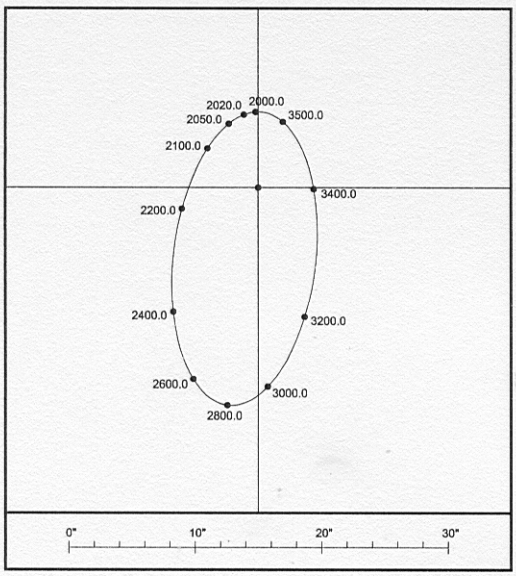
Orbit



Ephemeris for STT 547 AB (2010 to 2100)

Orbit by Pop (1996b) Period: 1550.637 years, Grade: 4

Year	PA(°)	Sep(")	Year	PA(°)	Sep(")
2010.0	186.4	5.94	2060.0	209.9	5.43
2020.0	190.8	5.88	2070.0	215.2	5.31
2030.0	195.3	5.79	2080.0	220.7	5.21
2040.0	199.9	5.68	2090.0	226.4	5.13
2050.0	204.8	5.56	2100.0	232.3	5.07

of little interest to modern astronomers but which do afford some attractive sights in small telescopes and binoculars. They are denoted by $O\Sigma\Sigma$ in older observing handbooks but the modern appellation is STTA. Until 1878 Otto continued to make small additions to the catalogue, and the last set of eight pairs brought the total to 547. The pair STT 547 is a particularly interesting system as it contains two red dwarfs in orbit and which are relatively close to the Solar System. The large proper motion means that the field has attracted the attention of people such as Burnham, who added further faint components to assist the astrometry of the pair. Component C is maguitude 11.6 at 116″ (distance increasing) and D is 12.65 at 110″ (incr.); E is 11.8 at 58″ (decr.) whilst a distant companion F (at 254° and 328″) has the same proper motion as AB and according to Shaya & Olling [270] has a near 100% probability of being physically connected to AB.

The Modern Era

There are two extant orbits for AB. Popovic [107] calculated the period to be 1550.6 years whilst Kiyaeva in 2001 et al. [108] found 509.7 years. The current USNO Sixth Orbit Catalog prefers Popovic's calculation. Both A and B have been found to have variable radial velocity (up to 45 km s^{-1} for A and 25 km s^{-1} for B). The 10.2 magnitude star F at 254° and 327″ has common proper motion and Tokovinin [177] in the MSC estimates a period of 169.2 kiloyears for the rotation around AB.

Observing and Neighbourhood

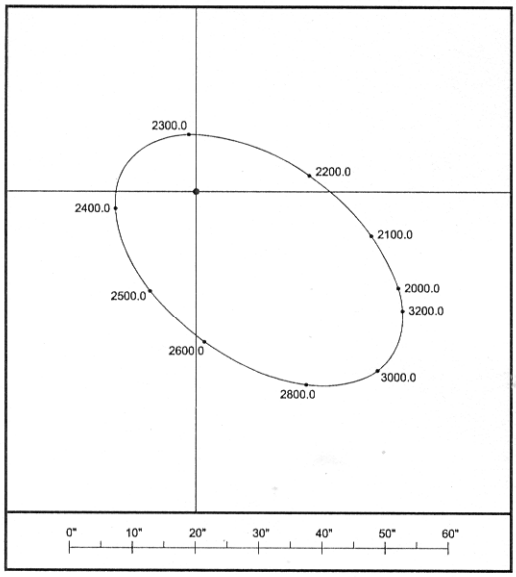
STT 547 is not plotted in the *Cambridge Double Star Atlas (2nd edition)* (*CDSA2*) because it is too faint; the finding chart is given here. I found both stars to be orange and equally bright in 1971 with a 10-inch mirror ×80 and ×300, and two distant field stars were also noted. The WDS gives stars of 13.7 at 263°, 116″, 12.5 at 230°, 110″, and 11.8 at 344°, 58″ (all at 2015), but these values are changing quickly owing to the large proper motion of AB. Close by (8′ S and 35″ of RA preceding) is the similar pair BU 997, which has, on occasion, been mistaken for STT 547. The magnitudes are 7.6 and 9.4 and the current position is 337° and 3″.8, but the colours are yellow and blue. By chance, the last pair in the original Pulkova catalogue, STT 514, is about 4° south. The stars are 6.2 and 9.7 at 170°, 5″.1, 2015. Just 30′ WSW of 26 And is HJ 1947 (6.2, 9.8, 75°, 9″.1, 2015), which is a long-period binary. DR2 finds almost identical parallaxes and proper motions and that the system is 320 light years distant.

DELETE 'Z'

Measures

Early measure (D)	111°.4	4″.24	1876.29
(Orbit	110°.7	4″.30)	
Recent measure (SER)	189°.7	6″.01	2016.92
(Orbit	189°.4	5″.90)	

Orbit



Ephemeris for GRB 34 AB (2010 to 2100)

Orbit by PkO (2014c) Period: 1253 years, Grade: 5

Year	PA(°)	Sep(")	Year	PA(°)	Sep(")
2010.0	65.4	34.65	2060.0	70.7	31.49
2020.0	66.4	34.08	2070.0	71.9	30.76
2030.0	67.4	33.48	2080.0	73.1	30.00
2040.0	68.5	32.85	2090.0	74.4	29.20
2050.0	69.6	32.19	2100.0	75.8	28.36

catalogue by a period which is about half as long. This is one of the closest known visual binaries to the Sun. The Gaia DR2 parallax puts it 11.62 light years away. The proper motion is correspondingly large. The current linear separation of the stars is 146 AU. Both components of GRB 34 are variable stars: A is GX And and B is GQ And, a BY Dra-type variable with starspots. Ster A has radial velocity variation at the metres per second level due to an exoplanet in orbit discovered by Howard *et al.* [118]. Star B is known to be a spectroscopic binary. Tanner *et al.* [119] reported deep exposures in the K band around both stars, and they revealed that there were three stars at around $K = 15$, two within 12″ of B and one at 6″ to A, none of which appeared to be connected to the components of the binary. The 11th-magnitude component C is also a background object and is rapidly being left behind by GRB 34. In 1925 it was at 232°, 36″ from A whilst by 2011 it was at 259°, 286″.

Exoplanet Host?

A planetary body was found in 2014 [118]. Known as GJ 15 Ab, it had a period of 11.4433 days and a minimum mass of 5.35 ± 0.75 Earth masses. However, Trifonov *et al.* [120] do not find the 11.4-day periodicity; rather they see a 52 Earth-mass planet with a period of about 7000 days.

Observing and Neighbourhood

The difficulty with this pair is both the difference in magnitudes and the faintness of the B component. The finder chart shows that the star can be found in the same low-power field as 26 And (STT 5) and HJ 1947 (see p. xx). The majestic slowness with which the companion moves can be seen in the ephemeris.

Measures

Early measure (STT)	52°.9	40″.05	1860.18
(Orbit	53°.2	39″.87)	
Recent measure (LOC)	64°.4	34″.27	2015.92
(Orbit	66°.0	34″.31)	

5. β TUC = LCL 119 = WDS J00315−6257AC

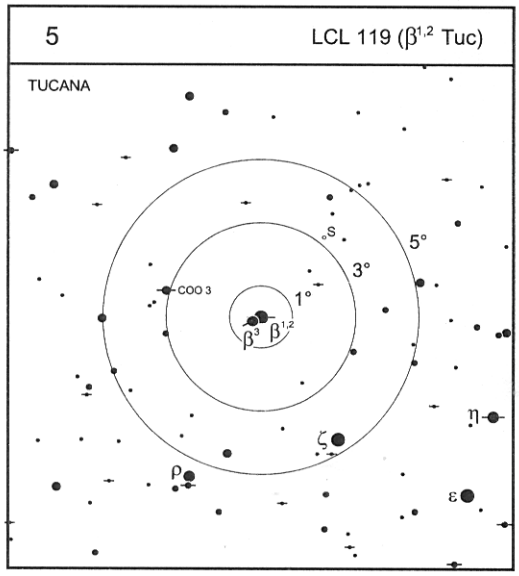
Table 9.5 Physical parameters for ~~LCL 119~~ β Tuc

LCL 119	RA: 00 31 32.69	Dec: −62 57 29.6	WDS: 1861(41)		
I 260			WDS: 1044(74)		
V magnitudes	A(β^1): 4.29	C(β^2): 4.51	E(β^3): 5.09		
$(B-V)$ magnitudes	A: −0.04	C: +0.14	E: +0.05		
μ(A)	82.74 mas yr^{-1}	± 0.41	−54.58 mas yr^{-1}	± 0.40 (DR2)	
μ(B)	105.61 mas yr^{-1}	± 1.47	−48.06 mas yr^{-1}	± 1.77 (DR2)	
μ(C)	86.42 mas yr^{-1}	± 0.21	−50.36 mas yr^{-1}	± 0.21 (DR2)	
π(A)	23.26 mas	± 0.25	140.2 light yrs	± 1.5 (DR2)	
π(B)	19.59 mas	± 0.97	166.5 light yrs	± 8.2 (DR2)	
π(C)	21.79 mas	± 0.13	149.7 light yrs	± 0.7 (DR2)	
Spectra	A: B8/A0	C: A2V	E: A0V		
Masses	A: 2.2	B: 0.5	C: 2.0	D: 1.5	Ea: 1.6
	Eb: 1.6				
Luminosities ($L_\odot$)	A: 32	B: 35	E: 18		
Catalogues (A/C/E)	HD 2484/5/3003	HR 126/7/36	SAO 248201/2/8	HIP 2484/7/2578	
DS catalogues	LCL 119 (AC)	DUN 1 (AC)	I 260 (CD)	B7 (AB)	B8 (Ea,Eb)
Radial velocity	+7.70 km s^{-1}	± 1.6			
Galactic coordinates	25°.242	−80.636			

