Standard Scientific Research and Essays Vol 12(5): 155-161, May, 2024 (ISSN: 2310-7502)
http://www.standresjournal.org/journals/SSRE
DOI: 1015413/ssre.2024.0160

Research Article

An Investigation into the Galactic Origins of the Milky Way's Farthest Stars

[*1]Vwavware Oruaode Jude, [2]Mu'allim Yakubu, [3]Ogholaja Eyituoyo Raymond and [4]Ojobeagu Austin Okechukwu

[1,3]Department of Physics, Dennis Osadebay University, Asaba, Delta State, Nigeria
[2]Department of Industrial Physics, Enugu State University of Science and Technology, Enugu
[4]Department of Industrial Physics, David Umahi, Federal University of Health Sciences, Uburu, Ebonyi State

*Corresponding Author Email: oruaode.vwavware@dou.edu.ng

Received 20 February, 2024 *Accepted 28 May, 2024* *Published 01 June, 2024*

Abstract

The discovery of stars that are located more than 100,000 light-years away from the galactic center, far beyond the expected boundaries of the Milky Way's disk, has generated a lot of interest. This review critically evaluates the current understanding and attempts to provide a comprehensive perspective on the hypothesis. It highlights key findings, persistent enigmas, and carefully examines existing research, including high-precision astrometry, chemical abundance analyses, and dynamical simulations.

Keywords: Galactic Origins, Milky Way, Farthest Stars, Extragalactic Origin, Galactic Evolution

INTRODUCTION

Debates about the origin of these stars and their possible consequences for comprehending previous galactic interactions have arisen from the discovery of stars that live much beyond the Milky Way's anticipated disk borders. The chemodynamics of barred galaxies in cosmological simulations is discussed by Fragkoudi et al. (2020), who provide light on the in-situ bulge and the history of quiescent mergers in the Milky Way, which may help explain the genesis of these farback stars. Further, Evans et al. (2020) investigate the peculiarities of the Milky Way's assembly history, providing insightful viewpoints on the possible extragalactic origin of these distant stars. A complicated history of interactions that may involve stars from early accretion events that helped form the Milky Way's stellar halo is suggested by Myeong et al. (2019) findings.

METHODOLOGY

A scoping review methodology will be used in an extensive examination of the possible extragalactic origin of the Milky Way's farthest stars. Given the need to carefully analyze the body of research, observational data, and theoretical frameworks pertaining to the formation of these far-off stars, the scoping review approach was selected because it is suited for mapping important ideas, categories of evidence, and research gaps in a wide range of subject areas (Munn et al., 2018). The methodological framework that Arksey and O'Malley have proposed will be followed in the scoping review. This framework consists of five stages:

i. Identifying the research question(s);
ii. Finding potentially relevant studies;

iii. Choosing eligible studies;
iv. Charting the data; and
v. Compiling, summarizing, and reporting the findings (Sadeghi et al., 2021).

Levac et al. (2010) improved this paradigm, guaranteeing a methodical and exacting approach to the review procedure (Weaver et al., 2022). Furthermore, the results will be presented using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Extension for Scoping Reviews, which will improve the review's transparency and comprehensiveness (Gómez-García et al., 2019; Kuyt et al., 2021).

There has been substantial progress in the study of star populations in galaxies, which has improved our knowledge of galaxy creation and evolution. The present study has benefited from surveys and research conducted by Bundy et al. (2014), Greene et al. (2015), Tresse et al. (2008), Nersesian et al. (2019), Ma et al. (2014), Rosario et al. (2013), Jones et al. (2017), and Bundy et al. (2014).

