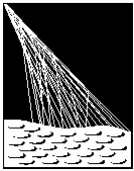


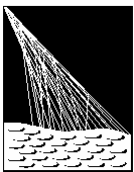
Plan for Northern Auger

- **Science Case**
 - Why All Sky Coverage?
- **Detector**
 - Why Hybrid with Water Tank?
- **Site**
 - Utah vs. Colorado
- **Schedule**



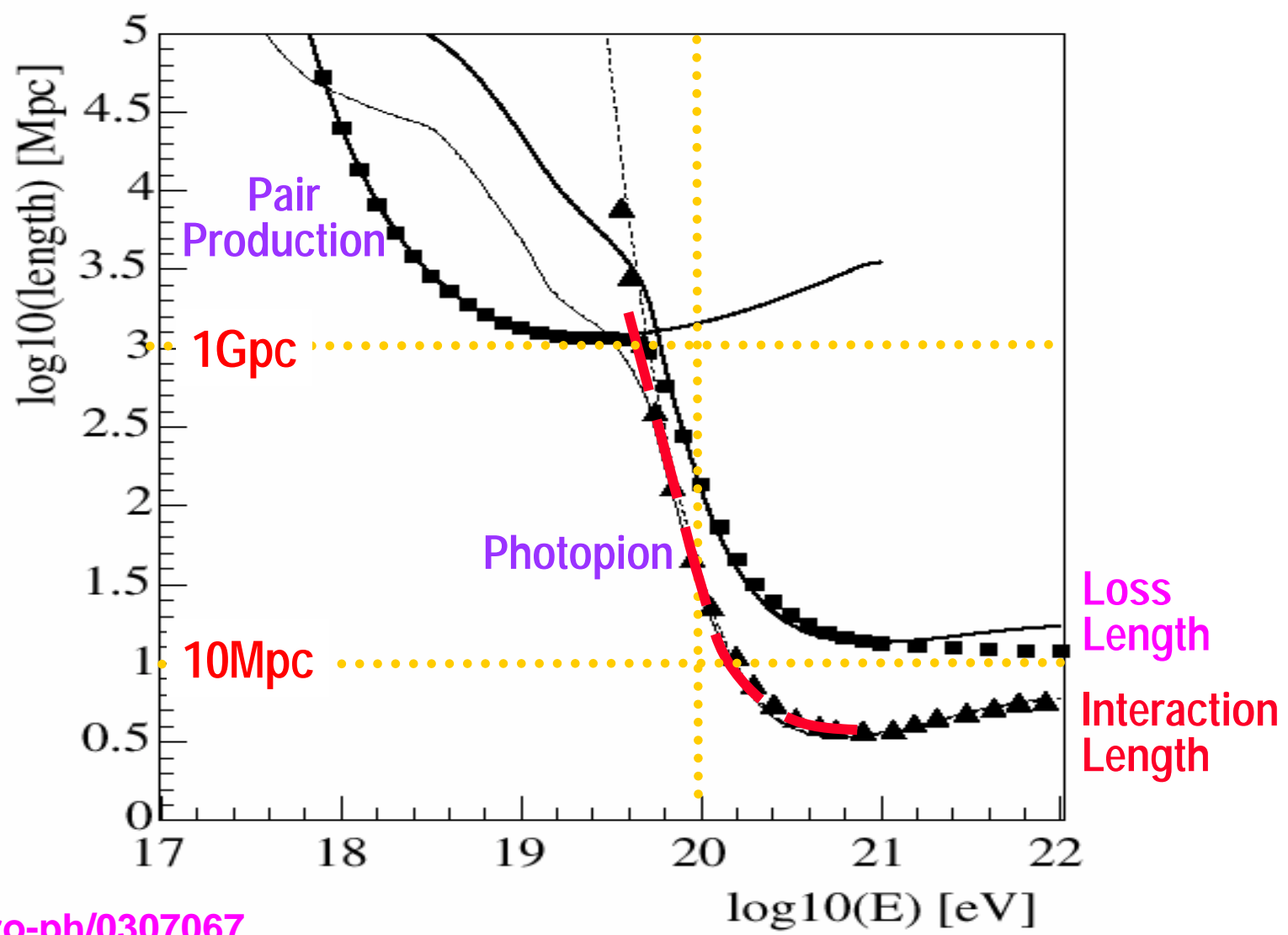
Why is $\sim 10^{20}$ eV so special?

- Protons can not travel beyond ~ 100 Mpc at $E > 10^{20}$ eV due to interaction with CMB.
 - GZK Cut-off
 - Violation of Special Relativity?
- Protons can travel straight at $E > \sim 4 \times 10^{19}$ eV.
 - Charged-Particle Astronomy
 - New Window of Extreme Universe
- Difficult to accelerate beyond 10^{20} eV.
 - Top-down Mechanism?



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Interaction Length of UHE Protons

