

# How to give a talk

**Why? What? To whom? When? Where? (the 5Ws)**

- Targeted audience

*To astronomers? School kids? General public?*

*For journal club? Colloquium? In English?*

- Location

*In a small discussion room? In a (dark) lecture hall? Stadium?*

- Use proper media

*PowerPoint? Verbally, board ...*

Different fonts, sizes, copy/paste (Time New Roman, 24 points)

Different fonts, sizes, copy/paste (Times New Roman, 32 points)

Different fonts, sizes, copy/paste (LM Roman Demi)

Different fonts, sizes, copy/paste (Cambria Math)

**Different fonts, sizes, copy/paste (Elephant)**

不同字型、大小 (新細明體 ; 32號字)

不同字型、大小 Chen' s (標楷體 ; 32號字)

不同字型、大小 Chen's (標楷體 + Times New Roman ; 32號字)

**不同字型、大小 (特明體 + Times New Roman ; 32號字)**

段  
距  
18  
points

# How to give a talk 44 point, Times New Roman

## Why? What? To whom? When? Where? **(the 5Ws)**

32 point, Times New Roman

- Targeted audience 32 point, LM Roman 9

*To astronomers? School kids? General public?*

*For journal club? Colloquium? In English?* 32 point, LM Roman 9, Italic

- Location

*In a small discussion room? In a lecture hall? Stadium?*

- Use proper media

*PowerPoint? Verbally, board ...*

# **Astronomy Colloquium**

National Central University

**Understanding Type Ia Supernova  
with UV Spectroscopy**

by

**Dr. Yen-Chen Pan (潘彥丞)**

**EACOA Fellow, NAOJ/ASIAA**

at

**Feb 15 (Friday) 2:00 pm**

**Chien-Shiung Building, Room 1013**

Ultraviolet (UV) observations of Type Ia supernovae (SNe Ia) are useful tools for understanding progenitor systems and explosion physics. In particular, UV spectra of SNe Ia, which probe the outermost layers, are strongly affected by the progenitor metallicity. Theory suggests that SN Ia progenitor metallicity is correlated with its peak luminosity, but not its light-curve shape. This effect should lead to an increased Hubble scatter, reducing the precision with which we measure distances. If the mean progenitor metallicity changes with redshift, cosmological measurements could be biased. Models also indicate that changing progenitor metallicity will have little effect on the appearance of optical SN data, but significantly alter UV spectra. To address this problem, we reduced and published the largest UV spectroscopic sample of SNe Ia to date. With this sample, we confirm theoretical predictions that SN Ia UV spectra are strong metallicity indicators. Our findings show that UV spectra are promising tools to further our understanding of SN Ia while directly improving the utility of SN Ia for cosmology.

An example of a  
colloquium announcement

with layers of assorted, eye-catching  
information

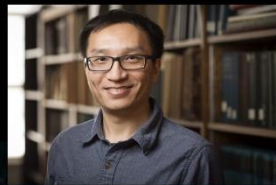
# 2018 年輕天文學者講座

中央大學 台達電子文教基金會

類星體看起來如點光源，像恆星一般，卻發出千億倍的能量，這是怎麼回事？類星體當中的超大質量黑洞究竟是什麼東西？

沈悅 博士 (Dr. Yue Shen)

美國 伊利諾大學 at Urbana-Champaign  
天文系助理教授



12/21 (五) 15:00~16:00

**The Final Parsec: Time-Domain Exploration of the Inner Regions of Quasars**

中央大學天文所 桃園市中壢區中南路300號

12/26 (三) 14:00~15:00

**Journey to the Center of Quasars**

台達電子台北總公司 台北市內湖陽光街256號

12/28 (五) 15:00~17:00

**A Life Story of Supermassive Black Holes**

台中一中 台中市育才街2號科學館演講廳

## An example of an award lecture

# How to give a talk (*cont.*)

- Be prepared

*Expect to show only 10% of what you know*

*Hide some slides after the end*

- Be confident

- Practice efficient language

- Write legibly

*Text & graphics; do not overcrowd the page vs*

*put immediate relevant contents side by side*

- Stick to the time limit

*Rule of thumb, e.g., 10~12 slides for a 15 min talk*

# How to give a talk (*cont.*)

- Exercise gestures/body language (walk around sometimes)
- Do **NOT** block the screen
- Stick to the time limit
- Pay attention to your audience
- Sprinkle a touch of humor (but only a touch!)

## Exercise:

- Give an “elevator talk”, about your research project.
- Limitations (How long, which elevator 😊) ?  
To whom?  
What do they care?  
Why should they care? Why should you?



# How to do a presentation ...

**Why? What? To whom? When? Where?**

- Be prepared (to show only 10% of what you know/prepare)
- Be confident
- Practice efficient language
- Use proper media (overhead, slides, PowerPoint; words only, blackboard ...)
- Write legibly (text & graphics)

# How to do a presentation ...

**Why? What? To whom? When? Where?**

- Be prepared (to show only 10% of what you know/prepare)
- Be confident
- Practice efficient language
- Use proper media (overhead, slides, PowerPoint; words only, blackboard ...)
- Write legibly (text & graphics)

# How to be an audience?

---

- Do homework/preview work  
(what do you expect to learn?)
- Learn a thing or/then two
- Do **NOT** chat with others
- Ask questions during and after the talk
- Describe what you have learnt to a friend.

What's the first thing employers notice on a resume? x (1) Home - Quora x +

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### What's the first thing employers notice on a resume?

Brent Salish, former Executive (Retired) at Microsoft (1991-2008)  
Answered Feb 27

I was downstream as a hiring manager, so by the time I saw resumes, they had already been screened as generally appropriate.

