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Concluding remarks

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Abstract. X ray sources: Her X-1, Cyg X-3, et al. Astrophysical jets. VHE astrophysics: MAGIC, HESS, CTA. Project highlights. GRB and SGR.

1. Introduction

Estimation of the magnetic field. If the line is produced by a magneto-dipole mechanism, than the magnetic field estimation is 2γ times less, than in pure cyclotron radiation. Electrons are ultra-relativistic along B, with $\gamma \sim 40$, and non-relativistic in the perpendicular direction, see Baushev, A.N., and Bisnovatyi-Kogan, G.S.: 1999, Astron. Reports, 43, 241.

Schematic structure of the accretion column near the magnetic pole of the neutron star (top), and its radiation spectrum (bottom) are presented in fig.1

2. X ray and gamma ray sources

Talks on this topic have been done by A. Zezas on LMXB in other galaxies, A. Zdziarski and K. Koljonen on Cyg X-3

Astrophysical jets have been discussed in the talks of J. Beall, with movies on evolving jets.

Big progress is expected in VHE astrophysics, as was presented in the talks of J. Paredes, M. Persic, G. Romero. Especially impressive are new perspectives, appearing with creation of the Cherenkov Telescope Network (CTA). The project should be not expensive, so we may speak about a development of "Non-billion astrophysics", contrary to numerous, extremely expensive space projects.

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3. Project highlights and reviews

Important results from different space projects have been highlighted, which include:

Chandra and XMM-Newton (M. Guainazzi, J. Weratschnig)
AGILE (C. Pittori, S.Venchelone)
SUZAKU (K. Mitsuda, K. Ebisawa, H. Yamaguchi)
SWIFT (M. Ajello, G. Gusmano)
Fermi (J. Knoedleseder)
Integral (R. Hudez)

4. GRB and SGR

This exciting topic was represented by the REVIEW TALKS of K. Hurley, L. Amati, E. Troja, P. Frontera , J.-L. Israel. In the theory we heard description of three, already familiar, original GRB models of D. Fargion, W. Kundt and A. Dar.

Let me remind, that two first Soft Gamma Repeaters (SGR) had been discovered in 1979 by KONUS observations, see Mazets et al. 1979, A.Zh.Lett, 5, 641-643, "Soft gamma-ray bursts from the source B1900+14"; and

