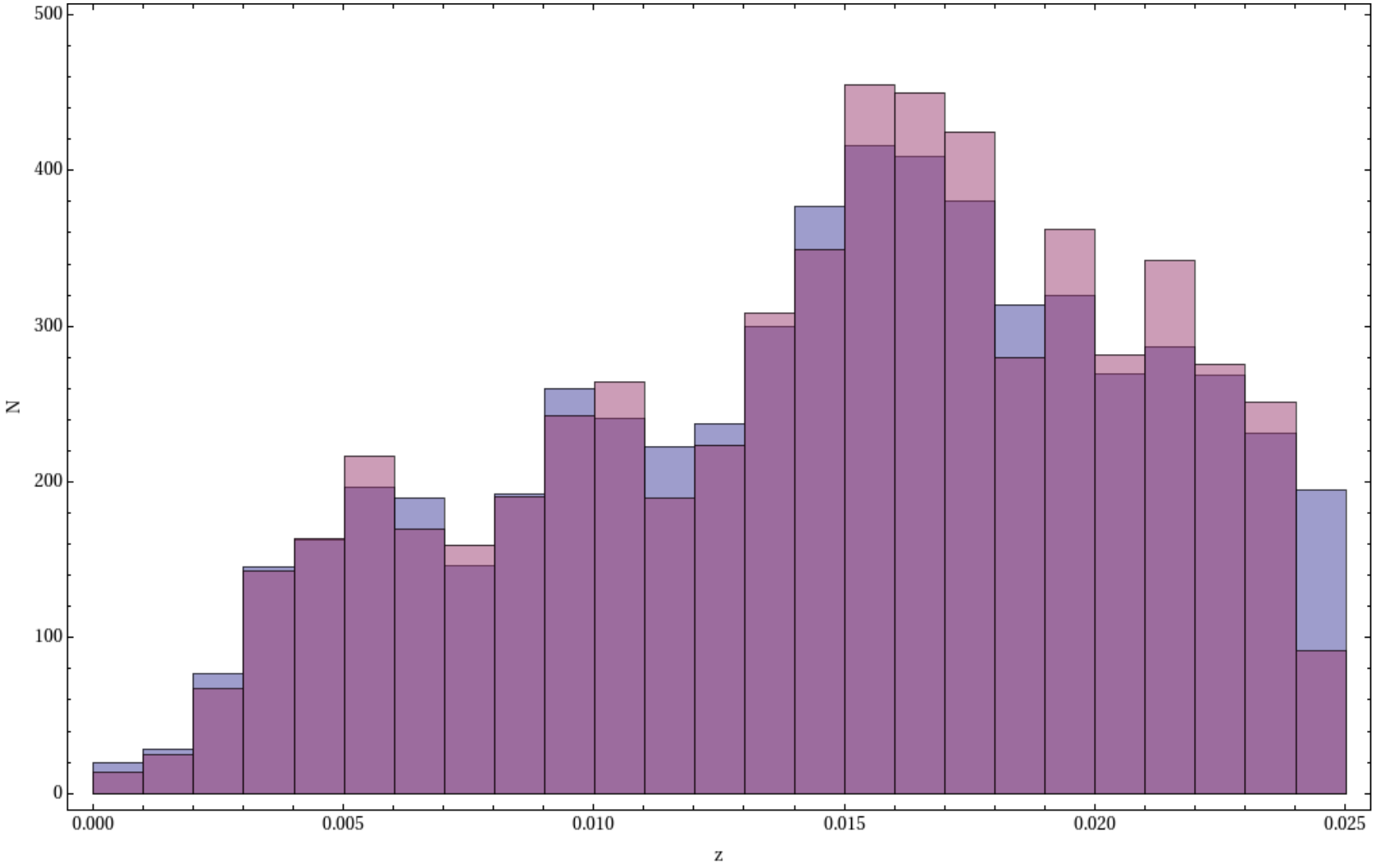
- Application to black hole mass distribution

