Abstract book

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Principles of Multi-wavelength
High-Time Resolution Astrophysics

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1 High precision photometric follow-up of the exoplanet XO-2 b

Luca Borsato

We show analysis of some high-precision, short-cadence light curves of the exoplanet XO-2b transits obtained between 2010 and 2011 from the facility of Asiago Astrophysical Observatory with the telescope Copernico located at Mount Ekar.

2 Optical Polarimetry of the Crab Nebula

Paul Moran

Time resolved polarisation measurements of pulsars provide insight into the structure and composition of the neutron star interior as well as the geometry of the emission region. Hubble Space Telescope (HST) po- larization data of the Crab Nebula was obtained from the Multimission Archive at STScI (MAST). The data composes of a series of observations of the Crab Nebula with the HST and ACS camera system taken in three different polarisation filters (0, 60 & 120 degrees) from August 2003 to December 2005. Polarisation vector maps of the Nebula were produced using the polarimetry software IMPOL. Lastly, the degree of polarisation and the position angle of the pulsars integrated pulse beam was measured, as well as that of the nearby synchrotron knot. Pulsar P.D. $= 4.90\% \pm 0.33\%$ and P.A. $= 106.46 \pm 1.90$ degrees. Synchrotron Knot P.D. $= 61.70\% \pm 0.45\%$ and P.A. $= 126.86 \pm 0.23$ degrees. These results are consistent with those of Dean et al. 2008 using INTEGRAL.

3 Analysis of V2362 Cyg (Nova Cygni 2006)

Yeliz Aksoyu

The photometric, spectroscopic and imaging data of V2362 Cyg (Nova Cygni 2006) were taken form TUBITAK National Observatory with RTT1150 1.5 metre telescope and TFOSC, between 2006 and 2011. Data reduced using IRAF code and results compiled by literature.

4 The (Very) Long-Term Variability of Ultraluminous X-ray Sources

Deatrick Foster

The nature of ultraluminous X-ray sources (ULXs) found in nearby galaxies continues to be a subject of intense speculation and debate. Because of their extreme brightness and well-determined distances, ULXs had been considered possible hosts of the long- sought intermediate-mass black holes (IMBHs); however more recent models invoke slightly heavier than stellar-mass black holes (20–50 solar masses) in extreme accretion states to account for their observed spectra and luminosities. Uncovering the true nature of ULXs is hindered by their extragalactic locations, which makes measuring basic properties such as their orbital periods and inclination properties that play a role in constraining the black hole masses more difficult. We focus here on the need for a systematic investigation of their long-term periodic and aperiodic modulations which may link ULXs to high-mass X- ray binaries (HMXBs), and therefore more firmly establish ULXs as stellar-mass black holes.

5 Spectral analysis of timing noise in NANOGrav pulsars

Delphine Perrodin

The NANOGrav collaboration seeks to detect gravitational waves from distant supermassive black hole sources using a pulsar timing array. In order to search for gravitational waves, it is necessary to have a good characterization of the timing noise for each pulsar of the pulsar timing array. Red noise is common in millisecond pulsars, and we need to quantify how much red noise is present for each pulsar. This can be done by looking at the power spectra of the pulsar timing residuals. However because the pulsar data are non-uniformly sampled, one cannot simply do a Fourier analysis. Also,

commonly used least-square fitting methods such as the Lomb-Scargle analysis are not adequate for steep red spectra. Instead, we compute the power spectra of NANOGrav pulsar timing residuals using the Cholesky transformation, which eliminates spectral leakage. This is done with the help of the TEMPO2 "SpectralModel" plugin developed by William Coles and George Hobbs.

6 Crab Pulsar: Enhanced Optical Emission during Giant Radio Pulses

Susan Collins

Previous observations of the Crab pulsar revealed a correlation between optical and giant radio pulse emission from the Crab pulsar (Shearer et al, 2003.) We present a new analysis using observations taken in December 2009 with the Iqueye time-tagging photometer.

7 Vela Optical pulsar timing with IquEye

Enrico Verroi

Iqueye is an optical single photon photometer for the 3.5m ESO NTT, a prototypes of a quantum photometer for the European Extremely Large Telescope. The instrument is able to store the arrival time of each detected photon referenced to UTC with a precision better than 500 picoseconds, continuously for hours of data acquisition. Here the analysis of the data obtained from the Vela pulsar is presented. The analysis is performed with a novel technique which makes use of the PCA (principal component analysis) applied to the waterfall diagrams for the pulsar optical light curve.

