Conventional structure

- ☐ Title
- ☐ Abstract, (key words),
- ☐ Sections: introduction, data sources/observations and analysis, discussion, conclusion, acknowledgments, references, (appendices).
- ☐ Each section: subsections, paragraphs, sentences, words
  --- structured and layered information

Start with simple sentences, and later … if the presentation flow/logic is smooth, it is easy to string sentences together

… avoid all short-sentences … avoid long paragraphs …
(let the reader breathe.)

Sentence connections

Glasman-Deal 1.2.2

Mind the gap between sentences

- Using an overlapping statement

  One way to ascertain stellar youth is detection of the lithium absorption line. As a result, …

- Using a pronoun (it, then) or a pro-form (this method, these data)

  One of the criteria for stellar membership in a star cluster is, in addition to aggregating in space volume, grouping in kinematics. The combination of proper motion plus distance, i.e., the tangential velocity, therefore renders …

- Using a signaling sentence connector (therefore, however)

The combination of proper motion plus distance, …. However, membership is not as constrained using radial velocity due to possible variations caused by binary orbital motion.

Avoid "since" (=because), "while" (=at the same time); try whereas

- Using a semicolon or a relative clause ("which")

Circumstellar disks disperse in about 10 Myr; the ubiquity of exoplanets implies an efficient planet formation process.

This is the method with which we used to analyzed the time-series data …

The method was found not applicable, which led to modifications …

"who" for a person' "which" for otherwise;
"that" for all, and for specification (any, same, very only …)\

This is the same method that we adopted …

Elsevier: Author guideline

https://www.elsevier.com/connect/author-guidelines-and-submission-process

Writing tips

- Show, don't just tell.
- Use action verbs; go easy on the adjectives.
- Choose active voice.
- Quotes should sound human.
- Avoid clichés.
- Say it simply.
- Define technical terms.
- Eliminate words that do not add meaning.

Draft version May 12, 2021
Typeset using LaTeX default style in AASTeX63

Astronomy journal writing exercise 7 Paraphrasin one astro-ph paper of interest

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Astro-ph paper

The paper of my interest is Fragmentation and kinematics in high-mass star formation: CORE-extension targeting two very young high-mass star-forming regions by Beuther et al. (2021). From this title it is clear to me that this paper is about characterizing the fragmented structures inside some star-forming clouds and analyzing their kinematics. Before reading the abstract, I guess the CORE-extension should be an algorithm to identify cores within the regions, but after going through the paper, I realized that CORE is actually the name of their project, which observes regions harboring high mass protostars with lines and continuum around 1.3mm and 0.3"–0.4" resolution using NOEMA. CORE-extension is the follow-up supplementary project of CORE, which maps targets in earlier evolutionary stage than previous ones.

In this paper, two young high mass star forming regions ISOSS22478 and ISOSS23053 are mapped with NOEMA and IRAM 30-m telescope. The fragmented cores in the region are identified and their gas dynamics is investigated. The first author, Henry Beuther, is a familiar name to me. He works on star forming region and is in Max Planck institute of Astronomy, Germany. In this work, he and his colleagues find 27 cores in these two regions and their mass-size relation can be either $M \propto r^2$, which indicates the cores have constant mean column densities, or $M \propto r^3$, which implies constant mean volume densities, based on different temperature assumptions. The mean nearest-neighbor separation of cores is 17170 AU for ISOSS22478 and 19560 AU for ISOSS23053. These values are consistence with the thermal Jeans length given the diverse physical properties of two clouds. From the analysis of the kinematics of the regions, a dynamic cloud collapse scenario, in which the global parental cloud collapse leads to the formation of filamentary structures and then filaments fragment into cores, is proposed to be the origin of both regions.

Initial 2 paragraphs?

REFERENCES

Beuther, H., Gieser, C., Suri, S., et al. 2021, Fragmentation and kinematics in high-mass star formation: CORE-extension targeting two very young high-mass star-forming regions. https://arxiv.org/abs/2104.02420

DRAFT VERSION MAY 12, 2021
Typeset using LaTeX default style in AASTeX63

Select a Model Paper

PO CHIH HSU

CHOICE A RECENT ASTROPHYSICAL JOURNAL

Paper title: The Thermal Reprocessing of Reflected Radiation in the AGN Accretion Disk (citation of this paper are not available online)

Author: Xiaogu Zhong, and Jiancheng Wang.

Guess of the title: In my opinion, this research is about some process use on the reflected radiation from active galactic nuclei (AGN) accretion disk. The process is thermal reprocessing, which I don't know what it is base on my current knowledge. I guess the "reprocessing" is going to process some thermal radiation or radiation emission, which is reflected from AGN accretion disk.

SHORT ESSAY ABOUT THE PAPER

This research is about to present reflected reprocessing model to study some relationship in the AGN accretion disk. These two author was from Chinese Academy of Sciences and University of Chinese Academy of Sciences at Kunming, and Beijing respectively.

The abstract talks about a model that study the thermal lag-wavelength relationship in the AGN accretion disk. Radiation from the AGN corona was assumed with the lamppost geometry on the axis of the black hole, which will irradiates the accretion disk and its reflection affects temperature. Consider thermal emission that respond to coronal irradiation, lag-wavelength relationship of the disk emission was obtained. Next, the author fit the observed data of four Seyfert galaxies, to test the reflected reprocessing model, and compare it with X-ray spectrum fitting. There have three main result. First, actual geometry of disk corona is more complex than lamppost. Second, Reference band is sensitive to the fitting time lag. Last, intrinsic bolometric luminosity is larger than the observed luminosity.

The first paragraph of introduction talks about the basic knowledge of AGN including different frequency of radiation from accretion disk was cause from different effect, relationship between temperature and disk radius, and lag-wavelength relationship, etc. Radiation emitted from AGN is powered by matter accreting into a super massive black hole at the center of galaxy. The radiation covers broadband spectrum from radio to gamma ray. X-ray and gamma ray usually was caused by hot matter (corona) above the disk by Compton scattering, while UV or optical usually came from cool accretion disk. The geometry and kinematics of corona are not well understand yet. According to the standard disk model, the relation between temperature and disk radius can be express as: $T(r)\ r^{-3/4}$, however, recent study discovered that temperature and radius cannot use that standard model to simply describe. Furthermore, physical origin of the continuum variability are still unclear, several studies show that X-rays leading UV variability. There exist a time lag of variability at different frequencies or wavelength, and are well correlated. There is a model that describe the lag-wavelength relationship, is that a point source of corona above accretion disk can irradiates the disk and reprocess the UV/optical emission, the time lag was cause by the light traveling time. Considering general relativity, light will be band due to strong gravitational force, and the author think that will be a reason to change lag-wavelength relationship.

Second paragraph of introduction talks about what author is going to present in this research, i.e., the model of reflected process to explain the observed thermal lag-wavelength relation. There is a assumption apply in the model: initial photons are emitted from the corona, which are like a lamppost, and irradiate accretion disk. Some photons would be absorbed by the accretion disk and the other will be reflect to the space. Absorbed photons are assumed to heat up the accretion disk rapidly, and emit thermal radiation. The lag-wavelength relationship from the coronal radiation illuminating the disk is calculated.

