



# A brief Introduction of the **VLBI** group at **XAO** and the **SMMAN** project

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**SMMAN**: quasi-Simultaneous Multi-wavelength Monitoring of AGNs with the NSRT



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# A glance of **NanShan Radio Telescope (NSRT)**

## ● Antenna

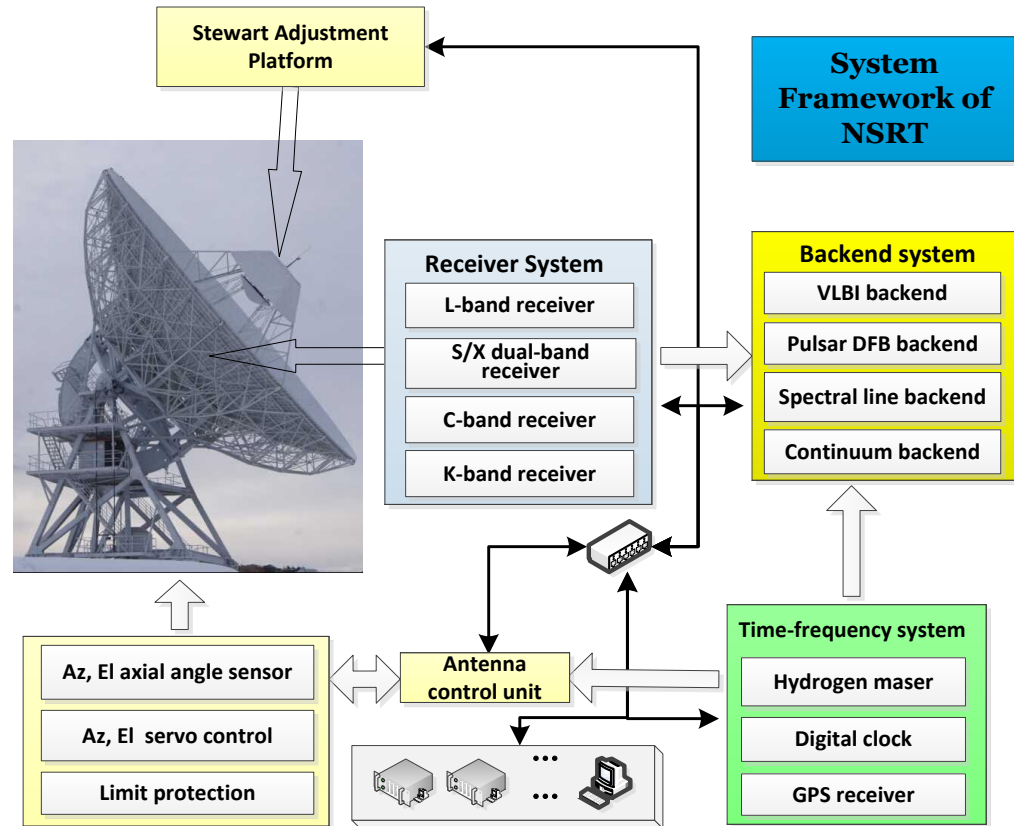
- Primary reflector: 26m, shaped Cass., surface RMS $\sim$ 0.4mm
- Sub-reflector: Stewart platform, surface RMS $\sim$ 0.1mm

## ● Receivers

- L, S/X, C & K bands working
- Q band receiver upcoming

## ● Backends

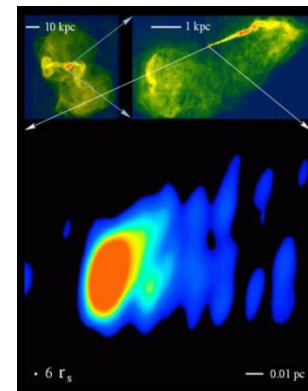
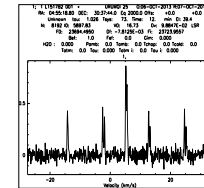
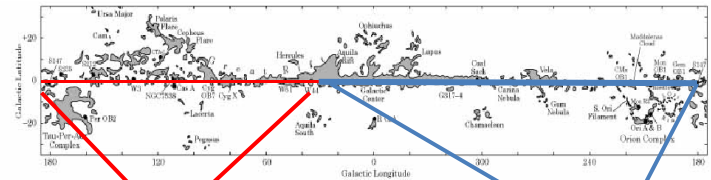
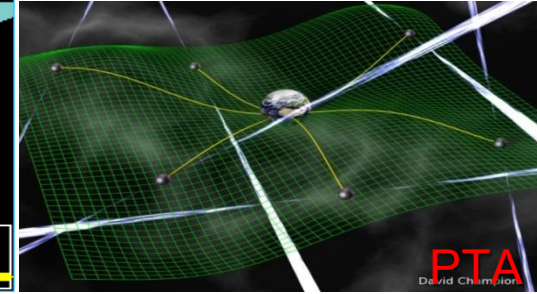
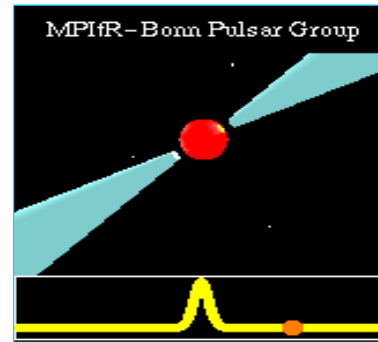
- VLBI, pulsar, spectral line & continuum backends





