

Division B;
Session 2B History of Radio Astronomy in East Asia
August 5, 2022, Pusan

History of Space-VLBI in Japan

Hisashi Hirabayashi

JAXA

History

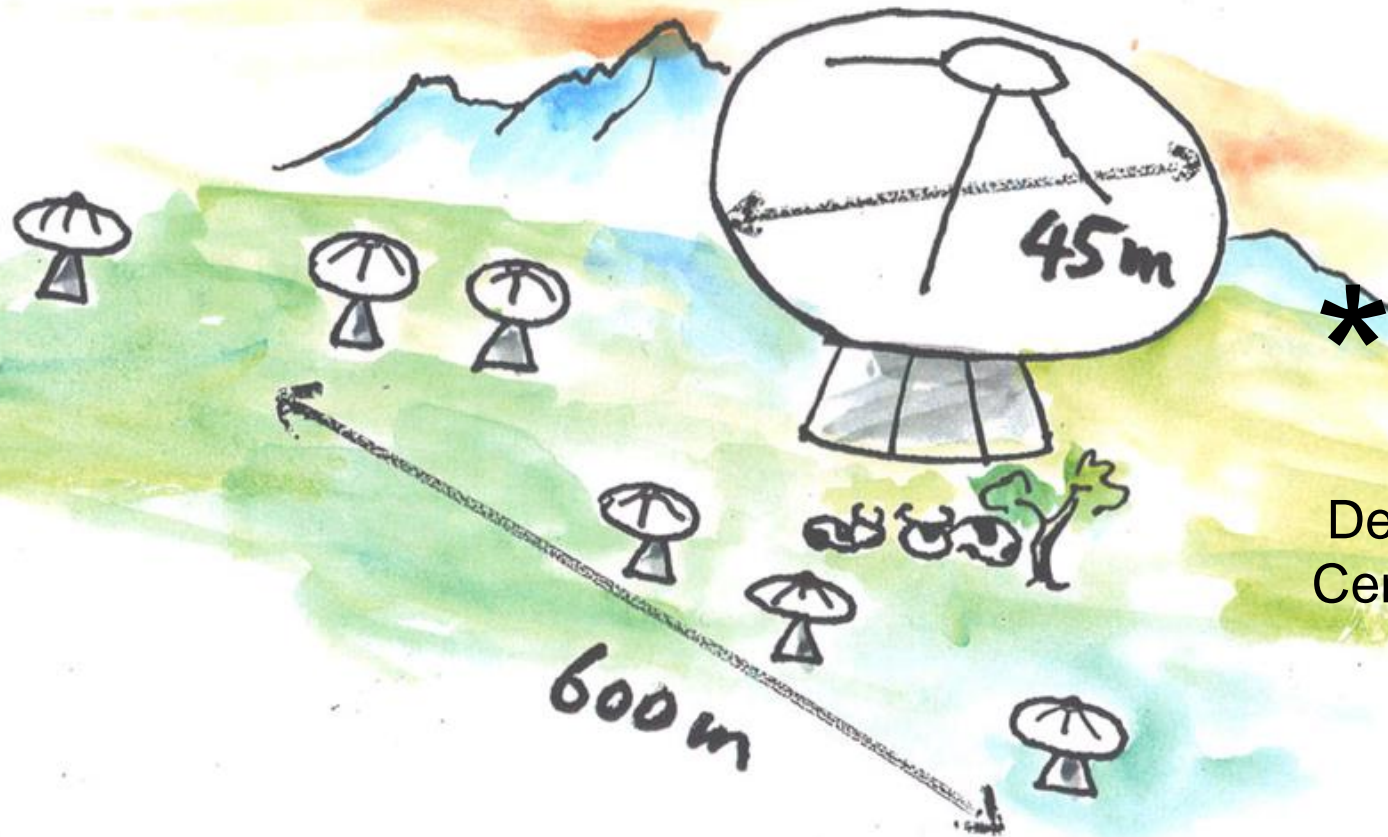
- 1980** VLA
- 1982** Nobeyama Radio Observatory 45m
- 1983** Kamioka v
- 1984** Usuda Deep Space Center 64m
- 1986-88** TDRSS-OVLBI
- 1989** VSOP start QUASAT died
- 1993** VLBA

- 1997** HALCA launch/Obs.start

- 2002** VERA

- 2006** VSOP end
- 2007** VSOP-2 (Astro-G) start
- 2009** VSOP-2 cancel
- 2011** RadioAstron launch