History

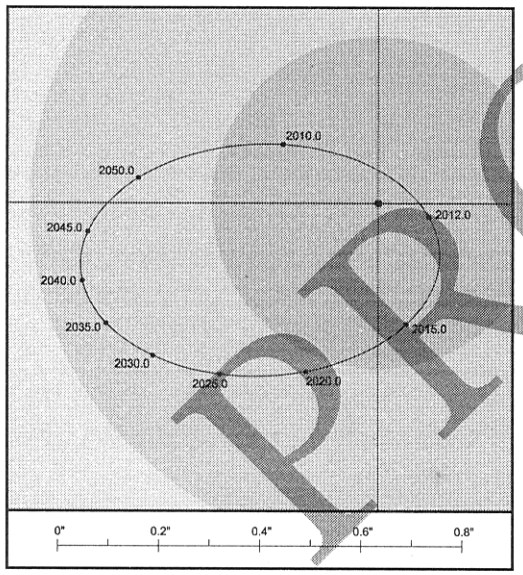
Nicolas-Louis de Lacaille spent a year between 1751 and 1752 surveying the southern skies from an observing site near Cape Town in South Africa. His observations led to the first systematic southern star catalogue, although he was using a telescope of only 0.5-inch (13.5-mm) aperture and 866 mm focal length, with a magnification of ×8 and a field of almost 3°. Even so he was able to note a number of bright double stars, one of which was β Tucanae. It was next observed in 1826 by James Dunlop during his observations from Parramatta in New South Wales, and it is the first entry in his catalogue of double stars although he does acknowledge that de Lacaille had already noted it. R. T. A. Innes, who had started a programme of double star discovery whilst an amateur observer in Sydney, continued to search for new double stars when he moved to South Africa and joined the staff of the Royal Observatory at the Cape. With the 7-inch Merz refractor there he found a number of new pairs but as there was no micrometer he was only able to make estimates of position angle and separation. One of the new objects was β^1 Tuc [122], which revealed itself as a rather unequal pair separated by about 0″.7. It was also discovered independently, and announced two years later, by Solon Bailey [248]. In 1925, using the 26.5-inch refractor at Johannesburg, W. H.

Finder Chart



00h 31.5m -62° 57'

Orbit



Ephemeris for I 260 CD (2018 to 2036)

Orbit by Tok (2015c) Period: 44.73 years, Grade: 2

Year	PA(°)	Sep(")	Year	PA(°)	Sep(")
2018.0	348.1	0.32	2028.0	309.1	0.51
2020.0	336.8	0.36	2030.0	304.3	0.54
2022.0	327.9	0.40	2032.0	300.0	0.56
2024.0	320.6	0.44	2034.0	295.9	0.58
2026.0	314.4	0.48	2036.0	292.1	0.60

van den Bos noted that both β^1 and β^3 were very difficult double stars: β^1 (B7) had a 14th magnitude companion about 2″ away whilst β^3 (B8) appeared to be an almost equally bright pair of stars separated by about 0″.15. Tokovinin assigns a period of 5.05 years to this pair, but, despite many efforts by van den Bos and Finsen, there are times when the pair is only marginally resolved and the orbit may be highly inclined. This system needs speckle interferometry with large apertures.

The Modern Era

This appears to be a physical septuple as the A component is also a spectroscopic binary. The three bright stars all appear to be at the same distance, allowing for the large formal error on the DR2 parallax of β^2, and the whole group would appear to be part of the moving group of young stars that forms the Tucana–Horologium association.

Observing and Neighbourhood

There is something for every telescope in this beautiful multiple system. The separation between β^1 and β^3 (549″) makes it a naked-eye object, that between β^1 and β^2 is ideal for the small telescope or large binoculars, and the close binary which forms β^1 is a challenge for 30-cm and, although the separation now widening, the stars will only reach 0″.6 in 2040 before starting to close again. Then there are the surpassingly difficult double stars that form B7 and B8, neither of which has been seen for the last 50 years or so. At 1°.5 following β is COO 3, a fine binary pair of magnitudes 6.3 and 8.0 at 73° and 2″.4 (2016) and closing slowly. Andrew James calls it 'an uncommonly beautiful pair'. About 8° south of COO 3 are the bright pairs κ and $\lambda^{1,2}$ Tuc. The star κ will be dealt with more thoroughly elsewhere (p. xx) whilst λ is the second entry in James Dunlop's catalogue. It appears to be a binary pair with magnitudes of 6.7 and 7.4 at 82° and 20″ (2013). Andrew James notes the that primary is deep yellow and the pair looks magnificent in binoculars or with a small telescope.

Measures

LCL 119 AC			
Early measure (DUN)	174°.1	25″.0	1826.50
Recent measure (ANT)	168°.4	27″.05	2009.71
I 260 CD			
Early measure (I)	297°.9	0″.76	1900.36
(Orbit	294°.7	0″.59)	
Recent measure (ANT)	15°.7	0″.25	2013.70
(Orbit	15°.5	0″.24)	

6. BU 395 CET = WDS J00373−2446

Table 9.6 Physical parameters for BU 395 Cet — ADD

BU 395	RA: 00 37 20.68	Dec: −24 46 02.1	WDS: 270(187)	
V magnitudes	A: 6.25	B: 6.62		
$(B-V)$ magnitudes	A: +0.78	B: +0.85		
μ	1450.34 mas yr^{-1}	± 3.77	−19.38 mas yr^{-1}	± 1.73
π	64.93 mas	± 1.85	50.2 light yr	± 1.4
Spectra	A: K1V	B: G		
Masses ($M_\odot$)	A: 0.90	± 0.01	B: 0.87	± 0.01
Radii ($M_\odot$)	A: 0.87		B: 0.88	
Luminosities ($L_\odot$)	A: 0.6	B: 0.4		
Catalogues	HR 159	HD 3443	SAO 166418	HIP 2941
DS catalogues	BU 395	BDS 335	ADS 520	
Radial velocity	+18.63 km s^{-1}	± 0.11		
Galactic coordinates	68°.846	−86°.049		

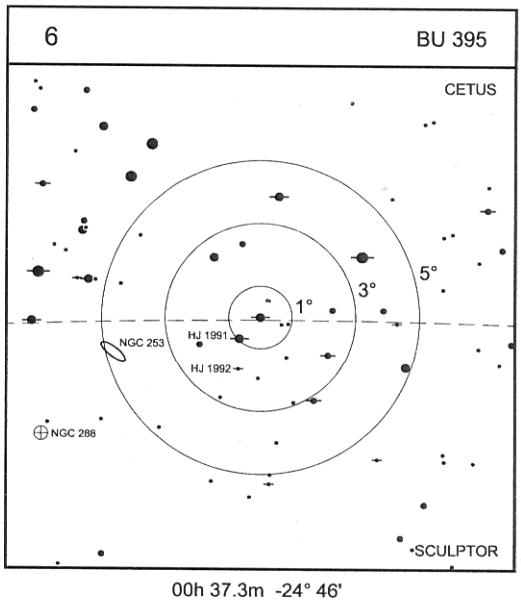
History

This pair was found by Burnham with his 6-inch Clark on 5 November 1875, along with BU 391 and BU 393. His note in AN [113] reads 'The third close pair tonight'.

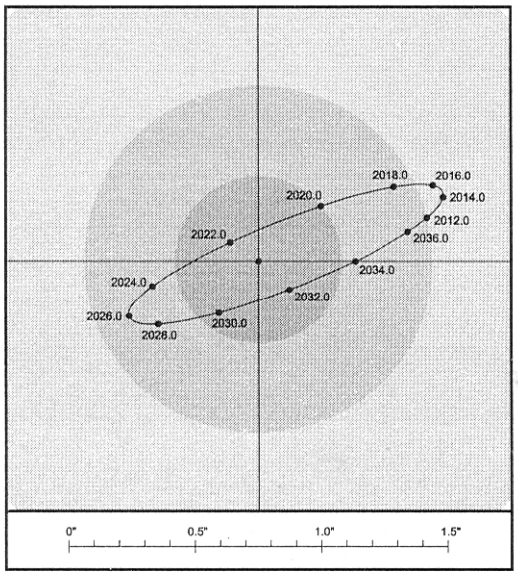
The Modern Era

The current orbit by Hartkopf is given grade 1. The two stars are in their sixth revolution since discovery. The separation varies from about 0″.8 to just over 0″.1 (2022). This pair is not included in Gaia DR2.

Finder Chart



Orbit



Ephemeris for BU 395 (2017 to 2026)

Orbit by Hrt (2010a) Period: 25.02 years, Grade: 1

Year	PA(°)	Sep(")	Year	PA(°)	Sep(")
2017.0	115.4	0.69	2022.0	237.3	0.13
2018.0	118.4	0.60	2023.0	273.0	0.28
2019.0	122.8	0.48	2024.0	283.4	0.43
2020.0	130.8	0.33	2025.0	289.0	0.52
2021.0	154.6	0.17	2026.0	293.3	0.56

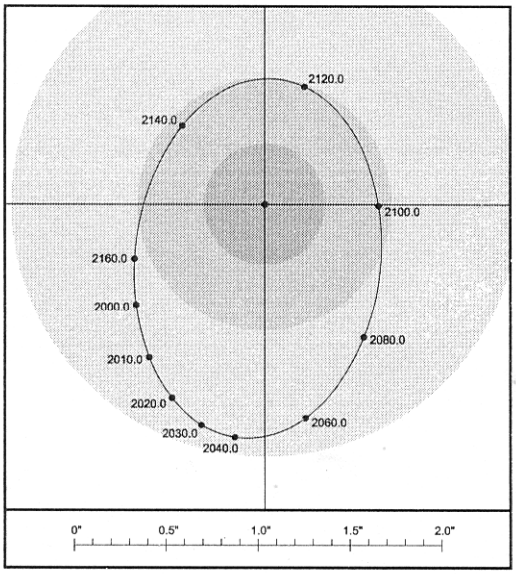
Observing and Neighbourhood

The pair BU 395 is located right on the border between Cetus and Sculptor. It is one of the shortest-period visual binaries which can be seen with a medium aperture. It is now closing rapidly but will reappear for apertures of 20-cm after 2025. Nearby are two wide pairs from the John Herschel catalogue. The pair HJ 1991 (6.6, 9.7, 95°, 47″, 2010) is 30′ away to the SE whilst a further 30′ south from here brings you to HJ 1992 (7.8, 8.9, 247°, 46″, 2013). Six degrees WSW is the pair κ^1 and κ^2 Sculptoris, the first of which is BU 391 (see p. xx). The magnificent spiral galaxy NGC 253 is 2°.5 to the E and slightly S.

