Report on the activity of the Evolved Stars sub-Working Group for joint KVN+VERA operation in 20111-2012

Sub-Working Group of Evolved Stars for KVN+VERA

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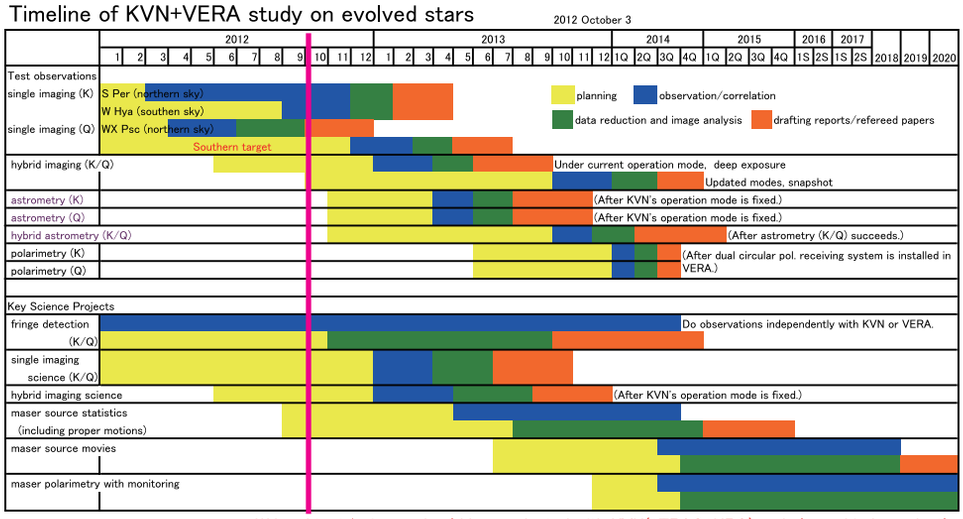
Main scientific interest

Stellar and interstellar astrophysics in final stage of stellar evolution probed by H_2O and SiO (43GHz) masers

mainly O-rich, intermediate and high mass stars with pulsation periods > 200 days

0. excitation mechanisms of masers
1. stellar pulsation-driven shock waves
2. asymmetric stellar mass loss

Timeline of KVN+VERA study on evolved stars



W band test/scinece should be conducted with KVN(+TRAO+NRO) and planned independently.

Major issues in planning of a KVN+VERA Key Science Project

Understanding observed properties of stellar masers and actual specifications of the KVN+VERA operation

a. distributions of spot sizes and lifetimes of stellar maser spots
b. flux density variation of masers associated with target stars
c. capability of snapshot imaging (integration shorter than ~3 hours)
d. capability of multi-band imaging
d.1. multi-frequency phase-referencing
d.2. multi-band imaging in single session
e. astrometry for image registration and trigonometric parallax distances

They should be elucidated through the test observations and the initial scientific operation.

See the timeline table.

Map comparison: the case of WX Psc SiO masers

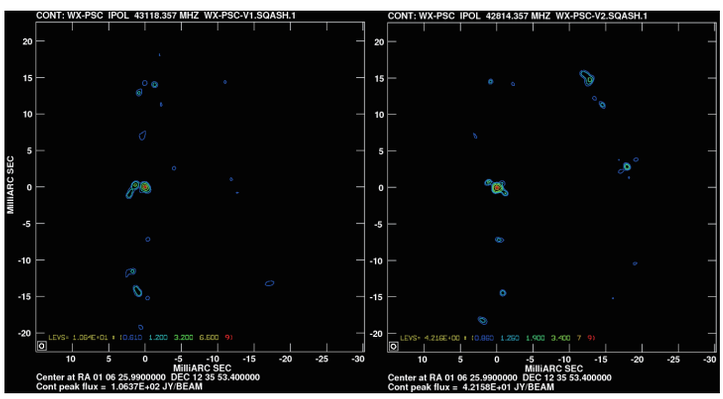


Figure 1 KVN+VERA (Y.J. Yun; on 2012 April 2)
Velocity integrated maps of the v =1 (left) and v =2 (right) J =1-0 masers. Their distributions extended a factor of 2 larger than those found in the VLBA (Soria-Ruis et al. 2004; Figure 3).
Registration of the v =1 and v =2 maps is still impossible due to unclear coordinates of the KVN stations, which will be soon available.

