The 4th Workshop on Extra-Solar Planet Search with Accurate Radial Velocity Measurements

7-9 October 2009

Jozankei View Hotel
Hokkaido
Japan

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Workshop Program

Date	Day	#	Time	⊿T	Title	Speaker	Institute
					Session 0. Arrival and Registration		
6	Tue		17:00 ~		<Registration>		
			18:00-20:00		<Dinner>		
					Session 1. Detection and Characteriztion of Exo Planets…… Chair:		
		1	09:10-09:50	40	Protoplanetary Disks around Intermediate-Mass Stars	Fukagawa, M.	Osaka U.
		2	09:50-10:30	40	Planet Characterization by Transit Observations	Narita, N.	NAOJ
			10:30-11:00	30	<BREAK>		
		3	11:00-11:30	30	Exoplanet Transit Observations at Weihai Observatory of Shandong University	Cao C.	SDU
		4	11:30-12:00	30	Progress of LiJET and Transit Search with Lijiang 2.4m Telescope	Bai J. M.	YNO
			12:00-14:00	120	<LUNCH>		
					Session 2. Theory of Planet Formation and Planetary Systems…… Chair:		
		5	14:00-14:40	40	Planet Formation Theory around Low-Mass or Intermediate-Mass Stars	Tanaka, H.	Hokkaido U.
		6	14:40-15:20	40	Planet Formation with Diffrent Disk-Depletion Time Scale: Comparing with Observations	Liu H.G.	NJU
			15:20-15:50	30	<BREAK>		
		7	15:50-16:30	40	Orbital Evolution of Planets around Evolving Low- and Intermediate-Mass Stars	Ikoma, M.	TITech
					Session 3. Host Stars and Their Evolution I…… Chair:		
		8	16:30-17:00	30	Characteristics of Oscillations in G-type Giants	Ando, H.	NAOJ
		9	17:00-17:30	30	Spectrophotometric Properties of the Nearest Pre-Main Sequence Stars	Lyo, A-R.	KASI
			18:00-20:00	120	<DINNER>		
					Session 4. Doppler Search for Planets among EAPS-NET…… Chair:		
8	Thu	10	09:00-09:30	30	Okayama and Subaru Planet Search Programs	Sato, B.	TITech
		11	09:30-10:00	30	Current Status of BOAO Planet Search Program	Han, I.	KASI
		12	10:00-10:30	30	Current Status and Future Prospect of Exoplanet Searching in Xinglong	Wang L.	NAOC

	10:30-11:00	30	<BREAK>, Workshop Photo		
13	11:00-11:20	20	Planet search with HDS at Subaru	Harakawa, H.	TITech
14	11:20-11:40	20	Current status of Korean-Japanese Planet Search Program	Omiya, M.	Tokai U.
15	11:40-12:00	20	Planet Detection and Abundance Analysis on Late G giants --- Status of Xinglong Planet Search Program	Liu Y.J.	NAOC
	12:00-14:00	120	<LUNCH>		
			Session 5. Instrumentation among EAPS-NET…… Chair:		
16	14:00-14:30	30	Progress in Developing the Fiber-Link of 188-cm Telescope and HIDES	Kambe, E.	NAOJ
17	14:30-15:00	30	The High Resolution Spectrograph for Chinese Weihai 1m Telescope	Wang L.	NIAOT
18	15:00-15:30	30	High-Contrast Coronagraph Development in China for Direct Imaging of Extra-solar Planets	Dou J. P.	NIAOT
	15:30-16:00	30	<BREAK>		
19	16:00-16:30	30	The Prototype Design and Feasible Experience for Multi-Object Exoplanet-Survey System Based on LAMOST	Zhang K.	NIAOT
20	16:30-17:10	40	Optical Frequency Combs for Astronomical Observations	Inaba, H.	AIST
21	17:10-17:40	30	Discussion: Astronomical Application of Optical Frequency Combs	All	…
	18:00-20:00	120	<WORKSHOP DINNER>		
9 Fri 22	09:00-09:30	30	Astronomy in China Today - Large Astronomical Facilities in China	Zhao G.	NAOC
			Session 6. Host Stars and Their Evolution II …… Chair:		
23	09:30-10:00	30	Abundances of Refractory Elements for Planet-Host Stars	Kang, W.-S.	SNU
24	10:00-10:30	20	Stellar Abundance for Galactic Archeology (SAGA) Database and its Extension for Planet-Hosting Stars	Katsuta, Y.	Hokkaido U.
	10:30-11:00	30	<BREAk>		
25	11:00-11:30	30	Solar Twins: Are They the Best Candidates for Finding Earth-Like Planets?	Chen, Y. Q.	NAOC
26	11:30-12:00	30	Discussion: Verification Methods of Exoplanet Candidates	All	…
	12:00-14:00	120	<LUNCH>		
27	14:00-15:00	60	Concluding Discussion	All	…