# Science with NSRT

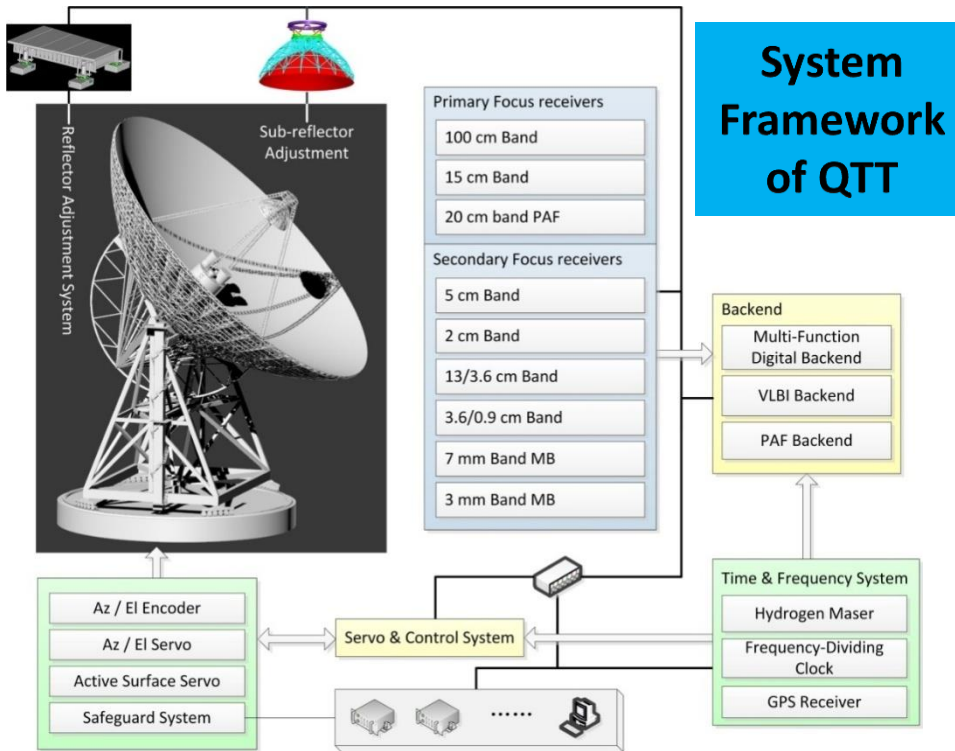
- Pulsar timing and physics
  - Pulsar timing noise
  - Radiation mechanism
  - Magnetar, FRB and other transients
  - GW detection with PTA
- Star formation and evolution
  - Molecular lines survey
  - High mass star formation
  - Molecular cloud evolution
- VLBI astrophysics and AGN flux monitoring
  - VLBI astrophysics and astrometry
  - Intra-Day Variability (IDV) of blazar
  - Multi-wavelength flux monitoring of AGN





# The QiTai radio Telescope (QTT)

-- A steerable 110-m aperture radio telescope



Specifications	QTT
Aperture (m)	110
Freq. Band (GHz)	0.15~115
Weight (t)	~5000
Active surface	Parabolic - shaping
Main reflector r.m.s. (mm)	Early stage $\leq 0.3$ Long term $\leq 0.2$
Pointing	Early stage 2.5" Long term 1.5"

Type	Band	RF Freq (GHz)	Focus	Feed	Poln	$T_{rec}$ (K)	Science Goals
Single Pixel	100 cm	0.15 - 0.6	Primary	Horn/Kildal	Linear	40	Pulsars, Transients, Recombination lines
	15 cm	0.6 - 4	Primary	Horn	Linear	30	Pulsars, Transients, HI, OH, Recombination lines, Galaxies
	5 cm	4 - 12	Greg.	Horn	Linear	20	Pulsars, Molecular lines, Galaxies, VLBI, System measurement
	2 cm	12 - 30	Greg.	Horn	Linear	20	Pulsars, H <sub>2</sub> O, NH <sub>3</sub> , Galaxies, VLBI
Dual Band	13/3.6 cm	2.2 - 2.5 8 - 9	Greg.	Horn	Circular	35/30	System measurement, VLBI, Space exploration
	3.6/0.9 cm	8 - 9 30 - 34	Greg.	Horn	Circular	30/35	VLBI, Space exploration
Multi-Pixel	20 cm	1 - 2	Primary	PAF	Linear	30	Pulsars, Transients, HI, OH, Galaxies
	7 mm	30 - 50	Greg.	Horn/PAF	Linear	40	Molecular lines, Re-shifted CO, VLBI
	3 mm	80 - 115	Greg.	Horn	Linear	60	Molecular lines, Galaxies, VLBI