☺ Importance Sampling

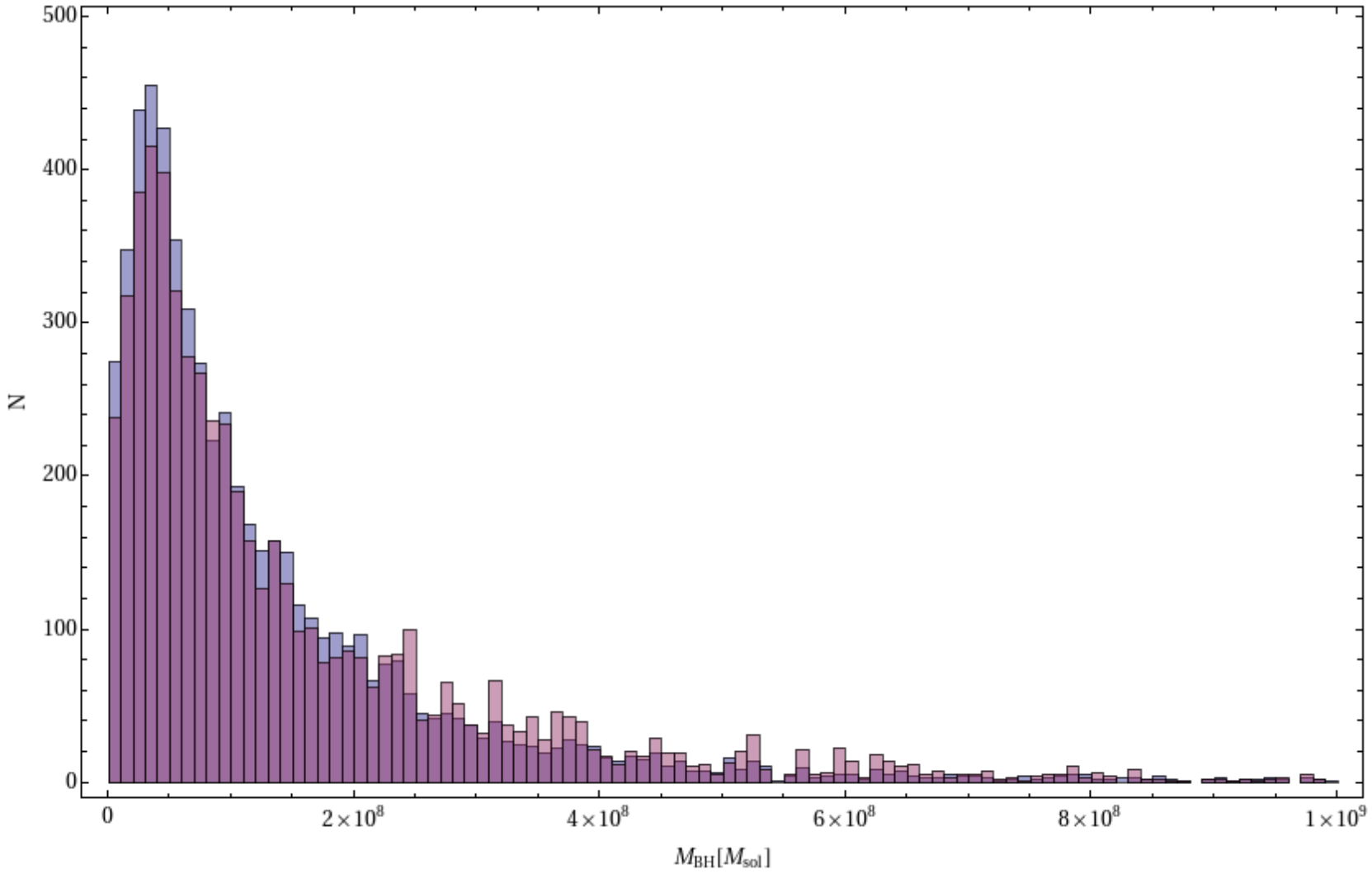
☺ Rejection Sampling

☺ Markov Chain Monte-Carlo Metropolis Hastings

- Markov Chain Monte-Carlo



- Markov Chain Monte-Carlo



• Conclusions&Discussion

- A simple scaling method to give a big catalog of black holes

- Lots of upgrades for the catalog possible after observations in radio, optical and infrared

- Monte-Carlo multi-dimensional simulations of distribution of mass, redshift, luminosity, etc. of black holes or black holes host galaxies