Three negatives would stand out to me immediately:

1. Job hopping - too many jobs in too short a period, especially recently. (I expect new college grads to wind up with a different job every summer! That kind of stuff doesn't count.) Long gaps would also catch my eye, but they weren't disqualifying; rather, if the rest of the resume appealed, I'd ask the recruiter to gather more info.
2. Typos. If you didn't have enough attention to detail to proofread, or weren't self-aware enough to know you needed to get someone to proofread, g'bye. (I'd be more lenient on resumes coming from overseas candidates where English was not one of the country's languages.)
3. General lack of self-awareness. Don't put your GPA on your resume if it's not a 4.0 or maybe one "B" short of that. Don't claim credit for things you couldn't have done, such as singlehandedly saving a company ten million bucks in an entry-level position. (Actually, that's occasionally possible, but you'd better explain it on the resume.) Being hand-wavingly vague about positions you held or what you accomplished. (Ex-CIA, yeah, okay, fine.) Focusing too much on stuff that doesn't matter (a college honor you earned fifteen years ago other than perhaps election to Phi Beta Kappa, which merits only a brief mention). Living on past glories, such as emphasis on stuff you did ten years ago to the exclusion to more recent victories.

Once you're survived that initial ten-second screening, then give me a reason to care, to want to hire you. Tell me about the difference you made somewhere (recently).

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Robert A. Day and Barbara Gastel



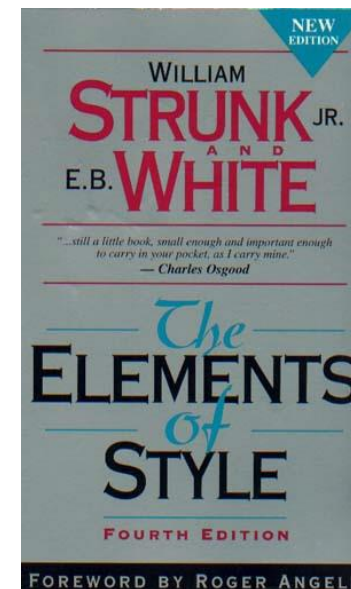
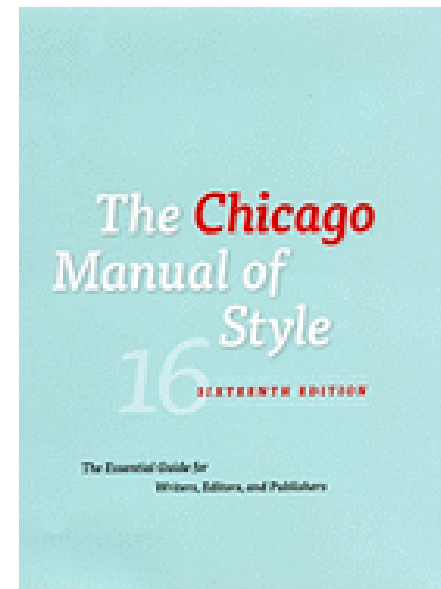
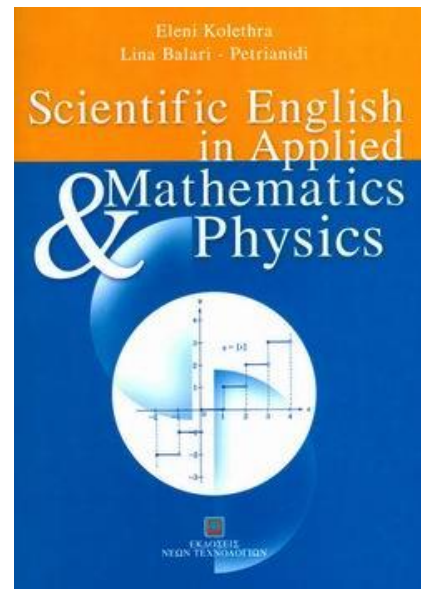
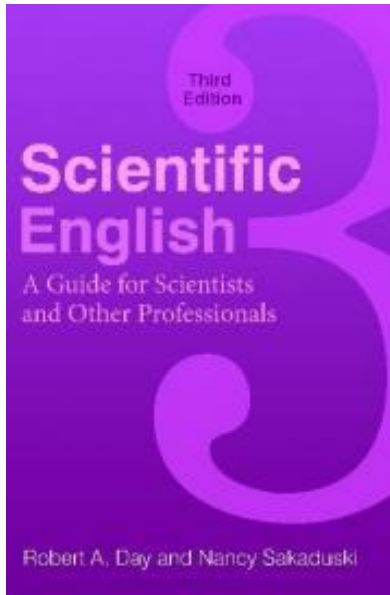
# How to Write and Publish a Scientific Paper

Sixth Edition

Seventh Edition

# How to Write and Publish a Scientific Paper

Robert A. Day and Barbara Gastel



## Common English mistakes made by native Chinese speakers by Philip Guo

天文物理類英文科技論文寫作的常見問題 張雙南、許云

# Contact Binary Variables as X-ray Sources

Kaushar Sanchawala <sup>a</sup>, Wen-Ping Chen <sup>a,b</sup> and Mu-Zhen Chion <sup>b</sup>

<sup>a</sup> Graduate Institute of Astronomy, National Central University, Chung-Li, Taiwan

<sup>b</sup> Physics Department, National Central University, Chung-Li, Taiwan

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## Abstract

We present cross-identification of archived x-ray point sources with optical variable stars found in All Sky Automated Survey (ASAS). In a surveyed sky area of 300 square degrees, 36 objects were identified as possible W Ursa Majoris type. We compute the distances to the W Ursa Majoris systems and present their x-ray luminosities.

