High Resolution Spectroscopy with IGRINS

Seoul Korea, 12-13 Nov. 2015

IGRINS Instrument Development and Maintenance one Year

Park, Chan (KASI)

Abstract

The IGRINS instrument development was performed from 2009 to 2013 and commissioned March 2014 at the McDonald Observatory. After one year successful operation since the science commissioning in Sept 2014, IGRINS was moved to UT Astronomy laboratory and serviced as the first regular maintenance check-up. In this talk, some of the characteristic features of the IGRINS instrument development and the progress of the summer maintenance will be reported.

Status of IGRINS Pipeline

Lee, Jae-Joon (KASI)

Abstract

I will present current status of the IGRINS data reduction pipeline. The pipeline takes raw detector images and produce extracted 1-d spectra and/or rectified 2-d spectra, with wavelength solutions that are derived using OH lines from sky spectra and further refined by telluric absorption features. I will also describe the characteristics of raw IGRINS data and possible artifacts. And I will discuss how these are mitigated in the pipeline and possible caveats that users need to be aware. Finally, future development plan of the pipeline will be discussed.

Spectroscopic Inference Techniques for IGRINS

Gully-Santiago, Michael (Kavli Institute for Astronomy and Astrophysics)

Abstract

The high resolution, high signal-to-noise ratio, high bandwidth spectra from IGRINS present an analysis challenge. There are few spectral atlases in the near-infrared at R~40,000 or greater. Spectral synthesis techniques like MOOG require painstaking iterative user-intervention to cover the large spectral bandwidth. Coarsely sampled grid spacings and missing model physics hinder the comparison of data to pre-computed synthetic stellar model grids. For example, poor oscillator strengths and limited line lists yield outlying line residuals. Recently Czekala et al. (2015) presented a strategy to forward model synthetic spectra with a flexible likelihood function in a robust framework for spectroscopic inference that can grapple with outlying spectral line residuals and coarsely sampled model grids. The tool--Starfish-- includes a strategy for emulating, and deriving and tracking the uncertainties associated with, synthetic spectra between pre-computed gridpoints. In this talk I will show how Starfish can be applied to IGRINS data, and how it's statistical framework can be expanded to solve simultaneously for stellar parameters, calibration parameters, and other physical parameters of interest. We present some limitations and future challenges. An expanded version of Starfish holds the power to drastically simplify the analysis challenge of IGRINS data of any type, provided that precomputed models grids are available. The Starfish code is open sourced, parallelized, maintained, documented, and permissively licensed.

2-D Analysis of Extended Objects with IGRINS: Constructing and Extracting Information from Position-Velocity Diagrams and Data Cubes

Kaplan, Kyle (UT Austin)

Abstract

2-D Analysis of Extended Objects with IGRINS: Constructing and Extracting Information from Position-Velocity Diagrams and Data Cubes

GMTNIRS

Jaffe, Dan (UT Austin)

Abstract

GMTNIRS

iSHELL: a 1.2-5.3 micron cross-dispersed R=70,000 immersion grating spectrograph for IRTF

Rayner, John (University of Hawaii)

Abstract

iSHELL is 1.2-5.3 micron high resolution spectrograph being built for the NASA Infrared Telescope on Maunakea, Hawaii. Dispersion is done with a silicon immersion grating provided by the University of Texas at Austin. The grating is of the same type as that used in IGRINS. iSHELL is optimized for 3-5 micron spectroscopy but also provides coverage of 1.2-2.5 micron. With wider wavelength range but smaller one-shot wavelength coverage the science capabilities of iSHELL complement those of iGRINS. First light is expected in mid-2016. Observing time with iSHELL will be open to all astronomers. I will discuss the design of iSHELL and its science capabilities.

IGRINS Survey of Protoplanetary Disks

Lee, Jeong-Eun (Kyung Hee University)

Abstract

Observations of the inner gaseous disks are important to understand the formation process of stars and planets since the

line features can provide information on accretion, wind, and rotation as well as the timescales of gas dissipation and/or planet formation. Although the inner disks are too small to be resolved spatially, they can be studied with high spectral resolution since different radii can be separated in velocity. The accurate measuring of the line width is also able to distinct the origin of the line, for example, disks, accretion flows, or inner winds. We here present the results from our survey of protoplanetary disks in wide ranges of age, luminosity, and mass (from Class I to wTTSs, and from low-mass TTSs to Herbig Ae/Be stars and massive YSOs) with IGRINS. We also observed FU Orionis-type objects to study the effect of heating by outburst on the physical structure in disks.We will focus on the hydrogen recombination lines, the H2 S(1) line, and the CO overtone lines to study the accretion, wind, and disk rotation, respectivley.