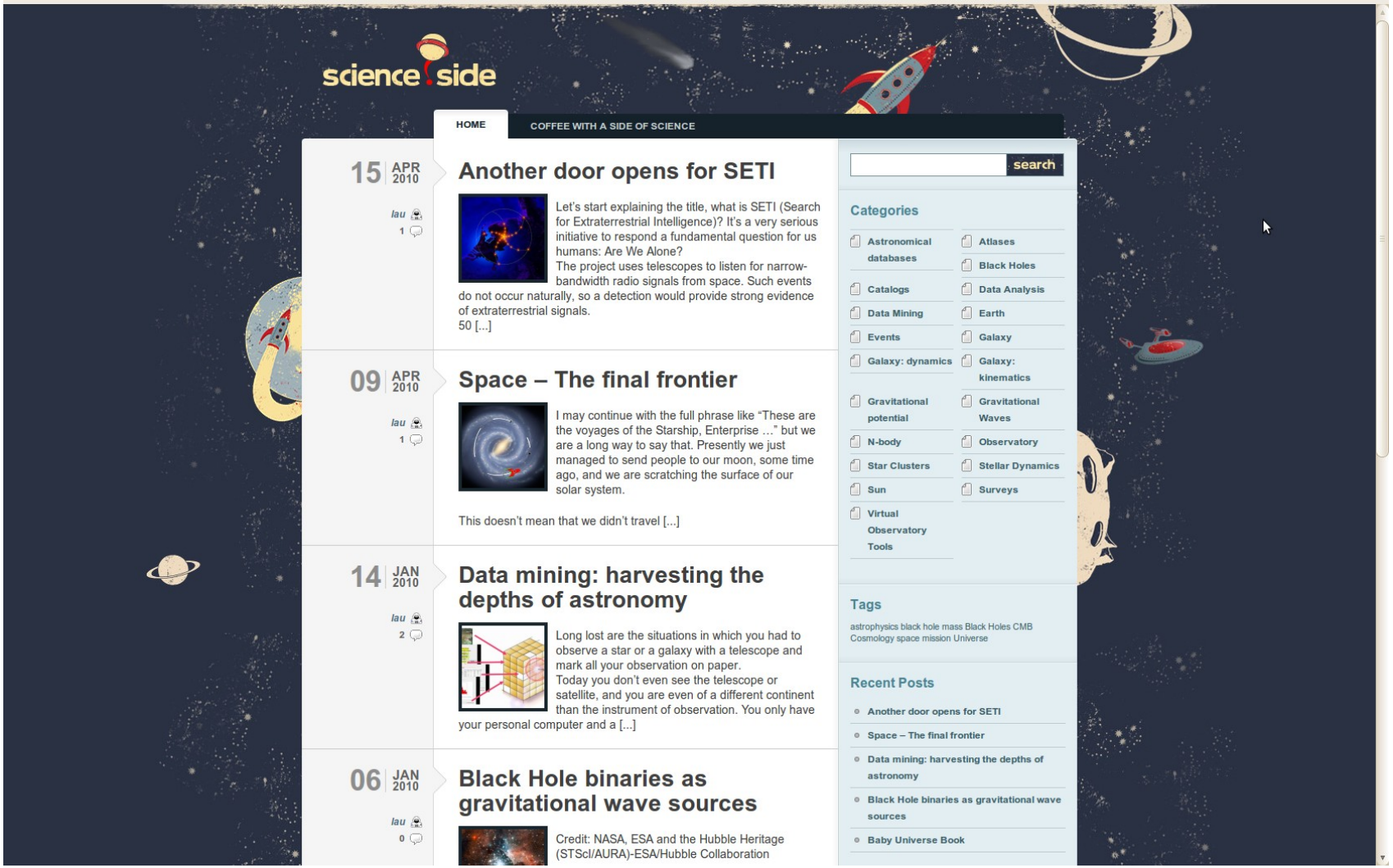
- More info

http://www.science-side.com/

http://www.spacescience.ro/new1/cosmo/

http://www.mpifr-bonn.mpg.de/div/theory/

- More info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15 APR 2010
Another door opens for SETI
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1
Let's start explaining the title, what is SETI (Search for Extraterrestrial Intelligence)? It's a very serious initiative to respond a fundamental question for us humans: Are We Alone?