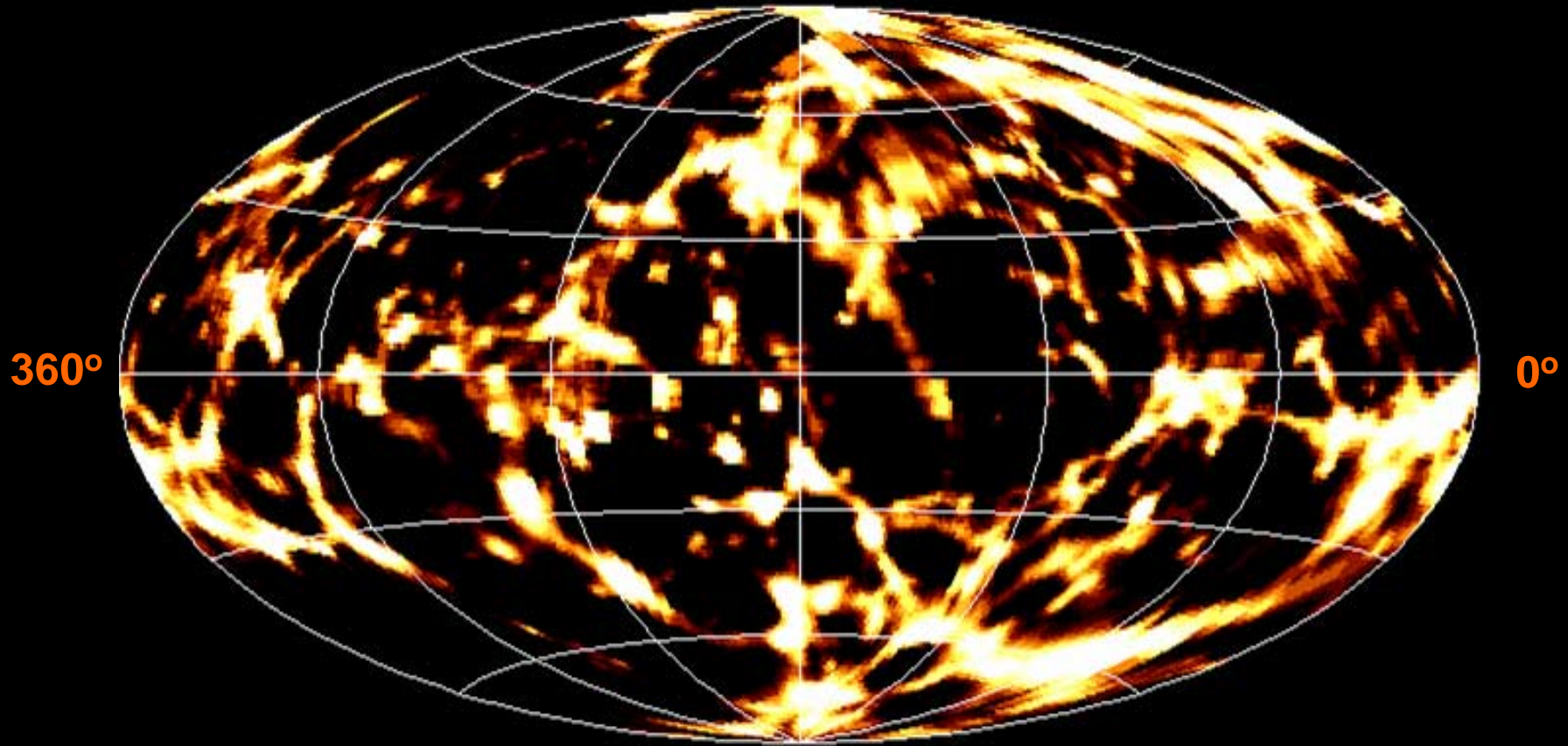


Blasi, astro-ph/0307067

Matter Distribution

($7 < R < 93$ Mpc)

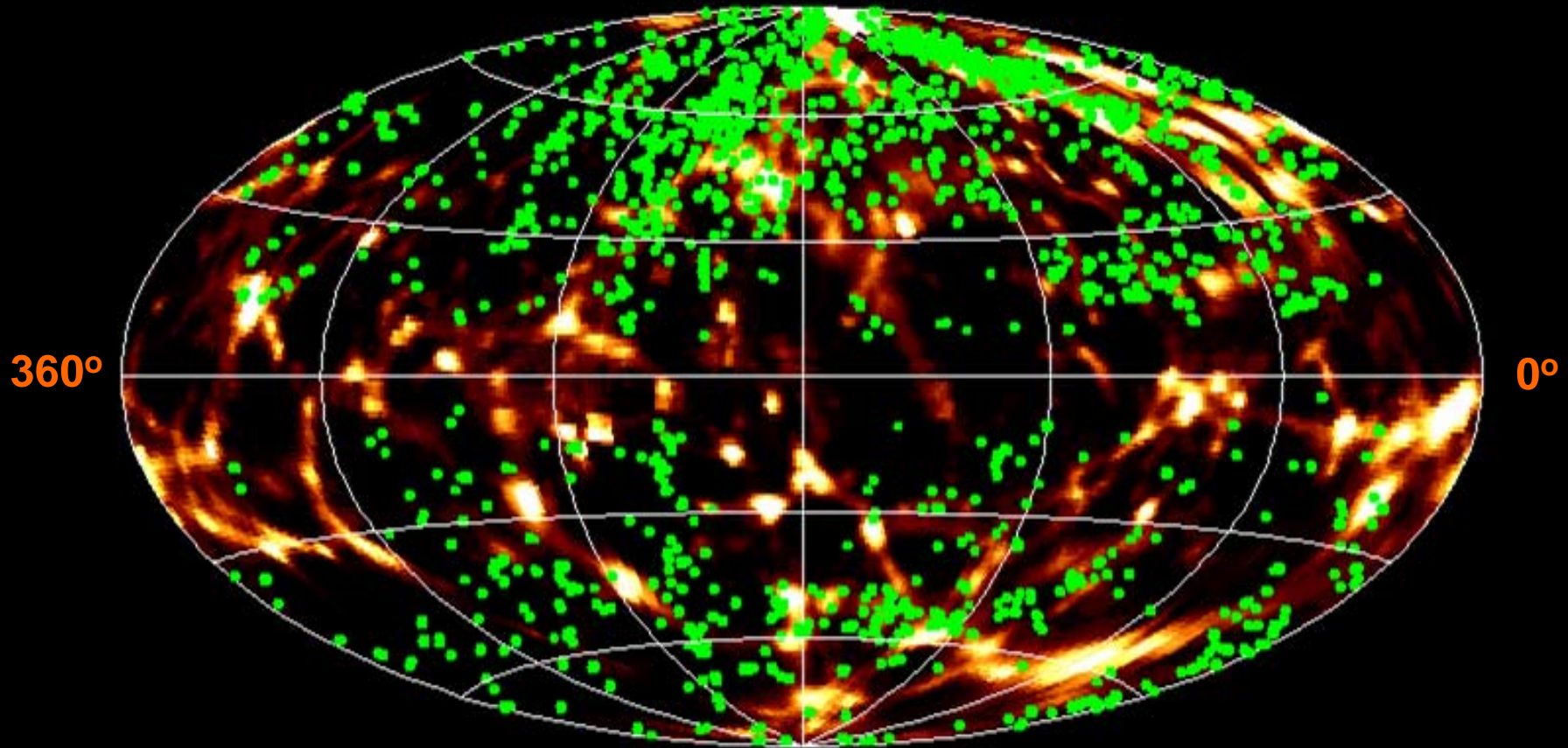
Projected matter distribution in a constrained realization ($7 < R < 93$ Mpc)