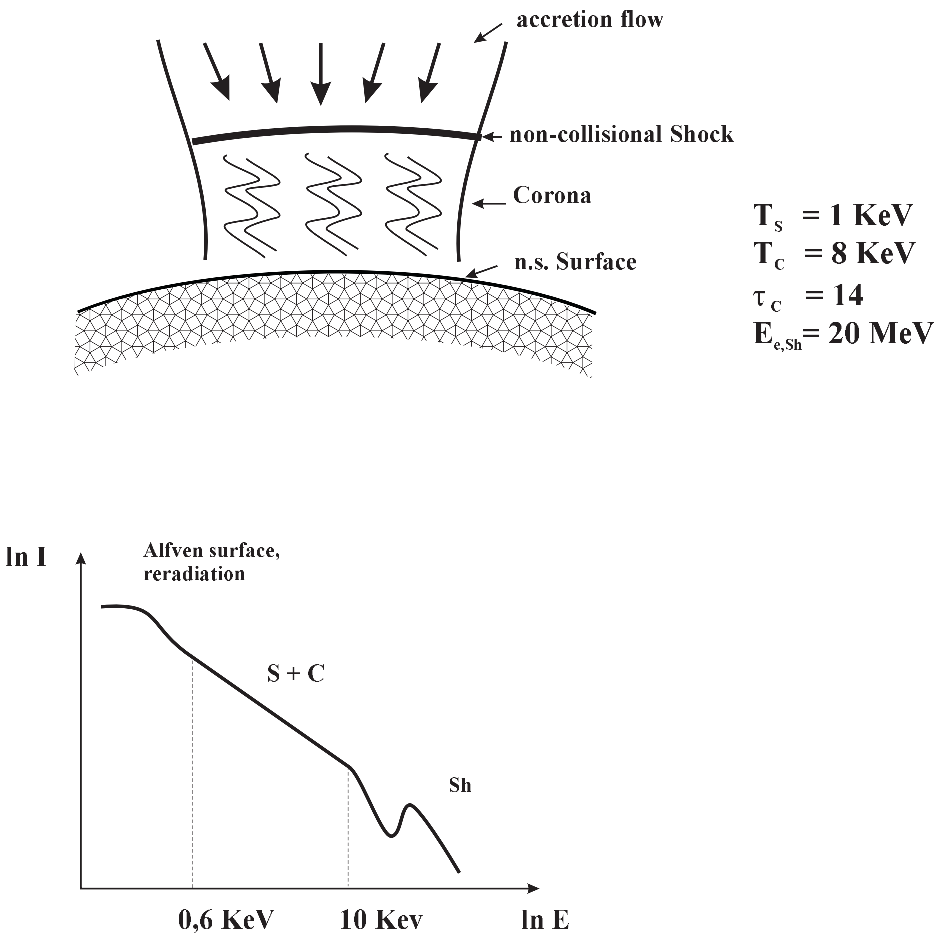

Fig. 1. Schematic structure of the accretion column near the magnetic pole of the neutron star (top), and its radiation spectrum (bottom), from Bisnovatyi-Kogan, G.S. 2002, Mem. S.A.It, 73, 318.

Mazets et al. 1979, A.Zh.Lett, 5, 636-640, "Recurrent gamma-ray bursts from the flaring source FXP 0520 - 66". Review on SGR had been given by K. Hurley, where in addition to the magnetar flares, he have mentioned models of a "Magnetars Fall back accretion disks", and "Phase transitions to quark stars".

I would like to mention an old model of a nuclear explosion (fission reaction) in the crust, near the surface of the neutron star, based on the existence of the non-equilibrium layer, see Bisnovatyi-Kogan G.S. and Chechetkin V.M., 1979, Uspekhi Fiz. Nauk, 127, 263-296. The non-equilibrium layer is formed in the neutron star crust (see fig.2), and has the fol-

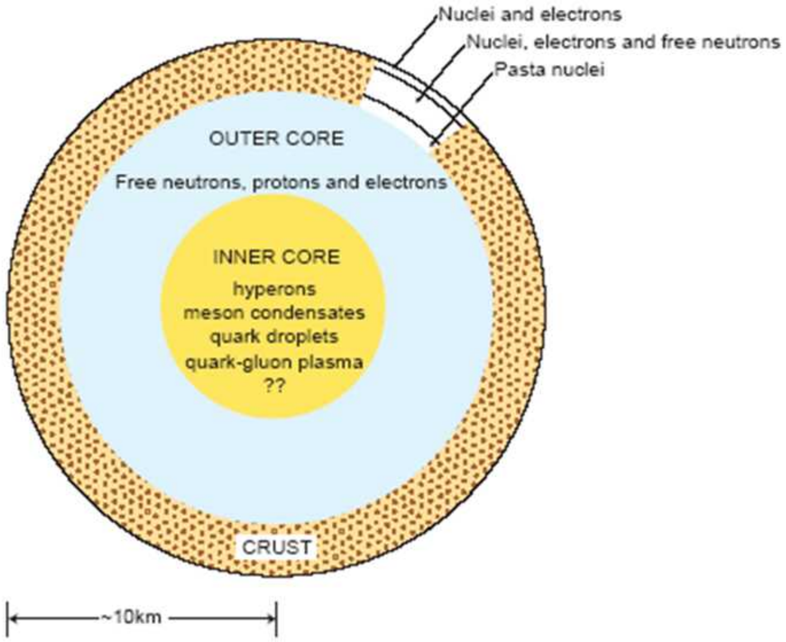

Fig. 2. Schematic cross section of a neutron star, from Baym, G. 2006, arXiv: nucl-th/0612021.

lowing properties. It is situated at densities $\rho_1 < \rho < \rho_2$, where $\rho = \rho_1 \approx 10^{11}$ g cm^{-3} at which exist a nucleus with $Z \sim 150$. The value $\rho_2 \approx 2 \times 10^{12}$ g cm^{-3} with a nucleus with $Z = 6$, $A = 22$. There are also free neutrons in the nonequilibrium layer, in addition to the exotic nuclei. The corresponding pressures are $P_1 \approx 7 \times 10^{27}$, and $P_2 \approx 2 \times 10^{30}$ in CGS units. The fission is started after the starquake, when the matter from the nonequilibrium layer is shifted in the low density region. The mass of a thin nonequilibrium layer is determined by the gravity of the neutron star, and the pressure difference,

$$M_{nel} \approx \frac{4\pi R^4}{GM}(P_2 - P_1) \approx 0.1(P_2 - P_1) \qquad (1)$$
$$\approx 2 \times 10^{29} g = 10^{-4} M_{\odot}.$$

