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Accepted Abstracts - Submitted Abstracts - Thesis Abstracts
Jobs Adverts - Meetings Adverts - Special Announcements

From the Editor

The Active Galaxies Newsletter is produced monthly. The deadline for contributions is the last day of the month. The Latex macros for submitting abstracts and dissertation abstracts are appended to each issue of the newsletter and are also available on the web page.

As always as editor of the newsletter I am very interested to hear any suggestions or feedback regarding the newsletter. So do not hesitate in emailing me your suggestions.

Many thanks for your continued subscription.

Melanie Gendre

Abstracts of recently accepted papers

Co-evolution of Galaxies and Central Black Holes: Observational Evidence on the Trigger of AGN Feedback

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A comprehensive analysis of extended emission line region (EELR) around quasars is presented. New Subaru/Suprime-Cam observation is combined with literature search, resulting in a compilation of 81 EELR measurements for type-1 and type-2 quasars with associated active galactic nucleus (AGN) and host galaxy properties. It is found that EELR phenomenon shows clear correlation with Eddington ratio, which links EELR to the constituents of the principal component 1 (PC 1), or eigenvector 1, of the AGN emission correlations. We also find that EELR is preferentially associated with gas-rich, massive blue galaxies. It supports the idea that the primary determinant of EELR creation is the gas availability and that the gas may be brought in by galaxy merger triggering the current star formation as well as AGN activity, and also gives an explanation for the fact that most luminous EELR is found around radio-loud sources with low Eddington ratio. By combining all the observations, it is suggested that EELR quasars occupy the massive blue corner of the green valley, the AGN realm, on the galaxy color - stellar mass diagram. Once a galaxy is pushed to this corner, activated AGN would create EELR by the energy injection into the interstellar gas and eventually blow it away, leading to star-formation quenching. The results presented here provide a piece of evidence for the presence of such AGN feedback process, which may be playing a leading role in the co-evolution of galaxies and central super-massive black holes.

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E-mail contact: matsuoka@a.phys.nagoya-u.ac.jp,
preprint available at http://arxiv.org/abs/1203.1356

Unusual quasars from the Sloan Digital Sky Survey selected by means of Kohonen self-organising maps

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We exploit the spectral archive of the Sloan Digital Sky Survey (SDSS) Data Release 7 to select unusual quasar spectra. The selection method is based on a combination of the power of self-organising maps and the visual inspection of a huge number of spectra. Self-organising maps were applied to nearly 10^5 spectra classified as quasars by the SDSS pipeline. Particular attention was paid to minimise possible contamination by rare peculiar stellar spectral types. We present a catalogue of 1005 quasars with unusual spectra. This large sample provides a useful resource for both studying properties and relations of/between different types of unusual quasars and selecting particularly interesting objects. The spectra are grouped into six types. All these types turn out to be on average more luminous than comparison samples of normal quasars after a statistical correction is made for intrinsic reddening. Both the unusual broad absorption line (BAL) quasars and the strong iron emitters have significantly lower radio luminosities than normal quasars. We also confirm that strong BALs avoid the most radio-luminous quasars. Finally, we create a sample of quasars similar to the two "mysterious" objects discovered by Hall et al. (2002) and briefly discuss the quasar properties and possible explanations of their highly peculiar spectra.

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preprint available at http://arxiv.org/abs/1203.0215

The discovery of high–power high synchrotron peak blazars

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We study the quasi-simultaneous near-IR, optical, UV, and X-ray photometry of eleven γ-ray selected blazars for which redshift estimates larger than 1.2 have been recently provided. Four of these objects turn out to be high-power blazars with the peak of their synchrotron emission between $\sim 3 \times 10^{15}$ and $\sim 10^{16}$ Hz, and therefore of a kind predicted to exist but never seen before. This discovery has important implications for our understanding of physical processes in blazars, including the so-called "blazar sequence", and might also help constraining the extragalactic background light through γ-ray absorption since two sources are strongly detected even in the 10−100 GeV *Fermi*-LAT band. Based on our previous work and their high powers, these sources are very likely high-redshift flat-spectrum radio quasars with their emission lines swamped by the non-thermal continuum.

