ABSTRACT BOOK

5th Gaia Science Alerts Workshop

9-12 September 2014

University of Warsaw, Poland

The titles are sorted following the agenda of the workshop.

Workshop's agenda on-line:

http://www.ast.cam.ac.uk/ioa/wikis/gsawgwiki/index.php/Workshop2014:agenda

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Dr Timo Prusti

ESA, ESTEC, Noordwijk, Netherlands

Gaia overview and status

Current status of Gaia

Dr Anthony Brown

Leiden Observatory, Leiden, Netherlands

Gaia data processing - for real now

I will provide an overview of the Gaia Data Processing and Analysis Consortium and show some examples of the data processing that took place during the commissioning of Gaia.

Dr Simon Hodgkin

Institute of Astronomy, University of Cambridge, UK

Gaia Science Alerts Operations

AlertPipe operations.

Dr hab. Łukasz Wyrzykowski

OAUW, Warsaw, Poland

Design of AlertPipe

I will present the design of the AlertPipe, the pipeline within Gaia data processing stream, which is responsible for near-real-time detections and classification of the anomalies and transient astrophysical events. Some early results and findings will also be presented.

Dr Guy Rixon

Institute of Astronomy, University of Cambridge, UK

Technical challenges and solutions for Gaia Science Alerts

An update on the evolution of the Gaia alerts pipeline to deal with the early-mission data-stream.

Nadia Blagorodnova

Institute of Astronomy, University of Cambridge, UK

Gaia: a Supernova Discovery Machine

Gaia is ESA's global space astrometry satellite, which launched in Dec 2013, to embark on its full-sky 5 year mission. During early summer 2014 it is expected to complete its commissioning phase. It will then carry out an Ecliptic Pole Scanning Mode set of observations for initialisation and validation purposes. The full-sky nominal operation mode will then commence. In this talk I will present the power of Gaia for transient discovery, and in particular how Gaia will detect a significant number of supernovae. I will detail Gaia's expected capabilities with special attention to: its ability to localise nuclear transients (Blagorodnova et. al., in prep.); the performance of GS-TEC[Gaia Spectro-photometry - Transient Events Classifier] (Blagorodnova et. al, 2014), the automated realtime classification of low-resolution Gaia spectro-photometry; status of the ground based follow-up and validation campaigns and the first performance results from the Ecliptic Pole Scanning Phase.

Dr George Seabroke

Mullard Space Science Laboratory (MSSL), University College London (UCL), UK

Gaia Radial Velocity Spectrometer follow-up of Gaia Science Alerts

I will present commissioning results from Gaia’s Radial Velocity Spectrometer (RVS) and how RVS can provide spectroscopic follow-up of Gaia Science Alerts (GSA). The GSA pipeline is being commissioned using 28 days of undisturbed Ecliptic Pole Scanning Law data from 25th July to 22nd August 2014. The RVS spectra from this period is being processed using the DPAC-CU6 Spectroscopic Processing pipeline running at the Mullard Space Science Laboratory (MSSL). If possible, I will present calibrated RVS spectra of potential alerts detected by the GSA pipeline.

Dr Nami Mowlawi

University of Geneva, Geneva Observatory, Switzerland

CU7 variability processing and analysis

We present the variability processing and analysis that is being put in place in CU7 to process the Gaia data of variable objects. We highlight the aspects that are of interest to both CU7 and the Gaia Science Alerts team in CU5, and mention the synergies that are to be developed between the two groups.

Christine Ducourant

Laboratoire d'Astrophysique de Bordeaux, Bordeaux University, Observatoire de Bordeaux, France

The millions of tiny galaxies that Gaia is observing

Gaia's main goal is to study the Milky Way and its stellar content and to provide us with their highly accurate astrometric and photometric parameters. However the satellite will also survey many others objects. Especially Gaia will observe a few millions of tiny galaxies of the local Universe and will give us a unique chance to access to a whole sky survey of these objects that no ground-based survey has recorded. The high resolution of Gaia’s observations, privilege of space astronomy, will allow the observation of small galaxies that could not be resolved from ground base surveys such as Sloan Digital Sky Survey, we present the "Extended Object" DU470 work to retrieve the morphology of such objects.

