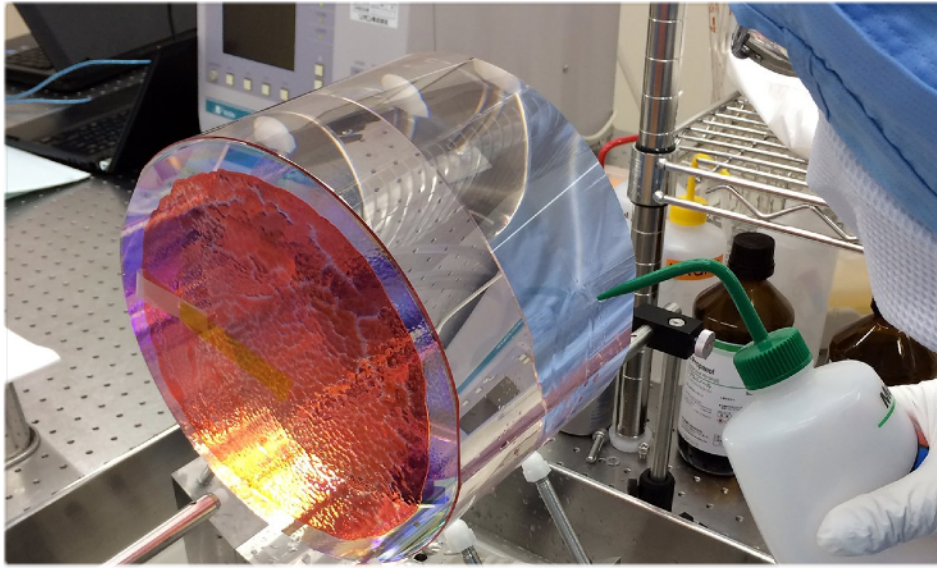


# KSC NewsLetter

The premiere issue



## Phase-1 operation starts on April 23

First cryogenic interferometer test will start soon.

After two years from the iKAGRA run, we will start phase-1 operation on April 23 to May 6. Due to the tight schedule for our upcoming real observation, system engineering office (SEO) decided to operate phase-1 with one cryogenic mirror (Y-arm), and the other at normal temperature. We do not know what will be the outcomes. So it might become a sort of fun. A detail list of tests planned during the run is at page-3.

The above photo, taken in a clean room in the University of Toyama, is our 23kg-Sapphire mirror for X-end, which is now under installation. The installation of the cryo-payload at X-end is almost done and the main beam is coming back to the center now 😊.

Three words you should not miss in our conversation.

**1** GW

Find GW.  
Here GW is not  
"Gravitational Wave",  
but "Golden Week".

**2** CRYOGENIC

Buy refrigerator, set  
freezing chamber,  
feel chilly, but try not to  
catch a cold.

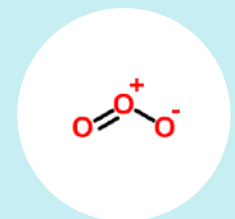
**3** O<sub>3</sub>

Not an oxygen-  
allotrope. Not a  
pathogenic *Vibrio*  
*Parahaemolyticus*.



### What is this NewsLetter?

Nobody knows if this is the first issue of a series of information letters, or just a April fool's day joke.



### O<sub>3</sub>=Ozone.

We are in a rush for O<sub>3</sub> this year. Let's finish looking for O<sub>2</sub>.



### We call for volunteers

We welcome your editorial participation to this journal. It will give you a career update definitely.

