Studies of Local Milky-Way Kinematics via Line-of-Sight Velocities

Invited talk

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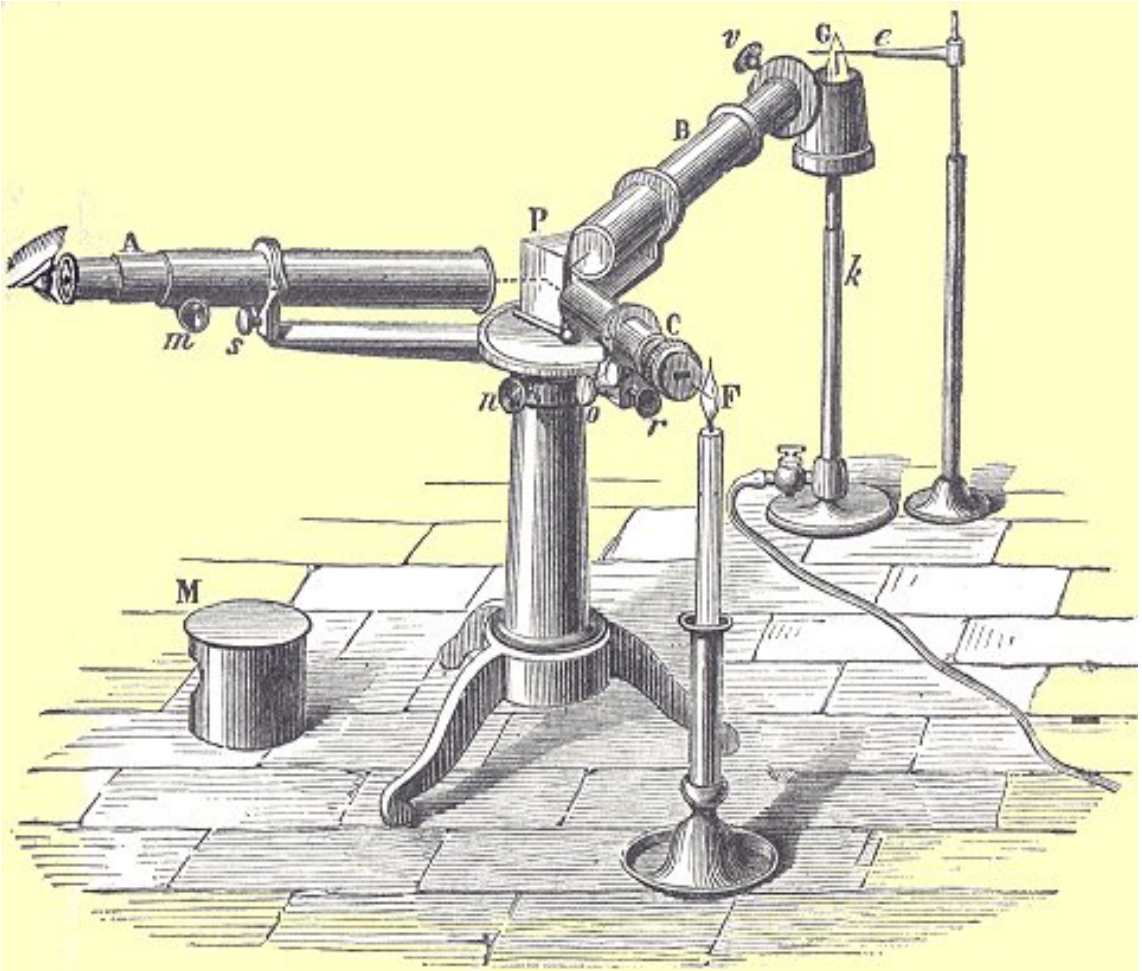
Doppler’s effect

- Doppler’s effect discovered in 1843 for sound waves
- Later extended to all types of waves by Fiseau and Mach
- Can be applied to stars

First measurement of line-of-sight velocity

- For Sirius by Sir William Huggins in 1868.
- Doppler’s shift noticed in spectrum of Sirius
- Found for Sirius to move from us more than 20 mps
- This result is very different from the modern one, but this is due to the orbital motion not known in the time of the discovery

An 1868 spectroscopic apparatus



Theories of stellar motions

- Kapteyn in 1904 two streams
- Schwarzschild in 1906 velocity ellipsoid

Methods of determination of solar motion and velocity ellipsoid based on line-of-sight velocities only

- They use the least-square method
- K-effect

Oort's constants

- J. H. Oort proposed two constants describing local field of gravitation A and B
- They can be determined also from analysis of line-of-sight velocities assuming rotation of the Milky Way