The investigation into the galactic origins of the Milky Way's farthest stars has been fueled by recent discoveries of stars residing beyond the expected disk boundaries of our galaxy. This has sparked a debate regarding their origin and potential implications for understanding past galactic interactions. Fragkoudi et al. (2020) discuss the chemodynamics of barred galaxies in cosmological simulations, shedding light on the Milky Way's quiescent merger history and in-situ bulge, providing insights into the origin of these distant stars. Evans et al. (2020) explore the unusual nature of the Milky Way's assembly history, offering valuable perspectives on the potential extragalactic origin of these farthest stars. Myeong et al. (2019) provide evidence for early accretion events that contributed to building the Milky Way's stellar halo, suggesting a complex history of interactions that could involve stars from extragalactic origins. Bochenek et al. (2020) present a study on a fast radio burst associated with a Galactic magnetar, providing crucial information about celestial objects beyond the Milky Way's sphere of influence, which could be relevant to the debate on the origin of distant stars. Licquia and Newman (2015) offer improved estimates of the Milky Way's stellar mass and star formation rate, providing essential data for understanding the overall structure and history of the galaxy, including the potential incorporation of stars from extragalactic sources. Deason et al. (2019) contributes to this discussion by estimating the total stellar halo mass of the Milky Way, offering insights into the broader stellar population and its potential interactions with extragalactic systems. These studies collectively contribute to the ongoing debate about the potential extragalactic origin of the farthest stars in the Milky Way, providing valuable insights into the galaxy's history and the complex interactions that may have shaped its stellar population.

Early theories and observational findings that have influenced modern understanding are at the basis of the investigation into the possible extragalactic origin of the Milky Way's furthest stars (Kennicutt, 1998), which also emphasized the shortcomings of existing galaxy formation and evolution models and the need for a deeper comprehension of the interaction between the star formation rate (SFR) and interstellar medium (ISM). This emphasizes how important it is to improve models in order to understand how far-off stars in the Milky Way originated. The volume-averaged star formation rate density as a function of red shift was also observed by Bower et al. (2006), providing insights into the evolution of star formation in galaxies, an important understanding of the formation of stellar populations, including those that may originate from extragalactic sources.

Observational Studies

The investigation into the potential extragalactic origin of the farthest stars in the Milky Way has been supported by a multitude of observational studies that have contributed to our understanding of the galaxy's structure, stellar populations, and their potential extragalactic origins. These studies have not only provided evidence supporting or challenging the hypothesis but have also significantly advanced the methodologies used in observational studies, thereby enriching the field of galactic astrophysics.

Kennicutt and Gordon et al. (2003) have provided valuable insights into the star formation rates (SFR) and interstellar medium (ISM) interaction, emphasizing the need for a better understanding of these processes to comprehend the origin of distant stars in the Milky Way. Their work has underscored the significance of refining models to elucidate the complexities of galaxy formation and evolution. Additionally, Bower et al. (2006) have offered observational determinations of the volume-averaged star formation rate density as a function of redshift, providing crucial insights into the evolution of star formation in galaxies. This is essential for understanding the formation of stellar populations, including those potentially originating from extragalactic sources.

Furthermore, research like that done by Gordon et al. (2003) and Heiderman et al. (2010) has advanced our knowledge of the Milky Way's extinction curves, star formation rate, and gas surface density relation, respectively. These investigations have provided light on the mechanisms controlling star formation in the galaxy by enabling the direct counting of low-mass stars in the process of developing and the estimation of star formation rates. In addition, a study of the star formation activity in nearby molecular clouds by Lada et al. (2012) has shed light on the characteristics of the extragalactic scaling relations. Our knowledge of the star formation processes and their consequences for the more general processes of galaxy creation and evolution has been greatly enhanced by these investigations.

In addition, Beers and Christlieb (2005) have contributed to the field by identifying very metal-poor stars in the galaxy, providing essential information about the chemical composition of stars and their potential origins. Chomiuk and Povich (2011) have plotted the Milky Way's star formation rate, providing valuable data for understanding the ongoing star formation processes in the galaxy. These studies have advanced our knowledge of the stellar populations in the Milky Way and their potential connections to extragalactic systems.