Nobeyama Radio Observatory 1982 - mm-wave radiotelescopes



Usuda

Deep Space
Center 64m

1984-



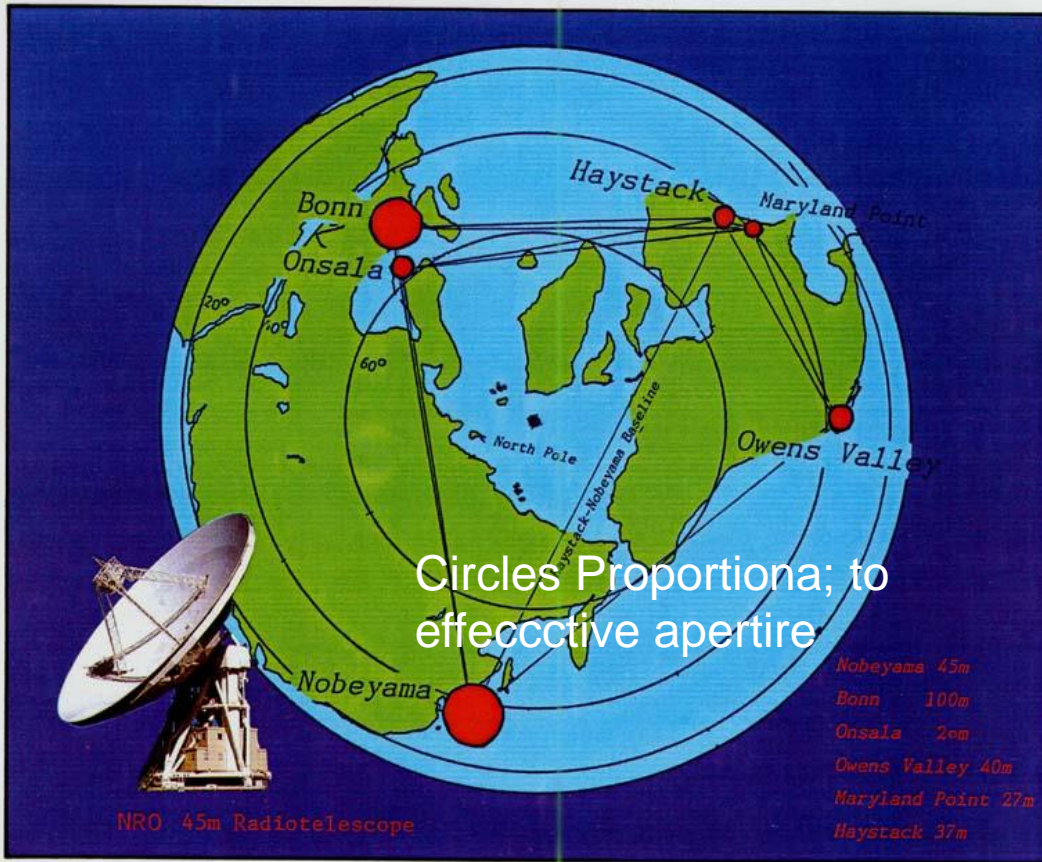
**“Morimoto-san,
mm-VLBI may be a good target
for 45 m mm Radio Telescope.”**



To form Nobeyama VLBI group.

mm VLBI

43GHz VLBI ネットワーク実験観測



First fringes 45m-Haystack

7mm fringes 1986

3mm fringes 1988

Correlated at Haystack

全世界を結んだ VLBI (超長基線電波干渉計) ネットワークのテスト観測が行われ、電波源の超微細構造をとらえた。上図で赤丸がネットワークに用いられた各国の電波望遠鏡 (大きさは集光力の大きさをあらわす) である。野辺山-ヘイスタックの基線長は9530kmで、角度にして0.00015秒の高分解能世界記録が達成された。

1986年



In Early 1980s Prof. Oda, whose first career was radioastronomy,
Called a meeting and asked, “**Is it crazy to think of ISAS-based space-VLBI mission ?**”

,,, to form space-VLBI WG (Nobeyama + ISAS)
and to propose the mission,,

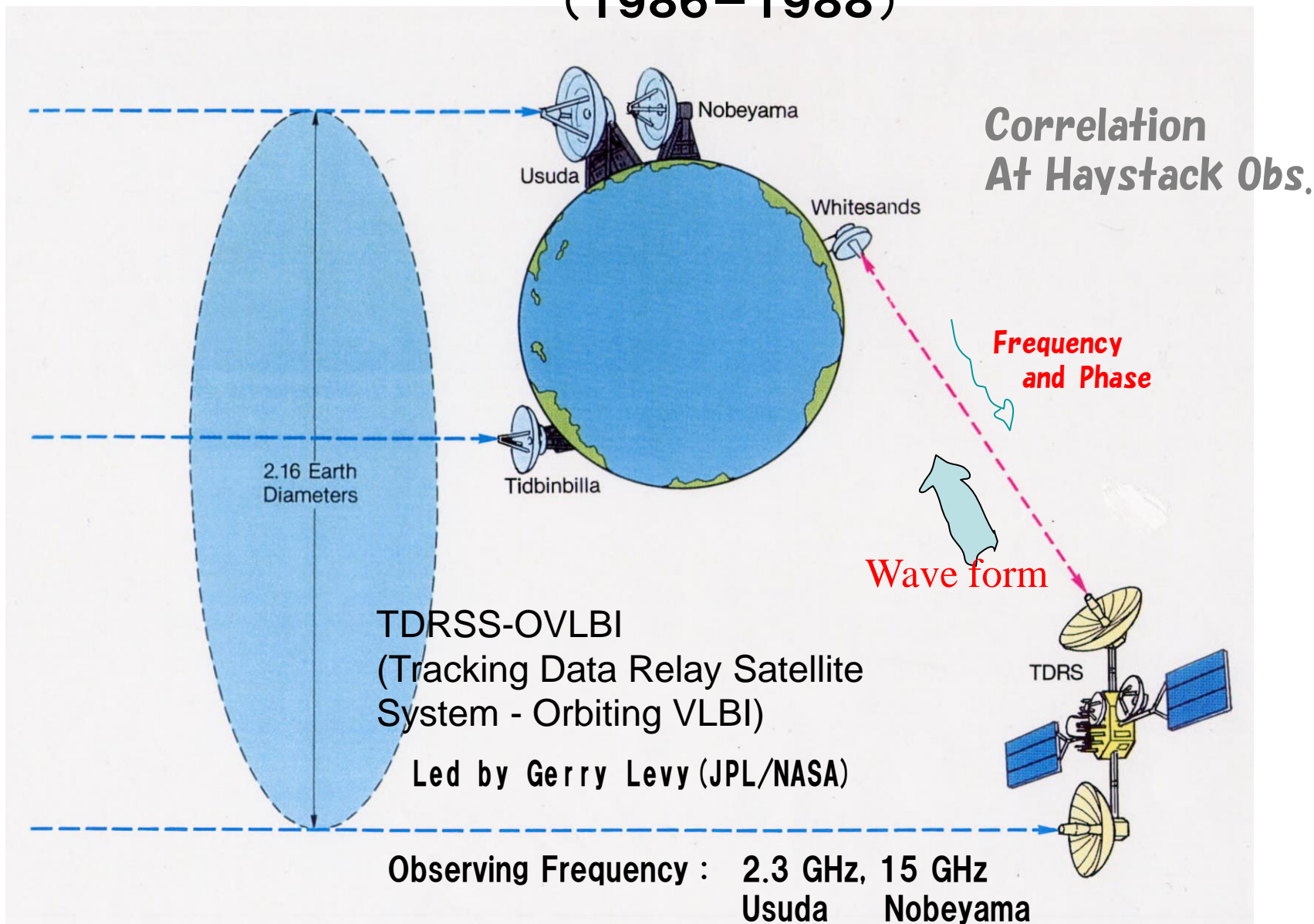
An aerial photograph of the Usuda Deep Space Center. The central focus is a large, white, parabolic radio telescope mounted on a complex, white, lattice-like support structure. To its left, a smaller, similar but much smaller antenna is visible. In the background, a large, multi-story, light-colored building complex is situated on a grassy field. The entire facility is surrounded by lush green hills and dense forests. The sky is overcast.

