

IGRINS Newsletter -- 2016 Trimester 2

Dear IGRINS community:

At the end of July 2016 IGRINS will have had more than 350 nights at McDonald Observatory since commissioning in Spring 2014. In the last year there have been 10 papers published with IGRINS observations and there are another dozen papers in preparation. It has been a very busy two years, and in August 2016 IGRINS will be back at UT Austin for annual maintenance.

As announced in the last McDonald Observatory call for proposals, IGRINS will not be available next trimester at McDonald Observatory. Instead, IGRINS will be at the Discovery Channel Telescope (DCT) in a partnership with Lowell Observatory. Commissioning is scheduled for September 2016 and we will use community suggested science targets. See below for more information on our DCT plans.

We also take this opportunity to announce that Kimberly Sokal will become the new IGRINS postdoc at UT, starting in July 2016. She is coming from the University of Virginia and will manage future IGRINS planning along with the team.

This fall Dr. Hwi Hyun Kim will also be leaving the team and joining Gemini Observatory in Chile as an Assistant Scientist. With more than 130 IGRINS observing nights in the last two years, and a knack for building bridges between the UT and KASI communities, her knowledge and initiative will be missed on the team. We wish her the best in this new opportunity.

Science publications are a major goal for the IGRINS instrument team, so please contact us if you are a current or prospective IGRINS user who needs any guidance getting your paper to submission. We would like to advertise IGRINS successes on department websites and through press releases. So, please don't hesitate to share your science!

With best wishes,
Dan Jaffe and the IGRINS Team

1. Current IGRINS Status and Performance

IGRINS is ready for its summer maintenance after a few minor hiccups and heavy use throughout the first half of 2016. Small recurring issues, like detector communication loss and unstable temperature regulation, have continued to impact us and long-term solutions to these problems will be the focus of our summer maintenance work. In May 2016, our instrument control computer failed and we switched to using the data storage computer for observing. A replacement control computer is now in place at McDonald and IGRINS observing is proceeding as before. We continue to work on converting IGRINS into a facility instrument, which will be tested with our DCT deployment this fall. Documentation and procedural notes are being compiled and numerous spare components are on order.

2. Scientific Data from the McDonald Commissioning Runs

Any member of the astronomical community may examine the IGRINS commissioning data to help form their future proposals. Science verification data from the commissioning runs are processed using the current pipeline and available online (<http://kgmtscience.kasi.re.kr/igrins/pipeline/>). Please be sure to read the "Sample Data Policy" also available on the same website. More information on these data can be found in previous newsletters:

<https://wikis.utexas.edu/display/IGRINS/IGRINS+Newsletters>

3. IGRINS DCT Commissioning

IGRINS+DCT commissioning in September 2016 will use community suggested targets for any on-sky testing. There will be ~5 nights for testing guiding, pointing, software communication and instrument performance. To request an observation during commissioning, please complete this form <http://goo.gl/forms/EYnM5WB81e4tIZRq1>. IGRINS observations during commissioning will be general use for the community (DCT, UT, KASI) to get all users acquainted with IGRINS data, but will be proprietary for publication to the requester for 24 months.

Typical observations with IGRINS on DCT are expected to be ABBA nod sets with 300 second exposures. For a $K=10$ target, this should provide peak signal-to-noise of ~150 per resolution element. The bright limit for IGRINS on DCT will be $K=4$, and typical targets should be fainter than $K=8$ to keep exposure times greater than pointing and acquisition overheads. The faint limit for IGRINS will be $K\sim 13$, depending on the observing conditions and the desired signal, with 2 hours of exposure time providing signal-to-noise ~90 at this limit. If your target is fainter than $K=11$, then you should have an off-slit guide star prepared for your target or plan to hand guide. For extended targets, we will gain higher spatial resolution with the same/similar brightness limit as at McDonald. The IGRINS slit at DCT is 0.63 arcseconds wide and 9.42 arcseconds long. As a high-resolution, near-IR spectrograph, IGRINS can be used in both bright and dark time.