The project uses telescopes to listen for narrow-bandwidth radio signals from space. Such events do not occur naturally, so a detection would provide strong evidence of extraterrestrial signals.
50 [...]
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I may continue with the full phrase like "These are the voyages of the Starship, Enterprise …" but we are a long way to say that. Presently we just managed to send people to our moon, some time ago, and we are scratching the surface of our solar system.
This doesn't mean that we didn't travel [...]
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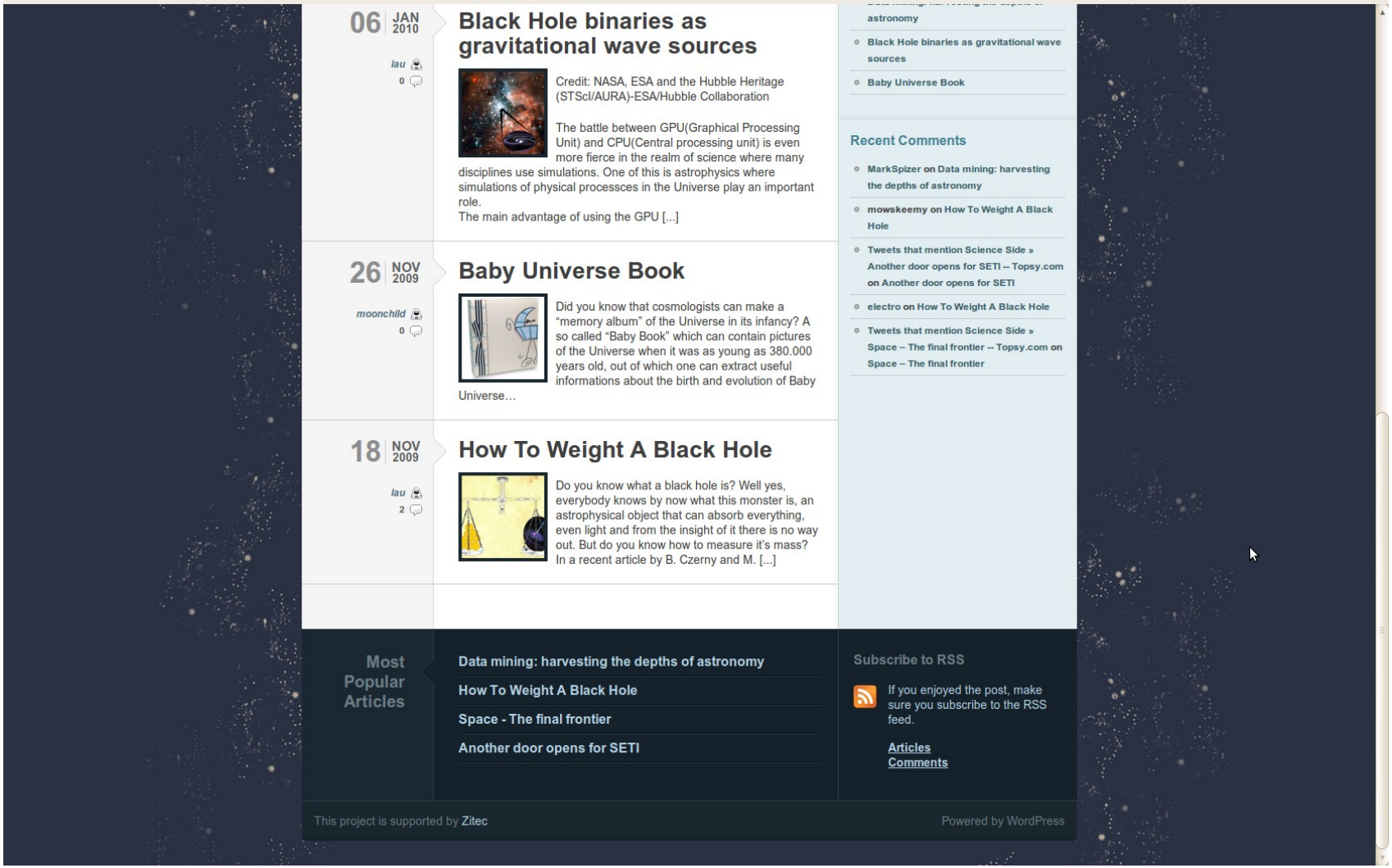
Baby Universe Book