IGRINS spectroscopy of Class I sources: IRAS 03445+3242 and IRAS 04239+2436

Lee, Seokho (Kyung Hee University)

Abstract

We have detected molecular and atomic line emission from the hot and warm disks of two Class I sources, IRAS 03445+3242 and IRAS 04239+2436 using the high resolution Immersion GRating INfrared Spectrograph (IGRINS). CO overtone band transitions and near-IR lines of Na I, all in emission, trace the hot inner disk while CO rovibrational absorption spectra of the first overtone transition trace the warm outer disk. The emission-line profiles for both sources show evidence for Keplerian disks. A thin Keplerian disk with power-law temperature and column density profiles with a projected rotational velocity of ~100 km s^{-1} and a gas temperature of ~5000 K at the innermost annulus can reproduce the CO overtone band emission. The narrow CO rovibrational absorption spectra (v= 0 -> 2) indicate that both warm (> 200 K) and cold (~20 K) CO gas are present along the line of sight to the inner disk. Many hydrogen recombination lines, molecular hydrogen rovibrational lines, and [Fe II] lines are also detected in emission. This study demonstrates the power of IGRINS as a tool for studies of the inner hot and outer warm protoplanetary disks with its simultaneous coverage of the full H and K bands with high spectral resolution (R=45,000) allowing many aspects of the sources to be investigated at once.

IGRINS Survey of Class I YSOs

Kidder, Benjamin (UT Austin)

Abstract

We have acquired IGRINS spectra for a sample of Class I YSOs, a subclass that require particular experimental attention. Class I sources are protostars with substantial residual molecular cores. The Class I phase represents the earliest point in a star's life that we can observe photospheric lines, and study the star, the disk and the envelope together. These sources have very high accretion rates and warm dust in their disks leading to large amounts of veiling in the infrared. There is also evidence of an unidentified component contributing excess continuum in the near-IR. We have developed a method to measure the excess by measuring line veiling across an IGRINS spectrum. By calculating the line veiling order by order, we can build a low-resolution spectrum of the excess that cannot be obtained by photometry or low-resolution spectroscopy. This can tell us whether we are dealing with hot dust, a disk photosphere, or a combination. We have used this technique to measure the excess spectrum for the Class I source HL Tau, and several other Taurus YSOs.

Exoplanet Atmospheres at High Spectral Resolution

Brogi, Matteo (University of Colorado at Boulder)

Abstract

After only two decades from the first discoveries, we know today about 2,000 planets orbiting stars other than the Sun. In order to truly understand the nature and the properties of these exoplanets, we need to study their atmospheres, a task performed nowadays with a range of observational techniques. In this talk I will focus on ground-based high-resolution (R>20,000) spectroscopy, which has recently excelled in delivering robust molecular detections and estimating their relative abundances. By resolving molecular bands into the individual lines and detecting their Doppler shift due to the planet orbital motion, high-resolution spectroscopy greatly reduces the chances of contamination. The correct identification of species is facilitated by cross correlating with model spectra. I will review the major breakthroughs achieved in recent years, among which are the first atmospheric detections for non-transiting planets, and the unprecedented measurements of their true masses and orbital inclinations. I will present current efforts focusing on constraining the atmospheric composition and on measuring planet rotational rates and winds. These high-dispersion observations highly benefit from spectrographs with large spectral range (such as IGRINS) and high throughput. When performed with the next generation of ELTs, high-resolution spectroscopy will truly enable comparative exoplanetology on a large and diverse sample. Furthermore, by pairing high spatial and spectral resolution, it will be possible to reach star/planet contrasts of >10^9, moving exoplanet characterization towards terrestrial planets in the Habitable Zone of their parent stars.

IGRINS Survey of T Tauri Stars in Tau-Aur: Status Report

Kim, Kyoung Hee (Korea Astronomy and Space Science Institute)

Abstract

In this talk, we will introduce an IGRINS Korean-Legacy program, IGRINS Survey of T Tauri Stars in Tau-Aur. We will report the main goal of the program and observation/reduction progress. Preliminary result will be discussed.

