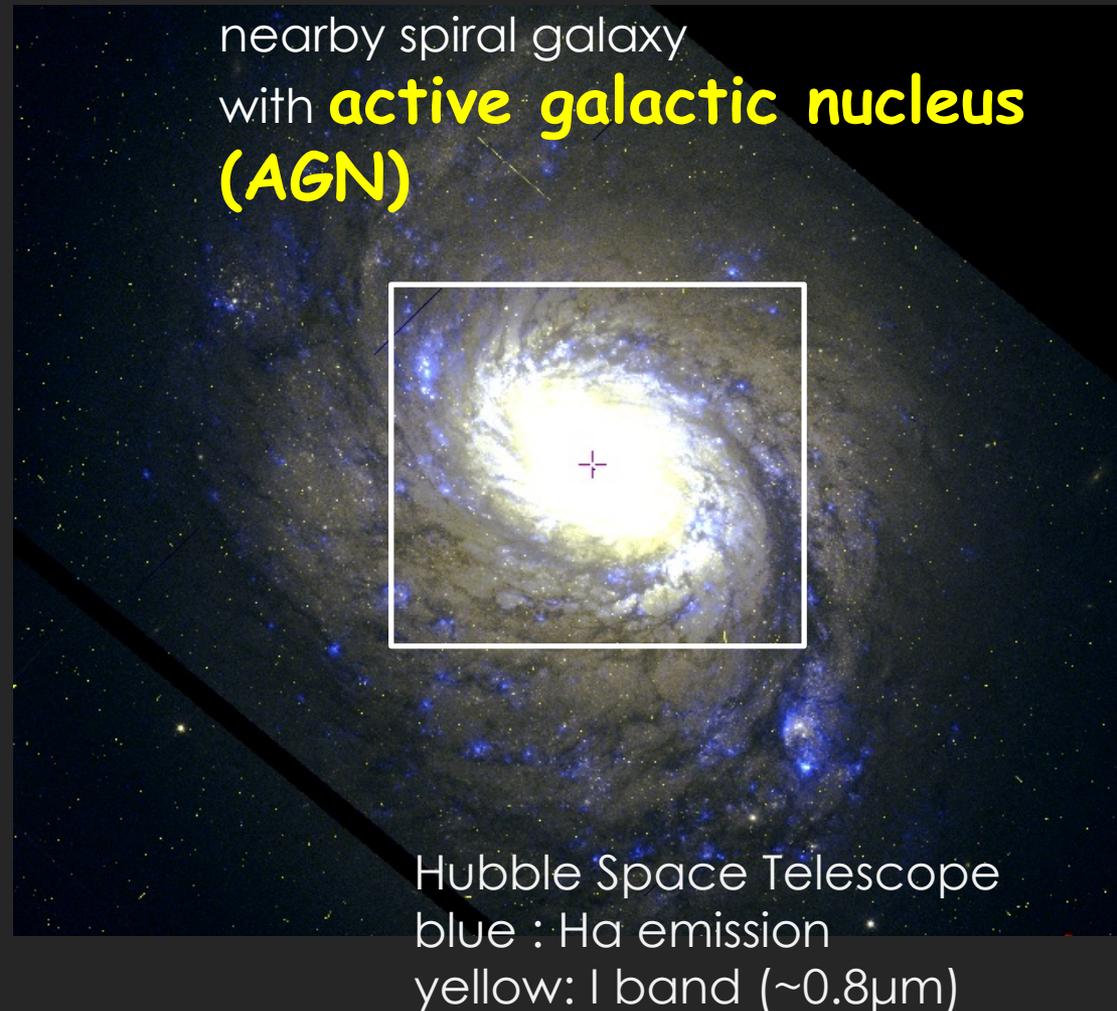
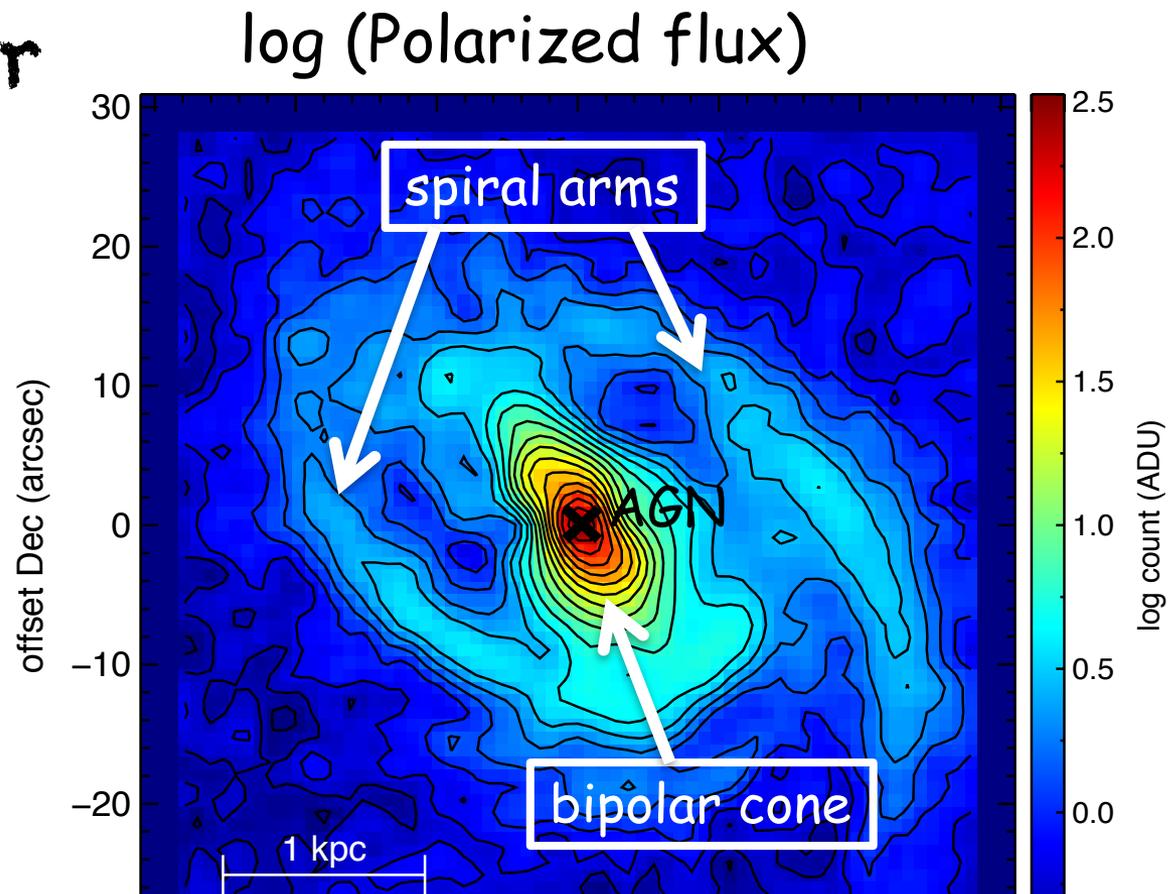