## ● QTT Science Highlights

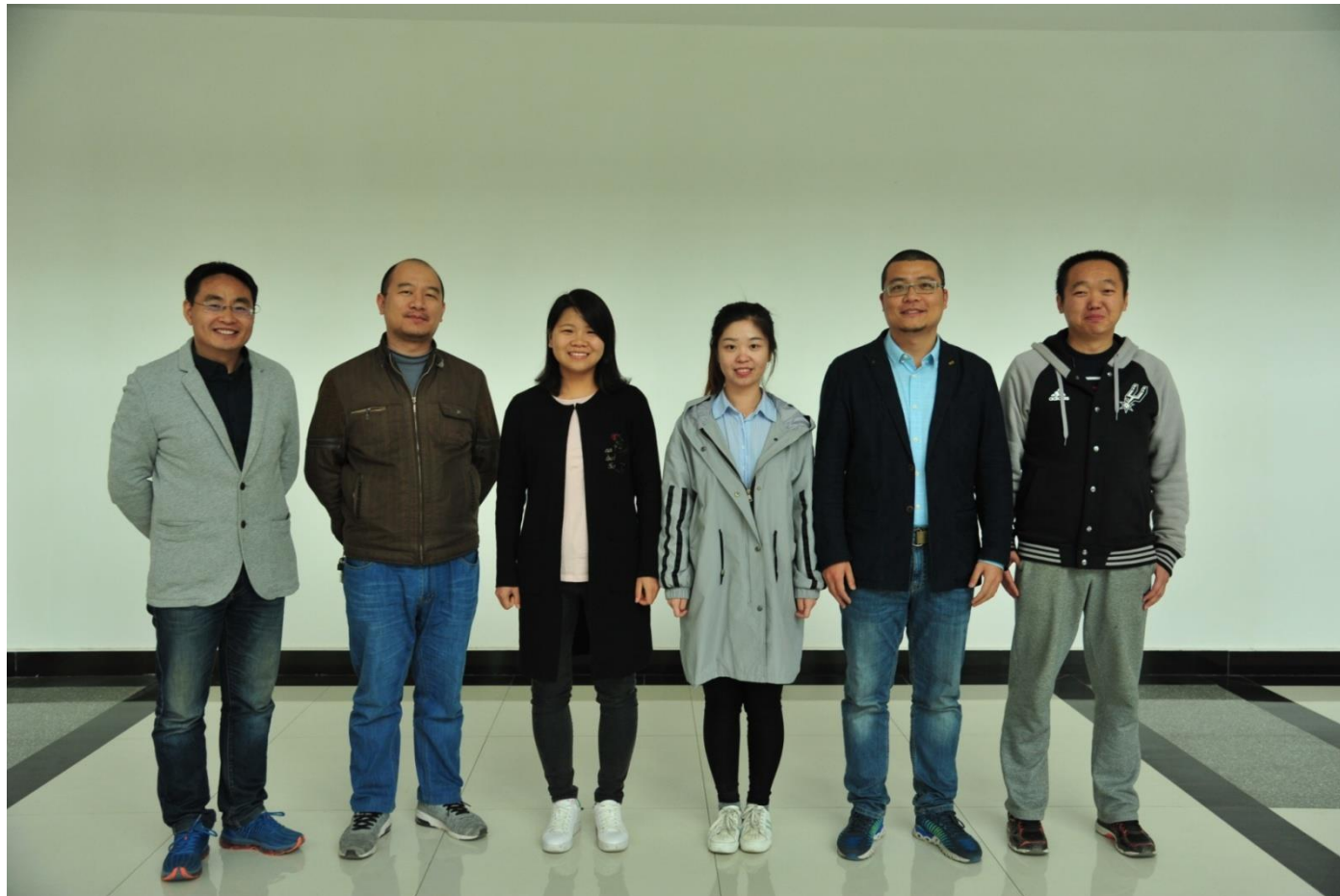
- ✓ PTA Gravitational Wave Detection
- ✓ Star formation & origin of COMs
- ✓ VLBI Astrophysics & Astrometry
- ✓ Space Exploring Application

## ● Project Progress

- ✓ Excellent site: easy accessible, radio quiet, good weather conditions
- ✓ Site infrastructure: underway
- ✓ Telescope preliminary design: finished
- ✓ Budget: approved by late 2016