Dr Grainne Costigan

Leiden Observatory, The Netherlands

CU9 Gaia Data Archive

Dr Massimo Turatto

INAF - Osservatorio Astronomico di Padova, Italia

Asiago supernova programme

Andrzej Piascik

Astrophysics Research Institute - Liverpool John Moores University, UK

A Spectrograph for the Rapid Analysis of Transients

The Spectrograph for the Rapid Acquisition of Transients (SPRAT) is a long-slit, low resolution (R = ~350), operating in the visible (400-800 nm) wavelengths and was developed by the Astrophysics Research Institute in Liverpool. It will perform rapid spectral classification of faint (V ~20) objects. Its primary purpose is to provide follow-up observations for transients detected by Gaia, iPTF (intermediate Palomar Transient Factory), LOFAR (Low Frequency Array) and high energy satellites. The dispersive element is a volume phase holographic (VPH) transmission grating combined with a prism pair (grism) in a linear optical path. It will operate at one of two peak central sensitivities, 600nm or 550nm, selectable by rotation of the grism to a fixed orientation. The instrument is designed for fully robotic operation on the Liverpool Telescope (LT) situated at La Palma in the Canary Islands and will be deployed in September 2014. The VPH and prism combination and entrance slit are both deployable and when removed from the beam the collimator/camera pair allows the target field to be imaged directly onto the detector. This mode of operation provides optimal automatic acquisition of the target onto the slit location prior to spectrographic observation through World Coordinate System fitting. The slit may also be retracted during observation to allow slit-less spectroscopy.

Dr Morgan Fraser
Institute of Astronomy, University of Cambridge, UK

Validating Gaia Alerts with ground based spectroscopy

Ground based spectroscopy of candidate Gaia Alerts.

Dr Simon Hodgkin
Institute of Astronomy, University of Cambridge, UK

Spectroscopic follow-up of Gaia Alerts

Status of the follow-up of Gaia Alerts.

Prof. dr hab. Andrzej Udalski
Warsaw University Observatory, Warsaw, PL

OGLE-IV overview

Dr Adam Miller
Jet Propulsion Laboratory/Caltech, USA

Current and Future Palomar Time-Domain Surveys

The Palomar Transient Factory (PTF) is a fully-automated, wide-field survey dedicated to optical studies of time-domain astronomy. PTF uses a ~7.8 sq. deg. camera mounted on the 1.2-m Samuel Oschin Telescope at Palomar Observatory. All aspects of the survey, from telescope operations to data processing to transient discovery to photometric follow-up are roboticized and proceed without human intervention. In my talk, I will briefly describe the PTF survey, provide some scientific highlights related to the discovery of explosive and eruptive variables, and discuss potential synergistic experiments between PTF and Gaia. Finally, I will close with a brief description of the Zwicky Transient Facility (ZTF; first light in 2016), the next generation Palomar time-domain survey, which will survey the sky ~10 times faster than PTF.

Dr Dorota Skowron
OAUW, Warsaw, PL

The All-Sky Automated Survey for Super Novae

Even in the modern era, only human eyes survey the entire optical sky for the violent, variable, and transient events that shape our universe. To change this, we have built and implemented the All-Sky Automated Survey for Supernovae (ASAS-SN). This is a long-term project designed to monitor the extragalactic sky down to V~17 mag every 2-3 days using multiple telescopes, hosted by LCOGT, in the

northern and southern hemispheres. Our telescopes consist of commercially available telephoto lenses and CCDs, so future expansion is straightforward. The primary focus of the survey is to find bright nearby supernovae (SNe) and other transient sources. We began running our real-time search for variable sources in late April 2013 with our first unit, "Brutus", and in May 2014 we have deployed "Cassius" in Chile. ASAS-SN has already found ~40 bright nearby SNe and outbursts from 200+ cataclysmic variable stars, many M-dwarfs, young stellar objects (YSO), AGN and a tidal disruption event 200 Mpc away. ASAS-SN is an ongoing survey which, judging by its current success and future expansion, promises to be innovative and prolific for years to come.

Dr Cosimo Inserra

Queen's University Belfast, UK

Overview of PESSTO

I am going to give an overview of PESSTO at the end of the second year. I will talk about what data are currently available, our timescales for data release (quick and final) and what we want to improve from SSDR1 to SSDR2. I will also show a quick comparison between PESSTO and other transient related searches, as well as an overview of the science topics treated and what is the scientific contribution PESSTO offered so far and what we want to achieve. Last but not the least, I will discuss about a future collaboration between Gaia and PESSTO.