Measures

Early measure (LV)	104°.7	0″.65	1886.85
(Orbit	103°.9	0″.67)	
Recent measure (TOK)	112°.8	0″.76	2015.91
(Orbit	112°.9	0″.76)	

Orbit



Ephemeris for STF 73 AB (2015 to 2060)

Orbit by Mut (2016b) Period: 167.5135 years, Grade: 2

Year	PA(°)	Sep(")	Year	PA(°)	Sep(")
2015.0	329.2	1.12	2040.0	352.7	1.29
2020.0	334.5	1.18	2045.0	357.0	1.28
2025.0	339.4	1.22	2050.0	1.4	1.26
2030.0	344.0	1.26	2055.0	5.9	1.23
2035.0	348.4	1.28	2060.0	10.7	1.19

magnitude 11 companion at 162″ (distance increasing) but this had already been seen by Burnham [130].

The Modern Era

Tokoyinin & Lépine [128] found a faint star 1407 arcseconds away with a common proper motion (TOK 447 AD). The Hipparcos catalogue puts the bright pair at a distance of 124 light years but, with a relatively high proper motion, this is a high-velocity star. The star AB has been suspected of variability and is catalogued as NSV 343.

Observing and Neighbourhood

DELETE

I have measured this ~~beautiful yellow~~ pair for over 25 years. In 1991 it was found at 289°.5, 0″.68 but it is now becoming much easier, and is just resolvable with 10-cm at present. (1)

About 1° N preceding the V = 4.4 magnitude star η And, there is a beautiful pair of yellow stars, 36 And, which is clearly resolved in 15-cm, and forms a resolution test for 10-cm. (2) The separation will continue to ease for several decades to come. Within four degrees are the pairs ψ^1 Psc (STF 88), 65 Psc (STF 61), and 55 Psc (STF 46). The pair ψ^1 Psc is a bright wide pair of hot, blue-white dwarf stars (magnitudes 5.3, 5.5) separated by 29″.7 in position angle 159° (2016). The primary is an 0″.14 pair currently just past widest separation (2017) in a 14.4 year orbit. Despite the large separation, AB,C appears to be a physical pair. 65 Psc (magnitudes 6.3 and 6.4 and 1°.5 NW of 67 Psc) is a neat pair which is perfect for small apertures and provides colour contrast (Webb, very yellow, very blue; Hartung, orange yellow and ashy). The position in 2015 was 116°, 4″.2. The pair 55 Psc is more of a test, the magnitude 8.5 companion to the magnitude 5.6 primary being only 6″.6 away in PA 192° (2014). The spectral types are K3 and F3 and they appear yellowish to several observers including Smyth and Haas.

Measures

Early measure (STF)	307°.8	0″.85	1832.14
(Orbit	307°.6	0″.89)	
Recent measure (ARY)	330°.2	1″.08	2015.50
(Orbit	329°.8	1″.08)	

(1) & (2) TRANSPOSE THESE SENTENCES

9. β PHE = SLR 1 = WDS J01061−4643AB

Table 9.9 Physical parameters for β Phe

SLR 1	RA: 01 06 05.10	Dec: −46 43 06.4	WDS: 883(85)	
V magnitudes	A: 4.10	B: 4.19		
$(B-V)$ magnitudes	A: +1.03	B: ?		
μ	-80.81 mas yr^{-1}	$\pm$ 13.24	34.97 mas yr^{-1}	$\pm$ 9.51
π	17.93 mas	$\pm$ 0.74	182 light yr	$\pm$ 8 (dyn.)
Spectra	A: G8III	B: G8III(?)		
Masses ($M_\odot$)	A: 2.5	B: 2.5		
Luminosities ($L_\odot$)	A: 60	B: 55		
Catalogues	HD 6595	HR 322	SAO 215365	HIP 5165
DS catalogues	SLR 1 (AB)	HJ 3417 (AB-C)		
Radial velocity	-1.10 km s^{-1}	$\pm$ 0.74		
Galactic coordinates	295°.506	−70°.198		

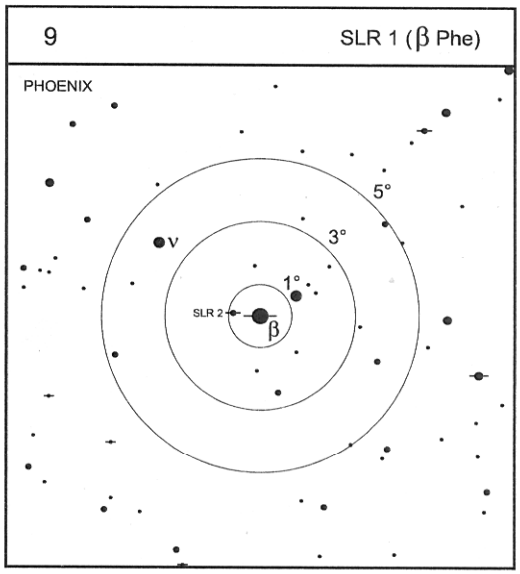
History

During one of his sweeps at Feldhausen, John Herschel noted a very faint companion to β Phoenicis, which he characterized as 'a mere blot'. From occasional measures of the distance and separation, both of which have increased since, we know that this is a background star. In 1891 R. P. Sellors [131] at Sydney Observatory found that β itself was a close, equal, double with separation about 0″.9. The stars slowly widened over the next few decades and attracted occasional measurements but the in brightness has clearly created problems, even for experienced micrometrists with substantial apertures, and thus measures of separation could differ significantly.

The Modern Era

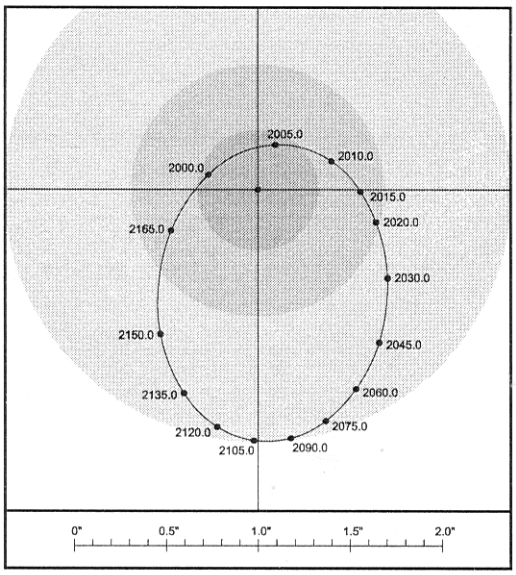
In 2002 RWA and colleagues Andreas Alzner and Elliott Horch [310] wrote a paper which highlighted five southern binaries of interest, of which SLR 1 was one. An orbit by Andreas Alzner using all the available data found a period of

Finder Chart



REPLACE FINDER CHART

Orbit



Ephemeris for SLR 1 AB (2015 to 2060)

Orbit by Ary (2015b) Period: 170.7 years, Grade: 3

Year	PA(°)	Sep(")	Year	PA(°)	Sep(")
2015.0	88.9	0.56	2040.0	43.4	1.00
2020.0	74.6	0.67	2045.0	38.4	1.06
2025.0	64.1	0.76	2050.0	33.9	1.12
2030.0	55.9	0.85	2055.0	29.8	1.17
2035.0	49.2	0.93	2060.0	26.1	1.22

195 years, but at that time the stars were close to periastron and less than 0″.3 apart. The next measures were not made until 2008 and in 2015 Alzner revised the orbit to 170.7 years. The total mass of the system was 5 $M_\odot$ and, assuming the stars are similar in all aspects, then they are G8 giants. Interpolating the orbit back by one revolution we see that in 1833 the stars were also at their closest, fully explaining why John Herschel failed to see them. The system β Phe is not included in DR2.

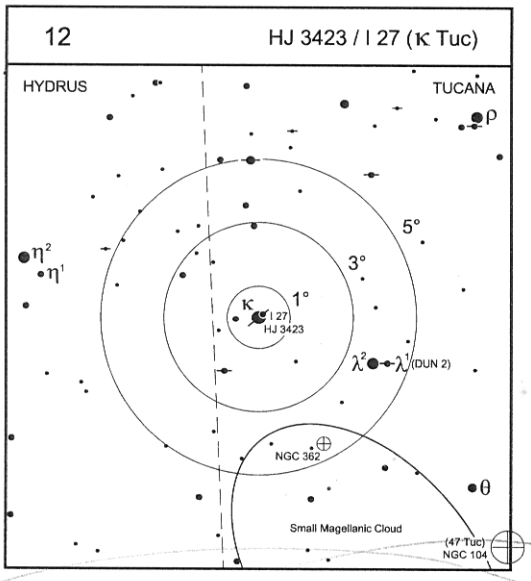
Observing and Neighbourhood

The pain β Phe is a bright naked-eye star about 12° NW of Achernar. It should be resolvable in 25–30-cm aperture and will continue to widen for about another 80 years. The widest separation, 1″.38, comes in 2100. Another binary pair (SLR 2) can be found in the same field some 25′ E. It was found by Sellors on the same night in 1891 as β (7.1, 8.7, 180°, 1″.3, 2016) having been at 0″.6 at discovery. Nine degrees due S of β is ζ Phe – a fine but difficult triple star. It contains the bright pair RMK 2 (see p. xx). Four degrees NW of β is I 47 (7.5, 8.0, 32°, 0″.8, 2010). This is an orbital pair with period 517 years and is currently at 0″.6 and closing slowly.