IGRINS High-Resolution Spectroscopy of the FU Ori Type Object 2MASS J06593158-0405277

Pyo, Tae-Soo (Subaru Telescope/NAOJ)

Abstract

We report high resolution spectra (R ~ 40,000) of 2MASS J06593158-0405277 which was discovered recently by Maehara, Kojima, and Fujii (ATEL #6770). The normalized spectrum in the

range of 2.3 - 2.32 micron where the CO first overtone band is dominant and mixed with H2O lines. shows very similar pattern with FU Ori (1999) but not with V1515 Cyg (1999) in Hartmann, Hinkle, and Carvet (2004, ApJ, 609, 906). We found that the Br_gamma line shows absorption not emission. The FWHM of the absorption is ~ 95 - 100 km/s. The line profile was almost symmetric at 21663.3 A on Dec. 25.31, 2014 UT. It shows a little asymmetric with the deepest point shifted to 21664.73 A on Dec. 26.44, 2014 UT. FU Ori, V1057 Cyg, V883 Ori, and L1551 IRS5 show the similar weak Br_gamma absorption, which can be only detected with high spectral resolution spectroscopy (Aspin et al. 2009, AJ, 137, 2968). We compared the spectra with other FU Ori objects and will present the result in detail.

Outflows with IGRINS: 1. Multiple outflows around Herbig Be star LkH_alpha 234, 2. Orion KL shocked outflow

Oh, Heeyoung (KASI)

Abstract

We present the results of IGRINS observation toward the multiple outflows around the Herbig Be star LkH_alpha 234. Previous studies indicate that the region around LkH_alpha 234 is complex, with several embedded YSOs and the outflows associated with them. In simultaneous H- and K-band spectra from HH 167, we detected 5 [Fe II] and 14 H_2 emission lines. We revealed a new [Fe II] jet driven by radio continuum source VLA 3B. Position-velocity diagrams of H_2 1-0 S(1) 2.122 micron line show multiple velocity peaks, which may be explained by a geometrical bow shock model. We detected a component of H_2 emission at the systemic velocity (V_LSR = -10.2 km/s) along the whole slit in all slit positions, which may arise from the ambient photodissociation region. Low-velocity gas dominates the molecular hydrogen emission from knots A and B in HH 167, which is close to the systemic velocity, while [Fe II] emission lines are detected at farther from the systemic velocity, at V_LSR = -100 - -130 km/s. We infer that the H_2 emission arises from shocked gas entrained by a high-velocity outflow. Population diagrams of H_2 lines imply that the gas is thermalized at a temperature of 2,500 - 3,000 K and the emission results from shock excitation. We also show the preliminary result of another IGRINS project, the Orion BN/KL outflow. We obtained the 3D datacube from slit-scanning observation on 15" x 15" area around OMC-1, where the emission comes from a dense shock region. In the position-velocity resolved space, we indicate the kinematics and excitation state through the analysis with over 30 H_2 lines.

Probing the physics of excited molecular hydrogen gas with IGRINS

Kaplan, Kyle (UT Austin)

Abstract

Abstract: The majority of the Milky Way's interstellar medium lies within photodissociation regions, neutral gas where ultraviolet photons from hot stars dominate the energetics and chemistry. Shocks in dense neutral gas are an important energetic phenomenon in astrophysical contexts ranging from protostars to post-main-sequence objects. The high spectral resolution, large wavelength coverage, and sensitivity of IGRINS makes it an unprecedented tool for probing the physics of molecular gas in the interstellar medium. Molecular hydrogen (H2), with up to 100 rovibrational transitions detectable in the H & K bands covered by IGRINS, can be excited by UV radiation from hot stars or by collisions such as in gas heated by shocks. IGRINS observations can isolate these transitions in position and velocity space and reveal a range of different conditions, even in a single object. I discuss our results for the Orion Bar, an edge on clumpy photo-dissociation region in the Orion Nebula illuminated by the O-stars in the Trapezium, where we took a deep single IGRINS pointing and made a 6" by 15" map. In the Orion Bar, we detect the clear signature of UV excited H2 along with evidence for de-excitation by collisions within the dense gas. In our 6" by 15" map, we find variations in the degree of collisional de-excitation within the Bar. In our deep pointing, we find excess populations of H2 in higher rotational states, possibly from H2 forming exothermically on dust grains. I also discuss our IGRINS results from planetary nebulae, such as PN M 1-11, where for the first time in this object we can clearly resolve in position-velocity space a ring of H2 excited purely by UV radiation from the central core and shocked H2 from a bipolar outflow.

