GRAM

GEORGIA REGIONAL ASTRONOMY MEETING

2023

Agnes Scott College

Nov 4, Saturday, 2023

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and the Georgia Space Grant.

AGNES SCOTT COLLEGE

GEORGIA Space Grant Consortium

Attendees

Georgia Regional Astronomy Meeting 2023

Name	Organization	Email
Heleen Amedi	Georgia Institute of Technology	hamedi6@gatech.edu
Ansley Aufiero	Agnes Scott College	aufiero662@agnesscott.edu
Dhruv Bal	Clemson University	dbal@g.clemson.edu
Alissa Bans	Emory University	abans@emory.edu
Temia Barker	Clark Atlanta University	tlbarker03@gmail.com
Aaron Bartleson	Georgia Institute of Technology	abartleson3@gatech.edu
Merida Batiste	Emory University	merida.g.batiste@emory.edu
Aysia Bittinger	University of North Georgia	albitt0194@ung.edu
Tamara Bogdanovic	Georgia Institute of Technology	tamarab@gatech.edu
Erin Wells Bonning	Emory University	erin.bonning@emory.edu
Laurel Bourg	Georgia Institute of Technology	lbourg3@gatech.esu
Emily Burns-Kaurin	Georgia State University	eburnskaurin1@student.gsu.edu
Chi-Ho Chan	Georgia Institute of Technology	chchan@gatech.edu
Lani Chastain	University of North Georgia	lmchas6644@ung.edu
Varun Chaturmutha	Georgia State University	varun@astro.gsu.edu
Nabanita Das	Georgia State University	ndas5@student.gsu.edu
Jay Dunn	GA State University, Perimeter College	jdunn1@gsu.edu
Cara Ebers	Agnes Scott College	ebers031@agnesscott.edu
Gregory Feiden	University of North Georgia	gregory.feiden@ung.edu
Carey Felius	Agnes Scott College	felius095@agnesscott.edu
Delta Flowers	Columbus State University	flowers_joy@students.columbusstate.edu
Kate Futrowsky	Georgia Institute of Technology	kfutrowsky@gatech.edu
Daniela Garcia-Lara	Agnes Scott College	garcialara395@agnesscott.edu
Sebastian Carrazco Gaxiola	Georgia State University	jcarrazcogaxiola1@gsu.edu
Griffin Goodwin	Georgia State University	ggoodwin5@gsu.edu
Philip Groce	Helping Planetariums Succeed, LLC	hps4075@bellsouth.net
Jessica Hamilton	Georgia State University	jhamilton58@gsu.edu
Xu Han	Emory University	xhan68@emory.edu
Kseniya Harrington	Georgia Institute of Technology	kharrington9@student.gsu.edu
R. Scott Harris	Charleston Planetarium	gageologist@gmail.com
Alice Heranval	Georgia Institute of Technology	aheranval3@gatech.edu
Zoe Hughes	Emory University	zlhughe@emory.edu
Colin Kane	Georgia State University	ckane6@gsu.edu
Nikita Khatiya	Clemson University	nkhatiy@g.clemson.edu
Samuel Kimball	Columbus State University	kimball_samuel@students.columbusstate.edu
Grace Krahm	Agnes Scott College	krahm581@agnesscott.edu
Matthew LaFountain	Georgia State University	matthewlafountain101@gmail.com
Mai Le	Agnes Scott College	le863@agnesscott.edu
Jamie Lester	Oglethorpe University	jlester3@oglethorpe.edu
Kayleen Linge	Columbus State University	linge_kayleen@students.columbusstate.edu
Braven Lyall	Georgia State University	blyall1@gsu.edu
Shanice Mack	Georgia State University	smack12@student.gsu.edu
Loris Magnani	University of Georgia	loris@uga.edu

