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Summary of workshop in alerting mechanisms

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Abstract

In this document we will provide a summary of the Workshop "Radio – γ-ray: Transient Alert Mechanisms" that has taken place in Amsterdam, September 26 - September 28, 2017. It will include a summary of the presentations and discussions and include evaluation results from the participants. We further discuss conclusions reached from this workshops and what has been learned for future workshops on this topic.

I Copyright Notice

II Delivery Slip

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III Document Log

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IV Application Area

This document is a formal deliverable for the GA of the project, applicable to all members of the ASTERICS project, beneficiaries and third parties, as well as its collaborating projects.

V Terminology

A complete project glossary is provided at the following page:
http://www.asterics2020.eu/about/glossary/

VI Project Summary

ASTERICS (Astronomy ESFRI & Research Infrastructure Cluster) aims to address the cross-cutting synergies and common challenges shared by the various Astronomy ESFRI facilities (SKA, CTA, KM3Net & ELT). It brings together for the first time, the astronomy, astrophysics and particle astrophysics communities, in addition to other related research infrastructures. The major objectives of ASTERICS are to support and accelerate the implementation of the ESFRI telescopes, to enhance their performance beyond the current state-of-the-art, and to see them interoperate as an integrated, multi-wavelength and multi-messenger facility. An important focal point is the management, processing and scientific exploitation of the huge datasets the ESFRI facilities will generate. ASTERICS will seek solutions to these problems outside of the traditional channels by directly engaging and collaborating with industry and specialised SMEs. The various ESFRI pathfinders and precursors will present the perfect proving ground for new methodologies and prototype systems. In addition, ASTERICS will enable astronomers from across the member states to have broad access to the reduced data products of the ESFRI telescopes via seamless interface to the Virtual Observatory framework. This will massively increase the scientific impact of the telescopes, and greatly encourage use (and re-use) of the data in new and novel ways, typically not foreseen in the original proposals. By demonstrating cross-facility synchronicity, and by harmonising various policy aspects, ASTERICS will realise a distributed and interoperable approach that ushers in a new multi-messenger era for astronomy. Through an active dissemination programme, including direct engagement with all relevant stakeholders, and via the development of citizen scientist mass participation experiments, ASTERICS has the ambition to be a flagship for the scientific, industrial and societal impact ESFRI projects can deliver.

VII Executive Summary

In this documment we will provide a summary of the Workshop "Radio – γ-ray: Transient Alert Mechanisms" (deliverable D5.8 of work package WP 5.2) that has taken place in Amsterdam, September 26 - Septermber 28, 2017. It will include a summary of the presentations. We invited members of most of the collaborations and the talks were of a high quality and followed by lively discussions. We further include evaluation results from the participants. The participants were very positive in their evaluations and were in particular happy about the organization of the workshop, as well as the talks and the time allocated for discussions. There was no vote against a follow-up meeting within two years. We further discuss conclusions reached from this workshops and what has been learned for future workshops on this topic. The main conclusion we can draw is that such a workshop was necessary to connect the transient communities across all wavelengths and the only point of critique was a lack of more colleagues from more collaborations.

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Figure 1: Poster of the workshop on Transient Alert Mechanisms

1 Introduction

The main focus of the workshop were Transient Alert Mechanisms at all wavelengths in context of the Cherenkov Telescope Array (CTA) and other ESFRI facilities. The goal of the workshop was to connect people from different instruments and collaborations to develop standards for the generation, dissemination, distribution, and reaction to multi-messenger events. Subgroups on specific sources (e.g., gravitational waves, pulsar outbursts) already exist, but rarely is there an exchange on best standards and exchange of information among all of the transient community. Particular focus during this workshop was the investigation of potential scientific synergies for implementing methods for automated follow-up observations. This workshop gave outside parties (from small optical telescopes to space programs) the chance to connect to these developments. The detection of astrophysical transients has become very important in astronomy and many efforts have started to enable follow-up observations at other wavelengths within hours or even minutes of a transient detection. A common interest of the ASTERICS partners is to port these practices to multimessenger astronomy and implement them for the large-scale RIs (including the E-ELT) of the future. One of the specific goals of the workshop was to explore the possibilities of implementing tools from the Virtual Observatory framework. The exchange of event messages can be implemented through VOEvents, defined by the Virtual Observatory community. However, for joint programs this effort must be enhanced to include the exchange of instrument status information and to define and implement handshake protocols to allow predictable and reliable handling of follow-up, or joint, observations. Because future observatories may create up to millions of alerts per night (e.g. LSST), a critical focus area will be on tools that can distill the most promising triggers for a specific facility. This implies a major effort dealing with the receiving system, authorization, prioritization and identity methodology. The poster of the meeting is shown in Fig 1. The website of the workshop is https://indico.astron.nl/event/rgammatam. It includes the slides of the presentations, a list of the participants, and an overview of the program.

