Magnetic field measurement in molecular cloud

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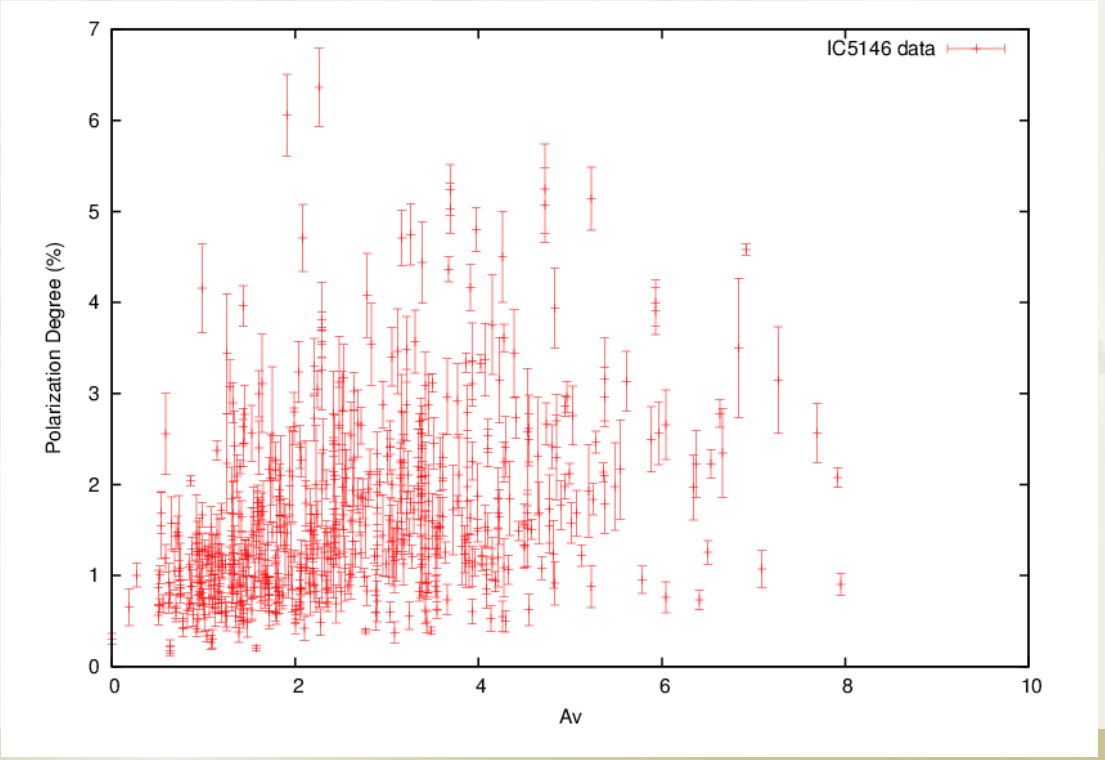
NTHU

Introduction

- The magnetic field aligned the dust inside a molecular cloud.
- The light from background star is absorbed by aligned dust, and thus show polarization parallel to the magnetic field.