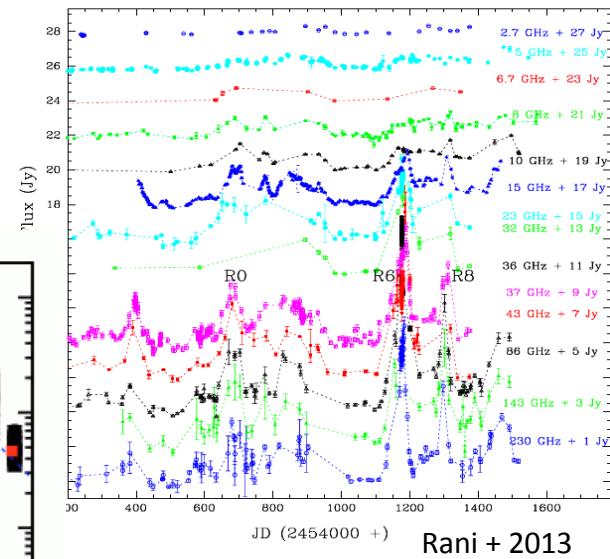
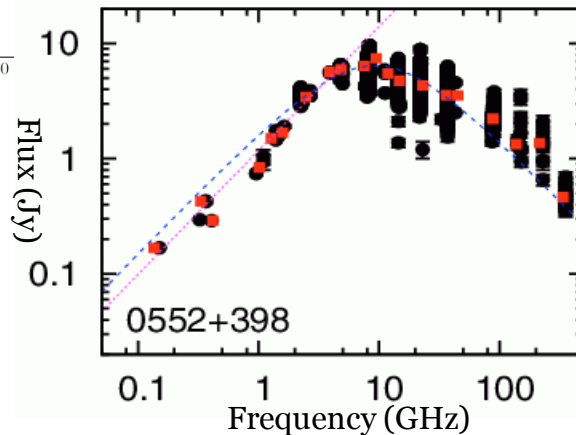
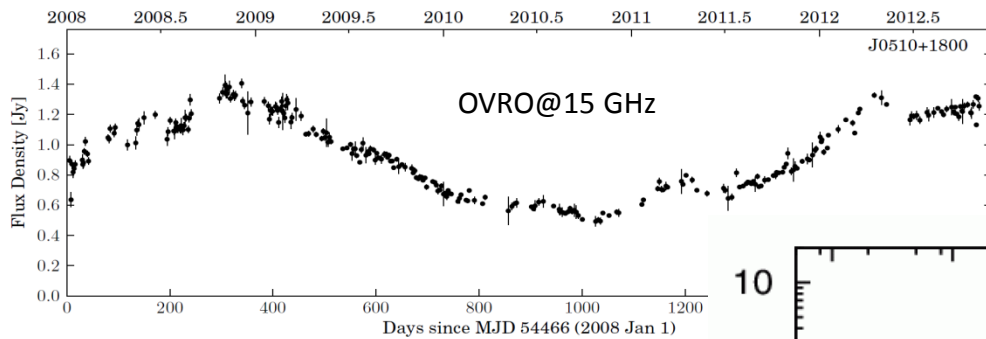
# The VLBI Group at XAO

- ✓ **Established:** Nov. 2015
- ✓ **Staff:** 9 members= 4 astronomers + 4 engineers + 1 secretary
- ✓ **Research interests:** AGN jet structure & flux monitoring, VLBI astrometry
- ✓ **Service:** EVN, CVN, EAVN & IVS observations



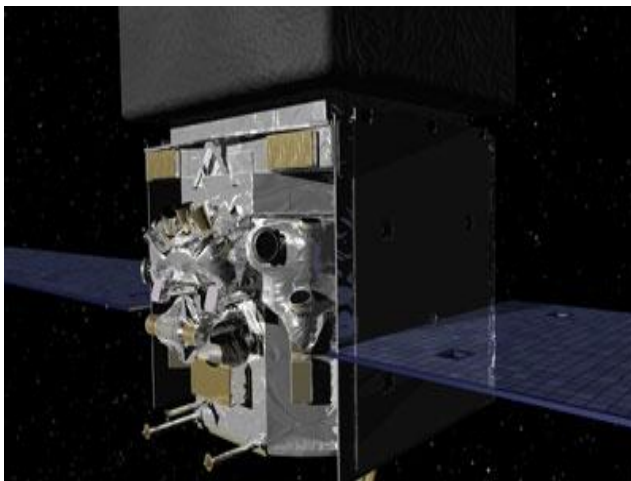
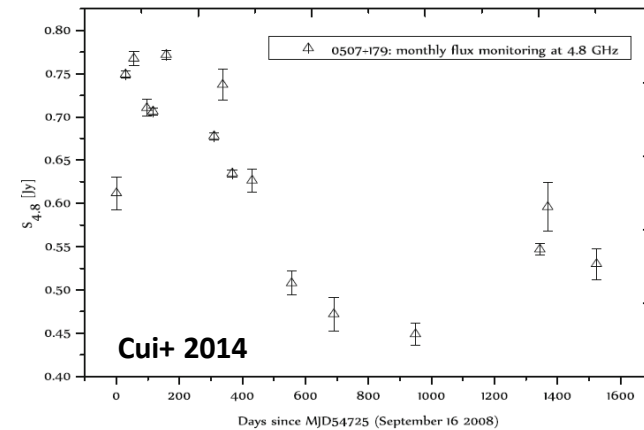
● *Scientific Motivations*