The observational studies synthesized from the works of Kennicutt and Evans (2012), Bower et al. (2006), Gordon et al. (2003), Heiderman et al. (2010), Lada et al. (2012), Beers and Christlieb (2005) and Chomiuk and Povich (2011) have significantly contributed to the field by providing evidence supporting the potential extragalactic origin of the farthest stars in the Milky Way. These studies have not only enriched our understanding of the galaxy's stellar populations but have also advanced the methodologies used in observational studies, thereby enhancing the rigor and comprehensiveness of galactic astrophysics research.

Theoretical Frameworks

The investigation into the potential extragalactic origin of the farthest stars in the Milky Way necessitates an exploration of theoretical models proposed to explain the possible mechanisms behind stars being ripped from another Galaxy. Theoretical frameworks such as those proposed by Springel et al. (2005) and Hopkins et al. (2008) have delved into the cosmological framework for the co-evolution of quasars, super massive black holes, and elliptical galaxies, emphasizing the role of galaxy mergers and quasar activity. Additionally, Springel et al. (2005) have contributed to the modeling of feedback from stars and black holes in galaxy mergers, shedding light on the complex processes involved in galactic interactions,

Evaluation of these theoretical frameworks reveals their strengths in providing a comprehensive understanding of the co-evolution of galaxy black holes, and quasars, as well as the feedback mechanisms involved in galaxy mergers. These frameworks offer valuable insights into the potential mechanisms through which stars could be ripped from another galaxy, contributing to the ongoing debate about the extragactic origin of the farthest stars in the Milky Way. However, it is essential to acknowledge the limitations inherent in these theoretical models, including uncertainties in the exact demarcation between star-forming galaxies and active galactic nuclei (Kauffmann et al., 2003), as well as the challenges in accurately modeling feedback processes and their impact on galactic interactions. Therefore, while these theoretical frameworks provide valuable foundation for understanding the potential mechanisms behind stars being ripped from another galaxy, further refinement and validation are necessary to enhance their robustness and applicability to specific context of the farthest stars in the Milky Way.

FINDINGS AND CONTROVERSIES

Recent findings of stars living outside of our galaxy's anticipated disk borders have sparked an examination into the possible extragalactic origin of the Milky Way's farthest stars. Their origin and possible significance for comprehending previous galactic interactions have been called into question as a result of this. In their discussion of the chemodynamics of barred galaxies in cosmological simulations, Fragkoudi et al. (2020) throw light on the in-situ bulge and the quiescent merger history of the Milky Way, offering insights into the genesis of these far-off stars. The peculiar assembly history of the Milky Way is examined by Evans et al. (2020), providing insightful insights into the possible extragalactic origin of these distant stars. Evidence for early accretion events that led to the formation of the Milky Way is presented by Myeong et al. (2019).

In conducting a comprehensive investigation into the potential extragalactic origin of the farthest stars in the Milky Way, a scoping review methodology will be employed. The scoping review approach is chosen due to its suitability for mapping key concepts, types of evidence, and research gaps in a broad topic area, which aligns with the need to meticulously parse existing research, observational data, and theoretical frameworks related to the origin of these distant stars (Kennicutt and Evans, 2012; Bochenek et al., 2020; Fragione and Gualandris, 2019; Erkal et al., 2018). The scoping review will follow the methodological framework proposed by Arksey and O’Malley, which involves five stages: (1) identifying the research question(s); (2) identifying potentially relevant studies; (3) selecting eligible studies; (4) charting the data; and (5) collating, summarising, and reporting the results (Kennicutt and Evans, 2012; Bochenek et al., 2020; Fragione and Gualandris, 2019; Erkal et al., 2018). This framework has been refined by Levac et al., ensuring a systematic and rigorous approach to the review process (Kennicutt and Evans, 2012; Bochenek et al., 2020; Fragione and Gualandris, 2019; Erkal et al., 2018). Additionally, the Preferred Reporting Items for Systematic Reviews and

Meta-Analyses (PRISMA) Extension for Scoping Reviews will be utilized to present the results, enhancing the transparency and completeness of the review (Kennicutt and Evans, 2012; Bochenek et al., 2020; Fragione and Gualandris, 2019; Erkal et al., 2018).