For additional background on IGRINS instrument performance, please see Park et al. (2014, <http://adsabs.harvard.edu/abs/2014SPIE.9147E..1DP>).

4. IGRINS at DCT Quarter 4 (October, November, December) 2016

IGRINS+DCT science time for this first visit is planned between 1 October 2016 and 28 February 2017. We anticipate ~10 queue nights in this timeframe for UT and KASI astronomers not part of the KASI Legacy programs or the UT YSO program. Seven of these nights will be scheduled in 2016Q4. Science requests by UT and KASI astronomers are welcome at this link, <http://goo.gl/forms/UGh7DCIryHhJXYID2>

The KASI Legacy (<http://kgmtscience.kasi.re.kr/drupal/content/igrins-dct-visit>) and UT YSO guaranteed programs for IGRINS will have a similar number of nights to the queue and will not request queue time. We continue to encourage collaboration with these programs rather than requesting separate observations of the same sources. Please contact these groups if you would like to collaborate.

It is our intention that IGRINS will visit the DCT for half a year at a time, for the next 3 years. Future visits are not yet scheduled.

Science Highlights:

A few of the initial science results from IGRINS are discussed below. If you would like to share your progress in the next newsletter, please let us know and we will be sure to contact you when we begin to put it together. If you have plans to publish IGRINS results soon, then be sure to contact the IGRINS PIs to make sure that your work follows team guidelines. Publication guidelines can be found at the end of the newsletter.

ADS Listed Science Papers:

Zodiacal Exoplanets in Time (ZEIT) III: A Neptune-sized planet orbiting a pre-main-sequence star in the Upper Scorpius OB Association, Andrew W. Mann, Elisabeth R. Newton, Aaron C. Rizzuto, Jonathan Irwin, Gregory A. Feiden, Eric Gaidos, Gregory N. Mace, Adam L. Kraus, David J. James, Megan Ansdell, David Charbonneau, Kevin R. Covey, Michael J. Ireland, Daniel T. Jaffe, Marshall C. Johnson, Benjamin Kidder, Andrew Vanderburg, Submitted to ApJ, arXiv:1604.06165

A Candidate Young Massive Planet in Orbit around the Classical T Tauri Star CI Tau, Christopher M. Johns-Krull, Jacob N. McLane, L. Prato, Christopher J. Crockett, Daniel T. Jaffe, Patrick M. Hartigan, Charles A. Beichman, Naved I. Mahmud, Wei Chen, B. A. Skiff, P. Wilson Cauley, Joshua A. Jones, G. N. Mace, Accepted to ApJ, arXiv:1605.07917

IGRINS Spectroscopy of Class I sources: IRAS 03445+3243 and IRAS 04239_2436, Seokho Lee, Jeong-Eun Lee, Sunkyung Park, Jae-Joon Lee, Benjamin Kidder, Gregory Mace, and Daniel T. Jaffe, Accepted to ApJ, arXiv:1605.07261

Direct Spectroscopic Detection: An Efficient Method to Detect and Characterize Binary Systems, Kevin Gullikson, Adam Kraus, Sarah Dodson-Robinson, Daniel Jaffe, Jeong-Eun Lee, Gregory N. Mace, Phillip MacQueen, Sunkyung Park, and Andrew Riddle, *AJ*, 2016, 151, 3

IGRINS Near-IR High-Resolution Spectroscopy of Multiple Jets around LkHa 234, Heeyoung Oh, Tae-Soo Pyo, In-Soo Yuk, Beyong-Gon Park, Chan Park, Moo-Young Chun, Soojong Pak, Kang-Min Kim, Jae Sok Oh, Ueejeong Jeong, Young Sam Yu, Jae-Joon Lee, Hwihyun Kim, Narae Hwang, Kyle Kaplan, Michael Pavel, Gregory Mace, Hye-In Lee, Huynh Anh Nguyen Le, Sungho Lee, and Daniel T. Jaffe, *ApJ*, 2016, 817, 148