Polarization degree of IC5146 stars taken from AIMPOL v.s Av

TRIPOL observation runs

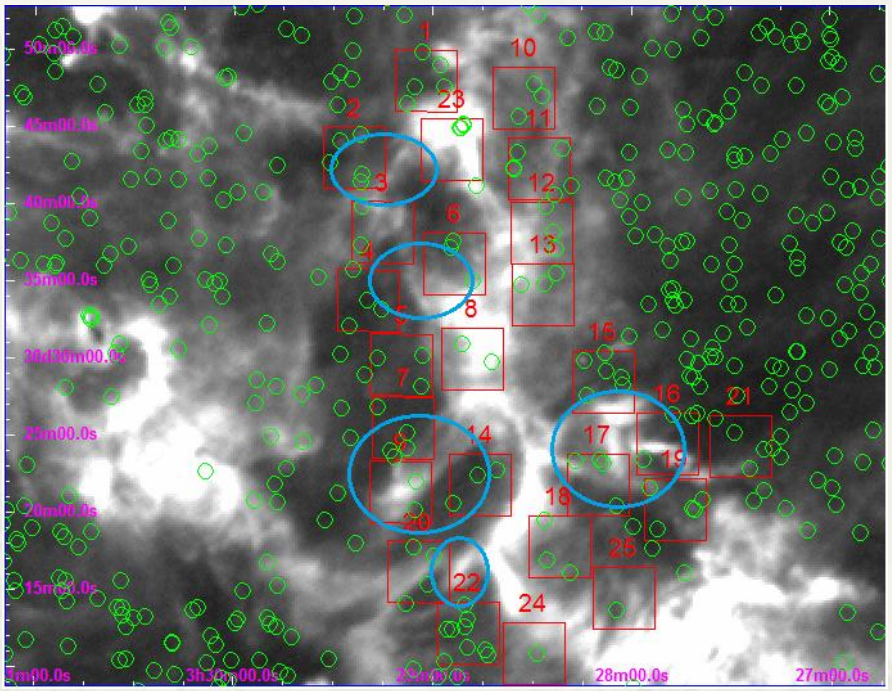
* 2011 test runs
* 2012 July
* 2012 December

2011 Test Run

- Propose to observe dense filaments with SMA polarization detection.
- However, those targets too far (>1 kpc) and dense, TRIPOL can only detect a few polarized stars.
- Those data is not enough to plot the magnetic structure, but we summarize some empirical constrain to select targets.

* From the data in 2011 run, the faintest star we can have 3σ polarization detection with 1 hour exposure is R magnitude ~ 16.

* If assume SN increase with $T^{0.5}$, we estimate we can detect [R]~16.5 with 1.5 hour exposure.

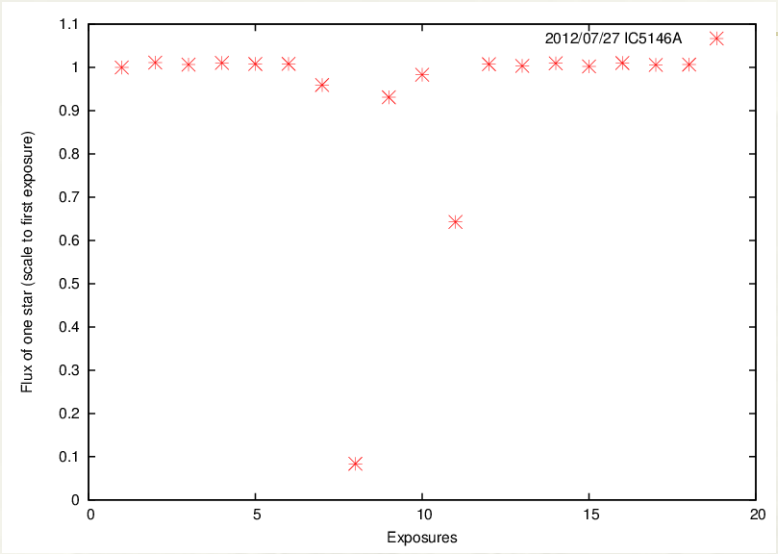


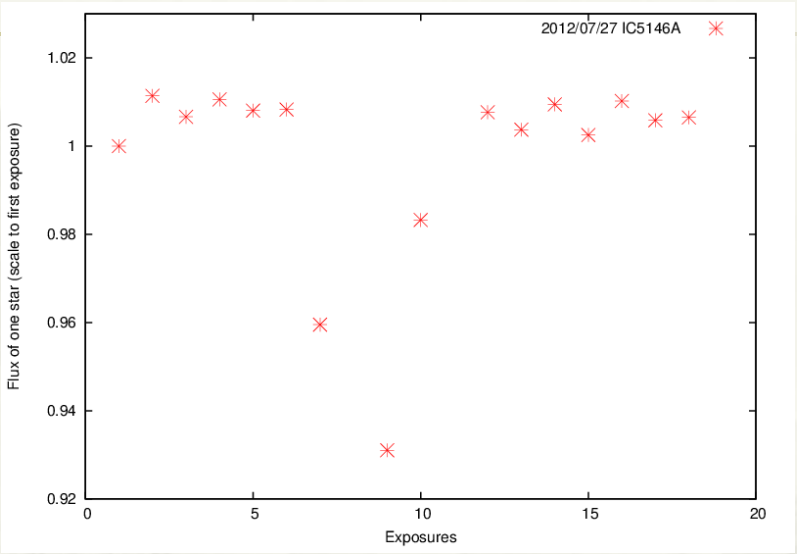
Proposal for 2012 observations. The image is Herschel 250um continuum, green circle is the star with [R] >16.5. Red box shows selected fields.