Draft version May 19, 2021
Typeset using LaTeX default style in AASTeX631

Identification and Brief Description of An Interested Paper

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1. A BRIEF DESCRIPTION OF THE PAPER

The paper is "*Follow-up spectroscopy of comet C/2020 F3 (NEOWISE)*" (Bischoff & Mugrauer, 2021). The authors are Richard Bischof and Markus Mugrauer, both from a German Institute, Astrophysical Institute and University Observatory Jena (Astrophysical Institute and University Observatory of Friedrich Schiller University). The paper was submitted to arXiv e-prints.

Apparently, from the title, we can know that the authors obtained the spectra by monitoring a specific comet: C/2020 F3 (NEOWISE). The observations were accomplished with the spectrograph FLECHAS. The authors analyzed the lines in the spectra and also measured the radial velocity from the NH_2 and sodium emission lines. They compared the results to those calculated with the JPL HORIZON system. The most prominent detection is the sodium lines, which were only detected in early periods of the observations. Sodium lines had been detected in the spectra of several bright comets. However, the real mechanisms of the production of sodium emission are still under a debate.

The format of the citation of an astro-ph paper?
Though it is only still an astro-ph paper, how should I know which journal it is submitted to? I only saw "arXiv e-print" for the corresponding information.
The affiliation was written in German originally. Is that legal? Or it should be written in English as well?

2. A SIMPLE DESCRIPTION FROM THE ABSTRACT

The authors focused on the center of the coma and conducted a series of spectroscopic observations by monitoring the comet C/2020 F3 (NEOWISE) at 5 nights in late July 2020 (July 21,23, 29-31). They identified the NH_2 emission and two oxygen forbidden lines. What's more, they also identified strong sodium emission lines but only in the spectra of the first two days (July 21 and 23). The sodium emission significantly decayed within the time slot and was no longer detected in the last three days. In this study, the authors analyzed the emission lines in the spectra and derived the radial velocity using the lines.

Is "what's more" an informal usage in paper writing?

3. PARAPHRASE OF THE INTRODUCTION IN THE PAPER

The comet C/2020 F3 (NEOWISE) was first captured by the Wide-Field Infrared Survey Exploreron (WISE) on March 23 2020. It is a long-period comet orbiting the Sun with a large inclination of 128.9° (in the meaning of retrograde) and a high eccentricity of 0.999 (near-parabolic). It was reported as the brightest comet in recent decades, observable in northern hemishere.

The authors carried out the observations with the spectrograph FLECHAS at the University Observatory Jena. In the following sections, they would present their observations with data processing, results including the detected variability and derived radial velocity, and things left to discuss, respectively.

The citations are taken off.
In my opinion, the information, especially for the brightness of the comet is not accurate enough. Though they cited

the International Comet Quarterly and brought out some comparisons, it is probably not accurate and couldn't arouse other's interest. Maybe it is because the comet was just discovered last year.

even more interesting? !

REFERENCES

Bischoff, R. & Mugrauer, M. 2021, arXiv:2105.02193

Describing an Interesting Paper

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(Dated: May 10, 2021; UTC: 21:30)

1. JUDGING THE TITLE AND READING THE ABSTRACT

I choose one interesting paper from *astro-ph* published on May 6 2021, which title is *Impact of PREX-II, the revised mass measurements of PSRJ0740+6620, and possible NICER observation on the dense matter equation of state* by Biswas (2021). By reading this title, I have no idea about what PREX-II, PSRJ0740+6620, and the dense matter are, and I do not know what they had revised, either. It might be to revise the technique of measurement, observations, equations, or something else I do not know. After reading the abstract, I can tell that PREX-II is a plan about laboratory experiment on neutron particles. PSRJ0740+6620 is a pulsar, i.e., a neutron star, which mass they wanted to calculate by using the result of PREX-II. The two words on the title, *dense* and *matter*, can not be seen in the abstract. The results they obtained are only about the radius of neutrons and the neutron star, but not the mass. So the better title, in my opinion, for this paper might be *Impact of PREX-II, the revised* ***radius*** *measurement of* ***pulsar****, PSRJ0740+6620, and possible NICER observation on* ***neutron stars*** *equation of state*. Although it is too long to be a title, it is more clear to understand than the original one.

2. BRIEFLY DESCRIBING THE *ABSTRACT* AND *INTRODUCTION* OF THE PAPER

In the abstract, they presented that with the result of the experiment PREX-II about neutron properties and the ~1.5-year observations from NICER, they could constrain the radius of the neutron star, PSRJ0740+6620. To combine the information from NICER and PREX-II, they used the Bayesian statistics. Several empirical parameters were listed, such as neutron skin thickness of ^{208}Pb ($R^{208}_{skin} = 0.02 \pm 0.04$ fm) and the neutron star's luminosity ($L = 69 \pm 16$ MeV) and radius ($R = 12.66^{+0.38}_{-0.47}$ km). They provided 5% accuracy of the neutron star's radius at 90% confidence interval by using the NICER observation, which is very impressive.

In the first paragraph of the *Introduction*, with multiple data set including gravitational wave from LIGO/Virgo, accurate X-ray observation from NICER, and some other radio observations, they could constrain the dense matter equation of state and understand more about the properties of neutron stars, such as radius, mass, tidal deformability, etc. To combine the observations listed above, they used Bayesian statistics based on the hybrid parameterization, which is used to explore the nature of mass-gap object.

The second paragraph of the *Introduction* is about the results obtained from the recent experiments, PREX-II, which reported the value of neutron skin thickness of ^{208}Pb ($R^{208}_{skin} = 0.29 \pm 0.07 fm$). Their aim is to learn more about the neutron star equation of state by combining their model, hybrid parameterization, and the results from PREX-II using the Bayesian statistics.

REFERENCES

Biswas, B. 2021, arXiv e-prints, arXiv:2105.02886.
https://arxiv.org/abs/2105.02886

DRAFT VERSION MAY 21, 2021
Typeset using LATEX RNAAS style in AASTeX63

Abstract Exercise

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The paper that I am interested in is "Investigating Clumpy Galaxies in the Sloan Digital Sky Survey Stripe 82 Using the Galaxy Zoo (Mehta et al. 2021)." It was finished by 10 scientists from USA, UK, France, and Netherlands. The first author, Vihang Mehta, is a postdoctoral researcher at the Minnesota Institute for Astrophysics, and he is under the supervision of the second author, Claudia Scarlata. Their research interest are galaxy formation and evolution. The third author, Lucy Fortson, is also from the Minnesota Institute for Astrophysics. She is known for the leadership of of citizen science projects, such as Galaxy Zoo and Zooniverse.

In the abstract, the authors clearly mention the motivations of this research, the data samples, their results, and the contributions. The clumps in high-redshift star-forming galaxies play a critical role to be related to the morphologies. Most of the former studies about clumps focus on the high-redshift galaxies, and there is few research of galaxy in local universe due to the small sample size. In this study, they presented the statistical results about the properties of clump in local universe ($z < 0.06$). They selected 92 clumpy local galaxies and identified 543 clumps within this sample using Galaxy Zoo. They performed photometry and estimated their stellar population properties. The results of this study are consist with them of the high-redshift except that they did not find the evidence of a gradient in clump ages or masses as a function of their galactocentric distances. They suggested that the results may pose the challenge to the inward migration scenario for clump evolution for the local universe and indicate a longer timescale for clumps to migrate.