Zodiacal Exoplanets In Time (ZEIT) I: A Neptune-sized planet orbiting an M4.5 dwarf in the Hyades Star Cluster, Andrew Mann, Eric Gaidos, Gregory Mace, Marshall Johnson, Brendan Bowler, Daryll LaCourse, Thomas Jacobs, Andrew Vanderburg, Adam Kraus, Kyle Kaplan, and Daniel Jaffe, *ApJ*, 2016, 818, 46

The Chemical Compositions of Very Metal-Poor Stars HD 122563 and HD 140283; A View From the Infrared, Melike Afsar, Christopher Sneden, Anna Frebel, Hwihyun Kim, Gregory N. Mace, Kyle F. Kaplan, Hye-In Lee, Hee-Young Oh, Jae Sok Oh, Soojong Pak, Chan Park, Michael D. Pavel, In-Soo Yuk, Daniel T. Jaffe, *ApJ*, 2016, 819, 103

Discovery of Rubidium, Cadmium, and Germanium Emission Lines in the Near-Infrared Spectra of Planetary Nebulae, Nicholas C. Sterling, Harriet L. Dinerstein, Kyle F. Kaplan, and Manuel A. Bautista, *ApJL*, 2016, 819, L9

High Resolution Optical and NIR Spectra of HBC 722, Jeong-Eun Lee, Sunkyung Park, Joel D. Green, William D. Cochran, Wonseok Kang, Sang-Gak Lee, Hyun-Il Sung, *ApJ*, 2015, 807, 84

Zodiacal Exoplanets in Time (ZEIT) II. A "Super-Earth" Orbiting a Young K Dwarf in the Pleiades Neighborhood, Eric Gaidos, Andrew Mann, Aaron Rizzuto, Larissa Nofi, Gregory Mace, Andrew Vanderburg, Gregory Feiden, Narita, Takeda, Tom Esposito, De Rosa, Ansdell, Hirano, Graham, Adam Kraus, Dan Jaffe, 2016, submitted to *MNRAS*, arXiv:1606.0581

Fluorescent H₂ Emission Lines from the Reflection Nebulae NGC 7023 observed with IGRINS

Huynh Anh N. Le, Soojong Pak, and the IGRINS Team

We have observed the northwestern (NW) filament of the reflection nebulae NGC 7023 using the Immersion Grating Infrared Spectrograph (IGRINS). Within the 1'' x 15'' slit, we combined pixels to define three sub-regions, each of which covers an area of 1'' x 5''. From the 66 detected H₂ emission lines, the estimated ortho-to-para ratios (OPR) are 1.53-1.87, indicating that the H₂ transitions in the observed regions are mostly from UV fluorescence. The gradients of temperature, velocity, and ortho-to-para ratios (OPR) of H₂ emission in the observed areas demonstrate the motion of the photodissociation region (PDR) front relative to the molecular cloud. In addition, we derive the column density of H₂ and compare these results with the PDR models in the literature covering a range of densities and incident UV field intensities. The noticeable difference between the PDR model predictions and the observed data in high rotational J levels of $\nu = 1$ shows that the formation temperature for newly formed H₂ should be lower. In order to investigate the density distribution, we also combine pixels in an area of 1'' x 1'' and derive the density in 0.002 pc scale. The gradient of density suggests that the area has a clumpy structure, including high density clumps of $\sim 10^5 \text{ cm}^{-3}$ with a size smaller than ~ 0.005 pc embedded in lower density regions of 10^3 - 10^4 cm^{-3} .