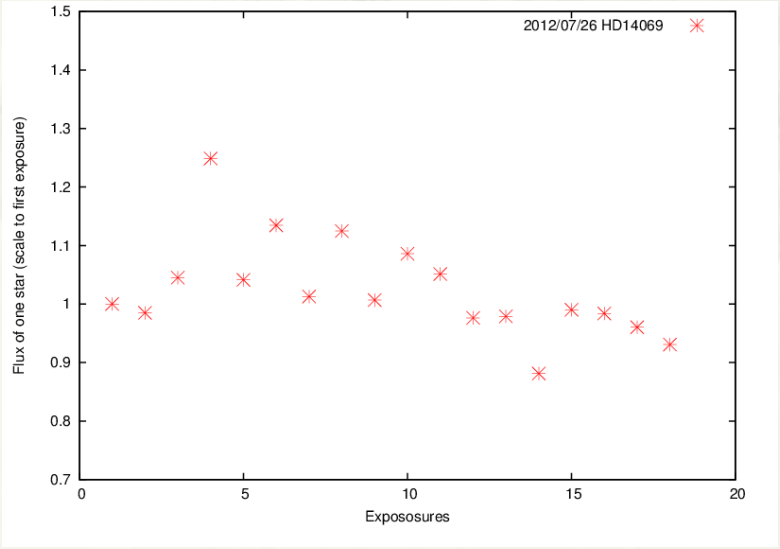
July 2012 Run

- The typhoon is coming, and weather is bad…
- The sky is only clear in half night, so we was observing another smaller back-up field, the northern stream in IC5146.

* Since the sky is still unstable, we trying to check the light curve for one star in different exposure.