- Monitoring multi-wavelength radio flux of gamma-ray AGNs to enrich the data of other AGN monitoring programs
- Studying periodic radio flux variability and the evolution of spectral index
- Looking for possible correlations between different radio bands and gamma-ray to understand the emission mechanisms of AGN



● *Monitoring Sample*

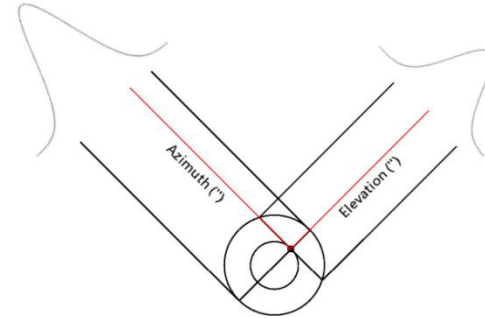
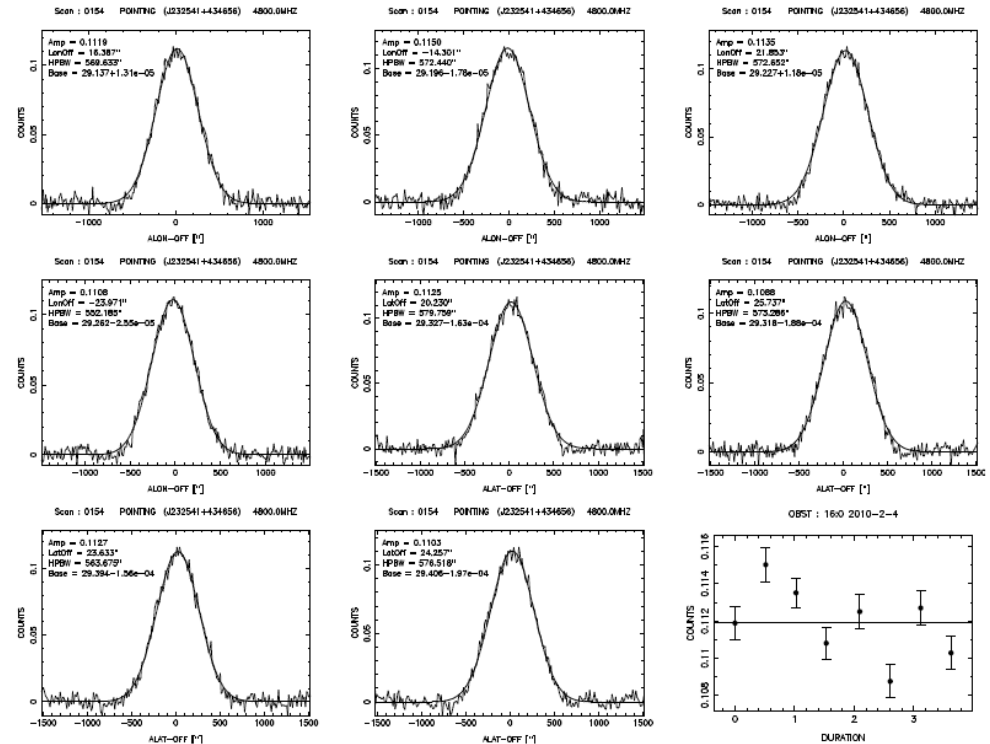
- Selected from Fermi-LAT 3FGL
- Selected criteria: Dec>0 deg &  $S_{1.4}>300$  mJy getting a candidate sample of 325 sources
- ~300 hrs test observations, finally determined the monitoring sample by late 2016
- The SMMAN sample: 143 gamma-ray AGNs, blazars dominate
- Jan. 2017, SMMAN launched





## ● Observation Strategy

- Monthly @ S, C, X, K bands and upcoming Q band,
- Observation mode: cross-scan, 5 HPBW
- ~5 mins/source, ~70 hrs/month