Dr Heather Campbell

Institute of Astronomy, University of Cambridge, UK

Type Ia Supernovae - Gaia

As Type Ia Supernovae surveys become increasingly large, systematic errors are now dominating the cosmological constraints. Studying SNe Ia as a function of the host galaxy is becoming increasingly important, as there appears to be many correlations between SNe Ia and host galaxy. It has been shown that not accounting for these correlations is one of the largest systematic errors in SNe Ia cosmological constraints. The photometrically classified SDSS-SN sample is a large homogenous sample useful for studying some of these interesting correlations. Including mass, metalicity and star formation rates. We also investigate galaxy spectra taken at the location of the SN for correlations. The large low redshift sample of SNe Ia from Gaia will enable study these correlations in much more detail in the future.

Dr Seppo Mattila

University of Turku, Finland

Supernovae in nuclear environments

Most searches are neglecting the supernovae that occur within the nuclear regions of galaxies and their nature and rate of explosion therein, especially in the most actively star forming galaxies, have remained largely unknown. In this talk I describe our efforts using high spatial resolution near-IR and radio observations to detect and study supernovae within the heavily dust-obscured nuclear environments. I will also discuss the potential of Gaia to discover supernovae within the unobscured nuclear regions of galaxies over the whole sky.

Dr Elme Breedt

University of Warwick, Coventry, UK

Accreting compact objects in the transient sky

Compact interacting binaries will be responsible for a large fraction of the transients observed by Gaia, be they supernova explosions, nova eruptions or accretion disc instabilities that result in dwarf nova outbursts. The study of these transient populations is key to improve our understanding of accretion physics and binary evolution. Gaia will have the advantage of a well-determined sampling pattern and constant limiting magnitude, independent of weather effects, so that selection effects can be accurately modeled. I will present recent results from the Catalina Real-time Transient Survey (which closely resembles Gaia in terms of limiting magnitude, duration, and total number of epochs) as a showcase for the scientific potential of Gaia transients. The large number (1000+) of cataclysmic variables discovered in CRTS allowed us to study the faint end of the accreting white dwarf population, and it also revealed a number of rarer systems such as ultra-compact double degenerate binaries and, potentially, X-ray binaries. I will briefly discuss our plans for follow-up observations, Pro-Am collaborations, and an online data base for the Gaia CVs.

Dr Peter Jonker

SRON, Netherlands Institute for Space Research & Radboud University Nijmegen, The Netherlands

The Gaia Science Alerts potential for discovering intermediate-mass black holes

In this presentation I will discuss the potential of Gaia for discovering intermediate-mass black holes. The emphasis will be on the use of the Science Alerts to this end. I will also show possible results related to the data coming out in the first release. In addition, I will highlight the potential, and in specific cases, the crucial importance of follow-up or even simultaneous observations of the region of the sky covered by the Gaia scans using in particular X-ray and radio observatories.

Thomas Wevers

RU Nijmegen, The Netherlands

Probing a new region of phase-space: very short timescale variability with Gaia

The phase-space of astrophysical transients in the optical is relatively well-sampled at a large range of timescales, except at the very short end. It is hard to obtain high-quality data on timescales of seconds to minutes from the ground due to atmospheric limitations. Gaia however provides an excellent opportunity to explore the shortest timescales, as it will provide ~mmag-precision photometry with a sampling of 4.4s. We are currently setting up an effort for the detection and subsequent characterisation of very short (intra-CCD timescale) photometric transients in the Gaia Alerts framework, because the standard detection algorithms are likely to miss such extremely short duration events. It is clear that this problem is extremely sensitive to potential sources of (predominantly instrumental) contamination, therefore we need to characterise all sources of variability in the data in detail to be confident that any changes in brightness we are detecting are astrophysically real.

Dr Jure Japelj

University of Ljubljana, Slovenia

Hunting for GRB afterglows with Gaia

Gamma-ray burst (GRB) optical afterglows represent one of the potential transients that will be detected by Gaia. The expected number of detected afterglows in the lifetime of Gaia is low - a few tens of events - and their short-lived nature will make the ground-based follow-up observations especially challenging. Despite the difficulties, the Gaia-detected afterglows may provide an important contribution to the GRB field and therefore the effort to use the satellite as an afterglow detector should be pursued. I will present the areas of GRB science we can explore with the help of Gaia. Special attention will be given to the challenges of automatic afterglow classification and the subsequent ground-based follow-up observations.

Prof. Dan Maoz

Tel-Aviv University, Israel

Fast Radio Bursts

Prof. Wyn Evans

Institute of Astronomy, University of Cambridge, UK

Predicting Microlensing Events

We estimate the number of predictable microlensing events for the GAIA five year mission and provide some specific examples.

