Contact Binaries

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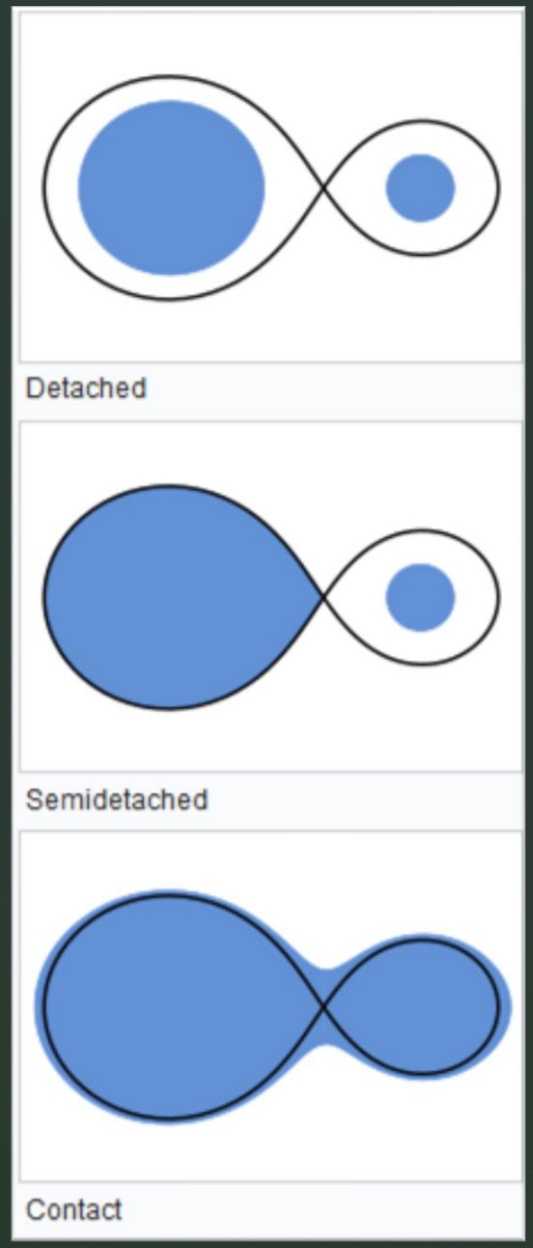
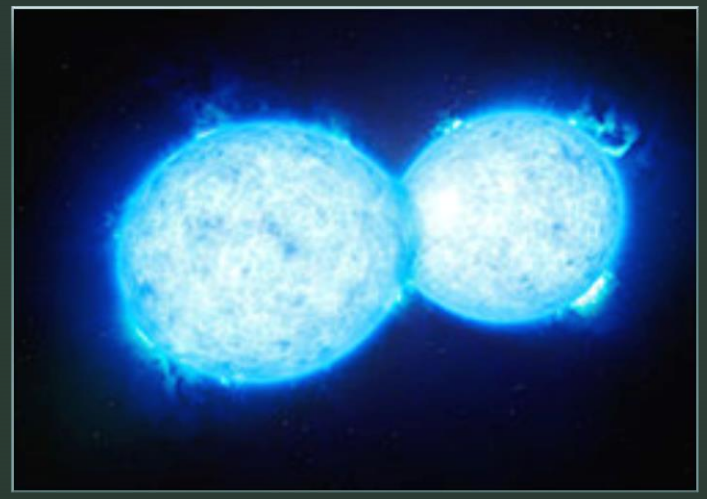
Formation of contact binaries

- Both stars are within Roche lobe
- The primary star fills its Roche lobe and mass transfer begins
- The secondary star begins to expand and fills the Roche lobe.



W Ursae Majoris (W UMa) variables

- Eclipsing contact binaries
  - Most common variety of contact binaries
- Primary and secondary eclipses are nearly equal in depth
- Very little color variation during eclipses
- Effective temperature of both stars are nearly equal
- Stars have unequal masses
  - Less massive star is oversized and overluminous for its mass



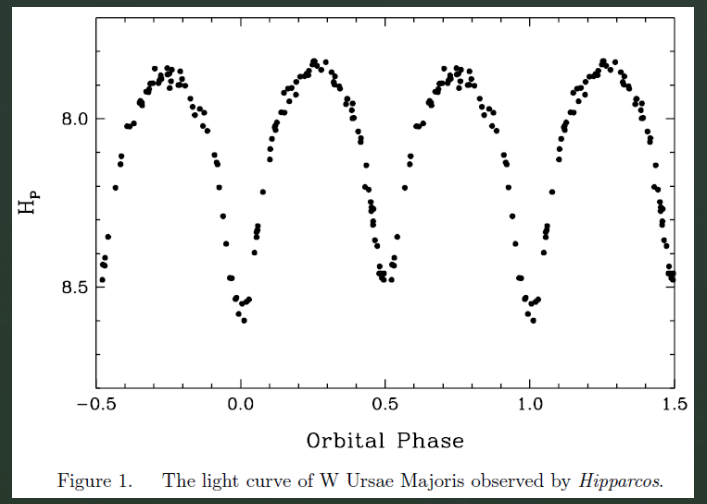


Figure 1. The light curve of W Ursae Majoris observed by *Hipparcos*.

Subclasses of W UMa binaries:

- A-type (1965)
  - Components with earlier spectral type (from A to G)
  - Higher luminosity, larger mass and smaller mass ratio
  - Larger star is hotter
- W-type (1965)
  - Components with later spectral type (from F to K)
  - smaller star is hotter
- B-type (1979)
  - Larger surface temperature differences
  - In geometrical contact, not in thermal contact
- H-type (2004)
  - High mass ratio, $q>0.72$

Properties of W UMa binaries:

- Period distribution from 0.22d (5.3h) to 100d
  - Concentrated at short periods
  - Strong maximum around 0.37d (8.9h)
- Main sequence stars
  - Primary star with mass >0.6 M_sun
    - Less massive star leads to unstable mass transfer

Problems

- Modeling of contact binaries is challenging problem
  - Magnetic braking, tidal friction, dynamo effect, thermal equilibrium, convective envelopes, hydrostatic equilibrium (might not be fully satisfied)

Sources

- **Contact Binaries**, Ronald F. Webbink
- **On the properties of contact binary stars**, Sc. Csizmadia & P.Klagyivik
- **The short-period limit of contact binaries**, Dengkai Jiang et al.
- Aavso.org, W Ursae Majoris

First two pictures are taken from Wikipedia. Light curve taken from Ronald F. Webbink article.