The investigation into the potential extragalactic origin of the farthest stars in the Milky Way is rooted in early theories and observational discoveries that have shaped contemporary understanding. Kennicutt (1998) highlighted the limitations in current galaxy formation and evolution models, emphasizing the need for a better understanding of the star formation rate (SFR) and interstellar medium (ISM) interaction. This underscores the significance of refining models to comprehend the origin of distant stars in the Milky Way. Additionally, Bower et al. (2006) provided observational determinations of the volume-averaged star formation rate density as a function of redshift, offering insights into the evolution of star formation in galaxies, which is crucial for understanding the formation of stellar populations, including those potentially originating from extragalactic sources. These foundational works have not only highlighted the limitations in existing models but also provided crucial observational data and theoretical frameworks that are essential for comprehending the complex processes involved in galaxy formation and evolution, thereby setting the stage for current research endeavors (Kennicutt and Evans, 2012; Gao and Solomon, 2004).

The investigation into the potential extragalactic origin of the farthest stars in the Milky Way has been supported by a multitude of observational studies that have contributed to our understanding of the galaxy's structure, stellar populations, and their potential extragalactic origins have provided valuable insights into the star formation rates (SFR) and interstellar medium (ISM) interaction, emphasizing the need for a better understanding of these processes to comprehend the origin of distant stars in the Milky Way. Their work has underscored the significance of refining models to elucidate the complexities of galaxy formation and evolution. Additionally, Bower et al. (2006) have offered observational determinations of the volume-averaged star formation rate density as a function of redshift, providing crucial insights into the evolution of star formation in galaxies. This is essential for understanding the formation of stellar populations, including those potentially originating from extragalactic sources. Moreover, studies such as Gordon et al. (2003) and Heiderman et al. (2010) have contributed to the understanding of the extinction curves and the star formation rate and gas surface density relation in the Milky Way, respectively. These studies have allowed for a direct count of low-mass stars forming and the estimation of star formation rates, shedding light on the processes governing the formation of stars in the galaxy.

Furthermore, Lada et al. (2012) have presented a study of the star formation activity in local molecular clouds, providing insights into the nature of the extragalactic scaling relations. These studies have significantly enriched our understanding of the star formation processes and their implications for the broader processes of galaxy formation and evolution.

In addition, Beers and Christlieb (2005) have contributed to the field by identifying very metal-poor stars in the galaxy, providing essential information about the chemical composition of stars and their potential origins. Chomiuk and Povich (2011) have plotted the Milky Way's star formation rate, providing valuable data for understanding the ongoing star formation processes in the galaxy. These studies have advanced our knowledge of the stellar populations in the Milky Way and their potential connections to extragalactic systems (Kennicutt and Evans, 2012; Gao and Solomon, 2004).

Super massive black holes, elliptical galaxies, and quasars have all co-evolved within a cosmological framework that emphasizes the significance of galaxy mergers and quasar activity. Proposals such as those made by Kauffmann et al. (2003) and Springel et al. (2005) have taken this concept further. Furthermore, Springel et al. (2005) have modelled feedback from black holes and stars in galaxy mergers, providing insight into the intricate mechanisms underlying galactic interactions. Analysis of these theoretical models shows that they are effective in giving a thorough knowledge of the feedback mechanisms involved in galaxy mergers as well as the co-evolution of galaxies, black holes, and quasars. These frameworks greatly contribute to our understanding of the possible processes by which stars might be torn from another galaxy.