The value of M_{nel} in (1) is calculated for the neutron star with a mass about $1.5 M_{\odot}$. The energy stored in this layer is $E_{nel} \sim 4 \times 10^{17}(P_2 - P_1) \approx 10^{48}$ erg. Neutron stars with a lower mass have larger radius, and their nonequilibrium layer may have $\sim$ 10 times larger mass, giving much stronger nuclear explosions. I suggest therefore, that SGR may be connected with young, low mass neutron stars. The schematic picture of the explosion is given in fig.3.

5. Puzzles

Two GCN telegrams reported about the most distant GRB, which is also the most distant visible now object in the universe.

1.GCN CIRCULAR NUMBER: 9222, DATE: 09/04/24 14:16:29 GMT SUBJECT: GRB 090423 We detect in the spectrum flux at wavelengths $\lambda > 1.1$ microns, and a flux compatible with zero below that limit. Interpreting

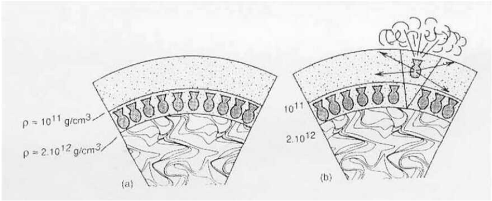

Fig. 3. The schematic picture of the nonequilibrium layer in the neutron star crust: a) in a quiescent stage; b) after a starquake and nuclear explosion, from Bisnovatyi-Kogan, G.S. 1992. In: "Gamma-ray bursts - Observations, analysis and theories", pp. 89-98.

this wavelength as the onset of Lyman alpha absorption in the IGM, this leads us to deduce a value of z 8.1. We have also analyzed all the available photometry (GCNs 9200, 9201, 9202, 9206, 9209, 9210, 9213, 9214, 9215, 9217, 9218 and 9220) and find that the data are well fit by an afterglow without intrinsic dust obscuration, a photometric redshift $7.6 < z < 8.5$, and a temporal decay index 0.50.

2. GCN CIRCULAR NUMBER: 9235, DATE: 09/04/24 21:57:44 GMT SUBJECT: GRB 090423

With the spectral parameters and fluence of GRB090423 as measured by Fermi (von Kienlin et al., GCN 9229) and given its redshift z=8.1 (Fernandez-Soto et al., GCN 9222), we estimate the isotropic equivalent energy $E_{iso} = 1.03 \times 10^{53}$ erg, and the isotropic equivalent peak luminosity $L_{iso} = 1.88 \times 10^{53}$ erg/s (the value of E_{iso} is consistent with that obtained with the Swift spectral results given in Palmer et al. GCN 9204). Given the rest frame peak energy $E_p = 746$ keV.

Early formation of compact objects is related to early production of heavy elements, enrichment of intergalactic gas by heavy elements, discussed in the talks of N. Panagia, J. Beckman

3. The paper of David F. Crawford "No Evidence of Time Dilation in Gamma-Ray Burst Dat", appeared in arXiv:0901.4169, 27 Jan 2009, rises an important question. Gamma-ray burst measures should show a time dilation proportional to redshift. An analysis of gamma ray burst data shows that the hypothesis of time dilation is rejected with a probability of 4.4×10^{-6} for redshifts out to z=6.6. To estimate this conclusion, farther analysis should be performed.

6. Who is the winner?

We heard here three GRB models, explaining ALL experimental data

1. D. Fragion: Precessing jets
2. W. Kundt: Local galactic model
3. A. Dar: Canonnball model

I would like to remind you another model

4. R. Ruffini: Dayadosphere, which also gives a complete picture of GRB.

A. Dar have made here the following statement: "Minority is always right in GRB field" According to this criteria, we may claim the winners in the GRB model race. D. Fragion (single) and W. Kundt (single) share the first place. A. Dar with his two coauthors wins the bronze medal, and R. Ruffini having a big team, is only at the 4-th place. This is the present list of winners, which is formed in a situation, close to complete ignorance. It may be changed, when we'll be able to use another criteria.

7. Congratulations to the Silver Jubilee of Vulcano Workshop!