**HALCA
VLBI tracking station
10m**

Deep Space stn.
64 m

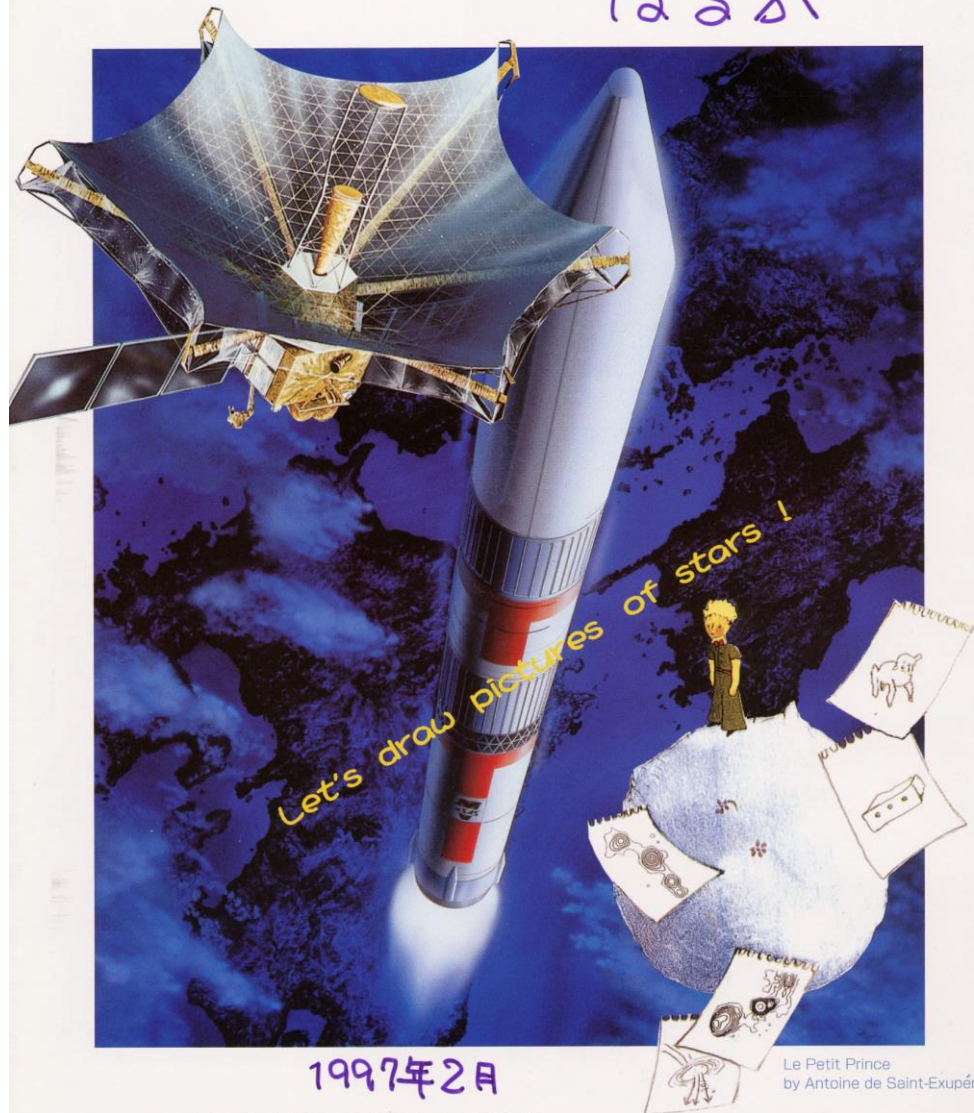
Usuda Deep Space Center / ISAS, 1994

Space-VLBI Demonstration Experiment with TDRSS (1986-1988)