### The ASAS Project

- The All-Sky Automated Survey first ran with a prototype ASAS-1 and ASAS-2 equipped with 768X512 Kodak CCD and 135/11.8 telephoto lens to monitor stars brighter than 14 magnitudes in the I band at the Las Campanas Observatory in Chile (4,5).
- From April 7, 1997 to June 6, 2000, more than 140,000 stars had been observed in the selected fields covering  $\sim 300$  square degree for nearly 50 million photometric measurements.
- More than 3500 variable stars have been found (ASAS-2) , of which nearly 90 % are new identifications. Among these 380 are periodic variables.
- The ASAS-3 system installed in August 2000, has discovered over 1000 eclipsing binaries, almost 1000 periodic pulsating variables, and over 1000 irregular stars among the 1,300,000 stars in the 0h 6h quarter of the southern hemisphere till date (6).

### The W Ursa Majoris Variables

- W UMa Majoris (also called EW) variables are contact eclipsing binaries, with periods  $p=0.2-1.4$  days.
- Their light curves show two nearly equal minima with virtually no plateau.
- The x-ray emission mechanism of these systems is not clearly known but is thought to be related to stellar magnetic activity.
- A large sample of W UMa systems with x-ray emission is an important first step to shed light on their x-ray nature.

### W UMa stars - Absolute Magnitude

- We made use of the ASAS-2 database of the variable stars and among the 380 periodic variables, identified 36 possible candidates of the W Ursa Majoris type.
- We searched the x-ray counterparts for these W UMa stars in the ROSAT database and found that 10 of the W UMa stars had x-ray counterpart (Angular separation  $< 30''$ ).
- In some cases, the cross-identification was relatively straightforward, either because the nominal positions of the x-ray and optical source coincided (Fig. 2) or because no other obvious star was near the x-ray position (Fig. 3). The fig. 4 shows the light curves of a few W UMa stars for which we found the x-ray counterpart in the ROSAT database.

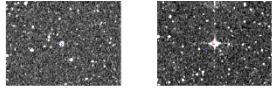


Fig. 2 ASAS67599 6228.7  
DSS Images : Red box indicates the position of ASAS objects whereas the blue box shows the position of their x-ray counterpart.

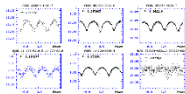


Fig. 4 Light curves of a few ASAS variables with x-ray counterparts in ROSAT.

For 8 of the W UMa stars, the angular separation was less than  $30''$  whereas for the remaining 2 it exceeded this limit. We used S. Rucinski's absolute magnitude calibration method (2), (3) to compute the absolute magnitudes of the stars and hence their distances.

The exact calibration used is as given below.

$$M_2 = b_{12} \log P + b_{11}(V - I_2) - b_{10}$$

$$\text{where } b_{12} = -4.4_{-1.2}^{+1.2}, b_{11} = 12.0_{-0.2}^{+0.2} \text{ and } b_{10} = 0.2_{-0.2}^{+0.2}$$

which is valid over the following ranges in period and color,

$$0.2T < P < 0.65; 0.38 < (V - I_2) < .21 \text{ \& } .5 < M_2 < 3.9.$$

Two of the W UMa stars with x ray counterparts, have the periods or colors outside the range of the calibration. Hence, we computed the absolute magnitudes of 8 W UMa stars in I band and their distances.

### W UMa stars - X-ray luminosity

We computed the x ray luminosities for the W UMa stars from their x ray counts. The flux was obtained by multiplying the energy conversion factor with the count rates (1).

$$ECF = (5.211H - 8.7)10^{-14} \text{ ergs cm}^{-2} \text{ s}^{-1}$$

where the hardness ratio  $H = (I - S)/(I + S)$ , for which  $I$  and  $S$  denote the source counts in the hard (0.5-2.0 keV) and soft (0.1-0.4 keV) passbands of ROSAT, respectively.

Table 1 lists the W UMa stars with their computed distances and their X-ray luminosities.

RA	DEC	P	V-I	d	L <sub>x</sub>
05:18:33	48:13:6	0.2554	1.044	117	7.24 $\times 10^{31}$
05:38:59	48:28:7	0.3622	0.740	214	4.16 $\times 10^{31}$
05:26:34	48:36:2	0.4171	0.789	255	5.16 $\times 10^{31}$
16:41:51	00:30:4	0.4333	0.654	37	1.87 $\times 10^{31}$
18:41:39	00:44:7	0.2915	0.923	209	1.26 $\times 10^{31}$
22:02:49	12:14:7	0.3867	0.873	173	1.62 $\times 10^{31}$
11:42:37	43:18:5	0.1993	1.131	111	5.17 $\times 10^{31}$
20:48:59	00:27:4	0.5134	0.604	493	2.50 $\times 10^{31}$

d is the exact distance in parsec and L<sub>x</sub> is the mean x-ray luminosity in erg s<sup>-1</sup>.  
Angular separation of the counterpart is  $< 30''$ .

### X-ray luminosity vs. rotation

To study the interplay between stellar rotation and magnetic activity, we see that for single stars (Fig. 5) the x-ray luminosity increases with rotation, until  $P < 1$  d, for which saturation occurs. The W UMa stars are tidally locked and all have periods below 0.63 d. As fast rotators, W UMa stars offer a good tool to investigate such relationship in contacting binary environment. Fig. 6 plots L<sub>x</sub> versus period for W UMa stars, with data from (1) and (8) and our work. It appears that the faster an W UMa star rotates, the weaker its x-ray emission is, which may also be hinted in the single star data. The actual reason of this "anti-correlation" is unknown, and we plan to study an enlarged W UMa sample (e.g., ASAS-3) for their x-ray emission to shed light on this issue.

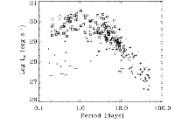


Fig. 5 X-ray luminosity vs. rotation of field dwarfs (crosses) and cluster stars (squares). Leftward arrows indicate field stars with periods derived from  $\tau = \text{data value from (1)}$ .

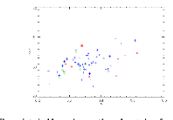


Fig. 6 The points in blue color are the values taken from (1), and in green color are the values taken from (8). The points in red color are the ones we obtained for the W UMa stars from ASAS-2.