## Directions

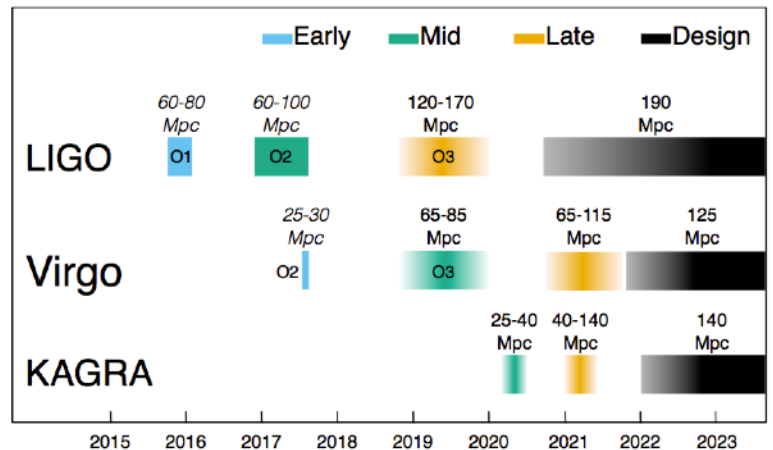
## Towards joining LIGO/Virgo's O3

In order to ensure a scientific result in our observation run, KAGRA began serious discussion with LIGO/Virgo for a joint operation plan.

At the face-to-face meeting at Tokyo Inst. of Tech. in December 2017, Takaaki Kajita, our PI, proposed to join LIGO/Virgo's O3 (observational run 3) by accelerating our original roadmap. One major reason was that we need a definite scientific "result" by the end of FY2019, but according to the original roadmap (see figure), KAGRA operate alone, making difficult to confirm possible detections. At F2F, the KSC members understood the importance and got a fundamental consensus to go.

Since then, SEO has revised, remodeled, and rescheduled the installation plan again and again, and the executive office (EO) decided to take contact LIGO and Virgo collaboration. Kajita-san sent a letter to LIGO/Virgo on February 8, and we received their warm replies the day after. When David Shoemaker, the spokesperson of LIGO, visited Kyoto for the YKIS conference, Kajita-san and some core members had a kick-off meeting with him. Our data analysis (DAS) group started to estimate scientific impacts of joining O3, and Hideyuki Tagoshi presented the status of KAGRA at the LVC meeting held in California USA in March 2018.

Discussions between KAGRA and LIGO/Virgo are on-going. Our intention is to sign up agreement (MOU) at the LV meeting in early September in the Netherlands.



The original roadmap shown in the "LVK-scenario paper", arXiv: 1304.0670v4 (updated in Sep. 2017). The distance is the maximum achievable observational distance of a GW signal coming from neutron star binaries. The new plan is to begin KAGRA's first observation somehow catching up within the O3 period, i.e. by the end of summer 2019.

[Hisaaki Shinkai](#) 🍏

### RECENT REVIEW TALKS (RELATED TO KAGRA PROJECT)

At the ASJ meeting at Chiba Univ. in March 2018, the special session on GW170817 was held.

**Nobuyuki Kanda** gave a plenary talk on what we know about binary systems from gravitational wave. In the GW session, **Mark Barton** gave an overview talk on KAGRA.

At the JPS meeting at Tokyo Univ. of Science in March 2018, the special symposium "Dawn of GW Astronomy" was held. The organizer was **Masaki Ando**. **Kiwamu Izumi** did a talk on the GW detectors, **Yousuke Itoh** gave a talk on how we extract information from the GW signal, and **Kipp Cannon** described a behind story of GW170817. In the GW session, **Takafumi Ushiba** gave an overview talk on KAGRA [JGW-G1808096].

At the LVC meeting at Sonoma Univ. in US in March 2018, **Hideyuki Tagoshi** gave an overview talk on KAGRA [JGW-G1808094-v4].

At the first annual symposium of the innovative area "Gravitational Wave Physics and Astronomy: Genesis" at ICRR in March 2018, **Masatake Ohashi** gave a (personal) overview talk on KAGRA.



Hokubu-kaikan (Left building) was renovated for KAGRA.

Kamioka

# New Office is Open!

Opening ceremony was held with the mayor of Hida-city, and local residents.