Abstract

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Protoplanetary Disks around Intermediate-Mass Stars

Misato Fukagawa (Osaka University)

Circumstellar disks are commonly observed around young A-type stars with infrared excesses. Observational study of protoplanetary disks gives insight into the initial condition of planet formation, while that of debris (second-generation) disks may hint the dynamical history of planetary systems. Therefore properties of disks around intermediate-mass stars can be related to statistics of mature planets around G giants.

I first review the observational results for protoplanetary disks around Herbig Ae stars, comparing with those for lower/higher-mass counter parts, and focusing on their spatial structure revealed in thermal and dust-scattered emission. High resolution, direct imaging by Subaru and HST in particular suggests significant variety in the outer disk morphology, which could be caused by evolution, multiplicity, or local star-forming environments. In addition to “diversity”, “variability” of disk structure is the other key to understand how disks evolve during the era of the planet formation. I mention recent multi-epoch infrared studies using various observing techniques for two intermediate-mass stars. The variability may be interpreted as temporal change of the inner wall of the dusty disk for one star, and production of debris is implied for another one.

Planet Characterization by Transit Observations

Norio Narita (NAOJ)

Transiting extrasolar planets provide us useful information to understand their characteristics such as orbits, size, density, etc, through photometric and spectroscopic observations of planetary transits. I will review several studies on transiting planets conducted so far, including determination of the planetary size, secondary eclipse observations, transit timing variations, transmission spectroscopy, and the Rossiter-McLaughlin effect.

Exoplanet Transit Observations at Weihai Observatory of Shandong University

Chen Cao (Shandong University at Weihai, China)
caochen@sdu.edu.cn

In this talk, I will first give a brief introduction to Weihai Observatory of Shandong University, mainly focus on its one meter telescope and related instruments. Weihai Observatory of Shandong University was joint constructed and managed by Shandong University, National Astronomical Observatories of China (NAOC) and Weihai city. The one meter German-made reflecting telescope is one of the largest optical telescopes among all the universities in China for advanced scientific researches.

About one year ago, we began to observe exoplanet transits using this telescope. Our purpose of research is: 1. Observe short-period exoplanet transits to obtain more data and try to make new discoveries by transit timing; 2. Try to detect transits of exoplanets which were discovered by the RV method but still without transit observations; 3. Prepare to make follow-up photometric observations of exoplanet candidates discovered by the new high-res spectrographs of NAOC and our university.

In the past year from Oct. 2008 to Sep. 2009, using about 30 nights, we have observed 63 predicted transit events and successfully detected 12 of them. The exoplanets which we detect transits are: TrES-1b, TrES-3b (*4), WASP-1b, WASP-2b, WASP-3b, XO-2b (*3), HAT-P-7b. I will show these transits' light curves and some derived results, then make prospects on our further studies.