Name	Organization	Email
Julie Malewicz	Georgia Institute of Technology	jlm@gatech.edu
Griffin McLeroy	Columbus State University	mcleroy_griffin@students.columbusstate.edu
Marta Dark McNeese	Spelman College	mldark@spelman.edu
William Gavarrete Mejia	Georgia State University	williamgavarrete3@gmail.com
Dave Mertins	University of West Georiga	dmertins@westga.edu
Lydia Miller	University of North Georgia	jeeplydiam@gmail.com
Will Mockridge	Georgia State University	wmockridge1@student.gsu.edu
Amanda Moffett	University of North Georgia	amanda.moffett@ung.edu
Iniya Mohan	Georgia Institute of Technology	iniyamohan77@icloud.com
Elizabeth Mone	Georgia Institute of Technology	emone3@gatech.edu
Namrata Nayar	Georgia Institute of Technology	namratamech@gmail.com
Kesha Patel	Emory University	kpat372@emory.edu
Ken	Atlanta Astronomy Club	poshedly@bellsouth.net
Nadia Qutob	Georgia Institute of Technology	nadiaqutob@gatech.edu
Aysha Rahman	Clark Atlanta University	ayshafr97@gmail.com
Tamima Saba	Georgia State University	tsaba1@student.gsu.edu
Viacheslav Sadykov	Georgia State University	vsadykov@gsu.edu
Richard Willis Schmude, Jr.	Gordon State College	schmude@gordonstate.edu
Yasmeen Shah	Georgia State University	yshah10@student.gsu.edu
Kayvon Sharifi	Georgia State University	ksharifi1@student.gsu.edu
Sydney Sharrock	University of North Georgia	slshar2162@ung.edu
Katherine Shepard	Georgia State University	kshepard3@gsu.edu
Jim Sowell	Georgia Institute of Technology	jim.sowell@physics.gatech.edu
Sofia Stepanoff	Georgia Institute of Technology	sofiastepanoff@gatech.edu
Nick Sterling	University of West Georgia	nsterlin@westga.edu
Yazmin Suastegui-Perulero	Agnes Scott College	suasteguip360@agnesscott.edu
Shivani Swaminathan	University of North Georgia	shivanis7077@gmail.com
Khushi Taori	Georgia Institute of Technology	ktaori3@gatech.edu
Vishal Tiwari	Georgia Institute of Technology	vtiwari@gatech.edu
Jacob Tutterow	Georgia State Univeristy	jtutterow1@student.gsu.edu
Mateo Valera	University of North Georgia	mvale2889@gmail.com
Aditi Venkatesh	Georgia Institute of Technology	avenkatesh63@gatech.edu
Jack Vogel	University of North Georgia	jv10165@gmail.com
Paul Wallace	Agnes Scott College	pwallace@agnesscott.edu
Edrick Wang	Emory University	ewang83@emory.edu
Zach Way	Georgia State University	zway1@gsu.edu
Nandana Weliweriya	University of Georgia	nandanaw@uga.edu
Ashley Wheeler	Georgia State University	awheeler24@student.gsu.edu
Russel White	Georgia State University	white@chara.gsu.edu
Devin Wiggins	Spelman College	devinwiggins@spelman.edu
Rosa Williams	Columbus State University	williams_rosa@columbusstate.edu
John Wise	Georgia Institute of Technology	jwise@physics.gatech.edu
Dr. David Yenerall	GA State University, Perimeter College	dyenerall@gsu.edu
Alexandra Yep	Agnes Scott College	ayep@agnesscott.edu
Mandy	Agnes Scott College	zhang473@agnesscott.edu
Xinghai Zhao	Dalton State College	xzhao@daltonstate.edu

Schedule

Georgia Regional Astronomy Meeting 2023

8:30 a.m.	*Breakfast*	————
8:55 a.m.	Welcome	Alexandra Yep, Agnes Scott College
9:00 a.m.	How is the Weather in Space?	Viacheslav Sadykov, Georgia State University
9:15 a.m.	Studying Spectral Line Formation and Wave Propagation in the Lower Solar Atmosphere by Realistic 3D Simulations and Radiative Transfer	Jessica Hamilton, Georgia State University
9:30 a.m.	Stellar Rotational Evolution of Low Mass Stars	Lydia Miller, University of North Georgia
9:45 a.m.	Characterizing of K Dwarfs within 40 Parsecs - Spectral Qualities of the Best Planet Hosts	Sebastian Carrazco Gaxiola, Georgia State University
10:00 a.m.	A Survey of High-Velocity Stars Using Gaia DR3	Braven Lyall, Georgia State University
10:25 a.m.	*Coffee Break + Posters*	————
10:45 a.m.	Observational Effects on the Morphology of Galaxies with AGNs	Edrick Wang, Emory University
11:00 a.m.	A Stellar Dynamical Mass for the Bright Seyfert Galaxy MCG-06-30-15	Nabanita Das, Georgia State University
11:15 a.m.	The Impact of Nebular Line Emission on SED-Derived Galaxy Properties	Grace Krahm, Agnes Scott College
11:30 a.m.	Emission properties of massive black hole binaries heading for merger	Chi-Ho Chan, Georgia Institute of Technology
11:45 a.m.	Properties of the X-ray spectra of inspiraling supermassive black hole binaries	Julie Malewicz, Georgia Institute of Technology
12:10 p.m.	*Lunch + Posters*	————
12:50 p.m.	*GRAM Committee Meeting*	*GRAM hosts and future hosts*
1:15 p.m.	Improving Ionic Column Density Determinations for PG1425+267 in the SUBWAYS Sample	Jay Dunn, GA State University, Perimeter College
1:30 p.m.	Lithium Enrichment in K-G Giants	Zoe Hughes, Emory University
1:45 p.m.	Low-Mass, Unresolved Binaries identified from their Gaia XP Spectra	Zach Way, Georgia State University

2:00 p.m.	Gravity's Effect on the Trajectory of Two Colliding Stellar Associations	Ansley Aufiero, Agnes Scott College
2:15 p.m.	The Kraft Break Sharply Divides Low Mass and Intermediate Mass Stars	Russel White, Georgia State University
2:40 p.m.	*Coffee Break + Posters*	———————
3:00 p.m.	Connecting Modern Astronomy to the Human Experience	Philip Groce, Helping Planetariums Succeed, LLC
3:15 p.m.	W Serpentis Stars	Katherine Shepard, Georgia State University
3:30 p.m.	Determining the Frequency of Cometary Impacts from the Geologic Record	R. Scott Harris, Charleston Planetarium
3:45 p.m.	Jupiter's Faint North Polar Hood	Richard Willis Schmude,Jr., Gordon State College
4:00 p.m.	First light and operations of the Trinity Demonstrator	Sofia Stepanoff, Georgia Institute of Technology
4:15 p.m.	Concluding Remarks	Alexandra Yep, Agnes Scott College

Talks

Georgia Regional Astronomy Meeting 2023

8:30 a.m. *Breakfast*

8:55 a.m. Welcome

Alexandra Yep, Agnes Scott College

9:00 a.m. How is the Weather in Space?