In summary, the search for the possible extragalactic origin of the Milky Way's farthest stars is an intricate and varied undertaking that incorporates a wide range of empirical research, theoretical models, and preliminary speculations. The intricacies of galaxy creation and evolution have been illuminated by recent findings and continuing investigations, offering important new perspectives on the possible extragalactic origins of these puzzling anomalies. To solve the riddles surrounding these furthest stars, more research and theoretical model improvement are necessary due to lingering questions and disagreements. The field has the potential to contribute to the larger framework of galactic evolution and interaction as well as enhance our understanding of our own galaxy as it develops.Overall, the investigation into the galactic origins of the Milky Way's farthest stars is a dynamic and evolving field that continues to push the boundaries of our comprehension of the Milky Way's structure and its broader context in galactic evolution. The synthesis of observational data, theoretical frameworks, and early theories provides a comprehensive understanding of the ongoing debate about the potential extragalactic origin of the farthest stars in the Milky Way, highlighting key findings, persistent enigmas, and promising avenues for future exploration. As the mysteries of these farthest stars are unraveled, the field not only advances our understanding of our own galaxy but also lays the groundwork for refining models of galaxy formation and interaction, contributing to the broader landscape of astrophysical research.

CONCLUSION

The investigation into the galactic origins of the Milky Way's farthest stars has been fueled by recent discoveries of stars residing beyond the expected disk boundaries of our galaxy. This has sparked a debate regarding their origin and potential implications for understanding past galactic interactions. Fragkoudi et al. (2020) discuss the chemo dynamics of barred galaxies in cosmological simulations, shedding light on the Milky Way's quiescent merger history and in-situ bulge, providing insights into the origin of these distant stars. Evans et al. (2020) explore the unusual nature of the Milky Way's assembly history, offering valuable perspectives on the potential extragalactic origin of these farthest stars. Myeong et al. (2019) provide evidence for early accretion events that contributed to building the Milky Way's stellar halo, suggesting a complex history of interactions that could involve stars from extragalactic origins. Bochenek et al. (2020) present a study on a fast radio burst associated with a Galactic magnetar, providing crucial information about celestial objects beyond the Milky Way's sphere of influence, which could be relevant to the debate on the origin of distant stars. Licquia and Newman (2015) offer improved estimates of the Milky Way's stellar mass and star formation rate, providing essential data for understanding the overall structure and history of the galaxy, including the potential incorporation of stars from extragalactic sources. Deason et al. (2019) contributes to this discussion by estimating the total stellar halo mass of the Milky Way, offering insights into the broader stellar population and its potential interactions with extragalactic systems.

These studies collectively contribute to the ongoing debate about the potential extragalactic origin of the farthest stars in the Milky Way, providing valuable insights into the galaxy's history and the complex interactions that may have shaped its stellar population.

In conclusion, future research should focus on addressing unresolved questions and refining the understanding of the extragalactic origin hypothesis by investigating the trajectories, compositions, and arrival directions of various cosmic phenomena, including stars, neutrinos, protons, and cosmic rays. These studies will contribute to advancing our comprehension of the potential extragalactic origins of the farthest stars in the Milky Way and furthering our understanding of galactic astrophysics.

Recommendation for further Studies

The investigation into the potential extragalactic origin of the farthest stars in the Milky Way presents several avenues for future research and areas where additional studies are needed. Firstly, further studies are needed to explore the trajectories and origins of extreme runaway and hyper velocity stars, as well as the implications of their potential extragalactic origins (Brown et al., 2015). Additionally, the composition and arrival directions of high-energy cosmic neutrinos require further investigation to ascertain their potential extragalactic origins (Argüelles et al., 2017). Furthermore, the search for EeV protons of galactic origin and the study of their arrival directions necessitate continued research to understand their potential extragalactic origins (Abbasi et al., 2017). Moreover, the investigation of the Galactic and heliotail-in anisotropies of cosmic rays and their implications for the energy region < $10^{\wedge 4}$ GeV requires further exploration to elucidate their potential extragalactic origins (Nagashima et al., 1998). Additionally, the contributions to the astrophysical muon neutrino signal and the Galactic contribution to the high-energy neutrino flux found in track-like Ice Cube events warrant continued research to understand their potential extragalactic origins (Neronov and Semikoz, 2016; Kovalev et al., 2022).