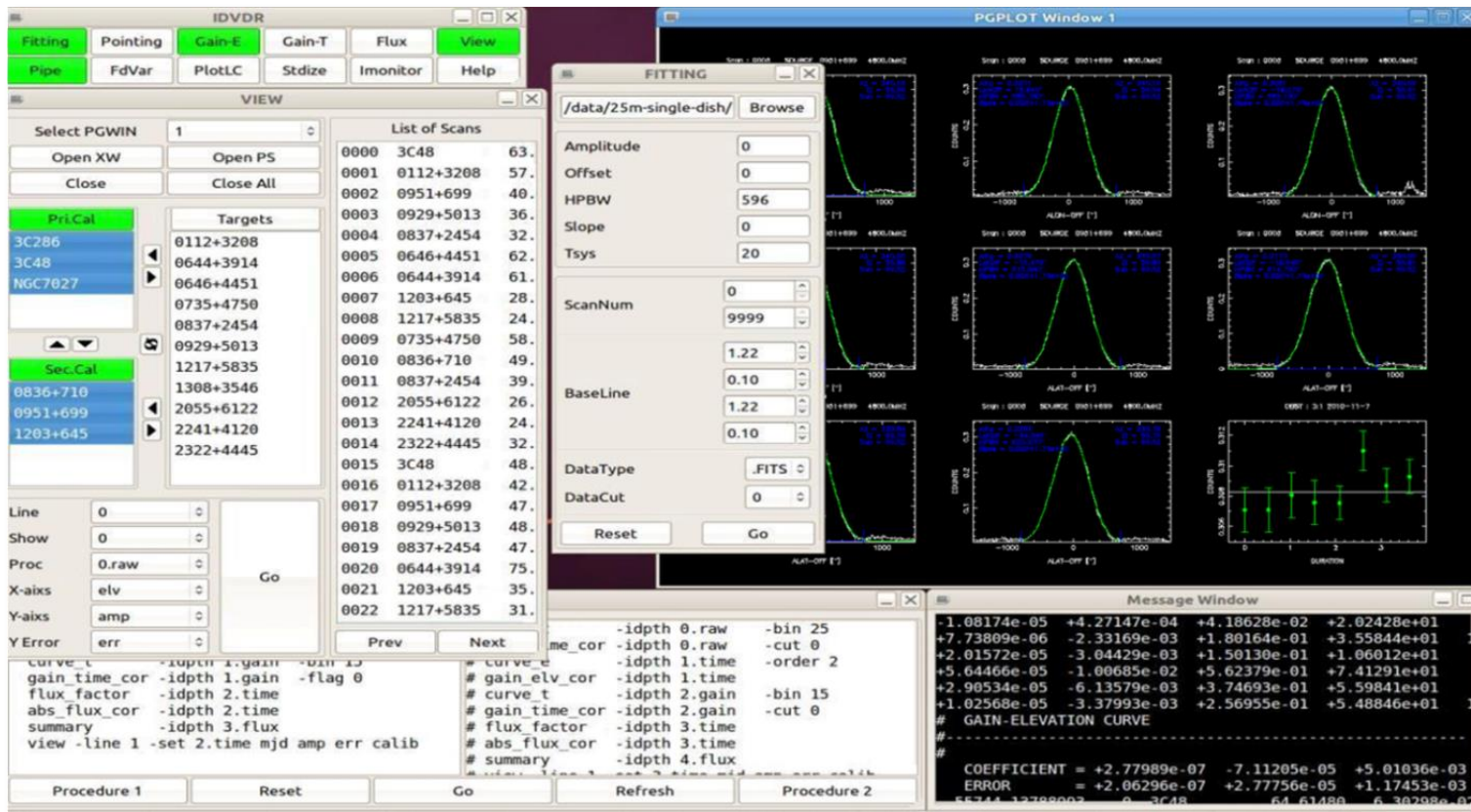



Observation control software

Cross-scan

## ● Data reduction and calibration

- Data reduction and calibration software: development finished
- The website for data release: under construction

