

Observation of the BL Lac objects 1ES 1215+303 and 1ES 1218+304 with the MAGIC telescopes

Elina Lindfors⁽¹⁾, Saverio Lombardi⁽²⁾, Josefa Becerra González⁽³⁾,
Pierre Colin⁽⁴⁾, Julian Sitarek⁽⁵⁾, Antonio Stamerra⁽⁶⁾
on behalf of the MAGIC Collaboration*

Affiliations: (1) Tuorla Observatory, Piikkiö, Finland (2) University and INFN Padua, Italy (3) Universidad de La Laguna and Instituto de Astrofísica de Canarias, La Laguna, Spain (4) Max-Planck-Institut für Physik, München, Germany (5) University of Lodz, Poland (6) DESY, Zeuthen, Germany
* for a complete list of MAGIC collaborators and extensive information on the telescopes: <http://www.magic.mppmu.mpg.de/>

ABSTRACT - Two BL Lac objects, 1ES 1215+303 and 1ES 1218+304 separated by 0.8 degrees, were observed with the MAGIC Cherenkov telescopes in 2010-2011. The January 2011 observations resulted in the first detection above 100 GeV of 1ES 1215+303 (known also as ON-325) which has been flagged as a promising Very High Energy (VHE) source candidate by the Fermi-LAT collaboration in October 2010. The January 2011 observations were triggered by the high optical state of the source as reported by the Tuorla blazar monitoring program. Comparison with 2010 data suggests that 1ES 1215+303 was flaring also in VHE gamma-rays. In addition, the Swift Target of Opportunity observations in X-rays showed that the flux was almost doubled with respect to previous observations (December 2009). Instead, 1ES 1218+304 is a well known VHE gamma-ray emitter located in the same field of view, which was then simultaneously observed with MAGIC. In this poster we present preliminary results of the MAGIC observations of these two VHE gamma-ray emitting AGNs.

1ES 1215+303 and 1ES 1218+304

BL Lac objects are Active Galactic Nuclei where the relativistic jet is pointing very close to our line of sight, causing flux enhancement and fast variability in all wavebands.

1ES 1215+303 (also known as ON 325) is a high energy peaking BL Lac object with uncertain redshift (two values can be found in the literature: $z=0.130$ and $z=0.237$). The source was classified as promising candidate TeV blazar by Costamante & Ghisellini (2002) and has been observed several times in VHE γ -rays prior to observations presented here. The previous observations have yielded in upper limits only (Whipple: $F(>430\text{GeV}) < 1.89 \times 10^{-11} \text{ cm}^{-2} \text{ s}^{-1}$ (Horan et al. 2004), MAGIC: $F(>120\text{GeV}) < 3.5 \times 10^{-11} \text{ cm}^{-2} \text{ s}^{-1}$ (Aleksić et al. 2011). The source was also in Fermi bright AGN catalog (Abdo et al. 2009) showing variable flux and hard spectra ($\Gamma=1.89 \pm 0.06$). In the Fermi band 1ES 1215+303 is an exceptional source, because it is the only high energy peaking source showing strong variability (Abdo et al. 2010a).

1ES 1218+304 is another high-peaking BL Lac object located only 0.8 degrees away from 1ES 1215+303. It has a redshift of 0.182 and was first detected to emit VHE γ -rays by MAGIC in 2005 (Albert et al. 2006). In 2009 VERITAS reported fast variability from the source, the peak flux reaching $\sim 20\%$ of the Crab flux (Acciari et al. 2010). In the Fermi one year catalog (Abdo et al. 2010b) the source is flagged non-variable.

Optically triggered Target of Opportunity observations

MAGIC has been successfully performing optically triggered Target of Opportunity (ToO) observations of AGN since the beginning of its science observations. The triggers have been provided by the Tuorla blazar monitoring program (<http://users/users/utu.fi/lm>) and the ToO observations with MAGIC have up to now resulted in the discovery of eight new VHE γ -ray emitting sources (see Aleksić et al. 2011 and references therein). However, in many cases it has not been possible to confirm if the sources were in a high VHE γ -ray state during the observations and therefore the question about the connection between the optical and VHE γ -ray states has remained open. In January 2011 1ES 1215+303 was observed to be in a high optical state (see Figure 3) which triggered the MAGIC observations of the source. The results of this observations together with previous observations (from 2010 in lower optical state) are presented in this poster.