Viacheslav Sadykov, Georgia State University

The term "Space Weather" serves as an overarching umbrella for the description of complex interactions of the Earth and its magnetosphere and atmosphere with the radiation, plasmas, and energetic particle flows from the Sun. Like for the regular weather on Earth, we experience mild breezes of the solar wind during the quiet periods (corresponding to the solar activity minimum) and severe geomagnetic and radiation storms during the 'hurricane' season (solar activity maximum). This presentation represents an attempt to overview the core effects of space weather on the terrestrial environment, both the solar-cycle-long and caused by rapid solar transient events (such as solar flares and solar energetic particles). The presentation will also highlight the space weather-related research activities at Georgia State University.

9:15 a.m. Studying Spectral Line Formation and Wave Propagation in the Lower Solar Atmosphere by Realistic 3D Simulations and Radiative Transfer

Jessica Hamilton, Georgia State University

Remote sensing of the solar atmosphere by observations of the broadband emission and spectral lines provides a possibility to diagnose the physical properties of the atmosphere and processes therein. One way to study how the spectral lines are formed is to pair the realistic atmospheric simulations and the synthesis of the spectra through radiative transfer. In this work, we combine high-resolution, realistic, 3D RHD simulations of the solar atmospheres by the StellarBox code with radiative transfer modeling with the RH1.5D code to understand the formation of the spectral lines and the relation of their dynamics to the wave propagation in the atmosphere. Specifically, we model five spectral lines formed in the lower solar atmosphere, Fe I 6713 Å, 6301 Å and 6302 Å (formed at 0-300 km) and Na I Doublet, 5890 Å and 5896 Å (500-1000 km). We determine the optimal atomic configurations, treatment of free electron densities, and equilibrium assumptions for the most appropriate and computationally efficient method of running the radiative transfer. The validity of the properties of the line profiles computed for StellarBox simulations with 1 Mm atmosphere used in this work is checked with the simulations with an extended atmosphere. We compute and analyze the cross-spectrum of the Fe I and Na I line Doppler shifts. We also study the energy flux through the atmospheric layer between the formation heights of these lines and its relation to the spectral line dynamics. The diagnostics will further aid in determining if solar atmospheric waves contribute to or even maintain the observed heating in the solar chromosphere and corona.

9:30 a.m. Stellar Rotational Evolution of Low Mass Stars

Lydia Miller, University of North Georgia

Low-mass stars spin-down with time due to angular momentum loss from magnetized stellar winds. Spin-down was thought to be a continuous process over time, but recent observations suggest that spin-down stalls for 0.1 – 2.0 Gyr among stars with a radiative core. The duration over which a star's spin-down stalls increases with decreasing stellar mass until the fully convective boundary, below which stars do not appear to stall their spin-down. In this talk, I present results exploring rotational evolution of M dwarf stars near the fully convective boundary (M_G≈10). Stars near this magnitude are known to oscillate between fully and partially convective states. Using rotation periods from Zwicky Transient Facility (ZTF) we find that stars that oscillate between convective states behave similar to stars with a radiative core. However, we find that there is a group of stars at the fully convective boundary with anomalously slow rotation rates compared to partially convective stars, or fully convective stars. These stars are kinematically younger than other stars with similar rotation periods indicating that they experienced a rapid spin-down. These slow spinning stars add more constraints around the stalling mechanism allowing for models to explore new mechanics of low mass stellar interiors.

9:45 a.m. Characterizing of K Dwarfs within 40 Parsecs - Spectral Qualities of the Best Planet Hosts

Sebastian Carrazco Gaxiola, Georgia State University

K dwarfs are key targets for both astrophysical studies and exoplanet surveys. To put K dwarf's activity in context with G dwarfs and M dwarfs, here we present the quality and observation status of the new RKSTAR (RECONS K Stars) sample from Gaia Data Release 3. The sample includes more than 1500 K dwarf primaries between declinations +30° to -90° within 40 parsecs observed with the CHIRON high-resolution echelle spectrograph (R=80,000) on the SMARTS 1.5m telescope at CTIO. We investigate S/N ratio quality limits for three spectral features: H alpha (6562.8 Å) and Ca II (8542 Å) for activity, and Li I (6707.8 Å) for age. For this purpose, we utilize a new standard post-reduction methodology for the spectral analysis that provides reliable equivalent width measurements and errors for all three features linked to a set of K dwarfs in young clusters with ages of 20 Myr to 750 Myr. We applied those S/N limits and obtained an observational status of our survey. Finally, These efforts will serve for the stellar characterization of the RKSTAR Survey that will uncover the activity and stellar companions of 11% of all stars in the solar neighborhood.

