VSOP AO2 PROPOSAL COVER SHEETS

DEADLINE : 8 May, 1998
SEND TO : VSOG, ISAS, 3-1-1 Yoshinodai, Sagamihara, Kanagawa 229-8510, JAPAN

Please read Appendix C of Announcement of Opportunity for details on how to fill in this Cover Sheet.

(1) Date prepared :
April 26, 1998

(2) Proposal title : **Monitoring at High Resolution of the Gamma-ray-loud Blazars 0528+134 and 1510−089**

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(5) Proposal Abstract :

With the present proposal we ask multiepoch (three) observations of the two blazars **0528+134** and **1510−089** with the ground-VSOP array at 5 GHz. These objects belong to a list of blazars which will be observed in a wide range of X–ray frequencies with the satellite SAX during the next two years of the mission. The proposed observations represent a unique opportunity to obtain simultaneous (or nearly simultanous) observations over the whole electromagnetic spectrum for these objects, and this is essential in order to test the models related to the X–ray and gamma–ray emission.

(6) Proposal Category (indicate all that apply):

Object type:
☑ AGN, ☐ Maser, ☐ Stellar, ☐ Pulsar, ☐ Other :

Observation type:
☑ Continuum, ☐ Spectral Line, ☐ Polarization, ☐ Time-critical, ☐ Other :

(7) Number of proposed experiments

An 'experiment' is one or more observations of one source at a fixed HALCA set-up. A request to observe the same source at 1.6 GHz and separately at 5 GHz requires two columns to be filled in in item (8) below. A request to observe the same source with HALCA simultaneously observing at 1.6 GHz and 5 GHz requires one column to be filled in. Multi-epoch observations of the same source at the same frequency – a 'monitoring experiment' – requires only one column to be filled in. Suggested observing dates, especially for for time-critical and monitoring experiments, should be specified in item (10).

The number of experiments in this proposal is: 2

(8) Details of proposed experiments

	Experiment 1	Experiment 2	Experiment 3	Experiment 4
Source name (J*hhmm*±*ddmm*)	0528+134	1510−089		
Alternative name				
RA(J2000) (hh mm ss.ssss)	05 30 56.409	15 12 50.549		
Dec(J2000) (dd mm ss.ssss)	13 31 55.45	-09 05 54.85		
Observing frequency band (GHz)	5	5		
Continuum observations:				
Standard VSOP freq. channels?	☑	☑	☐	☐
Channel A range (MHz)				
Channel B range (MHz)				
Spectral line observations:				
Ch.A spectral line rest freq. (MHz)				
Ch.A LSR velocity (km/s)				
Ch.B spectral line rest freq. (MHz)				
Ch.B LSR velocity (km/s)				
FWHM of field of view required (mas)				
Min. spectral channels per IF channel				
Correlator averaging time (sec)				
No. of correlating passes (if >1)				
Total flux density (Jy)	4	3		
Correlated flux (mJy)	2	2		
Ground Radio Telescopes:				
Suggested array given at Item (10)?	☑	☑	☐	☐
GRT observing mode:				
128Mbps LCP (standard)	☑	☑	☐	☐
128Mbps LCP/RCP	☐	☐	☐	☐
256Mbps LCP/RCP	☐	☐	☐	☐
Preferred correlator:				
No preference	☐	☐	☐	☐
Mitaka	☐	☐	☐	☐
Penticton	☐	☐	☐	☐
Socorro	☑	☑	☐	☐
Monitoring programs:				
Number of observations	3	3		
Mean interval (days)	360	360		
Related AO1 proposal code(s)	V009	V009		

(9) VSOP spacecraft observing mode (see Section 3 and Table 5 of the VSOP Proposer's Guide):

☑ 2 channel x 16 MHz, 2-bit (Standard mode),

☐ Other:

Phase calibration tones:

☑ On (Standard continuum mode),

☐ Off (Standard spectral line mode)

(Include justification of any non-standard choice at (10) below)

(10) Additional notes to the scheduler :

