2011 SAO Summer Intern Project Abstracts

An archival search for radio transients in M51

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We present results from the first search for radio transients in a nearby galaxy, M51 (NGC 5194). The search was conducted using archival data from the Very Large Array spanning a period of nearly 30 years. Most data were taken at a frequency of 4.9 GHz, with supplemental observations at other frequencies. Each epoch is $10-20$ minutes in duration and epochs are irregularly spaced, making us sensitive to transients on a wide range of timescales. This image depth allows us to detect transients at the distance of M51 down to a luminosity of $\sim 10^{25}$ erg/s/Hz. As our search includes data collected during the extensive monitoring of SN 1994I by Weiler et al. in the years following its discovery, we also present an independent analysis of a subset of radio observations of this important type Ic supernova. We find that the data is well-fit by a synchrotron self-absorption model and estimate a pre-explosion mass loss rate of $\sim 2-5\times 10^{-5}$ solar masses per year, which is consistent with a Wolf-Rayet progenitor for the SN.

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Properties of Quasar Close Pairs in the *Chandra* COSMOS Survey

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Black hole and galaxy co-evolution models predict a phase in which multiple galaxies with active black holes interact, with visible signatures of interaction, and that their activity may be stimulated by tidal disruptions of their ISM. Several studies have been recently conducted to prove the existence of this phase. However, a proper multiwavelength characterization of galaxy pairs is still missing.

We present analysis of X-ray emitting galaxy pairs selected in the Chandra COSMOS survey. The sources in each pair are within $\delta z < 0.2$ and a projected separation of 10 arcseconds, corresponding to projected physical separations ranging from 27 kpc to 82 kpc. In order to characterize the pairs in the context of the black hole/galaxy co-evolution scenario, we i) fit spectral energy distributions to determine the relative AGN and galaxy contributions, ii) calculated X-ray luminosities and hardness ratios to check the active nature of the black holes and to get a sense of the obscuration levels, iii) examined the morphologies for signatures of mergers; and iv) determined relative velocities from available spectra.

Active black holes are present in all of the galaxies, as they are very luminous in the X-ray band, though mildly obscured. In most of the sources, the host galaxy is overshining the nuclear light in the optical band. In several lower redshift pairs, where morphological features are more easily observed, we see disturbed morphology and tidal structures, signatures of a first close passage.

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Searching for Stellar X-ray Cycles with XMM-Newton

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Stellar activity cycles are known to be a widespread phenomenon amongst moderately active stars due to long term monitoring of chromospheric CaII H and K emission lines by O.C. Wilson and others. Whether or not similar periodicities exist in the X-ray spectra of most solar-type stars, however, is currently unknown. Apart from our sun, only a handful of stellar X-ray cycles have been observed (61 Cygni (A and possibly B), HD 81809 and Centauri B). We seek to improve our perspective of stellar X-ray cycles by surveying a large population of serendipitous stellar sources in XMM-Newton fields which have been observed frequently over long timescales of ≈ 10 years. We present our analysis of 46 sources (with 6 G and K stars) from 8 fields. We fit a single temperature APEC spectrum to each source and search for significant periodicities in the fitted APEC flux using a Lomb-Scargle Periodogram (LSP). Since errors are not taken into account in the LSP, we use Monte Carlo simulations to consider the APEC flux errors. No clear X-ray cycle is detected for any of the stellar sources in our sample. This work is supported in part by the NSF REU and DOD ASSURE programs under NSF grant no. 0754568 and by the Smithsonian Institution.

Worlds in Transit: Observations of Exoplanets TrES-1b, TrES-3b, XO-2b, and GJ-1214b using IRTF-MORIS

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We present new transits of targets TrES-1b, TrES-3b, XO-2b, and GJ-1214b, observed with IRTF-MORIS. The radius ratio we found for TrES-1b in Sloan r′ is 0.131190 ± 0.000057, which differs by 7σ from the Winn et al. (2007) value in z′. A possible cause for this inconsistency is wavelength variation by depth. The other parameters found for TrES-1b were consistent with the Winn et al. (2007) values. The timing for TrES-1b may indicate the need for a new ephemeris. The orbital and planetary parameters found for TrES-3b were consistent with previous values, which can be attributed to good observational conditions and a bright companion star. Likewise, the values found for XO-2b deviated very little from previous literature. Both TrES-3b and XO-2b demonstrated consistent timing values. Due to poor conditions and a lack of good comparison stars within the field of view, the parameter values for the radius ratio, inclination, and orbital distance, found for GJ-1214b are not reliable. The timing values, while still suspect, suggest consistency with the current ephemeris. This work is supported in part by the NSF REU and DOD ASSURE programs under NSF grant no. 0754568 and by the Smithsonian Institution.

A Chandra and Spitzer Study of IC 348

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We present a multi wavelength study of the young stellar cluster IC 348 making use of new Chandra X-ray observations as well as existing Spitzer infrared data. Overall, 484 X-ray sources were detected of which 271 correspond to known 2MASS or Spitzer IRAC cluster members. We find classical T Tauri Stars and weak-lined T Tauri Stars show similar mean X-ray luminosities. Transitional disk X-ray luminosities are investigated and compared to transitional disks in other young clusters. We report the detection of 22 hard X-ray photons from the vicinity of HH211's NW jet and possible scenarios for their origin are discussed. This work is supported in part by the NSF REU and DOD ASSURE programs under NSF grant no. 0754568 and by the Smithsonian Institution.

Exploring Frontal Events on Mars Using MRO MARCI Images

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We have processed global map swaths taken by MRO MARCI, and made Mars Daily Global Maps (MDGMs) for the second MRO mapping year (MY 29 Ls =121 to MY 30 Ls =112). We have used our MDGMs to make a catalog of all curvilinear clouds and dust storms called "frontal events", which are analogous to the cloud pattern of a terrestrial baroclinic storm.ÃĆÂă The spatial and temporal distribution of the frontal activity is presented. They are found to be largely consistent with previous observations conducted with the Mars Global Surveyor. There are more frontal events in the northern hemisphere than in the southern hemisphere. For the northern hemisphere, there are more frontal events in spring and summer than in the fall and winter. There are seperate seasonal periods when cloud frontal events or dust frontal events dominate. There is a period around the winter solstice when frontal events are suppressed. Before and after this period there are large flushing events transporting dust to low latitudes. Spatial distribution of frontal events in the north are most prevalent in the low topographical regions, especially in Acidalia. Frontal events in the south were found to be more frequent in the anti-cryptic zone. The temporal distribution follows a latitudinal trend in relation with the changing size of the polar caps. We have examined the fine structure of frontal events, and found blotchy textures in many cases, indicating that frontal circulation can trigger active dust lifting. This work is supported in part by the NSF REU and DOD ASSURE programs under NSF grant no. 0754568 and by the Smithsonian Institution.