NIR Emission from Planetary Nebulae

Montez, Rodolfo (Vanderbilt University)

Abstract

Planetary nebulae (PNe) are formed in the death throes of low- to intermediate-mass stars when the mass lost during the asymptotic giant branch (AGB) phase is swept into a shell by a nascent fast wind. The hot emerging core of the dying star ionizes this swept-up plasma and the PNe radiates across the electromagnetic spectrum from X-ray to radio. Each wavelength range probes the variety of radiative and kinematic conditions found in PNe. But the NIR presents a unique opportunity as emission from atomic lines, molecular lines, and dust are abundant. This allows us to study the interplay of gas and dust in these dynamic environments. The influence of shocks on the excitation of these emission lines provide further insight on the elusive shaping processes responsible for the morphology of PNe. In this presentation I review previous NIR studies of PNe and highlight opportunities to advance our understanding of the formation and evolution of PNe with high-resolution IGRINS observations.

Kinematic Study of Ionized and Molecular Gas in Monoceros R2

Kim, Hwihyun (KASI/UT Austin)

Abstract

Monoceros R2 (Mon R2) is an ultra compact HII region (UCHII; diameter < 0.1pc; density>10^4cm−3;Churchwell 2002) surrounded by PhotoDissociation Regions (PDRs), and an excellent example to investigate the chemistry and physics of early stage of massive star formation due to its proximity (830pc) and brightness. Previous studies by Jaffe et al. (2003) and Zhu et al. (2005, 2008), based on the 12.8μm [Ne II] observations of 16 UCHII regions, suggest that (a) essentially all of the different UCHII morphologies were the same (flows along cometary shells) but appeared different depending on viewing angle and (b) that

these wind-driven cometary shells could have much longer lifetimes than classical UCHII regions. In this picture, the wind from the star holds the ionized gas up against the dense molecular core and the higher pressure at the head drives the ionized gas along the shell. In order for the model to work, there should be evidence for dense molecular gas along the shell walls, irradiated by the UCHII region and perhaps entrained into the flow along the walls. We obtained the Immersion Grating INfrared Spectrograph (IGRINS) spectra of Mon R2 to study the kinematic patterns in the areas where ionized and molecular gases interact. The position-velocity maps from the high resolution H- and K-band (1.4-2.5μm) IGRINS spectra demonstrate that the ionized gases (Brackett and Pfund series, He and Fe emission lines; Deltal_V ~40km/s) flow along the walls of the surrounding clouds. This is consistent with the model by Zhu et al. (2008). In the PV maps of the H2 emission lines there is no obvious motion (Delta_V ~10km/s) of the molecular hydrogen right at the ionization boundary. This implies that the molecular gas is not taking part in the flow as the ionized gas is moving along the cavity walls.

IGRINS Observation of [Fe II] line Source G25.8+0.2 in the UWIFE survey

Kim, Yesol (Seoul National University)

Abstract

UWIFE(UKIRT Widefield Infrared survey for Fe+, Lee+2014) is an imaging survey of the first Galactic quadrant using narrow 1.64μm filter. The [Fe II] 1.64μm emission line mainly traces shock-excited dense gas, which can help us study violent astrophysical phenomena in supernova remnants, evolved stars, and star-forming regions. Exploiting the UWIFE data, we are compiling diffuse Ionic Fe Object(IFO) catalogue. The catalogue contains about 300 IFOs , some of which do not have known counterparts. In this talk, we report on the follow-up spectroscopic study of the IFO G25.8+0.2 using IGRINS. The source has been known as an HII region but also shows an X-ray emission. We will discuss IGRINS spectral features and discuss the origin of the source.

"[Fe II]-H2 reversal" in Supernova Remnants

Lee, Yong-Hyun (Seoul National University)

Abstract

We have recently detected a dozen Galactic supernova remnants (SNRs) with associated [Fe II] 1.64 μm and H2 2.12 μm emission features by using the UWIFE and UWISH2 surveys (UKIRT Widefield Infrared survey for Fe+/H2). In some of these SNRs, the H2 emission extends far beyond the radio and/or [Fe II] emission line boundary of the remnant. We obtained Ks-band, medium-resolution spectra using Anglo-Australian Telescope for some of the H2 features, and found H2 line ratios consistent with shock excitation, which is difficult to understand considering their large separations from the SNR boundary. To address this "[Fe II]-H2 reversal" problem in SNRs, we performed high-resolution, R=40000, H/K-band spectroscopy toward three SNRs (G11.2-0.3, KES 73, 3C 396) using IGRINS. We clearly detected a dozen of H2 lines within the waveband. The line ratios seem to be well consistent with those of thermal excitation, and their line widths are ≳10 km/s. We will discuss the implications of our result on the origin of the H2 gas.