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X-ray spectral curvature of High Frequency Peaked BL Lacs: a predictor for the TeV flux

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Most of the extragalactic sources detected at TeV energies are BL Lac objects. They belong to the subclass of "high frequency peaked BL Lacs" (HBLs) exhibiting spectral energy distributions with a lower energy peak in the X-ray band; this is widely interpreted as synchrotron emission from relativistic electrons. The X-ray spectra are generally curved, and well described in terms of a log-parabolic shape. In a previous investigation of TeV HBLs (TBLs) we found two correlations between their spectral parameters. (1) The synchrotron peak luminosity L_p increases with its peak energy E_p; (2) the curvature parameter b decreases as E_p increases. The first is consistent with the synchrotron scenario, while the second is expected from statistical/stochastic acceleration mechanisms for the emitting electrons. Here we present an extensive X-ray analysis of a sample of HBLs observed with *XMM-Newton* and *SWIFT* but undetected at TeV energies (UBLs), to compare their spectral behavior with that of TBLs. Investigating the distributions of their spectral parameters and comparing the TBL X-ray spectra with that of UBLs, we develop a criterion to select the best HBLs candidates for future TeV observations.

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X-ray and TeV emissions from High Frequency Peaked BL Lacs

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The majority of the extragalactic sources yet detected at TeV photon energies belong to the class of “high frequency peaked BL Lacs” (HBLs) that exhibit a spectral energy distribution with a lower peak in the X-ray band. Such spectra are well described in terms of a log-parabolic shape with a considerable curvature, and widely interpreted as synchrotron emission from ultrarelativistic electrons outflowing in a relativistic jet; these are expected to radiate also in γ rays by the inverse Compton process. Recently we have compared the X-ray spectral parameter distributions of TeV detected HBLs (TBLs) with those undetected (UBLs), and found that the distributions of the peak energies E_p are *similarly* symmetric around a value of a few keVs for both subclasses, while the X-ray spectra are *broader* for TBLs than for UBLs. Here we propose an acceleration scenario to interpret both the E_p and the spectral curvature distributions in terms of a coherent and a stochastic acceleration mechanisms, respectively. We show how the curvature parameter $b \simeq 0.3 - 0.7$ of the synchrotron X rays, that depends only on the latter acceleration component, can be related to the inverse Compton luminosity in γ rays, so introducing a link between the X-ray and the TeV observations of HBLs.

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Identification of the infrared non-thermal emission in Blazars

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Blazars constitute the most interesting and enigmatic class of extragalactic γ-ray sources dominated by non-thermal emission. In this Letter, we show how the *WISE* infrared data make possible to identify a distinct region of the [3.4]-[4.6]-[12] μm color-color diagram where the sources dominated by the the thermal radiation are separated from those dominated by non-thermal emission, in particular the blazar population. This infrared non-thermal region delineated as the *WISE blazar Strip* (WBS), will constitute a new powerful diagnostic tool when the full *WISE* survey data is released. The WBS can be used to extract new blazar candidates, to identify those of uncertain type and also to search for the counterparts of unidentified γ-ray sources. We show one example of the value of the use of the WBS identifying the TeV source *VER J0648+152*, recently discovered by VERITAS.

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Infrared colors of the Gamma-Ray detected Blazars

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Blazars constitute the most enigmatic class of extragalactic γ-ray sources, and their observational features have been ascribed to a relativistic jet closely aligned to the line of sight. They are generally divided in two main classes: the BL Lac objects (BL Lacs) and the Flat Spectrum Radio Quasars (FSRQs). In the case of BL Lacs the double bumped spectral energy distribution (SED) is generally described by the Synchrotron Self Compton (SSC) emission, while for the FSRQs it is interpreted as due to External Compton (EC) emission. Recently, we showed that in the [3.4]-[4.6]-[12] μm color-color diagram the blazar population covers a distinct region (i.e., the *WISE blazar Strip* , WBS), clearly separated from the other extragalactic sources that are dominated by thermal emission. In this paper we investigate the relation between the infrared and γ-ray emission for a subset of confirmed blazars from the literature, associated with *Fermi* sources, for which *WISE* archival observations are available. This sample is a proper subset of the sample of sources used previously, and the availability of *Fermi* data is critical to constrain the models on the emission mechanisms for the blazars. We found that the selected blazars also lie on the *WISE blazar Strip* covering a narrower region of the infrared color-color planes than the overall blazars population. We then found an evident correlation between the IR and γ-ray spectral indices expected in the SSC and EC frameworks. Finally, we determined the ratio between their γ-ray and infrared fluxes, a surrogate of the ratio of powers between the inverse Compton and the synchrotron SED components, and used such parameter to test different emitting scenarios blazars.

