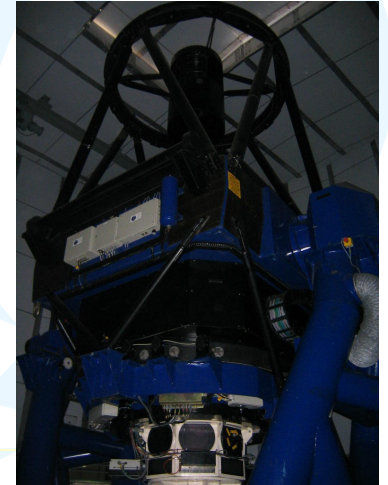




“Detection of UXOR variables”



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- **UXOR phenomenon**
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Introduction

- One third of the known T Tauri stars displays a few percent of linear polarization in visible and near IR.
- Among the T Tauri stars which exhibit variability in brightness and polarization, there are two categories.
- One which follow the classical UXOR behaviour and other which does not.

Polarization mechanism in T Tauri stars

- The polarization in T Tauri stars usually arises due to scattering from circumstellar disk which lies outside the high temperature gaseous region.
- But it may also arise because of scattering by molecules, atoms, and electrons in stellar photosphere .

T Tauri star

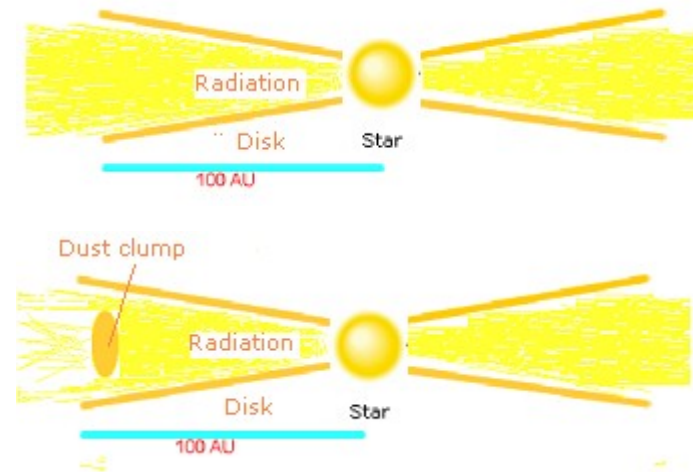
- T Tauri stars (TTS) are newly born (10^5 and 10^8 years old), roughly solar mass stars which have only recently emerged from their parent molecular cloud core to become optically visible.
- T Tauri stars mostly found in active star formation region like **Orion Nebula**.
- TTS are irregular variables, with amplitude typically 1 to 2 magnitude.
- TTS are generally of two types:
 - **Classical type T Tauri star (CTTS)**
 - **Weak type T Tauri star (WTTS)**

UXOR Phenomenon

Some T Tauri stars show increased polarization when the optical light of the star is faint & redder at fainter magnitude, while in extreme visual minima there is a color reversal, this phenomena is known as classical *Ux Ori* (*UXOR*) phenomenon..

When clump is not in our line of site ,the magnitude of star is less (**brightness is more**) and **polarization is less.**

When clump is in our line of site ,the magnitude of star is more (**brightness is less**)and **polarization is more.**



By ,now it is also known that at least half of the T Tauri stars do not follow the classical *Ux Ori* (*UXOR*) behaviour.

Oudmaijer and his group (EXPORT) in 2001 has classify 22 T Tauri stars in two group.

- First group of stars showing increased polarization with fainter magnitudes (Classical UXOR variable).
- Second group doesn't show increased polarization with fainter magnitudes.
- They also found some stars which don't fall in the any of group but they expected to be UXOR variables (Suspected variables).

UXOR Variables

- Bm And
- BF Ori
- RR Tau
- VY Mon
- BH Cep
- VX Cas
- Dk Tau

Other Ones

- CO Ori
- NV Ori
- SV Cep
- UX Ori

Suspected Variables

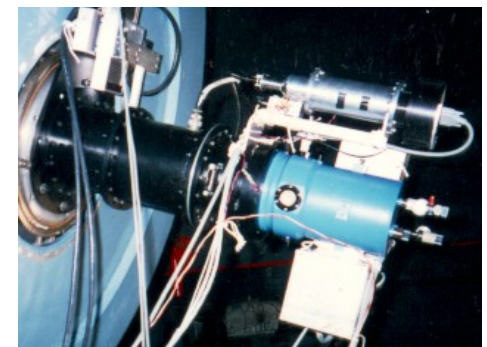
- XY Per
- CW Tau
- V1686 Cyg

Results

The main objective of this research is to understand the mechanism of UXOR variables and categories them.

- We made first time simultaneous photo-polarimetric observation in R band using IMPOL (An Imaging Polarimeter) at 2.34 meter VBT (Vainu Bappu Telescope), Kavalur.
- We found significant linear polarization approximately 0.9 to 1.8 % that confirms the disk like configuration around these T Tauri stars.

