AUSTRALIA TELESCOPE OBSERVING APPLICATION

PKS

yr,term:	97APRT

ATNF use
ident:
rcvd:

PARKES TELESCOPE

SEND TO: Director, ATNF, P.O. Box 76, Epping, NSW 2121, Australia

For ATNF information see : http://www.atnf.csiro.au

1. Title of proposal:

Space VLBI co-observing of Centaurus A at 22 GHz

2. Authors Principal investigator on line 1	**Institution/Country** (if not Australia)	**Ph.D. thesis ?**	**Present at Parkes ?**
K. Fujisawa	ISAS, Japan		
D. Meier	JPL, USA		
K. Kellermann	NRAO, USA		
H. Hirabayashi	ISAS, Japan		
D. Jauncey	ATNF		yes
R. Preston, S. Tingay	JPL, USA		

3. Contact author and mailing address: S. Tingay
Jet Propulsion Laboratory (MS 238-332)

phone: +1 818 354 4909 FAX: +1 818 393 6890 e-mail: tingay@hyaa.jpl.nasa.gov

4. Has this proposal been submitted before? No **Previous proposal no:** **Related proposal no:**

5. Scientific categories: ☐ Solar System ☐ Stellar ☐ Galactic ☐ Mag. Clouds ☒ Extragalactic

6. Type of observation:

☒ Continuum ☐ Spectral line ☐ Point source ☒ Mapping

☒ Monitoring ☐ Pulsar ☐ High time resol. ☐ Survey

☐ Lin pol ☒ Cir pol ☐ Solar ☐ Multibeam

7. Receiver(s): K band

8. Sidereal time range (please state): 10h - 15h

9. Total requested time (days): T.B.D. Minimum useful time (days): T.B.D.

Estimated telescope time needed (incl. above) to complete project (days): T.B.D. Time allocated so far (days): 0

10. Any publications to date from this proposal? No **(If YES, please list separately)**

11. Short summary of proposal (~150 words, minimum font size 8 point):

We propose to use the Parkes radio telescope at 22 GHz in support of VSOP space-VLBI observations of Centaurus A, as an element of the Earth-space VLBI array. Array elements at 22 GHz at southern latitudes, in conjunction with the VSOP space craft and the VLBA, are vital to achieve the best possible SVLBI u-v coverage for sources at the declination of Centaurus A. Baselines between the VSOP spacecraft, the VLBA, and Southern Hemisphere antennas fill the extremes of the u-v plane for Centaurus A, giving far better u-v coverage than if VSOP were used with the VLBA alone.

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12. Please indicate the amount of additional help required:

☐ None ☒ Consultation ☐ Friend (Epping: initial assistance with data reduction)
☐ Observing assistance ☐ Staff Collaborator

13. Spectroscopy only:	Line 1	Line 2	Line 3
transitions to be observed			
velocity range (km s^{-1})			
number of channels per spectrum			
approx observing frequency			
number of simultaneous spectra			
total bandwidth [MHz]			
receiver tuning range			

14. Back End System: S2 VLBI system

15. Feed(s): K band

16. Focal plane/vertex arrangements:

17. Computer programs:

18. Consumables (eg mag tape): S2 tapes

19. Number of sources: 1 [If more than 6 sources, please attach list. If more than 30 give only selection criteria and LST range(s)]

20. Name [order of priority]	**Coordinates (J2000)**		**Band**	**Intensity (cont)**		**rms noise required (mJy)**	**Cal. size (Jy)**	**Possible LST range h ⇒ h**	**Time requested (hr)**
	RA (h,m)	**DEC (±°,′)**	**(cm)**	**total (Jy)**	**peak (mJy)**				
Centaurus A	13 25 28	-43 01 09	1	∼ 100	4000	50	2	10 - 15	T.B.D.