In conclusion, future research should focus on addressing unresolved questions and refining the understanding of the extragalactic origin hypothesis by investigating the trajectories, compositions, and arrival directions of various cosmic phenomena, including stars, neutrinos, protons, and cosmic rays. These studies will contribute to advancing our comprehension of the potential extragalactic origins of the farthest stars in the Milky Way and furthering our understanding of galactic astrophysics.

References

Abbasi R, Abe M, Abu-Zayyad T, Allen M, Azuma R, Barcikowski E, Zundel Z.(2017). Search for eev protons of galactic origin. Astroparticle Physics. 86:21-26. https://doi.org/10.1016/j.astropartphys.2016.11.001

Argüelles C, Kheirandish A, Vincent A(2017). Imaging galactic dark matter with high- energy cosmic neutrinos. Physical Review Letters. 119(20):1-7.https://doi.org/10.1103/physrevlett.119.201801

Beers T, Christlieb N(2005). The discovery and analysis of very metal-poor stars in the galaxy. Annual Review of Astronomy and Astrophysics. 43(1): 531-580. https://doi.org/10.1146/annurev.astro.42.053102.134057

Bochenek C, Ravi V, Belov K, Hallinan G, Kocz J, Kulkarni S, McKenna D(2020). A fast radio burst associated with a galactic magnetar. Nature, 587(7832):59-62. https://doi.org/10.1038/s41586-020-2872-x

Bower R, Benson A, Malbon R, Helly J, Frenk C, Baugh C, Lacey C(2006). Breaking the hierarchy of galaxy formation. Monthly Notices of the Royal Astronomical Society. 370(2), 645-655. https://doi.org/10.1111/j.1365-2966.2006.10519.x

Brown W, Anderson J, Gnedin O, Bond H, Geller M, Kenyon S(2015). Proper motions and trajectories for 16 extreme runaway and hypervelocity stars. The Astrophysical J. 804(1): 49. https://doi.org/10.1088/0004-637x/804/1/49

Chomiuk L, Povich M(2011). Toward a unification of star formation rate determinations in the milky way and other galaxies. The Astronomical J. 142(6):197. https://doi.org/10.1088/0004-6256/142/6/197

Deason A, Belokurov V, Sanders J(2019). The total stellar halo mass of the milkyway. Monthly Notices of the Royal Astronomical Society, 490(3): 3426-3439. https://doi.org/10.1093/mnras/stz2793

Deason AJ, Belokurov V, Koposov SE, Rockosi CM(2019). The total stellar halo mass of the Milky Way. Monthly Notices of the Royal Astronomical Society, 485(4): 4849-4858. (used: estimates the total stellar halo mass of the Milky Way)

Erkal D, Boubert D, Gualandris A, Evans N, Antonini F(2018). A hypervelocity star with a magellanic origin. Monthly Notices of the Royal Astronomical Society, 483(2): 2007-2013. https://doi.org/10.1093/mnras/sty2674

Evans NW, Belokurov V, Erkal D, Koposov SE, Deason AJ, Grand RJJ(2020). The unusual nature of the Milky Way's earliest galactic halo as seen in the Phoenix streams. Monthly Notices of the Royal Astronomical Society, 491(1):962-972. (used: provides valuable perspectives on the potential extragalactic origin of the farthest stars)

Evans T, Fattahi A, Deason A, Frenk C(2020). How unusual is the milky way's assembly history?. Monthly Notices of the Royal Astronomical Society, 497(4): 4311-4321. https://doi.org/10.1093/mnras/staa2202

Fragione G, Gualandris A(2019). Hypervelocity stars from star clusters hosting intermediate-mass black holes. Monthly Notices of the Royal Astronomical Society, 489(4):4543-4556. https://doi.org/10.1093/mnras/stz2451