Our new office, Hokubu-kaikan, is now available next to the data-analysis building at Kamioka. The opening ceremony was held on March 2 with many guests, including Hida-city mayor Mr. Tsuduku, and people living in the Mozumi.

The building was originally used as a public hall and nursery school. Since 2012, we are using a part of the building at the first floor. Though the data-analysis building was newly built next to Hokubu-kaikan in 2014, it was not big enough due to the increasing number of people working at KAGRA site. Then, in 2017, we started to renovate the unused part of the building for staffs and students. Now we have a new refresh room and a meeting room, as well as office rooms. Note that this renovation was supported by the donation of the University of Tokyo Foundation to KAGRA project.

Ayaka Shoda 🍏



Memorial photo at the opening ceremony.

Projects

## A few details of Phase-1 operation

The table shows the plan as of March 28. The schedule may be changed. We do not call non-expert shift for this operation. Asterisk (\*) in the table means that it starts after the day-time tests finished.

bKAGRA phase-1 operation : List of experiments (as of March 28)

		Day (9am-5pm)	Night (5pm-9am next day)	Parallel
April 23	Mon	OLG measurements	cont.	Data transfer, Pipeline, GIF
24	Tue	Type-A Yend TRF	cont.	
25	Wed	BS TRF	CW injection	
26	Thu	Type-A Xend TRF	cont.	
27	Fri	Noise injection Center	CBC injection	
28	Sat	Noise injection Yend	*CBC injection	
29	Sun	Schnupp Asymmetry, IFO noise budget	cont.	
30	Mon	Noise injection Xend	*OLG measurements	
May 1	Tue	CRY extra-exp.1 (w interferometer)	cont.	
2	Wed	automatic operation		
3	Thu			
4	Fri			
5	Sat			
6	Sun	CRY extra-exp.2 (w/o interferometer)	cont.	
7	Mon	phase-2 starts		

## Upcoming Meetings

**Ewha Womans Univ.**

Introducing the host university of the next KAGRA International Workshop (KIW), June 29-30, 2018.

It is a great pleasure to hold the 5th KAGRA International Workshop at Ewha Womans University (梨花女子大学, 이화여자대학교) in Seoul, Korea. We are also very happy to have Kajita-san's public talk during the workshop. We would like to thank KASI (Korea Astronomy and Space Science Institute) and NRF (National Research Foundation of Korea) for financial support.

Ewha is the oldest and largest all-female university in Korea (founded in 1886). About 15,000 undergraduates and 6,000 graduate students are currently enrolled at Ewha. Transportation to Ewha is very convenient from both Incheon and Gimpo international airports. The nearest subway station is "Ewha Womans University (이대)" station on a green line (line no. 2). The campus is in a central region of Seoul, called Sinchon (新村, 신촌): it is one of the largest college towns in Seoul. Many eateries, cafes, and "fashion" streets are within walking distances from Ewha.



Shinkai-san (Osaka Inst. Tech.) says, "When I was a postdoc, I had a chance to stay at Ewha for a month. Prof. Sung-won Kim is an expert of wormholes, and I and Sean Hayward, who was a lecturer at that time at Ewha, worked together for dynamical evolution of wormhole. Sung-won organizes workshops and conferences frequently, so I visited Ewha several times, including for the last year's ICGAC-XIII (The 13th International Conference on Gravitation, Astrophysics, and Cosmology)".

Ewha is so close to many attractions in Seoul and we hope you can find some time to explore the city. Just one caution: Korean Monsoon may begin in June. Please bring an umbrella!

Chunglee Kim 🍏



## Upcoming Meetings

**Face-2-Face at Osaka City Univ., May 18-20.**

The details will be announced soon!

We will meet together again at Osaka after the phase-1 operations. The host persons are Nobuyuki Kanda & Yousuke Itoh. Osaka City University is located in front of the Sugimoto-Cho (杉本町) station of JR Hanwa-line (阪和線), where we can access in 12 minutes from Ten'noji (天王寺) terminal. Many hotels are in Ten'noji area.