Subsystems of the Milky Way as seen near the Sun

- Thin disc
- Thick disc
- Halo

Kinematics versus metallicity

- In general the three subsystems are also different as to their chemical composition
- From metal-poor halo to metal-rich thin disc

Kinematics versus age

- Age also estimated spectroscopically
- Age-metallicity relation

Kinematics versus spectral type I

- Spectral type available for many stars
- In thin disc noticed kinematics following spectral type
- For thin-disc MS stars velocity dispersion generally increases towards red end

Kinematics versus spectral type II

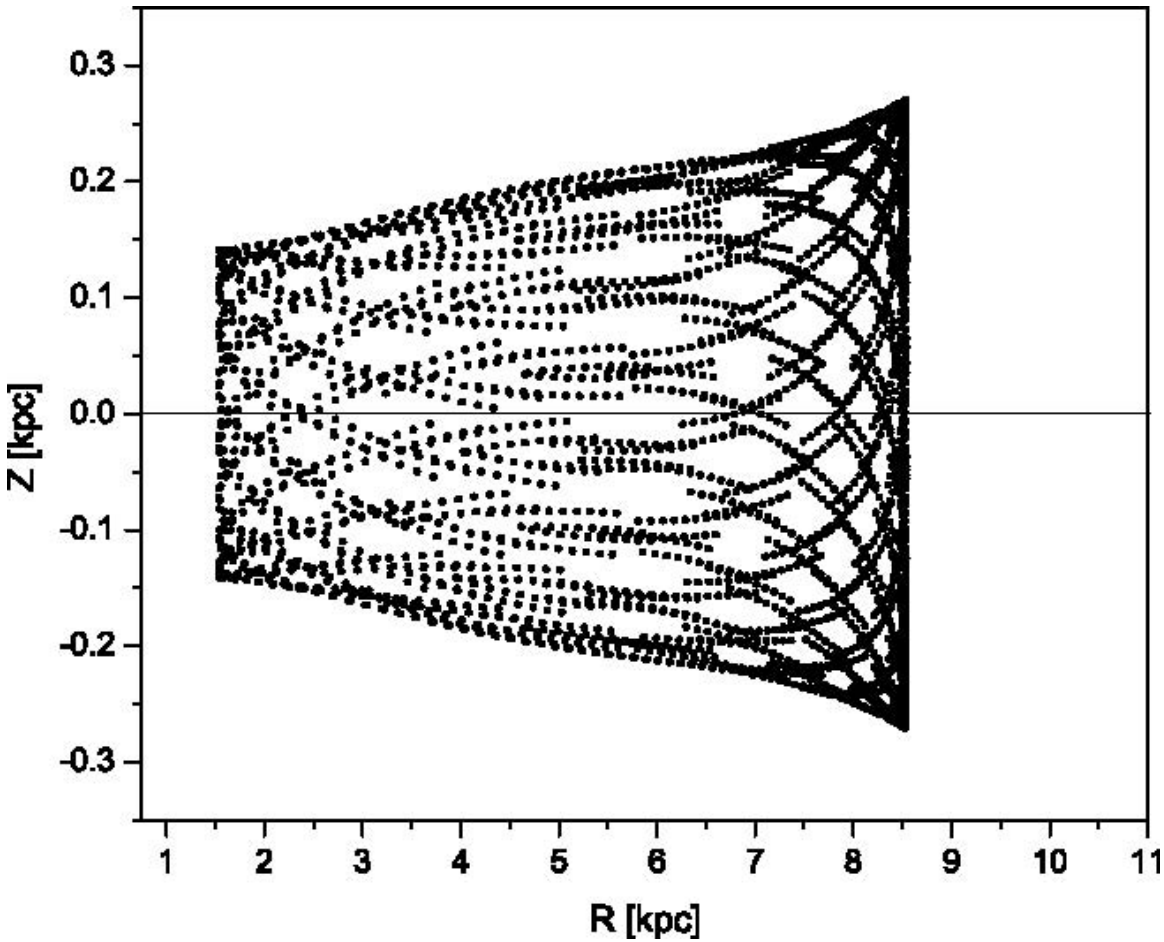
- Thin-disc MS stars velocity of rotation in correlation with spectral type
- Lag in rotation compared to circular velocity known as asymmetric drift
- asymmetric drift proportional to main component of velocity dispersion

More line-of-sight velocities necessary

- After recent astrometric catalogues (Hipparsoc etc) there are many stars (~10^5) with astrometric data
- Majority of them without line-of-sight velocity
- Conclusion: we should measure line-of-sight velocities for as many nearby stars as possible

Space motion

Astrometric data + line-of-sight velocity =
= space motion

- Space motion yields possibility to calculate galactocentric orbit

A galactocentric orbit