IRSFによる セイファート銀河NGC1068の偏光観測

村田勝寛（東工大）



This poster



We found two distinct polarization components.

- ✓ polarization of spiral arms
- ✓ polarization of bipolar cone

conclusion

The polarization of the bipolar cone may be caused by the scattering of AGN light.
The polarization of the arms may be caused by dichroic extinction of dust grains.

What can we know about AGNs with polarization?

We can know

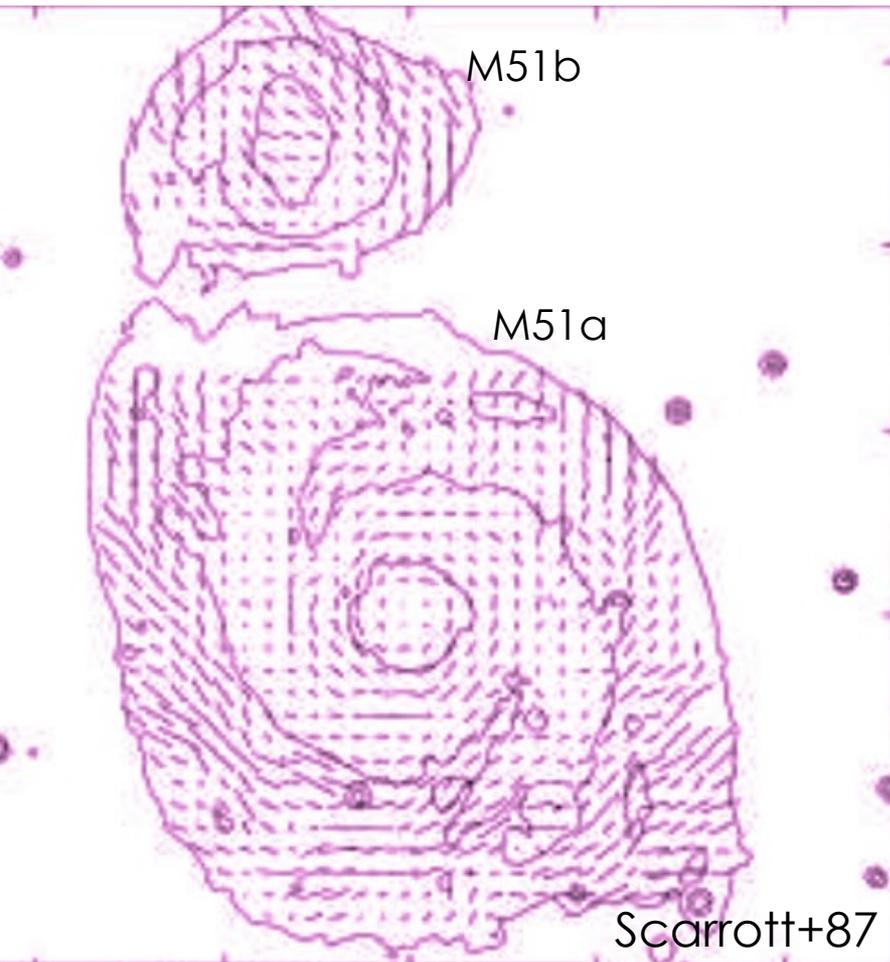
i) **magnetic field** of AGN host galaxy

ii) **scattering of AGN light** by the host galaxy medium

What can we know about AGNs with polarization?

i) Magnetic field of AGN host galaxy

optical polarization of merging spiral galaxies M51



contour : V band total flux
solid short lines : polarization vector
length -- polarization degree
direction -- polarization angle