Progress of LiJET and transit search with Lijiang 2.4m telescope

Jinming Bai (Yunnan Observatory)

In this talk, I will briefly introduce the progress of Lijiang Exoplanet Tracker (LiJET) which will be installed in October 2009, at the 2.4m telescope in Lijiang station of Yunnan Observatory. Then I will talk about the transit events follow up project with this telescope. The project is aimed to confirm planet detection and discover new planets, and emphases will be give to the detection of low mass (a few Earth masses) exoplanets around nearby bright solar-type stars. Planet candidates are mainly from the MARVELS (The SDSS-III Multi-object Apo Radial-velocity Exoplanet Large-area Survey) and SuperWASP (Super Wide Angle Search for Planets). We will also search for transits in some open clusters with the YFOSC (Yunnan Faint Object Spectrograph and Camera) which has a 9'X9' field of view, and will be installed at the Lijiang 2.4m telescope by the end of this year.

Planet formation theory around low-mass or intermediate-mass stars

Hidekazu Tanaka (Hokkaido University)

In my talk, I will review the theory of planet formation around various stars. Depending on the luminosity of the central star and the disk model, the locations of the habitable zone and the snow line would change. This causes a diversity of planet systems formed around low-mass or intermediate-mass stars. In the present theory of planet formation, rocky planets (and cores of giant planets) are expected to be formed through accumulation of planetesimals but the process of planetesimal formation still has a large uncertainty. Recent studies of planetesimal formation suggest that planetesimal formation might occur only in a limited region of protoplanetary disks. This limitation is more strict for intermediate-mass stars than low-mass ones. The limitation on planetesimal formation would strongly affect the final configuration of planet systems around intermediate-mass stars.

Planet Formation with diffrent disk-depltion time scale: comparing with observations

Huigen Liu, Zhou Jilin & Wang Su (Nanjing University)

Abstract

There are abundant fruits about the formations of various planets, while the observational data become more and more abundant. Some theories reproduce the distribution of a-M (the semi-major axis and the mass of planets) well comparing to observations. But few people consider the N-body interactions which play a key role during the evolution of planetary system and excite their eccentricities. This is mainly because of the exorbitant time-costing of simulations and the uncertainty of initial conditions.

In this series of papers, we focus on the influences of N-body interaction. As we know N-body interaction may excite the eccentricity by scattering and resonance. This interaction might still halt the migration of planets by resonance so that the distribution of semi-major axis changes possibly. We survey the distributions of planets especially the eccentricity of multi-planetary systems and try to reproduce them by Monte Carlo approach and comparing with observations. In this paper we mainly considerate the influence of the gas disk depleted time scale $¥tau_{disk}$, which will influence the evolutions of semi-major axis, planetary mass and eccentricity directly. We set a group of initial conditions with different $¥tau_{disk}$, and find some correlations. These correlations would be tested by further observations and will be useful for detecting other exoplanets.

Orbital Evolution of Planets around Evolving Low- and Intermediate-Mass Stars

Masahiro IKOMA

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About twenty planets orbiting evolved low- and intermediate-mass stars have been detected so far. Unlike around low-mass main-sequence stars, no planet has been found inside about 0.7AU around those stars. That deficit may be due to the evolution of their parent stars, which I have explored in this study. A star expands after leaving the main-sequence track and its radius reaches approximately 0.1AU; planets orbiting at < 0.1AU are thus engulfed by the star. In addition, the tidal action of the star removes the angular momentum from orbiting planets; thereby the planets migrate inward and may eventually spiral into the parent star. In contrast, loss of the mass of the parent star during its RGB phase pushes planets outward. In this study, I have simulated changes in semi-major axes of planets orbiting low- and intermediate mass stars evolving in the RGB phase, taking into account the effects of the tidal action and mass loss of the stars. I have not simulated the stellar evolution directly, but used data available on the Web. Our preliminary results show that the tidal effect dominates the mass-loss effect, resulting in orbital decay of the planets. The idea examined is consistent with the planetary deficit in the region interior to 0.7 AU around the intermediate-mass giants. Concerning low-mass giants, more detailed investigation is found to be necessary, because some of them are highly eccentric. I will discuss current uncertainties that have to be removed to specify the cause of the orbital properties of the planets around the evolved stars.