VSOP with Muses-B

はるみ



1997年2月

1989年(平成元年)春より製作・調整が行われてきた第16号科学衛星MUSES-Bは、工学実験衛星として、大型宇宙展開アンテナ、高感度受信器、大容量データ伝送、高精度姿勢・軌道決定など、スペースVLBI観測に必要な技術試験に挑戦します。さらにこれらの技術を総合して、超高解像度で宇宙の高エネルギー現象の姿を描き出すVSOP計画の中心となります。



The Institute of Space and Astronautical Science
文部省 宇宙科学研究所

Muses-B

(Mu-series Engineering Satellite-B)
later renamed HALCA

Deployable antenna
Low Noise Amplifier
Data/Phase transfer
Orbit Determination
Space-ground Interferometry
Space-VLBI Imaging
etc.

VSOP

(VLBI Space Observatory Programme)
Scientific Observing
with International Operation
Fully Open program

Project start 1989 .. end 2006
Launch by
New M-V rocket 1997

VSOP project started in 1989 (Heisei-reign 1)



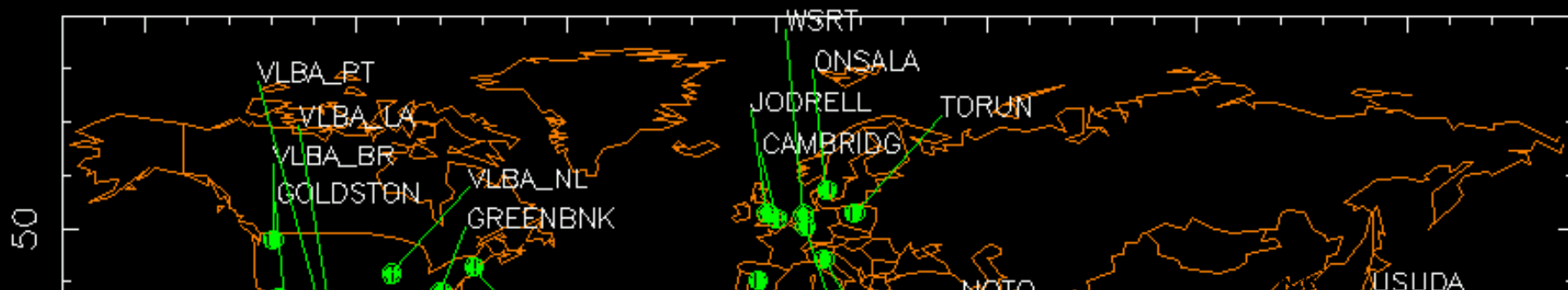
hEisei = satellite



International VSOP Symposium December, 1989

Nearly 47 overseas members attended
to make ISAS record.

Ground Radio Telescopes



The first GVWG (Global VLBI Working Group) meeting in Onsala, 1993, Chaired by R. Booth. Observatory directors of the world met, and enthusiastic collaboration started for space-VLBI.