2 Participants

In this section, we give an alphabetical list of all invited and all attending participants. Members of the LOC/SOC are marked in blue. A total of 43 persons attend this meeting, including the LOC members. This number includes 20 invited speakers.

Participants	Invited speakers
Prof. Dr. David Berge	Dr. Gemma Anderson
Dr. Ciro Bigoniari	Dr. Elisabetta Bissaldi
Dr. Alessandro Carosi	Dr. Steven Bloemen
Dr. Giuseppe Cimo	Dr. Catherine Boisson
Dr. Emma de Ona Wilhelmi	Dr. Alan Bridger
Kelly Gourdji	Dr. Eric Chassande-Mottin
Felix Jankowsky	Dr. Antonio Chrysostomou
Amruta Jaodand	Dr. Josep Colomé
Dr. Mark Kettenis	Dr. Daniela Dorner
Dr. Felicia Krauß	Dr. Phil Evans
Mark Kuiack	Dr. Anna Franckowiak
Dr. Pierre Le Sidaner	Dr. Azadeh Keivani
Dr. John Lightfoot	Dr. Jean-Paul Le Fèvre
Dr. Fabrizio Lucarelli	Dr. Dave Morris
Dr. Emily Petroff	Dr. Jakob Nordin
Dr. Heike Prokoph	Dr. Stefan Ohm
Rachel Simoni	Dr. Antonia Rowlinson
Dr. Antonio Stamerra	Dr. Fabian Schüssler
Dr. Lenka Tomankova	Dr. David Thompson
Prof. Stefan Wagner	Dr. Martin Will
Prof. Rudy Wijnands	
Dr. Roy Williams	
Dr. Ping Zhou	

3 Program

For this workshop we invited speakers from all of the major current facilities that observe transients. We further gathered experts on software development, e.g., for the Virtual Observatory tools. For an overview of the program see Fig. 2.

3.1 Day 1, September 26

After the registration, Prof. Dr. David Berge introduced the workshop and its goals. He further described the ASTERICS goals, with a focus on the CLEOPATRA work package. The first invited talk of the conference was given by Prof. Dr. Catherine Boisson (Observatoire de Paris), who is the transient working group coordinator for the Cherenkov Telescope Array (CTA) consortium. She introduced CTA with its 3 telescope sizes and showed the drastic improvement that CTA will bring in terms of sensitivity, angular and energy resolution, rapid slewing, field of view and energy range. She further explained the Key Science Projects, science goals that have a high priority for CTA. With its two sites, on La Palma, and in Chile, it will cover the entire sky. With its improved capabilities, many exciting discoveries will be made, with the transient domain being largely unexplored at TeVs energies. With the proposed Real-time analysis (RTA) of CTA, the expectation is that CTA will not only follow-up on external triggers, but send out alerts as well. It further became clear that the main challenges concerning transient science will be:

- time: delay between sending/receiving GCN Alerts and VOEvents
- politics: Memoranda of understanding between facilities have to be signed
- standards: which software and tools will be used for the generation, distribution and reaction to multiwavelength and multimessenger events

With early science expected in $\sim$2021, it will be a versatile multimessenger and multiwavelength observatory.
From the highest energies at γ rays, we moved to a session about the lowest energies: radio wavelengths. Many current generation radio telescopes have already implemented pipelines and software to handle alerts. The first presentation from Dr. Jan David Mol explained the The LOw Frequency ARray (LOFAR) phased array, which has 24 core stations in the Netherlands, 16 remote stations in the Netherlands and 13 international stations. As it has no moving parts, it is an ideal telescope to follow-up transients, but it requires full automation. After a server receives and processes a manual trigger, its LOFAR project quota will be checked and it will be assigned a priority. If no higher priority observation is ongoing, it will be scheduled. The advertised response time of less than five minutes is currently being achieved, with the latency often being smaller than 3 minutes, with an up-time of the LOFAR telescopes of 96%. In order to send triggers, it is necessary to have a successful proposal. LOFAR shows that automatization and priority pipelines can be implemented.