Characteristics of oscillations in G-type giants

Hiroyasu ANDO (NAOJ), Yusuke TSUBOI (Tokyo Univ.),
Eiji KAMBE(NAOJ), and Bun'ei SATO (TITech)

We have performed observation of four G-type giants (ζHya, ηHer, εTau, 11Com) with precise radial velocity measurement to detect solar-like oscillations. We found tiny amplitude oscillations in these giants, whose periods range from 4 hours to 10 hours and their amplitudes are 1-6m/s. We have conducted period analysis for these stars and confirmed a significant power excess centered at 30-80 μHz (νmax). In these period-grams, we can also see some equidistant power peak distribution like solar 5 min. oscillation, which is called large separation (Δν). These two oscillation characteristics are confirmed to follow the well-known scaling law. We also investigated damping time of these oscillations, whose times are about two days. These values are confirmed to exist in the extension of those for dwarfs like the sun. From these results, it is concluded that tiny oscillations in G-type giants are solar-like oscillation excited by turbulent convective motions.

In this program, stars with extra-solar planet, say, εTau, 11Com are included to see if characteristics of oscillations may be related with existence of exo-planet. But it is confirmed that there is no correlation between the two.

Spectrophotometric properties of the nearest pre-main sequence stars

A-Ran Lyo (Korea Astronomy and Space Science Institute)

We present a study of flux-calibrated low-resolution optical spectroscopy of the nearest pre-main sequence (PMS) associations; Eta Chamaeleontis, Epsilon Chamaeleontis, TW hydrae, Beta Pictoris, Lower Centaurus Crux. Using synthetic broad-band colors and narrow-band continuum, temperature- and gravity-sensitive spectral line, we can study the physical properties of PMS stars. Especially, we found that the gravity-sensitive indices are the very useful tools to address the age rank of these young stellar groups compared to the HR diagram.

Okayama and Subaru Planet Search Programs

Bun'ei Sato (Tokyo Institute of Technology)

We have been conducting a Doppler planet search program targeting intermediate-mass (1.5-5Msun) GK giants using the High Dispersion Echelle Spectrograph (HIDES) and 1.88m telescope at Okayama Astrophysical Observatory (OAO). Since 2001, we have been continuously monitoring about 300 GK giants and found 9 planets and 1 brown dwarf candidate around them so far. Although the number is still small, the planets show different properties from those around solar-type stars: high frequency of super-massive planets, lack of inner planets with semimajor axis of a <0.7AU, and lack of a metal-rich tendency in the planet host stars. We have also identified candidates of multi-planet systems and long-period planets residing in a>4AU.

We also started a large scale survey of GK giants using the High Dispersion Spectrograph (HDS) of Subaru 8.2m telescope in 2006. The main purpose of the Subaru program is to find planet-host candidates showing large radial velocity variations efficiently from hundreds of targets thanks to the large aperture of Subaru. We have screened about 200 stars in the last three years and found about 40 stars showing radial velocity variations with 30—200 m/s. These stars are now under follow-up observations mainly at OAO.

We here report the current status of these programs and discuss future prospects.

Current Status of BOAO Planet Search Program

Inwoo Han (KASI, e-mail: iwhan@kasi.re.kr),
B.-C. Lee, (KASI), and K.M. Kim, (KASI)

We have conducted exoplanet survey around about 50 K giant stars since 2003. Our sample includes some M giant and Ap stars. In this presentation we report the result of our survey - exoplanet candidates and their statistical characteristics. We will also present the detailed results of some exoplanet stars.