Star Formation in External Galaxies

Pak, Soojong (Kyung Hee University)

Abstract

We will present recent IGRINS observation results from star formation regions in nearby galaxies where the condistions are very different from that in our Galaxy. The preliminary data suggest possible observations of external galaxies using IGRINS.

High-resolution spectroscopy of NGC 7023

Le, Huynh Anh N. (Kyung Hee Univeristy)

Abstract

The high-resolution spectra of near-infrared H2 emission lines from the reflection nebulae, NGC~7023, are presented. Comparing the measured spectra from the same upper states of H2, we derive the extinction values which are larger than expected. The structure of the photodissociation regions (PDRs) would be affected from the dense clumps. The widths of the lines are resolved. The column density of each ro-vibrational state from the measured H2 emission lines are also calculated. Based on the H2 line ratios, we confirmed that the molecules in the observed regions are mostly excited by UV fluorescence. The H2 emission line ratios are compared with that of several model PDRs, covering a range of densities, UV fields, and temperatures.

Infrared Stellar Spectroscopy and Analysis

Ryde, Nils (Lund University, Sweden)

Abstract

We are entering a new era in stellar spectroscopy, thanks to the now readily available, little explored infrared wavelength region, recorded at high spectral resolution. This is the result of the development of cross-dispersed, high-resolution spectrometers, like IGRINS. I will first discuss the status of stellar-atmosphere modeling of cool stars and proceed to discussing issues to be aware of and advantages of spectral analyses of infrared stellar spectra. I will also point out what future progress is needed to fully exploit this region. I will high-light and discuss a few recent projects, which were only possible thanks to high-quality, infrared spectra at high resolution, in these cases with the CRIRES and TEXES/EXES spectrometers. I will end with an outlook on what will be possible with the new capabilities, that now are starting to be offered.

IGRINS Spectroscopy of G-K Giants over a Large Metallicity Range

Sneden, Chris (University of Texas at Austin)

Abstract

We have obtained IGRINS high resolution infrared spectra for a variety of bright evolved Galactic disk and halo stars. In this talk we first will discuss chemical abundances of two very metal-poor halo stars from the very few absorption features detectable in their H- and K-band spectra. Alpha-capture elements Mg, Si, S, and Ca dominate their spectra, and yield abundances as good as or even more reliable than those derived from optical-wavelength spectra. Second, we will report preliminary results from a survey of more metal-rich thin and thick disk so-called red horizontal branch stars. Many elements can be studied in these rich-lined spectra, and here we concentrate on studies of the CNO abundances and carbon isotopic ratios, which can be determined reliably from infrared features of CN, CO, and OH. Our results greatly strengthen the hints from optical spectra of very low 12C/13C ratios in many of these stars. Third, we will outline our early work on a large program to derive light element abundances in members of open star clusters.

IGRINS Spectral Library

Park, Sunkyung (Kyung Hee University)

Abstract

We present a library of high spectral resolution (R ~ 40,000) and high signal-to-noise ratio (S/N ~ 200) near-infrared spectra of ~60 stars. The spectra were obtained with Immersion GRating INfrared Spectrograph (IGRINS) covering the full H and K bands. The stars are mainly from MK standard stars which have well-defined spectral types and luminosity classes and cover wide ranges of effective temperatures and surface gravities. The spectra are corrected for telluric absorption lines. In this work, we present the preliminary results of spectroscopic diagnostics for stellar physical parameters. Our ultimate goal is to provide a library of near-infrared spectra of standard stars, which covers all spectral types and luminosity classes, with a high spectral resolution and high signal-to-noise ratio.

