



ASTROMETRY

Double Stars Overview





Double Stars Overview

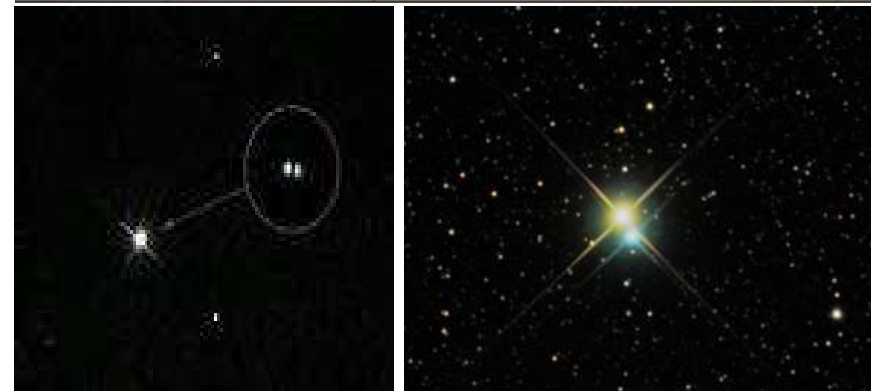
Overview

This presentation discusses the science of Double Stars.

In short: The value of Double Stars is that through determination of two stars in gravitational/mutual orbit, you can derive the stellar mass.

From the stellar mass, current astrophysical theories can be refined to greater detail with greater assurance.

Where Variable Stars rely on Photometry, Double Stars rely on the process of Astrometry.





Double Stars Overview

Common Definitions

Binary Stars:

- Two, or more, stars that revolve around each other as a result of their mutual gravitational attraction
- Offer one of the few ways to measure stellar masses
 - Stellar mass plays the leading role in a star's evolution

Double Stars:

- Often used synonymously with binary star; but typically refer to a system where a gravitational link has not been established.
- Most common Double Star are Optical doubles where two stars appear close together in the sky as seen from the Earth typically due to a line of sight chance alignment from our perspective.

Components	Count	Percent
2 (binary star)	82760	78.69%
3 (triple star)	12431	11.82%
4 (quadruple star)		
	4629	4.40%
5	1905	1.81%
6	854	0.81%
7	541	0.51%
8	380	0.36%
9	236	0.22%
10+ (star clusterlet)		
	1439	1.38%
Total	105175	100.0%