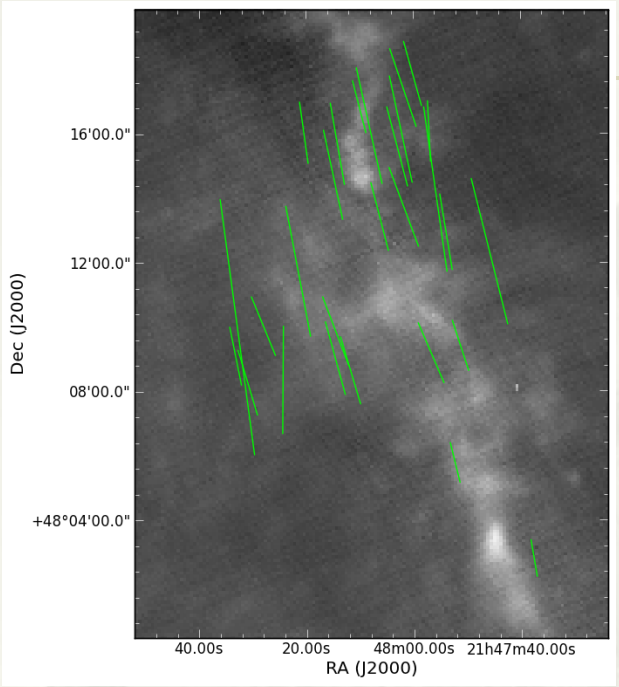


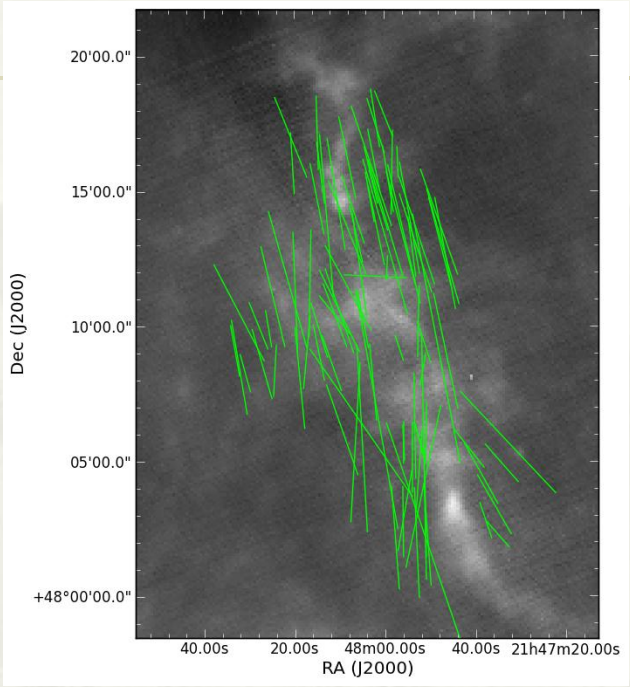


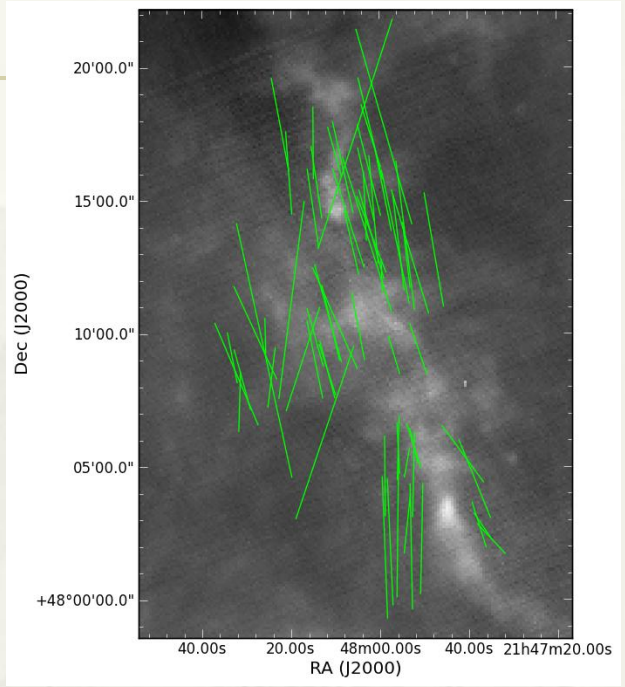


Light curve for the same star in different exposures. Top two are more stable case, and the bottom is unstable case.