Tuesday	Wednesday	Thursday
9:00 - 10:00 Registration	Chair: S. Ohm 9:15 - 10:00 Transient Events with *Fermi*-LAT *D. Thompson*	Chair: A. Stamerra 9:00 - 9:30 ZTF Transients *J. Nordin*
		9:30 - 10:00 The present and future realtime alerts from AMON *A. Keivani*
Chair: F. Krauß 10:00 - 10:15 Introduction	10:00 - 10:30 *Fermi*/GBM Transients *E. Bissaldi*	10:00 - 10:30 Transients with IceCube *A. Franckowiak*
10:15 - 11:00 Transients with CTA *C. Boisson*	10:30 - 11:00 Transient Events with *Swift* *P. Evans*	10:30 - 11:00 Electromagnetic follow-up of gravitational-wave candidates *E. Chassande-Mottin*
11:00 - 11:30 Coffee	11:00 - 11:30 Coffee	11:00 - 11:30 Coffee
Chair: E. Petroff 11:30-12:00 Transients with LoFAR *J.-D. Mol*	R. Wijnands 11:30-12:00 Black-GEM *S. Bloemen*	Chair: D. Berge 11:30-12:30 VO Tools *D. Morris*
12:00-12:30 Rapid-response Triggering with Radio Telescopes *G. Anderson*	12:00-12:30 The Svom alert system architecture *J.-P. Le Fèvre*	
12:30-14:00 Lunch	12:30-14:00 Lunch	12:30-14:00 Lunch
Chair: H. Prokoph 14:00-14:45 Follow-up of Transient Events with HESS *F. Schüssler*	Chair: M. Kettenis 14:00-14:45 Transients and science operations with SKA *A. Chrysostomou*	14:00-14:45 Discussion *D.Berge*
	14:20-14:40 WP5.4 - SKA scheduling *A. Bridger*	
14:45-15:30 HESS Transients II *S. Ohm*	14:40-15:00 WP5.4 - CTA operations and scheduling *J. Colomé*	15:00-15:30 Summary & conclusions *D. Berge*
	15:00-15:30 Scheduling large facilities *A. Bridger*	
15:30-16:00 The MAGIC Transient Program *M. Will*	15:30-16:00 Multi-facility scheduling: SKA & CTA test case *J. Colomé*	
16:00-16:30 Coffee	16:00-16:30 Coffee	
16:30-17:30 Discussion: Automatic prompt follow-up *D. Dorner*	16:30-17:30 Discussion: Priorities & multi facility scheduling *A. Rowlinson*	

Figure 2: Program of the workshop on Transient Alert Mechanisms

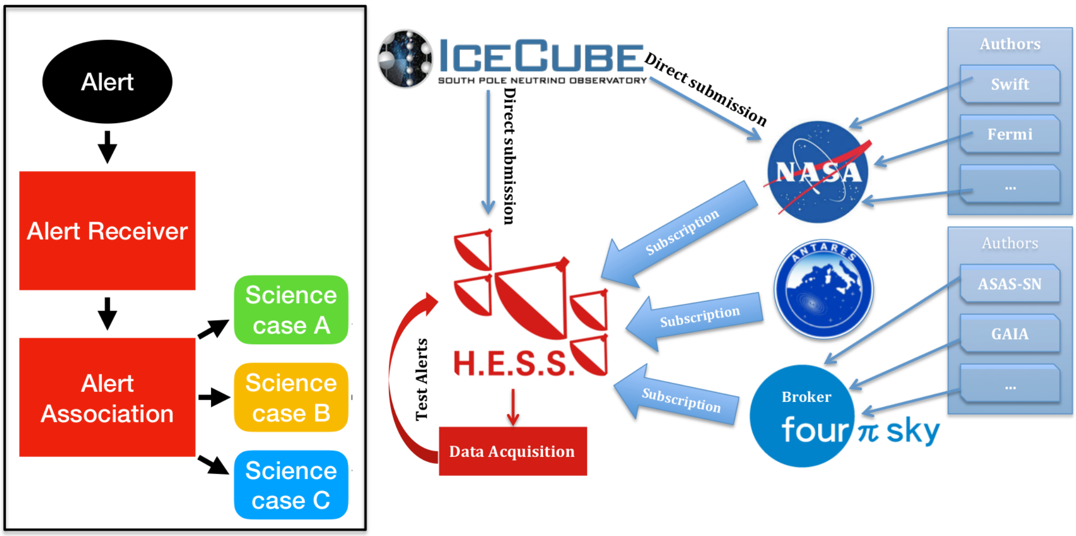


Figure 3: The H.E.S.S. Transients system, alert reception and association (Slide: S. Ohm)

The follow-up talk by Dr. Gemma Anderson talked about rapid response of radio telescopes. With the exception of LOFAR, other radio telescopes still have dishes, which need to be moved to observe a given target. Radio transients occur at various time scales: Some last only seconds (e.g., Fast Radio Bursts; FRBs), while others are seen for hours or even days (e.g., pulsar outbursts). The Arcminute Microkelvin Imager (AMI) Large Array robotically triggers on Gamma-ray Bursts (GRBs) and other multimessenger events. It utilizes the 4πSky VOEvent Broker. Currently the Australia Telescope Compact Array (ATCA) can be triggered after overcoming policy problems in the priorities. For an incoming trigger the software will check whether the target source is above the horizon and whether the current/running program can be overridden. The triggered observations can then still be rescheduled up to 48 hours. Currently implemented pipelines in radio telescopes will provide useful starting points for further large arrays, such as the CTA or the SKA telescopes. From the questions from the audience and answers it seems to be unclear whether the current pipelines can be easily adjusted to different telescopes or telescope arrays.