### References

- [1] K. Stepien *et al.* in A&A 370,157, (2001)
- [2] S. Rucinski in PASP 106,462, (1994)
- [3] S. Rucinski in AJ 113,407, (1997)
- [4] G. Pojmanski in Acta Astronomica 47,467, (1997)
- [5] G. Pojmanski in Acta Astronomica 50,177, (2000)
- [6] G. Pojmanski in Acta Astronomica 52,397, (2002)
- [7] N. Pizzolatto *et al.* in A&A 397, 147, (2003)
- [8] P. A. McGee *et al.* in MNRAS 280, 627, (1996)

### Acknowledgments

KS would like to thank Yang-Shiyang Li, Chin-Wei Chen and Wen-Hau Yeh for all the help and to make her stay (both academically and otherwise) at NCU very enjoyable.  
Last update: April 17, 2003

# Deep Intermediate-Band CCD Photometry of Globular Cluster M13 and Its Stellar Population

Yang-Shiyang Li & Wen-Ping Chen

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email: m909003@astro.ncu.edu.tw

## Abstract

We present CCD photometry, in 13 intermediate bands covering from 450-1000 nm, on the galactic globular cluster M13 (NGC 6205). The data — effectively low-resolution spectroscopy — were taken by the 60/90 cm Schmidt telescope, with a 1-degree field, as part of the Beijing-Arizona-Taipei-Connecticut (BATC) color survey. The spectral energy distribution of individual stars in the outer region of the cluster provides information of their membership and of the evolutionary status of the cluster. We will also derive surface color gradient of the unresolved core, from which stellar population and the dynamical status of the cluster are inferred.

### The Galactic Globular Cluster M13

- M13 (NGC6205,  $\alpha = 18^{\text{h}}09^{\text{m}}52^{\text{s}}$ ,  $\delta = 74^{\circ}02'$ ), one of the biggest and prominent galactic globular clusters in the northern hemisphere, discovered by Edmond Halley in 1714.
- Distance to the sun: 7.0 kpc
- Metallicity  $[Fe/H] = -1.54$ , a low metallicity GC
- Core radius:  $0.78''$
- Tidal radius:  $25.5'' \sim 1 pc$  (Harris, 1996)
- The surface brightness profile is well fitted by King model.

### BATC Color Survey

The Beijing-Arizona-Taipei-Connecticut (BATC) Color Survey of the Sky (<http://vega.bcc.pku.edu.cn/batc/v1file/index.htm>) (Fan *et al.*, 1996) is a large field and multi-color photometry project. The main goal of BATC is to obtain the SED of every celestial object in the program fields and to classify special objects such as QSOs and active galaxies based on SEDs with efficiency. The BATC filter system including 15 intermediate band filters is designed to avoid the contaminations of sky background emissions. The transmission curve of each filter is shown in Fig.1.

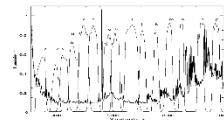
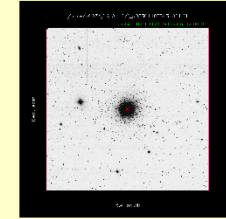


Fig.1 BATC filter systems.

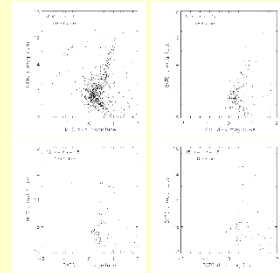
The BATC observations on M13 (see Table 1 for details) are performed with the 60/90 cm f/3 Schmidt telescope during 1995 to 2002. The telescope is equipped with a Ford 2048  $\times$  2048 CCD which gives a  $58'' \times 58''$  field of view (plate scale =  $1.67''/\text{pixel}$ ).

Table 1: Observational log of M13			
No.	Filter Wavel.(Å)	Exp.(s)	# stars
3	4193.5	300	1701
4	4540.0	15601	13174
5	4925.0	13511	11176
6	5266.8	7500	12450
7	5780.9	1800	11545
8	6073.9	10241	15197
9	6655.9	3000	18860
10	7057.4	4202	11895
11	7545.3	8400	13985
12	8023.2	10800	15654
13	8484.3	11400	14846
14	9182.2	15600	13029
15	9728.5	16800	10782

### M13 in BATC p (676Å) band.

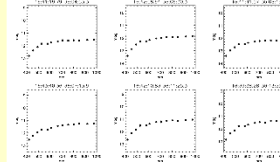


### Color-Magnitude Diagram (CMD) & Stellar SEDs

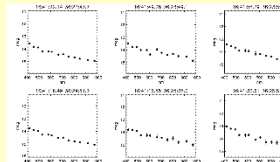


The BATC CMD is deep enough to allow for stellar population analysis of post-main sequence and some main sequence stars.

### Red Giant Branch Stars (RGBs)



### Blue Horizontal Branch Stars (BHBs)



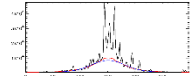
The BATC photometry provides unique information of the spectral type and existence of peculiar spectral lines of each object in the field, more so than a CMD.

### Data Reduction and Calibration

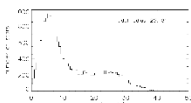
- The coordinates and instrumental magnitudes of stars are resolved with BATC Pipeline II (a customized DAOPHOT package).
- BATC magnitudes (Zhou *et al.*, 2002) are defined on the Oke-Gunn (1983) system as  $A_B$  magnitudes. The  $A_B$  magnitude relates to physical energy flux directly.
- After photometric calibration, we obtained the SED of resolved objects.