In the first paragraph of introduction, the authors mention the importance of galaxy morphology and the difference of morphology between local galaxies and high-redshift galaxies from observation. From the study of galaxy morphology, scientists can have furher understanding of galaxy formation and evolution. The local galaxies are mostly dominated by *spiral* and *elliptical* morphologies; however, the high-redshift galaxies have different kinds of morphologies. The typical star-forming galaxies in local universe tend to have disk-like morphology, but the high-redshift counterparts are more chaotic and have irregular morphology.

In the second paragraph of introduction, the authors focus on introducing the clumps in high-redshift star forming galaxies and exhibit some observational studies. The clumps in galaxies appear brighter and have intense star formation. Thus, the clumps can be seen obviously most from the rest-frame UV image. In the end of this paragraph, the authors give some observational studies about clumps in different wavelength, such as rest-frame UV, rest-frame optical, Hα, Paα, and CO.

REFERENCES

Mehta, V., Scarlata, C., Fortson, L., et al. 2021, The Astrophysical Journal, 912, 49, doi: 10.3847/1538-4357/abed5b

Introduction

The hands of your paper

Chapter 13-14 of Lebrun
Unit 1 of Glasman-Deal

- Introduction is something more difficult to write than the “methodology” or “results/discussion” section.
- It should bring the reader up to speed and reduce the initial knowledge gap. It poses the problem, the proposed solution, and the scope. It answers the questions raised by the title and the abstract.
- The introduction should be written, or at least in a preliminary form, right at the beginning of the writing, or even when the research project starts (when the observing proposal was written). It shows the skill of communication of the writer, in a personal way.

- Much of the readership may be outside of your subject. So many of your readers, sometime even the referee, will require an introduction of your paper.
- Too often an introduction contains (i) a short paragraph to describe the problem, (ii) a paragraph to place the contribution in context with densely packed references, and (iii) a final “table of contents”. Only a few experts in the field --- who are familiar with the material already anyway --- would appreciate this kind of an introduction. What purpose does it serve?

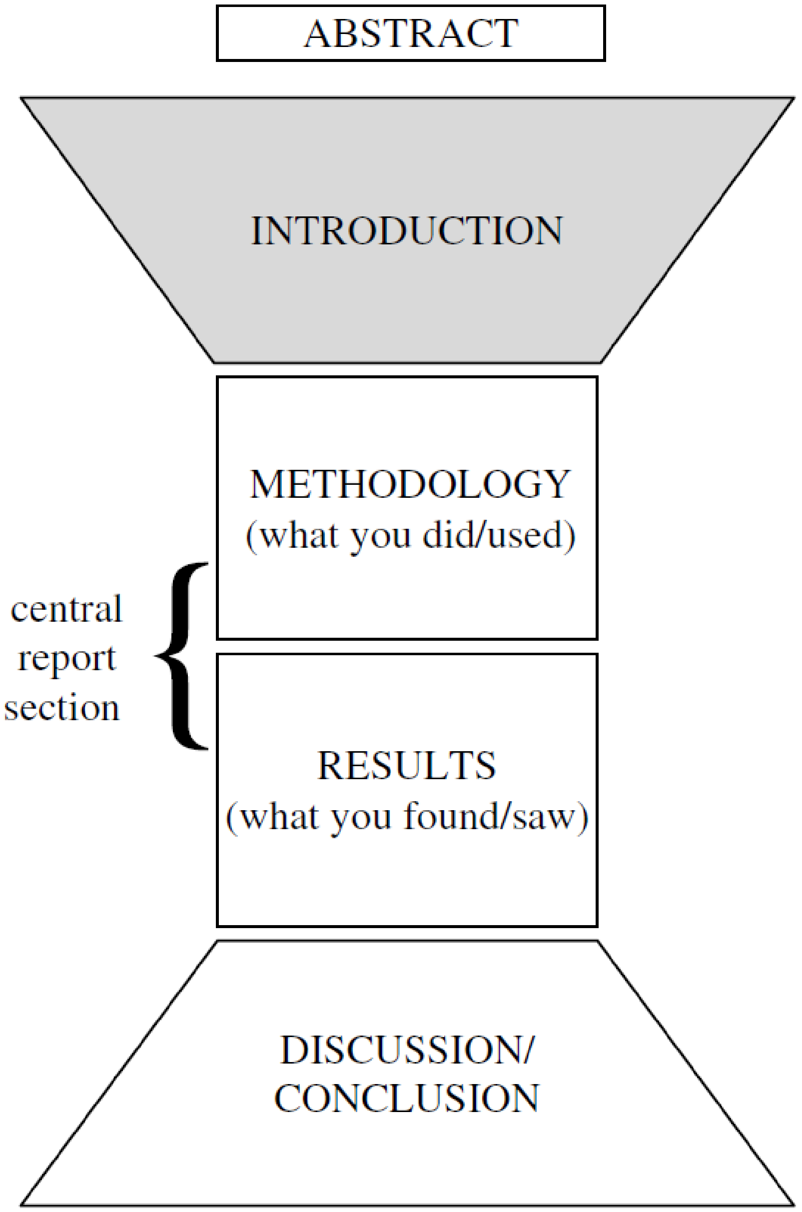

Fig. 1. The shape of a research article or thesis.

Zooming in for Introduction …

- *Big picture/story first* …
- *My approach* …
- *This contribution* …

Zooming out for Discussion/Conclusion …

- Our *results* …
- *The solution to the problem* …
- *Limitations, prospects* ..

Application of a Probabilistic Neural Network in radial velocity curve analysis of the spectroscopic binary stars Schulte 3, HD 37366, HD 195987, HD 101131 and HD 93205

Using measured radial velocity data of five double-lined spectroscopic binary systems Schulte 3, HD 37366, HD 195987, HD 101131 and HD 93205, we find corresponding orbital and spectroscopic elements via a Probabilistic Neural Network (PNN). Our numerical results are in good agreement with those obtained by others using more traditional methods.

Using radial velocity data, we derived orbital elements, via the Probabilistic Neural Network technique, of five double-lined spectroscopic binary systems: Schulte 3, HD37366, HD 195987, HD 101131, and HD 93205 .... Our results are in good agreement ... using traditional methods (!)

Probabilistic Neural Network (PNN) is a new tool to derive the orbital parameters of the spectroscopic binary stars. In this method the time consumed is considerably less than the method of Lehmann-Filhés and even less than the non-linear regression method proposed by Karami & Teimoorinia [4].

In the present paper we use a Probabilistic Neural Network (PNN) to find the optimum match to the four parameters of the V_R curves of the five double-lined spectroscopic binary systems: Schulte 3, HD 37366, HD 195987, HD 101131 and

combined-light photometry is reddened [11]. HD 101131 is a brightest objects in the young open cluster IC 2944. This system is a double-lined spectroscopic binary in an elliptical orbit with a period of P= 9.64659 days. It is a young system (approximately 2 million years old) and The spectral type is O6.5 V((f)) and O8.5 V for the primary and the secondary star , respectively [12]. HD 93205 is an O-type spectroscopic binary and The spectral type is O3V and O8V for the primary and the secondary star, respectively, and the orbital period is P=6.0803 days [13].

This paper is organized as follows. In Sect. 2, we introduce a Probabilistic Neural Network (PNN) to estimate the four parameters of the V_R curve. In Sect. 3, the numerical results are reported, while the conclusions are given in Sect. 4.