The meeting is held in three-day style. The invited speaker from LIGO is Albert Lazzarini. We will call your contributions both in oral and poster sessions.

KSC board is trying to organize "the presentation award" for young researchers. So, don't miss it.

**KAGRA SITE VISITORS (FEBRUARY-MARCH)**

- Feb 6: SSH Nagano-Suwa-Seiryu high school, 27 students
- Feb 7: Nisshin Steel Co., Ltd, 5 persons
- Feb 19: Tokyo Univ., Human Resource.
- Feb 23: Tohoku Univ., 18 Freshmen of Dept. Physics.
- March 2: Ministry of Finance, 13 persons.
- March 13: NHK, "Cosmic Front" video taking.
- March 20: Iwanami audio-visual media Co.,Ltd.

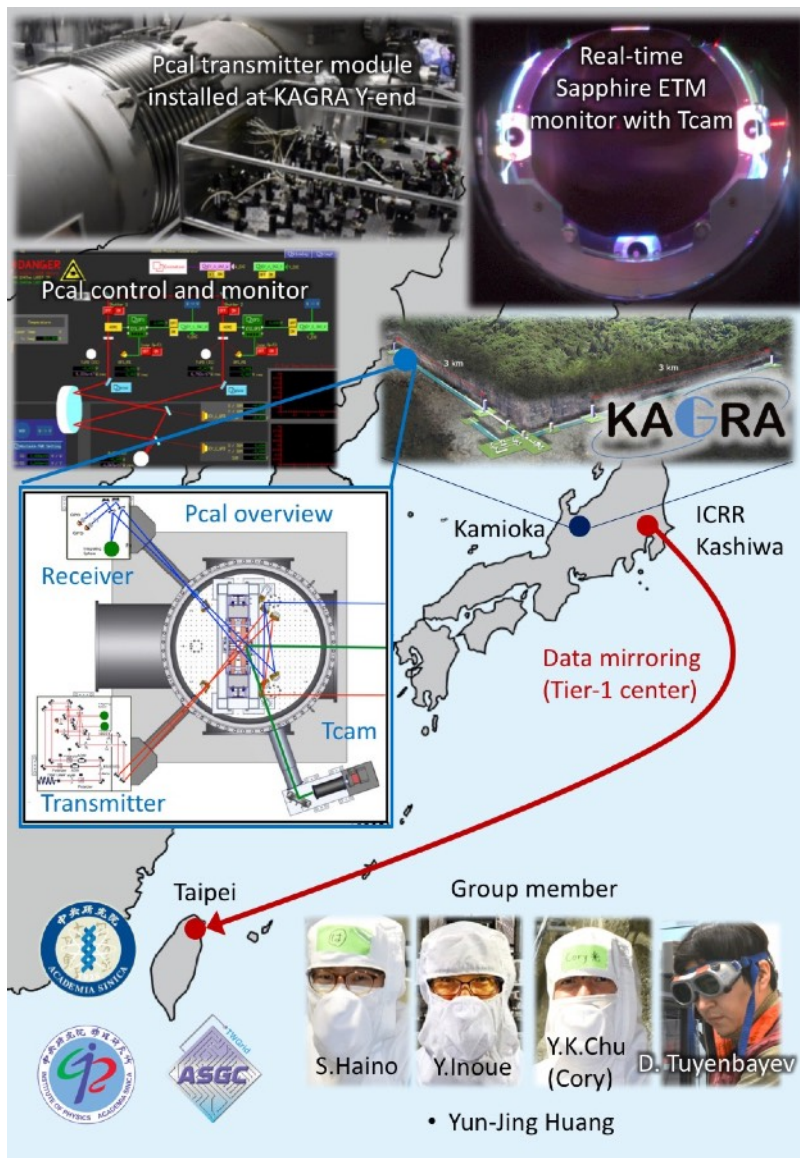
## Lab. interview

## Academia Sinica, Institute of Physics

Academia Sinica Institute of Physics (中央研究院 物理研究所, AS IoP) is located in the east side of Taipei city in Taiwan. AS IoP joined KAGRA collaboration in 2016. The current members are Sadakazu Haino (Associate Research Fellow), Yuki Inoue (Distinguished Post-doc. Fellow), Darkhan Tuyenbayev (Post-doc. Researcher), Yu-Kuang (Cory) Chu (Visiting Master student), and Yun-Jing Huang (Visiting Master student). The main activities of AS IoP in KAGRA include :

1. Developments of Telephoto-camera (Tcam) and GW Photon-calibrator (Pcal) as calibration (CAL) subsystem instruments and commissioning tools.
2. Full KAGRA data mirroring to the Tier1 data center at AS Grid Center (ASGC) as a data management (DMG) task.
3. GPU-accelerated CBC parameter estimation and simulation of various KAGRA observation cases in collaboration with TGWG (Taipei Gravitational Wave Group).

Y. Inoue and S. Haino are the KSC board members as post-doc. and foreign institute representatives, respectively. AS has hosted the 3rd. KIW in May, 2017 with more than 80 participants both from inside and outside Taiwan. [Sadakazu Haino](#) 🍏



[interviewer HS] How GW group interacts with other groups in AS IoP?

[Haino] AS IoP consists of various research groups like particle-, nano-, and bio-physics and supporting staffs. GW group has been newly formed and is having various discussions and support with/from other groups.

[HS] Could you describe a procedure to get a postdoc position in Taiwan?