10:00 a.m. A Survey of High-Velocity Stars Using Gaia DR3

Braven Lyall, Georgia State University

We present the results of an all-sky, systematic survey of the Gaia DR3 catalog in search of high-velocity stars, including hypervelocity star (HVS) candidates. Our analysis made use of newly available radial velocity data from the third Gaia data release. This search resulted in 206 high-velocity candidates with galactocentric velocities ≥ 550 km/s. Through a combination of analyzing their dynamical properties, along with determining the ages of these targets through the use of isochrones, we have identified candidates whose velocities exceed the escape velocity of the Milky Way.

10:25 a.m. Coffee Break + Posters

10:45 a.m. Observational Effects on the Morphology of Galaxies with AGNs

Edrick Wang, Emory University

Illustris TNG is a cosmological manetohydrodynamical simulation which produces terabytes of data on galaxies, stars and other astronomical objects. The data provided by IllustrisTNG have high resolution such that individual galaxies can be thoroughly analyzed. Here, we aim to utilize the public data released by IllustrisTNG and compare with one of the six AGNs available in the observational database. Our goal is to obtain a sample of galaxies from the simulation data that are similar to an observational sample, and perform integral field spectroscopy on the sample to compare with observational data. In this presentation, I will discuss the preliminary steps of this project.

11:00 a.m. A Stellar Dynamical Mass for the Bright Seyfert Galaxy MCG-06-30-15

Nabanita Das, Georgia State University

Black hole mass (M_{BH}) is one of the two measurable fundamental properties that characterize a black hole. In the case of nearby galaxies, dynamical modeling is one of the few techniques available for a direct measurement of M_{BH}. We present our preliminary results from stellar dynamical modeling of the mass of the central black hole in the nearby Seyfert galaxy MCG-06-30-15. The spatially resolved K-band nuclear stellar kinematics for this galaxy were obtained with SINFONI on VLT. We applied the Schwarzschild orbit superposition method to fit the line-of-sight velocity distributions using the open-source code FORSTAND, which is both fast and flexible, allowing exploration of the 3D galaxy shape. MCG-06-30-15 is one of the rare galaxies where we can compare M_{BH} from stellar dynamical modeling with M_{BH} from reverberation mapping, as there are only a handful of active galaxies that are near enough to allow the black hole sphere of influence to be spatially resolved. A direct comparison of M_{BH} is necessary to identify and investigate the possible sources of bias associated with different mass measurement techniques, and thus influences our understanding of black hole and galaxy coevolution across cosmological timescales.

11:15 a.m. The Impact of Nebular Line Emission on SED-Derived Galaxy Properties

Grace Krahm, Agnes Scott College

Spectral energy distribution (SED) modeling is commonly used in observational studied to estimate the stellar mass of a galaxy. However, this method relies on several sets of a assumptions in the radiative transfer process such as the galaxy's star formation history and its impacts on the dust and gas in the galaxy. Nebular line emission from the HII regions around young stars can be an unexpected source of detected flux from the galaxy which impacts the SED modeling. Observationally detecting these nebular lines can be very time intensive and often impossible for galaxies that are farther away. We construct synthetic SEDs with and without nebular lines using the Powderday radiative transfer code on galaxies from the SIMBA hydrodynamical simulations. By backwards modeling and fitting the SEDs with Prospector, we can quantify the extent of how nebular lines impact estimated stellar masses throughout cosmic time.

11:30 a.m. Emission properties of massive black hole binaries heading for merger

Chi-Ho Chan & Vishal Tiwari, Georgia Institute of Technology

Gravitational waves (GW) from inspiraling and merging massive black holes (MBHs) are prime targets for the Laser Interferometer Space Antenna (LISA) and Pulsar Timing Arrays (PTAs). MBH binaries in gas-rich environments may also produce electromagnetic (EM) radiation coincident with the GWs, powered by accretion in the circumbinary disk and the minidisks. Simultaneous detections of these EM and GW signals will revolutionize our understanding of how MBHs grow and evolve, but the feasibility of such detections depends sensitively on the properties of accretion flows near these binaries. Motivated by this, we perform the first radiative magnetohydrodynamics simulations to predict the EM signatures of an equal-mass circular binary with a total mass of 2×10^7 solar masses. A binary separation of 100 gravitational radii places the binary in the regime where orbital evolution is governed by GW emission. Our simulations evolve the gas simultaneously with the radiation, capturing in a self-consistent manner disk heating and cooling. We demonstrate how proper treatment of radiation results in disk structures different from previous simulations. We also discuss what our simulations imply for EM observations.

11:45 a.m. Properties of the X-ray spectra of inspiraling supermassive black hole binaries

Julie Malewicz, Georgia Institute of Technology

Supermassive black hole binaries (SMBHB) are expected to be prime multimessenger sources if they can be detected in both the gravitational wave (GW) and electromagnetic domains. Motivated by the prospect of such detections, we model the X-ray spectra associated with gas bound SMBHBs inspiraling due to the emission of GWs. We use the relativistic reflection model relxill to calculate the composite X-ray spectra from the two accretion disks gravitationally bound to the black holes separated by 100 gravitational radii. We examine the properties and time variability of the spectra (including the Fe Kα line) as a function of the

SMBHB mass ratio and mass accretion rate and consider the prospects for their detection. This work is relevant for the current and future X-ray observatories and the GW observatories, such as the Pulsar Timing Arrays (PTAs) and the Laser Interferometer Space Antenna (LISA).