- The final result from TRIPOL July 2012

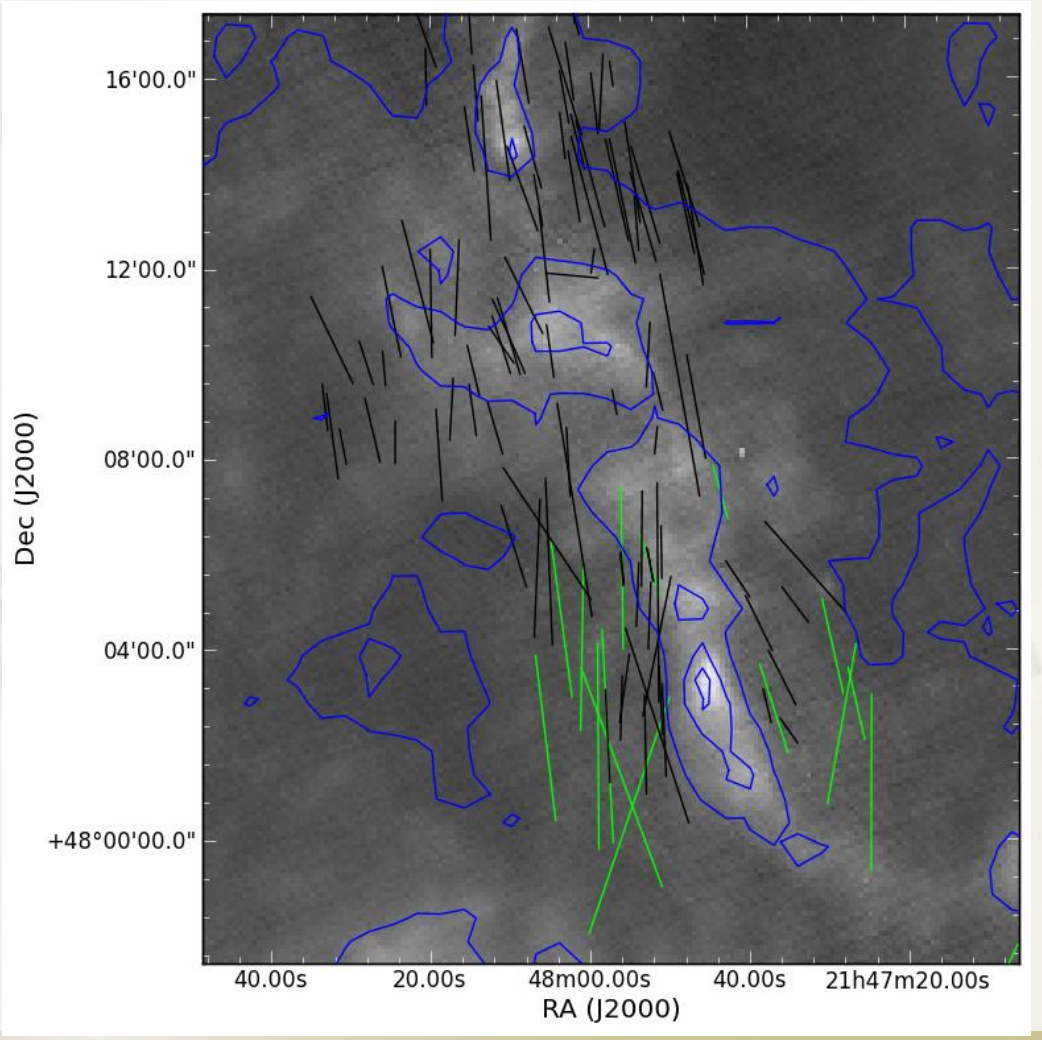






The figure shows the polarization measured in g, r and i band overlapped with Herschel 250 um continuum map. The magnetic field measured is clearly paralleled to the filamentary cloud.

* To confirm the result we taken in July 2012, we observe one of the field by AIMPOL in November 2012. The large structure of AIMPOL and TRIPOL is consistent.



AIMPOL data (green) and TRIPOL data (black) overlapped on Herschel image.

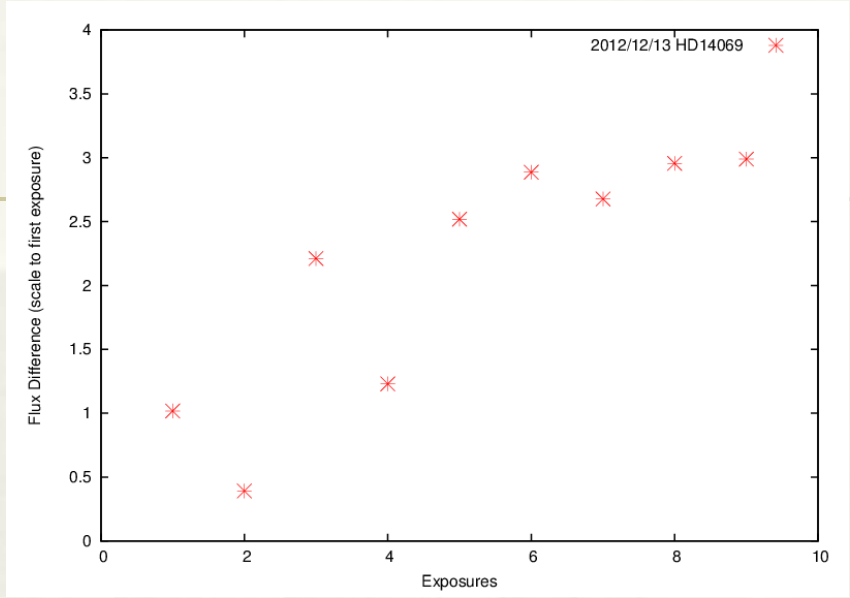
* Since TRIPOL and AIMPOL have different sensitivity and FOV, only five stars are detected by both instrument.