[Haino] For AS postdoc fellowships, applications are open twice every year (March and August). Project postdoc researcher positions are always available depending on the funding situation of each project.

[HS] Does AS have a short stay program for grad students, or senior staffs?

[Haino] Yes, for both of them.

[HS] What was the most culture-shocking event to you comparing with the life in Japan?

[Haino] Taiwan is very similar to Japan or even more Japanese-like than Japan (you will feel as in Japan ~20 years ago).

[HS] What does "kagra" mean in Taiwanese?

[Haino] I asked colleagues, but there is no special meaning.

[HS] What KAGRA project means for Taiwan?

[Haino] GW activities are new in Taiwan and by joining KAGRA, which is (fortunately or unfortunately) still under development, we can learn lots of GW-related research activities

## Physics

## What Stephen Hawking did in Relativity?

One of the pioneering giants in general relativity died at 76 in March 2018.

Steven Hawking, a well-known wheelchair scientist, passed away March 14. He mentioned sometimes that he was born on the 300th anniversary of Galileo Galilei's death (Jan 8). Since March 14 is the day of birth of Albert Einstein, he has one more episode in his introduction.

Hawking made a lot of revolutions in relativity. In his PhD thesis, he showed mathematically that a collapsing over-massive star would result in a singularity (a place of infinite matter density and curvature). The idea was soon developed with Roger Penrose, and summarized as the singularity theorems (1970), which denote the appearance of singularity is general, and big-bang type of singularity is also inevitable. These theorems indicate general relativity itself has the limit.

Hawking showed also that the area of black hole's horizon (event horizon) is always increasing (1973), which later connects to the notion of BH's entropy. He also showed that BH's horizon has a topology of sphere (1973), which is later used as the procedure of showing the uniqueness of Kerr solution, i.e. stationary BHs can be always expressed with Kerr metric (in 4-dimensional space-time) which indicates the nature is amazingly simple.