21. Special hardware, software or operating requirements: Standard S2 VLBI setup

22. Non-standard equipment supplied by user: *(by arrangement, OIC, Parkes Observatory)*

23. Preferred range of dates for scheduling: June - August (see text for details)

24. Unsuitable dates: see text

25. Please attach a description and scientific justification of proposal, in not more than 1500 words

Space VLBI co-observing of Centaurus A at 22 GHz

Introduction

The Japanese VSOP space VLBI mission will launch an Earth-orbiting radio telescope in early February 1997. In conjunction with ground-based VLBI arrays the space craft will produce maximum baseline lengths of approximately 2.5 Earth radii and the level of u-v plane filling required for image formation. A resolution of 50μas will be achieved at its highest operating frequency, 22 GHz.
We have been granted observing time on the space craft to observe Centaurus A, the closest active radio source to us at a distance of 3.5 Mpc (Hui, X. et al. 1995); Centaurus A was ranked as one of the most important sources for observation by the VSOP mission science review.
The VSOP observing frequency of 22 GHz has been chosen to take advantage of the inverted spectrum core of the radio source (Jauncey et al. 1995) and to maximise the linear resolution; 50 μas with VSOP plus ground telescopes corresponds to approximately 1 light day at the source.
The great increase in angular resolution provided with coordinated Earth-space VLBI observations allows us the opportunity to probe deeper into the compact radio source at the core of Centaurus A. Previously we have examined Centaurus A with the SHEVE array and the VLBA at cm wavelengths, revealing an inverted spectrum core component (Meier et al. 1989; Jauncey et al. 1996), subluminal components in the pc-scale jet, some of which are rapidly evolving (Meier et al. 1992; Tingay et al. 1994; Jauncey et al. 1995), and a sub-pc-scale counterjet (Jones et al. 1996). The highest resolution VLBI observations of Centaurus A to date have been made with the VLBA at 43 GHz, showing the existance of a core component approximately 0.01 pc in extent (Kellermann, Zensus, and Cohen 1997). It is structure on this and smaller scales that we hope to probe in detail with space VLBI observations.
We are undertaking extensive observations in support of this project, including total flux density monitoring at cm and mm wavelengths with the ATCA and SEST.

Scientific Justification

Figure 1 shows the u-v coverage for 22 GHz space VLBI observations of Centaurus A if the VSOP space craft is used in conjunction with the VLBA for a sample observation period, 1997 June 19 UT 23:00 - June 20 UT 10:00. Figure 2 shows the u-v coverage for the same observation if ATNF antennas (Parkes and Mopra) are included. Several significant improvements in u-v plane coverage can be had with the inclusion of only two southern antennas. First, baselines formed between the ATNF antennas and the VLBA antennas in Mauna Kea and the west coast of the continental USA significantly fill the inner portions of the u-v plane. Second, baselines between the ATNF antennas and the VSOP space craft provide the longest projected baseline lengths during the observation, hence increasing the angular resolution of the resulting images. Third, elements of the VSOP-ATNF-VLBA combination provide valuable large closure phase triangles.

Feasibility and requirements

The Mopra telescope already has a commitment to supporting observations for VSOP and has been considered in the scheduling of the Centaurus A observations. The addition of a second nearby telescope clearly strengthens the highest resolution u-v plane constraints and offers redundancy for the Centaurus A observations. The 70 m DSN telescope at Tidbinbilla will be available to play this role in a limited capacity. The major commitment of the DSN telescope is in the tracking of the Galileo space craft.
Galileo is also a major commitment for Parkes. Parkes, however, because of its shorter pre-cal time and higher elevation limit should be more available than Tidbinbilla to track Centaurus A while it is rising in the east, not interfering with its track of Galileo. This is the most important time for Parkes to track Centaurus A; as it rises there will be overlap with both VSOP and the VLBA, and the position angle of the milliarcsecond-scale structure of Centaurus A is such that important total flux density information will be obtained during this period on the short Parkes - Mopra baseline.
Thus, we request any available time to observe Centaurus A at 22 GHz with the Parkes telescope (not interfering with Galileo tracks) at several epochs between June and August 1997, the period in which Centaurus A can be observed by VSOP with optimal Earth-space coverage during the first 18 month AO period of the mission. The number of observations and dates of the observation epochs is not yet known and is subject to the final VSOP schedule, which will not be available until after the current proposal deadline. We ask, therefore, for the possibility of providing the observation epoch dates once they become known to us.
The LST range of interest for these observations is 10h - 15h, which should not interfere with the Galileo commitment at Parkes. Three hours of Centaurus A observation at each of the epochs would be ideal for our purposes. A minimum useful time of two hours per epoch would be acceptable.
For the observations we will require the K-band receiver and S2 VLBI recording equipment. The S2 tapes will be copied to VLBA format via the S2-VSOP-VLBA translators in Japan and correlated with VLBA and VSOP data at the VLBA