Measures

Early measure (SLR)	24°.4	0″.92	1892.93
(Orbit	23°.3	1″.25)	
Recent measure (ARY)	83°.8	0″.70	2016.69
(Orbit	83°.5	0″.60)	

Finder Chart



REPLACE FINDER CHART

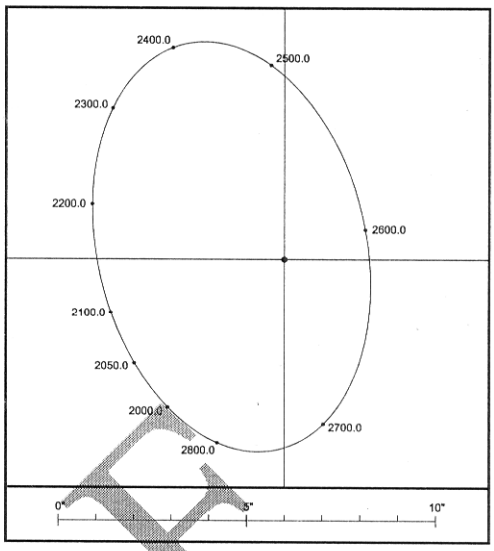
The Modern Era

The two pairs, which are 319″ apart, are physically linked – they have almost identical parallaxes and similar proper motions. Two spectra, taken earlier this century 1529 days apart, showed the radial velocity of AB varying by more than 30 km s^{-1}, but no confirming measurements appear to have been made since. Baize & Petit [144] noted that the A component is NSV 454. Tokovinin notes that Hipparcos found an astrometric perturbation in A, making the system quintuple. The relatively large formal error on the DR2 parallax of A supports this notion of the structure.

Observing and Neighbourhood

This is spectacular quadruple for the small telescope. A 15-cm at about ×200 should show all four stars clearly. The close pair has the plane of its orbit tilted towards us, so the distance varies only between 0″.9 and 1″.1. The orbit of AB is much less certain but it is likely to be in range of 7.5-cm apertures for the next century or more. In 2016 with the Johannesburg 67-cm refractor, the colours of AB were noted as yellow and bluish whilst those of CD appeared yellow and lilac. κ Tucanae is about 4° NNE of the Small Magellanic Cloud and about 5° NE of the fine globular cluster 47 Tuc. Also worth searching out nearby are the bright binocular pair $\lambda^{1,2}$ Tuc, the fainter component of which is DUN 2, magnitudes 6.7, 7.4 and separated by 20″ at 82°, 2013, and the globular cluster NGC 362. Due N by 2°.5 is HJ 3426, a fine pair (6.4, 8.3, 328°, 2″.5, 2013).

Orbit for JH 3423 AB

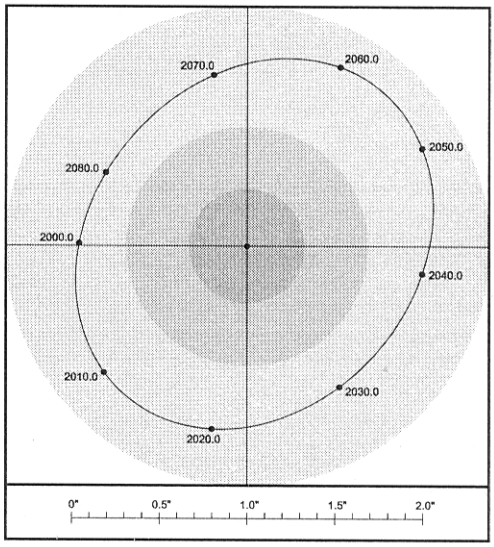


Ephemeris for HJ 3423 AB (2010 to 2100)

Orbit by Sca (2005b) Period: 857.0 years, Grade: 5

Year	PA(°)	Sep(")	Year	PA(°)	Sep(")
2010.0	318.7	4.99	2060.0	301.4	4.84
2020.0	315.3	4.95	2070.0	297.9	4.83
2030.0	311.9	4.92	2080.0	294.3	4.82
2040.0	308.5	4.89	2090.0	290.7	4.82
2050.0	305.0	4.86	2100.0	287.2	4.83

Orbit for I 27 CD



Ephemeris for I 27 CD (2016 to 2034)

Orbit by Sod (1999) Period: 85.2 years, Grade: 3

Year	PA(°)	Sep(")	Year	PA(°)	Sep(")
2016.0	333.9	1.10	2026.0	14.3	1.00
2018.0	341.4	1.09	2028.0	23.5	0.98
2020.0	349.2	1.07	2030.0	33.0	0.96
2022.0	357.2	1.05	2032.0	42.8	0.96
2024.0	5.5	1.02	2034.0	52.6	0.96

Measures

HJ 3423 AB — ADD			
Early measure (HJ)	16°.4	4″.75	1836.75
(Orbit	15°.0	4″.54)	
Recent measure (ARY)	315°.6	4″.77	2016.68
(Orbit	316°.5	4″.98)	
I 27 CD — ADD			
Early measure (SLR)	185°.4	1″.55	1893.10
(Orbit	179°.7	1″.05)	
Recent measure (ARY)	324°.3	1″.05	2013.70
(Orbit	325°.5	1″.11)	

13. τ SCL = HJ 3447 = WDS J01361−2954AB

DELETE

τ Scl

Table 9.13 Physical parameters for ~~HJ 3447~~

HJ 3447	RA: 01 36 08.50	Dec: −29 54 26.5	WDS: 551(115)	
V magnitudes	A: 6.03	B: 7.34		
$(B-V)$ magnitudes	A: +0.34	B: +0.49		
μ	117.37 mas yr^{-1}	± 0.92	46.72 mas yr^{-1}	± 0.48
π	14.42 mas	± 0.81	226 light years	± 13
μ(A)	127.16 mas yr^{-1}	± 0.47	34.77 mas yr^{-1}	± 0.23 (DR2)
π(A)	18.53 mas	± 0.31	176 light yrs	± 3 (DR2)
Spectra	A: F2V	B		
Masses ($M_\odot$)	A: 1.70	± 0.05	B: 1.45	± 0.03
Luminosities ($L_\odot$)	A: 9	B: 3		
Catalogues	HR 462	HD 9906	SAO 193201	HIP 7463
DS catalogues	HJ 3447			
Radial velocity	3.00 km s^{-1}	± 4.5		
Galactic coordinates	231°.360	−79°.800		

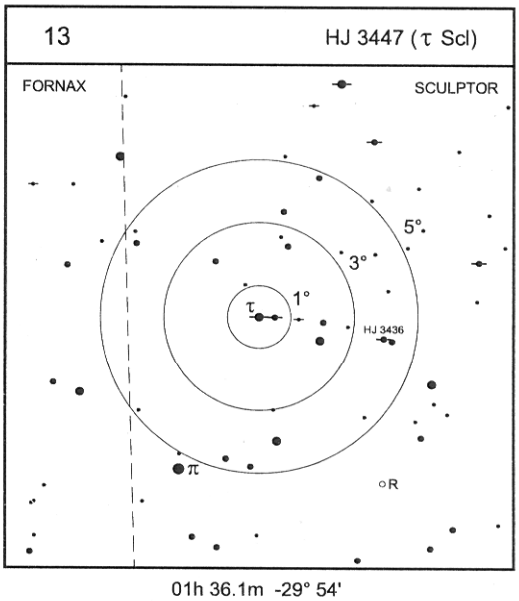
History

This object was discovered by John Herschel [142] on 19 November 1835, during his survey of the southern sky from Feldhausen. 'A fine double star' he recorded, assigning it magnitudes of 6 and 8.

The Modern Era

The system τ Scl is a pair of yellow dwarfs that form a long-period binary. If the current catalogue orbit is correct then the closest separation (0″.80) was passed in 2003 and the stars will continue to widen for nine centuries, until the maximum separation of 4″.5 is reached, although the orbit is essentially indeterminate and will remain so for many years

Finder Chart



14. P ERI = Δ 5 = WDS J01398−5612 AB

DELETE

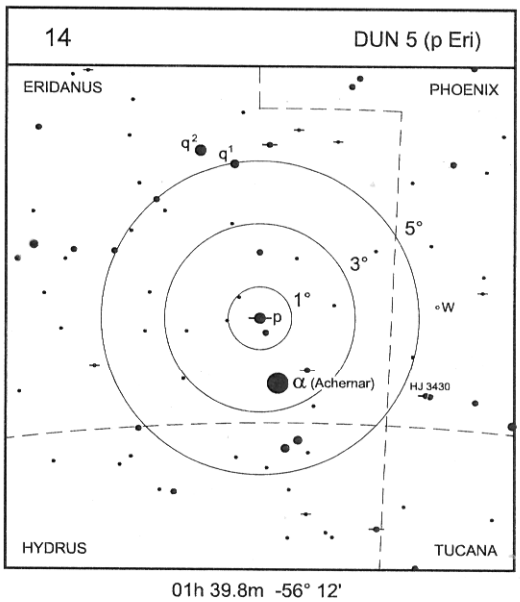
Table 9.14 Physical parameters for p Eri

DUN 5	RA: 01 39 47.83	Dec: −56 11 36.0	WDS: 326(166)	
V magnitudes	A: 5.78	B: 5.90		
$(B-V)$ magnitudes	A: +0.99	B : +1.02		
μ(A)	309.10 mas yr^{-1}	± 0.08	10.69 mas yr^{-1}	± 0.07 (DR2)
μ(B)	262.38 mas yr^{-1}	± 0.08	15.33 mas yr^{-1}	± 0.07 (DR2)
π(A)	122.13 mas	± 0.05	26.71 light yrs	± 0.01 (DR2)
π(B)	122.06 mas	± 0.05	26.72 light yrs	± 0.01 (DR2)
Spectra	A: K2V	B: K2V		
Luminosities ($L_\odot$)	A: 0.3	B: 0.2		
Catalogues (A/B)	HR 486/7	HD 10360/1	SAO 232490	HIP 7751
DS catalogues	DUN 5 (AB)			
Radial velocity(A/B)	+22.5 km s^{-1}	± 0.9	+19.5 km s^{-1}	± 0.9
Radial velocity(A/B)	+20.14 km s^{-1}	± 0.16	+21.59 km s^{-1}	± 0.16 (DR2)
Galactic coordinates	289°.595	−59°.662		

History

This near-equally-bright rich yellow southern pair was discovered by James Dunlop [12] in 1824 when the components were almost at their closest distance, estimating separation by the two Airy disk sizes as 2″.5. Later, during December 1825, he measured the position angle as 343°.1. Early micrometric measures found the stars slowly widening but could not determine any true attachment, and p Eridani was deemed important because few binary stars were then known in the southern skies. During 1850, Captain William S. Jacob [145] (1813–1862) in Madras was first to publish a premature orbit. Yet by June 1880, Henry Chamberlain Russell (1836–1907) boldly published several papers claiming that the system was optical. Several inconclusive orbital solutions then followed, until in 1956 G. B. van Albada [146] found a moderately long period of 454 years.