He developed the analogy discussion of BH and thermodynamics with Bardeen and Carter, which is now widely accepted as BH thermodynamics (1973). What is, then, the "temperature" of a BH? Hawking considered quantum effects in a rotating BH and concluded that BHs made black-body radiation, known as the Hawking radiation today. Radiation carries out the energy from BH, so that BH will lose its mass and evaporate itself in the end. This BH evaporation (1974) was a sensation to researchers, but it shows BHs are key-objects connecting classical and quantum theories. If BHs evaporate away, then where are all information captured in BHs going to? This is called BH information-loss paradox, and still in debates. Recent battle field is in holographic principle of string theory and/or definition of black hole horizon (firewall, fuzzball, no BH, ...). At the JPS meeting this March, I was quite upset when several particle physicists started saying, "BH is a evaporating object without horizon, ...".

In 1980s, Hawking tried to solve the puzzle of big bang singularity with Hartle by assuming 'no boundary' boundary condition. The idea was to work in Euclidean space-time (signature +---, not like Riemannian -+++ ) without cusp, and to accept imaginary time for the dynamics. We now recognize this was one of the proposals for interpreting the beginning of the Universe, although we do not have



The picture from his official page, <http://www.hawking.org.uk/>  
The page describes himself as:

Stephen William Hawking. 1942 - 2018

Cosmologist, space traveller and hero.

other successful models.

Hawking's name became popular after he published the book, "Brief History of Time" (1988). It was translated in more than 40 languages, and sold over 25 million copies. I always use his phrase in my lecture: "Someone told me that each equation I included in the book would halve the sales. I therefore resolved not to have any equations at all. In the end, however, I *did* put in one equation, Einstein's famous equation,  $E = mc^2$ . I hope that this will not scare off half of my potential readers". This appears in the acknowledgment but only in the first edition (though Japanese version still has). Hawking erased this phrase when the second edition issued in 1998.

For GW researchers like us, we should know that the maximum limit of GW energy from colliding BHs was derived by Hawking (1971). The number is 29%, which can be obtained simply as the following inset shows.

Hisaaki Shinkai 🍏

Suppose two BHs with mass  $M_1, M_2$  merge to a single BH of mass  $M_f$ . The radiated energy as GW is

$$E_{GW} = M_1 + M_2 - M_f.$$

The area of BH is  $A = 16\pi M^2$  in  $c = G = 1$  unit, and BH area theorem says  $A_1 + A_2 \leq A_f$ . We therefore get

$$E_{GW} \leq M_1 + M_2 - \sqrt{M_1^2 + M_2^2}.$$

For  $M_1 = M_2 = m$  case, the maximum of  $E_{GW}/2m$  (radiated energy per original mass) is  $(1 - 1/\sqrt{2}) = 0.29$ .

## WE HEAR THAT ...

**Hyung Mok Lee** moved from Seoul National Univ. to Korea Astronomy and Space Science Institute (KASI) as the president, January 2018.

**Chunglee Kim** moved to Ewha Womans University from KASI as an assistant professor, March 2018.

**Kazuhiro Hayama** moved from ICRR to Fukuoka University as a associate professor, April 2018.

**Kyohei Kawaguchi** moved from AEI to ICRR as an assistant professor, March 2018.

**Koh Ueno** moved from Univ. Wisconsin-Milwaukee to RESCEU (Univ. Tokyo) as a postdoc, April 2018.

**Eleonora Capocasa**, after she finished Master in Pisa and PhD in Paris, she joined NAOJ GWPO on Jan. 2018 as a project researcher till Aug., and as a JSPS research fellow after Sept. 2018.

**Tatsuya Narikawa**, JSPS postdoc, changed his host from ICRR to Kyoto Univ. from April, 2018.

**Nami Uchikata** moved from ICRR to Niigata Univ. as a postdoc researcher, April, 2018.

**Rahul Kumar** left KEK and moved to Caltech as a research associate, March 2018.

**Kazuki Sakai** got doctoral degree with his thesis, "Application of the Hilbert-Huang transformation to gravitational wave data analysis" (supervised by Hirotaka Takahashi), in February 2018. He is now an assistant professor at National Institute of Technology, Nagaoka College.