- More info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Credit: NASA, ESA and the Hubble Heritage (STScI/AURA)-ESA/Hubble Collaboration
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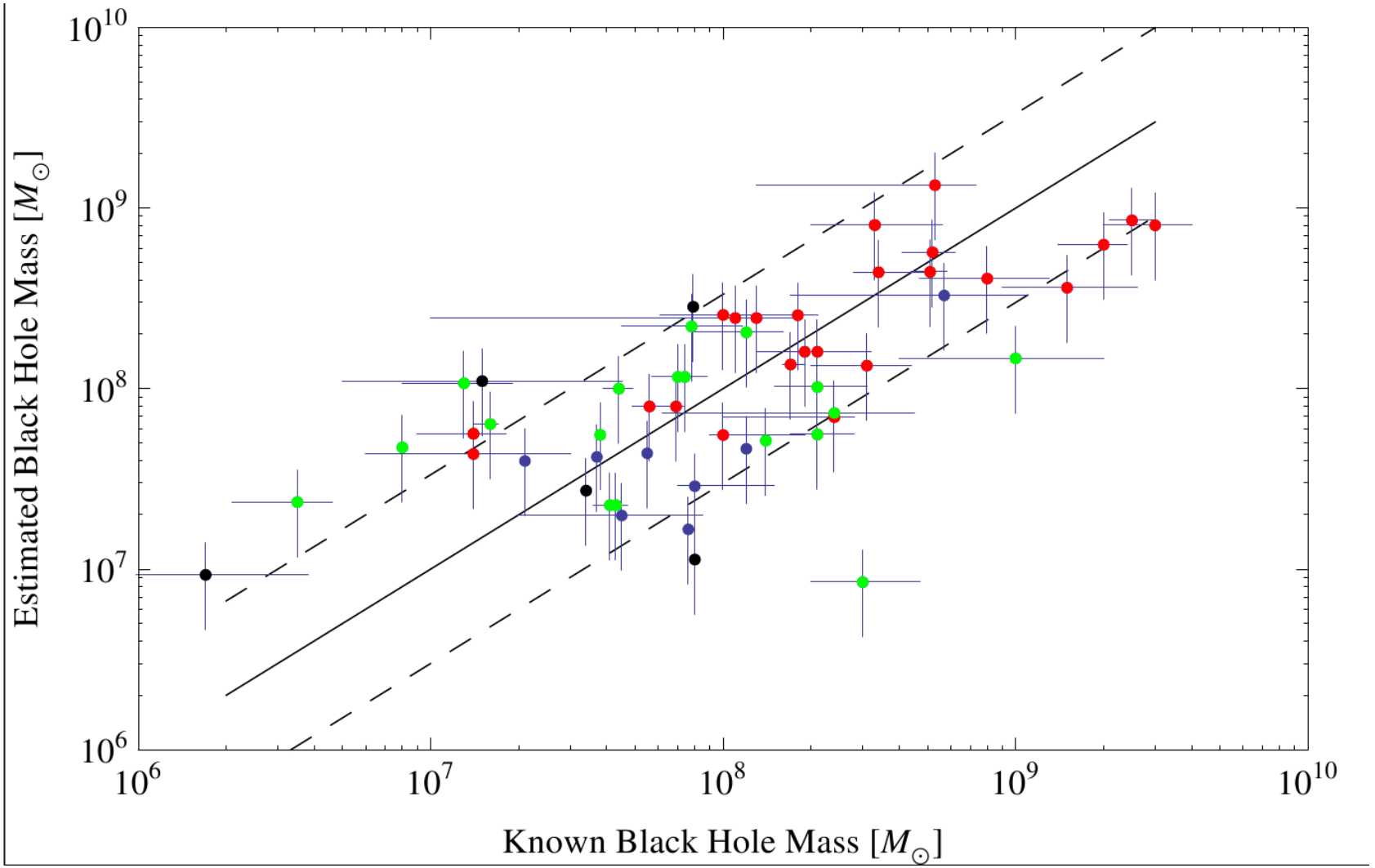
10^{10}
10^{9}
10^{8}
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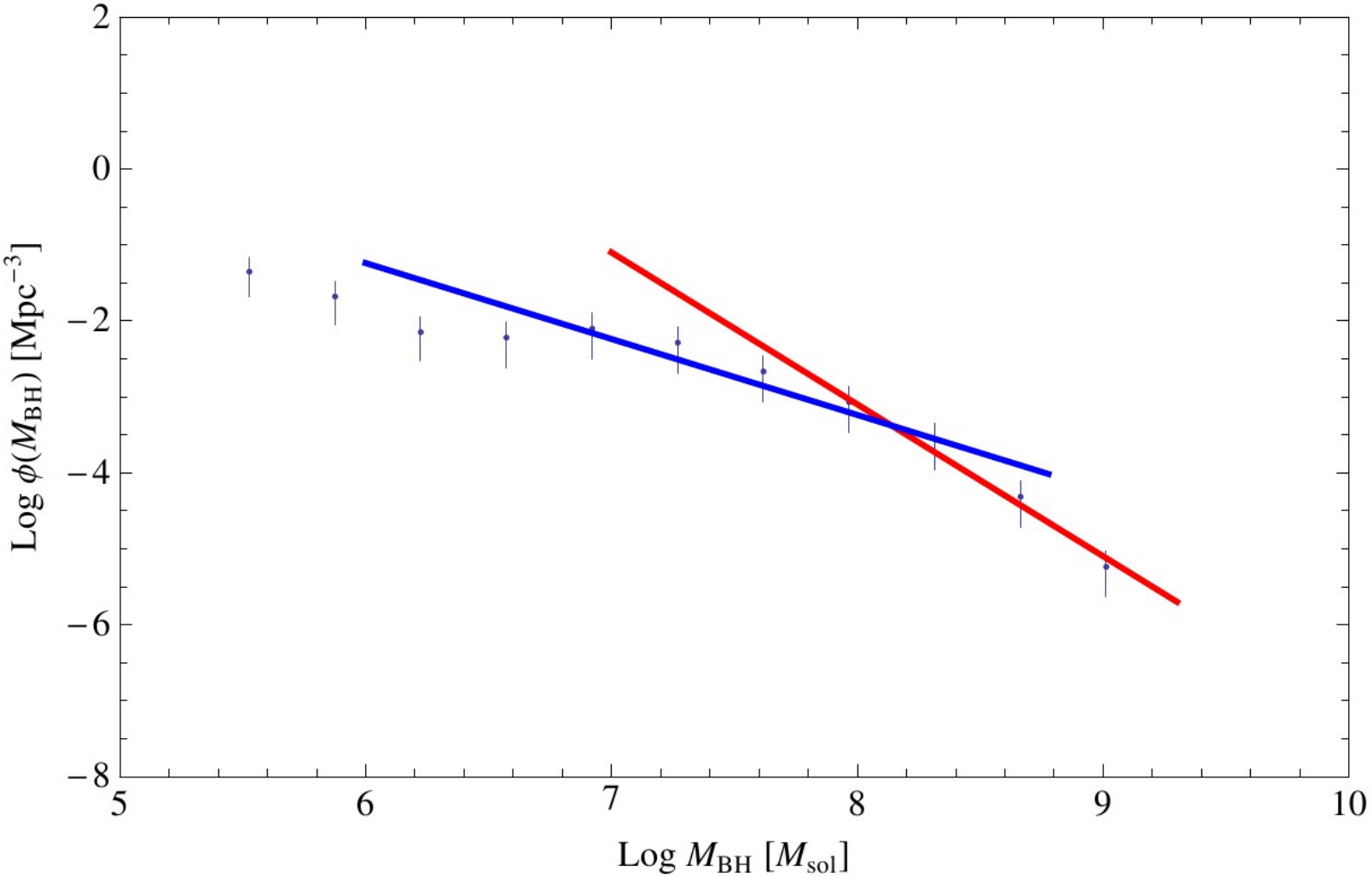