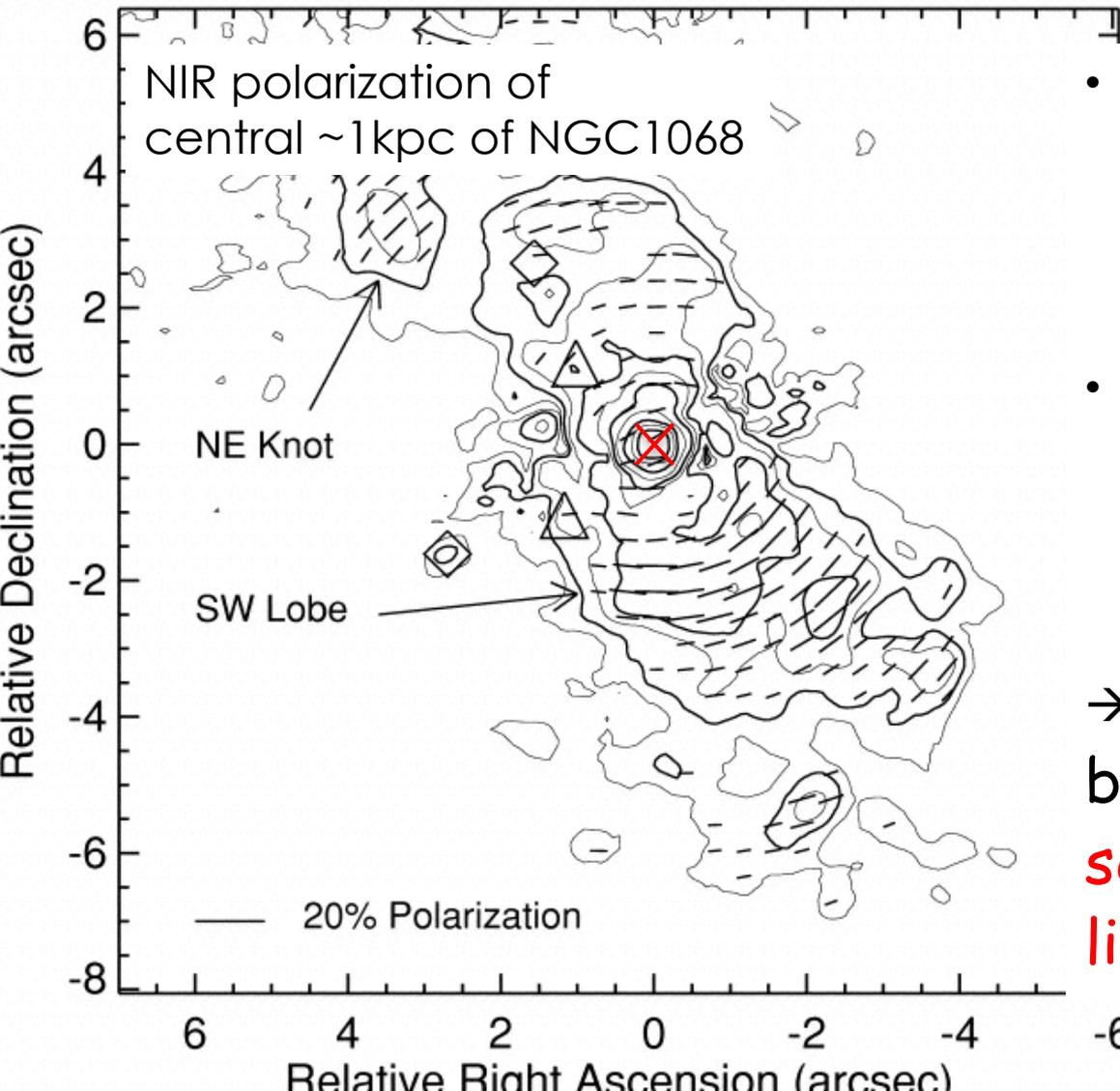
The polarization follows the spiral arms.

If we assume this polarization is caused by **dichroic extinction of elongated dust grains** which is aligned by large scale magnetic field, the polarization angle follows magnetic field.

→ We can know magnetic field using polarization.

What can we know about AGNs with polarization?

ii) Scattering of AGN light



- The polarization around the AGN shows circular-symmetric pattern centered about the AGN.
- Circular-symmetric polarization is a signature of the scattering of light from bright source.

→ The polarization may be caused by **the scattering of the AGN light.**

(Simpson+02)

Our polarimetric observation of AGN host galaxies

In order to investigate magnetic field and scattering of AGN light,

Imaging polarimetry (linear polarization)
of AGN host galaxies
using IRSF/SIRPOL

Target AGN host galaxies

20 galaxies listed in the right table
nearby and bright AGN host galaxies

Detection of Polarization

NGC1068, Circinus galaxy, NGC1808

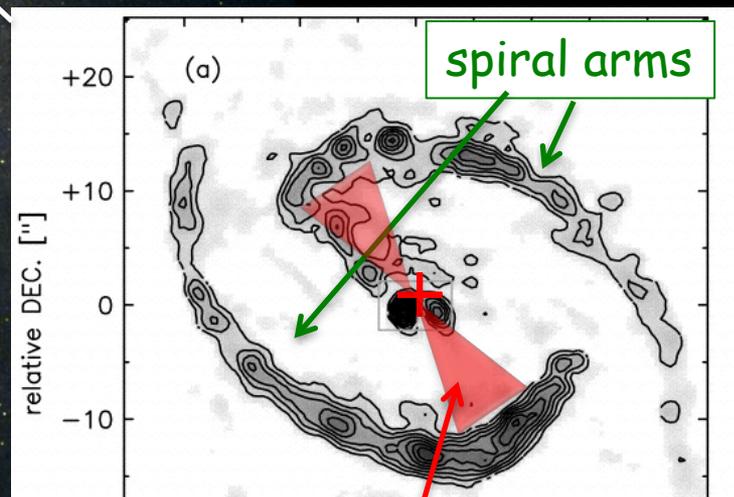
name	R.A. (deg)	Dec (deg)	K_s (total) (mag)
NGC6384	263.10	7.06	7.528
NGC6814	295.66	-10.32	7.657
NGC1052	40.27	-8.25	7.451
NGC1068	40.66	-0.01	5.788
NGC1097	41.57	-30.27	6.252
NGC7410	343.75	-39.66	7.232
IC1459	344.29	-36.46	6.805
NGC7552	349.04	-42.58	7.536
NGC7582	349.59	-42.37	7.316
NGC613	23.57	-29.41	7.031
NGC660	25.76	13.64	7.336
NGC7213	332.31	-47.16	7.035
NGC289	13.17	-31.20	7.997
NGC1365	53.40	-36.14	6.373
NGC1566	65.00	-54.93	6.886
NGC1672	71.42	-59.24	7.020
NGC1808	76.92	-37.51	6.656

name	R.A. (deg)	Dec (deg)	K_s (total) (mag)
Circinus	213.29	-65.34	4.984
NGC4945	196.37	-49.47	4.483
NGC4594	190.00	-11.62	4.962

In this poster,
I will show you preliminary results of NGC1068.
The polarization is detected in the central 50"x50"
region around the AGN.