12:10 p.m. *Lunch + Posters*

12:50 p.m. *GRAM Committee Meeting (for GRAM hosts and future hosts)*

1:15 p.m. Improving Ionic Column Density Determinations for PG1425+267 in the SUBWAYS Sample

Jay Dunn, Georgia State University, Perimeter College

Using novel techniques, we measure the ionic column densities, line-of-sight covering fractions, and blended trough dual covering fractions for 7 distinct kinematic components for the quasar, PG1425+267, as observed by the Cosmic Origins Spectrograph on board the Hubble Space Telescope. These are updated from previous measurements that assumed apparent optical depth, which can only provide lower limits on the column density. We also use the ionic column densities to construct photoionization models to ascertain the physical state of the clouds forming the detected kinematic components.

1:30 p.m. Lithium Enrichment in K-G Giants

Zoe Hughes, Emory University

The observance of large lithium abundances, or lithium enrichment, in K-G type giant stars challenges models of stellar evolution, as low lithium abundances are expected in stars when they reach their giant phase. Existing spectra from the FAST spectrograph for IR excess objects were closely evaluated for peculiar lithium abundances. Lithium abundances were derived from the equivalent widths of the lithium absorption line at 6707 Angstroms. In this talk, I will compare the properties of our FAST candidates to other sets of lithium enriched K-G giants that suggest a trend between infrared excess and lithium enrichment in these stars. Further investigations aim to uncover potential correlations between additional stellar properties of K-G giants to provide evidence for the origins of their lithium enrichment. Beyond quantifying peculiar lithium abundances and IR excess, I will analyze stellar spectral lines to quantify stellar metallicities and rotational velocities.

1:45 p.m. Low-Mass, Unresolved Binaries identified from their Gaia XP Spectra

Zach Way, Georgia State University

Fundamental parameters of low-mass stars can potentially be determined by their location on an HR diagram with sufficiently accurate photometry and parallaxes. This is, however, complicated by the fact that ~20-40% of low-mass stars are predicted to be unresolved binaries and they would appear more luminous compared to single stars with comparable fundamental parameters. Here we present a method to separate out the binary stars from the single-star main sequence K and M dwarfs with their Gaia DR3 XP spectra. Using the Gaia database, we create a sample of stars with pristine astrometry and photometry composed of single stars and equal mass binaries within 100 parsecs. We then iteratively train Random Forest Regression (RFR) models to predict absolute magnitude and color given a star's red photometer (RP) spectral coefficients. We use the final model to predict the absolute magnitudes of the full 200 parsec sample of K and M dwarfs and find that ~29% of the sample is significantly more luminous than our prediction. This method provides a novel approach at breaking the multiplicity-metallicity degeneracy that plagues the lower main sequence and can be a useful tool for wide-field surveys to predict the multiplicity of a given source.

2:00 p.m. Gravity's Effect on the Trajectory of Two Colliding Stellar Associations

Ansley Aufiero & Cara Ebers, Agnes Scott College

Stars are born in clusters or associations. Stellar associations move through space together until they disperse over the course of a few hundred million years. In the more active regions of space, such as the Gum Nebula in the plane of the Milky Way Galaxy, stellar associations will interact with one another. It was not until recently that these interactions have been documented, so there is a limited amount of studies surrounding this subject. Our aim is to predict individual stars' trajectories over the course of 4 million years while taking into account the gravitational potential of the Galactic Center. Through this research, it is possible to determine what could happen as a result of star systems undergoing a close stellar encounter. Assuming an Oort Cloud exists, the presence of another star close by could cause disruptions of those comets and send them flying into any exoplanets the star may harbor.

2:15 p.m. The Kraft Break Sharply Divides Low Mass and Intermediate Mass Stars

Russel White, Georgia State University

Main sequence stars transition at mid-F spectral types from being slowly rotating (cooler stars) to being rapidly rotating (hotter stars), a transition known as the Kraft Break and attributed the disappearance of the outer convective zone, causing magnetic braking to become ineffective. To investigate the location and width of this Break more precisely, we assembled Gaia DR3 data and spectroscopic measurements of 405 F stars within 33.33 pc of the Sun. Once young stars, evolved stars and candidate binary stars are removed, the distribution of projected rotational velocities show the Break to be well-defined and sharp. All stars redder than G_BP-G_RP = 0.60 mag are slowly rotating (vsini < 20 km/s), while only 4 of 40 stars bluer than G_BP-G_RP = 0.54 mag are slowly rotating, consistent with that expected for a random distribution of inclinations. The Break boundaries correspond to spectral types F4 and F5, effective temperatures of 6650 K and 6450 K, and stellar masses of 1.42 M_Sun and 1.33 M_Sun, respectively. The results imply that magnetic braking becomes ineffective with an increase in effective temperature of 3.1% or an increase in stellar mass of 6.1%. A study of F stars in the ~625 Myr Hyades open cluster show that the Break, as defined above, is nearly but not fully established by this age. Finally, we propose that Kraft Break provides a less ambiguous division, for both professional and pedagogical purposes, between what are called low mass stars and intermediate mass stars; the Break is observationally well-defined and is physically linked to a change in stellar structure.