After lunch, we returned to the highest energies, with summaries of the ongoing transient programs from the current generation of Cherenkov Telescopes. The first two talks were from members of the H.E.S.S. collaboration, Dr. F. Schüssler and Dr. S. Ohm. The two talks gave a detailed overview of the H.E.S.S. strategy for follow-up of transient events. A project has been implemented there for multimessenger follow-up of neutrino events from IceCube and ANTARES. Follow-up for gravitational wave events is done on an event-by-event basis. H.E.S.S. is also in the process of implementing a real-time analysis and the lessons learned from this pipeline will become very useful for CTA.

The second talk focused on the technical implementations, again emphasizing the need for automated follow-up, especially for transients on a sub-day time scale. Prompt observations are required for GRBs, soft gamma repeaters (SGR), neutrino events and gravitational waves. H.E.S.S uses the Transient Factory with a VO Alerter (based on the Comet Broker) and a filtering algorithm before follow-up of transient events is scheduled (see Fig. 3). The advantage of H.E.S.S. is its rapid slewing capability and its large field of view (FoV). There are dedicated algorithms in place for correlation of gravitational wave events with galaxy catalogs (GLADE; http://aquarius.elte.hu/glade/ that allow improved coverage of the uncertainty regions of a gravitational wave event. As H.E.S.S has only recently begun to explore the transient sky and the VO system, it has not reached its full potential, but the lessons learned will help the CTA observatory for establishing its own transient program.

After the H.E.S.S. talk, Dr. M. Will presented the ongoing MAGIC (Major Atmospheric Gamma-Ray Imaging Cherenkov) transient program. The MAGIC program is focused on follow-up of GRBs, gravitational waves, neutrinos and FRBs. MAGIC uses 15% of its total observation time for these sources and has implemented automatic repositioning for GRBs and SGRs, with planned implementations for Neutrino and gravitational wave alerts. MAGIC further has a project to observe the Cherenkov light from τ-neutrinos at PeV energies that produce a charged current (τ) in the ocean, with an up-going shower. The Cherenkov light can then be seen by the MAGIC telescopes. The lessons learned for CTA are that a lower energy threshold and a fast repositioning speed is optimal for follow-up of transient events. It is further possible to analyze moonlight-affected data using tuned MC simulations, allowing to double the duty cycle. It is further necessary to coordinate follow-up with other instruments for optimizing the science return.

3.2 Day 2, September 27

On the second day we started at high energies, with a summary of the *Fermi*/LAT transient program and FAVA software tool by Dr. D. Thompson. As the *Fermi* satellite has a large field of view (FoV) and has been set to changing rocking angles, it can cover the whole sky in $\sim$3 hours. It measures individual photons and the data becomes public immediately. Still there is a delay between data-taking and the data being public due to limited down-link possibilities and data processing, which on average takes 10 hours. After nine years of experience, the high-energy sky and transients seen by LAT are very well known. The benefits of the LAT instrument are the full sky coverage, no day/night or seasonal limitations, and no weather limitations. The disadvantage is the small size, which limits the effective area and angular resolution. For follow-up of transient alerts, where the counterparts are uncertain, several different light curve analyses are used, including Fixed Time Interval searches, adaptive time interval searcher, and searching through Low Energy Events. There are two automated pipelines, the automated science processing, which generates maps on 6 hour time scales and determines all significantly detected sources, providing source location, TS value, flux, spectral index, and likely source counterpart/association. The other tool is the *Fermi* All-sky Variability Analysis (FAVA), which uses longer term observations as baseline for an "average" γ-ray sky and looks for differences from that average on different time scales, including weekly.

The second presentation was by Dr. Elisabetta Bissaldi about the second instrument on *Fermi*, the GLAST Burst Monitor (GBM). It is specifically designed to detect GRBs, which are then localized and classified before an alert is sent via GCN (of the order of 10 s after the burst. The GBM further also sees Terrestrial Gamma-ray flashes (TGFs), Soft Gamma-ray Repeaters (SGRs), and solar flares.

After GBM, we moved to X-ray energies, with a talk by Dr. Phil Evans (Leicester) about transient events with *Swift*. He highlighted the difference between automatic and manual follow-up of triggers. which can be external or internal. Internal triggers from the BAT telescope are automatically followed-up, always stopping the ongoing observations. Manual follow-up of multimessenger has presented considerable challenges, including an increase in the slew speed. While *Swift* already provides a database for internal GRB triggers he emphasized that such a tool is needed by the wider transient community. Such a tool needs to allow queries for events, e.g. by type or date, and should further collate follow-up efforts of various teams. The largest uncertainty of such an efforts are the politics. Do MoUs need to be signed and access restricted to certain parties and collaborations?