Finder Chart



16. α PSC = STF 202 = WDS J02020+0246 AB

AB
|
ADD

Table 9.16 Physical parameters for α Psc

STF 202	RA: 02 02 02.80	Dec: +02 45 49.4	WDS: 29(616)	
V magnitudes	A: 4.10	B: 5.17	C: 8.25	D: 8.59
$(B-V)$ magnitudes	A: −0.05	B: +0.31		
μ	32.45 mas yr^{-1}	± 1.01	0.04 mas yr^{-1}	± 0.72
π	21.66 mas	± 1.06	151 light yr	± 7
μ(A)	32.69 mas yr^{-1}	± 0.94	−2.90 mas yr^{-1}	± 0.82 (DR2)
π(A)	19.80 mas	± 0.67	164.7 light yr	± 5.6 (DR2)
Luminosities ($L_\odot$)	A: 50	B: 20		
Catalogues (A/B)	HR 596/5	HD 12447/6	SAO 110291	HIP 9487
DS catalogues	H 2 12 (AB)	STF 202 (AB)	BDS 1061	ADS 1615
Spectra	A: A0p	B: A2p		
Radial velocity	+7.50 km s^{-1}	± 1.8		
Galactic coordinates	155°.351	−55°.600		

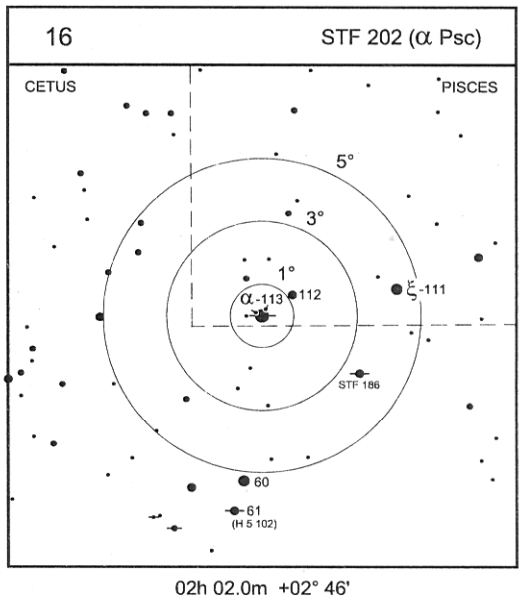
History

This object was noted by William Herschel on 19 October 1779. He recorded that both stars were white and 'with ×222 the separation was not quite 2 diameters of L.' (L was the large or primary star). The two faint and very distant companions (C is at 63°, 405″ and D is at 335°, 435″) listed in the WDS were first measured by Eyre B. Powell [149] (1819–1904). An amateur astronomer working from Madras in the 1850s, he used a 4-inch refractor and a Simms micrometer to make the observations.

The Modern Era

The observed arc of the apparent orbit now amounts to about 75°, and the two stars are almost as close as they will ever get. The use of modern observational techniques has meant that relative positions are now measured very accurately.

Finder Chart



17. 10 ARI = STF 208 = WDS J02037+2556AB

10 Ari

Table 9.17 Physical parameters for ~~STF 208~~

STF 208	RA: 02 03 39.26	Dec: +25 56 07.6	WDS: 191(229)		
V magnitudes	A: 5.82	B: 7.87			
$(B-V)$ magnitudes	A: +0.54	B: +0.59			
μ(A)	126.53 mas yr^{-1}	± 0.14	13.21 mas yr^{-1}	± 0.15 (DR2)	
μ(B)	132.99 mas yr^{-1}	± 0.63	28.90 mas yr^{-1}	± 0.52 (DR2)	
π(A)	19.38 mas	± 0.75	168.3 light yr	± 6.5 (DR2)	
π(B)	22.81 mas	± 0.57	143.0 light yr	± 3.6 (DR2)	
Spectra	F8IV/V				
Luminosities ($L_\odot$)	A: 10	B: 2			
Catalogues	10 Ari	HR 605	HD 12558	SAO 75114	HIP 9621
DS catalogues	STF 208	BDS 1074	ADS 1631		
Radial velocity	+13.0 km s^{-1}	± 0.2			
Radial velocity (A)	+13.22 km s^{-1}	± 0.23 (DR2)			
Galactic coordinates	142°.615	−34°.161			

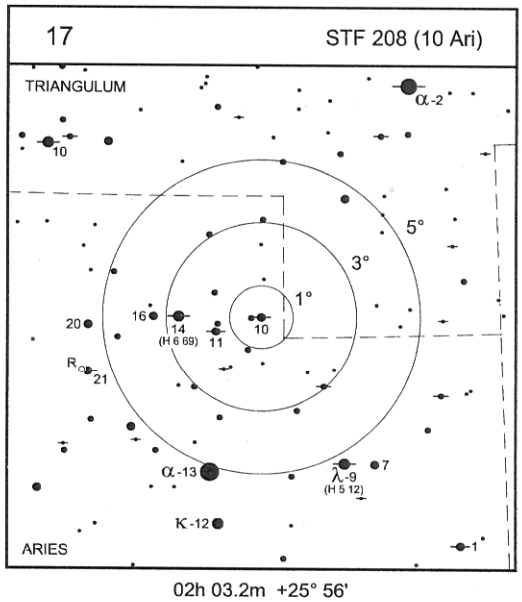
History

The star 10 Arietis revealed itself to be be double during the survey at Dorpat by F. G. W. Struve. John Herschel called it a miniature of ϵ Bootis (Pulcherrima). Near 2″ when first seen by Struve, the stars closed steadily throughout the nineteenth century, reaching a minimum separation of 0″.4 around 1910 before slowly widening.

The Modern Era

The USNO Sixth Orbital Catalog prefers to include the Grade 2 orbit by Heintz [309], but this predicts separations about 0″.3 wider than those actually observed at the time of going to press.

Finder Chart



REPLACE FINDER CHART

18. $\gamma^{1,2}$ AND = STF 205 = WDS J02039+4220A,BC

Table 9.18 Physical parameters for ~~STF 205~~ γ And

STF 205	RA: 02 03 53.92	Dec: +42 19 47.5	WDS: 84(374) (A-BC)		
			WDS: 88(360) (BC)		
V magnitudes	A: 2.31	B: 5.3	C: 6.5		
μ(A)	+43.08 mas yr^{-1}	± 0.71	−50.05 mas yr^{-1}	± 0.52	
μ(B)	+43.1 mas yr^{-1}	± 0.7	−50.8 mas yr^{-1}	± 0.6	
π	9.19 mas	± 0.73	355 light years	± 28	
μ(B)	30.02 mas yr^{-1}	± 1.43	−51.64 mas yr^{-1}	± 0.97 (DR2)	
π(B)	12.57 mas	± 0.59	259.5 light yr	± 12.1 (DR2)	
Spectra	A: K3IIb	B: B8V+B9V	C: A0V		
Masses ($M_\odot$)	A: 14.5	Ba: 3.1	Bb: 2.5	C: 2.9	
Luminosities ($L_\odot$)	A: 620	B: 40	C: 15	D	
Catalogues (A/B)	57 And	HR 603	HD 12533	SAO 37734	HIP 9640
DS catalogues	Mayer 7	H 3 5 (A-BC)	STF 205 (A-BC)	STT 38 (BC)	
	BDS 1070	ADS 1630			
Radial velocity (A/B)	−11.7 km s^{-1}	± 0.9	14 km s^{-1}	± 5	
Galactic coordinates	136°.965	−18°.559			

History

Thomas Lewis [194] noted that Charles Messier was comparing the light of γ Andromedae with the Andromeda nebula on a fine night in August 1764 but noticed neither that it was coloured nor that it was double. The wide pair was discovered by Christian Mayer on 29 January 1777 [152], although he too made no special remarks about the colours of the stars; the first measure was made by the elder Herschel on 17 August 1779. He noted the colours as reddish-white and a fine, light, sky-blue tending to green. 'A most beautiful object'. Subsequently, Otto Struve [153] at Pulkova using the new 15-inch (38-cm) refractor in 1842 found that B was itself double (STT 38). Hermann Struve considered the bright star itself to be a close double and measured an elongation on three nights in 1887 and 1890, but there have been no confirming observations of this. In the last century, star B was discovered to be a spectroscopic binary, making the system a quadruple; the period is 2.670 days.

The Modern Era

The BC pair has been below 0″.4 since 2004 and will not reach that value again until sometime in 2026 (see the ephemeris). The bright component is not in DR2 but the wide visual companion has been measured and shows a significantly greater parallax than that of Hipparcos for the bright star.

