High proper motion objects with ILMT

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Motions of star:

(i) Motion towards or away from observer – **Radial velocity**
    Not depend on distance.

(ii) Apparent angular motion of a star across the sky with respect to more distance stars – **Proper motion**
Typical proper motion is $\sim 0.1$ arcsec/yr

Largest: 10.25 arcsec/yr

**Barnard's star** ~ In 1916, Barnard measured the PM relative to the Sun.

They are $\sim 6$ light year away.

**Proper motions are cumulative**

The effect of proper motions build up over time.

The longer you wait, the greater the apparent angular motion.

**Proper motion depends on the distance**
High proper motion stars

J. Skuljan et al. (1999)
Why do we search high PM stars

- To know the complete census of the Solar neighborhood stars.
- About 70% stars are M dwarfs in the Solar vicinity.
- Most of them (~60 – 70%) are single, making them more likely to host planets.
- A complete census will help to understand mass function, star formation, and kinematics of the Galaxy.
• Stars within galaxy can be classified based on their motions.

• A star moving faster than 65 to 100 km/s, relative to the average motion of stars in solar neighborhood – **high velocity stars**

• High velocity stars can be three types: Runaway, halo and hyper velocity stars.

• **Runaway stars** points away from the star cluster, of which the star was formerly a member.
• **Mechanisms to produce runaway stars**
  - Gravitational interactions between stars in a star cluster.
  - Collision or close encounter between stellar systems or galaxies.
  - A supernova explosion in a multiple star system.

• **Halo stars** are old one. Their motion is not like Sun or solar neighborhood stars.

• The nearest 45 stars called **Kapteyn’s stars** are example of high velocity halo stars.

• **Proper motion of Kapteyn’s stars** are ~ 8 arcsec/yr.
High proper motion surveys

- The most straightforward method to identify nearby stars is from proper motion surveys.
- First attempt was made by van Maanen (1915).
- Other attempts: Wolf (1919) and Ross (1939); they listed stars PM more than 0.2 arcsec/yr.
- A survey by Luyten (1979) listed 58,845 stars having PM more than 0.2 arcsec/yr.
- Lepine (2005) compiled a list of 61977 stars with PM more than 0.15 arcsec/yr in northern hemisphere down to V ~ 19 mag.
- Recently, Shen (2018) detected 61500 stars with PM more than 0.2 arcsec/yr using gaia DR2 catalogue.
ILMT high proper motion survey

(I) Two epoch images – large time gap

- First epoch image can be taken from other surveys.
- Similar filters will be preferred on both epoch.

(ii) Measure accurate positions of stars on two epoch - using PSF
(iii) Transform the positions on reference image.
(iv) Compare the positions with respect to reference image.
Thanks