THE ASTRONOMICAL JOURNAL VOLUME 99, NUMBER 3 MARCH 1990

A SURVEY FOR CIRCUMSTELLAR DISKS AROUND YOUNG STELLAR OBJECTS

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ABSTRACT

Continuum observations at 1.3 mm of 86 pre-main-sequence stars in the Taurus–Auriga dark clouds show that 42% have detectable emission from small particles. The detected fraction is only slightly smaller for the weak-line and "naked" T Tauri stars than for classical T Tauris, indicating that the former stars often have circumstellar material. In both categories, the column densities of particles are too large to be compatible with spherical distributions of circumstellar matter—the optical extinctions would be too large; the particles are almost certainly in spatially thin, circumstellar disks. Models of the spectral energy distributions from 10 to 1300 μm indicate that for the most part the disks are transparent at 1.3 mm, although the innermost ($\leqslant$1 AU) regions are opaque even at millimeter wavelengths. The aggregate particle masses are between 10^{-5} and 10^{-2} $\mathscr{M}_{\odot}$, implying total disk masses between 0.001 and 1 $\mathscr{M}_{\odot}$. The disk mass does not decrease with increasing stellar age up to at least 10^7 years among the stars detected at 1.3 mm. There is some evidence for temperature evolution, in the sense that older disks are colder and less luminous. There is little correlation between disk mass and Hα equivalent width among the detected stars, suggesting that the Hα line is not by itself indicative of disk mass. Spectral indices for several sources between 1.3 and 2.7 mm suggest that the particle emissivities ϵ are weaker functions of frequency ν than is the usual case of interstellar grains. Particle growth via adhesion in the dense disks might explain this result. The typical disk has an angular momentum comparable to that generally accepted for the early solar nebula, but very little stored energy, almost five orders of magnitude smaller than that of the central star. Our results demonstrate that disks more massive than the minimum mass of the proto-solar system commonly accompany the birth of solar-mass stars and suggest that planetary systems are common in the Galaxy.

I. INTRODUCTION

There is little doubt that the solar system was born from a disk of gas and dust encircling the Sun five billion years ago. The evidence that similar disks surround many young, solar-mass stars in the Galaxy today is compelling, although it is usually circumstantial. Basic quantities such as the disk mass are poorly constrained by available observations, however, making it impossible to ascertain the number of stars that will eventually have planetary systems like our own. If the distribution of mass and energy, the characteristics principally responsible for disk evolution, were known, we could begin to assess whether planetary systems are common or rare and, by comparing planetary evolution around neighboring stars, gain insight into our origins.

Most estimates suggest that approximately half of all young stars have disks. Strom *et al.* (1989; hereafter referred to as SSECS) use the presence of infrared emission in excess of that expected from a stellar photosphere to infer the presence of disks around 60% of the youngest pre-main-sequence stars in their sample. In a similar study, Cohen, Emerson, and Beichman (1989) examined 72 stars in Taurus–Auriga and concluded that about one-third of the stars have appreciable disks. Calculations of emission from circumstellar disks [Lynden-Bell and Pringle 1974; Adams, Lada, and Shu 1987 (hereafter referred to as ALS), 1988; Kenyon and Hartmann 1987; Bertout, Basri, and Bouvier 1988] demonstrate clear infrared signatures accompanying disks similar to the proto-solar nebula; these calculations provide the underpinnings for the observations cited above, but are not the only indicators of disk matter. The disks indirectly affect other radiation, for example, by shadowing the receding portions of stellar mass loss and creating preferentially blueshifted spectral lines (Edwards *et al.* 1987), asymmetric scattering of visual and near-infrared light from the stars (Beckwith *et al.* 1989), anomalously large extinction (Cohen 1983), and large degrees of polarization of the starlight (Bastien 1982; Hodapp 1984; Sato *et al.* 1985). But these effects are less useful for understanding the frequency with which disks occur.

At wavelengths shortward of 100 μm, these disks are usually opaque, making infrared and visual observations insensitive to the mass of the disks. The strengths of the far-infrared emission depends on the disks luminosity and temperature distribution, both strong functions of the energy balance in the disk (cf. Sec. IV*c*). To discuss the likelihood of planet formation, it is desirable to measure the total mass in a disk and its spatial distribution.

At wavelengths shortward of 100 μm, these disks are usually opaque, making infrared and visual observations insensitive to the mass of the disks. The strengths of the far-infrared emission depends on the disks luminosity and temperature distribution, both strong functions of the energy balance in the disk (cf. Sec. IV*c*). To discuss the likelihood of planet formation, it is desirable to measure the total mass in a disk and its spatial distribution.

Thermal emission from small particles entrained in these disks is optically thin at wavelengths of order 1 mm and is proportional to the total particle mass (Beckwith *et al.* 1986; Sargent and Beckwith 1987). Observations of millimeter-wave emission from young stars provide an excellent way to measure disk masses directly, minimizing the uncertainties introduced by energetic activity near the star. With the unprecedented sensitivity and spatial resolution of the new class of large, millimeter-wave telescopes and sensitive bolometer detectors, it is now possible to detect thermal emission from circumstellar disks with total masses only a few times that of Jupiter.

We present here the results of a survey for 1.3 mm radiation toward 86 stars in the Taurus–Auriga dark clouds. The sample contains classical T Tauri stars, stars in T associations identified from proper-motion surveys, and a few weak emission-line stars or naked T Tauri stars from x-ray selected samples. These stars are predominantly solar mass, well above the main sequence, with ages ranging from 10^5 to 10^7 yr. Our sensitivity was sufficient to detect particle masses of $\sim 10^{-4}\ \mathscr{M}_\odot$, corresponding to total masses of 0.01 $\mathscr{M}_\odot$, the minimum mass of the solar nebula at its birth.

Series/Serial comma (Oxford comma, Harvard comma) is the final comma that is placed before a coordinating conjunction ("and" or "or") in a set of three or more terms.

We exercised different periodogram analysis schemes, the classical Fourier transform, Lomb-Scargle algorithm, and minimum phase dispersion …

I invited to the party my two classmates, Trump and Obama.
I invited to the party my two classmates, Trump, and Obama.
(How many did you invite? Who else is your classmate, Biden?)

It is stylish, i.e., optional.

Its use is standard in the USA, but not, e.g., in the UK.

e.g., (exempli gratia; for example=such as)
i.e., (id est; that is=specifically=namely)
cf (conferre; compare=cp=see)

Commonly used Latin abbreviations

e.g., (*exempli gratia*; for example=such as)

i.e., (*id est*; that is=specifically=namely)

cf (*conferr*e; compare=cp=see)

et al. (*et alii*; and others) for people

etc./etc (*et cetera*; and the rest=and so on) for things

erratum/errata (=error)

ibid. (*ibidem*; in the same book/journal)

viz. (*videlicet;* namely=that is to say)

vs. (versus; against)

ca./ca (*circa*; around=approximately)

Some Latin terms

bona fide = with good faith; genuine

The object is proven (to be) a bona fide infant star.

ad hoc = to this

The data should not be taken in an ad hoc way; an ad hoc committee

de factor = of fact = in fact *I am her de factor adviser*. ↔ figurehead

impromptu = spontaneous

The images were acquired impromptu with two telescopes.

in absentia = in the absence *The dissertation can be written in absentia.*

in camera = in chambers = in private

Now the in-camera session of the thesis defense begins…

per se = in itself

It was not the result per se, but the process, that was important

vice versa = the other way around=interchangeable

An introduction should

- ***be clear*** of the objectives/motivations, and of what is new in the paper.
- ***answer key questions***. Identify the question that your title and abstract are supposed to answer. If you cannot phrase your contribution in a question form, you are not ready to write the paper. State the question as soon as possible in your introduction. Why now? Why this? Why this way? Why should the reader care? The readers rely on you to answer these questions.
- ***set the foundation of your credibility***. One should present both sides of an issue, i.e., "intellectual honesty". What are the limitations of your work?