We moved on to optical wavelengths with the BlackGEM telescope, an effort led by the university of Nijmegen. The goal of BlackGEM is the optical follow-up of Gravitational Wave events. The talk given by Dr. Steven Bloemen showed first results from the MeerLICHT prototype at Sutherland, South Africa. BlackGEM will be 3 telescopes at La Silla, with an expected completion at the end of 2018. The all-sky data will be made public and the goal is to publish transient events with as little a delay as possible.

The following talk was given by Dr. Jean-Paul Le Fèvre on the Svom mission. It is a French-Chinese space mission with an expected launch by the end of 2021 by a Long March rocket. The Svom's mission goal is to follow-up GRBs, providing quick accurate positions, as well as the spectral shape of prompt emission, the redshift, and afterglow information. It will have a range of instruments with a coverage of the optical ($\sim$400 nm) to low-energy γ rays ($\sim$5 MeV). The plan is to stay in constant contact with the ground to down-link transient events as quickly as possible. Due to its time frame, it will have excellent synergies with the GRB science of CTA. With its other multiwavelength capabilities, it might be useful to ask for additional time for Galactic and Extragalactic CTA projects.
In the afternoon, we moved on to a session that was organized by the ASTERICS Work Package 5.4 community, with talks from Dr. Antonio Chrysostomou, Dr. Alan Bridger, and Dr. Pep Colomé. They highlighted the transient science with SKA and its scheduling problems, as well as the common science questions of SKA and CTA.

3.3 Day 3, September 28

The last day started with a multimessenger session. First was a talk by Dr. Jakob Nordin about transients seen by the Zwicky Transient Facility (ZTF). It uses a wide field of view optical camera with fast readout. It is used in survey mode, allowing for the detection of transient events.
We moved to multimessenger events with a talk by Dr. Azadeh Keivani about the present and future real-time alerts from AMON. AMON is a network that has MoUs with many of the current multiwavelength facilities, including the VHE instruments. Users can subscribe to a stream of transient events or alerts that are distributed through the AMON network, while restricting access to outside parties. It is clear that AMON has the potential to become a powerful tool for transient science.

We then heard a talk by Dr. Anna Franckowiak, who talked on behalf of the IceCube collaboration. IceCube is a neutrino detector, with optical modules drilled kilometer deep into the ice of the Antarctic, located near the South Pole. Its goal is to detect Cherenkov light from neutrinos through a charged current or neutral current channel. The origin of astrophysical neutrinos remains unclear. There are several ways to answer these questions: either through clusters of neutrinos at the position of an astrophysical source, or through multiwavelength follow-up. With a planned update to IceCube Gen-2 and real-time alerts, this facility will be an important target for multiwavelength facilities. It will allow for answering fundamental questions about the origin of cosmic rays and astrophysical acceleration mechanisms.

The final talk of this session was a talk by Dr. Eric Chassande-Mottin about Gravitational Waves. He highlighted that with the current three stations, the localization of gravitational waves has dramatically improved, allowing for a quick and efficient multiwavelength follow-up.
The last talk of the conference was by Prof. Dr. Dave Morris about the VO Tools. He emphasized that the Virtual Observatory is a standard for transient science, and provides guidelines. It does not provide tools and software, however, a lot of software has been developed based on this standard, e.g. including the externally developed TopCat and Aladin Vizier. The standards for transient science are highlighted in the VOEvent Transport protocol, which has now been implemented by numerous collaborations and instruments. Feedback to the VOEvent team is welcome, and they are working on implementing JSON format. The main challenge will be filtering large streams, such as the amount of transients expected from the Large Synoptic Survey (LSST).

3.4 Discussion sessions

Every day we set aside one hour to discuss relevant topics with the whole audience. The goal was to hear various opinions on topics relevant to transient science. It was also a goal to discuss controversial issues and talk about lessons learned from other instruments. On the first day, Dr. Daniela Dorner led the discussion about automatic prompt follow-up. The following question sparked some controversy: How realistic is automatic prompt follow-up? Many agree that this is limited by hardware and the priorities of the ongoing observations at the time of the trigger. However, others argued that a human is necessary to sometimes make decisions. It was concluded that there is a difference between the prompt follow-up, which is ideally robotic, and longer-term follow-up, that usually needs human interaction. Dr. Antonia Rowlinson mentioned that some projects are willing to accept (more) false-positives if it means they will receive alerts earlier. An example is an incoming trigger of a transient event. The automatic scheduling finds it has a higher priority than the ongoing observation, so the current observation is interrupted and immediate follow-up of the transient begins. The RTA will determine if a counterpart is found. A human (e.g., Burst/Flare Advocate) will then decide, based on preliminary analysis of the data and on the information in the transient alert if more follow-up is necessary/desired. However, Dr. Gemma Anderson remarked that the policy of only overriding running observations if the priority of a trigger is strictly higher means that there is only a relatively small chance a trigger is actually observed.