2:40 p.m. *Coffee Break + Posters*

3:00 p.m. Connecting Modern Astronomy to the Human Experience

Philip Groce, Helping Planetariums Succeed, LLC

The first color astro-photo was taken in 1958, the first high-resolution tri-color filter images were taken in the late 1970's. Before these events, astronomical images were black and white or the grey images observed through telescopes. Color images transformed the public's view of the universe and have led to dramatic enhanced colorations of images by Hubble, Webb and other orbiting and earth-based observatories. It is the presenter's experience that the individual impact of viewing a near monochromatic Saturn through an eyepiece of a small telescope is not a disappointment. Rather, its emotional impact is often greater than viewing all of the beautiful Cassini spacecraft images combined. This eyepiece experience is personal and creates a human connection to the planet. More importantly, to planetariums and observatories, the value of the high-resolution spacecraft photos is made greater by the individual's personal view through the telescope. Like Museums displaying and interpreting real artifacts, astronomy educators need to seek real/human astronomical experiences to give value to the far more esoteric discoveries recorded in modern astronomical imagery. Public observatories and public telescope viewing at celestial events are critical to making human connections to astronomy. These personal connections give the public greater appreciation of astronomical discoveries.

3:15 p.m. W Serpentis Stars

Katherine Shepard, Georgia State University

W Serpentis stars are a class of massive binary systems that are actively undergoing non-conservative mass transfer. This mass forms a circumbinary disk or shell around the system that produces variable light curves and an infrared excess. These systems are believed to be the predecessors to a variety of objects, including rapid rotators, algol systems, and core collapse supernovae. In order to determine the outcome for a system, we need to know how much mass is lost from the evolving stars into the circumbinary disk. This can be accomplished with near-IR interferometric observations, modeling, and image reconstruction. Supplemented with spectroscopic observations, we can determine the light distribution and extent of the disk as well as the composition, orbital period, and structure of the circumbinary material.

3:30 p.m. Determining the Frequency of Cometary Impacts from the Geologic Record

R. Scott Harris, Department of Geology, University of Georgia; Department of Earth, Environmental, and Planetary Science, Brown University; Gwinnett County Public Schools; Charleston Planetarium

The frequency and consequences of Earth's close encounters with comets have been the subjects of mystery, mythology, art, and scientific investigation since people began to observe the sky. In recent years, many claims of cometary impacts or air bursts in the recent past have been broadcast through popular media. Some purported evidence of impacts that might have coincided with significant events in human history even have even been proffered in mainstream journals. In response, some astronomers have turned their attention to finding any observational evidence of an increased flux of comets during the last twelve thousand years. Many of these studies have been rejected by the impact geology community, and some have begun to be retracted from the literature. But among the clamor for sensational headlines, there are very real lines of evidence for relatively recent air bursts that could have been witnessed by people and which left behind materials pointing to collisions with either active comets or dead cometary nuclei. I will update my recent work on three Pleistocene to Holocene air bursts, including our first mineralogic confirmation of a cometary impactor (Schultz et al., Geology, 2022) and our recent follow-up field work in the Atacama. And I will discuss the implications for the actual recent flux of cometary material in the Earth-Moon system.

3:45 p.m. Jupiter's Faint North Polar Hood

Richard Willis Schmude, Jr., Gordon State College

In the past three years, Earth-based observers have been able to image a faint North Polar Hood (NPH) that is visible in narrowband filters centered at a wavelength of 889 nanometers. In early 2023, the NPH extended to 67.7 degrees North. There is no evidence it extends farther south near the morning or evening limbs. In late 2022, a large bump also developed in the NPH that moved and a mean rate of -29 degree/30 days with respect to Jupiter's magnetic field. The Cassini and Juno spacecraft have imaged the NPH.

4:00 p.m. First light and operations of the Trinity Demonstrator

Sofia Stepanoff, Georgia Institute of Technology

A first of its kind air shower telescope hunting for tau neutrinos. About a month ago our telescope saw first light looking for air shower produced by neutrinos originating from Blazers and AGN. I will be discussing deployment, how we operate the telescope remotely in Utah from Georgia, and what is to come for the Demonstrator.

4:15 p.m. Concluding Remarks

Alexandra Yep, Agnes Scott College

Posters

Georgia Regional Astronomy Meeting 2023

Are the derived GRB spectral parameters consistent across different telescopes?

Dhruv Bal, Clemson University

GRBs are highly energetic objects, which prove useful probes for a multitude of studies. Thus, it is crucial that the spectral characteristics derived from observations are as accurate as possible. We specifically look at the case of GRB 190613B observed by Swift-BAT, Fermi-GBM, and AstroSat-CZTI. Since it is the same event observed by three different instruments, we expect the properties of the GRB, such as photon spectrum, fluence, and duration (T90) derived from the data of the instruments to be comparable within errors. We initially notice that the properties concluded from GBM and CZTI data are significantly different from the BAT-reported values. However, upon considering a modified T90 after discussions with the BAT team, we find the properties of GRB 190613B derived from all three instruments to agree within errors. We conclude that the careful analysis of the properties with multiple observations of the same GRB greatly aids in determining its true properties that are useful for further studies.