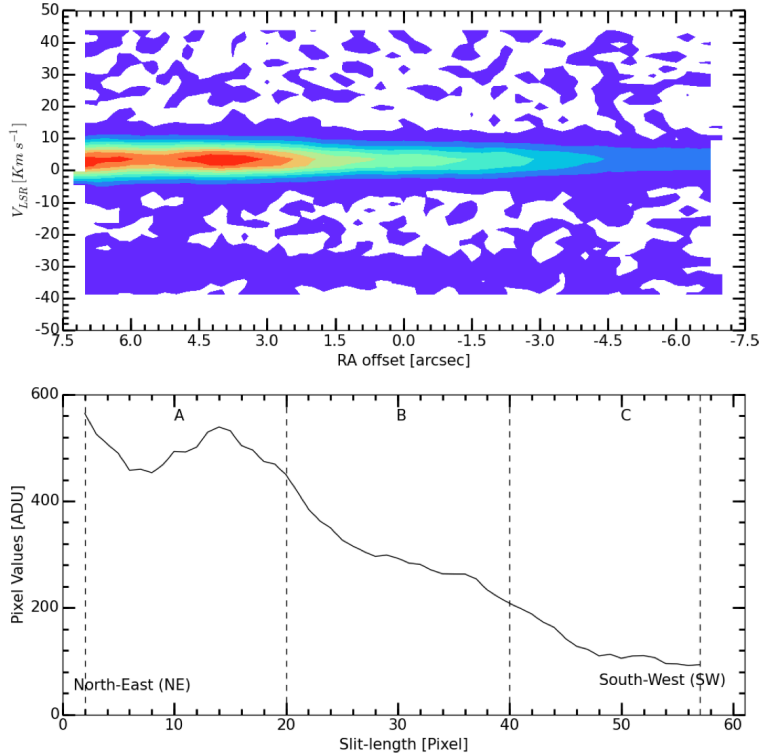


Fig. 2.— Radial velocity diagram of the 1-0 S(1) line (top plot). In the diagram, 1'' = 3.66 pixels. The bottom plot shows the intensity profile at the peak of the 1-0 S(1) line. The black-dash lines show the separated regions, A, B, and C along the slit-length.