The second discussion was led by Dr. Antonia Rowlinson, about priorities and multi-facility scheduling. She asked the audience where we can join forces, and which software and tools (e.g. for handling transient alerts) is instrument specific and cannot be used for other telescopes. She further discussed standards and guidelines for multi-facility transient policy and science. This approach would not be enforced, but would rather serve as guidelines for the community and the facilities. She suggested a common priority ranking, allowing multi wavelength follow-up without implementing multi-facility scheduling. It is unclear how ongoing observations (and their respective priorities) affect this schedule. It was further discussed to ensure that an expert on transient science serves on the Time Allocation Committees for the facilities, to ensure that the best transient science gets done. Co-observing and multi-facility scheduling is very complicated to organize, but it might be possible to organize more communication (e.g., LOFAR only observes the target *if CTA is observing). It was clear that this has the largest uncertainties, as there is not much experience with this. It is unclear which science cases would profit from this the most, but fast transients (less than a day), seem to gain a lot. However, there is a lack of a communication protocol, and how to deal with facility specific dynamic scheduling changed due to e.g., weather, incoming alerts, and telescope status.

The last discussion by Prof. Dr. David Berge dealt with policies. This included the discussion of public versus private data and the various advantages of either. He further discussed whether it will be possible in the future to avoid the long and tedious MoU procedures. Possible solutions are code of conducts and restrictions on the server side (by networks such as AMON). He argued that a risk is that smaller telescopes or collaborations will be left out of those networks or agreements.

4 Recommendations for transient science

In the following we summarize the main conclusions of the workshop that came out of the talks, questions to the talks, and discussion sessions. These can be seen as guidelines, or recommendations for transient science in the era of ESFRI facilities.

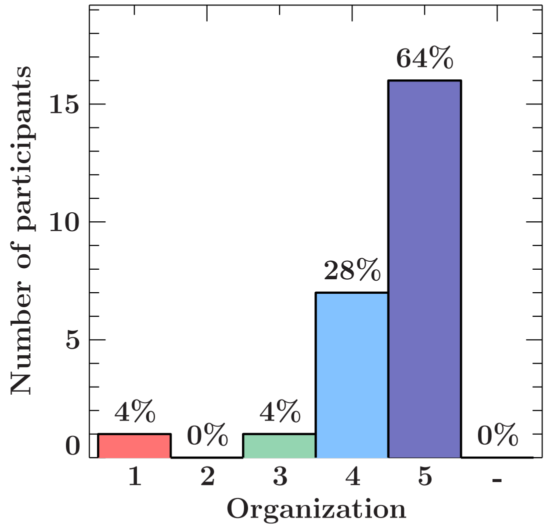
1. Science should drive policies: We want to avoid missing important science results because of policy problems, or because MoUs have not been finalized.
2. Networks for communication, compilation and dissemination of multimessenger (transient) events will be crucial, however, we have to avoid leaving out (smaller) facilities. The Astrophysical Multimessenger Observatory Network (AMON) partly solves this problem.
3. Many events will soon be public immediately (gravitational waves, IceCube alerts), which will increase science outcome and fast follow-ups.
4. A central database for transient events would be useful, where information is collated and can be queried by users. Such a database could be tied to guidelines that all interested parties have to agree to. This could be an ideal approach to avoid the long MoU procedures.
5. Researchers should adhere to a "handshake policy" in transient science, to assure scientific standards and confidentiality and to allow for fast communication of transient events.

5 Evaluations

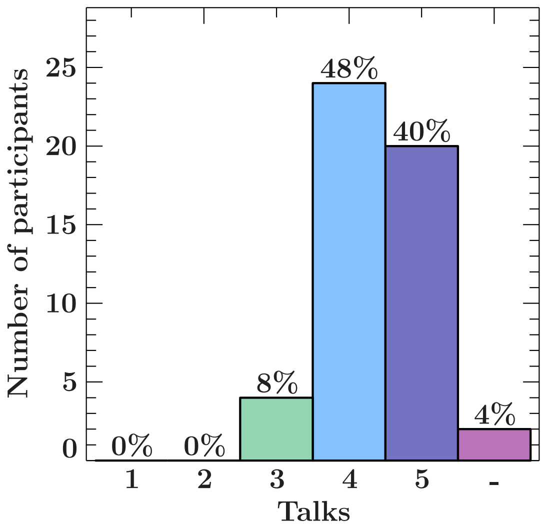
The participants have been asked to fill out an evaluation form after the closing of the meeting. We have received 25 answers from a total of 43 participants, including the LOC members, which have likely not participated in the survey. Excluding the LOC members, this yields a 67% response rate. We estimate that the results are representative for all participants of the workshop. In the following we show the evaluation results and discuss their findings briefly. First, the questions are described below, and the answers are presented in Fig 4a through Fig. 6b.