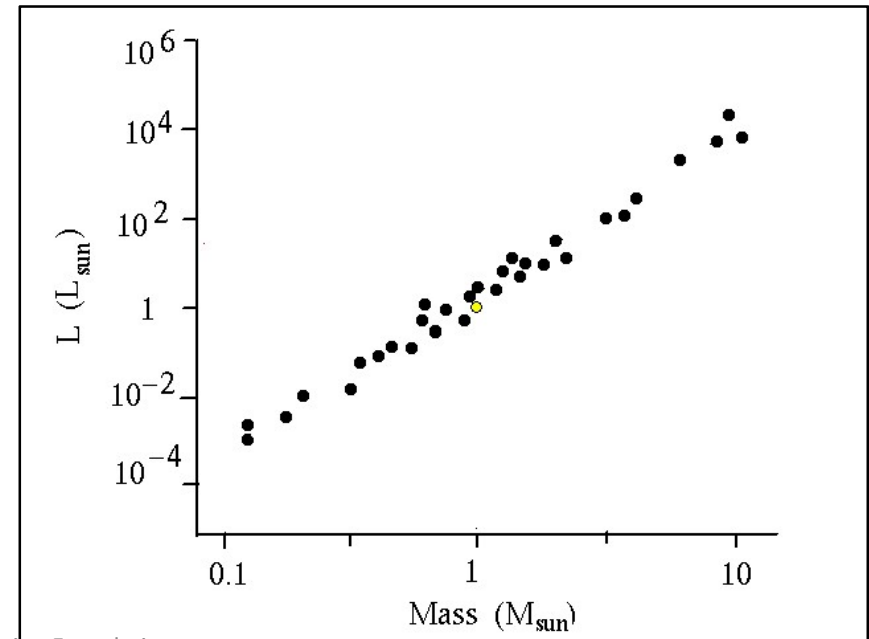
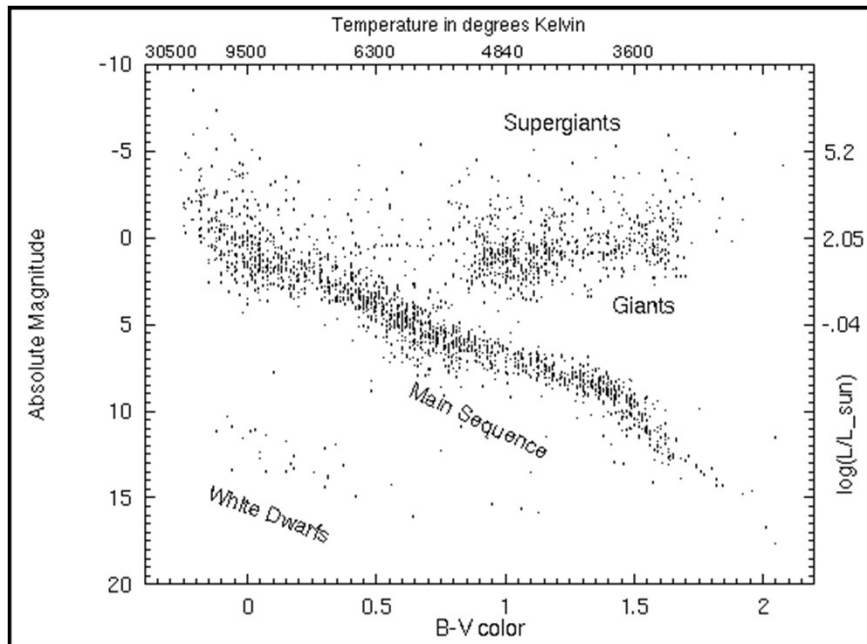
Source: Washington Double Star Catalogue (2012)



Double Stars Overview

Double Astrophysical Importance

- The only way to “weigh” a star through determination of a Binary Star’s orbit.
- From Mass, the single most important characteristic of a star, you can determine the life cycle of the star: Birth, Fusion, Luminosity, Death



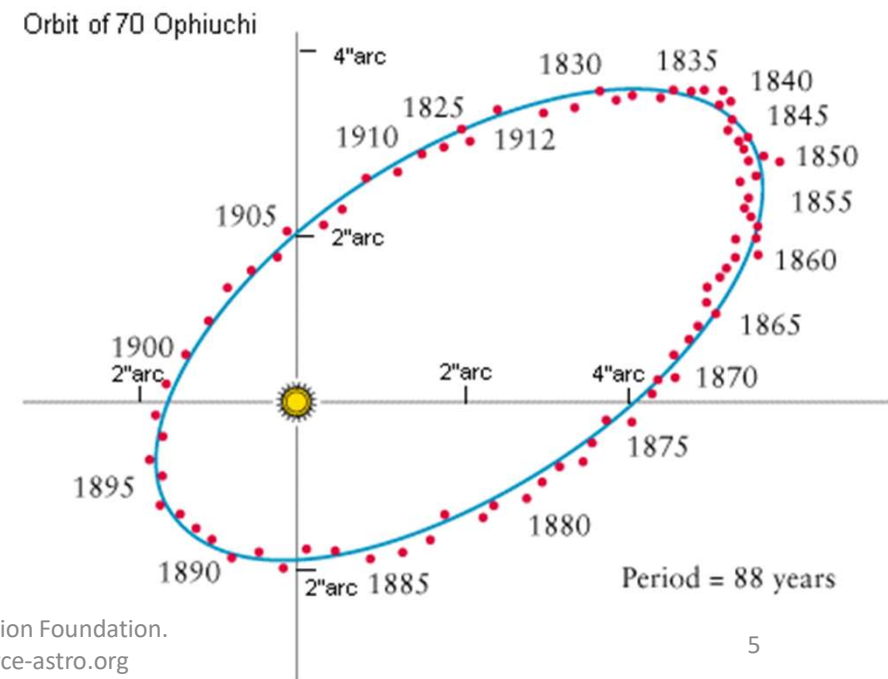
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Double Stars Overview