correlator in Socorro.

References

Hui, X. et al. 1993, ApJ 414, 463

Jauncey, D.L. et al. 1995, Proc.Nat.Acad.Sci.USA 92, 11368

Jones, D.L. et al. 1996, ApJ 466, L65

Kellermann, K.I., Zensus, J.A. and Cohen, M.H. 1997, ApJ 475, L93

Meier, D.L. et al. 1993, in Sub-arcsecond Radio Astronomy eds. R.J. Davis and R.S. Booth (Cambridge University Press), 201

Meier, D.L. et al. 1989, AJ 98, 27

Tingay, S.J. et al. 1994, Aust.J.Phys 47, 619

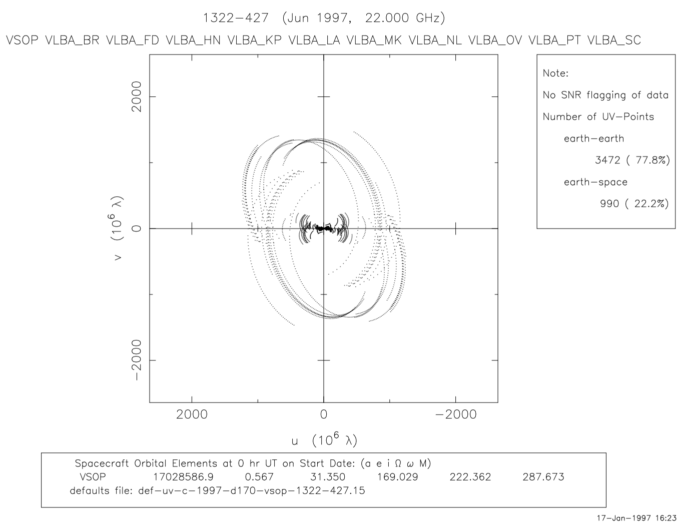

Figure 1. u-v plane coverage for SVLBI observations involving the VLBA and VSOP.

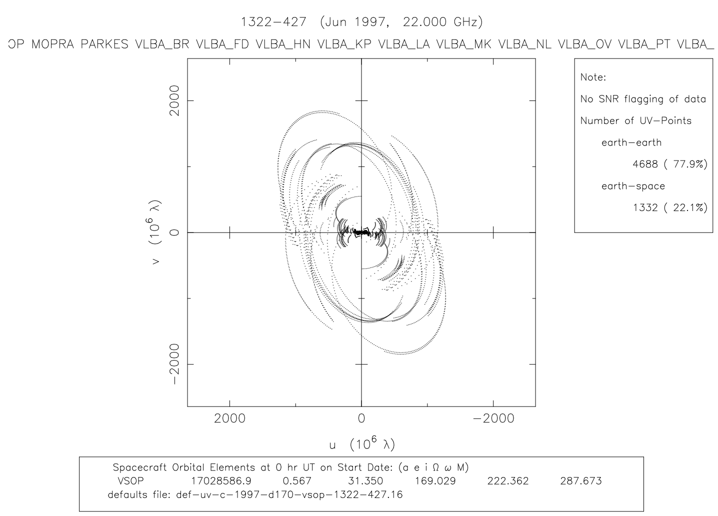

Figure 2. u-v plane coverage for SVLBI observations involving the VLBA, Parkes, Mopra, and VSOP.