An introduction should

- ***justify your choice of method*** in the introduction to strengthen the credibility.

  Our classification algorithm does not make any assumption on the resolution of the images, nor does it make any assumption on the shape of a galaxy.

- ***give your own definition***; frame your own scope of your contribution.

  An effective classification scheme should have the following desirable features …

An introduction should

- ***be active and personal***. You want to tell a story, your story, not a report. Use “we” or “our”.

  We were curious to see whether we could resolve the discrepancy between these models by using the latest observations.

  Passive voice is acceptable in the rest of your paper. But in introduction, use active voice.

  OK to use a dummy subject.

  This paper presents a set of criteria to select membership of a star cluster against field stars.

  Our results testify that …

An introduction should

- ***be engaging and motivating***. The readers should want to read further. They should appreciate you as a writer, not just as a scientist.

> "*I do not usually read introductions. Most of what's in there is repeated verbatim elsewhere in the paper anyway. They are a waste of time. They always say the same thing: the problem is important, everybody else but the author is doing it wrong, and they usually end up with a boring table of contents. So, I skip them*."

--- quoted from "Kumar" in Lebrun's book

Lebrun thinks some introductions are repetitive because they are written after the work is done, so the fun and excitement are gone! Write the introduction early, with the tantalizing hypothesis, supportive preliminary data, and fruitful methods.

Spell out the importance of the subject, rather than just saying "it is important."

An introduction should

- ***avoid a vacuous false start***

In the era of all-sky surveys, we are confronted with large amounts of data …

Significant progress in detector technology in general, and data analysis in particular, often prompts to enable …

*(**Reader yawning**:) Is there anything I do not know already?*

An introduction should

- ***avoid a considerable false start***

  There has been a surge, in recent times, toward the increasing use of …

  There has been considerable interest in recent years in this technology, and, as trends indicate, it is expected to show continuing growth over the next decade …

  (***Reader OS***:) *Should I be excited by the sheer popularity of the problem (not the solution)?*

- ***avoid a dead table-of-contents ending***

  Say more; “connect the dots”

- Do not cut and paste sentences from various parts of your paper into the introduction.

- The abstract is more precise than the introduction for key numerical results. The abstract is factual and can be passive *"These results demonstrate …"*; the introduction is personal and active *"We demonstrate …"*.

<u>*Abstract*</u> … *The HBLRs and non-HBLRs identified in this data set had significantly different [NII]/Fe ratios, in accord with analysis of other AGN samples. These results demonstrate the emission to originate from different regions* …

<u>*Introduction*</u> … *We demonstrate that the emission of HBLRs and non-HBLRs comes from different parts of the* ….

Popular Traps

☐ The Trap of the Story Plot

A story (from Lebrun)

I'm so excited about telling you this great story. My father is on the front lawn cleaning the lawn mower. My sister is in the back kitchen making a cake. My mom has gone shopping, and I am playing my guitar in my bedroom.

- Your readers are left ice cold. There is no plot, no relationship or connection between the elements of the story.
- Identify your story plot in the introduction.

A better story --- with a thread

I'm so excited. I am going to tell you a great story. My father is on the front lawn cleaning the lawn mower. Do you know what this means? Trouble! He hates it. He wants everyone to help bring him this or that in order to feel less miserable. Whenever that happens, we all run away, not because we refuse to help him, but because he wants us to stand there and watch idly while he works. So, my sister is taking refuge in the back kitchen and is plunging her hand in flour to slowly making a cake. My mom has suddenly discovered that she is missing something, and has rushed out to shop, saying she would be gone for an hour or so. As for me, I am in my bedroom playing the electric guitar with my amplifier at maximum volume.

A terrible story

I'm so excited. I am going to tell you my second best story. A red Ferrari would take me to Vladimir Toldoff's house in 5 hours. It is fast. ***However****, it is very expensive. A red bicycle is much less expensive and is quite convenient for short trips. So, if Vladimir Toldoff came to live near my house, it would be quite cost effective.* ***However****, a bicycle that does not have a mudguard requires a bicycle clip so as not to dirty trousers. Since red athletic shoes do not require a bicycle clip, they are a better solution than a bicycle to travel short distances.* ***However****, their color is easily degraded by adverse weather conditions, particularly in the muddy rainy season.* ***On the other hand****, brownish open plastic sandals do not have any of the previous problems: they are cheap, convenient, require no bicycle clip, and do not show mud stains.* ***Furthermore****, they are easy to clean, and are fast to put on.* ***However****, contrary to the Ferrari, they reflect poorly on the status of their owners. Therefore, I am working on a framework to integrate self-awareness into the means of transportation, and will validate it through the popular Sims 2 simulation package.*

The disconnect plot and however plot are frequently found because they are convenient:

- They allow a list of loosely related references to be easily assembled.
- The shallow analysis of related works is fast because it does not require extensive reading of other people's works (abstracts or even titles are enough in most cases)

Usually a plot that works well in movies is also useful in scientific writing. It is all right if you show the readers how the story ends before it even starts. The readers have a full picture, so they can place your contribution in it. They know your limitations and expect that you will deal with them.

□ The Trap of Plagiarism

- Plagiarism happens when someone else's words are found in your paper without proper quotes or references.
- For an academic position, **plagiarism = end of career**.
- Changing a word here and there does not get rid of plagiarism → "patchwork plagiarism"
- Changing every word except the keywords does not help.
- Even quoting yourself can be dangerous. You might have coauthors. The copyright, after a paper is published, no longer belongs to you.
- Free or open access does not imply free right of use.
- Quoting is a good practice. You do not interpret; you cite.

- When doing the electronic literature study, keep relevant documentation about the information source.
- Completely rewrite without looking at the original, and express your point of view.

In apparent support of the cold dark matter cosmology, Chen (2012) provided observational evidence of …

With the skillful use of the word "***apparent***", the author starts in the next paragraph with "***However***" to express disagreement.

□ The Trap of Imprecision

- So your paper mentions 30 or more references. Did you read them all? Or did you just skim the abstracts?

- Words like *typical, generally, commonly, can/may, a number of, the majority of, substantial, probably, several, less, various, frequent, many, others, more, often, most, a few, the main*…

  Many people have been working on this problem [1,2,3,4,5,6,7,8,9,10], and others have recently improved on the method [11,12,13,14,15,16,17].

- Very often, the rest of the paper does not contain as many references.
- As a referee, how do you think of this paper?

If you read only the abstracts, or fill your paper with references of papers you have not read (or even do not have them), it will hurt you in the following ways:

- Your paper will have superficial statements, so the referee will lower the value of your contribution.
- Your research will not be clearly positioned on the research landscape.
- Your story will lack of details and, therefore, interest.
- The reader will doubt your expertise.   Why should they believe you otherwise?