Andrey Kravtsov

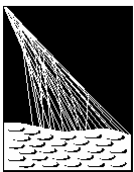
Matter ($7 < R < 93$ Mpc)

Galaxies ($R < 45$ Mpc)

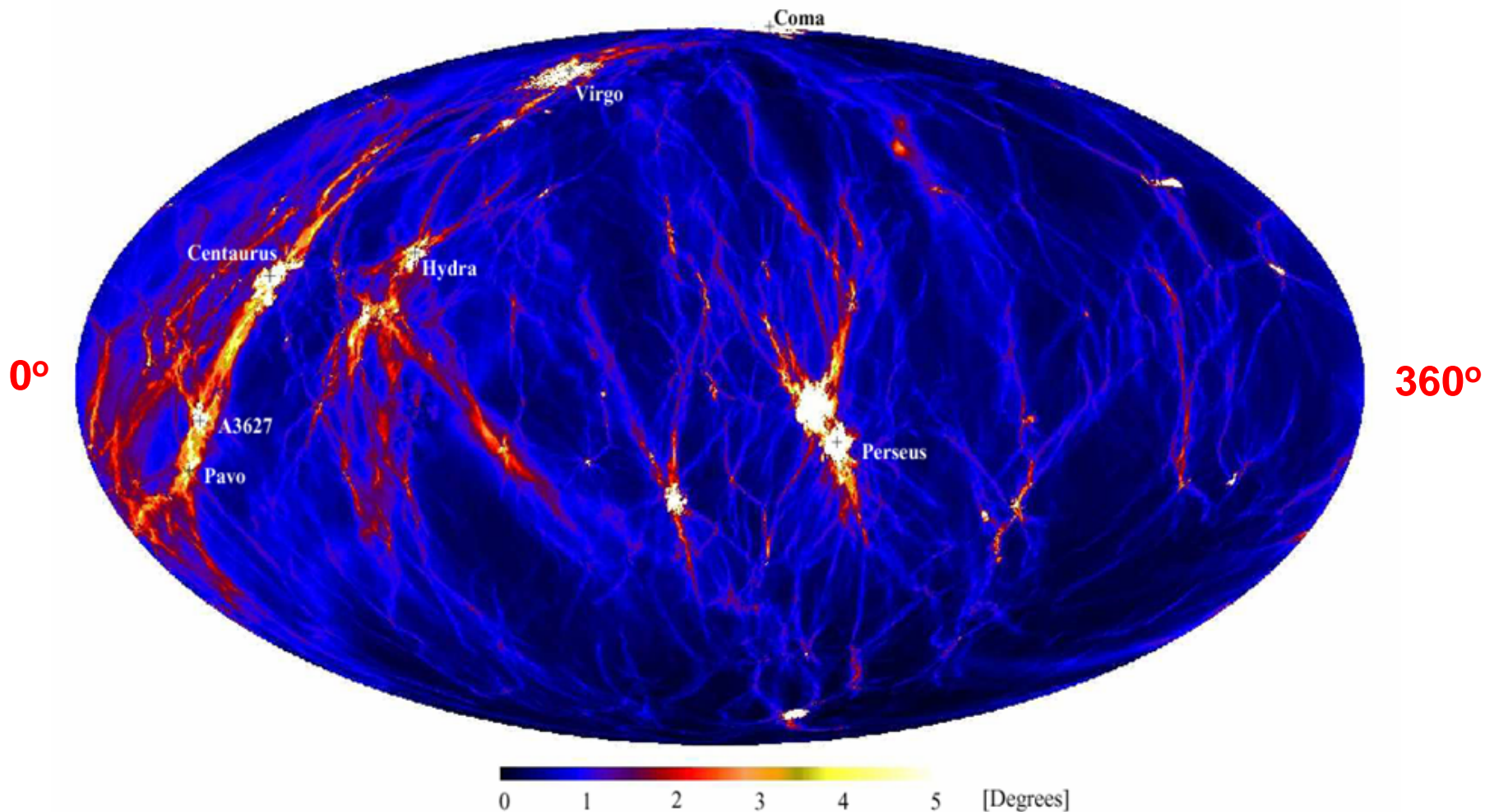


Andrey Kravtsov

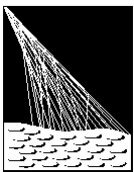
Deflection of 4×10^{19} eV Protons ($R < 107$ Mpc)