Name of star	P(%)	σ_p	P.A θ	σ_θ (Deg)
Su Aur	0.0944	± 0.0486	107.23	± 1.47
Bf Ori	1.5	± 0.0814	89.48	± 1.55
Co Ori	1.77	± 0.0898	155.82	± 1.45
Ux Ori	1.52	± 0.1130	64.05	± 2.14



Calculation of polarization

Linear polarization p & position angle θ can be determined by the normalized Stokes parameter q & u according to this eqⁿ :

$$R(\alpha) = \frac{I_o - I_e}{I_o + I_e} = \frac{Q \cos 4\alpha + U \sin 4\alpha}{I}$$
$$= q \cos 4\alpha + u \sin 4\alpha$$

$$R(\alpha) = p \cos(2\theta - 4\alpha)$$

$$q = p \cos 2\theta \quad u = p \sin 2\theta$$

$$p = \sqrt{q^2 + u^2}$$

$$\theta = \frac{1}{2} \tan^{-1} \left(\frac{u}{q} \right)$$

$$q = \frac{I_o(0^\circ) - I_e(0^\circ)}{I_o(0^\circ) + I_e(0^\circ)}$$

$$u = \frac{I_o(22.5^\circ) - I_e(22.5^\circ)}{I_o(22.5^\circ) + I_e(22.5^\circ)}$$

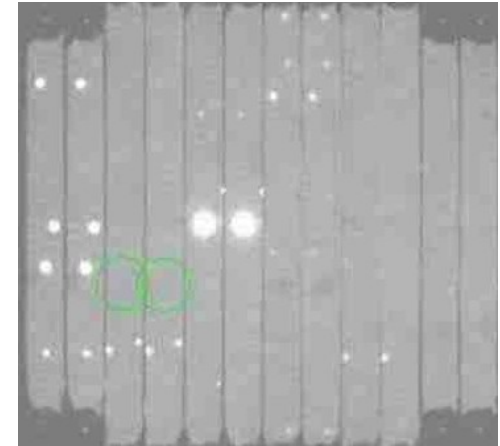


Image of Co Ori

Co Ori:

Oudmajer (2001) found a gradual decrease in brightness over five days in October 1998 but very slight change in degree of polarization, from 2.4 to 2.6 % in I band. We also found degree of linear polarization 1.77 % in R band.

Ux Ori:

Ux Ori is the suspected UXOR variable and we found the degree of linear polarization 1.52% in our data in R band.

BF Ori:

UXOR behavior of **BF Ori** was previously discussed by Grinin et al.(1989). They have shown that at the time of minimum flux, polarization reaches to 5 %. We found the degree of linear polarization of **BF Ori** is near about 1.5 % .So from this data we can clearly say that at the time of observation the dust clump was not in our line of sight and this polarization is originated from the disk like configuration around the **BF Ori**.

Su Aur:

We could not find any simultaneous photo polarimetric variation in Su Aur from our data. We found 0.94% of degree of linear polarization in R band. Which conforms that the star has disk like configuration.

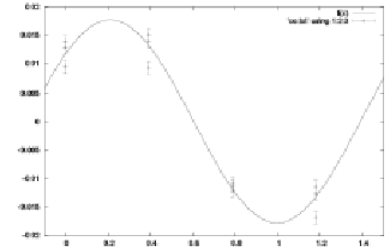


Figure 3: Co Ori

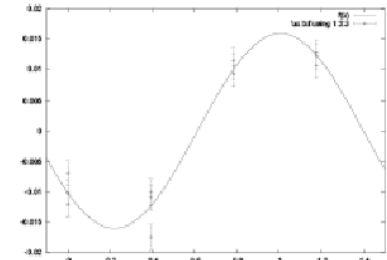


Figure 4: Ux Ori

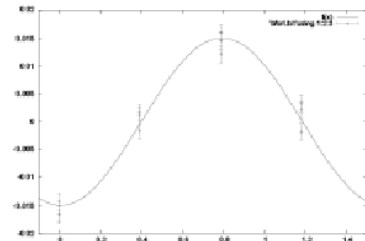


Figure 1: Bf Ori

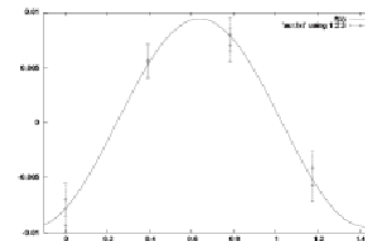
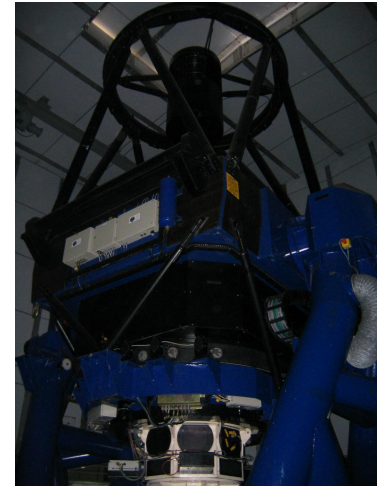


Figure 2: Su Aur

Future plans

- Observe and detect simultaneous photo-polarimetric variation in listed T Tauri star from IGO.
- We will use **(IUCAA Faint Object Spectrograph & Camera (IFOSC))** in polarimetric mode.
- Classify this star and understand the cause and origin of variability.
- Try to find disk orientation and its effect on variability.

- Su Aur
- Bf Ori
- Ux Ori
- Co Ori
- Xy Per
- Cw Tau



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