Current Status and Future Prospect of Exoplanet Searching in Xinglong

Liang Wang (National Astronomical Observatories of China)

As a part of East Asia Planets Search Network (EAPSNet), precise Doppler survey by iodine cell on 2.16m telescope in Xinglong has been undertaken since 2004. About 1,500 exposure of more than 100 G,K giants have been taken in the past 5 years. One brown dwarf candidate and one planet have been discovered. The 1k x 1k CCD of the Coude Echelle Spectrograph had been replaced by a 2k x 2k one on April, 2009. This talk will focus on current status, instrumental upgrading and some new ideas on data reduction pipeline and precision limitation. Furthermore, a laser frequecy comb for wavelength calibration on fiber-feed echelle spectrograph is under development in NIAOT and Institute of Physics, Chinese Academy of Sciences. An estimation of radial velocity precision of this new reference system is also given.

Planet search with HDS at Subaru

Hiroki Harakawa, Bun'ei Sato, Shigeru Ida, Yasunori Hori (TITech), Masashi Omiya (Tokay University), Debra A. Fischer (San Francisco State University)

Since 1995, precise radial velocity (RV) observations have unveiled more than 350 extrasolar planets from thousands of nearby (<100pc) stars. They show a great diversity in their mass and orbital parameters, and some theoretical approaches to understand the origin of the properties have been proposed during the past decade. And new planets with remarkable properties have been being discovered even now. Thus it is important to find further planets in various parameter spaces of planets and host stars and to establish their properties. We have identified tens of planet-host candidates with HDS at Subaru from a survey carried out in the framework of N2K consortium which is a collaborative planet searching project between US and Japanese teams.

It is important to increase the number of target stars to enlarge the detection of planetary candidates. Also, improving the RV precision is important to avoid observational biases against low-mass planets and enhance the detection rate. We applied the methods of Sato et al. (2002) to the RV analysis for HDS and attained a typical short-term precision of 5-6 m/s and long-term one of 10 m/s. However, in the case of Okayama/HIDES with revised RV methods described in Kambe et al. (2008), the precision of RV observations could reach below 3 m/s which is equivalent to a velocity semi-amplitude of the Sun imparted by a Saturn mass planet in semimajor axis of 5 AU. Furthermore, Keck telescope/HIRES have reached almost 1 m/s. The RV methods with Subaru/HDS should be improved to catch up with them.

Current status of Korean-Japanese Planet Search Program

Masashi Omiya (Tokai University)

Korean-Japanese Planet Search Program has been carried out since 2005 to search for planets around intermediate-mass giant stars (1.5-5.0 solar masses) by an international collaboration between Korean and Japanese researchers. In this planet search program, we have been carrying out a precise Doppler survey of 188 GK-type giants ($6.2<V<6.5$) using 1.8m telescope at Bohyunsan Optical Astronomy Observatory (BOAO, Korea) and 1.88m telescope at Okayama Astrophysical Observatory (OAO, Japan).

So far, we observed in total 178 stars more than three times and detected about 45 candidate stars in our sample stars. Among the candidate stars, we discovered a brown dwarf-mass companion with a semimajor axis of 1.71 AU and a minimum mass of 37.6 Jupiter masses orbiting an intermediate-mass giant star HD 119445 (G6III) with a mass of 3.9 solar masses. This companion is the most massive one discovered within 3 AU of a central intermediate-mass star. The host star also ranks among the most massive stars with substellar companions detected by the Doppler surveys. This result supports the current view of substellar systems that more massive substellar companions tend to exist around more massive stars.

We also detected a probable planet candidate star. Adopting the host star mass of 2.7 solar masses, the planet has a semi-major axis of 0.8 AU and a minimum mass of 1.8 Jupiter masses. Moreover, we found 7 candidate stars with a periodic radial velocity variation, which may indicate the existence of a planet or a brown dwarf-mass companion.

We report the recent results and current status of Korean-Japanese Planet Search Program.

Planet Detection and Abundance Analysis on Late G giants ---Status of Xinglong Planet Search Program

Yujuan Liu (NAOJ/NAOC)

We report the detection of a brown dwarf orbiting the intermediate-mass giant star 11 Comae (G8 III) and a planet candidate around HD173416 from our Japan-China Planet Search Program. Due to precise Doppler measurements of the stars from Xinglong station and Okayama Astrophysical Observatory (OAO), the minimum masses of the two companions are 19.4±1.5 M_J and 2.7±0.3 M_J, respectively. We make abundance analysis for a part of Xinglong Planet Search Program sample--58 late G-type giants taken with OAO, and establish the atmospheric parameters, as well as determine surface chemical compositions, especially for C and Na.