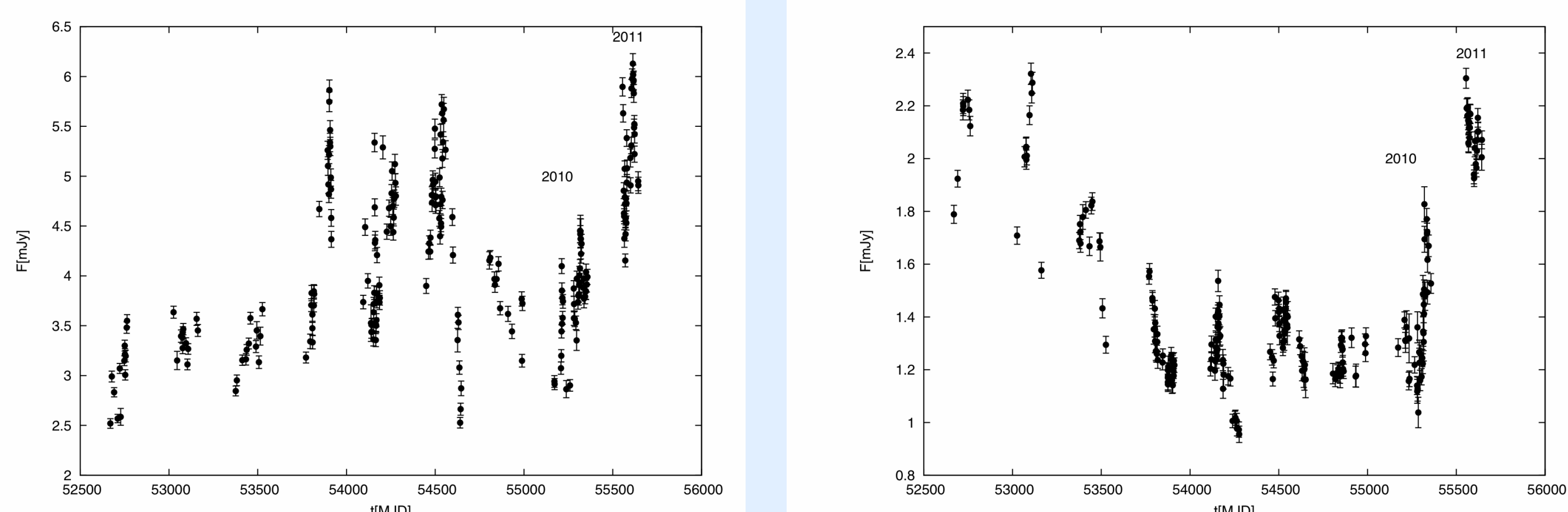


Fig 3 - Long-term optical light curves of 1ES 1215+303 (left) and 1ES 1218+304 (right) from Tuorla blazar monitoring program. Both sources were in a high state in optical band during the 2011 observations and in a lower state in 2010.

References: Abdo et al. 2009, ApJ 700, 597; Abdo et al. 2010a, ApJ 722, 520; Abdo et al. 2010b, ApJS 188, 405; Acciari et al. 2010, ApJ 709, 163; Albert et al. 2006, ApJ 642, 119; Aleksić et al. 2011a, A&A, submitted arXiv; Aleksić et al. 2011b, ApJ 729, 115; Colin et al. 2009, in Proc. 31st ICRC (Lodz) (arXiv:0907.0960); Costamante & Ghisellini 2002, A&A 384, 56; Horan et al. 2004 ApJ 603, 51; Moralejo et al. 2009, in Proc. 31st ICRC (Lodz) (arXiv:0907.0943).

The MAGIC telescopes

MAGIC consists of two 17 meter Imaging Air Cherenkov Telescopes located at the Canary Island of La Palma 2200 meters above sea level. The stereoscopic system has been in operation since 2009 and has a sensitivity of 0.8% Crab (Colin et al. 2009) above 250 GeV. MAGIC camera has a field of view of 3.5° .



Fig 1 - The MAGIC telescopes.



Fig 2 - The KVA optical telescope.

MAGIC observations of 1ES 1215+303 and 1ES 1218+304

1ES 1215+303 and 1ES 1218+304 were observed by MAGIC in January-February 2010, May-June 2010 and January-February 2011 for a total of 48 hours. The observations were done in the so called wobble mode in dark night and moderate moon conditions. The data were taken in zenith angles from 1 to 40 degrees.