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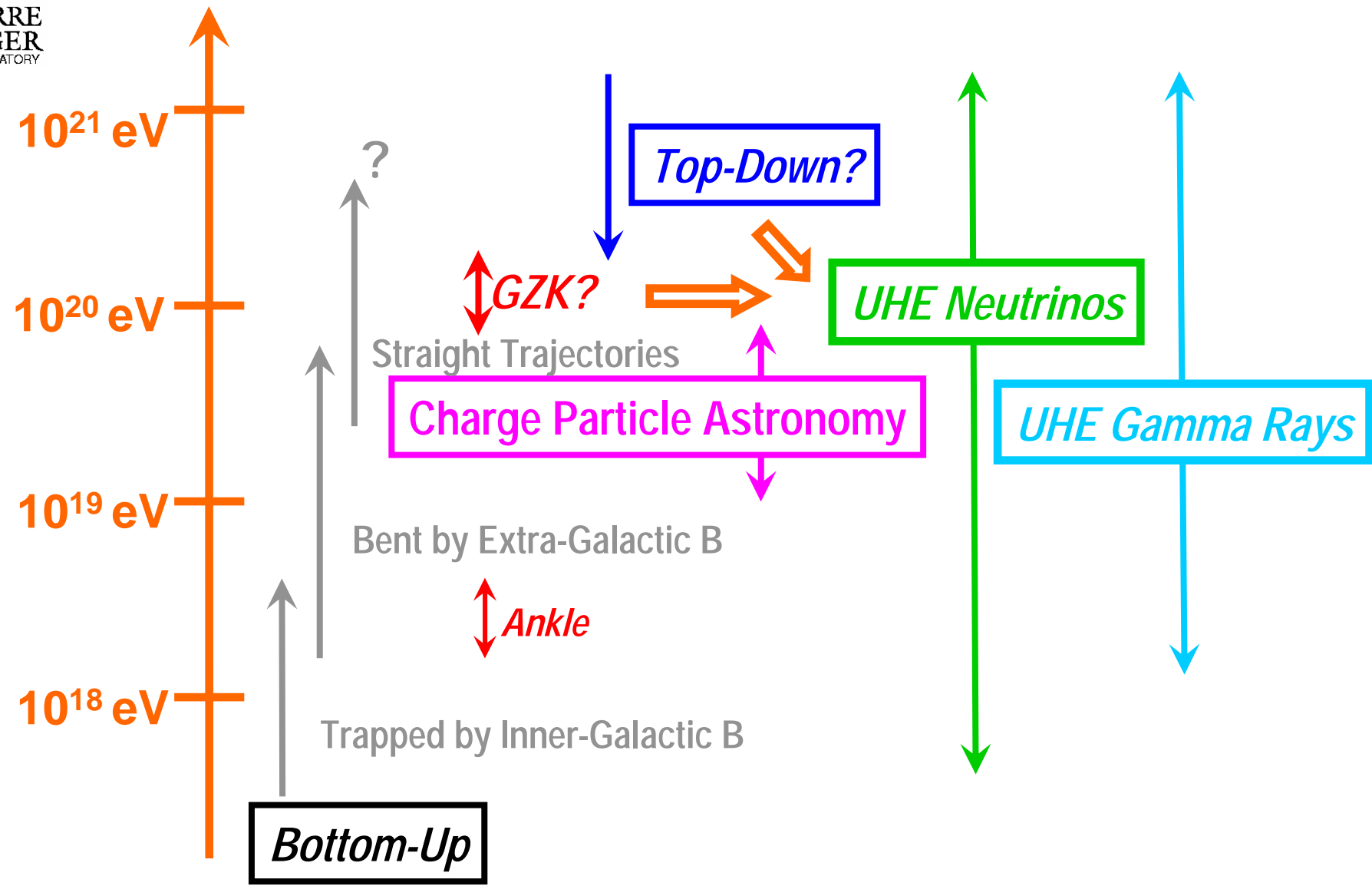


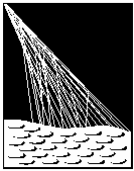
Dolag et. al. [astro-ph/0310902](https://arxiv.org/abs/astro-ph/0310902)



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Rich Physics and Astronomy



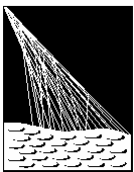


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Science Case for North

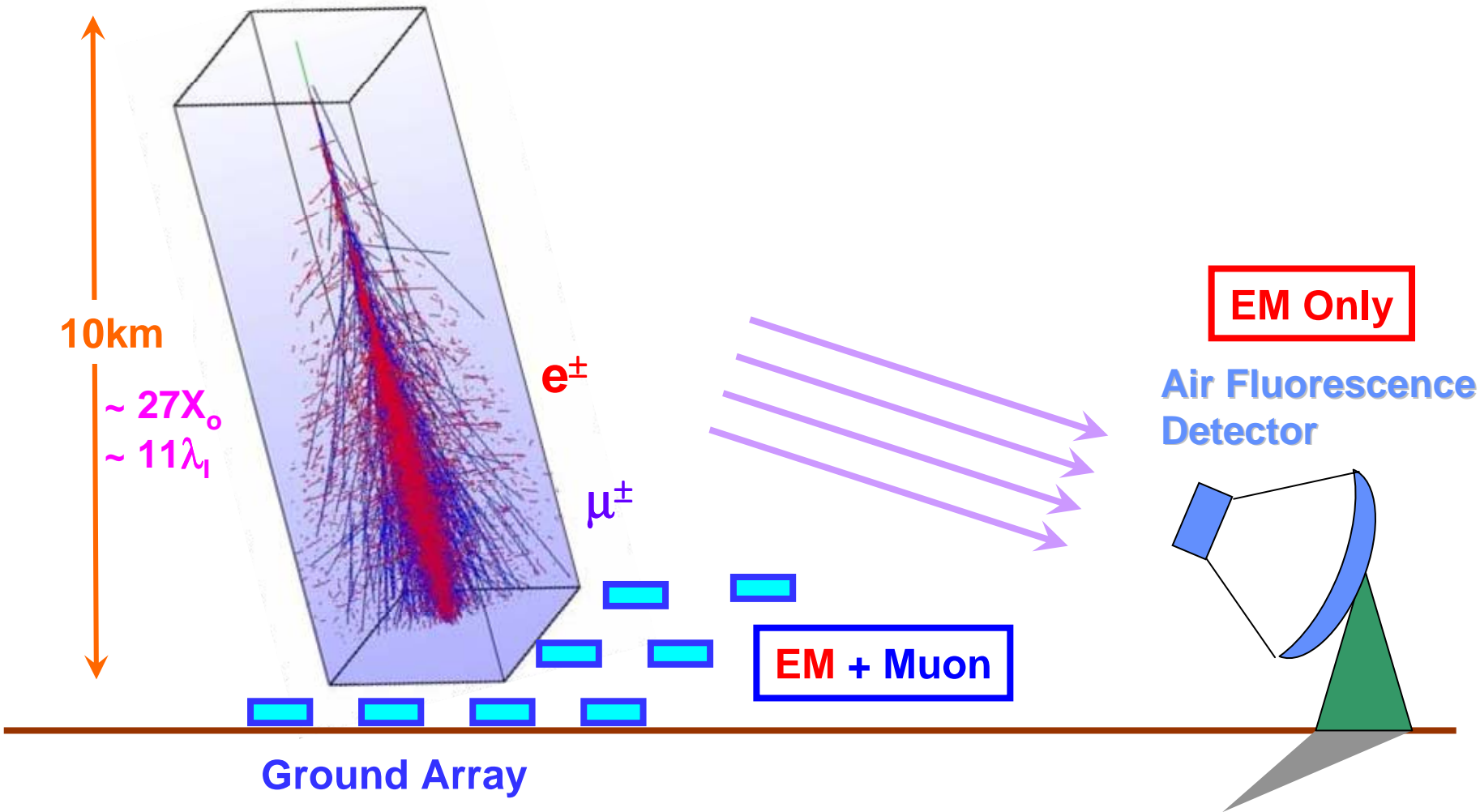
- Clear Window of “Charged Particle Astronomy”
 - $\sim 4 \times 10^{19}$ eV – $\sim 1 \times 10^{20}$ eV
 - Regardless of existence of the GZK cutoff
 - Northern sky is very different from Southern Sky
- Need for the Largest Detector beyond GZK
 - High statistics post-GZK events
 - Neutrinos from Top-down Mechanism

