論文 / 著書情報
Article / Book Information

題目(和文)	「すざく」衛星で観測されたX線バーストによる中性子星の質量半径関係への制限
Title(English)	Constraints on the Mass-Radius Relation of Neutron Stars from Thermonuclear X-ray Bursts Observed with Suzaku
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出典(和文)	学位:博士(理学), 学位授与機関:東京工業大学, 報告番号:甲第10053号, 授与年月日:2016年3月26日, 学位の種別:課程博士, 審査員:堂谷 忠靖,河合 誠之,松原 英雄,垣本 史雄,中村 隆司
Citation(English)	Degree:Doctor (Science), Conferring organization: Tokyo Institute of Technology, Report number:甲第10053号, Conferred date:2016/3/26, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

専攻： Department of	基礎物理学 専攻	申請学位（専攻分野）： Academic Degree Requested	博士 （ 理学 ） Doctor of
学生氏名： Student's Name	岩井 將親	指導教員（主）： Academic Advisor(main)	堂谷 忠靖
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

Extreme conditions that are not possible in the ground experiments are sometimes realized in the universe. A good example is a neutron star, the end product of the supernova explosion of a massive star. It is a very compact object supported by the degeneracy pressure of neutrons and its internal density may be comparable with, or may exceed, that of atomic nuclei. The extreme density of a neutron star allows us to probe the nature of the ultra-dense matter. For that purpose, precise measurements of the mass-radius relation of a neutron star are crucial. Among the various observational methods, gravitational redshift at a neutron-star surface, which corresponds to the mass-radius ratio of the neutron star, is most promising as it is in principle measurable with little systematics using the spectral features produced at the neutron-star surface. The spectral features may be preferentially produced during a thermonuclear X-ray burst, which is the runaway thermonuclear reaction on a neutron-star surface, because the temperature structure of the bursting atmosphere and the production of heavy elements are suited to form the spectral features. If we can detect spectral features in the energy spectra of the X-ray bursts and can, in addition, identify the ions responsible for the features, their apparent energies compared to the laboratory values directly give the gravitational redshift at the neutron-star surface. For this purpose, we systematically analyzed thermonuclear X-ray bursts using the archive data of Suzaku, which is Japan's fifth X-ray astronomy satellite launched in 2005. Among 44 thermonuclear X-ray bursts observed from 9 different sources, we focused on the X-ray burst detected from GRS 1747-312, a low-mass X-ray binaries located in the globular cluster Terzan 6. During a part of the Galactic bulge mapping observations, which covered the sky field including the source, the X-ray burst was serendipitously detected and had a long duration, exceeding an hour, with moderate photospheric-radius expansion. Unfortunately, most of the decay of the burst was not observed due to the satellite passage through the South Atlantic Anomaly, in which the detectors are turned off to prevent damage. The time-resolved energy spectra of the burst were reproduced by the conventional model of an absorbed blackbody most of time, but significant deviation was detected in the late cooling phase. The deviation was due to a clear roll-off in the energy spectra above 7 keV. In order to identify the origin of the roll-off, we examined various models to reproduce the roll-off including non-Planckian burst spectra, partial covering absorption, and Doppler-smeared absorption edges due to the rapid spin of a neutron star. As a result, we found that the roll-off is most probably explained by two Doppler-smeared absorption edges of hydrogen-like Fe and Zn ions, which should be the major products of nuclear burning in the burst. They can also naturally explain the emergence of the feature in the late cooling phase of the burst as the change of the ionization degree of the above burst products, which are considered to be ejected by the radiation-driven wind during the photospheric-radius expansion phase and be exposed on the neutron star surface later. If this interpretation is correct, the gravitational redshift is estimated to be 1.49 ± 0.04, corresponding to a neutron-star radius range of 8-11 km for an assumed neutron-star mass range of 1.4-2.0 solar mass. Because the absorption edge is not completely smeared out despite of the rapid spin of the neutron star, this can be a powerful observational tool to measure the gravitational redshift of neutron stars.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).

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