Progress in developing the fiber-link of 188-cm telescope and HIDES

E. Kambe, M. Yoshida, H. Izumiura, H. Koyano, S. Nagayama, Y. Shimizu,
K. Okita, A. Sakamoto (NAOJ/OAO), B. Sato (Tokyo Inst. Tech.),
T. Yamamuro (Optcraft)

We have been developing the fiber-link from the Cassegrain focus of our 188-cm reflector to its Coude focus where the entrance slit of the HIDES spectrograph locates. The primary purpose of this project is to increase the through-put of our observing system by one magnitude, by skipping some mirrors/windows between two foci and by introducing the image slicer at the fiber output. If it is successful, we will be able to monitor four times as many targets as we have now for such observations where exposure times are limited. Thus, exoplanet hunting and asteroseismology are greatly benefited from this project.

Throughout this project, we also envisage development of a state-of-the-art fiber-fed high-resolution spectrograph in near future and plan to examine very carefully how the fiber modal noise affects the signal-to-noise ratio of the spectra and radial velocity measurement. For this purpose, we have made a low cost, narrow wavelength-coveraged high-resolution spectrograph on a optical bench at our laboratory.

We have almost completed optical components and mechanical parts of the fiber-link and are now making final assembly. We expect to have its first-light very soon.Okayama and Subaru Planet Search Programs

The high resolution spectrograph for Chinese Weihai 1m telescope

Lei Wang[1,2], Yongtian Zhu[1,2], Zhongwen Hu[1,2]

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2. Key Laboratory of Astronomical Optics & Technology, Nanjing Institute of Astronomical Optics & Technology, Chinese Academy of Sciences, Nanjing 210042,China

Abstract

Whrs, a high-resolution fiber-fed echelle spectrograph is currently under development for Chinese Weihai 1m telescope at Weihai observatory of Shandong University. The flexible scheduling character of Chinese Weihai 1m telescope allows for long-term monitoring programs with a focus on stellar astrophysics. The Whrs spectrograph will significantly enlarge the scientific potentiality of 1m telescope with the possibility to obtain high quality spectrum. The optical design is based on a middle R2.9 echelle, operating in quasi-Littrow and white-pupil configuration, and a double-prism cross-disperser. This instrument records the spectrum from 370 to 940 nm in one single exposure on a 2k×2k CCD. With a large fiber aperture of 2.5 arcsec, the resolving power is 38000, a value that can be increased to 55000 with an adjustable slit at the fiber exit. The ThAr lamp or I2 cell wavelength calibration methods is available. High instrument stability is achieved by installing the whole instrument in a precisely temperature controlled chamber. This work presents the spectrograph design.

High-contrast Coronagraph Development in China for Direct Imaging of Extra-solar Planets

Jiangpei Dou[1, 2], Deqing Ren[1, 2, 3], Yongtian Zhu[1, 2], Xi Zhang[1, 2, 4]

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2. Key Laboratory of Astronomical Optics & Technology, Nanjing Institute of Astronomical Optics & Technology, Chinese Academy of Sciences, Nanjing 210042,China
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4. Graduate University of Chinese Academy of Sciences, Beijing 100049, China

Abstract

A high-contrast coronagraph is proposed for direct imaging of extra-solar planets orbiting nearby bright stars. We have developed a coronagraph based on the step-transmission filter in which the intensity is apodized with a finite number of steps of identical transmission in each step. At present, the step-transmission filter based coronagraph has reached a high contrast of 10^{-6} at an angular distance of $4\lambda/D$. At first, the coronagraph should be installed on a large ground based telescope equipped with state-of-the-art adaptive optics systems. In that case, contrast ratios around 10^{-5} should be accessible within 0.1 arc seconds of the central star, which is promising to direct image the young extra-solar plants. In recent progress, a upgraded coronagraph with circular apodizing filter has been developed to direct image extra-solar planets, which is specifically suitable for ground observation. For a long-term run, we will improve the contrast of the coronagraph to 10^{-9}~10^{-10} through inducing other techniques such as speckle removing and differential imaging techniques. Such a coronagraph should be installed on a space telescope and is promising to direct image earth-like planets finally.