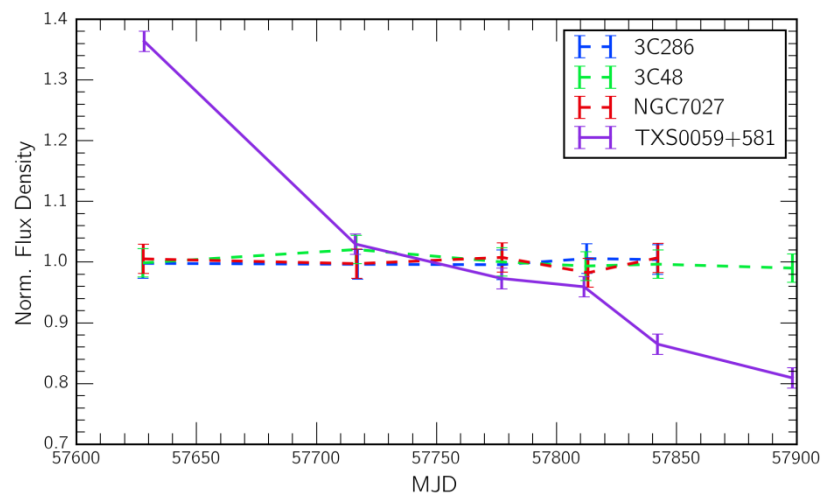
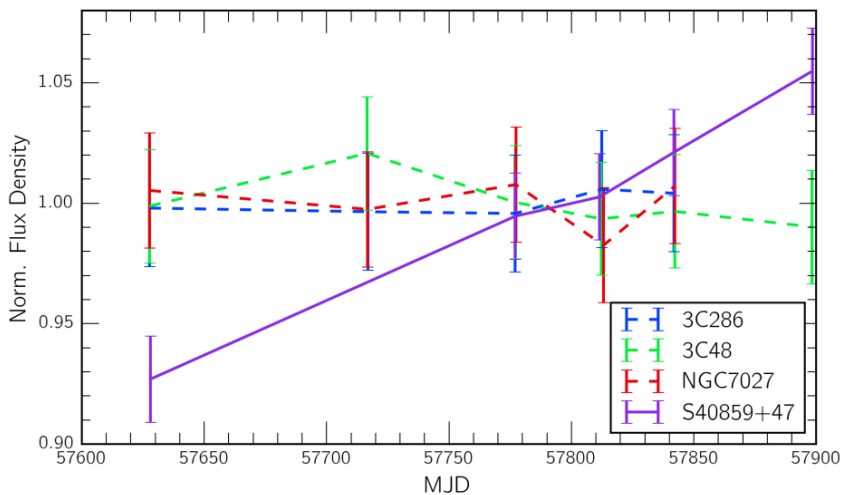
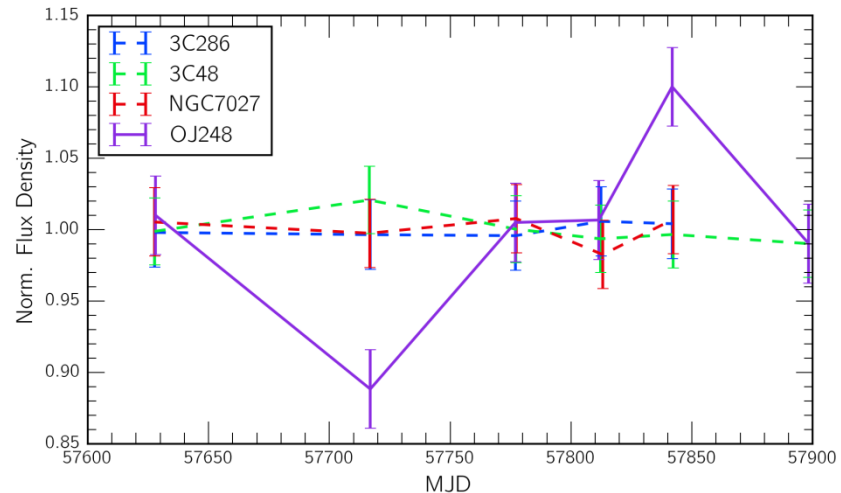
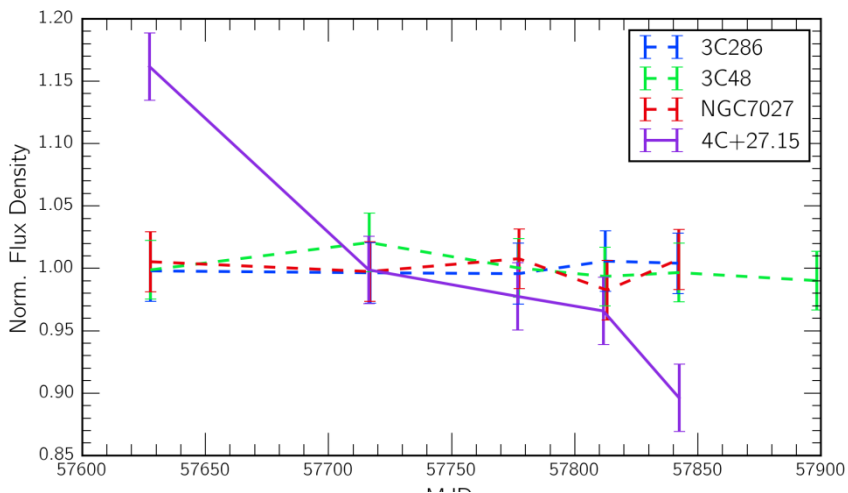


