Future plans of the Polish Fireball Network

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The current status and the future plans of the Polish Fireball Network have been presented. A new funding became available and new equipment will be purchased next year. We are testing three megapixel cameras which are sufficiently sensitive for meteor research. We plan to create more than 10 fireball stations equipped with digital megapixel cameras with high quality lenses.

1 Introduction

The Polish Fireball Network has been founded in 2004. The network has been created by polish amateur and professional astronomers, members of the Comet and Meteors Workshop. First video observations were done in 2002 as a test of the new CCTV video equipment. First regular video observations started during the night of 15–16 November 2002 as a part of the Leonid campaign. The activity outburst of the Leonids has been observed by 4 CCTV Tayama cameras with 8mm lenses, the cameras were located in Ostrowik Observatory, 40km south of Warsaw. The collected data were used for accurate radiant determination and for the description of the activity profile (Wiśniewski et al., 2002).

A bright fireball has been observed over the central part of Poland on 20 February 2004. Data from the photographic cameras located in Ostrowik and EN fireball station Lysa Hora have been used for precise trajectory determination (Spurny et al., 2004). This fireball was a milestone for the PFN. The same year the first permanent video stations were created in Ostrowik, Poznań, Kraków and Złotokłos.

Presently the Polish Fireball Network consists of more than 30 video stations with 74 different CCTV cameras (mostly Tayama C3102 but also some with modern Mintron 12V6 and Watec-902H). Most of these cameras have been founded by the Siemens Building Technologies grant between 2004 and 2006. In the last few years new PFN equipment has been purchased by the observers themselves, without any external funding. The Polish Fireball Network currently observes more than 30000 of meteors per year. These data are reduced using PyFN software (Zoladek, 2011), UFOAnalyzer and UFO Orbit. Data recorded using MetRec software may be analyzed directly by PyFN or by UFO software, with a video data converter created for this purpose. Since 2010 the Polish Fireball Network is connected with the other neighboring fireball networks as a member of the EDMOND network.

2 Future plans

At the end of 2013 the Polish Fireball Network, cooperating with the Nicolaus Copernicus Astronomical Center, received a large national grant for the years 2014-2017. More than 150000 Euro may be spent on conferences, scientific expeditions and other similar projects. About 30% of all these funding can be used for the purchase completely new observing equipment.

During the last few years new, very sensitive, CMOS and CCD megapixel cameras became available. There are plenty of models with resolutions ranging from 0.9 to 5 Mpix but few of them have also very good quantum efficiency. For example the Sony ICX 692 Mono CCD chip has a peak quantum efficiency of 72 %, also the latest CMOS detectors have a QE larger than 70%. For meteor science applications these new megapixel cameras have some advantages for video and photographic methods. They are sensitive and they give live video stream with at least 15fps but also provide an image resolution comparable to the first digital DSLRs.

Before the purchase of these new megapixel cameras we decided to test some equipment. As we have a quite large area to cover we need cameras which are not very expensive but with a good sensitivity and frame rate. We found three models with sufficiently good parameters: ZWO ASI120MM (provided by Roman Piffl from the CEMENT network), QHY5-LII Mono and Pointgrey BlackFly 0.9 Mono. The first two cameras are produced with the same Aptina CMOS sensor while the last one has a Sony ICX692 CCD sensor.

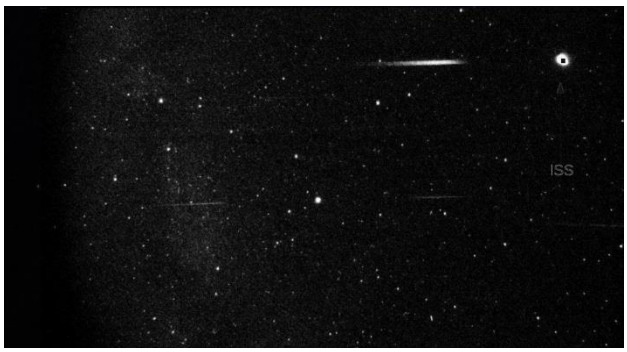

Figure 1 – Image taken using PointGrey BlackFly 09 Mono camera with Tokina 3-8mm f/1.0, under a very dark sky.

The PointGrey 0.9 BlackFly Mono is a very small, lightweight CCD camera with a GiGE interface. With native software it is able to take 1s exposures or can be used with higher fps as a typical video camera. The user can separately set the frame rate and the exposure time,

the gain and all other parameters. It is possible to define a region of interest (ROI), images can be saved with 8 and 12 bit depth. This is a high quality CCD megapixel camera but it has some disadvantages too. The first disadvantage is that the sensitivity remains a bit below the expectations (but still sufficient for meteor detection). The second disadvantage is that the video stream format is completely incompatible with UFO Capture and UFO Capture HD.

PointGrey BlackFly 0.9 became the first megapixel camera of the PFN and works continuously at the PFN55 Ursynow station with designation MDC01 (Meteor Digital Camera 1).

Figure 2 – Image from the QHY5-LII Mono camera with Tamron 3-8mm f/1.0 megapixel lens. A meteor is visible in the middle part of the image. Clear weather and a moonless night with significant light pollution.

The second camera tested was the QHY 5-LII Mono, a small unit originally designed as a guiding and planetary camera. This camera uses the Aptina MT9M034 CMOS chip with QE=74%. The resolution of this chip is 1280 x 960 pixels and this is a bit higher than the resolution of the Pointgrey camera. The images taken with this camera look a bit noisy but the limiting magnitude is surprisingly good and comparable to the typical CCTV camera used by PFN. The QHY 5-LII will hopefully work properly with the standard version of UFO Capture. Currently there are some problems with the live image preview. The QHY staff is working on a special version of the driver designed for UFO Capture compatibility. This is the most promising camera and probably will be our best choice. Currently it is mounted at the PFN55 station as a MDC02 camera. The cost of one QHY5-LII is about 300 EUR.

The last megapixel unit tested was the ZWO ASI120 MM camera. It's based on the same CMOS sensor like the QHY and it is also very sensitive. We had the opportunity to test this camera during the Camelopardalids 2014 maximum in Canada. Recently the new version of UFO Capture HD has been developed which is fully compatible with this ZWO camera.

For the test purposes a simple image stacking software has been developed. It uses the images saved by the megapixel cameras on the hard disk and stack it into 1-minute frames.

This way these cameras can be used with exposure times like 100ms, with a low background level. Images processed this way can be easily reviewed after the night and measured with methods used for photographic plates. We are using these cameras as photographic units but we start to work on our own software which will be able to process 14-bit video data in real time.

In the near future we plan to deploy more than ten megapixel fireball stations. Each station will consist of two megapixel cameras pointed into opposite directions. Such station will cover more than half of the sky and will cooperate with another two stations located in other parts of the country. The parts of the atmosphere which are not covered by one pair of the station will be covered by another pair. Additionally, a few spectroscopic stations will be created using megapixel cameras and 1000 groves/mm diffraction gratings. These stations will cover areas observed by other equipment and will provide spectroscopic data of all bright meteors over Poland with good spectral dispersion.

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