Keywords: Extra-solar planet, earth-like planet, high-contrast imaging, stellar coronagraph, apodizing filter.

The prototype design and feasible experience for multi-object exoplanet-survey system based on LAMOST

Kai Zhang[1,2,3], Yongtian Zhu[1,2]

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3. Graduate University of Chinese Academy of Sciences, Beijing 100049, China

Abstract

A new technique called External Dispersed Interferometer (EDI) is recently used to enhance the measurement accuracy of medial resolution spectrometer. Now, a related multi-object system with this advanced technique based on LAMOST is being developed by NIAOT and NAOC, and supported by National Natural Sciences Foundation of China (NSFC). This system is composed of a multi-object fixed delay interferometer and a multi-object medial resolution spectrometer. In the meeting, the prototype design for multi-object exoplanet-survey system based on LAMOST, and some results of feasible experience inner door are given.

Keywords: External Dispersed Interferometer; multi-object exoplanet-probing system; multi-object medial resolution spectrometer; multi-object fixed delay interferometer

Optical frequency combs for astronomical observations

Hajime Inaba, Kaoru Minoshima, Atsushi Onae, and Feng-Lei Hong

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Optical frequency combs provide an absolute, repeatable wavelength scale defined by a series of laser modes equally spaced across the spectrum, which is suitable for astronomical observations [1]. The train of femtosecond pulses from a mode-locked laser generates a frequency comb equally spaced by the pulse repetition rate, frep. Therefore, in the frequency domain, the frequency of the pulses can be written as $f(n) = fceo + n \times frep$. Here, fceo is the offset frequency from the multiple of frep, so called "carrier envelope offset frequency". fceo is originated from a difference between the group and phase velocities of the pulses. The detection of fceo is a key technique to count optical frequency based on microwave reference frequency. n is a large integer, typically between 30 000 and 10 000 000. Optical frequencies f(n) are at hundreds of THz whereas both frep and fceo are radio frequencies and can be handled with present electronics and stabilized by an atomic clock. The preciseness in each mode's absolute frequency is basically dominated by the reference clock.

We have developed mode-locked, erbium-doped fiber-laser-based frequency combs (fiber combs) because of their robustness, compactness, and cost effectiveness in recent years. In this presentation, basics and a proposal of the comb used for the astronomical observations are described.

[1] T. Steinmetz, et al., Science 321, 1335 (2008).

Astronomy in China Today
- Large Astronomical Facilities in China

Gang Zhao (NAOC)

During the last decade, astronomy in China has experienced enormous advances, among which the most significant progress is reflected by the construction and development of large astronomical facilities. This talk will give a brief introduction of some facilities and missions representing current status of astronomy in China as well as future projects in designing and planning. Many ground-based facilities have been or are planned to be built, including the Large sky Area Multi-Object fiber Spectroscopic Telescope (LAMOST), which is unique in combining a large aperture with wide field of view and worldly renowned for its unprecedented 4000 fibers for spectroscopy; the Five-hundred-meter Aperture Spherical Radio Telescope (FAST), and taking advantage of the unique Karst depression of the site; the 21 CentiMeter Antenna (21CMA), which aims to carry out a survey to detect the first light after Big Bang, and a number of facilities for solar physics. On the other hand, progresses in space missions are also remarkable. With the successful launch of the first dedicated Chinese space astronomy satellite Chang'E, several more missions with strong international collaborations are planned for launch in between 2010 through 2015, which includes the Hard X-ray Modulation Telescope (HXMT), a multi-wavelength GRB project - SVOM, the World Space Observatory (WSO/UV), space lab for GRB polarization - POLAR, and also a series of space telescopes for solar physics like Space Solar Telescope (SST), and SMall Explorer for Solar Eruptions (SMESE). The development of large facilities vividly witnesses and strongly reflects the impressing progress taking place in the astronomy of China, and also promises a more prosperous future for Chinese astronomy.