19. O CET = JOY 1 = WDS J02193−0259AAAB

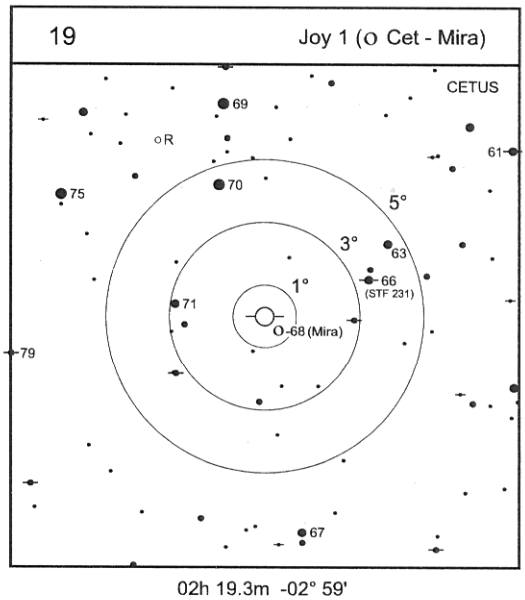
Table 9.19 Physical parameters for ~~JOY 1~~

JOY 1	RA: 02 19 20.29	Dec: −2 54 26.5	WDS: 551(115)		
V magnitudes	Aa: 2–10	Ab: 10–12.5	B: 14.1	C: 9.7	
$(B-V)$ magnitudes	A: +1.10				
μ	9.33 mas yr^{-1}	± 1.99	−237.36 mas yr^{-1}	± 1.58	
π	10.91 mas	± 1.22	300 light yr	± 33 (Hipparchos)	
π	9.09 mas	± 0.41	360 light yr	± 16 (PL relation)	
Spectra	A: M5–9 III	B: DA			
Masses ($M_\odot$)	A: 2.0		B: 0.6		
Radii ($R_\odot$)	A: 176–201	B:			
Luminosities ($L_\odot$)	A: 1–1600	B: 0.1–1			
Catalogues	68 Cet	HR 681	HD 14386	SAO 129825	HIP 10826
DS catalogues	H 6 1 (AC)	JOY 1 (AaAb)	BDS 1209	ADS 1778	
Radial velocity	63.50 km s^{-1}	± 0.6			
Galactic coordinates	167°.755	−57°.983			

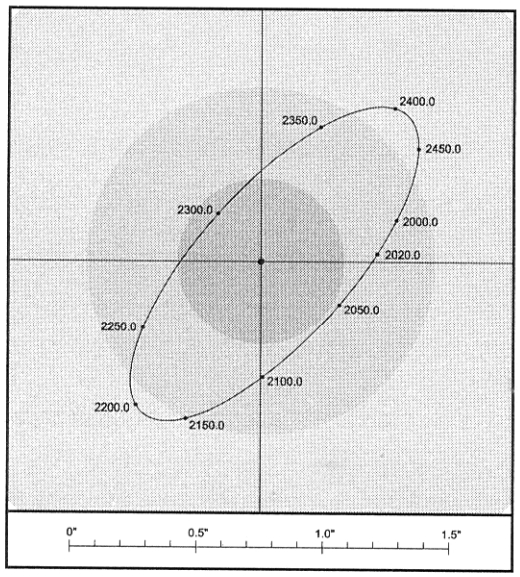
History

Omicron Ceti, better known as Mira Ceti, was first noticed on 3 August 1596 by David Fabricius, who thought it was a nova but then re-observed it in 1618. The period of variability was first determined by Johannes Holwarda in 1638 and the current value of 332 days is very close to that found by Holwarda. The discovery of the companion is discussed elsewhere. William Herschel added a distant star of maguitude 9 on 20 October 1777 and made two separate sets of measures about five years apart, giving mean distances of 104″ and 113″. He commented that 'I can hardly doubt the motion of this star' but subsequent observations show little actual motion and that there must be an error in the first distance. In 1877 Burnham [656], using the 18.5-inch at Dearborn, found a 14th magnitude object, which is now catalogued as B and appears to be a field star.

Finder Chart



Orbit



Ephemeris for JOY 1 Aa,Ab (2015 to 2060)

Orbit by Sca (2001f) Period: 497.88 years, Grade: 5

Year	PA(°)	Sep(")	Year	PA(°)	Sep(")
2015.0	97.8	0.49	2040.0	74.0	0.38
2020.0	93.9	0.46	2045.0	67.8	0.36
2025.0	89.7	0.44	2050.0	61.2	0.35
2030.0	85.0	0.42	2055.0	54.2	0.35
2035.0	79.7	0.40	2060.0	47.1	0.35

The Modern Era

Few Mira stars are in binary systems, and those that are are of long period, so astrometric measurements of the two components need to be very precise to allow even an approximate estimate of the mass of the variable. Since the first observations by Aitken [155] in 1923 the position angle has decreased by only 32° whilst the separation has almost halved. Observations in 2014 using the ALMA array [156] produced extremely accurate relative positions for Mira A and B and continuing these over 10 or 20 years may be enough to constrain the orbit significantly. In 2010 Sokoloski confirmed that B was a white dwarf, because it was seen to vary on timescales of minutes, pointing to a compact object, and the spectrum resembled those of known white dwarves in cataclysmic variable systems. See Chapter xx for more details. The Hipparcos parallax is not likely to be very reliable since the stellar diameter is three times the measured parallax. Recently, studies of the period–luminosity and period–colour–luminosity relationships for Mira have more or less agreed on a value of 110 parsecs with an uncertainty of about 5 pc. Gaia DR2 contains an entry for Mira but gives only a *G* magnitude. ADD PAGE NO.

Observing and Neighbourhood

Visually resolving Mira is going to be difficult. Attempts need to be made when Mira is faint and should be carried out as soon as possible, as the current orbit shows the stars closing over the next 50 years; however, for the next few years it may be possible to succeed using 40-cm. The two components are significantly different colours – orange-red and white. An added complication is that Mira B is also a variable (VZ Ceti with a range of 10–12.5) and would need to be near maximum at the same time that Mira is near minimum to minimise the apparent magnitude difference. Much easier is 66 Cet (STF 231), which is 1°.7 to the WNW (5.7, 7.7, 235°, 16″.9, 2016). Star C is 11.5 at 53°, 147″; the distance is decreasing owing to the proper motion of AB, which amounts to more than 0″.3 per year. DR2 finds the distance to A and B to be 124 and 125 light years respectively. Star A is a close pair (TOK 39).

Measures

Early measure (A)	130°.3	0″.91	1923.84
(Orbit	133°.2	0″.82)	
Recent measure (ALM)	98°.7	0″.47	2014.81
(Orbit	98°.0	0″.49)	

20. ι CAS = STF 262 = WDS J02291+6724AB

Table 9.20 Physical parameters for iota Cas

STF 262	RA: 02 29 03.95	Dec: +67 24 08.9	WDS: 147(263) (AB)		
			WDS: 189(230) (AC)		
V magnitudes	Aa: 4.65	Ab: 8.63	B: 6.89	Ca: 9.1	Cb: 11.8
$(B-V)$ magnitudes	A: +0.08	Aa: +0.72	B: +0.43	C: +1.0	
μ(A)	-12.59 mas yr^{-1}	$\pm$ 0.37	6.54 mas yr^{-1}	$\pm$ 0.42 (DR2)	
μ(B)	-20.64 mas yr^{-1}	$\pm$ 0.19	-4.25 mas yr^{-1}	$\pm$ 0.23 (DR2)	
μ(C)	-43.91 mas yr^{-1}	$\pm$ 0.08	10.30 mas yr^{-1}	$\pm$ 0.11 (DR2)	
π(A)	21.96 mas	$\pm$ 0.33	148.5 light yr	$\pm$ 2.2 (DR2)	
π(B)	21.70 mas	$\pm$ 0.14	150.3 light yr	$\pm$ 1.0 (DR2)	
π(C)	22.22 mas	$\pm$ 0.08	146.8 light yr	$\pm$ 0.5 (DR2)	
Spectra	A: A5p + G6V?	B: F5	C: G7V+M2V?		
Masses ($M_\odot$)	Aa: 1.98	Ab: 0.90	B: 1.2	Ca: 0.8	Cb: 0.6
Luminosities ($L_\odot$)	Aa: 24	Ab: 0.6	B: 3	Ca: 0.4	Cb: 0.03
Catalogues	HR 707	HD 15089	HIP 11569	SAO 12298	
DS catalogues	H 1 34 (AB)	H 3 4 (AC)	STF 262 (ABC)	BDS 1262	ADS 1860
	CHR 6 (AaAb)				
Radial velocity	+1.2 km s^{-1}	$\pm$2			
Galactic coordinates	132°.163	+6°.290			

History

On 11 June 1782 William Herschel observed ι Cas and noted that it was a triple star, with the closer companion very unequal and its more distant neighbour 'extremely unequal'. He placed them in different categories, with the closer of the stars at 2″.5 apart in class I whilst the more distant of the companions was allocated class III status. Otto Struve at Půlkova had shown that there was significant motion in the AB pair and it was followed more assiduously. In 1906 Thomas Lewis [194] considered the astrometric history of the pair. The motion of AB caused some concern; Lewis at first attributed an unusual variation, amounting to a loop in the motion, as a function of observational personality. After looking more closely and 'correcting' the measures of Otto Struve, the loop still remained and he concluded that this was a genuine feature and due to the presence of an invisible body and that the period was about 40 years. It was clear that the perturbation was around the A component as there was a corresponding loop in the motion of AC. Neither Burnham, nor Aitken in their general catalogues noted anything unusual.