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The *WISE* gamma-ray strip parametrization: the nature of the gamma-ray Active Galactic Nuclei of Uncertain type

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Despite the large number of discoveries made recently by *Fermi*, the origins of the so called unidentified γ-ray sources remain unknown. The large number of these sources suggests that among them there could be a population that significantly contributes to the isotropic gamma-ray background and is therefore crucial to understand their nature. The first step toward a complete comprehension of the unidentified γ-ray source population is to identify those that can be associated with blazars, the most numerous class of extragalactic sources in the γ-ray sky. Recently, we discovered that blazars can be recognized and separated from other extragalactic sources using the infrared (IR) *WISE* satellite colors. The blazar population delineates a remarkable and distinctive region of the IR color-color space, the *WISE* blazar strip. In particular, the subregion delineated by the γ-ray emitting blazars is even narrower and we named it as the *WISE* Gamma-ray Strip (WGS). In this paper we parametrize the *WGS* on the basis of a single parameter s that we then use to determine if γ-ray Active Galactic Nuclei of the uncertain type (AGUs) detected by *Fermi* are consistent with the *WGS* and so can be considered blazar candidates. We find that 54 AGUs out of a set 60 analyzed have IR colors consistent with the *WGS*; only 6 AGUs are outliers. This result implies that a very high percentage (i.e., in this sample about 90%) of the AGUs detected by *Fermi* are indeed blazar candidates.

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Unidentified gamma-ray sources: hunting γ-ray blazars

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One of the main scientific objectives of the ongoing *Fermi* mission is unveiling the nature of the unidentified γ-ray sources (UGSs). Despite the large improvements of *Fermi* in the localization of γ-ray sources with respect to the past γ-ray missions, about one third of the *Fermi*-detected objects are still not associated to low energy counterparts. Recently, using the Wide-field Infrared Survey Explorer (*WISE*) survey, we discovered that blazars, the rarest class of Active Galactic Nuclei and the largest population of γ-ray sources, can be recognized and separated from other extragalactic sources on the basis of their infrared (IR) colors. Based on this result, we designed an association method for the γ-ray sources to recognize if there is a blazar candidate within the positional uncertainty region of a generic γ-ray source. With this new IR diagnostic tool, we searched for γ-ray blazar candidates associated to the UGS sample of the second *Fermi* γ-ray catalog (2FGL). We found that our method associates at least one γ-ray blazar candidate as a counterpart each of 156 out of 313 UGSs analyzed. These new low-energy candidates have the same IR properties as the blazars associated to γ-ray sources in the 2FGL catalog.

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Searching for γ-ray blazar candidates among the unidentified *INTEGRAL* sources

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The identification of low-energy counterparts for γ-ray sources is one of the biggest challenge in modern γ-ray astronomy. Recently, we developed and successfully applied a new association method to recognize γ-ray blazar candidates that could be possible counterparts for the unidentified γ-ray sources above 100 MeV in the second *Fermi* Large Area Telescope (LAT) catalog (2FGL). This method is based on the Infrared (IR) colors of the recent Wide-Field Infrared Survey Explorer (*WISE*) all-sky survey. In this letter we applied our new association method to the case of unidentified *INTEGRAL* sources (UISs) listed in the fourth soft gamma-ray source catalog (4IC). Only 86 UISs out of the 113 can be analyzed, due to the sky coverage of the *WISE* Preliminary data release. Among these 86 UISs, we found that 18 appear to have a γ-ray blazar candidate within their positional error region. Finally, we analyzed the *SWIFT* archival data available for 10 out these 18 γ-ray blazar candidates, and we found that 7 out of 10 are clearly detected in soft X-rays and/or in the optical-ultraviolet band. We cannot confirm the associations between the UISs and the selected γ-ray blazar candidates due to the discrepancies between the *INTEGRAL* and the soft X-ray spectra. However, the discovery of the soft X-ray counterparts for the selected γ-ray blazar candidates adds an important clue to help understand their origin and to confirm their blazar nature.