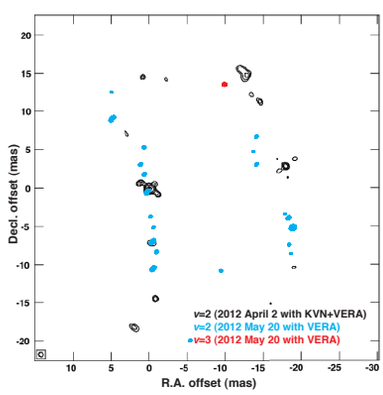


Figure 2 VERA (H. Imai et al. on 2012 May 20)
Velocity integrated maps of the v =2 (blue) and v =3 (red) masers with comparison with the v =2 map of Figure 1. The v =3 masers seem to be located at the inner part of the v =2 masers.
Registration of the v =2 and v =3 maps is made based on VERA astrometry.

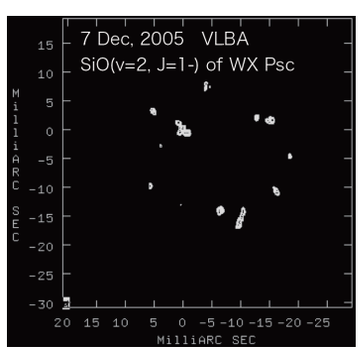


Figure 3 VLBA
(N. Matsumoto, on 2005 Dec. 7)
Velocity integrated maps of the v =2 masers.
Maser emission extending over 1 mas is spatially resolved out.

Current progress in sub-WG

A. First deep exposure imaging of stellar H_2O and SiO masers
A.1. S Per H_2O (see K. Kusuno' s poster)
finding spot size histograms, with comparison with previous VLBA and J-Net maps (Y. Asaki; H. Imai)
A.2. WX Psc SiO (Y.-J. Yun, see Fig. 1)
comparison with previous VLBA and VERA maps (H. Imai, see Fig. 2; N. Matsumoto, see Fig. 3)
B. Single-dish monitors of H_2O and SiO masers (see sources lists)
B.1. J.-H. Kim, S.-H. Cho, et al. 2010, ApJS, 188, 209)
B.2. S.-H. Cho & J.-H. Kim 2010, ApJ, 719, 126 (symbiotic stars)
C. SiO v=3 J=1-0 maser imaging
C.1. H. Imai et al. 2010, PASJ, 431 (W Hya)
C.2. H. Imai et al. 2012, PASJ (Letter), 64, in press (W Hya, WX Psc)
D. Construction of theoretical model of SiO maser excitation
Y.J. & Y.-S. Park 2012, A&A, 545, A136
E. Planning the KVN+VERA KSP (see the right-side disussion)
collection of information of target sources (M. Oyadomari)
wiki page update (H. Imai)

Boundary conditions of the KVN+VERA Key Science Project

Establishment of astronomical legacy themes in the coming decade
i. large project unreplaceable with multiple smallar projects: 200-300 hours per year
ii. unique scientific theme (now in open discussion)
tracing final evolution of stars with different stellar masses, requesting 20 - 30 targets with different pulsation periods at different phases
How to cover the IRAS/ASKRI color-color diagram?
iii. standard operation mode for KSP
(now in open discussion)
intensive target monitor with time resolution of ~1/20 pulsation cycle
VLBI session spacing of 15 - 90 days
long term monitor with time baseline of ~2.5 pulsation cycle: monitor for 2 - 10 years
How to cover the pulsation period range ?