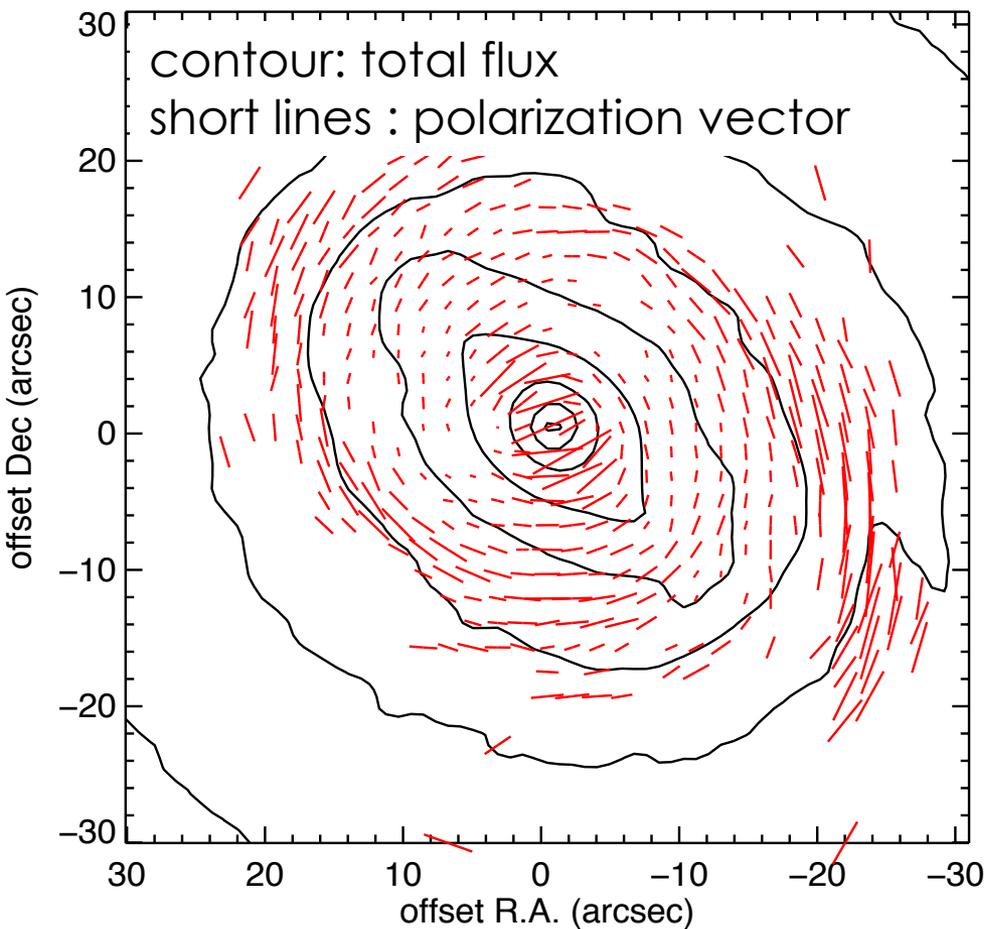


50" x 50"



"bipolar cone"
of ionized gas
which extends from SW to NE

Polarization vector of IRSF H band



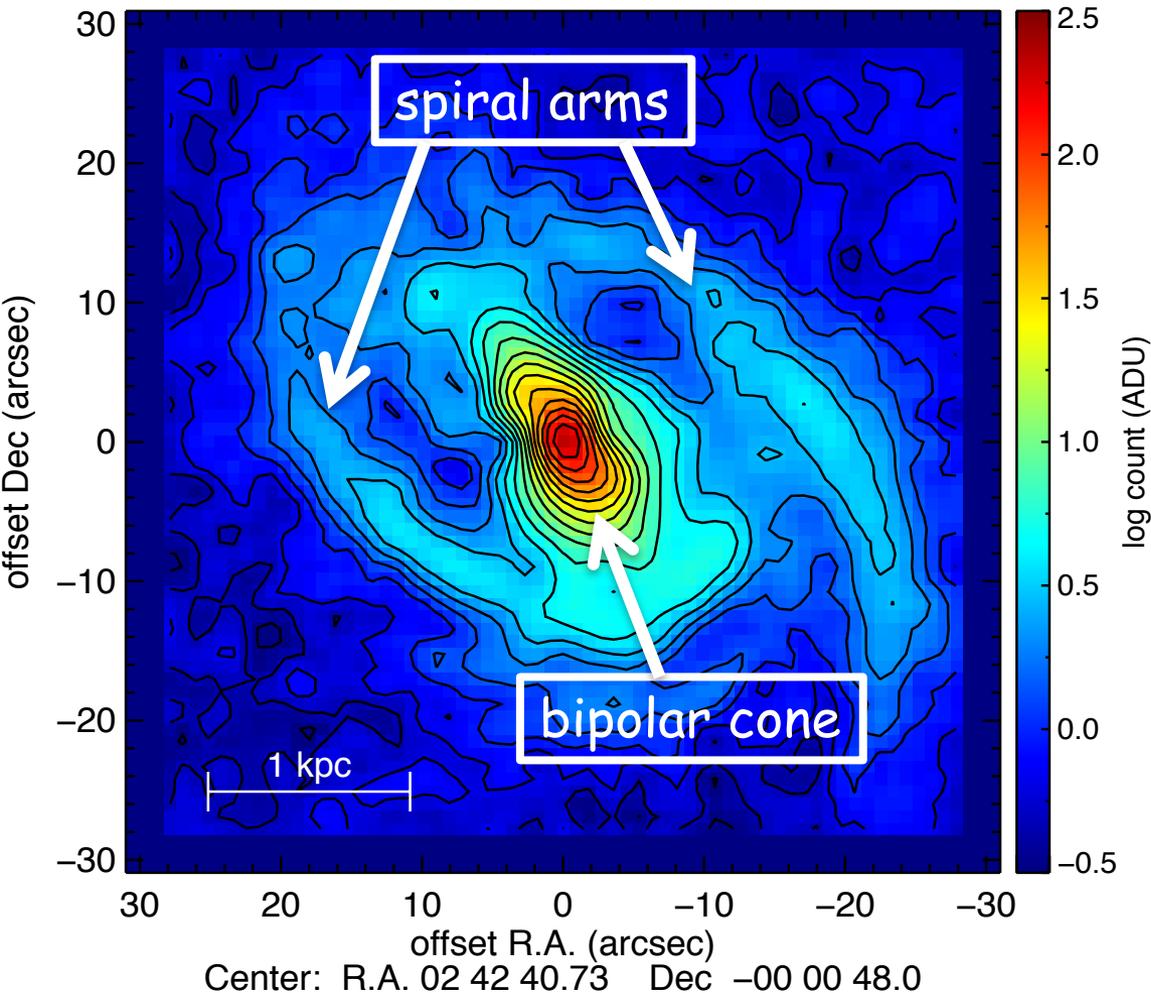
The polarization degree is $P=1-4\%$.