Searching for Binary Pulsar Candidates in Gaia DR3

Carey Felius, Agnes Scott College

Rapidly rotating neutron stars called pulsars have become an invaluable part of the search for low frequency gravitational waves using pulsar timing arrays, such as the North American Nanohertz Observatory for Gravitational Waves (NANOGrav). Here we utilize the Gaia Data Release 3 to search for potential binary pulsars that might be detectable with the Green Bank Telescope. Using the data provided in Gaia DR3's Binary Sources catalog, we used radial velocity measurements to constrain companion star masses, and created a list of sources with plausible neutron star companions. For each of the 12 candidate sources, upper flux density limits were collected using VLASS and NVSS. We have identified a sample of candidate NS binaries and have proposed to use the Green Bank Telescope to search for radio pulsations from them, with the ultimate goal of identifying millisecond-pulsars to be added to the NANOGrav roster.

Prospects for multimessenger observations of massive black hole binaries with LISA and electromagnetic observatories

Kate Futrowsky, Georgia Institute of Technology

The Laser Interferometer Space Antenna (LISA) is expected to observe the gravitational radiation emitted from the inspiral and merger of massive black hole binaries (MBHBs). Although detection of the gravitational wave (GW) signals alone from such events will lead to significant scientific advancements, multimessenger observations with LISA and electromagnetic (EM) observatories will enable advances across astrophysics which are impossible with only GW or EM observations. Using the Illustris-TNG cosmological simulations, we investigate the number and characteristics of galaxies within the LISA error volume as it shrinks over time as the MBHB approaches merger. We also investigate the feasibility of simultaneous EM observations of MBHBs with an array of existing and future observatories in the IR/optical (Roman, JWST, Vera Rubin LSST, etc) and X-rays (STROBE-X, Athena, etc).

Investigating Performance Trends of Simulated Real-time Solar Flare Predictions: The Impacts of Training Windows, Data Volumes, and the Solar Cycle

Griffin Goodwin, Georgia State University

Solar flares pose a significant threat to satellites, power grids, and the safety of astronauts. Therefore, it is crucial that we develop reliable models capable of accurately predicting the occurrence of such events in real-time. To address this, we explore the behavior of machine learning-based flare forecasting models deployed in simulated operational environments. Using GSU's SWAN-SF benchmark dataset, we examine the impacts of training methodology and the solar X-ray background flux on decision tree, support vector machine, and multilayer perceptron performance. We implement our classifiers using three novel training windows we label as stationary, rolling, and expanding. For each window, a number of features and temporal sizes were tested. We find that when utilizing a 20-month training window, skill scores are comparable regardless of the window type, feature count, and classifier selected. Furthermore, reducing the window size only marginally decreases performance. This implies that a single classifier can be trained and deployed successfully throughout the solar cycle, without the need for retraining. Finally, a positive correlation was found to exist between the solar X-ray background flux and the observed flare-quiet false positive rate. This suggests that the solar cycle phase has a considerable influence on forecasting.

Imaging the Coolest Rapid Rotators to Constrain 2D Convection

Colin Kane, Georgia State University

The radiative envelop of stars hotter than mid-F spectral type (~1.3 $M_\odot$), does not enable magnetic braking, the phenomenon that has slowed the rotation of the Sun and most low mass stars. We are investigating rapidly rotating stars right at this radiative / convective transition, a sample of stars that we call the coolest rapid rotators. For these stars the rapid rotation is expected to distort the shape and extent of the convective zone. Popular 1D prescriptions for convection are likely inappropriate for these stars, while new 2D and 3D prescriptions are poorly constrained by observations. To begin correcting this, we have identified 3 stars (ups UMa, h UMa and ksi Gem) as the nearest, cool rapid rotators. Their close proximity (< 35pc) and large angular sizes (>1”) will enable GSU's CHARA Array to measure directly their oblate shapes and gravity darkened profiles. These surface measurements, ideally conducted at multiple wavelengths, will provide valuable constraints on new convection models being developed specifically for oblate stars with convection.

Can Gamma-ray Bursts (GRBs) explain the missing flux of the Extragalactic Gamma-ray Background (EGB)?

Nikita Khatiya, Clemson University

Similar to the relic Cosmic Microwave Background (CMB), the Extragalactic Gamma-Ray Background (EGB) is an important and open question being extensively investigated. It has been shown that Blazars make up more than half of the EGB at higher energies (above 100 MeV) but do not contribute as much in the lower energy ranges. Recent studies indicate that other sources such as star-forming galaxies, quasar outflows, radio galaxies, and supernovae contribute to the EGB in the MeV range, falling off at higher energies. While some report that most of the EGB background in the MeV can be explained by the production of radioactive elements in supernovae, they cannot explain all of the EGB in this range. We explore the possibility of GRB contribution to the EGB by assuming a common spectrum that can explain most observed GRBs. Combining this with recent Star formation rate (SFR) models and assuming a ΛCDM cosmology, we expect to find that GRBs contribute a non-negligible amount to the EGB below 100 MeV. Future missions like COSI and MAMBO will greatly aid in constraining this contribution.