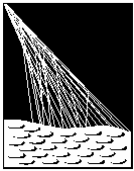
Principle of Hybrid Detection



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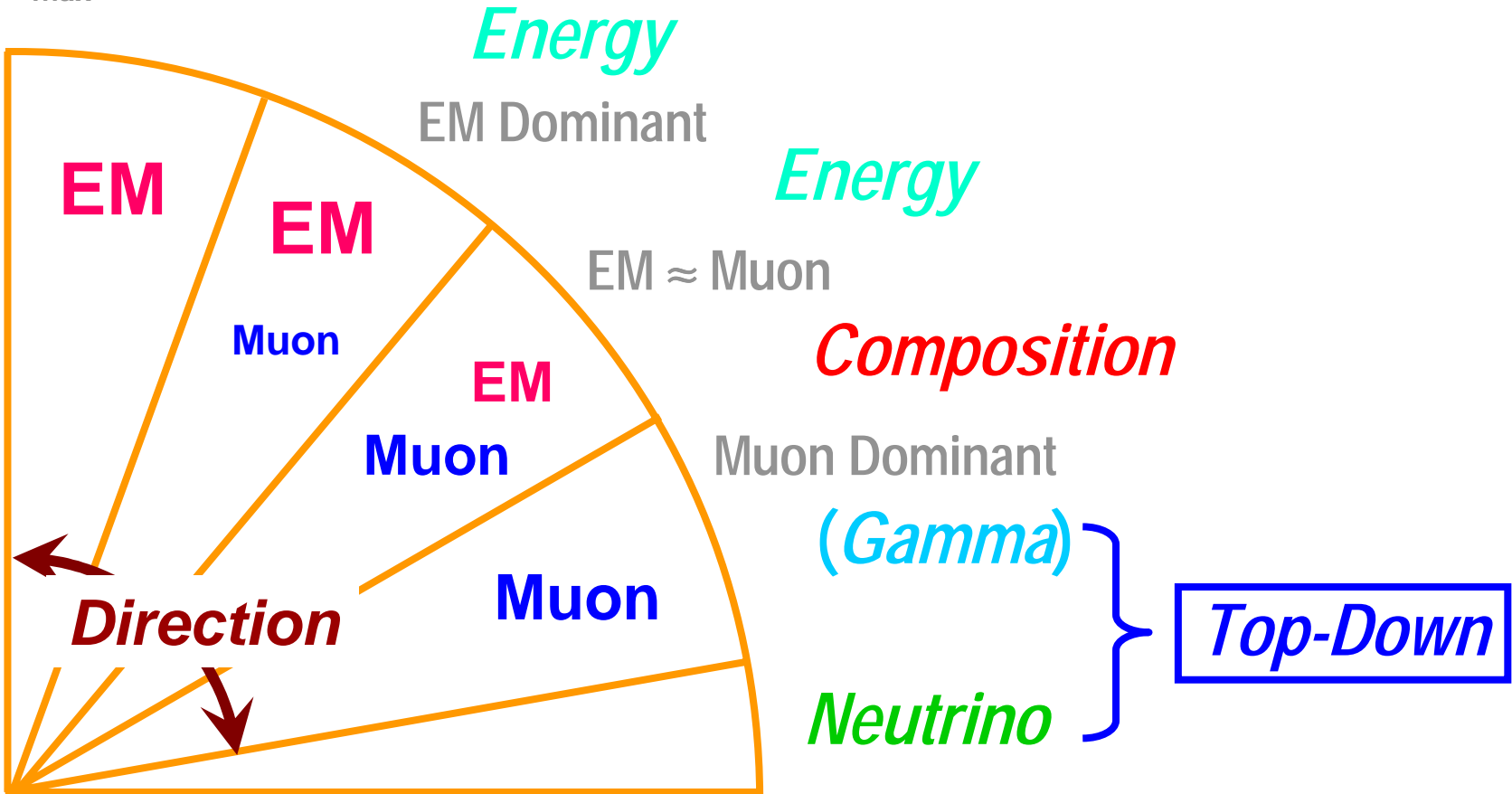
MC Simulation of 10^{19} eV Proton Shower