Abundances of Refractory Elements for Planet-Host Stars

Won-Seok Kang[1], Sang-Gak Lee[1], Kang-Min Kim[2]
[1]Department of Physics and Astronomy, Seoul National University,
[2]Korea Astronomy and Space Science Institute

We obtained the spectra of Planet-Host Stars(PHSs) and normal field stars of the same spectral type with BOES. We measured the equivalent width of Fe and some refractory element lines using the automatic EW measurement program, TAME(Tools for Automatic Measurement of Equivalent-widths). Since the absence of planets in the normal field stars cannot be "completely" proved, this work focused on the PHSs which have the massive planets close to the parent star relatively, called as "Hot Jupiter". We carried out an investigation for the difference of abundances between stars with "Hot Jupiter" and normal field stars with no known planets. We examined the chemical composition of the host stars with planets, especially "Hot Jupiter", to find some characteristic feature.

Stellar Abundance for Galactic Archeology (SAGA) Database and its Extension for Planet-Hosting Stars

Yutaka Katsuta (Hokkaido University)

One of the major characteristics of the planet-hosting stars(PHS) is that they have high surface metal abundances. These overabundances are well studied on iron, and PHSs have on average about 0.2 dex overabundance in [Fe/H] compared to average stars. In recent years, many researches are presented on PHSs' chemical abundances other than iron, and the differences in the chemical abundance between PHS and non-PHSs are discussed. In this talk we introduce the metal-poor star database system (SAGA; http://saga.sci.hokudai.ac.jp/) which is open to the public since 2008, and the metal-rich star and PHS database system under development. The SAGA is designed as a web-based application, so that users can search objects and plot data such as chemical abundances, stellar parameters and so on with a web-browser. These data and functions of the database with extension to metal-rich stars and PHSs enable us to use the enormous data statistically, and it is expected that the databases helps us to clarify the Galactic chemical evolution from extremely metal-poor stars to the super-metal-rich stars and reveal the nature of the PHSs.

Solar Twins: Are They the Best Candidates for Finding Earth-like Planets?

Yuqin Chen (NAOC)

The search and the study of stars identical to the Sun (solar twins) are interesting in the sense that they may be the best targets for future space missions that will probe Earth-like planets. In this respect, we have carried out the search for solar twins among photometrically-selected solar analogues in the solar neighborhood and made the differential abundance analysis between solar analogues and the Sun.

In this talk, I will involve with three subjects. Firstly, present status of finding solar twins in the literature is briefly introduced and the colors of the Sun are derived from solar twins by product. Then the detection of one new solar twin among 27 solar analogues in our project and its main characteristics are presented. Finally, we attempt to summarize the observation views on the physical link between solar twins with earth-like planet search in the future.

The new high resolution spectrograph for Chinese 2.16 meter telescope

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ABSTRACT

The new high-resolution echelle spectrograph that is currently under construction to be used for Chinese 2.16 meter telescope is presented. In order to obtain a resolution-slit product of about 76800 as required by science case, the less expensive design used a 140 mm beam feeding a 420mm deep Echelle (R3) is good solution. The optical design of high resolution Echelle spectrograph for Chinese 2.16 meter telescope is given. This spectrograph will be more powerful tool for exoplanet research using high-resolution spectroscopy in China. Some new technology and novel design concepts have been adopted in this spectrograph, such as white pupil collimator system and all-refracting camera without central obstruction and so on.

Keywords: Instrumentation; spectrograph; high resolution; Echelle grating.

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