21. α UMI = POLARIS = STF 93 = WDS J02318+8926AB

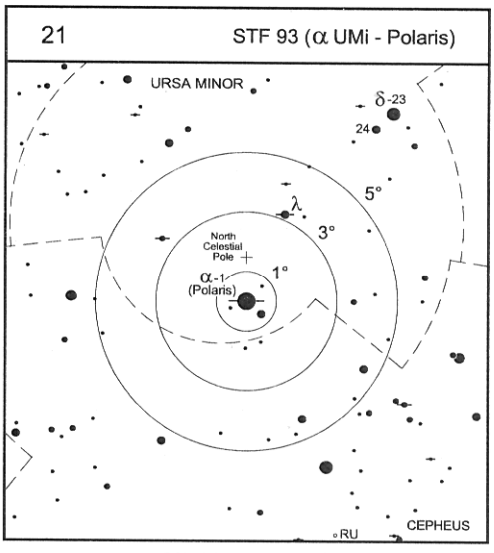
Table 9.21 Physical parameters for Polaris

STF 93	RA: 02 31 47.09	Dec: +89 15 15.50	WDS: 1351(63)		
V magnitudes	Aa: 2.30	Ab: 4.30	B: 9.1		
$(B-V)$ magnitudes	A: +0.67	B: +0.49			
μ(A)	44.48 mas yr^{-1}	± 0.11	−11.85 mas yr^{-1}	± 0.13	
μ(B)	42.09 mas yr^{-1}	± 0.05	−13.64 mas yr^{-1}	± 0.06 (DR2)	
π(A)	7.54 mas	± 0.12	433 light years	± 6	
π(B)	6.26 mas	± 0.24	521 light years	± 20 (HST)	
π(B)	7.29 mas	± 0.03	447.4 light years	± 1.8 (DR2)	
Spectra	Aa: F7Ib-IIv	Ab: F3V			
Masses ($M_\odot$)	A: 4.5	(+2.2 −1.4)	B: 1.26	(+0.14 −0.07)	
Radii ($R_\odot$)	A: 46	± 0.3			
Luminosities ($L_\odot$)	A: 2500	B: 4			
Catalogues	1 UMi	HR 424	HD 8890	SAO 308	HIP 11767
DS catalogues	H 4 1	STF 93	BDS 713	ADS 1477	WRH39 (AaAb)
Radial velocity	−16.42 km s^{-1}	± 0.03			
Galactic coordinates	123°.281	+26°.461			

History

Polaris is the bright star which is currently close to the North Celestial Pole. Closest approach occurs around 2100 when the separation will be less than half a degree. The star was observed by William Herschel on 17 August 1779; he noted the colours as 'Pale r(ed) or nearly r(ed). Garnet or deeper red than the other'. In 1852 Seidel [161], and later Schmidt [162] in 1856, reported a small photometric variation in Polaris. In 1899 Campbell [163] announced that Polaris was an SB with a period of 3.96809 days but, according to Aitken, this was later dismissed as a measurement of the pulsation period of the star. However, Campbell [164] did also note a small change in the systemic velocity of the star, evidence of a longer-period orbital motion. An astrometric companion with a period of 30 years was detected by Gerasimovič [169]. Raymond

Finder Chart



22. γ CET = STF 299 = WDS J02433+0314AB

DELETE 'O'

Table 9.22 Physical parameters for γ Cet

STF 299	RA: 02 43 18.040	Dec: +03 14 08.9	WDS: 181(237)		
V magnitudes	A: 3.54	B: 6.18			
$(B-V)$ magnitudes	A: +0.09	B: +0.52			
μ	-146.10 mas yr^{-1}	$\pm$ 0.71	-146.12 mas yr^{-1}	$\pm$ 0.55	
π	40.97 mas	$\pm$ 0.63	79.6 light yr	$\pm$ 1.2	
μ(A)	-151.26 mas yr^{-1}	$\pm$ 1.39	-147.57 mas yr^{-1}	$\pm$ 1.38 (DR2)	
π(A)	43.60 mas	$\pm$ 0.82	74.82 light yr	$\pm$ 1.4 (DR2)	
Spectra	A2Vn	F4V			
Masses ($M_\odot$)	A: 2.0	B: 1.0			
Luminosities ($L_\odot$)	A: 20	B: 1.5			
Catalogues	86 Cet	HR 804	HD 16970	HIP 12706	SAO 110707
DS catalogues	STF 299	BDS 1401	ADS 2080	ALD 124 (AC)	
Radial velocity	-4.90 km s^{-1}	$\pm$ 0.9			
Galactic coordinates	168°.919	-49°.382			

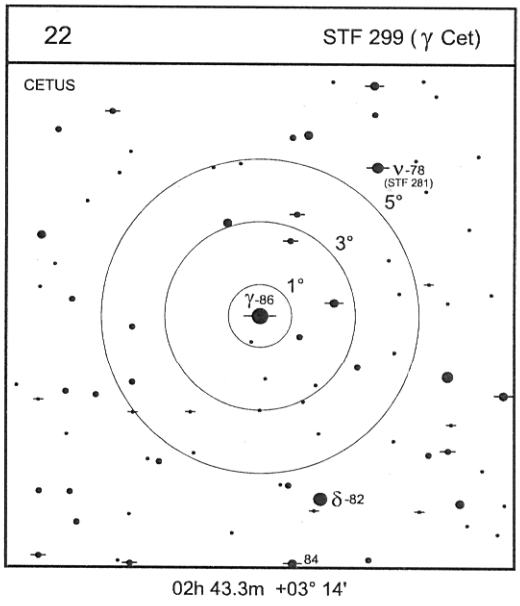
History

Alden & van de Kamp [172], working with the 26-inch refractor at McCormick Observatory, used photography to derive a parallax for γ Ceti. In the course of this work they noted that a star of magnitude 10.15 at a distance of 843″ turned out to have the same proper motion as the close pair. This angular distance converts to a linear distance of 21,000 AU. In the same paper Alden quoted the parallax of γ from five determinations as being 40 mas. This is in remarkably good agreement with the Hipparcos value given above.

The Modern Era

Hartkopf [173], using the 4-metre KPNO telescope for speckle photography in 1984, found that the bright component was single at the 30-mas level. Fuhrmann *et al.* [641] gave the

Finder Chart



Annie Cannon [176] classified the spectrum of θ Eri A as A2, although noting that some contamination from the B star had been seen.

The Modern Era

The brighter component is widely referred to as a spectroscopic binary but there are no obvious references to radial velocity measurements and there seems to have been no attempt to publish an orbit. Hurly & Warner [178] used an area scanner for the photometry of southern double stars using the telescopes at Sutherland, South Africa, but they were not able to confirm a report that the primary star was variable. Tokovinin notes in his MSC [177] that the period of θ^1 and θ^2 is expected to be about 1.1 million years.

Observing and Neighbourhood

'One of the gems of the southern sky' says Hartung in *Astronomical Objects for Southern Telescopes*. This is a brilliant pair of white stars which is clearly a long-period binary system. It sits in a visually sparse area of sky. Five degrees SSE is the triple star JC 8/HJ 3556 (p. xx). There is an attractive John Herschel pair to be found 2°.5 W, and slightly S: HJ 3527, 7.0, 7.2, 40°, 2″.3, 2013. RWA found a distant comes (ARY 95), maguitude 11.6 at 80°, 133″, whilst observing at Johannesburg in 2013.

Measures

Early measure (JC)	82°.4	8″.11	1851.76
Recent measure (ARY)	91°.1	8″.63	2013.67

24. ϵ ARI = STF 333 = WDS J02592+2120AB

Table 9.24 Physical parameters for ϵ Ari

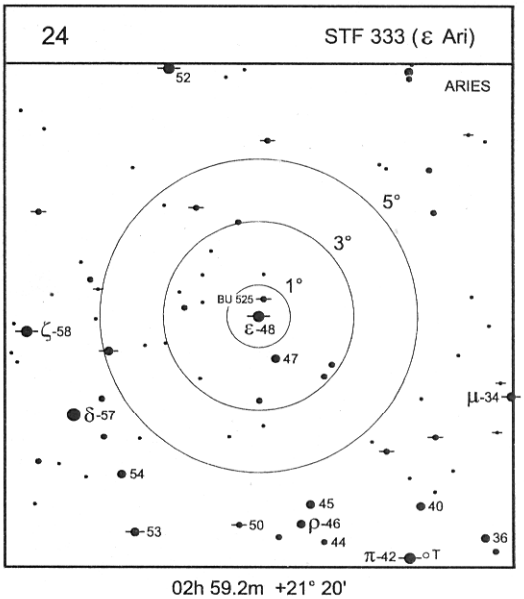
STF 333	RA: 02 59 12.73	Dec: +21 20 25.6	WDS: 57(452)		
V magnitudes	A: 5.17	B: 5.51			
$(B-V)$ magnitudes	A: +0.06	B: +0.07			
μ	-13.5 mas yr^{-1}	$\pm$ 0.93	-5.0 mas yr^{-1}	$\pm$ 0.64	
π	9.54 mas	$\pm$ 0.72	342 light yr	$\pm$ 26	
μ(B)	-14.09 mas yr^{-1}	$\pm$ 0.56	-7.35 mas yr^{-1}	$\pm$ 0.46 (DR2)	
π(B)	8.51 mas	$\pm$ 0.34	383 light yr	$\pm$ 15 (DR2)	
Spectra	A2Vs	A2Vs			
Luminosities ($L_\odot$)	A: 100	B: 70			
Catalogues (A/B)	48 Ari	HR 888/7	HD 18520/19	SAO 75673	HIP 13914
DS catalogues	STF 333	BDS 1512	ADS 2257		
Radial velocity	-7.9 km s^{-1}	$\pm$ 0.9			
Galactic coordinates	158°.693	$-32°.514$			