◻ The Trap of Judgmental Adjectives

- When you refer to other's work, some adjectives are dangerous (*poor, good, fast, faster, not reliable, primitive, naïve, limited*).
- Every adjective is a claim, and in science, claims have to be substantiated. How do you justify "poor"?
- Use those adjectives that you later justify with data or figures. Let adjectives be based on facts, or on quotes from other authors stating their own limitations of assumptions.

- State that your work agrees (or disagrees) with another paper's conclusions. State that your results are different or consistent.
- Use facts and numbers.
- Define your uniqueness.
- Quote another paper that independently supports your views.

About authorship

1. The complex variability of blazars: Time-scales and periodicity analysis in S4 0954+65, Raiteri, C. M., Villata, M., Larionov, V. M., et al. (including **Chen, W. P**., Hou, W. J., and Tsai, A. from NCU), 2021/07, *Mon. Not. R. Astron. Soc*, 504, 5629
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3. The TAOS II Survey: Real-Time Detection and Characterization of Occultation Events, Huang, Chung-Kai, Lehner, Matthew, Contreras, Agueda Paula Granados, Castro-Chacón, Joel. H., **Chen, Wen-Ping**, Alcock, Charles, Alvarez-Santana, Fernando I., Cook, Kem H., Geary, John C., & Peña, Carlos Alberto Guerrero, 2021/03, *Pub. Astron. Soc. Pac*., 133 ,1021
4. Sustaining Star Formation in the Galactic Star Cluster M36? Panja, Alik, **Chen, Wen Ping**, Dutta, Somnath, Sun, Yan, Gau, Yu, and Soumen, Mondal, 2021/03, *Astrophy. J.,* 910,80

The Astrophysical Journal, 775:123 (9pp), 2013 October 1 doi:10.1088/0004-637X/775/2/123

CHARACTERIZATION OF THE YOUNG OPEN CLUSTER G144.9 + 0.4 IN THE CAMELOPARDALIS OB1 ASSOCIATION

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Received 2013 May 5; accepted 2013 August 2; published 2013 September 13

ABSTRACT

Our star-count analysis of the Two Micron All Sky Survey point sources resulted in an identification of the star cluster G144.9 + 0.4. The cluster was found, but not characterized, by Glushkova et al. We show that the cluster is physically associated with the Cam OB1 association at a distance of about 1 kpc and with an age of 1–2 Myr. Pre-main sequence stars are identified on the basis of photometric and proper motion data. A total of 91 additional OB star candidates was found in subgroups 1A and 1B, a significant increase from the currently known 43 OB stars. The OB members show an age spread that indicates a sustained star formation for at least the last 10–15 Myr. The young cluster G144.9 + 0.4 represents the latest episode of sequential star formation in this cloud complex.

1. READ THE TITLE

   and try to predict the type of information you expect to see
2. LOOK AT THE NAME OF THE AUTHOR

   What you know about the writer will help you predict and evaluate the content.
3. CHECK THE DATE

   and use it to help you assess the content.
4. READ THE ABSTRACT

   to find out what the researchers did and/or what they found
5. LOOK QUICKLY AT THE FIRST PARAGRAPH

   without trying to understand all the words.
6. LOOK QUICKLY AT THE FIRST SENTENCE OF EACH PARAGRAPH

   without trying to understand all the words
7. LOOK QUICKLY AT EACH FIGURE/TABLE AND READ ITS TITLE

   to try and find out what type of visual data is included
8. READ THE LAST PARAGRAPH

   especially if it has a subtitle like 'Summary' or 'Conclusion'

Gladman-Deal

The synthesis of flexible polymer blends from polylactide and rubber

Introduction

1 Polylactide (PLA) has received much attention in recent years due to its biodegradable properties, which offer important economic benefits. **2** PLA is a polymer obtained from corn and is produced by the polymerisation of lactide. **3** It has many possible uses in the biomedical field[1] and has also been investigated as a potential engineering material.[2,3] **4** However, it has been found to be too weak under impact to be used commercially.[4]

In Sentence 1	**the writer establishes the importance of this research topic.**
In Sentence 2	**the writer provides general background information.**
In Sentence 3	**the writer does the same as in Sentences 1 and 2, but in a more specific/detailed way.**
In Sentence 4	**the writer describes the general problem area or the current research focus of the field.**

5 One way to toughen polymers is to incorporate a layer of rubber particles[5] and there has been extensive research regarding the rubber modification of PLA. **6** For example, Penney *et al.* showed that PLA composites could be prepared using blending techniques[6] and more recently, Hillier established the toughness of such composites.[7] **7** However, although the effect of the rubber particles on the mechanical properties of copolymer systems was demonstrated over two years ago,[8] little attention has been paid to the selection of an appropriate rubber component.

In Sentence 5	**the writer provides a transition between the general problem area and the literature review.**
In Sentence 6	**the writer provides a brief overview of key research projects in this area.**
In Sentence 7	**the writer describes a gap in the research.**

8 The present paper presents a set of criteria for selecting such a component.

9 On the basis of these criteria it then describes the preparation of a set of polymer blends using PLA and a hydro-carbon rubber(PI). **10** This combination of two mechanistically distinct polymerisations formed a novel copolymer in which the incorporation of PI significantly increased flexibility.

In Sentence 8	**the writer describes the paper itself.**
In Sentence 9	**the writer gives details about the methodology reported in the paper.**
In Sentence 10	**the writer announces the findings.**

1	ESTABLISH THE IMPORTANCE OF YOUR FIELD PROVIDE BACKGROUND FACTS/INFORMATION (possibly from research) DEFINE THE TERMINOLOGY IN THE TITLE/KEY WORDS PRESENT THE PROBLEM AREA/CURRENT RESEARCH FOCUS
2	PREVIOUS AND/OR CURRENT RESEARCH AND CONTRIBUTIONS
3	LOCATE A GAP IN THE RESEARCH DESCRIBE THE PROBLEM YOU WILL ADDRESS PRESENT A PREDICTION TO BE TESTED
4	DESCRIBE THE PRESENT PAPER

1. ESTABLISHING SIGNIFICANCE

This includes phrases such as *Much research in recent years*. A good list of commonly used words and expressions will encourage you to include this in your first sentences.

Importance of the subject

2. PREVIOUS AND/OR CURRENT RESEARCH AND CONTRIBUTIONS

This includes all past tense verbs describing what researchers did, *i.e. calculated, monitored, etc.* Instead of just using *did, showed* and *found*, you often need to be more specific about what a researcher actually 'did'!

Previous work/Literature

3. GAP/PROBLEM/QUESTION/PREDICTION

This includes ways to say exactly how previous and/or current research is not yet complete or has not addressed the problem your paper deals with, *e.g. However, few studies have focused on…*

Problem

4. THE PRESENT WORK

This may include your purpose, your strategy and the design of your paper, using language such as *the aims of the present work are as follows:*

Our solution

1. ESTABLISHING SIGNIFICANCE

This includes phrases such as *Much research in recent years*. A good list of commonly used words and expressions will encourage you to include this in your first sentences.