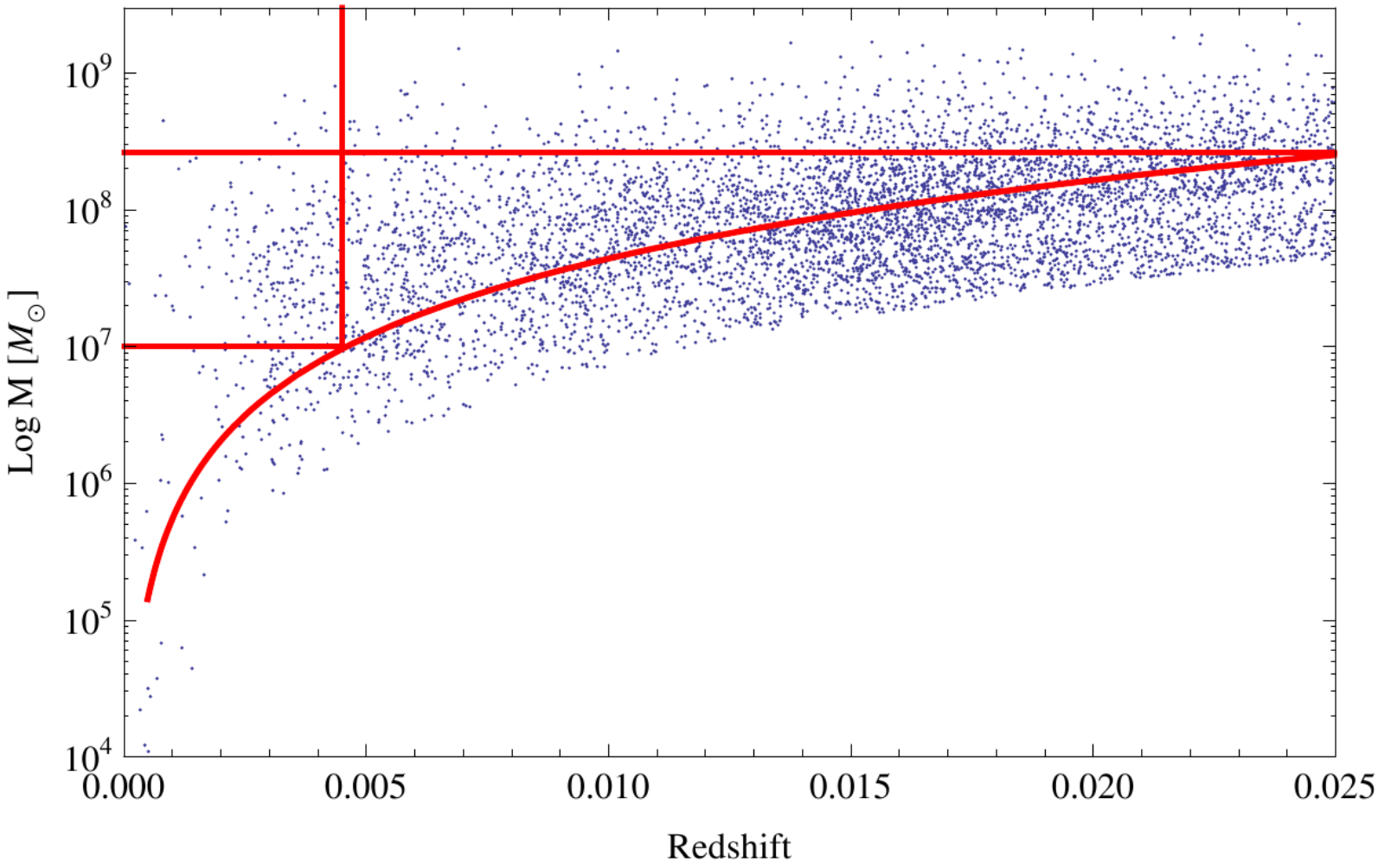
Estimated Black Hole Mass [$M_\odot$]
Known Black Hole Mass [$M_\odot$]

- More info



Integral mass function corrected for Hubble type sampling, 2928 objects, the slope of the lines is: red line −2.0 fitting > 10^8 Msol , and blue line −1.0 fitting between 10^7 Msol and 10^8 Msol .

- More info



Plot of Mass over redshift for the massive black hole catalog with the selection curve for elliptical galaxies in blue. This also shows the stepwise selection procedure with the two most extreme cases, the lowest mass, and the highest redshift, also in red.

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