For the analysis the data was divided into two samples corresponding to two observing epochs: 2010 and 2011. The data were analyzed using standard MAGIC software (Moralejo et al. 2009) with additional adaptations incorporating the stereoscopic observations. The preliminary analysis of the 2010 data resulted in 3σ excess from 1ES 1215+303 while 1ES 1218+304 was detected with 12σ . For 2011 data the preliminary analysis detects 173 On and 62.6 ± 3.4 Off events corresponding to 10.15σ , which is the first significant detection of VHE γ -rays from 1ES 1215+303 (Figure 4). 1ES 1218+304 is detected with significance of 12σ . The skymaps from the preliminary analysis corresponding to 2011 observations are shown in Figure 5.

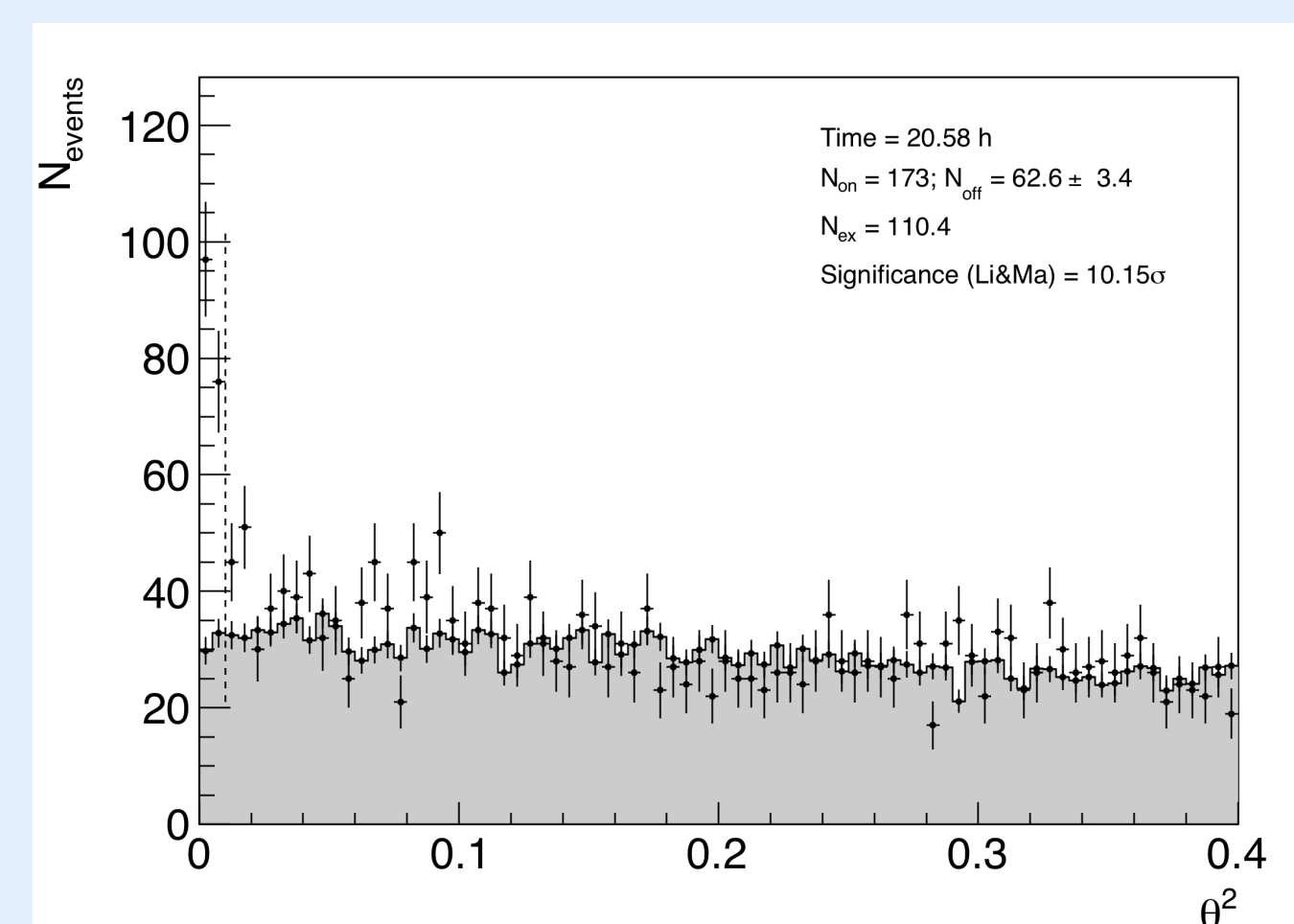


Fig 4 - Reconstructed shower direction (θ^2), for the On and Off data as observed on January-February 2011 by MAGIC from 1ES 1215+303.