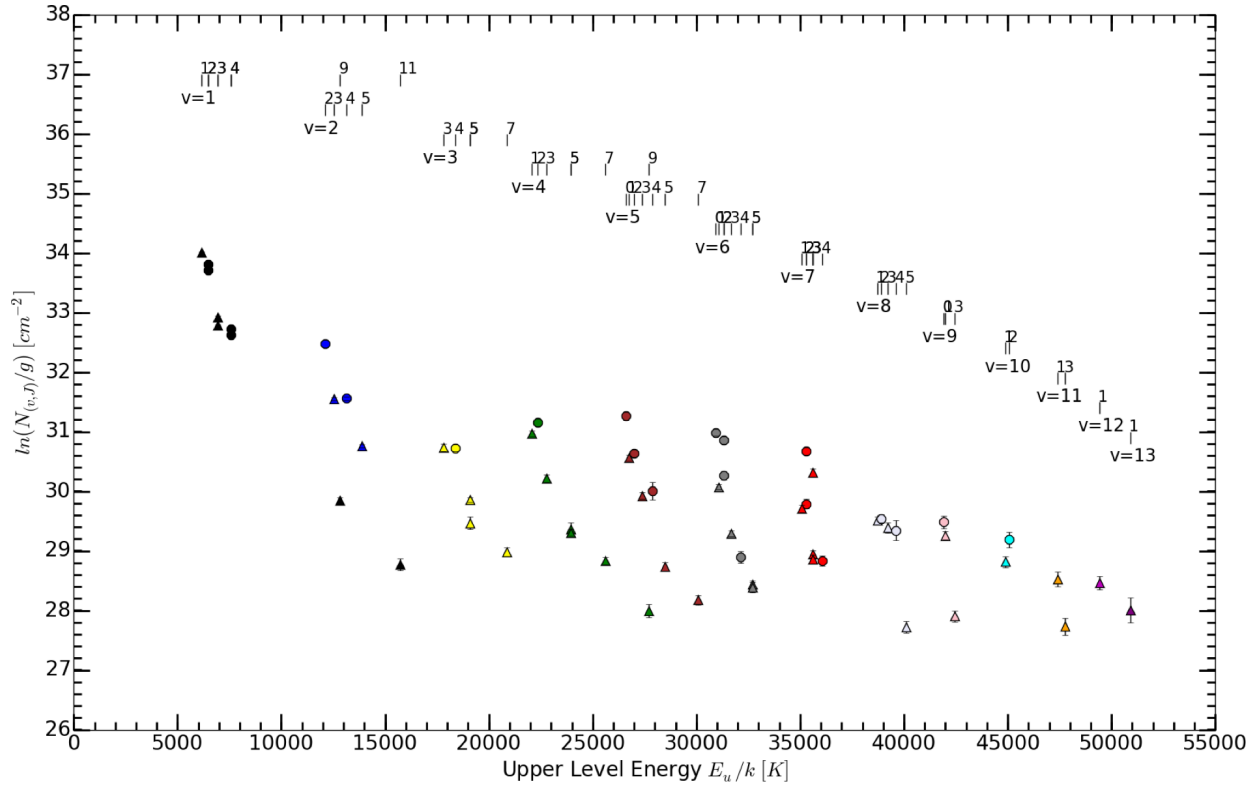
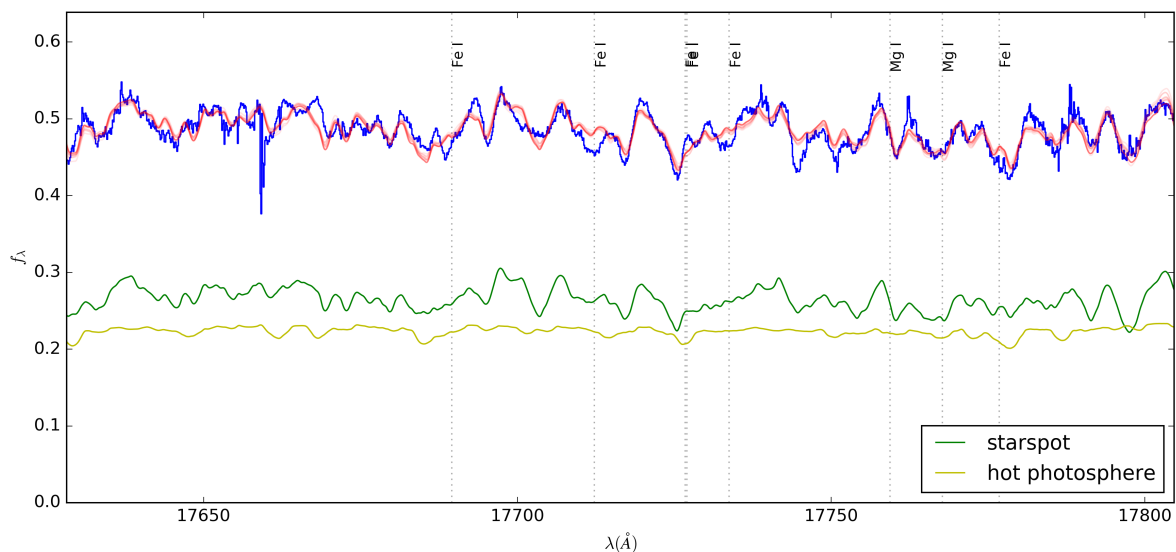


Fig. 11.— Excitation diagram of the H₂ level column density distribution for region A.

The observed column densities have been corrected for extinction, $A_V = 2.2$ mag. The column densities have been divided by the level degeneracies, assuming the ortho-to-para ratio is 3. The circles and triangles present the ortho and para H₂, respectively.