Binary Star Orbits

- Typically, the brightest star is always assumed to be the Primary (A), secondary (B), tertiary (C), and so on, are dependent on decreasing order of brightness
- However, there are many cases where the primary, secondary, and so on were determined in the order of which they were first discovered.
- The Primary is assumed not to move in the orbital model



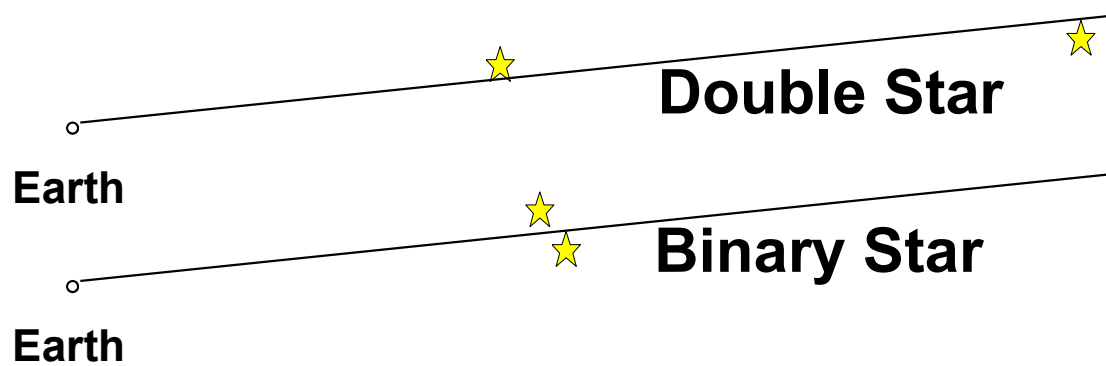
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Double Stars Overview



Double/Binary Star Classifications

Optical vs. Gravitationally Bound

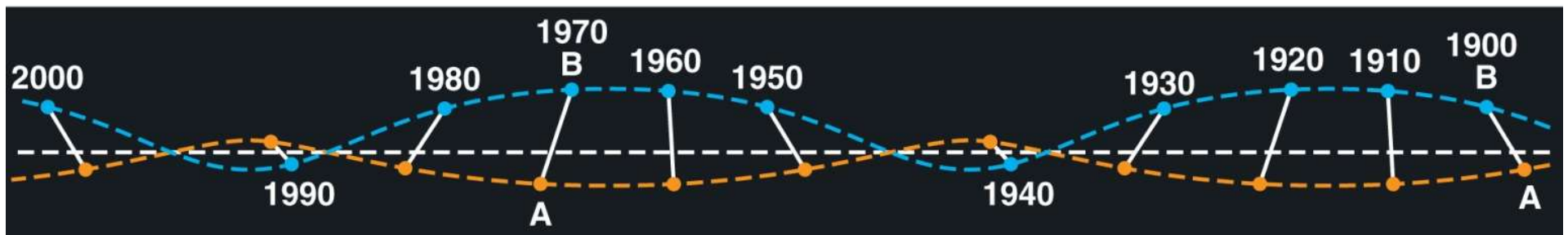




Double Stars Overview

Binary Stars: Astrometric Binaries

Stars that orbit so closely that the presence of the second star is derived through the effect of the “tug” on the primary star’s path in the sky.