Polarization due to dichroic extinction of elongated dust grains in our galaxy is expected to be $< 0.02\%$ from the extinction toward NGC1068. (Packham+97).

→ The polarization of NGC1068 is not affected by foreground dust of our galaxy.

Polarization with $S/N > 2$ are shown in this figure.

log (Polarized flux)



There are two distinct polarization components.

- spiral arms
- bipolar cone

Polarized flux in the bipolar cone is much brighter than the spiral arms.

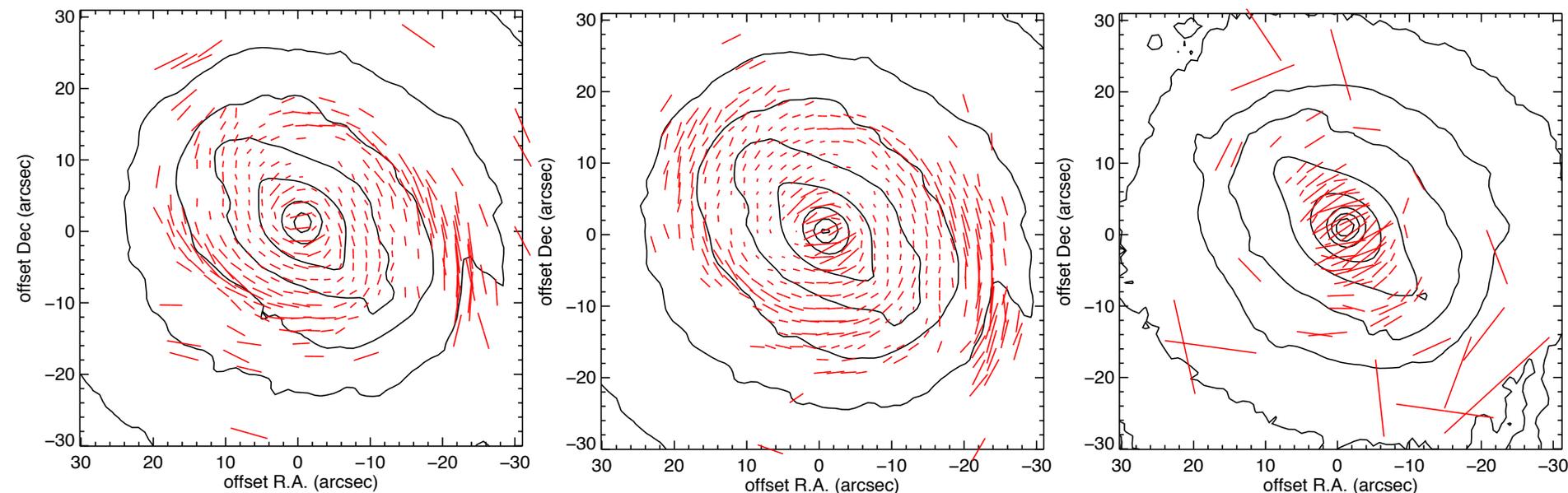
The polarized flux of the bipolar cone decrease with the distance from the AGN.

→ The polarization of the bipolar cone may be related with AGN light.

J band

H band

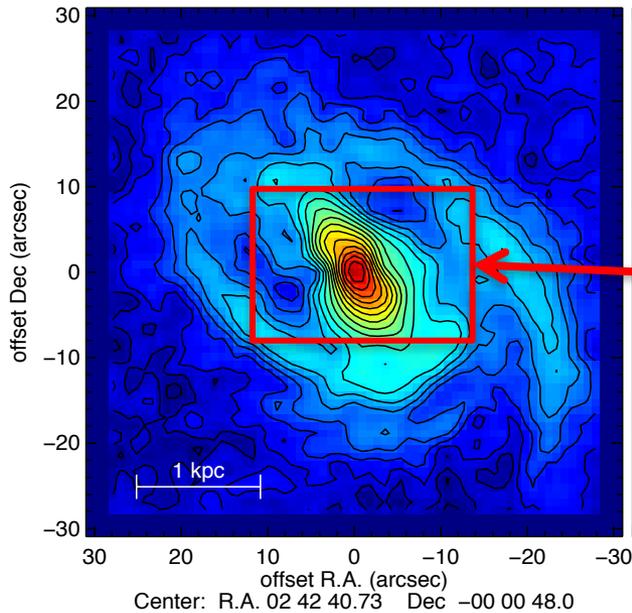
Ks band



The polarization pattern of J band is similar with H band.