5.1 Evaluation results

Question 1. Using the scale 1 to 5 (where 1 is unsatisfactory and 5 is very good, and - is no opinion) how would you rate the general organization of the conference (Fig. 4a)
Question 2. Using the scale 1 to 5 (where 1 is unsatisfactory and 5 is very good, and - is no opinion) how would you rate the relevance and quality of the talks (Fig. 4b).

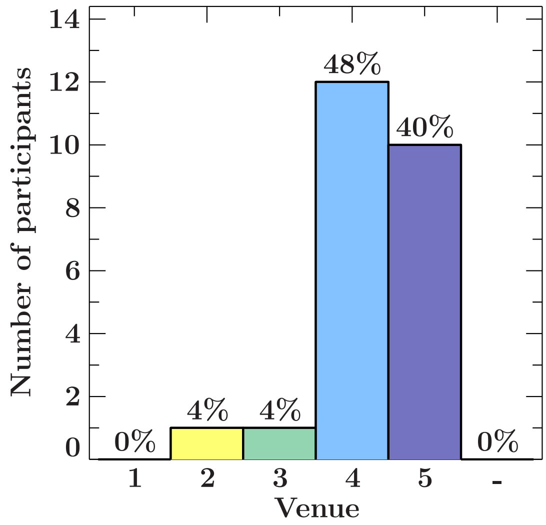


(4a) Evaluation of the organization of the conference

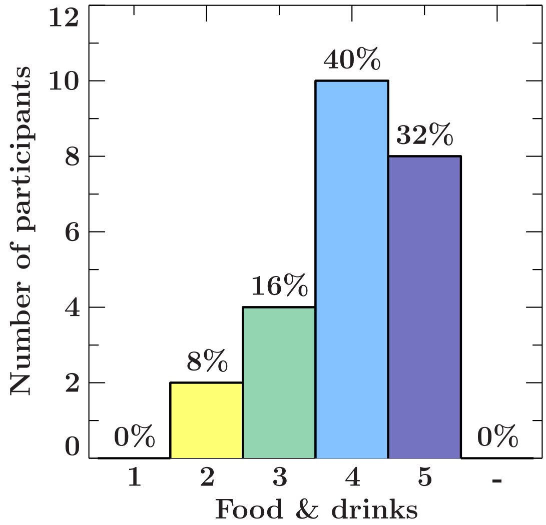


(4b) Evaluation of the talks of the conference

From the first two questions we find that 92% of the participants of the survey (hereafter: participants) rate the general organization of the conference with a 4 or a 5, indicative of a general satisfaction with the workshop, although one person provided the minimum score of 1, but apparently no further feedback on the dissatisfaction. Participants seemed almost equally satisfied with the quality and relevance of the talks, with 88% of the participants rating the talks at a 4 or 5. Four percent did not have any opinion, possibly because they did not attend the full meeting.
Question 3. Using the scale 1 to 5 (where 1 is unsatisfactory and 5 is very good, and - is no opinion) how would you rate the conference venue in general (Fig. 5a).
Question 4. Using the scale 1 to 5 (where 1 is unsatisfactory and 5 is very good, and - is no opinion) how would you rate the food and drinks provided during the conference (Fig. 5b).
These two questions concerned the venue of the conference. The first question is