8 The Swift/XRT Catalogue of GRBs

Elena Zaninoni

Gamma Ray Bursts (GRB) are intense flashes of gamma-ray radiation able to outshine the gamma- ray sky during their short lives. In spite of many theoretical and observational progresses, the nature of their central engine is still clouded in mystery. We present here the widest analysis of GRB X-ray afterglows, ever: during its 6 year life-time, Swift has provided X-ray afterglow data for more than 600 bursts. Using this catalogue we

can address the study of GRB afterglows from a statistical point of view; moreover, for the first time, we can study the properties of these events in the source rest frame, constraining the luminosity and amount of energy released during the different phases of the X-ray afterglow evolution.

9 Timing residuals of precessing pulsars

Tomasz Joachimiak (UZG), Andrzej Maciejewski (UZG)

Pulsars are spinning neutron stars that emit radiation in beams that sweep across the space like similar to a lighthouse. Analysis of long term pulsar observations data allows to establish pulsar period with great accuracy. Recent radio pulsar observations have shown that some pulsars have interesting long term period variations which can be approximated with a convolution of periodic functions. Such periodicities could be explained as free precession of pulsar or as evidence of planetary system around it (like PSR 1257+12). We present pulsar timing simulations of three dynamic models of precessing neutron star: homogeneous rigid body, Zhukovski-Volterra gyrostat (rigid body carrying rotator inside) and rigid mantle with a triaxial ellipsoidal cavity filled with inviscid fluid.

10 Single pulses of PSR B1133+16 with 60 μs resolution at 8.35 GHz

Krzysztof Krzeszowski (UZG), Agnieszka Słowikowska (UZG), Jarosław Kijak (UZG)

PSR B1133+16 is one of the brightest pulsars known with flux of around 26 mJy at 1.4 GHz. The strength of this source makes it ideal for single pulses analysis even at relatively high radio frequencies. There were numerous studies of B1133+16 single pulses which revealed many interesting features like giant pulses, nulls, subpulse drift to name a few. We want to show the results of microsecond resolution radio data analysis focused on flux measurements of single pulses. The data was recorded at 8.35 GHz with 1.1 GHz bandwidth using Effelsberg 100-m Radio Telescope (MPIfR), which is one of the largest fully steerable radio telescopes. The most important conclusion of the analysis is, that the strongest single pulse emission at 8.35 GHz contributes almost exclusively to the trailing part of the leading component of the pulsar mean profile, whereas studies at lower frequencies report that the contribution is spread almost uniformly covering all phases of the pulse

mean profile. This behaviour confirms theoretical prediction of the pulsar radio emission.

11 The maximum mass of rotating neutron stars

Marcin Kucaba (UZG, Poland), Dorota Gondek-Rosinska (UZG), Anna Snopek (UZG), Izabela Kowalska (OA, University of Warsaw), Loic Villain (University of Tour, France)

We study the effect of degree of differential rotation and stiffnest of an equation of state on the maximum allowed mass of neutron stars. We numerically construct stellar models using a relativistic code based on a multi-domain spectral method. We show that depending on the degree of differential rotation and the equation of state the maximum allowed mass of neutron stars can be 0.6 to more than 2 times larger than the non-rotating value. It give us a new view on the properties of a remnant of coalescing neutron stars and a newly born compact object as sources of gravitational radiation.

12 Properties of rotating strange stars

Magdalena Szkudlarek (UZG), Dorota Gondek-Rosinska (UZG)

Strange quark stars are considered as a possible alternative to neutron stars as compact objects (e.g. Weber 1999). We present the first relativistic calculations of differentially rotating strange stars. A newly born, hot compact star, formed in a supernova explosion is supposed to rotate differentially. Using a highly accurate, relativistic code we calculate main properties (e.g. allowed masses, spins) of rigidly and differentially rotating strange stars. Detailed comparisons with neutron star models is given. We show that rotation may cause a significant increase of maximum allowed mass of a strange star, much larger than in the case of neutron stars. A compact star stabilized by differential rotation is considered to be an important source of gravitational waves.