219th AAS Meeting – Austin, TX January, 2011

AAS Winter Meeting Abstracts

Gravitational microlensing provides a unique probe to study the innermost part of quasar accretion disks close to the event horizon of supermassive black holes. We report our long-term monitoring data using Chandra for five gravitationally lensed quasars: Q2237+0305, QJ0158-4325, SDSS0924+0219, SDSS1004+4112 and HE0435-1223. We discover for the first time chromatic microlensing differences between the soft and hard X-ray bands in the X-ray continuum emission. Our results indicate that the coronae above the accretion disk thought to generate X-rays have a non-uniform electron distribution, and the hard X-ray emission may track the event horizon of black holes. We detect metal emission lines for all X-ray images in all lenses. This enables us to compare the microlensing variability between the X-ray continuum and metal emission lines and constrain the metal line emission regions relative to the X-ray continuum. Our results also confirm earlier microlensing results that quasar X-ray emission regions are significantly smaller than the optical emission regions.

226.05 – **Optical Discovery of Stellar Tidal Disruption Flares**

Glennys R. Farrar[1], S. van Velzen[2]

[1]*New York University,* [2]*Radboud Univ., Netherlands.*

2:50 PM - 3:00 PM

We model the SED and light-curves of two probable tidal disruption flares (TDFs) found by van Velzen et al (2011) in a search for the tidal disruption of stars by super-massive black holes in non- active galaxies, using archival multi-epoch SDSS imaging data (Stripe 82). These flares were shown to be very difficult to reconcile with a SN or AGN-flare explanation, based on the SDSS observations, UV emission measured by GALEX and spectra of the hosts and of one of the flares. The flares have optical black-body temperatures 2×10^4 K and observed peak luminosities $M_g = -18.3$ and -20.4 ($\nu L_\nu = 5 \times 10^{42}$, 4×10^{43} erg/s, in the rest-frame); their cooling rates are very low, qualitatively consistent with expectations for tidal disruption flares. Best-fitting models for the observed SED and light curves are reported, and the rate of tidal disruption events is given. The possibility that tidal disruption flares produce Ultrahigh Energy Cosmic Rays is discussed. Fundamental questions in astrophysics and cosmology that can be addressed with a large sample of TDFs are enumerated.

226.06 – **Swift J164449.3+573451: Jet Emission from a Tidal Disruption Event - the 9 Month Update**

David N. Burrows[1], J. A. Kennea[1], P. Romano[2], V. Mangano[2], N. Gehrels[3]

[1]*Penn State Univ.,* [2]*INAF – Istituto di Astrofisica Spaziale e Fisica Cosmica, Italy,* [3]*NASA/Goddard Space Flight Center.*

3:00 PM - 3:10 PM

On March 28, 2011, the Swift Burst Alert Telescope triggered on an object that has no analog in over six years of Swift operations. Followup observations by the Swift X-ray Telescope have shown a new, bright X-ray source with highly variable flux (covering 3 orders of magnitude in flux over the first few days) that has been much more persistent than gamma-ray burst afterglows. Optical photometry shows a decaying NIR source coincident with the X-ray object. Ground-based spectroscopy found a redshift of 0.35, implying extremely high luminosity, with integrated isotropic X-ray energy output exceeding 10^{53} ergs in the first two weeks after discovery. Deep serendipitous archival X-ray observations show no counterpart over the past 20 years to fluxes orders of magnitude below the light curve peak values. There is strong evidence for a collimated (or beamed) jet. The observational properties of this object are unlike anything ever before observed. We interpret these unique properties as the result of emission from a relativistic jet produced in the aftermath of the tidal disruption of a star by a massive black hole in the center of the host galaxy. If so, we expect the source to decay slowly as the stellar remnants are accreted onto the central black hole. We will discuss the results of daily monitoring of this object by the Swift X-Ray Telescope for over 9 months.

226.07 – **Testing The Cas A Neutron Star Temperature Decline With Other Chandra Instruments**

Khaled Elshamouty[1], C. O. Heinke[1], W. C. G. Ho[2], D. J. Patnaude[3], P. S. Shternin[4], D. G. Yakovlev[4]

[1]*University of Alberta, Canada,* [2]*University of Southampton, United Kingdom,* [3]*Smithsonian Astrophysical Observatory,* [4]*Ioffe Physical Technical Institute, Russian Federation.*