Starfish Forward Modeling for Stellar Parameters

Michael Gully-Santiago (Kavli Institute for Astronomy and Astrophysics) has forward modeled IGRINS data using the spectral inference framework described in Czekala et al. 2015. The framework leverages pre-computed synthetic spectral model grids to derive stellar parameters from all spectral orders in the presence of spectral line outliers and calibration artifacts. Gully-Santiago extended the framework to model composite spectra attributable to cool starspots, disk emission veiling, and binarity. The software has been demonstrated on a variety of computer system architectures, including the Texas Advanced Computing Center. The Python 3 open source codebase is being actively developed at <http://www.github.com/gully/Starfish>. Using this technique, Gully-Santiago has measured the temperature and areal coverage fraction of starspots on the heavily spotted weak-lined T-Tauri star (wTTs) LkCa 4. The results were demonstrated at the 19th Cambridge Workshop on Cool Stars, Stellar Systems and the Sun in Uppsala, Sweden in a poster: <https://zenodo.org/record/58442>. Gully-Santiago is seeking IGRINS data on more wTTs systems to expand the sample of pre-Main Sequence sources for which starspot properties have been measured.



Publication policy

Observing PIs are expected to analyze and publish their data promptly. It is up to each observing group to determine the number and type of publications to produce from any observing run.

Decisions about authors and author orders of general publications are the responsibility of the proposal PI. The IGRINS team member(s) on the observing proposal(s) should be included as paper authors. Wherever possible, PI's should seek reasons to give first authorships to junior team members, in particular to students and postdocs. All authors should have intellectual ownership of the material and have contributed to the work. The IGRINS team is committed to ethics in publication and does not condone "courtesy" authorships.

When several groups are working on similar science programs, the IGRINS team will try to inform the groups of this fact. While we encourage appropriate collaboration and data-sharing between groups, it is up to the groups themselves to make such arrangements.

The IGRINS team will archive IGRINS spectra. The current proprietary period is 24 months from the date the data are taken. At the discretion of either the UT or KASI PI's, this period can be extended for up to 36 months upon request for graduate students who have not yet completed their dissertation. Observing groups, will be subject to the policy that was in place at the time their observing time was awarded.

Refereeing:

The IGRINS team will have an internal refereeing process for observing and instrumentation papers. We strongly recommend that all papers to be submitted to a refereed journal and using IGRINS data or technical information go through the IGRINS internal refereeing process. Papers for non-refereed conference proceedings may also make use of this service. The PI or a designee will serve as IGRINS editor. First authors should submit papers that are ready for publication to the IGRINS editor in pdf form. Comments and suggestions will be sent to the author within 3 weeks. Revisions in response to these comments can be made at the discretion of the authors but there will be no further review.

Authors should inform the IGRINS editor of the acceptance of *all* papers, refereed and non-refereed, at the time of acceptance, giving the title, journal, volume, and author list.

Acknowledgements:

Any paper using IGRINS science or engineering data must reference the designated IGRINS instrument paper(s):

Park, C. et al., "Design and early performance of IGRINS (Immersion Grating Infrared Spectrometer)," Proc. SPIE 9147 (2014).

Authors should inquire of one of the PIs about the appropriate references and the recommended form of the acknowledgement at the time of submission. Currently, the correct acknowledgement reads:

"This work used the Immersion Grating Infrared Spectrograph (IGRINS) that was developed under a collaboration between the University of Texas at Austin and the Korea Astronomy and Space Science Institute (KASI) with the financial support of the US National Science Foundation under grant AST-1229522, of the University of Texas at Austin, and of the Korean GMT Project of KASI."

Talks and Colloquia:

The IGRINS editor should be informed of any IGRINS conference talks or colloquia given by team members or observing PIs. No approval is needed for talks about one's own results. Review talks or summary talks about IGRINS results or instrument performance, however, should have approval of the PI of the speaker's team.