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BLR kinematics and Black Hole Mass in Markarian 6

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We present results of the optical spectral and photometric observations of the nucleus of Markarian 6 made with the 2.6-m Shajn telescope at the Crimean Astrophysical Observatory. The continuum and emission Balmer line intensities varied more than by a factor of two during 1992–2008. The lag between the continuum and $H\beta$ emission line flux variations is 21.1 ± 1.9 days. For the $H\alpha$ line the lag is about 27 days but its uncertainty is much larger. We use Monte-Carlo simulation of the random time series to check the effect of our data sampling on the lag uncertainties and we compare our simulation results with those obtained by random subset selection (RSS) method of Peterson et al.(1998, PASP 110, 660). The lag in the high-velocity wings are shorter than in the line core in accordance with the virial motions. However, the lag is slightly larger in the blue wing than in the red wing. This is a signature of the infall gas motion. Probably the BLR kinematic in the Mrk 6 nucleus is a combination of the Keplerian and infall motions. The velocity-delay dependence is similar for individual observational seasons. The measurements of the $H\beta$ line width in combination with the reverberation lag permits us to determine the black hole mass, $M_{BH} = (1.8 \pm 0.2) \times 10^8 M_{\odot}$. This result is consistent with the AGN scaling relationships between the BLR radius and the optical continuum luminosity ($R_{BLR} \propto L^{0.5}$) as well as with the black-hole mass–luminosity relationship ($\mathrm{M}_{BH} - L$) under the Eddington luminosity ratio for Mrk 6 to be $L_{bol}/L_{Edd} \sim 0.01$.

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Extreme star formation in the host galaxies of the fastest growing super-massive black holes at z=4.8

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We report new Herschel observations of 25 $z \simeq 4.8$ extremely luminous optically selected active galactic nuclei (AGNs). Five of the sources have extremely large star forming (SF) luminosities, L_{SF}, corresponding to SF rates (SFRs) of 2800–5600 $M_{\odot}$ yr^{-1} assuming a Salpeter IMF. The remaining sources have only upper limits on their SFRs but stacking their Herschel images results in a mean SFR of 700 ± 150 $M_{\odot}$ yr^{-1}. The higher SFRs in our sample are comparable to the highest observed values so far, at any redshift. Our sample does not contain obscured AGNs, which enables us to investigate several evolutionary scenarios connecting super-massive black holes and SF activity in the early universe. The most probable scenario is that we are witnessing the peak of SF activity in some sources and the beginning of the post-starburst decline in others. We suggest that all 25 sources, which are at their peak AGN activity, are in large mergers. AGN feedback may be responsible for diminishing the SF activity in 20 of them but is not operating efficiently in 5 others.

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A Near-Infrared Template Derived from I Zw 1 for the Fe II Emission in Active Galaxies

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In AGN spectra, a series of Fe II multiplets form a pseudo-continuum that extends from the ultraviolet to the near-infrared

(NIR). This emission is believed to originate in the Broad Line Region (BLR), and it has been known for a long time that pure photoionization fails to reproduce it in the most extreme cases, as does the collisional-excitation alone. The most recent models by Sigut & Pradhan (2003) include details of the Fe II ion microphysics and cover a wide range in ionization parameter $\log U_{\rm ion}$= (-3.0 → -1.3) and density $\log n_{\rm H}$ = (9.6 → 12.6). With the aid of such models and a spectral synthesis approach, we study for the first time in detail the NIR emission of I Zw 1. The main goals are to confirm the role played by Lyα fluorescence mechanisms in the production of the Fe II spectrum and to construct the first semi-empirical NIR Fe II template that best represents this emission and can be used to subtract it in other sources. A good overall match between the observed Fe II+Mg II features with those predicted by the best fitted model is obtained, corroborating the Lyα fluorescence as a key process to understand the Fe II spectrum. The best model is then adjusted by applying a deconvolution method on the observed Fe II+Mg II spectrum. The derived semi-empirical template is then fitted to the spectrum of Ark 564, suitably reproducing its observed Fe II+Mg II emission. Our approach extends the current set of available Fe II templates into the NIR region.