Polarization Degree(AIMPOL)	Polarization Angle(AIMPOL)	Polarization Degree(TRIPOL)	Polarization Angle(TRIPOL)	Difference of Polarization Degree (in unit of σ)	Difference of Polarization Angle (in unit of σ)
1.235±0.295	30.105±5.458	0.877±0.142	52.01±4.07	0.088	-3.217
0.839±0.157	33.726±3.922	1.09±0.03	31.34±0.59	-0.411	0.602
2.095±0.668	178.306±7.922	1.197±0.14	179.68±3.034	0.289	-0.162
2.646±0.42	6.273±4.086	2.8±0.076	5.5±0.74	-0.181	0.186
2.535±0.759	2.289±7.647	3.14±0.182	4.686±1.59	-0.343	-0.307

Dec 2012 run

- The sky sensor shows the sky is very clear in Dec 2012 run, and there is no visible cloud on the sky. However, the standard stars taken in the five nights are not self-consistent.
- The standard stars taken in first day have 0.5% instrumental polarization degree much larger than last 3 nights (0.1-0.3%).
- Data taken in the second night have even 3% instrumental polarization degree.

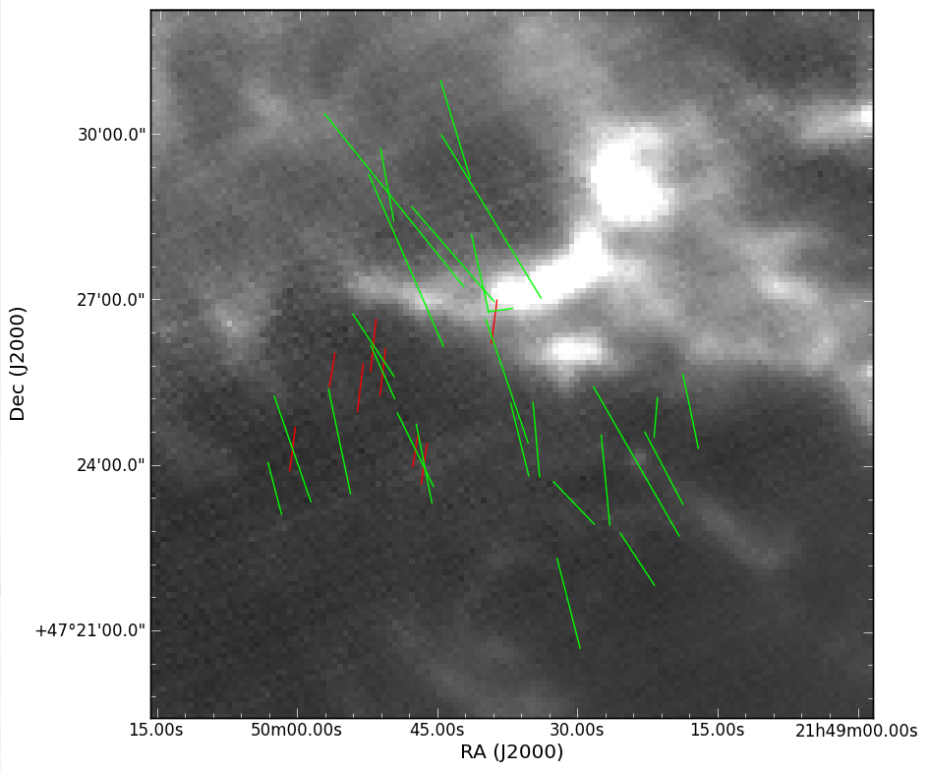
* The light curve for standard stars in different exposure shows the sky is still unstable.