History

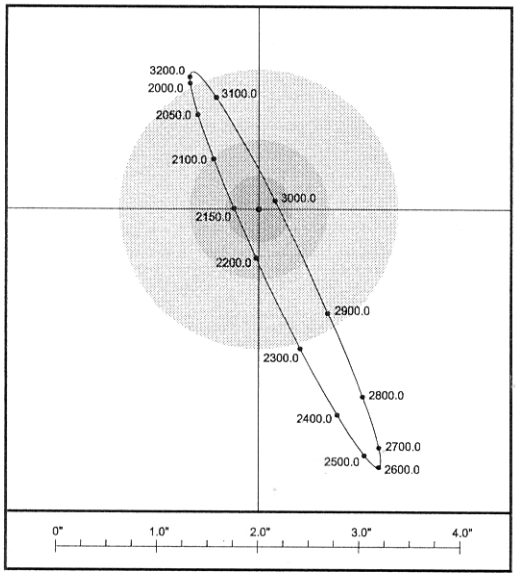
This double star was discovered by F. G. W. Struve at Dorpat. According to Smyth, Struve regarded ϵ Ari as perhaps the closest of his double stars and actually recorded them as in contact in his 1827 catalogue. Smyth also says that W. R. Dawes first observed this pair with Smyth's 5.9-inch refractor at Bedford (now on view at the Science Museum in Kensington). William Henry Smyth (1788–1865) was a direct descendant of Captain John Smith of Virginia. He went to sea early, and later saw action with large British fighting ships against the French and Spanish during the Napoleonic period. He learned hydrography and carried out a survey of Sicily, and later other areas in the Mediterranean, and during this time made the acquaintance of Piazzi, for whom he proofread some of the pages of the Palermo catalogue. In 1830 he acquired a 5.9-inch Tulley refractor with which he carried out the work for *A Cycle of Celestial Objects* [179], often known as the Bedford catalogue of 1844, which contained extensive notes

on 680 → MOVE TO NEXT PAGE

Finder Chart



Orbit



Ephemeris for STF 333 AB (2010 to 2100)

Orbit by FMR (2012g) Period: 1215.913 years, Grade: 4

Year	PA(°)	Sep(")	Year	PA(°)	Sep(")
2010.0	209.3	1.37	2060.0	214.0	1.02
2020.0	210.1	1.32	2070.0	215.4	0.94
2030.0	210.9	1.25	2080.0	217.1	0.85
2040.0	211.8	1.18	2090.0	219.2	0.76
2050.0	212.8	1.10	2100.0	221.9	0.66

double and multiple stars. He later wrote *Sidereal Chromatics* [180], a treatise on double star colours.

Add 'on 680'

FROM PREVIOUS PAGE

The Modern Era

An orbit for this pair with a period of 1215 years was calculated by Rica [181]. This is rather premature since the motion in position angle amounts to only 20° over 200 years. The B component is in DR2 but with a *G* magnitude only.

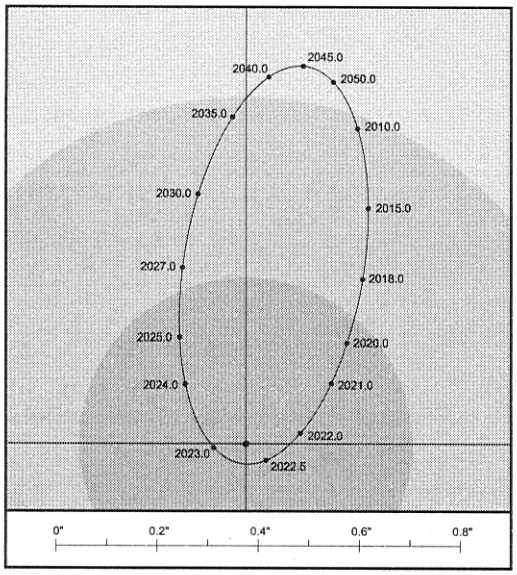
Observing

To find ϵ Ari, which forms a faint naked-eye pair with 47 Ari, start with β Arietis (V = 2.65) and move eastwards by 16°. This is an excellent test for a 10-cm aperture. Hartung finds both components to be pale yellow, although RWA has always seen them as white. The pair should be in the range of a 10-cm aperture for some decades to come. In the same field 17′ N is BU 525, a stiff test for 25-cm on a good night. The stars have an orbital period of 242 years and are both maguitude 7.5. The positions are 0″.47 and 279° (2020) and the stars will continue to edge closer for the next 50 years or so.

Measures

Early measure (STF)	189°.7	0″.58	1831.16
(Orbit	191°.5	0″.62)	
Recent measure: (ARY)	209°.9	1″.41	2012.66
(Orbit	209°.5	1″.36)	

Orbit



Ephemeris for JC 8 AB (2017 to 2026)

Orbit by Sod (1999) Period: 45.2 years, Grade: 3

Year	PA(°)	Sep(")	Year	PA(°)	Sep(")
2017.0	147.9	0.45	2022.0	101.2	0.11
2018.0	144.8	0.40	2023.0	276.9	0.06
2019.0	140.7	0.35	2024.0	225.5	0.17
2020.0	134.9	0.28	2025.0	211.9	0.25
2021.0	125.3	0.21	2026.0	204.7	0.31

suggest the detection of a planet outside the solar system. The star HJ 3556 was observed by Jacob in 1856 and he noted 'a strong suspicion that A is a close double in a direction nearly S., but the definition is not good enough to be certain'. Over the next 40 years or so the star was unobserved until it was 're-discovered' by the Harvard observers [248] in Chile in 1895, by Innes [187] in 1896, who acknowledged that Jacob had suspected the duplicity of A in 1856 but nevertheless assigned his discovery number 55 to it, and by Sellors [186] in 1897 who was aware of Innes' observation the year before but called it SLR 25.

The Modern Era

Olin Eggen [189], in a study of the radial velocities of double and multiple systems, noted that there was a significant variation in the radial velocities of this system and that the system was quadruple. This conclusion was questioned by Heintz in 1979; he argued that the observed mass ratio in the close pair does not support a fourth component. Heintz also estimated [185] that the period of the Herschel component was close to 1000 years. Recent radial velocity measures of the close AB and C stars by Tokovinin using the 100-inch Du Pont telescope at Las Campanas suggest that the stars are fast rotators and that they have 'similar' velocities. The current orbit by Söderhjelm gives the period as only 45.2 years, yet, surprisingly, the orbit is graded only as three despite having been observed through almost 3 complete revolutions. However, the apparent ellipse takes the companion from a distance of around 0″.8 to 0″.04 when angular motion is rapid, and there is no coverage of this part of the orbit.

Observing and Neighbourhood

The JC 8 stars are easily found about 5° SSE of the maguitude 3.0 θ Eri, a very bright pair, details of which can be found on p. xx. The pari JC 8 will require 40-cm for the years to 2020 (135°, 0″.28), after which it closes rapidly and will not exceed 0″.30 again until 2027 or so. The bright Herschel companion is a much easier object and is accessible to 7.5-cm. Another John Herschel pair can be found 2°.5 SE. This is HJ 3576, 7.3, 8.8, 342°, 2″.8, 2015, closing since discovery.

Measures

JC 8			
Early measure (I)	182°.4	0″.87	1900.72
(Orbit	180°.1	0″.68)	
Recent measure (TOK)	149°.6	0″.48	2015.91
(Orbit	150°.8	0″.49)	
HJ 3556			
Early measure (HJ) :	233°.3	1″.5	1835.80
Recent measure (ANT) :	188°.6	3″.75	2013.72

27. 95 CET = AC 2 = WDS J03184−0056

Table 9.27 Physical parameters for 95 Cet

AC 2	RA: 03 18 22.426	Dec: −00 55 49.04	WDS: 681(100)		
V magnitudes	A: 5.60	B: 7.97	C: 16.2		
$(B-V)$ magnitudes	A: +1.26	B: +0.64			
μ	-253.18 mas yr^{-1}	± 0.95	-60.32 mas yr^{-1}	± 0.78	
π	14.89 mas	$\pm$ 0.84 mas	219 light yr	$\pm$ 12	
μ(A)	249.67 mas yr^{-1}	$\pm$ 0.24	-60.71 mas yr^{-1}	$\pm$ 0.24 (DR2)	
μ(C)	250.77 mas yr^{-1}	$\pm$ 0.22	-57.77 mas yr^{-1}	$\pm$ 0.21 (DR2)	
π(A)	15.63 mas	$\pm$ 0.18	208.7 light yr	$\pm$ 2.4 (DR2)	
π(C)	15.71 mas	$\pm$ 0.16	207.6 light yr	$\pm$ 2.1 (DR2)	
Spectra	A: G9IV	B: ?	C: DA		
Luminosities ($L_\odot$)	A: 20	B: 2	C: 0.001		
Catalogues	95 Cet	HR 992	HD 20559	SAO 130408	HIP 15383
DS catalogues	AC 2 (AB)	BDS 1650	ADS 2459	LDS 3472 (AC)	
Radial velocity	31.2 km s^{-1}	$\pm$ 0.2			
Radial velocity (A)	31.97 km s^{-1}	$\pm$ 0.12 (DR2)			
Galactic coordinates	123°.976	−39°.236			

History

The names of Alvan Clark (AC) and Alvan G. Clark (AGC) are associated with some rather difficult and interesting binary systems. The most famous example is Sirius (AGC1) – another is τ Cygni (AGC 13). Neither man was a double star observer but during the course of testing the firm's famous telescope objectives they often resorted to using stars to make the final assessment. In 1853 Alvan was checking the performance of a 7.5-inch objective on the sky when he looked at the star 95 Cet and noted that it was a close and unequal double (*Burnham Double Star Catalogue*, 1906). Clark happened to come to Europe later that year and met the Reverend W. R. Dawes. When Dawes heard about this difficult pair he became very keen to obtain such an objective for his own observatory. In 1854 the lens was duly delivered and Dawes was delighted with its performance. At the end of the nineteenth century the pair was difficult to observe (it was then separated by about 0″.4) and Aitken [191] noted that Burnham called 95 Ceti 'the most mysterious and strange double star in the heavens'. Burnham added 'I have tried it, first and last, perhaps hundreds of times with apertures all the way from 6 to 36 inches without being able to see any trace of the little star'. Aitken was reluctant to ascribe this to variability, pointing out it could be due to poor seeing or a poor telescope.

The Modern Era

Baize & Petit [144] included 95 Cet in their catalogue of 1989 and marked the A component as an RS CVn variable, whilst Willem Luyten [192], in a search for common proper motion