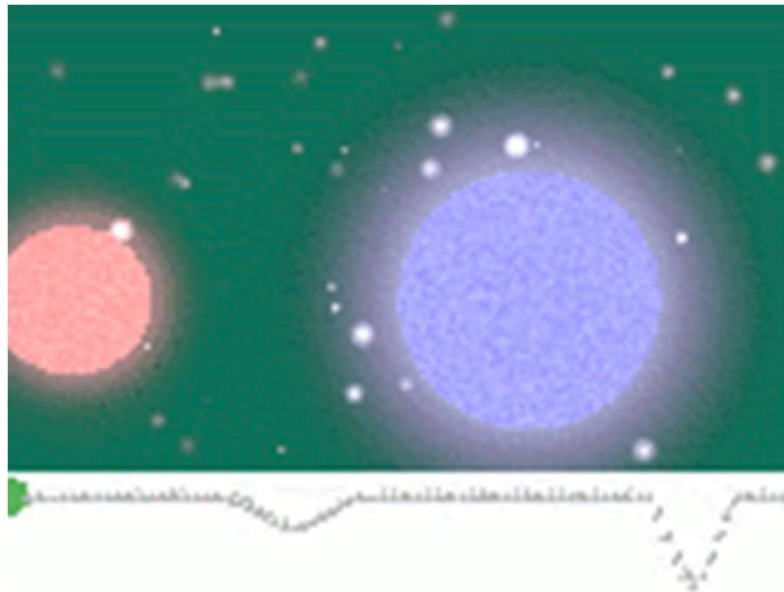
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Double Stars Overview

Binary Stars: Eclipsing Binary

A binary star system in which one star can eclipse the other star



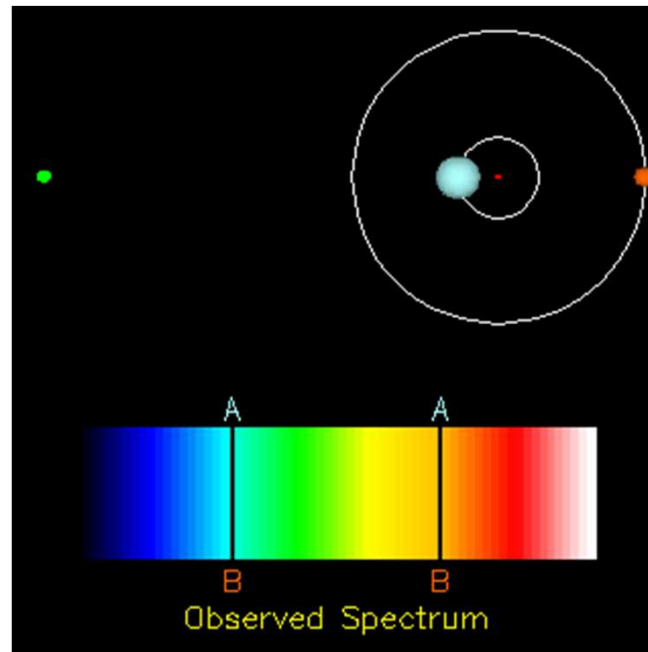
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Double Stars Overview

Binary Stars: Spectroscopic Binary

Spectroscopic binaries are systems that are inferred to be binary by a comparison of the system's spectra over time



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Double Stars Overview

Washington Double Star Catalog

The most recent values for separation and position angle can be found in the Washington Double Star Catalog (WDS).

The catalog is sustained and updated regularly by the United States Naval Observatory.

It also includes proper motion vectors, precise coordinates, magnitudes, date of discovery, and other information that may or may not be useful for a given study.

