Jets at all scales
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Relativistic jets in Narrow-Line Seyfert 1

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Abstract. Narrow-Line Seyfert 1 (NLS1) class of active galactic nuclei (AGNs) is generally radio-quiet, but a small percent of them are radio-loud. The recent discovery by *Fermi*/LAT of high-energy $\gamma-$ray emission from 4 NLS1s proved the existence of relativistic jets in these systems. It is therefore important to study this new class of $\gamma-$ray emitting AGNs. Here we report preliminary results about the observations of the July 2010 $\gamma-$ray outburst of PMN J0948+0022, when the source flux exceeded for the first time 10^{-6} ph cm^{-2} s^{-1} ($E > 100$ MeV).

Keywords. Galaxies: jets – Galaxies: Seyfert – Gamma-rays: observations

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The recent discovery of variable $\gamma-$ray emission from 4 NLS1s revealed the presence of a third class of $\gamma-$ray AGNs (Abdo *et al.* 2009a). This poses intriguing questions to the current knowledge of relativistic jet systems and on how these structures are generated. One of these sources, PMN J0948 + 0022 ($z = 0.5846$) is classified a typical NLS1, but it displays also strong, compact and variable radio emission, with inverted spectrum, suggesting the possibility of the presence of a relativistic jet (Zhou *et al.* 2003). The confirmation came with the detection of high-energy variable γ rays by *Fermi*/LAT (Abdo *et al.* 2009b, Foschini *et al.* 2010a). A multiwavelength campaign performed in March-July 2009 displayed coordinated variability at all frequencies, thus confirming that the source detected by *Fermi* is indeed the high-energy counterpart of PMN J0948+0022 (Abdo *et al.* 2009c).

PMN J0948 + 0022, the first NLS1 detected at γ rays, was soon followed by three more (Abdo *et al.* 2009a). Their main differences with respect to blazars and radio galaxies are the optical spectrum and the radio morphology, which is quite compact and

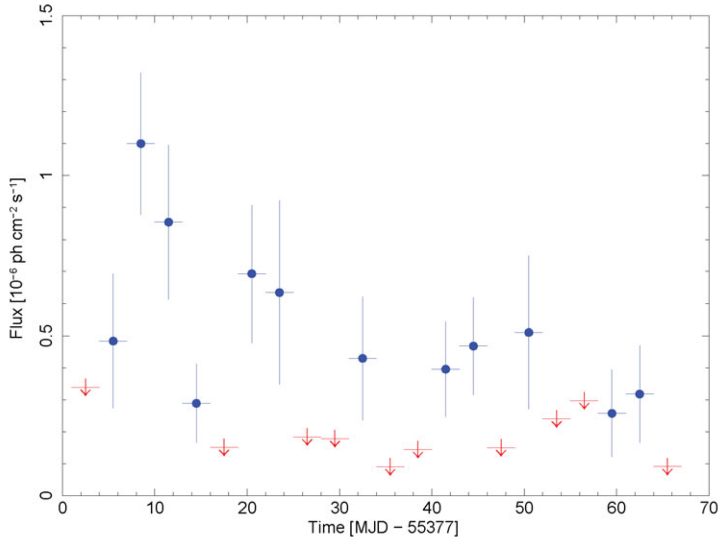

Figure 1. *Fermi*/LAT lightcurve (0.1 − 100 GeV) of PMN J0948 + 0022 in July-August 2010, with 3 days time bin. Blue points are detection with $TS > 10$ ($\sim 3\sigma$), while the others are 2σ upper limits. LAT data have been analyzed as described in Foschini *et al.* (2010b).

without extended structures. These characteristics point to systems with relatively low masses of the central black hole ($10^{6-8} M_{\odot}$) and high accretion rates (up to 90% of the Eddington value), common for NLS1s, but not for blazars or radio galaxies. In addition, since the $\gamma-$ray NLS1s seem similar to blazars, i.e. small viewing angles, there should be a parent population with the jet viewed at large angles (as blazars vs radio galaxies). The first source of this type has been recently found (PKS 0558 − 504, Gliozzi *et al.* 2010). Therefore, it seems that NLS1s could be a low mass set of systems "parallel" to blazars and radio galaxies. A key question was the power released by jets of NLS1s. The early observations and the 2009 MW campaign have shown that the maximum luminosity reached by PMN J0948 + 0022, the most powerful of these NLS1s, is $\sim 10^{47}$ erg s^{-1} (0.1 − 100 GeV). On the other hand, blazars can reach greater luminosities ($\sim 10^{49}$ erg s^{-1} in the case of 3C 454.3, e.g. Foschini *et al.* 2010b). The question was answered in July 2010, when PMN J0948+0022 underwent a strong outburst (Donato *et al.* 2010, Foschini 2010c) with a peak flux of $\sim 10^{-6}$ ph cm^{-2} s^{-1} (0.1 − 100 GeV), corresponding to a luminosity of $\sim 10^{48}$ erg s^{-1} (Fig. 1). Even if the source position was too close to the Sun for a full MW campaign, some coverage was obtained. Further details will be available in a forthcoming paper.

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