0528+134: Suggested array: EF MC NT JB VLBA VSOP
Minimum Array: EF VLBA (without MK)
Suggested period for first observation: between 1Sep99 and 15Nov99
1510-089: Suggested array EF MC NT VLBA VSOP
Minimum Array: EF VLBA (without MK)
Suggested period for first observation: from Mar99 to Jun99

(11) Attach a scientific and technical justification, not in excess of 2 pages of text and 2 pages of figures. Up to one page of (u,v) plots per source may optionally be included.
(Refer to the VSOP Announcement of Opportunity for detailed instructions.)
Preprints and reprints will not be forwarded to the Scientific Review Committee.

Send two paper copies of the complete proposal to:

VSOP Observing Proposals
VSOP Science Operations Group
Institute of Space and Astronautical Science
3-1-1 Yoshinodai, Sagamihara
Kanagawa 229-8510 JAPAN

In addition, e-mail the completed LaTeX file to submit@vsop.isas.ac.jp

Information from the Cover Sheets of scheduled proposals will be made available from the VSOP WWW site.

Proposals must be received at ISAS by 8 May 1998

1 Scientific Justification

The discovery of gamma-ray emission from "blazars" (BL Lacertae objects, optically violently variable quasars, high and low polarised quasars are members of this class) represents a fundamental advance in our observational knowledge of these objects. Their luminosity in the 0.1–1 GeV range often largely exceeds that in the rest of the electromagnetic spectrum, so that explaining the gamma–rays is an important step in the understanding of these objects.
The models proposed involve beamed emission from a jet of relativistic particles (Maraschi, Ghisellini & Celotti, 1992, ApJ 397, L5 (MGC92) and references therein). This condition is placed by the strong requirement that the source be transparent to photon–photon interaction, due to the fact that the gamma–ray luminosity dominates the total emission.
It is suggested that the gamma–rays are generated by the IC process, while the spectrum from the radio to UV frequencies is believed to be due to synchrotron radiation. The two processes are related to each other since the relativistic electrons, radiating synchrotron radiation, upscatter the synchrotron photons, or other photons, to the gamma–ray energies. For such reason, it is clearly important to couple the information on the X and gamma–ray part of the spectrum with high resolution radio data. These last, providing the best imaging available at any frequency, allow to probe regions close to where the gamma–ray emission is produced. A measure of the proper motion and of the source brightness temperature allow to strongly constrain the Lorentz factor in the jet, which is a fundamental parameter for the interpretation of the gamma–ray emission.
A study of the blazar 3C279, now a classic, was made by Maraschi Ghisellini & Celotti (MGC92), and a multifrequency campaign was carried out in 1993 (Maraschi et al., 1994, ApJ 435, L91). They applied the "relativistic jet model" in order to explain the whole electromagnetic spectrum of this object. The study, which considered also the fast gamma–ray variability, showed that the gamma–ray photons are produced, by IC process, in a region 0.1 pc length in a relativistic jet with Doppler factor larger than 10.

2 The SAX mission and the present proposal

In april 1996 the Italian National Space Agency launched the X–ray satellite SAX, equipped with several instruments which allow to observe over more than three decades of energy, from 0.1 to 100 KeV, with relatively large area, good energy resolution and imaging capabilities (about 1 arcmin) in the range 0.1 to 10 KeV.
Several gamma–ray blazars have already been observed extensively during the first two years of the SAX mission, and others will be observed within the next two years. The aim is to determine the X–ray spectrum at higher energy and see how it connects to the gamma–rays and to study the variability over time scales as short as a few days.
A coordinated study in various bands of the electromagnetic spectrum is being undertaken by the italian astronomical community, the aim being to increase the number of blazars for which a multifrequency study exists, with observations carried out simultaneously, or nearly simultaneously, going from the radio to the highest energy available with SAX. The request of simultanous observations comes from the very high variability of these sources over the whole electromagnetic spectrum.
Among the sources selected for the satellite X–ray observations, high priority will be given to **0528+134** and **1510−089** during the next two years of the SAX mission (project leader of the SAX observations is L. Maraschi). These sources are OVV, with a polarisation > 3 detected by EGRET. At radio frequencies they are extremely compact, and barely resolved with ground VLBI. For this reason with the present proposal we want to ask for ground–VSOP observations at 5 GHz for these two sources in order to increase the knowledge on their radio properties at very high angular resolution. We are particularly interested in their high resolution morphology, in the dimensions of the compact component, in the search of superluminal motion as close as possible to the radio nucleus. The achievable linear resolution will be in the range 1–6 pc

