20 years of "FRONTIER OBJECTS IN ASTROPHYSICS & PARTICLE PHYSICS"





As every year, the selection, based on personal impressions, will be arbitrary and unfair

MOTTOS of the Birthday Workshop

DM is everywhere!

The sky is full of JETS !

Dark Matter

_ Reionization of the early Universe
_ GRBs

_ Neutrino astronomy

_ TeV astronomy

_ Microquasars

_ Astro-archeology

DM is everywhere !





The signal from DAMA (significant annual modulation) is very exciting

But, if interpreted as due to DM annihilation (model dependent) it seems to be too strong comparing with other astrophysical constraints (deduced limits on the DM annihilation energy release)

We have to be patient !

Fascinating story of the Universe coming out of the DARK AGES

Happened at $z \sim 15 \div 6$

At z=5.8 the Universe was already fully ionized At z=6.3 not quite yet

What were the ionizers ?

HUDF-JD2: A Distant Galaxy in the HUDF



HUDF-JD2: A summary

- Massive, luminous, protypical Balmer-break galaxy
- It has had an important impact (>20%) on the reionization of the IGM starting at z~15
- With the "help" of fainter companions distributed according to an α =1.6 Schechter LF it may account for the whole effect



We live in a SWIFT era

Short bursts with redshift

0.226	Discovery – E1 Galaxy
0.1606	EmAbs Galaxy - Old
0.258	
0.5465	XRT light curve - break
??0.722	?? Likely wrong
0.03 ??	IC 328 – Very Uncertain
?? 0.71	Extremely uncertain
	0.226 0.1606 0.258 0.5465 ??0.722 0.03 ?? ?? 0.71

Short Bursts Statistics

- 9 X ray follow up for 2 no search
- 6 Opt detection
- 2 E Host Galaxy (x=0.22 & z=0.26)
- 1 E_A Galaxy (GRB050709) z=0.16
- 1 Star Forming (GRB0561221) z=0.55
- 16 Shorts detected by Swift & Hete (updated GRB060313)
- 2 Redshift uncertain (0.03 & 0.722)

OBSERVATIONS

Large part (majority ?) of short GRBs are compact objects mergers

Some of them must be giant outbursts of distant magnetars

Events such as Dec. 27, 2004 outburst of SGR 1806-20 must happen in nearby galaxies (they occur at a rate of ~ 0.1/yr in our Galaxy)

If they occur within ~ 100 Mpc, they have to be classified as short GRBs

THEORY

GRBs lost their status of the most energetic explosions in the Universe

They became "side-shows" of SNe

The theoretical interpretations seem to converge towards strongly collimated (CB-type) phenomenon

The element still discussed is how strong is this collimation: 10^{-6} (CB model) or $10^{-2} \div 10^{-3}$ (common wisdom)

This translates into the frequency of the events (and also their energetics): is the fraction of SNe that are accompanied by GRBs $\geq 10^{-1}$ or rather ~ 10^{-3} ?

New SWIFT data indicate that light curves breaks are not achromatic

common wisdom has a problem

The prompt emission is produced by jetted ejecta



But the volume occupied by the relativistic particles and emitting radiation is conical

NEUTRINOS

The evidence for the neutrino oscillations is very robust

- _ m _i≤0.7 eV
- M_{heaviest} > 0.5 eV

Probably m ~ 0.5 eV, m $_{e,}$ m ~ 0.01 eV

The mass of the neutrino is the first (and so far the only) indication of the physics beyond the SM

MOTIVATION FOR A "NEW" (BEYOND SM) PHYCICS

INFLATION

DARK ENERGY

DARK MATTER

BARIOGENESIS

MASSIVE (non-zero mass) NEUTRINOS

At least 4.5 (out of 5) of these arguments come from **ASTROPHYSICS** !

PWN: middle aged systems

Aharonian, F. et al. (H.E.S.S. coll.) subm



Aharonian, F. et al. 2005, A&A 442, 25

Aharonian, F. et al. 2006, A&A 448, 43



Aharonian, F. et al. 2005, A&A 435, 17



Smoothed maps of excess events above 400 GeV. (A) 15.5 hours corresponding to data around periastron, i.e. between orbital phases 0.2 and 0.3. (B) 10.7 hours at orbital phase between 0.4 and 0.7. The number of events is normalized in both cases to 10.7 hours of observation. The position of the optical source LSI +61 303 (yellow cross) and the 95% confidence level (CL) contours for 3EG J0229+6151 and 3EG J0241+6103 (green contours), are also shown. The bottom-right circle shows the size of the point spread function of MAGIC (1_ radius). No significant excess in the number of events is detected around periastron passage, while it shows up clearly (9.4_ statistical significance) at later orbital phases, in the location of LS I +61 303.

Fe 6.4 keV line from Sgr B2

Fluorescence: Koyama et al. 1996, HE electron bomberment Predehl et al. 1999

(ASCA: Koyama et al. 1996)



Lx @ 300 yrs ago = $3 \times 10^{39} \text{ ergs s}^{-1}$

Supporting the past AGN activity of Sgr A*!!

History of SMBH activity



My nomination to the conference hit goes this year to

TeV astronomy !

SEE YOU AT VULCANO!

If not next year, than in 2008 !