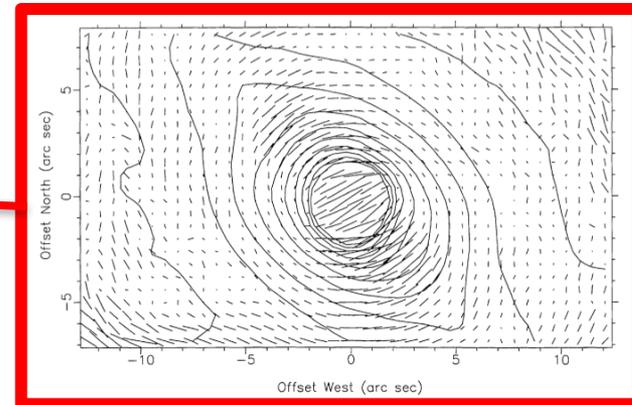
In Ks band, we detected polarization only in the bipolar cone. The bipolar cone polarization is similar with the J and H band.

our obs. with IRSF



Packham+97

AAT (Anglo-Australian Telescope)



the largest map of polarization
in the previous NIR polarimetry of
NGC1068

Results

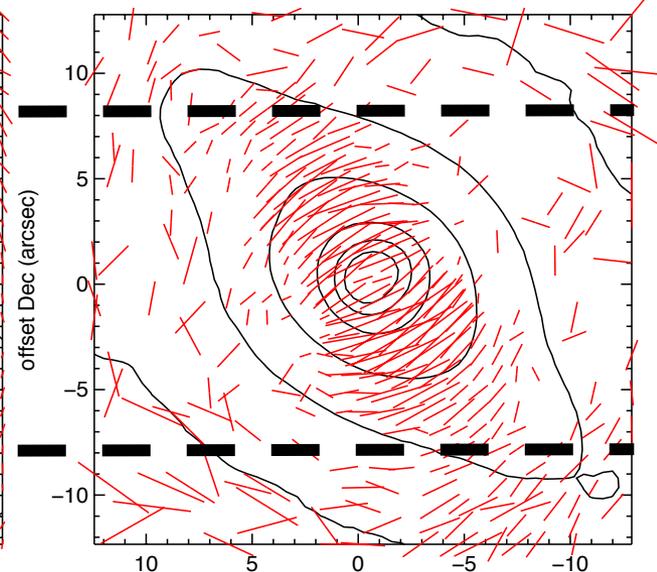
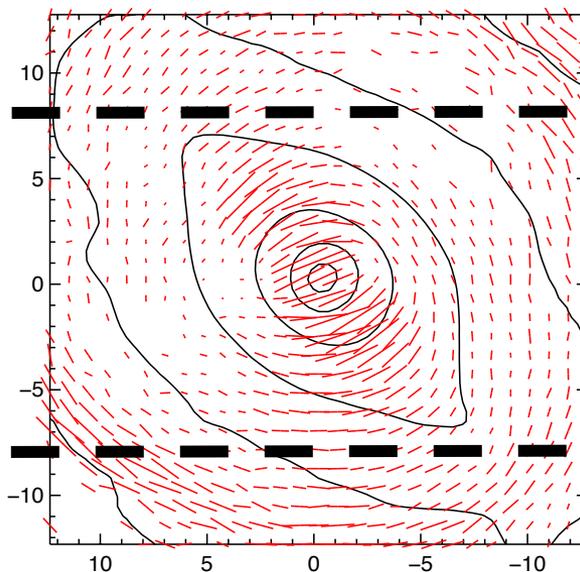
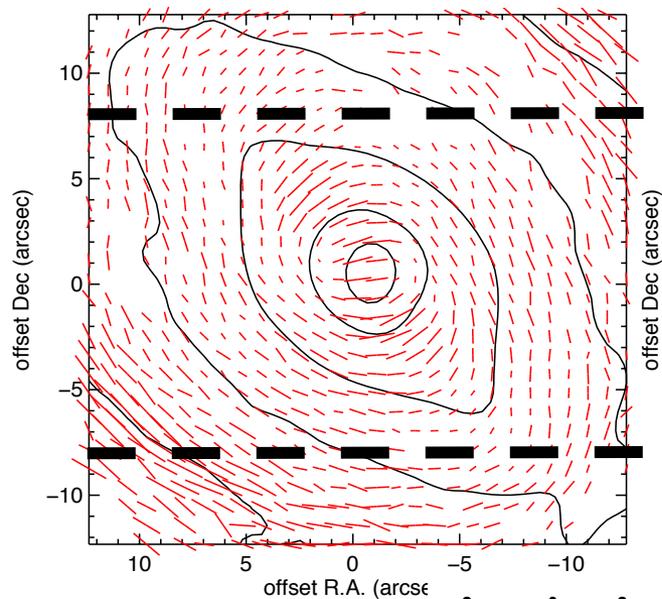
Polarization of J, H, Ks band

Our polarization of J and Ks band is also consistent with the previous NIR observation.

J band

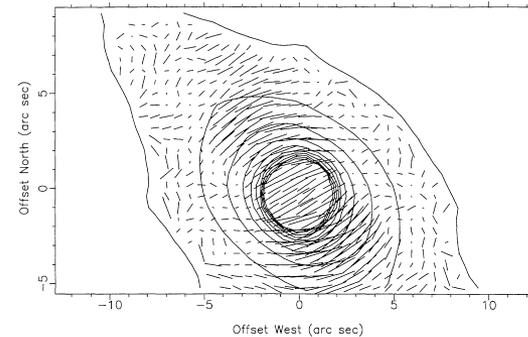
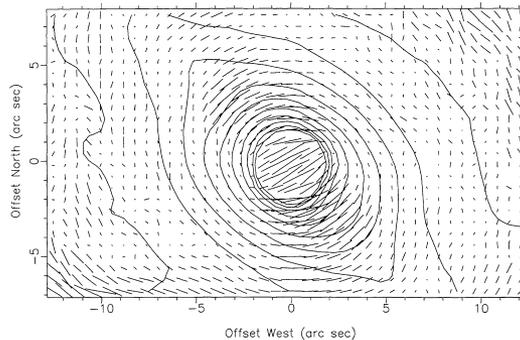
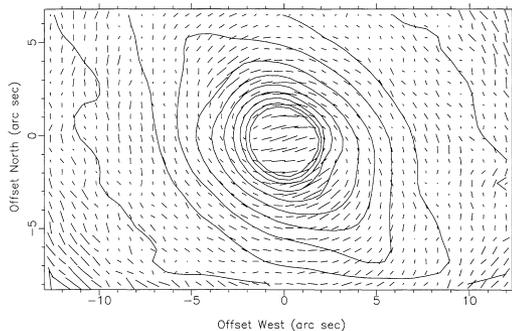
H band