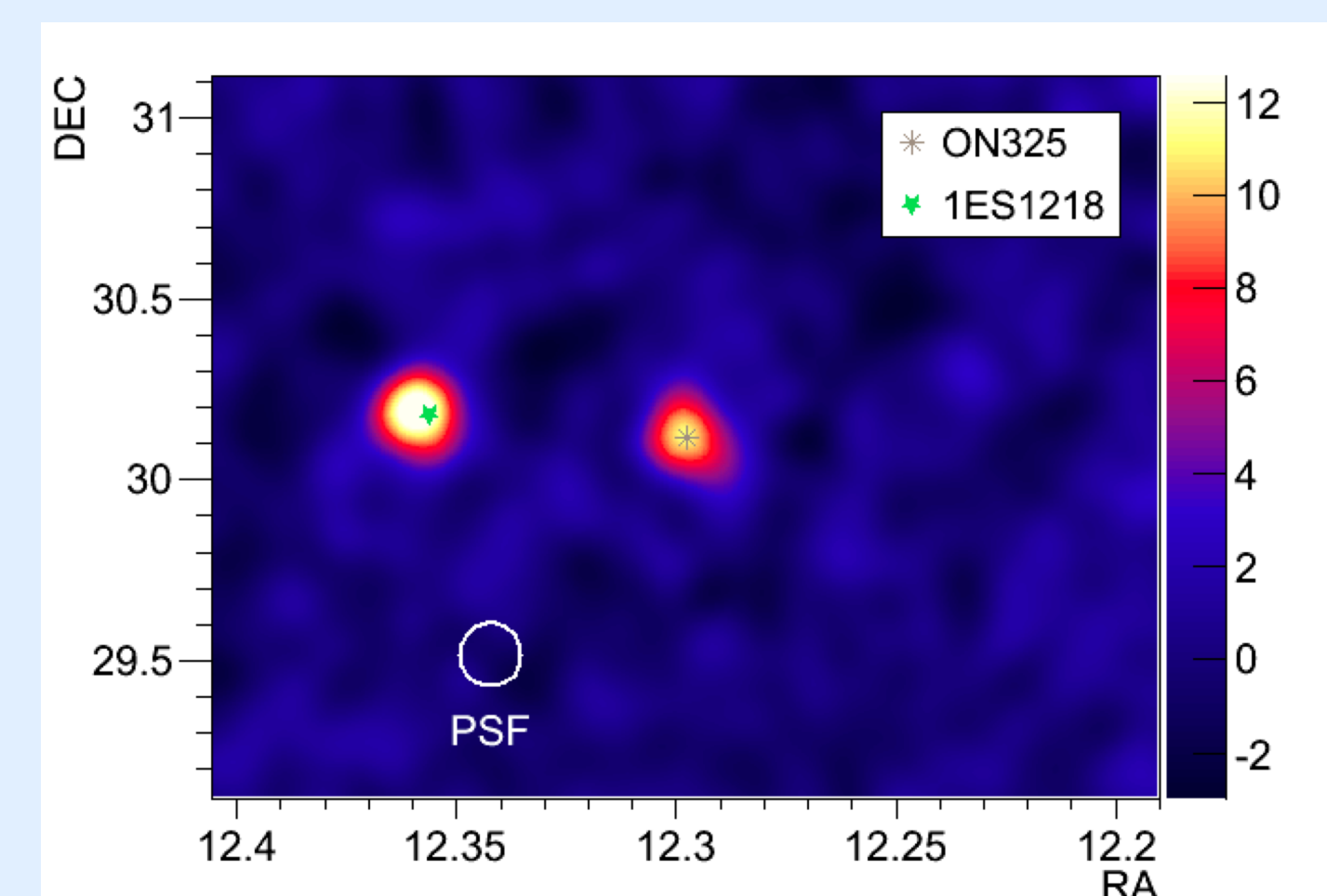


Fig 5 - Significance skymap for 2011 observations. Both 1ES 1215+303 and 1ES 1218+304 are clearly visible at VHE.

Multiwavelength data simultaneous and quasi-simultaneous to MAGIC observations of 1ES 1215+303 were collected from radio to the γ -ray regime including e.g. Metsähovi 37 GHz data, optical R-band and polarization data from KVA, Swift and Fermi data. The analysis and interpretation of these data are ongoing. For 1ES 1218+304 the simultaneous spectra from Fermi and MAGIC cover continuously more than 3 orders of magnitude in energy and can bring new constraints on the EBL and on IGMF (the study is ongoing).