for 0528+134 and 1510−089 respectively. The direct measurements of the sizes of the emitting regions can be compared with these derived from the cross-correlation of the X–ray and delayed millimeter emission. Furthermore, in case observing time will be allocated to the present proposal, we plan to use the VLBA antennas at 22 GHz during the VSOP idle time. With the simultaneous 5 GHz space VLBI and 22 GHz VLBA observations we will be able to decompose the spectral index in those of the various components, and to derive the turnover frequency in each component. A previous work by Valerio et al. (1997, Mem. S.A.It. 68, 159) suggests that the turnover frequency lies in the range 10 - 20 GHz. With the proposed study, we expect to give a major contribution to the above mentioned larger project in the radio window.

3 The Selected Sources

The sources we selected are prototypes of the classes of "Low Polarized Quasars" and "High Polarized Quasars". In particular:

0528+134 is a LPQ at a redshift 2.07. This source has been mapped recently by Pohl et al. (1995, A&A 303 383, see figure 1) with a global VLBI array at 22 GHz and with a geodetic VLBI network at several epochs. The source has components which show superluminal motion. It is strongly variable at high frequencies. This source will be regularly observed by EGRET.

1510–089 is a HPQ at a redshift 0.361. It is a strong variable radio source (Padrielli et al., 1987, A&A 67, 63), with correlated broad band variability down to 408 MHz, following the the canonical behaviour (varying first at high frequencies and then with reduced amplitude at progressively lower frequencies). Maps at 18 and 6 cm with a global array (fig. 2, from Price et al., 1993, ApJS 86, 365; Bondi et al., 1996 A&A 308, 415) showed a core–jet structure, with the mas jet in p.a. $\sim 170^{\circ}$, aligned with the large scale structure (Morganti et al., 1993, MNRAS 263, 1023). The core is very compact, as from the TDRS observations, with a brightness temperature exceeding 10^{12} K.

The total power fluxes of these two sources, together with the other blazars in the SAX sample, has been monitored since January 1996 with the two VLBI antennas in Medicina and Noto at 8.4 GHz and 5 GHz and our monitoring program will continue on monthly basis throughout the SAX and VSOP missions (Venturi, 1997, Mem. S.A.It 68, 193). The aim of our monitoring program is to derive the behaviour of the energy bursts in these variable sources, such as their evolution with time and propagation at lower frequencies, in order to reveal the size and location of the radio emitting region. The light curves of both sources are given in Fig. 3. They show that the total flux of 0528+134 has been steadily decreasing since our monitoring program started, while 1510−089 shows variations on timescales of the order of few months.

4 Details of the Requested Observations

We ask to observe 0528+134, and 1510−089 with the VSOP satellite at 5 GHz, each source for two orbits, in order to optimise the u–v coverage. The flux of these sources is of the order of a few Jy over the whole radio spectrum, and allows therefore good imaging with the VSOP capabilities. Given the aim of this proposal, it is essential for us to have multiepoch observations for these two objects, in order to detect possible superluminal motion. The best choice for our aims is to observe each source three times. We would like the first two epochs to be 6 months apart, and the third one roughly 1.5 years after the second epoch. Such monitoring sampling should allow us to easily detect proper motions with β_{app} in the range 1 to 20.
In Section 10 of the VSOP Proposal Cover Sheet we report the preferred array, the minimum array and the preferred epochs. The simulations were done by means of the updated version of program FAKESAT (Murphy, 1995).