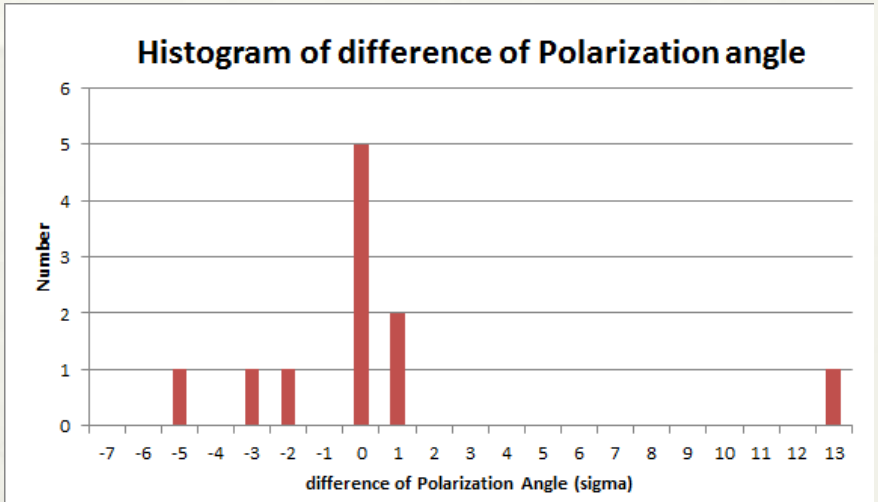


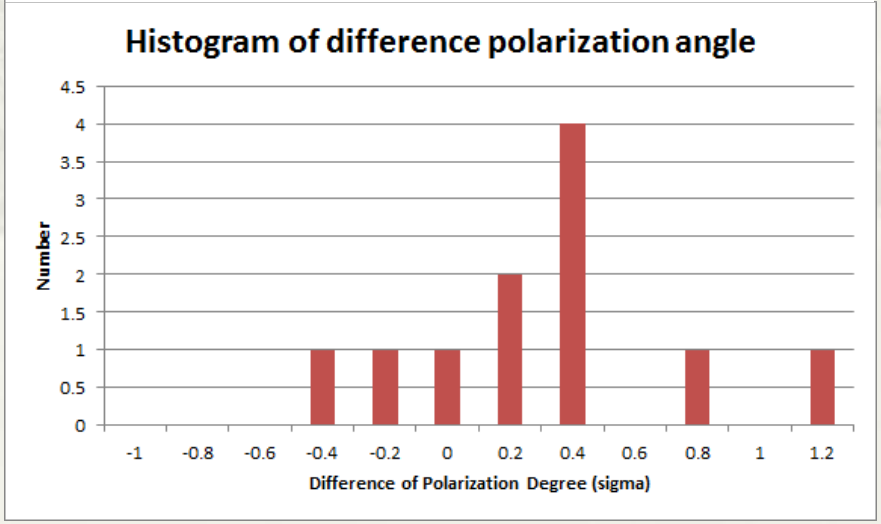
* Even the sky is very clear in Lulin, the invisible cloud can still significantly affect the polarization observations?

* Plotting the light curve of each exposure could be a tool to quickly recognize if the data is trustable.

* We have measured one IC5146 field in the first night to compare with AIMPOL data, the TRIPOL result is inconsistent with AIMPOL.







Conclusion

- If the target has enough bright background stars (R <~16), TRIPOL have good sensitivity enough to map the magnetic field in molecular cloud.
- However, the most difficulty is the unstable weather in Lulin. Even when the sky is clear, the thin cloud possibly significantly affect the results.
- Still need to think about a method to quickly recognize if the data is trustable.