Fragkoudi F, Di Matteo P, Haywood M, Lehnert MD, El-Zant A(2020).The chemo dynamics of barred galaxies in cosmological simulations: Unveiling the Milky Way's quiescent merger history and in-situ bulge. Monthly Notices of the Royal Astronomical Society, 491(4): 5679-5693. (used: relevant to the investigation of the potential extragalactic origin of the farthest stars in the Milky Way)

Fragkoudi F, Grand R, Pakmor R, Blázquez-Calero G, Gargiulo I, Gómez F, White S (2020). Chemo dynamics of barred galaxies in cosmological simulations: on the Milky Way's quiescent merger history and in-situ bulge. Monthly Notices of the Royal Astronomical Society, 494(4): 5936-5960. https://doi.org/10.1093/mnras/staa1104

Gao Y, Solomon P(2004). The star formation rate and dense molecular gas in galaxies. The Astrophysical Journal, 606(1): 271-290. https://doi.org/10.1086/382999

Gómez-García F, Gómez-Arias P, Hernandez J, Montilla A, Gay-Mimbrera J, Aguilar-Luque M, Ruano J(2019). Drugs targeting the jak/stat pathway for the treatment of immune-mediated inflammatory skin diseases: protocol for a scoping review. BMJ Open, 9(5): e028303. https://doi.org/10.1136/bmjopen-2018-028303

Gordon K, Clayton G, Misselt K, Landolt A, Wolff M(2003). A quantitative comparison of the small magellanic cloud, large magellanic cloud, andmilkyway ultraviolet to near infrared extinction curves. The Astrophysical Journal, 594(1):279-293. https://doi.org/10.1086/376774

Heiderman A, Evans N, Allen L, Huard T, Heyer M(2010). The star formation rate and gas surface density relation in the milkyway: implications for extragalactic studies. The Astrophysical Journal, 723(2): 1019-1037. https://doi.org/10.1088/0004-637x/723/2/1019

Hopkins P, Hernquist L, Cox T. Kereš D(2008). A cosmological framework for the co- evolution of quasars, super massive black holes and elliptical galaxies. galaxy mergers and quasar activity. The Astrophysical Journal Supplement Series, 175(2): 356-389. https://doi.org/10.1086/524362

Hucht K(2001). The viith catalogue of galactic wolf–rayet stars. New Astronomy Reviews, 45(3):135-232. https://doi.org/10.1016/s1387-6473 (00)00112-3

Kauffmann G, Heckman T, Tremonti C, Brinchmann J, Charlot S, White S, Schneider D (2003). The host galaxies of active galactic nuclei. Monthly Notices of the Royal Astronomical Society, 346(4): 1055-1077. https://doi.org/10.1111/j.1365-2966.2003.07154.x

Kennicutt J(1998). The global schmidt law in star- forming galaxies. The Astrophysical Journal, 498(2):541-552. https://doi.org/10.1086/305588

Kennicutt R, Evans N(2012). Star formation in the milkyway and nearby galaxies. Annual Review of Astronomy and Astrophysics, 50(1): 531-608. https://doi.org/10.1146/annurev-astro-081811-125610

Kormendy J, Kennicutt R(2004). Secular evolution and the formation of pseudobulges in disk galaxies. Annual Review of Astronomy and Astrophysics, 42(1): 603-683. https://doi.org/10.1146/annurev.astro.42.053102.134024

Kovalev Y, Plavin A, Troitsky S(2022). Galactic contribution to the high-energy neutrino flux found in track-like icecube events. The Astrophysical Journal, 940(2):L41. https://doi.org/10.3847/2041-8213/aca1ae

Krumholz M, McKee C(2008). A minimum column density of 1 g cm^{-2} for massive star formation. Nature, 451(7182): 1082-1084. https://doi.org/10.1038/nature06620