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Enhanced star formation rates in AGN hosts with respect to inactive galaxies from PEP-Herschel

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We compare the average star formation (SF) activity in X-ray selected AGN hosts with a mass-matched control sample of inactive galaxies, including both star forming and quiescent sources, in the $0.5 < z < 2.5$ redshift range. Recent observations carried out by PACS, the $60 - 210$ μm photometric camera on board the Herschel Space Observatory, in GOODS-S, GOODS-N and COSMOS allow us to obtain an unbiased estimate of the far-IR luminosity, and hence of the SF properties, of the two samples. Accurate AGN host stellar mass estimates are obtained by decomposing their total emission into the stellar and the nuclear components. We report evidence of a higher average SF activity in AGN hosts with respect to the control sample of inactive galaxies. The level of SF enhancement is modest (~ 0.26 dex at $\sim 3\sigma$ confidence level) at low X-ray luminosities ($L_X \lesssim 10^{43.5}$ erg s^{-1}) and more pronounced (0.56 dex at $> 10\sigma$ confidence level) in the hosts of luminous AGNs. However, when comparing to star forming galaxies only, AGN hosts are found broadly consistent with the locus of their 'main sequence'. We investigate the relative far-IR luminosity distributions of active and inactive galaxies, and find a higher fraction of PACS detected, hence normal and highly star forming systems among AGN hosts. Although different interpretations are possible, we explain our findings as a consequence of a twofold AGN growth path: faint AGNs evolve through secular processes, with instantaneous AGN accretion not tightly linked to the current total SF in the host galaxy, while the luminous AGNs co-evolve with their hosts through periods of enhanced AGN activity and star formation, possibly through major mergers. While an increased SF activity with respect to inactive galaxies of similar mass is expected in the latter, we interpret the modest SF offsets measured in low-L_X AGN hosts as either *a*) generated by non-synchronous accretion and SF histories in a merger scenario or *b*) due to possible

connections between instantaneous SF and accretion that can be induced by smaller scale (non-major merger) mechanisms. Far-IR luminosity distributions favour the latter scenario.

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Quasar Structure & Radiation Pressure

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All quasar spectra show the same atomic features in the optical, UV, near-IR and soft X-rays over all of cosmic time, luminosity black hole mass and accretion rate. This is a puzzle. Here I show that it is possible that all of these atomic features can be accounted for by gas from an accretion disk driven the three forms of radiation pressure: electron scattering, line driving and dust driving. The locations where they successfully drive an escaping wind, and those where they produce only a failed wind are both needed.

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Slicing the Torus: Obscuring Structures in Quasars

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Quasars and Active Galactic Nuclei (AGNs) are often obscured by dust and gas. It is normally assumed that the obscuration occurs in an oblate "obscuring torus", that begins at the radius at which the most refractive dust can remain solid. The most famous form of this torus is a donut-shaped region of molecular gas with a large scale-height. While this model is elegant and accounts for many phenomena at once, it does not hold up to detailed tests. Instead the obscuration in AGNs must occur on a wide range of scales and be due to a minimum of three physically distinct absorbers. Slicing the "torus" into these three regions will allow interesting physics of the AGN to be extracted.