The screenshot shows the Naval Oceanography Portal website. The header includes the USNO logo and navigation links: Home, Time, Earth Orientation, Astronomy, Meteorology, Oceanography, Ice. The breadcrumb trail reads: You are here: Home > USNO > Astrometry > Optical/IR Products > Double Stars > WDS. The main content area is titled "The Washington Double Star Catalog" and contains a description of the catalog, a list of contents, and a sidebar with a file tree. The sidebar tree includes: Optical/IR Products, NOMAD, UCAC, URAT, USNO-B1.0, Double Stars (with WDS selected), ORB6, LIN1, INT4, DM3, WMC, DSL, Solar System Bodies, USNO Image and Catalog Archive Server, VLBI-based Products, and Astrometry. The main text describes the WDS as the world's principal database of astrometric double and multiple star information, containing 115,769 systems based on 824,698 means (as of 1 January 2012). The contents list includes: Introduction and Growth of the WDS (with sub-items for cross-reference files and format changes), Unpublished Measures, Neglected Doubles, Hipparcos, Tycho-2, & the TDSC, Duplicate discovery designations, Arcsecond coordinates and other topics, Single Stars, Available files, Requests and Acknowledgments, WDS Catalog (~14.2MB) (with sub-items for 00-06, 06-12, 12-18, and 18-24 hour sections), Format of the current WDS, Notes file for the WDS (~2.0MB), and References and discoverer codes (~2.2MB). On the right side, there is a "USNO Master Clock Time" widget showing "Thu, 16 Aug 2018 17:23:12 UTC" and a "The Sky This Week" widget showing "The Sky This Week, 2018 August 14 - 21".

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Double Stars Overview

Summary

Double Stars can either be gravitationally bound, or optically aligned.

The study of these over time can lead to an orbital determination which can lead to a mass determination.

Double Stars relies heavily on the process called: Astrometry



Double Stars Overview

Questions?



Double Stars Overview

Washington Double Star Catalog

The WDS can be used to select targets for study.

Three key aspects of a double star usually determine whether or not it can be studied with the observer's equipment:

- Separation in arcseconds
- Magnitude
- Location in the sky for the time of year

The screenshot shows the Naval Oceanography Portal website. The header includes the USNO logo and navigation links: Home, Time, Earth Orientation, Astronomy, Meteorology, Oceanography, Ice. A search bar is present with the text 'only in current section'. The main content area is titled 'The Washington Double Star Catalog' and includes a description of the catalog, a list of contents, and a sidebar with a file tree. The file tree shows the following structure:

- Optical/IR Products
 - NOMAD
 - UCAC
 - URAT
 - USNO-B1.0
 - Double Stars
 - WDS
 - ORB6
 - LIN1
 - INT4
 - DM3
 - WMC
 - DSL
 - Solar System
 - Bodies
 - USNO Image and Catalog Archive
 - Server
 - VLBI-based Products
 - Astrometry

The main content area includes the following text:

The Washington Double Star Catalog

The Washington Double Star Catalog (WDS) maintained by the United States Naval Observatory is the world's principal database of astrometric double and multiple star information. The WDS Catalog contains positions (J2000), discoverer designations, epochs, position angles, separations, magnitudes, spectral types, proper motions, and, when available, Durchmusterung numbers and notes for the components of 115,769 systems based on 824,698 means (as of 1 January 2012). The catalog is updated nightly.

Contents:

- [Introduction and Growth of the WDS](#)
 - [Cross-reference files \(WDS/IDS/ADS/BDS, Bayer/Flamsteed, etc.\)](#)
 - [Change in WDS format](#)
- [Unpublished Measures](#)
- [Neglected Doubles](#)
- [Hipparcos, Tycho-2, & the TDSC](#)
- [Duplicate discovery designations, Arcsecond coordinates and other topics](#)
- [Single Stars](#)
- [Available files](#)
- [Requests and Acknowledgments](#)