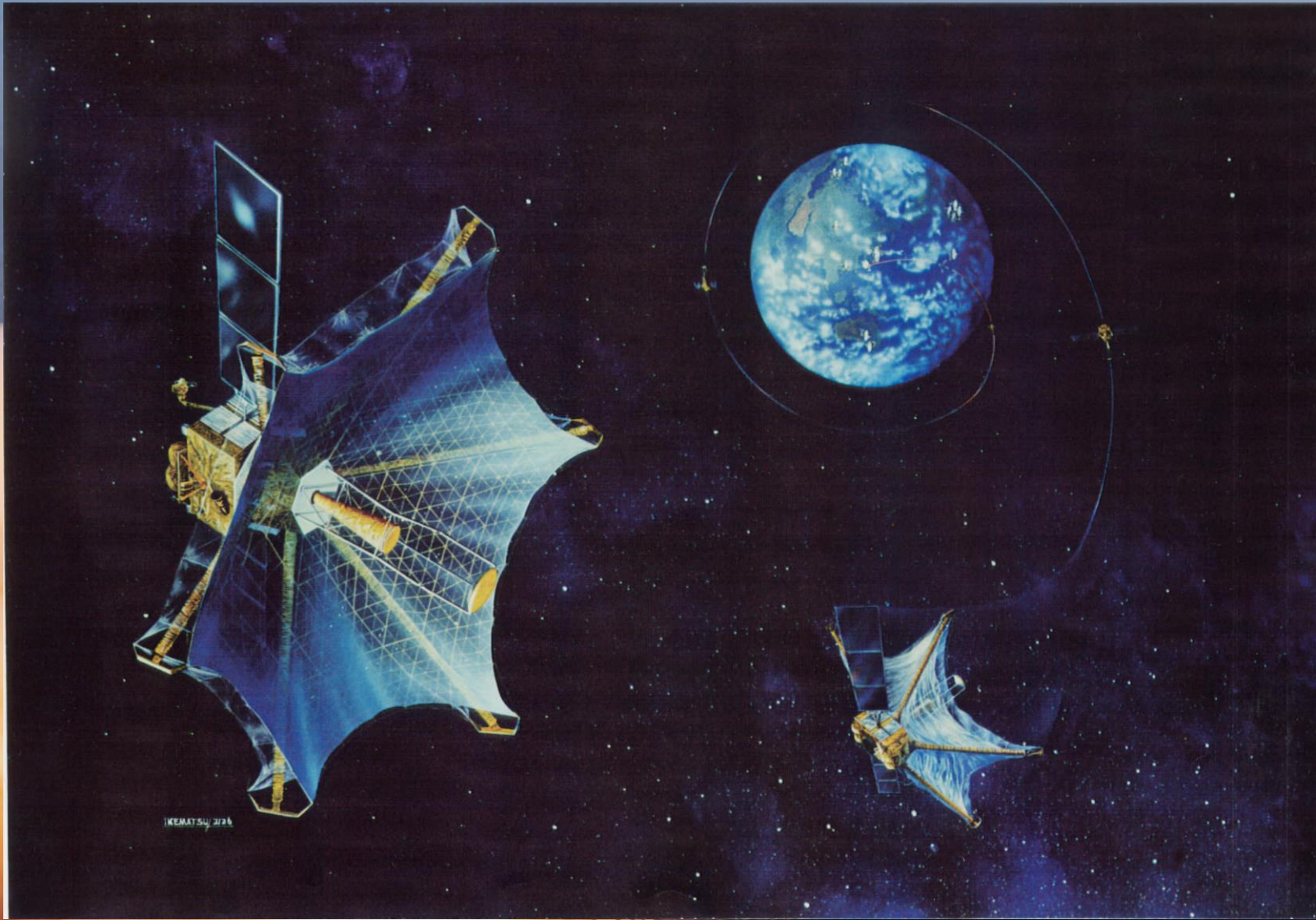
VaeSOP's Fables

1989-1997



8-years' efforts
for satellite
developments
are reviewed
as this cartoon.

M-V 1

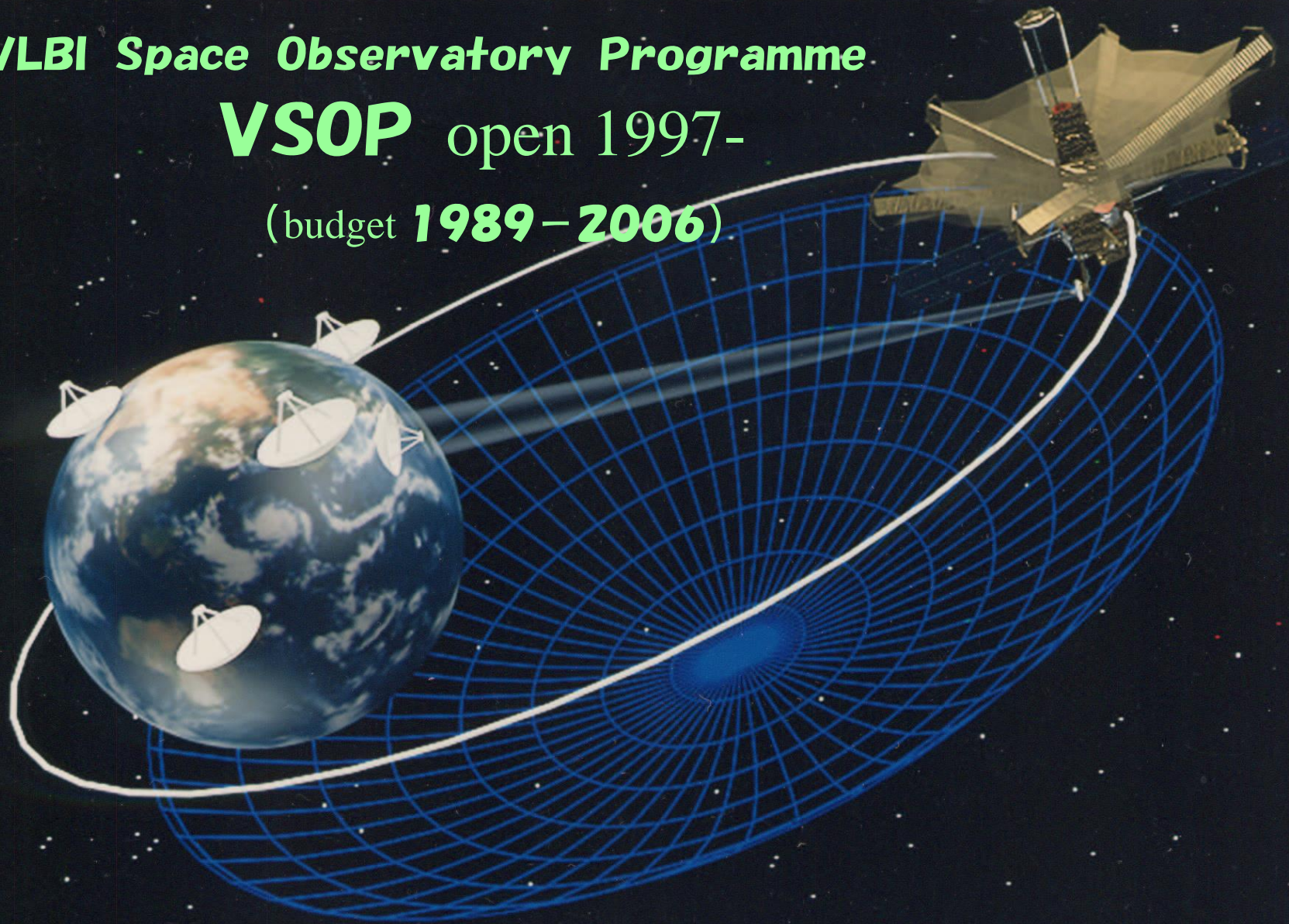


Halca Launch (1997)

VLBI Space Observatory Programme

VSOP open 1997-

(budget **1989–2006**)



VISC
VSOP International Science Council

guided the discipline
of VSOP scientific matter
throughout the mission time.

