Evolution of X-ray sources at the Galactic center after the burst of star formation

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Abstract. X-ray binary population at the Galactic center is proposed here to form as a result of a starburst, which is synthesized by using the "Scenario Machine"– the code of binary star evolution. For the currently assumed starburst age of 6-8 millions years, our results are consistent with the recent *GRANAT* X-ray observations of the Galactic center and predict a substantial number of X-ray binaries with black holes.

We are exploring the evolution of massive binary star populations for a starburst occurring in the conditions similar to the Milky Way galaxy, in its central part (see Ozernoy 1994), on a time scale of 10 Myr. A computer code is applied allowing for computing, by using Monte Carlo simulations the evolution of a large ensemble of binary systems, with proper accounting for spin evolution of magnetized neutron stars (NSs) (see the description of the code in Kornilov & Lipunov 1983 and Lipunov et al 1995).

Monte-Carlo simulations of binary star evolution allow one to investigate the evolution of a large ensemble of binaries and to estimate the number of binaries at different evolutionary stages. We also take into account that the collapse of a massive star into a NS can be asymmetrical, so that an additional kick velocity, v_{kick}, presumably randomly oriented in space, should be imparted to the newborn NS. In the present calculations, the kick velocity was taken to be 75 km/s.

Our results include the number of X-ray transients (NS + Be star on highly eccentric orbit), super-accreting black holes (SS 433- like sources), and binaries consisting of a BH and a supergiant (Cyg X-1–like sources), all as functions of time. In order to obtain statistically significant results, the evolution of 300,000 binary systems was computed. Then we normalized the figures so as to be in agreement with the Tamblyn & Rieke (1993) calculations of the number of massive OB-stars (1,900 stars with $M > 10$ M$_{\odot}$) that survived $\sim 6-8$ Myrs after the starburst onset.

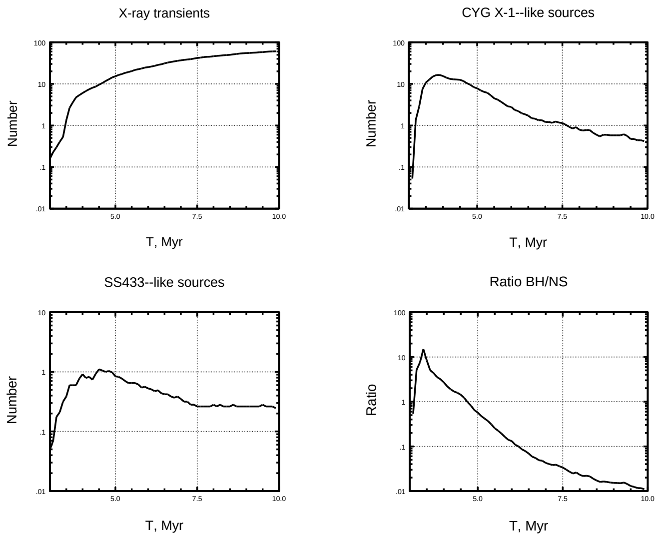

Figure 1. The evolution of some selected types of X-ray binaries during the starburst at the Galactic center.

We find that by 7 Myr after such a starburst one expects ~1 X-ray source with a BH (Cyg X-1– like), ~1 SS 433-like source (BH in the regime of superaccretion), and ~37 transient sources with a NS, all to be within the central 1 kpc or so. An interesting result that can be considered as a specific starburst feature, is that the ratio of the number of systems like SS 433 to the number of X-ray transients is about 1:100, compared to 1:1000, characteristic to the average ratio in the galactic field. The ratio of the total number of X-ray sources containing a BH (of Cyg X-1 + SS 433 types) to the number of X-ray transients with NSs turns out to be a sensitive function of the age of the starburst, and its computed value ~0.04 is consistent with the observations of the *GRANAT* satellite (see Pavlinsky et al 1994).

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