Dr Martin Dominik

SUPA, University of St Andrews, UK

Measuring masses - Microlensing with Gaia

With Gaia's technical capabilities, we will for the first time be able to observe the astrometric signature of a large number of gravitational microlensing events. For some of these, the mass of the lens objects in the Galactic disk can be inferred, leading to a measurement of the local mass function, including dark or faint objects such as black holes, neutron stars, white dwarfs, and brown dwarfs. Such a goal is best achieved if Gaia observations are complemented by photometric follow-up with a world-spanning telescope network. Gaia will not only detect ongoing microlensing events by means of their astrometric and/or photometric signature, but its precise measurements of proper motions allow rather accurate predictions of upcoming microlensing events. One such opportunity has already been identified to arise for Proxima Centauri.

Dr Kailash Sahu

Space Telescope Science Institute, Baltimore, USA

Astrometric Microlensing with GAIA

I will discuss several projects involving astrometric microlensing with GAIA, including: (i) Astrometric microlensing by nearby high proper motion stars, (ii) Mass determination of planet-bearing lens stars towards the Galactic bulge, and (iii) Detection and mass determination of stellar remnants acting as lenses

Sjoert van Velzen

Radboud University Nijmegen, The Netherlands

Optical TDE and Gaia

Dr Zsolt Paragi

Joint Institute for VLBI in Europe (JIVE), NL

Tidal Disruption Events and the search for Massive Black Holes (<10^6 Msun)

Dr Krzysztof Hryniewicz

University of Geneva, Switzerland

Search for TDE candidates with Swift BAT

Only a handful of tidal disruption events (TDE) have been detected at hard X-ray, even though the high-energy band is immune to absorption and contaminati on by the host galaxies. Depending on their peak luminosity and timing properties, these high energy flares could be connected with emission from a relati vistic jet or from

the corona accompanying the accretion flow. We used the complete Swift BAT archive to search for hard X-ray flares with time scales cor responding to these expected for TDE. We extracted hard X-ray lightcurves for 53000 nearby galaxies in two energy bands and with various time binning. Pot ential candidates and their statistics will be presented and compared to theoretical expectations.

Prof. Gerry Gilmore

Institute of Astronomy, University of Cambridge, UK

OPTICON

Dr Anna Hourihane

Institute of Astronomy, University of Cambridge, UK

Gaia outreach in the UK

I will present the current UK Gaia outreach activities and plans for an Alerts-based schools outreach programme.

Dr hab. Łukasz Wyrzykowski

Warsaw University Observatory, Warsaw, Poland

Time-domain Network within OPTICON

I will describe the activities within the OPTICON, which purpose is to facilitate organise the European resources of small and medium telescopes as a network for time-domain astronomy (variable stars and transients).

Dr Krzysztof Ulaczyk

Warsaw University Observatory, Warsaw, Poland

Ephemeris tools for follow-up planning

Liam Hardy

University of Sheffield, UK

pt5m on La Palma - ready to follow up Gaia transients

I will give a very brief update on the state of the telescope, including recent and upcoming upgrade work. I will detail a few recent observing campaigns conducted by the pt5m, and finish with information about our alert-handling software already in operation.

Dr Hasan Esenoglu

TUBITAK National Observatory & Istanbul University, Turkey

Photometric Contribution to Gaia Alerts from Robotic and Remote Control TUG

TUBITAK National Observatory's (TUG) telescopes of 1.5m, 1m, and 60cm have been allocated to Gaia alerts at a certain rate. While the telescope of 1.5m contributes to both spectroscopy and photometry, the telescopes of 1m and 60cm have been only assigned photometric observations. All TUG telescopes have often succeeded tests of Gaia alerts. Critical observations on light curves of the follow-up Gaia alerts belong to TUG telescopes. TUG telescopes are ready to observe Gaia satellite alerts.

Milan Stojanovic

Astronomical Observatory in Belgrade, Serbia

Serbian-Bulgarian mini-network telescopes as a part of Gaia-Follow-Up Network

We present an overview of our activities in the Gaia-Follow-Up Network which includes establishing Serbian-Bulgarian mini-network of telescopes, test observations and some results. Our network consists of five telescopes at thre sites, ASV in Serbia, Belogradchik and Rozhen in Bulgaria. Since one of the most important Gaia's requirements for photometric alerts is fast observation and reduction response, that is, submitting of observations within 24 hours. For that reason we have developed a pipeline. In line with possibilities of our new telescope (D(cm)/F(cm)=60/600) at the Astronomical Station Vidojevica (ASV, of Astronomical Observatory in Belgrade), we joined the Gaia-Follow-Up Network for Transients Objects (Gaia-FUN-TO) for the photometric alerts. During the next year we expect a new 1.4 m telescope at ASV site. The speed of data processing (from observation to calibration server) could be one day.