SNRs: The Stellar Graveyard

Samuel Kimball, Kayleen Linge, & Rosa Williams, Columbus State University

Supernova Remnants (SNRs) are gaseous clouds left behind after the explosion of a massive star or a white dwarf in a binary star system. These events create most of the naturally occurring elements heavier than carbon, and form cavities of hot gas in the surrounding interstellar medium. A neighboring satellite galaxy, the Large Magellanic Cloud (LMC), provides a broad sample of SNRs at a common distance, allowing differences in observations to roughly correspond to differences in physical properties. We use a new optical survey from Cerro Tololo Inter-American Observatory's 4m Mount Blanco Telescope, with the Dark Energy Camera, in the [SII] and Hα emission lines, to examine the LMC for SNRs. We use the astronomical imaging application SAOImageDS9 to compare the two wavelengths and look for enhanced [SII]/Hα ratios which may indicate associated shock conditions. In this work, we search for optical counterparts to SNR candidates found in radio (Yew et al. 2020) or X-ray (Maggi et al. 2016) that appear as filaments. Such counterparts will strengthen the case that a proposed candidate is indeed a SNR, extending our catalog of LMC SNRs to larger and fainter objects than previously identified and furthering our understanding of late-stage SNR evolution.

Photometric Determination of the Distance to the RR Lyrae Star YZ Capricorni

Jamie Lester, Oglethorpe University

The RR Lyrae YZ Cap was observed using photometric methods to determine its pulsation period and distance. Light curves in the Bessell B and V and SDSS i' and z' filters were used to determine the period, which was found to be 0.274 ± 0.003 day. The distances calculated using a luminosity-metallicity (V filter) and period-luminosity-metallicity relationship (i' filter and z' filter) were: V: 1107 ± 52 pc, i': 1191 ± 126 pc, and z': 1092 ± 128 pc. These are in agreement with the distance measurement from the second Gaia data release, 1144 ± 90 pc. This demonstrates the potential to use ground-based observations in the visible and near-infrared to determine the distance to RR Lyrae variable stars.

Determination of Black Hole Candidacy

Elizabeth Mone, Georgia Institute of Technology

In recent years, there have been many observations of supermassive quasars illuminating the cores of early universe black holes. Many seeding mechanisms for such supermassive black holes have been proposed, and as of yet the direct collapse black hole (DCBH) formation seems the most likely for producing the size and mass of what we observe in the early universe. However, there is not currently a framework for the detection of halos likely to form a DCBH. This poster and the research presented in it aims to understand the physical quantities and environments that contribute to the formation of a black hole through direct collapse. Using current physics-rich simulations and a selection process based on prior works in this field we analyze halos selected for DCBH candidacy and use statistical analysis to understand and compare the halo properties. In future, we plan to use this research and machine learning methods to formulate such a framework that will determine if a halo is a candidate for direct collapse for application in simulation and extension to real world data.

Using Galfit to Develop 2D Models of Lenticular Galaxies

Kesha Patel, Emory University

To improve fits of the luminosity function for a set of lenticular galaxies, we utilize the software, Galfit, to fit and map the light distributions of Hubble images into a 2D computational model. Through this process, we develop PSF distributions and a parameter file to input into Galfit, to eventually obtain the output of the model and residual image, which measures how well the model fares in comparison to the original image. With an improved model, we are better able to identify structural components of these galaxies, and more tightly constrain measurements of bulge effective radius. In turn, this will allow us to better constrain the stellar dynamics within different structural components of the galaxy, to give a better understanding of the relationship between these dynamics and the mass of the central supermassive black holes.

Dwarf Planet Ceres' Contribution to Seeding Life Across Our Solar System

Jacob Tutterow, Georgia State Univeristy

The question of whether other bodies in our solar system could support life is one of the major unanswered problems in astrophysics today. Using REBOUND, an N-Body integrator, we explore how the dwarf planet Ceres could potentially seed other objects with life – i.e. panspermia, the theory that explores how life or prebiotic material can naturally be exchanged among astronomical bodies. Our results show that material from Ceres can traverse the entire solar system, with some particles being captured by other planets or leave the solar system entirely.

Characterizing the Metallicity Dependence of Wind Speeds for Wolf-Rayet Stars

Mateo Valera, University of North Georgia

Wolf-Rayet (WR) stars are important for understanding the evolution of massive stars. A major component of this evolutionary significance is their intense wind, which leads to considerable mass loss. Models indicate that the metallicity of WRs affect the strength of their terminal winds. Previous empirical data comparing WR stars in the Large and Small Magellanic Clouds and the Milky Way indicated a relationship between the metallicity and wind strengths of WR stars. However, the analysis assigned the average metallicity of their respective galaxies to all WR stars, ignoring potential differences between stars. Furthermore, precise parallaxes from Gaia produce different mass-loss and luminosity measurements than those previously used. We present a project working toward determining the metallicity and wind strengths of individual WR stars using measurements from Gaia DR3 and ground-based data. A count of 18 WR stars along with comoving F, G, and K type stars will be analyzed using optical, high-resolution, and ground-based spectroscopy to measure the metallicities and terminal wind velocities of the WR stars. This analysis will lead to a better understanding of the causes of the formation of such intense winds.

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