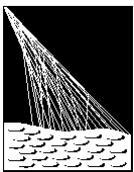




Multi Messenger Detection as a function of Zenith

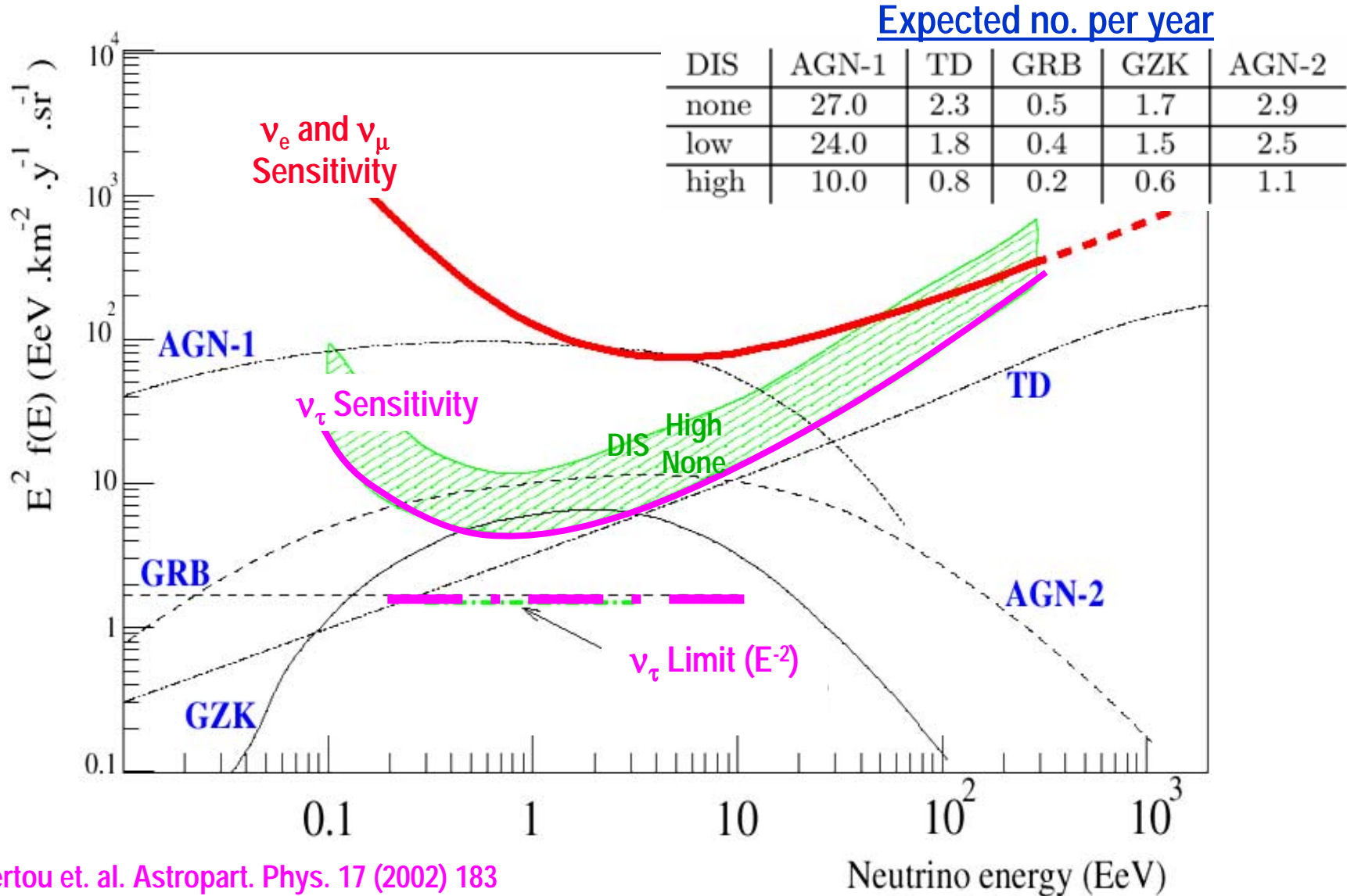
X_{\max} underground



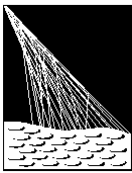


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Neutrino Sensitivities (per site)



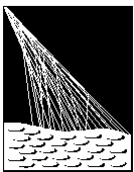
X. Bertou et. al. *Astropart. Phys.* 17 (2002) 183



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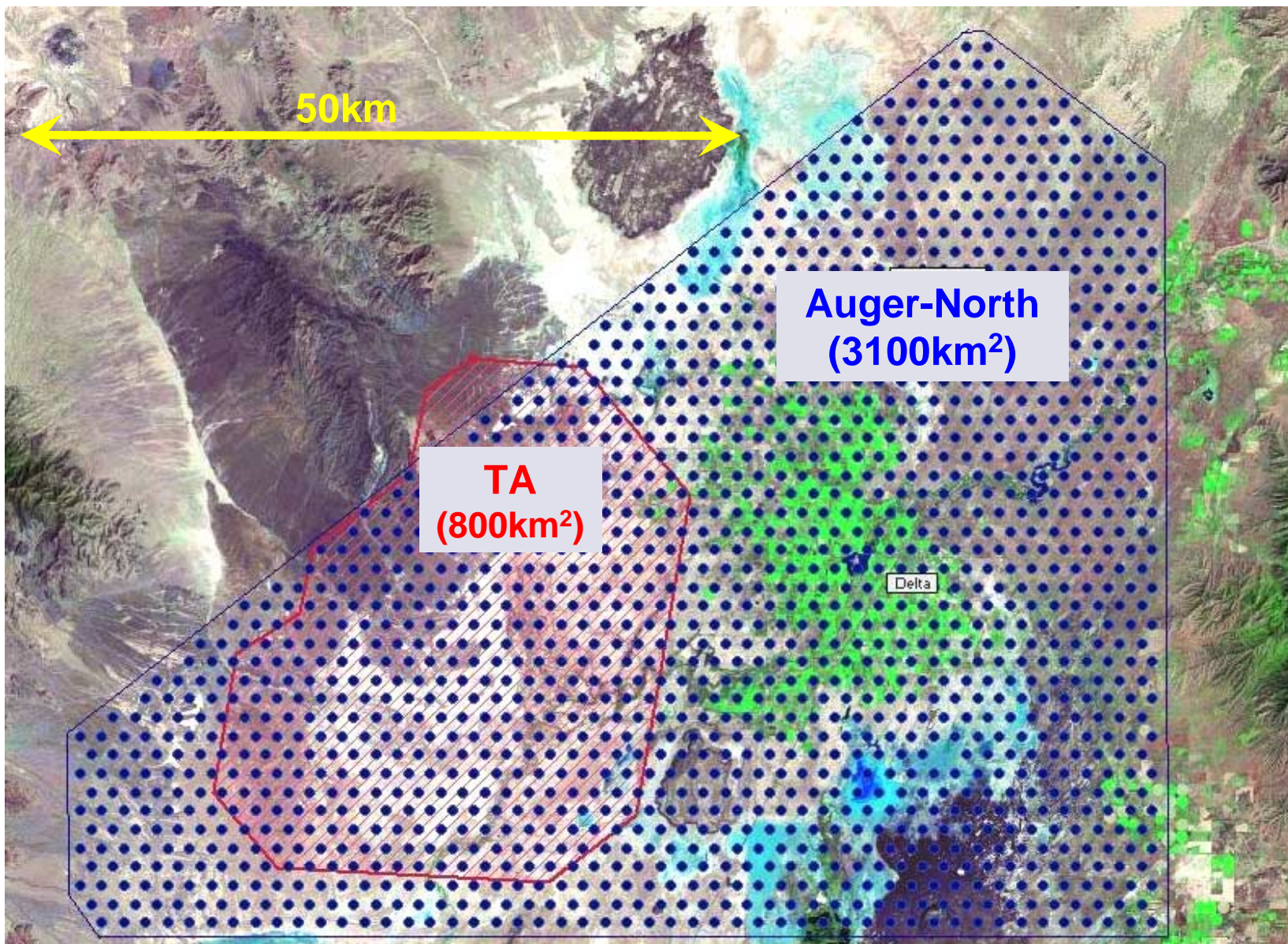
Site Comparison