### Stellar Population and Color Gradient

Color gradient has been seen almost exclusively in post-core-collapse clusters (in M30, M15 and 47 Tuc, Piotto *et al.* (1988), Burgarella *et al.* (1996), Guhathakurta *et al.* (1998)) which show a power law cusp in the core of their surface brightness profiles. So far there has been only one prominent case of color gradient detected in a King-type globular cluster, NGC 7089 (Sohn *et al.*, 1996). The analysis of individual stellar SEDs in the outer region provide us the information of stellar population so does the color gradient, and after smoothing the extended core of M13 with a proper running-box median filter in order to mask the giant stars, we would exploit if such color gradient (hence stellar population or chemical abundance distribution) exists in M13.



### A Halo in M13???



In the histogram of angular distance from an object detected in i band to the center of M13, we can depict an enhancement in star numbers around the tidal radius. The genuineness of the peak or its possible causes still need further examinations and explanations.

### References

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- Fan, X. *et al.* 1996, AJ, 112, 628
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### Acknowledgments

We would like to thank Zhou Xu and Jiang Zhao-Ji for the great help on data reduction and photometric calibration during Y. S. Li's visit to the Beijing Astronomical Observatory in November, 2002.

Last update: April 18, 2003

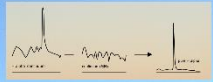
# Young Stellar Population in the Lupus 3 Dark Cloud

Fong-Yi Huang (黄峰毅), Wen-Ping Chen (陈文屏) & Zhi-Wei Zhang (张智威)  
Graduate Institute of Astronomy, National Central University, Zhongli 320, Taiwan

**Abstract:** The Lupus dark clouds are among the nearest star-forming regions. We analyzed a 30'x30' field of the UK Schmidt H-alpha images centered around the 2 A-type stars of the Lupus 3 cloud to identify H-alpha emission stars. Together with the 2MASS infrared colors, a list of 46 candidate T Tauri stars have been identified, among which 22 are new identifications.

## Lupus 3 Dark Cloud

The Lupus dark cloud complex is one of the nearest star-forming regions. Among several dark clouds in Lupus (Fig. 1), the Lupus 3 cloud has the strongest CO emission. Schwartz (1977) in an objective prism H-alpha survey of eastern star-forming regions, found 41 emission stars in the Lupus 3 region. These are likely classical T Tauri stars (CTTS) which are characterized by strong H-alpha emission and IR excess. Krause et al. (1997) used ROSAT data to search for weak-lined T Tauri stars (WTTS). They found that the WTTS spread out over the whole Lupus star-forming region. In this study, we used the archival H-alpha and near-infrared data to conduct a comprehensive survey of the young stellar population in the Lupus 3 dark molecular cloud.



## Data Reduction

We downloaded the H-alpha and SR images of the Lupus 3 cloud from the SRS website. The SR image serves as the continuum. We scaled the star counts, measured by aperture photometry in the H-alpha and SR images by grid and cross so that the majority of stars away from the clouds, i.e., likely non-PMS stars, have null net counts. The continuum image was then subtracted from the H-alpha image (line plus continuum) to get the line image (Fig. 3) from which the net line flux is measured for each star. Choosing a different scaling factor would affect the absolute flux level, which is more relevant anyway because of the non-linearity of the photographic data, but does not change the relative order of the H-alpha strength, i.e., relative strong emission line stars remain so regardless of the scaling. At the end, a list of stars with significant H-alpha line strength (equivalent width) is produced. These H-alpha emission stars are the CTTS candidates.

## Results

We have developed a working pipeline to select young stars in a molecular cloud with archival H-alpha and 2MASS data. In this pilot project, we identified 46 H-alpha emission stars in the central 30'x30' field in the Lupus 3 cloud (Fig. 2), of which 22 have not been cataloged before. Our sample includes all the emission stars previously known except the 3 too close to the two luminous A-type stars. No WTTS have been found. Some of the H-alpha stars show 2MASS colors consistent with being CTTS stars (Fig. 4). This list of CTTS candidates effectively doubles the known young star sample, and once spectroscopically confirmed, would provide the most comprehensive young star population in the Lupus 3 dark molecular cloud.

## References

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- IRPMP, www.irmp.cea.fr
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- Rebers et al., 2003, ApJ 597-276

Fig. 1. Map of the Lupus 3 molecular cloud, marked by a square. This is the same as the SR image, with the color scale in magenta. The color bar on the right indicates the intensity of the CO emission. The color bar on the left indicates the intensity of the H-alpha emission.

Fig. 2. The detection of emission-line stars. The x-axis is 'H-alpha line strength (equivalent width)' and the y-axis is 'H-alpha line strength (equivalent width)'. A diagonal line represents the detection threshold. Points above the line are identified as emission-line stars.

Fig. 3. The line image of the Lupus 3 cloud, obtained by subtracting the continuum image from the H-alpha image. The color scale on the right indicates the intensity of the H-alpha emission.

Fig. 4. 2MASS color-color diagram of the target 3 H-alpha emission stars (red points). The color excess  $E(B-V)$  is shown by the size of the points. The color excess  $E(B-V)$  is shown by the size of the points. The color excess  $E(B-V)$  is shown by the size of the points.

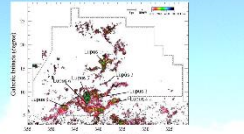


Fig. 1. Map of the Lupus 3 molecular cloud, marked by a square. This is the same as the SR image, with the color scale in magenta. The color bar on the right indicates the intensity of the CO emission. The color bar on the left indicates the intensity of the H-alpha emission.

## UKST H-alpha Survey

The project was done by the UK Schmidt telescope (UKST) of the Anglo-Australian Observatory which surveyed the southern galactic plane with its 1.02 m and the Magellan clouds. Two kinds of H-alpha and G100R filters, as well as the Tech-Pan filter as the detector which provides high resolution and sensitivity. The original plates were scanned by the SuperCOSMOS measuring machines at the Royal Observatory Edinburgh. Online digital atlas of the SuperCOSMOS H-alpha survey (SHS) are available. The SHS provides homogenized data with unprecedented coverage and depth, suitable to study the H-alpha sky.