■ **WDS Catalog (~14.2MB)**

- [00-06 hour section \(~3.1MB\)](#)
- [06-12 hour section \(~4.0MB\)](#)
- [12-18 hour section \(~2.7MB\)](#)
- [18-24 hour section \(~4.5MB\)](#)
- [Format of the current WDS](#)
- [Notes file for the WDS \(~2.0MB\)](#)
- [References and discoverer codes \(~2.2MB\)](#)

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Double Stars Overview

Washington Double Star Catalog

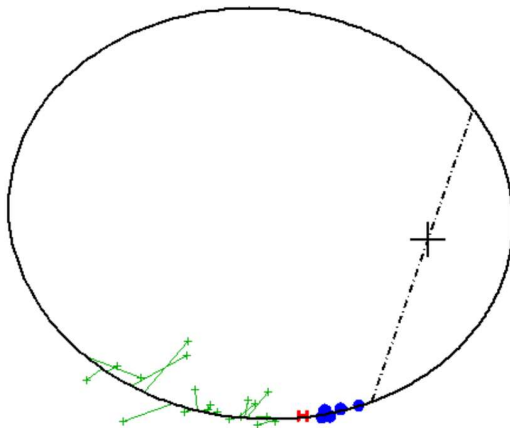
The WDS has two companion lists.

One has all of the published orbits of binary stars, however precise, called the Sixth Orbit Catalog.

WDS 00006-5306

HJ 5437

(Kiy2017)



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The screenshot shows the Naval Oceanography Portal website. The main navigation bar includes links for Home, Time, Earth Orientation, Astronomy, Meteorology, Oceanography, and Ice. The current page is titled "Sixth Catalog of Orbits of Visual Binary Stars" and is part of the ORB6 sub-section. A sidebar on the left lists various data products, with ORB6 selected. The main content area provides a detailed description of the catalog's history and current status, mentioning that it contains 2,662 orbits of 2,558 systems as of April 2016. A right-hand sidebar displays the USNO Master Clock Time as Thursday, 16 Aug 2018, 17:26:32 UTC, and a "The Sky This Week" section for August 14-21, 2018.



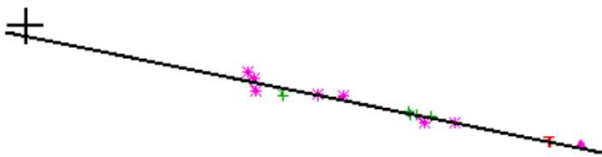
Double Stars Overview

Washington Double Star Catalog

The WDS has two companion lists.

Another is the Catalog of Rectilinear Elements.

WDS 01073-3452 COO 6 (USN2011)



Accessibility Help/Contact

Search

only in current section

Home Time Earth Orientation Astronomy Meteorology Oceanography Ice

You are here: Home > USNO > Astrometry > Optical/IR Products > Double Stars > LIN1

USNO

Catalog of Rectilinear Elements
(last update: 6 November 2013)

Introduction & Purpose

Many systems in the Washington Double Star Catalog have shown significant relative motion since their discovery. The *Catalog of Rectilinear Elements* provides linear fits for those systems whose motion does not appear to be Keplerian. While a few of these may in fact be very long-period physical pairs whose orbital motion is not yet apparent, most are probably optical pairs (i.e., chance alignments of unrelated stars). These linear fits, then, just describe the relative proper motions between these pairs of stars.

The purposes of this catalog are threefold. First, the very well-defined motions of some of these systems means they may prove useful for scale calibration for imaging systems such as CCDs or photographic cameras. Also, these differential proper motions may allow us to improve upon proper motions of individual components. Finally, these linear fits, especially in comparison with Hipparcos proper motions, may be useful in searches for submotions due to closer components. These investigations are underway.

- Optical/IR Products
 - NOMAD
 - UCAC
 - URAT
 - USNO-B1.0
 - Double Stars
 - WDS
 - ORB6
 - LIN1**

USNO Master Clock Time
Thu, 16 Aug 2018 17:26:52 UTC

The Sky This Week
The Sky This Week, 2018 August 14 - 21
More...

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