3:10 PM - 3:20 PM

The neutron star in the Cassiopeia A supernova remnant is ~330 years old, making it the youngest neutron star in the Milky Way. Heinke & Ho (2010) reported a rapid cooling drop of 4% in its surface temperature (21% drop in observed flux) from Chandra ACIS-S archival data between 2000 and 2009. This opened the suggestion of enhanced neutrino emission due to a superfluid transition in the core to account for the observed rapid cooling (Page et al. 2011, Shternin et al. 2011). Here we present analysis of archival Chandra ACIS-I, HRC-I and HRC-S data over the same time period to test the rate. We used the best ACIS-S carbon atmosphere spectral fits to infer the countrates corresponding to various temperatures, along with current (CALDB 4.4.6) estimates of the effective area and its changes over time for these cameras, to calculate the temperature drops in each instrument. We find that the HRC-I data are consistent with the ACIS-S result, though tending to smaller declines. The ACIS-I data suggest a slightly larger drop. The HRC-S data (with the longest exposures) indicate a marginal temperature decline of 0.9+0.7-0.7 % (90% conf.) over 9 years.

226.08 – **Hard X-ray Emission by Resonant Compton Upscattering in Magnetars**

Zorawar Wadiasingh[1], M. G. Baring[1], P. L. Gonthier[2], A. K. Harding[3]

[1]*Rice Unversity,* [2]*Hope College,* [3]*NASA Goddard Space Flight Center.*

3:20 PM - 3:30 PM

For inner magnetospheric models of hard X-ray and gamma-ray emission in high-field pulsars and magnetars, resonant Compton upscattering is anticipated to be the most efficient process for generating continuum radiation. For magnetars, this is due in part to the proximity of a hot soft photon bath from the stellar surface. Moreover, the scattering cross section becomes resonant at the cyclotron frequency, exceeding the classical Thomson value by over two orders of magnitude and thereby enhancing the efficiency of continuum production and the cooling of relativistic electrons. We present angle-dependent hard X-ray upscattering model spectra for uncooled monoenergetic relativistic electrons injected in inner regions of pulsar magnetospheres. These spectra are integrated over closed field lines and obtained for different observing perspectives. Electron cooling rates for resonant Compton interactions are also presented, in preparation for future radiation-reaction limited acceleration and emission models of non-thermal magnetar X-rays. Our research employs a new Sokolov and Ternov (ST) formulation of the QED Compton scattering cross section in strong magnetic fields. Such an ST formalism is formally correct for treating spin-dependent effects that are important in the cyclotron resonance, and has not been addressed before in the context of Compton upscattering models of magnetar hard X-ray tail emission.

227 – Astronomy 101 Teaching & Learning

Oral Session – Room 16A – Tuesday, January 10, 2012, 2:00 PM - 3:30 PM

227.01 – **Fostering the Development of Quantitative Life Skills through Introductory Astronomy: Can it be Done?**

Katherine B. Follette[1], D. W. McCarthy[1]

[1]*University of Arizona.*

2:00 PM - 2:10 PM

We present preliminary results from a student survey designed to test whether the all-important life skill of numeracy/quantitative literacy can be fostered and improved upon in college students through the vehicle of non-major introductory courses in Astronomy. Many instructors of introductory science courses for non-majors would state that a major goal of our classes is to teach our students to distinguish between science and pseudoscience, truth and fiction, in their everyday lives. It is difficult to believe that such a skill can truly be mastered without a fair amount of mathematical sophistication in the form of arithmetic, statistical and graph reading skills that many American college students unfortunately lack when they enter our classrooms. In teaching what is frequently their “terminal science course in life” can we instill in our students the numerical skills that they need to be savvy consumers, educated citizens and discerning interpreters of the ever-present polls, studies and surveys in which our society is awash? In what may well be their final opportunity to see applied mathematics in the classroom, can we impress upon them the importance of mathematical sophistication in interpreting the statistics that they are bombarded with by the media? Our study is in its second semester, and is designed to investigate to what extent it is possible to improve important quantitative skills in college students through a single semester introductory Astronomy course.

227.02D – **Understanding the Correlations Among Undergraduates’ Spatial Reasoning Skills and Their Ability to Learn Astronomy Concepts**

Inge Heyer[1]

[1]*University of Wyoming.*

2:10 PM - 2:30 PM

We tacitly assume that astronomy is a conceptual domain deeply entrenched in three dimensions and that learners need to utilize spatial thinking to develop understanding of the field. In particular, cognitive science generally views students’ spatial thinking abilities as something that can be enhanced through purposeful instruction, whereas aptitude and ability to learn complex ideas might be immutable. Yet, precise investigations into the underlying relationship between students’ spatial reasoning ability and their ability to learn astronomy content in college science classes are beginning to reveal insight into how students cognitively engage in learning astronomy. In support, researchers at the CAPER Center for Astronomy and Physics Education Research