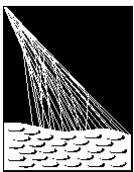
	Southern Site	Northern Sites under Consideration	
Location/Geography			
Country	Argentina	USA	USA
State (Province)	Mendoza	Utah	Colorado
Latitude	35 -35.3 South	39 North	37 45' North
Longitude	68.9 – 69.4 West	112 West	102 45' West
Altitude	1300 m (E) 1500 m (W)	1400-1450m	1330 m (SW) 1220 m (NE)
Maximum Area (confirmed)	5,800 km ²	7,200 km ²	15,000 km ²
Geography	Flat with a gentle slope	Great Basin	High plains, gentle slope
Land Usage	Ranching (goat, cattle), small farming	Ranching, farming	Ranching, farming
Infrastructure			
Nearby Local Town	Malargue	Delta / Fillmore	Lamar
Population	18,000	3,000 / 2,000	9,000
Major City/ Airport	Mendoza, San Rafael	Salt Lake City	Denver
Distance to Site	420 km, 200 km	210 km	320 km
Weather			
Temperature (Summer)	January 20°C	July mean 24°C	July mean 25°C
(Winter)	July 4°C	January mean -3°C	January mean -2°C
"Cloudiness"		≈ 10%	≈ 7.5%
Irradiance	≈ 380 W/m ²	≈ 253 W/m ²	≈ 250 W/m ²
Land Ownership			
Private	≈100 owners (95%)	≈200 owners (20%)	≈280 owners (95%)
Federal-Owned	0 %	BLM (75%)	negligible
State-Owned	≈ 5%	≈ 5%	≈ 5%