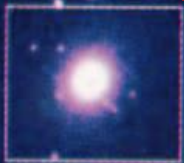


SRC
Science Review Committee

HST
5000 ly

10 ly

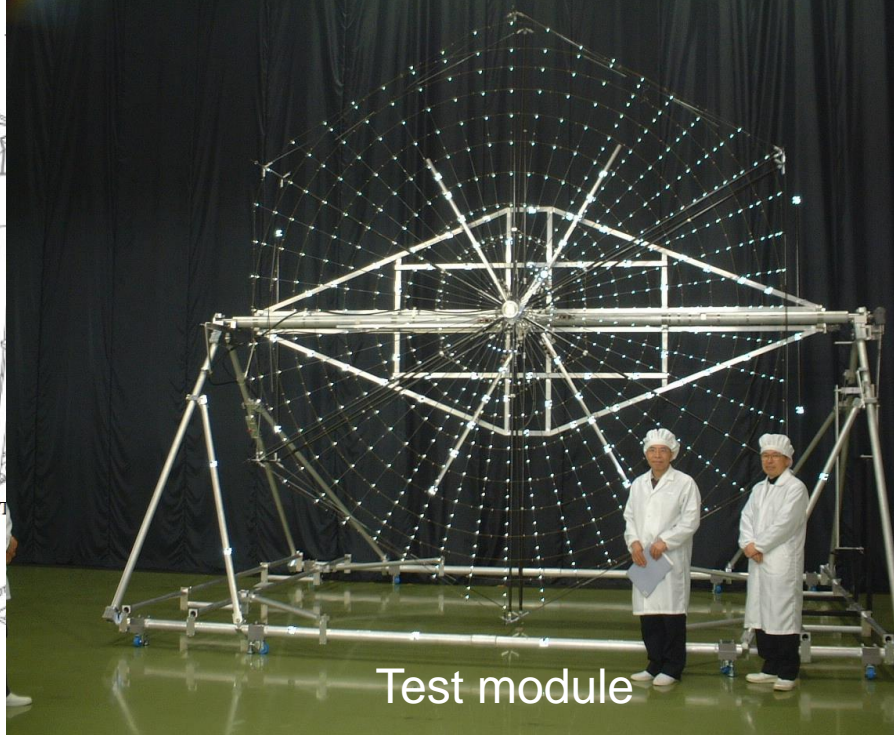
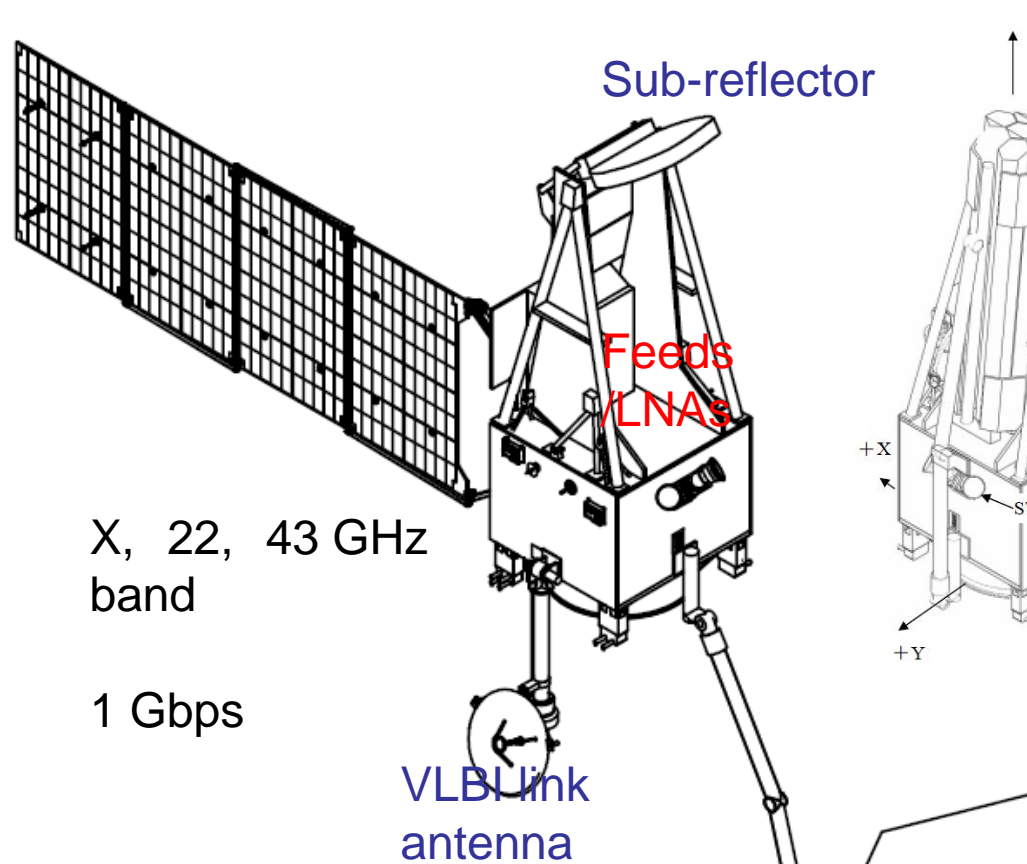
VSOP 18cm 300Rs