**Hirotaka Yuzurihara** got doctoral degree with his thesis, "Search for gravitational waves from compact binary coalescences and correlation analysis of laser interferometer" (supervised by Nobuyuki Kanda, Osaka City Univ.), in December 2017. He is now a postdoc at ICRR, Kashiwa.

**Congratulations!** If you have other news, please let the editors know.

## KAGRA COLLABORATION ARTICLE

Construction of KAGRA: an Underground Gravitational Wave Observatory

T. Akutsu et al. (KAGRA Collaboration)

*Progress of Theoretical and Experimental Physics*, Volume 2018, Issue 1, 1 January 2018, 013F01,

<https://doi.org/10.1093/ptep/ptx180>

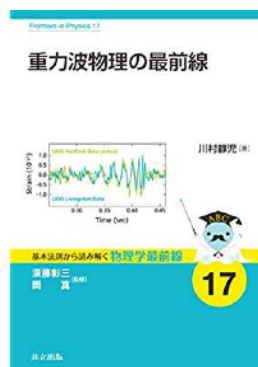
## New Book on GW physics

Seiji Kawamura published a textbook, "Frontiers of Gravitational Wave Physics" from Kyoritsu Publishing Co., in March 2018.

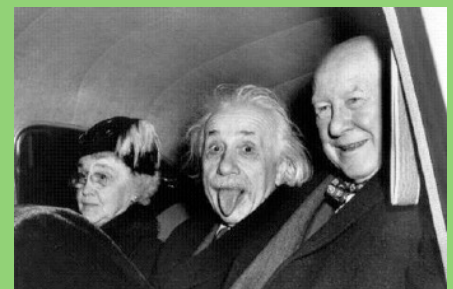
ISBN-13: 978-4320035379

186 pages, 292 g, 2160 yen.

In Japanese.



## SPACE FOR ADS



This is the original shot by a photographer Arthur Sasse.

## KAGRA MEETING SCHEDULE IN FY 2018

Mark your calendar now for the following meetings. Note that: this is real.

**The 19th KAGRA Face-to-Face meeting** at Osaka City Univ. **May 18 (Fri) -20 (Sun)**

[The registration will be announced soon in middle April.]

**The 4th KAGRA International Workshop**, at Ewha Womans Univ., Seoul, Korea, **Jun. 29 (Fri) -30 (Sat)**

**The 20th KAGRA Face-to-Face meeting** at Toyama Univ. **Aug. 24 (Fri) - 26 (Sun)**

**The 21st KAGRA Face-to-Face meeting** at somewhere, and sometime in **December**

[We call for the host university/institute.]

**The 5th KAGRA International Workshop**, at Perugia, Italy, **Feb. 14 (Thur) - 16 (Sat), 2019**

[We will have a joint session with Virgo.]

## You are supposed to ...

**If your affiliation address (or email) changes:** Contact to Ms. Rie Kikuchi (ICRR).

**If your group has new members:** Contact to Ms. Rie Kikuchi (ICRR), and member-list admins Hideyuki Tagoshi (ICRR) and Ken'ichi Nakao (Osaka City U.), and also mail to the KSC NewsLetter editors.

**If you moved to a new place to KAGRA collaboration:** Contact to KSC board. You will be requested to make an introduction at face-to-face meeting.

**If you want to join KAGRA collaboration independently:** Contact to KSC board. You are supposed to have a public interview at face-to-face meeting.

**If you have nice photo:** Let the KSC NewsLetter share them.

## FROM EDITORS

We hope that this newsletter will help the information exchange and will not help you to waist your time for research. We welcome your feedbacks. We need editorial volunteers, and we want your posts and/or leaks of information, if there will be the next issue.

Please send your inquiries to current editorial staff.

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We thank Eleonora Capocasa, Matteo Leonardi, and Simon Zeidler for proof-reading the draft.

Our dream is to get the No.1 download-counts in JGWdoc.