Dr Jochen Greiner

Max-Planck Inst for extraterrestrial Physics, Garching, Germany

GROND capabilities for Gaia transient follow-up

GROND is a simultaneous 7-channel (400-2400nm) imager operated at the 2.2m Max-Planck telescope at La Silla (ESO). I will describe the capabilities of the instrument incl. reaction times on alerts, turn-around time for data analysis, and access details.

Dr Chris Davis

Astrophysics Research Institute - Liverpool John Moores University, Liverpool, UK

Time domain astronomy with the Liverpool Telescope

A brief overview of the Liverpool Telescope, Europe's premier robotic observatory, will be given. The LT specializes in delivering high-impact results in time-domain astrophysics, and is the largest facility of its kind in the world. The LT offers a range of optical instrumentation that includes imaging, spectroscopy, and polarimetery, and will shortly commission a new near-IR cameram and high-throughput spectrometer. The LT is certyainly very well suited to photometric and spectroscopic follow-up of all manner of GAIA transients.

Prof. Werner Zeilinger

Department of Astrophysics at the University of Vienna, Austria

Gaia Science Alerts: Report on test observations

Observations of transients at the Belgrade and Vienna Observatories within the framework of the Gaia Science Alerts Working Group.

Prof. M. Dennefeld(1)
W. Thuillot(2), S. Bouquillon(3), B. Carry(2), L. Jorda(4),
J.-B. Marquette(1), D. Souami(5), P. Tanga(6), F. Taris(3), P. Tisserand(1),
A. Le Van Suu(4,7)

(1) Institut d'Astrophysique de Paris, France, (2) IMCCE-Paris Observatory, France, (3) SYRTE-Paris Observatory, France, (4) Pytheas Institute, Marseille, France, (5) NAXYS, Namur Center for Complex Systems, Dept of Mathematics, Univ. of Namur, Belgium, (6) Observatoire de la Côte d'Azur, Nice, France, (7) Observatoire de Haute-Provence, Saint Michel, France

Joint observations for Gaia alerts at OHP

Science alerts will be soon triggered within the framework of the Gaia space mission. Accordingly, we have organized several means to be able to react to them from the Haute-Provence Observatory (OHP). The main telescope used there will be the 1.2m telescope which is equipped with a CCD camera. We will describe the specificities of that telescope and will briefly describe the other facilities of the observatory. Astrometric and photometric observations will be performed. Spectroscopic follow-up may also be possible for bright objects, pending the commissioning of a new, low-dispersion spectrograph. One of the main objectives is to participate in the Gaia-FUN-SSO network (Gaia Follow-Up Network for Solar System Obkects). This follow-up network, coordinated by IMCCE (Paris Observatory), will observe Solar System Objects newly detected from space by Gaia as these objects will not be re-observed by the satellite due to its scanning law. We will describe this network and its potentialities. Other objectives will be to react on alert for other transients: photometric follow-up for astrophysical objects which will not be uniformly monitored from space, or spectroscopic classification when possible. The main targets will be Supernovae, Novae, or other eruptive variables.

Lovro Palaversa
Geneva Observatory, Switzerland

Geneva Observatory

Dr Johanna F Jarvis
Open University, UK

PIRATE's on board

Following a recent control system upgrade and detailed re-calibration I will present the status of PIRATE, a brief introduction to its science, teaching and outreach goals as well as its readiness for Gaia transit follow-up.

Dr Zbigniew Kołaczkowski
University of Wroclaw, Poland

Wroclaw Observatory

Wroclaw Observatory and follow-up activities

Michał Pawlak
Warsaw University Observatory, Poland

Warsaw Observatory and follow-up activities

Dr Yogesh Joshi
Aryabhatta Research Institute of Observational Sciences (ARIES), India

Multi-domain analysis in the Nainital Microlensing Survey data

I will present our results of the Nainital Microlensing Survey which had been carried at Nainital, India using 104-cm telescope with the main aim of detecting gravitational microlensing events towards M31 galaxy. In the process of 4-year long survey, apart from microlensing event in the direction of M31, we have also detected many pulsating variables and cataclysmic variables in M31. The identification of large number of Cepheids has enabled us to determine the distance of the M31 through their period-luminosity relation.