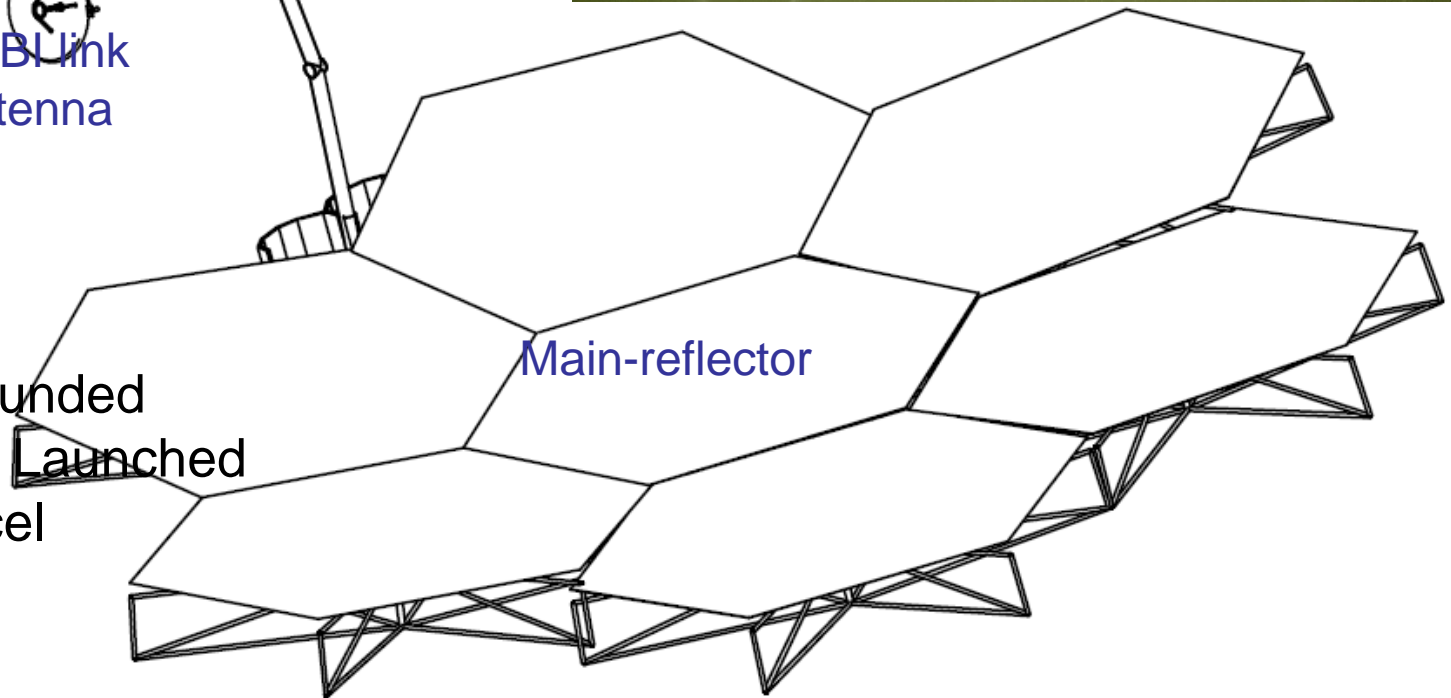
M87



International VSOP-2 Meeting July 8, 9, 1999 ISAS



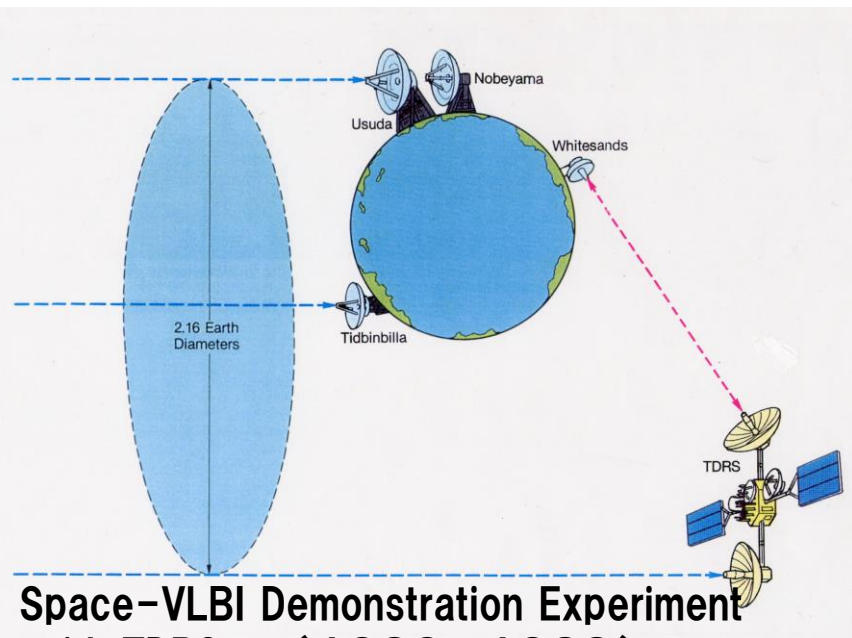
Astro-G .
2007 July Funded
2012 to be Launched
2009 Cancel