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Utah Site

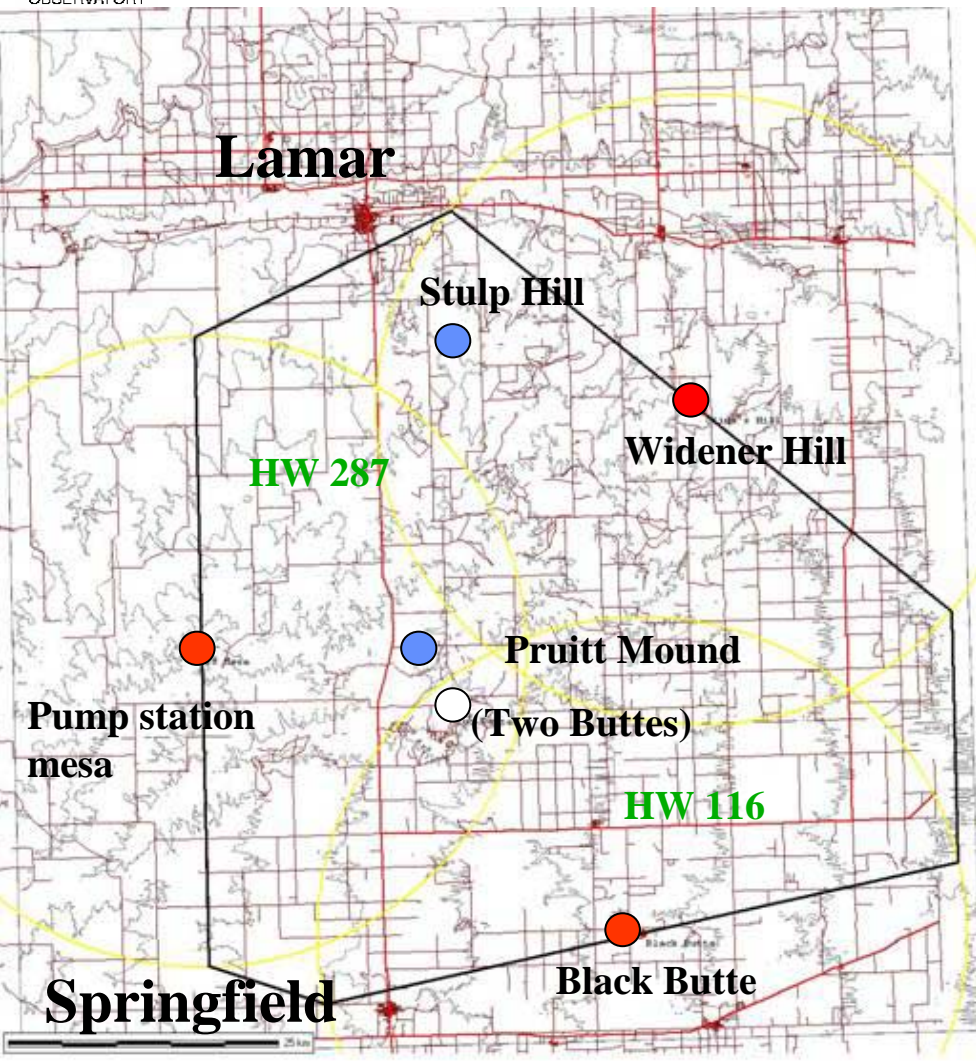




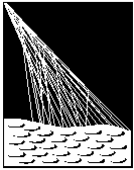
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Colorado Site

- Lamar ★ was a candidate during the 1996 search for the northern Auger site.
- Possible to expand to ~15,000km².



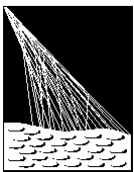
©2003 MapQuest.com, Inc.; ©2003 AND Data Solutions B.V.



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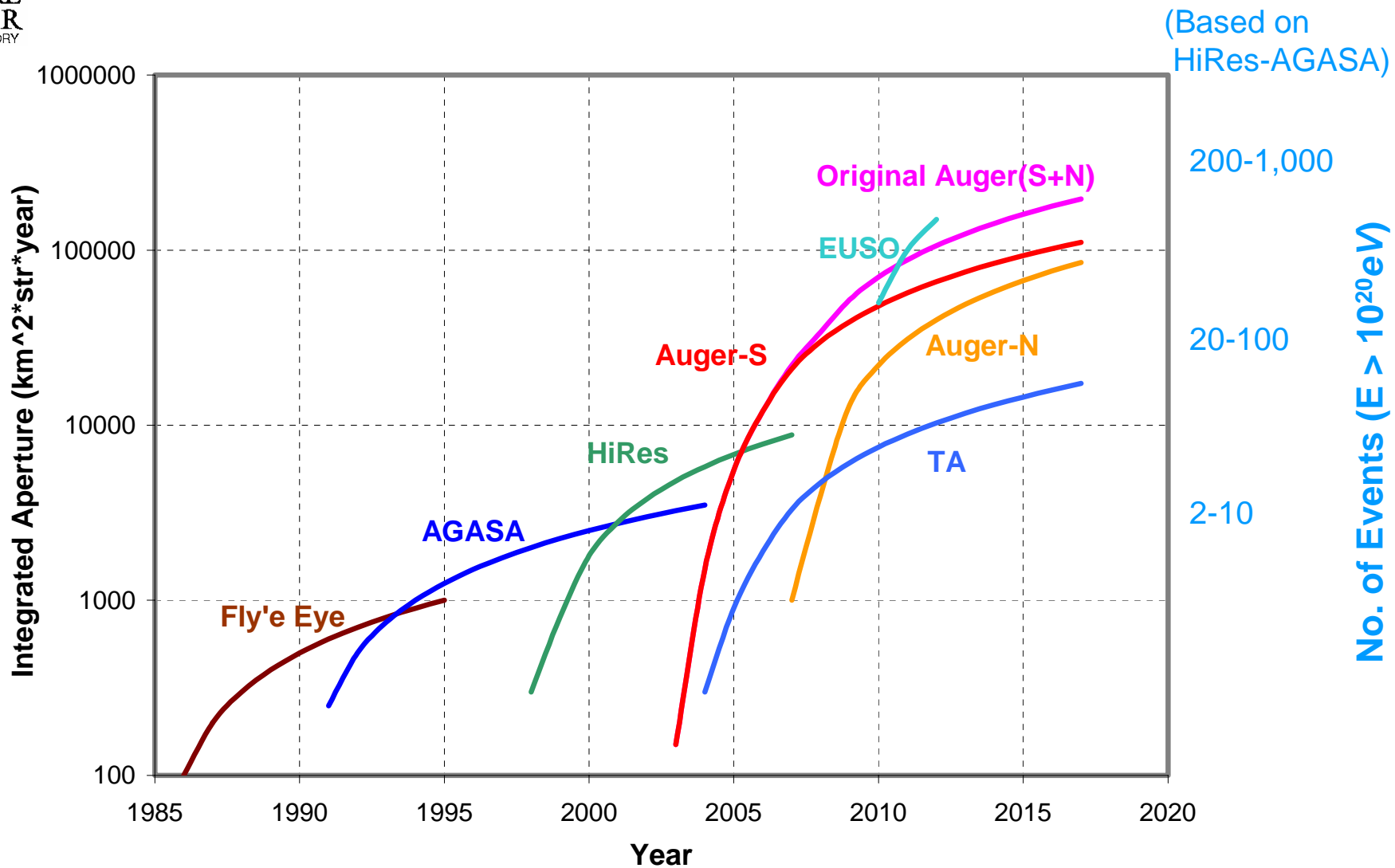
Milestones

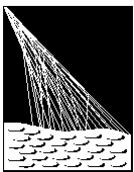
Year	Quarter	Milestone	#Tanks South	#Tanks North
2003	1		40	
	2		80	
	3		130	
	4		200	
2004	1	LOI (R&D Budget Request)	360	
	2	SAGENAP-I	580	
	3		700	
	4	Site Decision	910	
2005	1		1130	
	2	SAGENAP-II	1250	
	3	First Physics from South, Full Proposal for North	1370	
	4	Completion of Southern-Augur	1600	
2006	1			
	2	SAGENAP-III		
	3			
	4	Construction of North begins		50
2007	1			200
	2			400
	3			600
	4			800
2008	1			1000
	2			1200
	3			1400
	4	Completion of Auger Observatory (S+N)		1600



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Integrated Sensitivity of Various Experiments





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