# A photo of yours? A QR code of the poster or of a relevant paper of yours?

## Light Curve Analysis of AZ Capricorni – A Low-Mass Member in the Beta Pictoris Moving Group

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## Abstract

AZ Capricorni (BD 1761218), is an X-ray source and a variable star with uncertain variability. The star is one of the members in the beta Pictoris moving group (BPMG), which consists of 28 known stellar systems sharing the similar space moving motion as beta Pic, the famous star with a prominent planetary debris disk. The BPMG, at a typical distance 36 pc from the earth, and with an age of 20 Myr, represents an interesting case of dissolving stellar groups after star formation out of parental molecular clouds. Here we present the light curves of AZ Cap, a low-mass member in the BPMG, collected with telescopes at Tainan and at Lulin from 2010 to 2012 to shed light on the nature of this star.

## Moving groups of stars

It is widely accepted that stars are formed in groups out of molecular clouds, with dozens to thousands of members. These clusters disassociate with time (Zuckerman et al. 2001), but the members still share the same motion through space. Members in a moving group have the same origin, or even an relatively old system could be diagnosed of its evolutionary state by studying individual members widely separately in the sky.

## The Beta Pic Moving Group

The Beta Pictoris moving group (BPMG) is a young moving group of stars located relatively near Earth, sharing a common motion through space as well as a common origin. Beta Pictoris, the title member of the BPMG, has a prominent planetary debris disk detected by the IRAS.

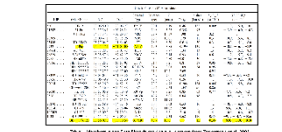


Fig. 1. Light curve of AZ Cap, showing the variation of the star's brightness over time. The x-axis is 'Time (JD - 2454900)' and the y-axis is 'Mag (V)'. The plot shows a series of data points with error bars and a fitted curve, indicating periodic variability.

## AZ Capricorni

AZ Cap (BD 1761218, RA=20:56:02.7, DEC=-17:10:54, J2000), a member of the BPMG, is 47.7 pc from the Earth (Zuckerman et al. 2001). The star emits copious X-rays (Chen et al. 2006) is of spectral type K7, and is a known variable with a possible period of about 3.4032 day (Messina et al. 2010), on the basis of the ASAS Automated Survey (ASAS, Pajunowski 1997) data. The ASAS gives V=10.45, B-V=0.68 and classifies the star as a CV-FU (or Viregins Cepheids) or BY-UV (rotating variable) type of variable (Pajunowski 2004). The 2MASS data, J=7.85, H=7.25, and Ks=7.04 suggest induced a late type dwarf. The nature of AZ Cap, regarding the origin of the X-ray emission or its flux variability, however, remains elusive. Here we present the study of the star, including the photometric monitoring with a time span of 2 years from 2010 to 2012. The figure on the right shows the finding chart of the AZ Cap field along with the 4 possible reference stars for photometric comparison.

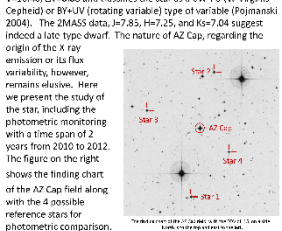


Fig. 2. WISE/MIR color-color diagram of all stars (gray), and Class I (blue) and Class II (orange) YSOs selected by colors.

## Observations

We use the 0.81 m Imager II (32") telescope in Tucson, Arizona, USA and the SU (40 cm) at Lulin Observatory to perform imaging photometry of AZ Cap in the B, V and R bands. In 2010 the target was observed only in three nights with 48 measurements. The monitoring was intensified in 2011 (from September 26 to December 11), and continued in 2012. In each session we usually started with a complete set of BVR images, followed by a few R band images within a night, normally with an exposure time of 10 seconds. The differential light curve of AZ Cap, mag (AZ Cap) minus mag (RefSt), from end of 2010 to end of 2012 is shown below. The variability is obvious, when compared with mag (RefSt) minus mag (RefSt).

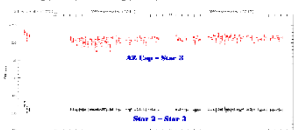


Fig. 3. 2MASS-NIR color-color diagram of all stars (gray), NIR excess stars (black) and H-alpha stars (red).

## Periodicity

The 2012 light curve, analyzed by the NASA Exoplanet Archive Periodogram Service site (<http://exoplanetarchive.ipac.caltech.edu>) shows a possible period of 3.4 d (see figure on the right). Interestingly, the 2011 data, generally with much larger variation amplitude, did not seem to show the same period.

## Discussion

Chen et al. (2006) analyzed the X-ray property of AZ Cap, using an earlier ASAS classification as an M UG star. While the period and X-ray emission are consistent with the classification, the quasi-periodic, and often abrupt photometric variations in AZ Cap presented here indicate that the star should be a BY UV variable, which is a late-type dwarf with rotational variability due to star spots and chromospheric activity. Close inspection revealed a close comparison (see inset), whose effects on the confusion of the various peculiar properties of AZ Cap await further investigations.

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# Diagnosing triggered star formation in the cloud complex Sh-142/NGC 7380

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<sup>1</sup>Graduate Institute of Astronomy, National Central University  
<sup>2</sup>Aryabhata Research Institute of Observational Sciences  
<sup>3</sup>Purple Mountain Observatory



## Introduction and Motivation

Star formation does not occur in isolation, but rather in a molecular cloud complex, it is an intricate interplay of gas, dust and stars already in existence in the vicinity. Fierce stellar winds or UV radiation from massive stars may disperse nearby cloud, hampering further starbirth. Alternatively, under certain conditions, the stars could photoionize the surface of a nearby molecular cloud (a bright-rimmed cloud), leading to an impulsive shock to trigger the formation of the next generation of stars. Here we present such evidence of triggered star formation in a molecular cloud complex.