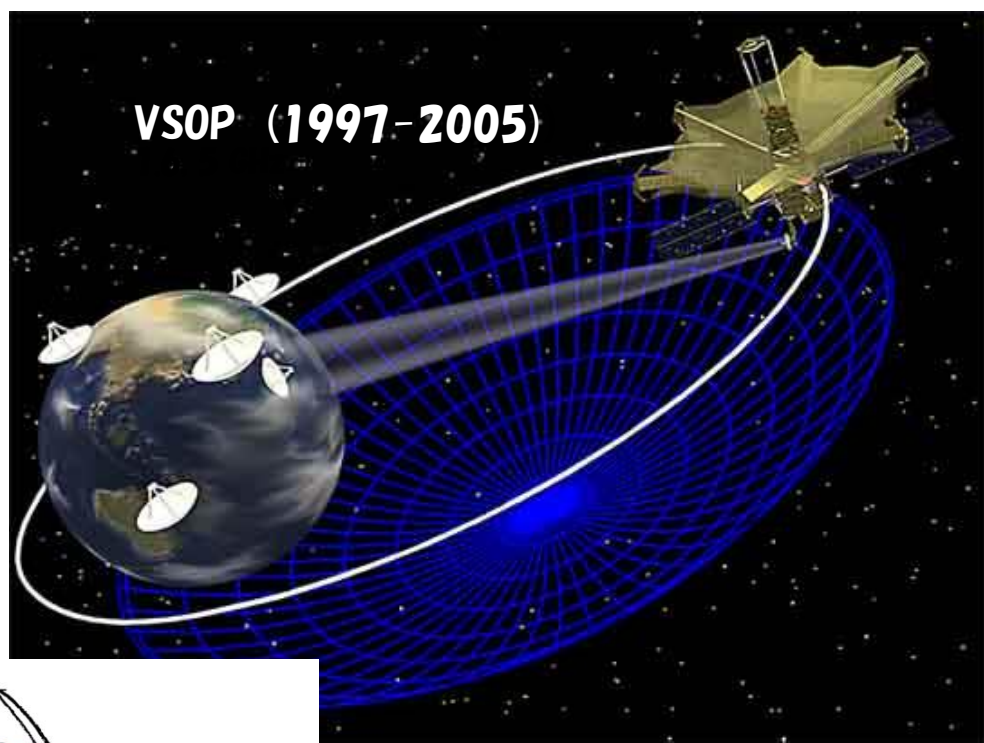


Launched
July 2011

RadioAstron Symposium, 2008, Moscow



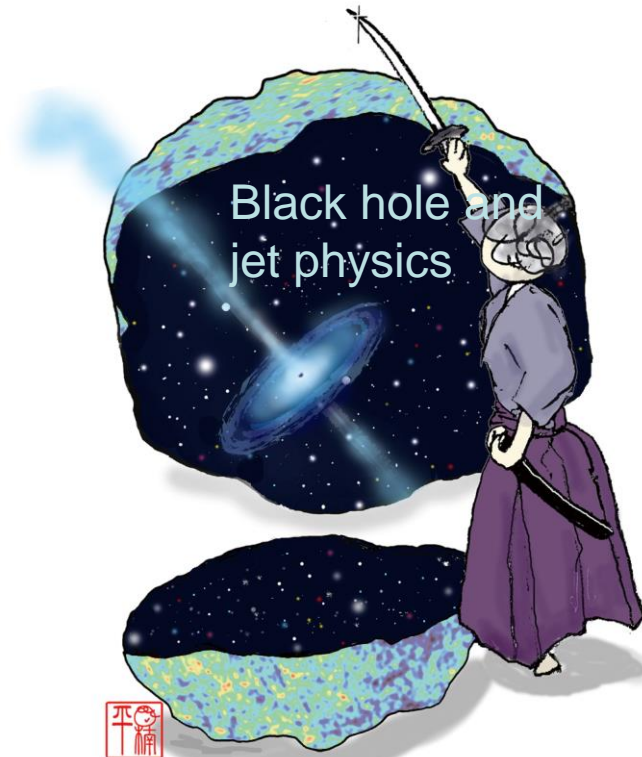
Space-VLBI Demonstration Experiment with TDRS (1986-1987)
2.3 GHz, 15 G



VSOP (1997-2005)

43GHz VLBI ネットワーク実験観測

全世界を結んだ VLBI (超長基線電波干渉計) ネットワークのテスト観測が行われ、電波源の超微細構造をとらえた。上図で赤丸がネットワークに用いられた各国の電波望遠鏡 (大きさは集光力の大きさをあらわす) である。野辺山-ヘイスタックの基線長は9530kmで、角度にして0.00015秒の高分解能世界記録が達成された。



Black hole and jet physics

8. 22, 43 GHz
VSOP-2 (2012-)

VSOP-2
a next generation Space-VLBI project



Birnie
Burke
(MIT)

Hirax
Hirabayashi
(NRO)



Once upon a time,
3 wise men and a Japanese business man
met in a ryokan in Nobeyama.

Gerry
Levy
(JPL)
Richard
Schilizzi
(JIVE)



Soon after HALCA launch at Kagoshima Space Center, Feb.1997

**IAA (International Academy of Astronautics)
2005 Laurels for Team Achievement Award
to VSOP team October 16, 2005**



**The Award was established in 2001,
and for mer recipients were :**
MIR space station (2001)
Space Shuttle (2002)
SOHO (2003)
HST (2004)
VSOP(2005)