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We gratefully acknowledge support from the Simons Foundation and member institutions

Short Gamma-ray Bursts: the mass of the accretion disk and the initial radius of the outflow

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(Submitted on 13 Jul 2011)

In this work we estimate the accretion-disk mass in the specific scenario of binary-neutron-star-merger with current observational data. Assuming that the outflows of short Gamma-ray Bursts (GRBs) are driven via neutrino-antineutrino annihilation we estimate the disk mass of about half of short bursts in the sample to be $\sim 0.01-0.1 M_\odot$, in agreement with that obtained in the numerical simulations. Massive disks ($\sim {\rm several} 0.1 M_\odot$) found in some other short GRBs may point to the more efficient magnetic process of energy extraction or the neutron star and black hole binary progenitor. Our results suggest that some short bursts may be really due to the coalescence of double neutron stars and are promising gravitational wave radiation sources. For future short GRBs with simultaneous gravitational-wave detections, the disk mass may be reliably inferred and the validity of our approach will be tested. We also propose a method to constrain the initial radius of a baryonic outflow where it is launched (R_0) without the need of identifying an ideal thermal spectrum. We then apply it to GRB 090510 and get that $R_0 \lesssim 6.5\times 10^{6}(\Gamma_{\rm ph}/2000)^{-4}$ cm, suggesting that the central engine is a black hole with a mass $< 22 M_\odot (\Gamma_{\rm ph}/2000)^{-4}$, where $\Gamma_{\rm ph}$ is the bulk Lorentz factor of the outflow at the photospheric radius.

Comments:	8 pages including 1 table, to appear in ApJ
Subjects:	**Cosmology and Extragalactic Astrophysics (astro-ph.CO)**; High Energy Astrophysical Phenomena (astro-ph.HE)
Cite as:	**arXiv:1107.2656 [astro-ph.CO]**
	(or **arXiv:1107.2656v1 [astro-ph.CO]** for this version)

Submission history

From: Fan Yizhong [view email]
[v1] Wed, 13 Jul 2011 20:00:37 GMT (16kb)

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