(5a) Evaluation of the venue of the conference

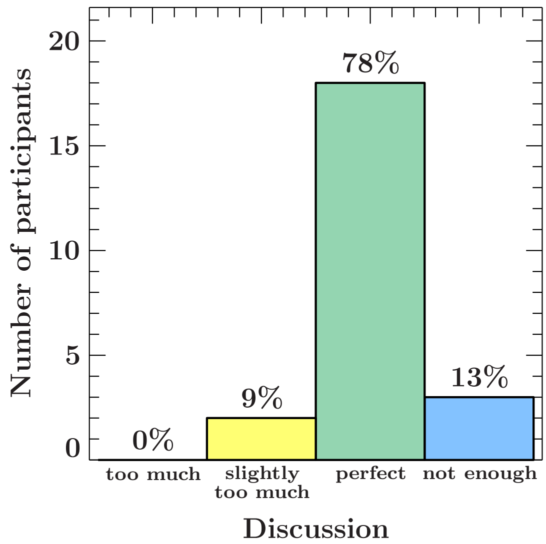


(5b) Evaluation of the food at the conference

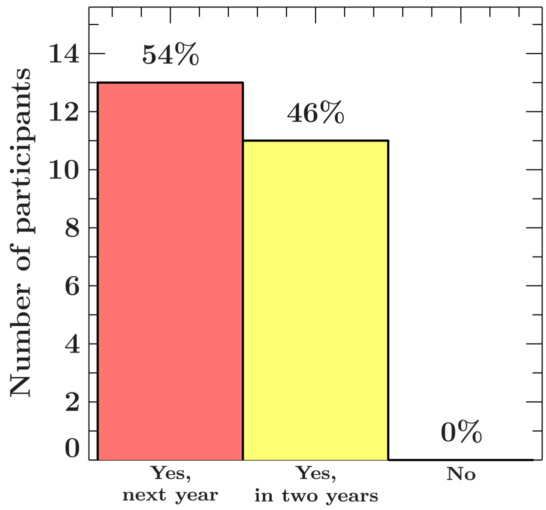
designed to give an overview of the opinion of all available facilities, while the second questions specifically targets the food and drinks provided during the conference. The results of the first question (Fig. 6.a) indicates a general satisfaction with the venue, with 88% rating at 4 or 5 out of 5. A further 72% were satisfied with the food and drinks, while 24% were not completely satisfied with the food.

Question 5. What do you think about the time allocated to discussion? (Fig. 6a).

Question 6. Would you be interested in another workshop on the same topic ?(Fig. 6b)



(6a) Evaluation of the discussions at the conference



(6b) Continuation of the conference

Question 5 was asked to gain feedback about the amount of time allocated for discussion, and 78% were satisfied with the discussion. Nine percent found it too much discussion, while 13% found that it was not enough time to discuss, making it clear that it is generally difficult to satisfy everyone. The last questions concerns a follow-up conference, and we received no votes in favor of no follow-up conferences. A slight majority

(54% vs. 46%) prefers a follow-up conference within one year instead of within two years.

5.2 Further feedback

This section includes further feedback that was provided by the participants as part of the anonymous evaluation form on the website. Concerning contents, the main points where to include Chinese colleagues and collaborations (such as the DAMPE collaboration) and to have more technical talks. Further feedback mostly concerned the setup with two projectors and the food and coffee breaks. Following are copies of the comments made, where each bullet point came from a different person.

- Need to include some Chinese people, and also people with the power to decide whether the sort of things we discuss will be used by facilities.
- I'd like to have more talks about software and technical stull[sic]
- Several interesting ideas and projects have emerged in the discussions (e.g., centralized data server for follow-up observations). It would be nice that this be concretized into projects or working groups withing Asterics.
- The setting with two projections was not optimal. Everything else was great!
- This meeting was a good opportunity to talk to people I do not ordinarily encounter. The only reason for suggesting two years for another is that there should be major progress by that time (not so certain in one year).
- I greatly appreciated the relaxed atmosphere and the long coffee/lunch-breaks, very useful for informal discussions. I would have put some signs along the way from the train station to the conference hall.
- Coffee/tea/cookies in the morning before the sessions starst! Do not use a lecture room with two screens. That is very cumbersome.

5.3 Summary of evaluations

The evaluations were very positive, with the main central point that a larger workshop that involves more collaborations and people should be held in the future. Participants were always seen discussing enthusiastically during lunch and coffee breaks.

6 Science results

Shortly before the workshop (September 17), a high energy neutrino event was observed by the IceCube observatory (Kopper & Blaufuss 2017). During the conference and elevated flux of a blazar (TXS 0506+056) was observed by *Fermi*/LAT, consistent with the time and position of the neutrino event (Tanaka et al. 2017). This Astronomer's telegram (ATel) was submitted during the conference (September 28), with the information being shared with the other participants before the submission of the ATel. This allowed for a quick follow-up with a multitude of instruments, including (but not limited to): *Swift*, *NuSTAR*, MAGIC, H.E.S.S., VERITAS, *Agile*, Maxi, ASAS-SN, SALT, VLT

(Keivani et al. 2017; Fox et al. 2017; Mirzoyan 2017; de Naurois & H.E.S.S. Collaboration 2017; Mukherjee 2017; Lucarelli et al. 2017; Negoro et al. 2017; Franckowiak et al. 2017; Soelen et al. 2017; Coleiro & Chaty 2017; Steele 2017) This was an unprecedented effort in neutrino astrophysics and was greatly helped along by having members of almost all of the teams present at the workshop, quickly sharing developments and science results.

7 Conclusion

From the evaluations and conversations with many of the participants we conclude that the workshop has been a success in bringing together different communities, including radio, optical, X-ray, γ-ray, and multimessenger observatories. While many questions about transient science and the best procedures remain unclear, it is an important first step to increase our network and start communicating with many other facilities and collaborations. In this document we have outlined recommended standards for the dissemination, distribution and reaction to multimessenger events. This is based on the ASTERICS policy forum, which has been recommended to the CTA management. From the enthusiasm of the participants we recommend a follow-up workshop about Transient Alert Mechanisms to reach even more people and collaborations and to further strengthen the existing connections. We recommend that this workshop will be held in the framework of ASTERICS if possible.

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