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preprint available at Preprints.html

A remarkable long-term light curve, and deep, low-state spectroscopy: Swift & XMM monitoring of the NLS1 galaxy Mkn 335

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The Narrow-line Seyfert 1 galaxy (NLS1) Mkn 335 is remarkable because it has repeatedly shown deep, long X-ray low-states which show pronounced spectral structure. It has become one of the prototype AGN in deep minimum X-ray states. Here we report on the continuation of our ongoing monitoring campaign with Swift and the examination of the low state X-ray spectra based on a 200 ks triggered observation with XMM in June 2009. Swift has continuously monitored Mkn 335 since May 2007 typically on a monthly basis. This is one of the longest simultaneous UV/X-ray light curves so far obtained for an active galactic nucleus (AGN). Mkn 335 has shown strong X-ray variability even on time scales of hours. In the UV, it turns out to be one of the most variable among NLS1s. Long-term Swift monitoring allow us to examine correlations between the UV, X-rays and X-ray hardness ratios. We find no significant correlation or lag between the UV and X-ray variability; however, we do find distinct trends in the behavior of the hardness ratio variability. The hardness ratio and count rate are correlated in the low-flux state, but no correlation is seen in the high-state. The X-ray low-state spectra of the 2007 and 2009 XMM observations display significant spectral variability. We fit the X-ray spectra with a suite of phenomenological models in order to characterize the data. The broad band CCD spectrum can be fitted equally well with partial absorption and blurred reflection models. These more complicated models are explored in further detail in upcoming work.

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Short timescale variations of the Hα double-peaked profile of the nucleus of NGC 1097

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The broad (FWHM $\sim$ 10,000 km s^{-1}) double-peaked Hα profile from the LINER/Seyfert 1 nucleus of NGC 1097 was discovered in 1991, and monitored for the following 11 years. The profile showed variations attributed to the rotation of gas in a non-axisymmetric Keplerian accretion disk, ionized by a varying radiatively inefficient accretion flow (RIAF) located in the inner parts of the disk. We present and model 11 new spectroscopic observations of the double-peaked profile taken between 2010 March and 2011 March. This series of observations was motivated by the finding that in 2010 March the flux in the double-peaked line was again strong, becoming, in 2010 December, even stronger than in the observations of a decade ago. We also discovered shorter timescale variations than in the previous observations: (1) the first, of $\sim$7 days, is interpreted as due to reverberation" of the variation of the ionizing source luminosity, and the timescale of 7 days as the light crossing time between the source and the accretion disk; this new timescale and its interpretation provides a distance between the emitting gas and the supermassive black hole and as such introduces a new constraint on its mass; (2) the second, of $\approx$ 5 months, was attributed to the rotation of a spiral arm in the disk, which was found to occur on the dynamical timescale. We use two accretion disk models to fit theoretical profiles to the new data, both having non-axisymmetric emissivities produced by the presence of an one-armed spiral. Our modeling constrains the rotation period for the spiral to be $\approx$ 18 months. This work supports our previous conclusion that the broad double-peaked Balmer emission lines in NGC 1097, and probably also in other low-luminosity active nuclei, originate from an accretion disk ionized by a central RIAF.

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Meetings

5th International Symposium on High-Energy Gamma-Ray Astronomy

Heidelberg, Germany
July 9-13, 2012

Webpage: `http://www.mpi-hd.mpg.de/hd2012/`
Email: `hd2012@mpi-hd.mpg.de`

The 5th International Symposium on High-Energy Gamma-Ray Astronomy (Gamma2012), organized by the Max-Planck-Institut für Kernphysik, will take place July 9-13, 2012, in Heidelberg, Germany. Following the tradition of past Symposia, the meeting will cover the major observational and theoretical aspects of the field with an emphasis on the high (GeV) and very high (TeV) energy intervals of the electromagnetic spectrum.
Scientific topics to be addressed will range from the origin of galactic and extragalactic cosmic rays to the physics and astrophysics of compact objects (Pulsars, Microquasars, AGN) and cosmological issues related to Dark Matter and Intergalactic radiation and magnetic fields.
Being dedicated to a centenary of cosmic ray research triggered by Victor Hess' report in Physikalische Zeitschrift 13 (1912), this 2012 Symposium will have a special focus on the link between VHE gamma- and cosmic-rays.
The Symposium will be held at the historic Kongresshaus Stadthalle Heidelberg, which can comfortably accommodate 300-400 participants.
On behalf of SOC: F. Aharonian (Chair) and LOC: W. Hofmann (Chair) and F. Rieger (Co-Chair).