Ks band



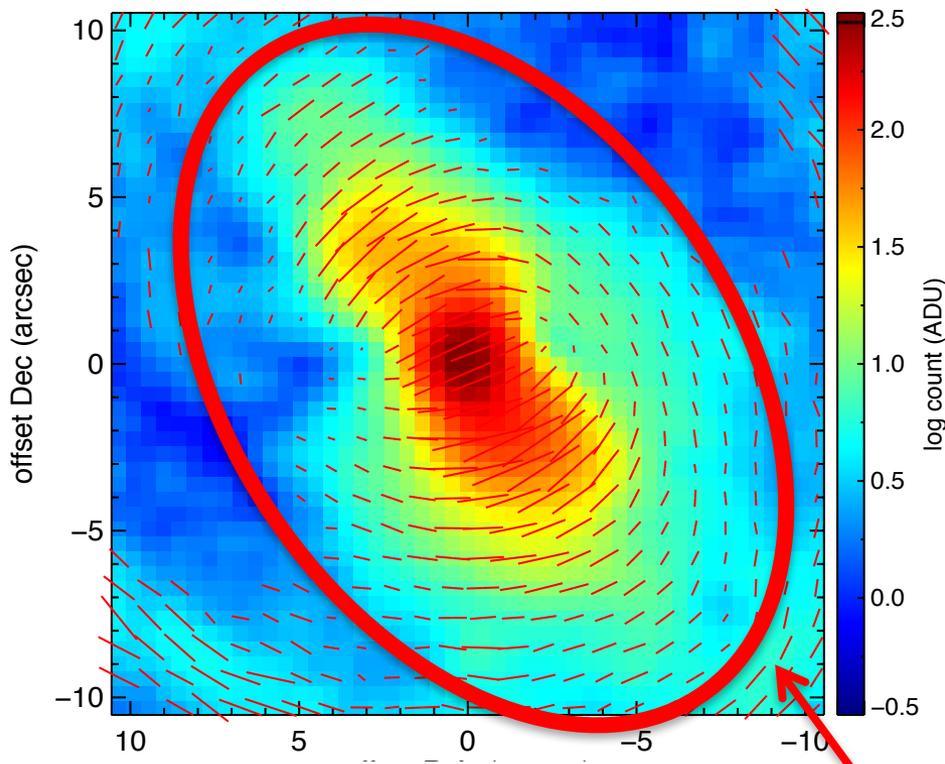
Anglo-Australian Telescope (AAT)