Data reduction and calibration



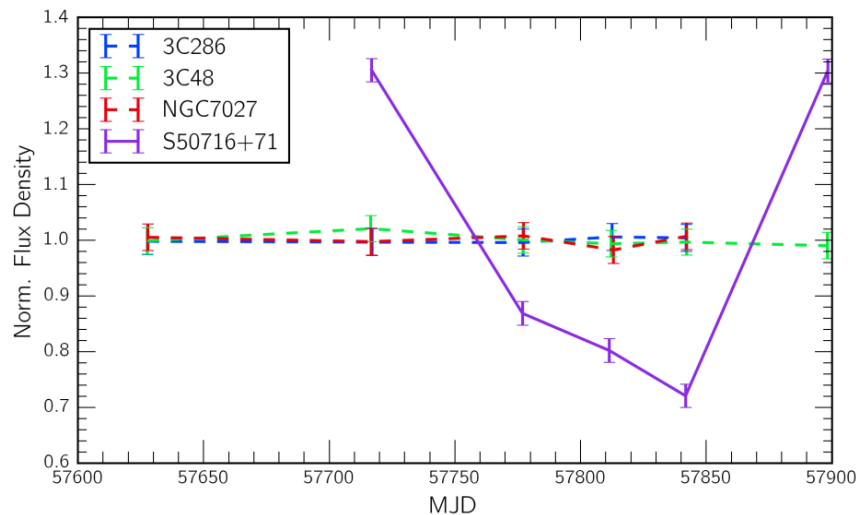
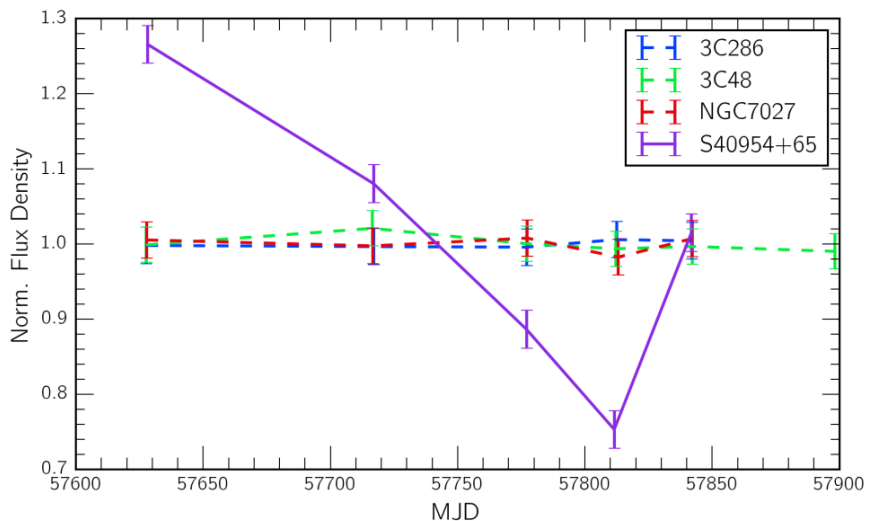
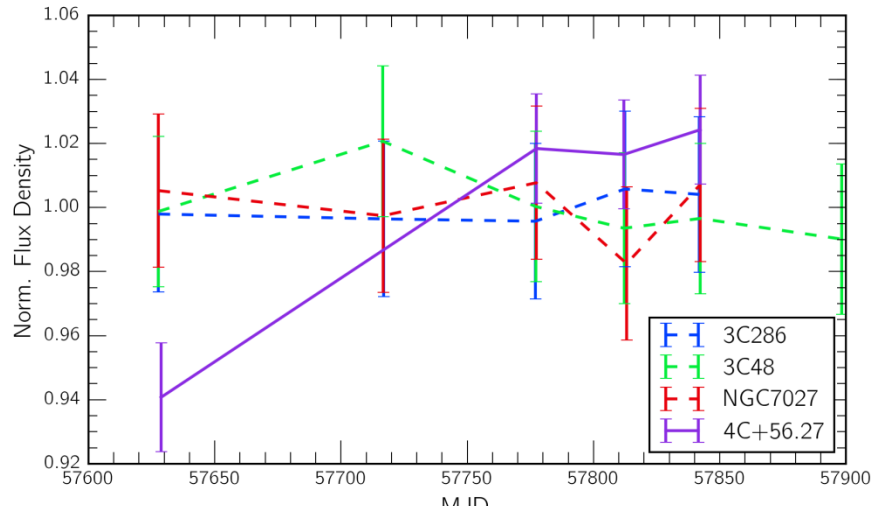
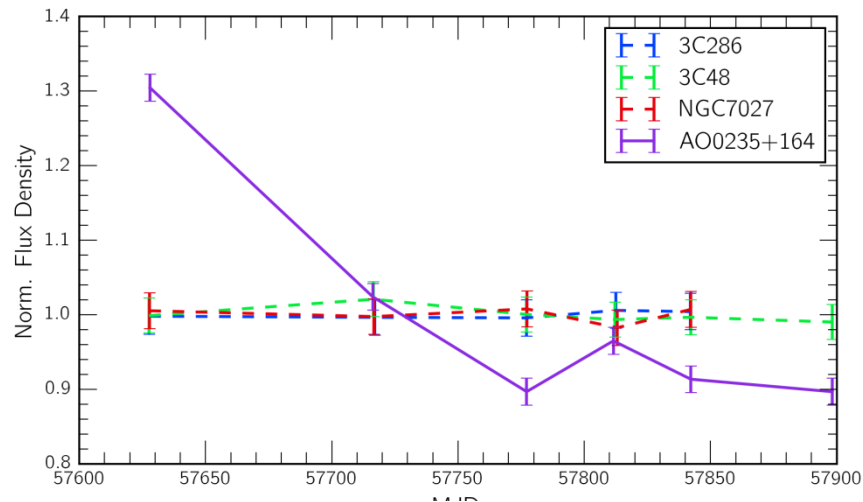
## ● Preliminary Results (@ 5GHz)

### ➤ Inter-month variations?



● Preliminary Results (@ 5 GHz) – cont.

➤ Inter-month variations?





# **SMMAN:** quasi-Simultaneous Multi-wavelength Monitoring of AGNs with NSRT

## ● *Summary*

- The newly established VLBI Group is now in charge of all the VLBI stuff at XAO.
- By using NSRT, we are carrying out a long-term multi-wavelength AGN flux monitoring program, namely SMMAN.
- The data of SMMAN will be opened soon and welcome to use and enjoy it.

Thanks for listening!