(an) increasing number	numerous investigations
(an) interesting field	of great concern
(a) key technique	of growing interest
(a) leading cause (of)	often
(a) major issue	one of the best-known
(a) popular method	over the past ten years
(a) powerful tool/method	play a key role (in)
(a) profitable technology	play a major part (in)
(a) range (of)	possible benefits
(a) rapid rise	potential applications
(a) remarkable variety	recent decades
(a) significant increase	recent(ly)
(a) striking feature	today
(a) useful method	traditional(ly)
(a) vital aspect	typical(ly)
(a) worthwhile study	usually

1. ESTABLISHING SIGNIFICANCE

(a) basic issue	economically important
(a) central problem	(has) focused (on)
(a) challenging area	for a number of years
(a) classic feature	for many years
(a) common issue	frequent(ly)
(a) considerable number	generally
(a) crucial issue	(has been) extensively studied
(a) current problem	importance/important
(a) dramatic increase	many
(an) essential element	most
(a) fundamental issue	much study in recent years
(a) growth in popularity	nowadays

(an) advantage	well-documented
attracted much attention	well-known
benefit/beneficial	widely recognised
commercial interest	widespread
during the past two decades	worthwhile

2. PREVIOUS AND/OR CURRENT RESEARCH AND CONTRIBUTIONS

This includes all past tense verbs describing what researchers did, *i.e. calculated, monitored, etc.* Instead of just using *did, showed* and *found*, you often need to be more specific about what a researcher actually 'did'!

conclude	implement	reveal
conduct	imply	revise
confirm	improve	review
consider	incorporate	show
construct	indicate	simulate
correlate	interpret	solve
deal with	introduce	state
debate	investigate	study
define	measure	support
demonstrate	model	suggest
describe	monitor	test
design	note	undertake
detect	observe	use
determine	prefer	utilise

2. VERBS USED IN THE LITERATURE REVIEW TO PRESENT PREVIOUS AND/OR CURRENT RESEARCH AND CONTRIBUTIONS

achieve	develop	obtain
address	discover	overcome
adopt	discuss	perform
analyse	enhance	point out
apply	establish	predict
argue	estimate	present
assume	evaluate	produce
attempt	examine	propose
calculate	explain	prove
categorise	explore	provide
carry out	extend	publish
choose	find	put forward
claim	focus on	realise
classify	formulate	recognise
collect	generate	recommend
compare	identify	record
concentrate (on)	illustrate	report

3. GAP/PROBLEM/QUESTION/PREDICTION

This includes ways to say exactly how previous and/or current research is not yet complete or has not addressed the problem your paper deals with, *e.g. However, few studies have focused on…*

unanswered
uncertain
unclear
uneconomic
unfounded
unlikely
unnecessary
unproven
unrealistic
unresolved
unsatisfactory
unsolved
unsuccessful
unsupported

ineffective
inefficient
inferior
inflexible
insufficient
meaningless
misleading
non-existent
not addressed
not apparent
not dealt with
not repeatable
not studied
not sufficiently + adjective
not well understood
not/no longer useful
of little value
over-simplistic
poor
problematic
questionable
redundant
restricted
time-consuming

(to be) confined to
(to) demand clarification
(to) disagree
(to) fail to
(to) fall short of
(to) miscalculate
(to) misjudge
(to) misunderstand
(to) need to re-examine
(to) neglect
(to) overlook
(to) remain unstudied
(to) require clarification
(to) suffer (from)

few studies have...
it is necessary to...
little evidence is available
little work has been done
more work is needed
there is growing concern
there is an urgent need…
this is not the case
unfortunately

This is often signalled by words such as however, although, while, nevertheless, despite, but.

ambiguous	(the) absence of
computationally demanding	(an) alternative approach
confused	(a) challenge
deficient	(a) defect
doubtful	(a) difficulty
expensive	(a) disadvantage
false	(a) drawback
far from perfect	(an) error
ill-defined	(a) flaw
impractical	(a) gap in our knowledge
improbable	(a) lack
inaccurate	(a) limitation
inadequate	(a) need for clarification
incapable (of)	(the) next step
incompatible (with)	no correlation (between)
incomplete	(an) obstacle
inconclusive	(a) problem
inconsistent	(a) risk
inconvenient	(a) weakness
incorrect	

4. THE PRESENT WORK

This may include your purpose, your strategy and the design of your paper, using language such as *the aims of the present work are as follows:*

4. THE PRESENT WORK

(to) facilitate (to) illustrate (to) improve (to) manage to (to) minimise (to) offer (to) outline (to) predict (to) present (to) propose (to) provide (to) reveal (to) succeed	(this) work begin by/with close attention is paid to here overview	simple straightforward successful valuable
		aim goal intention objective purpose

Review critically the first 3 sections of this manuscript

https://www.astro.ncu.edu.tw/~wchen/Courses/SciWriting/BRC_v1.pdf

The referee report
https://www.astro.ncu.edu.tw/~wchen/Courses/SciWriting/BRCreport.pdf

The final, published paper
https://www.astro.ncu.edu.tw/~wchen/Courses/SciWriting/BRCpub.pdf

An example …

The Astronomical Journal, 158:240 (13pp), 2019 December https://doi.org/10.3847/1538-3881/ab4e16

Gaia 19ajj: A Young Star Brightening Due to Enhanced Accretion and Reduced Extinction

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Received 2019 July 16; revised 2019 October 12; accepted 2019 October 14; published 2019 November 20

Abstract

We report on the source Gaia 19ajj, identifying it as a young star associated with a little-studied star-forming region seen along a complex line of sight through the Gum Nebula. The optical lightcurve recently recorded by *Gaia* exhibits a slow and unsteady 5.5 mag rise over about 3 yr, while the mid-infrared lightcurve from NEOWISE over the same time period shows a 1.2 mag rise having similar structure. Available color information is inconsistent with pure extinction reduction as the cause for the photometric brightening. Optical spectroscopic characteristics in the current bright phase include: little in the way of absorption except for the hallmark Li I 6707 Å signature of youth plus weak, e.g., Ca I and notably Ba II; strong wind/outflow in Ca II, Mg I b, Na I D, Hα, K I, and O I; jet signatures in [O I], [S II], [Ca II], [Fe II], and [Ni II]; and narrow rest-velocity emission in neutral species such as Fe I, Ni I, and Mg I. The infrared spectrum is also characterized by outflow and emission, including: a hot He I wind, jet lines such as [Fe II] and H_2; and weak narrow rest-velocity atomic line emission. The ^{12}CO bandheads are weakly in emission, but there is also broad H_2O absorption. Gaia 19ajj exhibited a previous bright state in the 2010–2012 time frame. The body of photometric and spectroscopic evidence suggests that the source bears resemblance to V2492 Cyg (PTF 10nvg) and PV Cep, both of which similarly experience bright phases that recur on long timescales, with large-amplitude photometric variations and emission-dominated spectra. We interpret the behavior of Gaia 19ajj as caused by cycles of enhanced disk accretion accompanied by reduced extinction.

Unified Astronomy Thesaurus concepts: Stellar accretion disks (1579); Stellar accretion (1578); Circumstellar matter (241); Stellar activity (1580); Star formation (1569); T Tauri stars (1681); Herbig Ae/Be stars (723)

1. Introduction

The evolution of circumstellar material around young stars is a topic of great interest for problems ranging from the build-up of stellar mass during star formation and early stellar evolution to the formation of planets in circumstellar disks. These processes are heavily influenced over the first several mega-years of a star's life by the trades between—on the one hand—envelope infall and disk accretion bringing mass inward, and—on the other hand —outflows, jets, and winds arising from a range of locations in the stellar/circumstellar environment, which eject mass from the system.