Packham+97

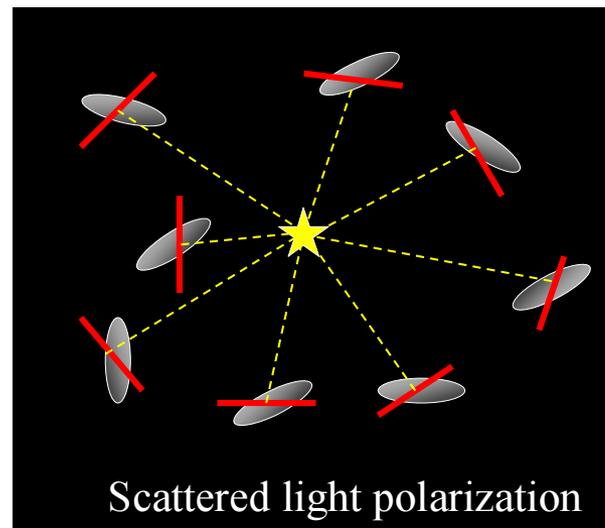


Origin of bipolar cone polarization

polarization vector on polarized flux



circular-symmetric polarization

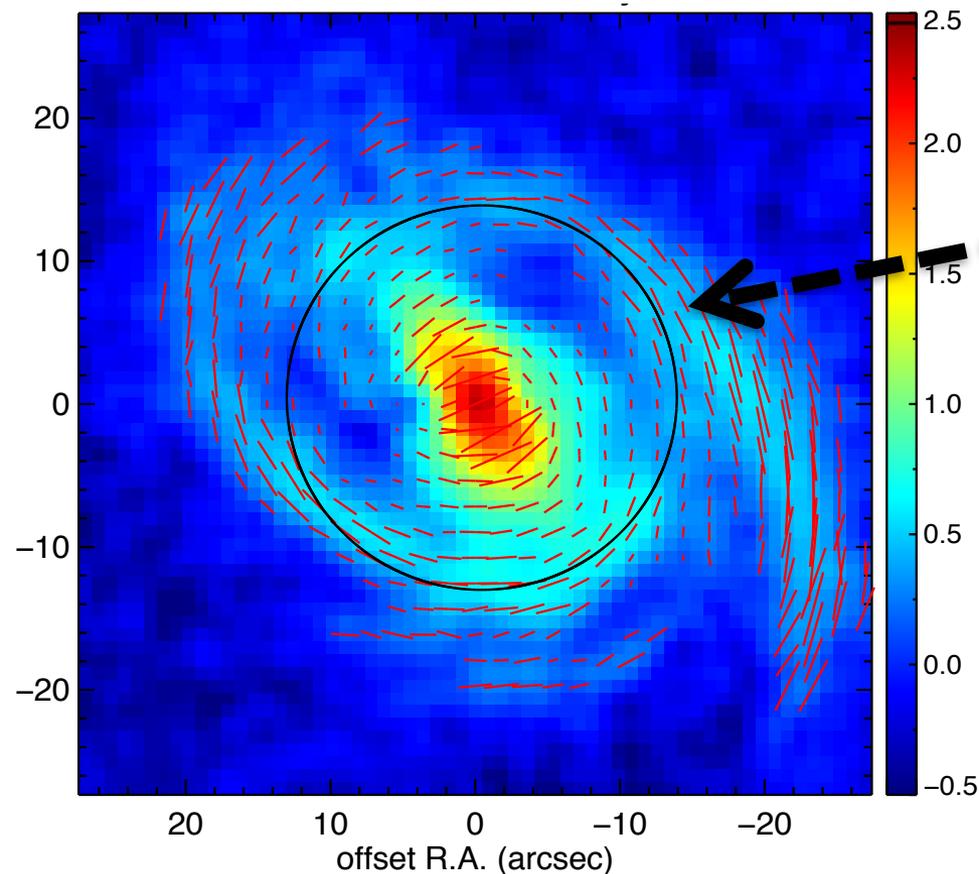


from Tamura-san's slide

- The polarization in the bipolar cone shows circular-symmetric pattern and its center is AGN. The circular-symmetric pattern is a signature of the scattering of light from bright source.
 - The polarized flux decreases with the distance from the AGN.
- The polarization may be caused by the scattering of AGN light by bipolar cone medium (dust and/or electron)

Origin of polarization of spiral arms

polarization vector on polarized flux

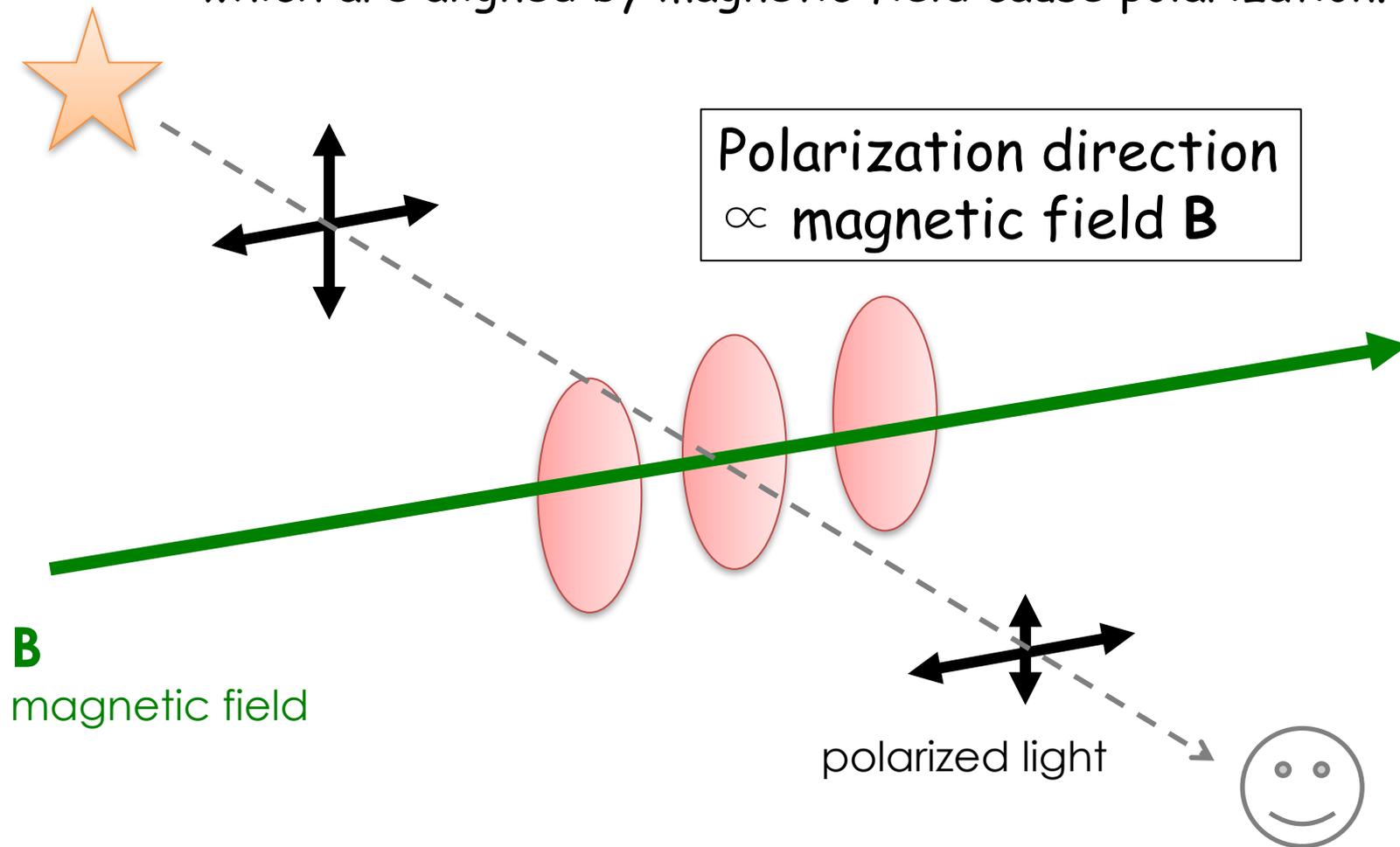


The polarization of spiral arms
do **not show circular-**
symmetric pattern.
But it follows the spiral arms.

→ The polarization is **NOT**
due to scattering of AGN
light.

Another polarization mechanism is
necessary for the arm polarization.
It may be dichroic extinction by
elongated dust grain.

Dichroic extinction by elongated dust grains which are aligned by magnetic field cause polarization.



The polarization degree increases with increasing dust extinction.

Summary

- We observed NGC1068 with IRSF/SIRPOL.
 - We detected two distinct polarization components, spiral arms and bipolar cone, in J, H and K band within central $\sim 50'' \times 50''$ region.
 - The polarization of the **bipolar cone** may be caused by the **scattering of the AGN light** by the cone medium.
 - Polarization in the **spiral arms** may be caused by **dichroic extinction of elongated dust grains** which are aligned with **magnetic field**.
- Magnetic field may follow the spiral arm in NGC1068.