The Study of exoplanetary Atmosphere with IGRINS

Park, Keun-Hong (SNU)

Abstract

The study of exoplanetary atmosphere is one of the most challenging tasks in Astronomy. To detect absorption features of an exoplanetary atmosphere, we plan to observe the host stars of several transiting planets in and out of primary eclipse phase. There have been several studies of the composition and properties of exoplanetary atmospheres using this method. However previous observations were done with spectral resolution which is too low to resolve the absorption features or too narrow wavelength coverage to see several lines at once. Therefore we propose to take advantage of the high spectral resolution and broad wavelength coverage of IGRINS. We observed the non-transit star, Tau Boo and the transit-star WASP-3, and have studied to find out the feature of the exoplanetary atsmosphere.

Photospheres of young stars

Herczeg, Gregory (KIAA/Peking University)

Abstract

Absolute ages of young stars are important for many issues in pre-main sequence stellar and circumstellar evolution but are long recognized as difficult to derive and calibrate. Robust characterization of pre-main sequence stellar photospheres requires a consistent and rigorous analysis of high-resolution spectra. In this talk, I will present how IGRINS spectroscopy of young stars can contribute to improved measurements of young stellar photospheres.

Stellar Radial Velocities with IGRINS

Mace, Gregory (UT Austin)

Abstract

Radial velocities of M and L dwarfs are the missing component of most moving group studies. Radial velocities precise to ~1 km/s can verify group membership, but RV precision lower than 200m/s is required to find missing brown dwarf companions or moderate separation binaries. We can cross correlate any F through L dwarf observed with IGRINS to produce statistically robust radial velocities with median uncertainties of ~150m/s (0.1 pixels), and as low as 50 m/s (0.025 pixels). The precision is increased in cases where the signal-to-noise ratio is larger and the number of comparison spectra is greater. Precision is limited by additive uncertainties in the instrument flexure, cross-correlation function, and relative offsets from all template spectra. We have cross correlated more than 200 nearby stars and brown dwarfs and determined radial velocities consistent with the literature (primarily Chubak et al. 2012, arXiv:1207.6212). With these new radial velocities we can search for binaries using literature RVs as the first epoch of observation, update orbital parameters of known binaries, and test moving group membership.

Constraining Blue Straggler Formation and Triple Star Processes in M67 with IGRINS

Gosnell, Natalie (University of Texas at Austin)

Abstract

The formation of blue straggler stars (BSSs), typically defined to be stars bluer and brighter than the main sequence turnoff, has perplexed astronomers since their first discovery over sixty years ago. Many BSSs and potential evolved BSSs (yellow giants) are in binaries, and the type of companion star constrains the possible BSS formation mechanisms. Mass transfer BSSs have white dwarf companions, but BSSs formed through a merger in a hierarchical triple via the Kozai mechanism have low-mass main sequence companions. I will present preliminary results from our study of BSSs in open cluster M67 with IGRINS. IGRINS spectra can directly reveal, for the first time, M dwarf companions of BSSs formed through the Kozai mechanism. Previous radial-velocity (RV) studies of BSSs have only been in the optical, where the flux ratio between a BSS and an M dwarf companion is too high to result in a double-lined binary. There are very few empirical constraints of the triple population in clusters, so any M dwarf secondaries detected with IGRINS will have a major impact on predicted rates of triple star dynamical processes. If no M dwarf companions are detected we will know

that the Kozai mechanism is a very rare process and can place important limits on the triple fraction in cluster environments.

IGRINS Observations of Galactic Luminous Blue Variables

Kim, Hyun-Jeong (Seoul National University)

Abstract

We present the IGRINS observations of Galactic luminous blue variables (LBVs), which are massive post-Main Sequence stars with photometric and spectroscopic variabilities and high mass-loss rates. As a project of the near-infrared spectroscopic monitoring of Galactic LBVs and LBV candidates (cLBVs), we have obtained the spectra of seven objects among eleven during the commissioning and the first-year runs of IGRINS, although most of them were observed only once. The noticeable features of the IGRINS LBV spectra are a series of Brackett lines of hydrogen, He I lines, and metallic emission lines, some of which appear as P-Cygni profiles. The line shapes and detected species vary from one object to another as well as depending on their variable phases. In this study, we report the preliminary results of our observations, in particular, of the (c)LBVs that have been relatively well studied earlier. By comparing the IGRINS spectra with the previously obtained ones from the literature, we will examine the spectral line variabilities and/or newly detected features revealed owing to the high-resolution of IGRINS. We also compare the observed spectra with the models produced by the non-LTE atmospheric code CMFGEN to have an insight on the physical parameters such as wind velocity or mass-loss rate. Based on the results, we will discuss the scientific significance and implications of the LBV observations using IGRINS.