One way of tracing dynamical effects in young stars is through photometric variability. For nearly a century, highly variable astronomical objects have been reported in the literature (e.g., Joy 1945; Herbig 1946) that were later associated with young stars (Ambartsumian 1949; Herbig 1954, 1957). The many flavors of young star variability were subsequently characterized by various authors, notably by Herbst et al. (1994) and Herbst & Shevchenko (1999); see also Ismailov (2005). Over the past decade, the true diversity of young star behavior in the time domain has become more fully appreciated and the lightcurve categories more rigorously defined. Increasingly higher cadence and more photometrically precise data sets (e.g., Cody et al. 2014; Cody & Hillenbrand 2018), as well as long-duration, multidecade investigations (e.g., Ibryamov et al. 2015; Mutafov et al. 2019) have contributed. Such studies have been possible due to dedicated monitoring efforts over small fields, and modern all-hemisphere, and even all-sky, time domain surveys. The involvement of amateur astronomers with sophisticated equipment and eyes on the sky has also been important, particularly in the identification of rare large-amplitude brightness changes.

For nearly a half century, we have recognized a small sample of large and very large-amplitude (>3 mag) young star variables as outbursting sources (Herbig 1977, 1989; Connelley & Reipurth 2018). The basic paradigm of episodic accretion, or punctuated periods of enhanced mass accretion/outflow that builds up the final ∼10% of the stellar mass, was developed based on these early but scant observations (see a review by Hartmann & Kenyon 1996). The rates for the different types of outbursts remain relatively poorly constrained empirically (Hillenbrand & Findeisen 2015), though for recent significant progress see Contreras Peña et al. (2019). Especially over the past decade, our understanding of the diversity in behavior of young stars during such large-amplitude brightenings has been enhanced by the coordination of multicolor photometric and multiwavelength spectroscopic follow-up of detected brightening events.

In this paper, we describe a large-amplitude brightening of the newly appreciated young stellar object Gaia 19ajj. The *Gaia* mission, although primarily an astrometric mission, offers public alerts[6] based on photometric changes exceeding 2 mag in the broadband optical G filter (Hodgkin et al. 2013, 2020, in preparation). One such alert was issued on 2019 January 31 for Gaia 19ajj. Since that time, the source at position 08:10:45.78–36:04:30.94 (J2000.) has continued to brighten.

In this paper, we first describe the source Gaia 19ajj and its environment in Section 2. In Section 3, we report on the publicly available *Gaia* lightcurve of Gaia 19ajj and its historical context based on the All-Sky Automated Survey (ASAS) and VST Photometric Hα Survey (VPHaS) photometry. We also present *Wide-field Infrared Survey Explorer* (*WISE*) and NEOWISE photometry at mid-infrared wavelengths covering essentially the same time baseline. Our follow-up near-infrared photometry is presented in Section 4 and the critical spectroscopy at both optical and infrared wavelengths in Section 5. Section 6 contains a summary and short discussion of the context of this source amid the complex zoo of young star variables, and Section 7 contains our conclusions regarding its similarity to sources like V2492 Cyg (PTF 10nvg; Covey et al. 2011; Hillenbrand et al. 2013; Giannini et al. 2018) with PV Cep another good analog.

https://journals.aas.org/aastexguide/#tables

```
\begin{deluxetable*}{cchlDlc}
\tablenum{1}
\tablecaption{Fun facts about the first 10 messier objects\label{tab:messier}}
\tablewidth{0pt}
\tablehead{
\colhead{Messier} & \colhead{NGC/IC} & \nocolhead{Common} & \colhead{Object} &
\multicolumn2c{Distance} & \colhead{} & \colhead{V} \\
\colhead{Number} & \colhead{Number} & \nocolhead{Name} & \colhead{Type} &
\multicolumn2c{(kpc)} & \colhead{Constellation} & \colhead{(mag)}
}
\decimalcolnumbers
\startdata
M1 & NGC 1952 & Crab Nebula & Supernova remnant & 2 & Taurus & 8.4 \\
M2 & NGC 7089 & Messier 2 & Cluster, globular & 11.5 & Aquarius & 6.3 \\
M3 & NGC 5272 & Messier 3 & Cluster, globular & 10.4 & Canes Venatici &  6.2 \\
M4 & NGC 6121 & Messier 4 & Cluster, globular & 2.2 & Scorpius & 5.9 \\
M5 & NGC 5904 & Messier 5 & Cluster, globular & 24.5 & Serpens & 5.9 \\
M6 & NGC 6405 & Butterfly Cluster & Cluster, open & 0.31 & Scorpius & 4.2 \\
M7 & NGC 6475 & Ptolemy Cluster & Cluster, open & 0.3 & Scorpius & 3.3 \\
M8 & NGC 6523 & Lagoon Nebula & Nebula with cluster & 1.25 & Sagittarius & 6.0 \\
M9 & NGC 6333 & Messier 9 & Cluster, globular & 7.91 & Ophiuchus & 8.4 \\
M10 & NGC 6254 & Messier 10 & Cluster, globular & 4.42 & Ophiuchus & 6.4 \\
\enddata
\tablecomments{This table ``hides'' the third column in the \latex\ when compiled.
The Distance is also centered on the decimals.  Note that when using decimal
alignment you need to include the {\tt\string\decimals} command before
{\tt\string\startdata} and all of the values in that column have to have a
space before the next ampersand.}
\end{deluxetable*}
```

Table 1. Fun facts about the first 10 messier objects

Messier Number (1)	NGC/IC Number (2)	Object Type (3)	Distance (kpc) (4)	Constellation (5)	V (mag) (6)
M1	NGC 1952	Supernova remnant	2	Taurus	8.4
M2	NGC 7089	Cluster, globular	11.5	Aquarius	6.3
M3	NGC 5272	Cluster, globular	10.4	Canes Venatici	6.2
M4	NGC 6121	Cluster, globular	2.2	Scorpius	5.9
M5	NGC 5904	Cluster, globular	24.5	Serpens	5.9
M6	NGC 6405	Cluster, open	0.31	Scorpius	4.2
M7	NGC 6475	Cluster, open	0.3	Scorpius	3.3
M8	NGC 6523	Nebula with cluster	1.25	Sagittarius	6.0
M9	NGC 6333	Cluster, globular	7.91	Ophiuchus	8.4
M10	NGC 6254	Cluster, globular	4.42	Ophiuchus	6.4

Note—This table "hides" the third column in the LaTeX when compiled. The Distance is also centered on the decimals. Note that when using decimal alignment you need to include the `\decimals` command before `\startdata` and all of the values in that column have to have a space before the next ampersand.

Exercise

Get *Gaia* data toward Omega Centauri within an angular radius of 10 arcmin. Tabulate the RA, RAe, DE, DEe, plx, plxe, pmRA, pmRAe, pmDE, pmDEe, gMag, gMage, bpMag, bpMage, rpMag, rpMage

Produce a position plot, and a color-magnitude diagram, g versus (BP-RP).

LaTex the table and two figures.