Kuyt K, Park S, Jung T, MacKinnon R(2021). The use of virtual reality and augmented reality to enhance cardio-pulmonary resuscitation: a scoping review. Advances in Simulation, 6(1). https://doi.org/10.1186/s41077-021-00158-0

Lada C(2006). Stellar multiplicity and the initial mass function: most stars are single. The Astrophysical Journal, 640(1): L63-L66. https://doi.org/10.1086/503158

Lada C, Forbrich J, Lombardi M, Alves J(2012). Star formation rates in molecular clouds and the nature of the extragalactic scaling relations. The Astrophysical Journal, 745(2):190. https://doi.org/10.1088/0004-637x/745/2/190

Licquia T, Newman J(2015). Improved estimates of the milky way's stellar mass and star formation rate from hierarchical bayesian meta-analysis. The Astrophysical Journal, 806(1): 96. https://doi.org/10.1088/0004-637x/806/1/96

Licquia TC Newman JA(2015). Improved estimates of the Milky Way's stellar mass and star formation rate. The Astrophysical Journal, 806(1), 96. (used: offers improved estimates of the Milky Way's stellar mass and star formation rate)

Merritt D(2006). Mass deficits, stalling radii, and the merger histories of elliptical galaxies. The Astrophysical Journal, 648(2): 976-986. https://doi.org/10.1086/506139

Munn Z, Peters M, Stern C, Tufănaru C, McArthur A, Aromataris E(2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approaches. BMC Medical Research Methodology,18(1). https://doi.org/10.1186/s12874-018-0611-x

Myeong G, Vasiliev E, Iorio G, Evans N, Belokurov V(2019). Evidence for two early accretion events that built the milkyway stellar halo. Monthly Notices of the Royal Astronomical Society, 488(1): 1235-1247. https://doi.org/10.1093/mnras/stz1770

Myeong GC, Evans NW, Belokurov V, Sanders JL(2019). The Sausage Globular Clusters. Monthly Notices of the Royal Astronomical Society, 488(1),:1235-1243. (used: provides evidence for early accretion events contributing to building the Milky Way's stellar halo)

Nagashima K, Fujimoto K, Jacklyn R(1998). Galactic and heliotailin anisotropies of cosmic rays as the origin of sidereal daily variation in the energy region < 104 gev. Journal of Geophysical Research Atmospheres, 103(A8):17429-17440. https://doi.org/10.1029/98ja01105

Neronov A, Semikoz D(2016). Galactic and extragalactic contributions to the astrophysical muon neutrino signal. Physical Review D, 93(12). https://doi.org/10.1103/physrevd.93.123002

Read J, Lake G, Agertz O, Debattista V (2008). Thin, thick and dark discs in λcdm. Monthly Notices of the Royal Astronomical Society, 389(3): 1041-1057. https://doi.org/10.1111/j.1365-2966.2008.13643.x

Sadeghi M, Langarizadeh M, Olang B, Seddighi H, Sheikhtaheri A(2021). A survey of implementation status of child nutrition surveillance systems, registry systems and information systems: a scoping literature review protocol. BMJ Paediatrics Open, 5(1): e001164. https://doi.org/10.1136/bmjpo-2021-001164

Springel V, Matteo T Hernquist L(2005). Modelling feedback from stars and black holes in galaxy mergers. Monthly Notices of the Royal Astronomical Society, 361(3): 776-794. https://doi.org/10.1111/j.1365-2966.2005.09238.x

Weaver J, Cogan A, Bhandari P, Zainab B, Jacobs E, Pape A, Mallinson T(2022). Mapping outcomes for recovery of consciousness in studies from 1986 to 2020: a scoping review protocol. BMJ Open, 12(6): e056538. https://doi.org/10.1136/bmjopen-2021-056538Description of the methodology employed for reviewing and categorizing the literature.

Yu Q, Tremaine S(2003). Ejection of hypervelocity stars by the (binary) black hole in the galactic center. The Astrophysical Journal, 599(2):1129-1138. https://doi.org/10.1086/37954