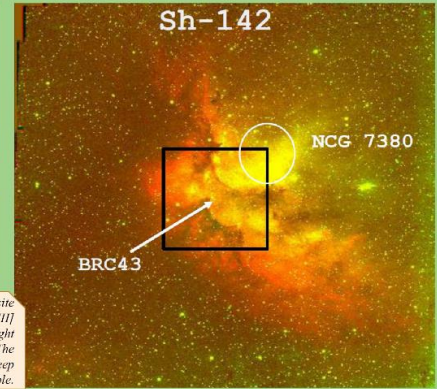
## Target of Study

Here we investigate the triggered star formation activity in Sh-142 /Sharpless 142, a prominent HII region at 2.4 kpc, associated with the bright rimmed cloud BRC 43, and the open cluster NGC 7380. The spectroscopic binary DH Cep dominates ionizing activity of the region.

## Data

- Archival NIR (2MASS) and MIR (WISE) data
- Optical BVI images for BRC 43
- Molecular emissions of <sup>13</sup>CO/<sup>13</sup>CO/<sup>12</sup>CO

Figure 1. Color composite image H-alpha (red) and O(III) (green) of Sh-142 and bright rimmed cloud BRC 43. The black square marks where deep optical image is available.



## Young Stellar Candidates

- H-alpha emission stars near BRC 43 (Ogura et al. 2002), and NIR-excess stars (with dusty circumstellar disks) are pre-main sequence stars signifying recent star formation.
- MIR-excess stars signpost embedded objects with ongoing star formation. They are selected by IR colors Koenig et al. (2012)

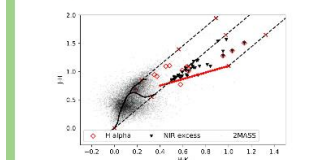


Figure 2. 2MASS-NIR color-color diagram of all stars (gray), NIR excess stars (black) and H-alpha stars (red).

## Protostars

Stars being formed within dense molecular cores, i.e., protostars, exhibit characteristic prominent thermal emissions from circumstellar dust, as indicated by their spectral energy distributions

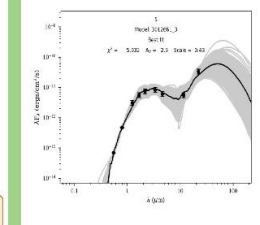


Figure 4. The spectral energy distribution of an example a Class I object (protostar)

## Molecular Clouds

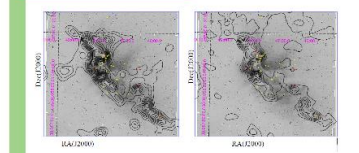


Figure 5. (Left) <sup>12</sup>CO (1-0) and (Right) <sup>13</sup>CO (1-0) contours on the H-alpha image. Candidates of Class I (red) and Class II (yellow) YSOs selected by IR colors are marked.

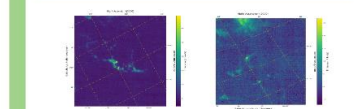


Figure 6. <sup>12</sup>CO (1-0) integrated emission (Left) in velocity range -50 km/s to +35 km/s, and (Right) in velocity range -35 km/s to 0 km/s

## Evidence of triggered star formation

- YSOs line up along the interface between molecular gas and ionized gas(HII).
- Class I sources are found to be embedded in molecular clouds.
- Class II sources are mostly located at the periphery of the molecular clouds or HII region
- No sources deeply embedded in BRC 43 are found in our data.

## References

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- Chen W. P., et al., 2011, AJ, 142, 71

- Koenig, X. P., et al. 2012, ApJ, 744, 130

## Triggered and Induced Star Formation in the Orion and Monoceros Molecular Clouds

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Abstract: We investigate the triggered star formation in the Orion and Monoceros molecular clouds. We use the archival H-alpha and near-infrared data to conduct a comprehensive survey of the young stellar population in the Orion and Monoceros molecular clouds.

## Theory of Triggered Star Formation

Stars are formed in groups out of molecular clouds, with dozens to thousands of members. These clusters disassociate with time (Zuckerman et al. 2001), but the members still share the same motion through space. Members in a moving group have the same origin, or even an relatively old system could be diagnosed of its evolutionary state by studying individual members widely separately in the sky.

## Small Scale Triggering

Direct triggering of pre-existing clouds is induced by high velocity. This includes triggering by high-velocity protostars and small cometary objects.



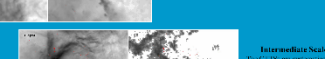
## Intermediate Scale Triggering

Compression of pre-existing clouds into dense cores, leading to the formation of new stars.



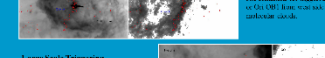
## Large Scale Triggering

Compression of pre-existing clouds into dense cores, leading to the formation of new stars.



## Observations of Triggered Star Formation in the Orion and Monoceros Molecular Clouds

We use the archival H-alpha and near-infrared data to conduct a comprehensive survey of the young stellar population in the Orion and Monoceros molecular clouds.



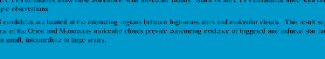
## Small Scale Triggering

Direct triggering of pre-existing clouds is induced by high velocity. This includes triggering by high-velocity protostars and small cometary objects.



## Intermediate Scale Triggering

Compression of pre-existing clouds into dense cores, leading to the formation of new stars.



## Large Scale Triggering

Compression of pre-existing clouds into dense cores, leading to the formation of new stars.



Figure 1. Light curve of AZ Cap, showing the variation of the star's brightness over time. The x-axis is 'Time (JD - 2454900)' and the y-axis is 'Mag (V)'. The plot shows a series of data points with error bars and a fitted curve, indicating periodic variability.

Figure 2. WISE/MIR color-color diagram of all stars (gray), NIR excess stars (black), and H-alpha stars (red).

Figure 3. 2MASS-NIR color-color diagram of all stars (gray), NIR excess stars (black) and H-alpha stars (red).

Figure 4. The spectral energy distribution of an example a Class I object (protostar)

Figure 5. (Left) <sup>12</sup>CO (1-0) and (Right) <sup>13</sup>CO (1-0) contours on the H-alpha image. Candidates of Class I (red) and Class II (yellow) YSOs selected by IR colors are marked.

Figure 6. <sup>12</sup>CO (1-0) integrated emission (Left) in velocity range -50 km/s to +35 km/s, and (Right) in velocity range -35 km/s to 0 km/s

Figure 7. 2MASS-NIR color-color diagram of all stars (gray), NIR excess stars (black), and H-alpha stars (red).

Figure 8. WISE/MIR color-color diagram of all stars (gray), NIR excess stars (black), and H-alpha stars (red).

Figure 9. The spectral energy distribution of an example a Class I object (protostar)

Figure 10. (Left) <sup>12</sup>CO (1-0) and (Right) <sup>13</sup>CO (1-0) contours on the H-alpha image. Candidates of Class I (red) and Class II (yellow) YSOs selected by IR colors are marked.

Figure 11. <sup>12</sup>CO (1-0) integrated emission (Left) in velocity range -50 km/s to +35 km/s, and (Right) in velocity range -35 km/s to 0 km/s

Figure 12. WISE/MIR color-color diagram of all stars (gray), NIR excess stars (black), and H-alpha stars (red).

Figure 13. The spectral energy distribution of an example a Class I object (protostar)

Figure 14. (Left) <sup>12</sup>CO (1-0) and (Right) <sup>13</sup>CO (1-0) contours on the H-alpha image. Candidates of Class I (red) and Class II (yellow) YSOs selected by IR colors are marked.

Figure 15. <sup>12</sup>CO (1-0) integrated emission (Left) in velocity range -50 km/s to +35 km/s, and (Right) in velocity range -35 km/s to 0 km/s

Figure 16. WISE/MIR color-color diagram of all stars (gray), NIR excess stars (black), and H-alpha stars (red).

Figure 17. The spectral energy distribution of an example a Class I object (protostar)

Figure 18. (Left) <sup>12</sup>CO (1-0) and (Right) <sup>13</sup>CO (1-0) contours on the H-alpha image. Candidates of Class I (red) and Class II (yellow) YSOs selected by IR colors are marked.

Figure 19. <sup>12</sup>CO (1-0) integrated emission (Left) in velocity range -50 km/s to +35 km/s, and (Right) in velocity range -35 km/s to 0 km/s

Figure 20. WISE/MIR color-color diagram of all stars (gray), NIR excess stars (black), and H-alpha stars (red).

Figure 21. The spectral energy distribution of an example a Class I object (protostar)

Figure 22. (Left) <sup>12</sup>CO (1-0) and (Right) <sup>13</sup>CO (1-0) contours on the H-alpha image. Candidates of Class I (red) and Class II (yellow) YSOs selected by IR colors are marked.

Figure 23. <sup>12</sup>CO (1-0) integrated emission (Left) in velocity range -50 km/s to +35 km/s, and (Right) in velocity range -35 km/s to 0 km/s

Figure 24. WISE/MIR color-color diagram of all stars (gray), NIR excess stars (black), and H-alpha stars (red).

Figure 25. The spectral energy distribution of an example a Class I object (protostar)

Figure 26. (Left) <sup>12</sup>CO (1-0) and (Right) <sup>13</sup>CO (1-0) contours on the H-alpha image. Candidates of Class I (red) and Class II (yellow) YSOs selected by IR colors are marked.

Figure 27. <sup>12</sup>CO (1-0) integrated emission (Left) in velocity range -50 km/s to +35 km/s, and (Right) in velocity range -35 km/s to 0 km/s

Figure 28. WISE/MIR color-color diagram of all stars (gray), NIR excess stars (black), and H-alpha stars (red).

Figure 29. The spectral energy distribution of an example a Class I object (protostar)

Figure 30. (Left) <sup>12</sup>CO (1-0) and (Right) <sup>13</sup>CO (1-0) contours on the H-alpha image. Candidates of Class I (red) and Class II (yellow) YSOs selected by IR colors are marked.

Figure 31. <sup>12</sup>CO (1-0) integrated emission (Left) in velocity range -50 km/s to +35 km/s, and (Right) in velocity range -35 km/s to 0 km/s

Figure 32. WISE/MIR color-color diagram of all stars (gray), NIR excess stars (black), and H-alpha stars (red).

Figure 33. The spectral energy distribution of an example a Class I object (protostar)

Figure 34. (Left) <sup>12</sup>CO (1-0) and (Right) <sup>13</sup>CO (1-0) contours on the H-alpha image. Candidates of Class I (red) and Class II (yellow) YSOs selected by IR colors are marked.

Figure 35. <sup>12</sup>CO (1-0) integrated emission (Left) in velocity range -50 km/s to +35 km/s, and (Right) in velocity range -35 km/s to 0 km/s

Figure 36. WISE/MIR color-color diagram of all stars (gray), NIR excess stars (black), and H-alpha stars (red).

Figure 37. The spectral energy distribution of an example a Class I object (protostar)

Figure 38. (Left) <sup>12</sup>CO (1-0) and (Right) <sup>13</sup>CO (1-0) contours on the H-alpha image. Candidates of Class I (red) and Class II (yellow) YSOs selected by IR colors are marked.

Figure 39. <sup>12</sup>CO (1-0) integrated emission (Left) in velocity range -50 km/s to +35 km/s, and (Right) in velocity range -35 km/s to 0 km/s

Figure 40. WISE/MIR color-color diagram of all stars (gray), NIR excess stars (black), and H-alpha stars (red).

Figure 41