$\sim$
2.5
??
α
1
$d =$
$197\pm$
45
$_2008). It has a limb darkened angular diameter of$
$\pm 0.15^2$
$_2009 which means that it subtends the largest angular diameter of any star in the northern sky apart from the Sun. It is by far the$
$formation region Ori OB1$ [?, see, e.g.,]] $hoogerwerf_2000, and was a spectral type O9V star while on the main sequence, where i$
$20\,M_\odot$
?
$18 M_\odot$
$^{-2}$
$2\times$
$10^{-5} g_\odot$
$10-$
17
$^{-1}$
$\sim$
$3\times$
$10^{-6} M_\odot yr^{-1}$
$_2001. Like most late-$
$type evolved stars, Betelgeuse's terminal wind velocity_\infty$
v_{esc}
??
α
α

		... ? ...
	0.45 ± 0.4	?
	$^{h\,m\,s}$	?
	$^{\circ\,\prime}$	?
$^{-1}$		?
$^{-1}$		?
π	5.07 ± 1.1	?
	197 ± 45	?
$M_\star M_\odot$	~ 20	?
		?
$M_\star M_\odot$	~ 18	?
θ_{UD}	43.33 ± 0.04	?
θ_{LD}	44.28 ± 0.15	?
$R_\star R_\odot$		?
T_{eff}		?
$_{10}\,L_\star/L_\odot$	5.10 ± 0.22	?
$_{10}\,g_\star{}^{-2}$		?
$v_{rad}{}^{-1}$	20.7 ± 0.4	?
$v_{esc}{}^{-1}$		
$v_\infty{}^{-1}$		?
T_{wind}	< 4000	?
$M_\star M_\odot{}^{-1}$	3×10^{-6}	?
$H_\star R_\star$		...
[]	0.05 ± 0.14	?
		?
		?
$B_\star$	$-3 \rightarrow +2 \pm 0.5$	?
	...	?
	...	?
	...	?
1213	6 ± 1	?
1617	525 ± 250	?
1618	700 ± 300	?

$\sim$
17
$_1998, which implies that it is probably experiencing very limited action of a solar-$
$like dynamo. This rotation period is in stark contrast to the equatorial solar rotation rate which is just 24.5 days. Its larger radius$
$950\,R_\odot$
$H_\star \sim$
$0.01\,R_\star$
?
$_2007.$ [?] $have recently monitored Betelgeuse over a three year period using high resolution spectropolarimetry, and find a long$
± 0.5
$+2\pm$
0.5
$T_e \sim$
8000
$_1982, hartmann_1984. In fact, high resolution UV photon scattering imaging with the HST partially resolved the hot chromosph$
$_1996. However,$ [?] $spatially resolved Betelgeuse with the 'old' VLA at 5 different wavelengths and showed that the mean electr$
$2000-$
4000
??
?
$<$
2500
?
?
$_template/3/lim1.ps[trim = 0pt 20pt 0pt 0pt, clip, scale = 0.35]/home/eamon/thesis/thesis_template/3/lim2.ps[VLA spati$
$\sim$
$5.4\times$
10^{-4}
$_2001, bowers_1987, and low molecular abundances knapp_1980, huggins_1987, jewell_1991, lambert_1978. However, it is known to$
$0.1 R_\star$
$\sim$
1500
$\sim$
$1.4 R_\star$
2

$_2$009.Thedatawerecomparedto3−
Dhydrodynamicalsimulationsby[?], resultinginthedetectionofagranulationpatternonthesurface.Theyconcludedthatth
30
5−
15
1.04−
2.17μm
$R_\star$
$R_\star$
$_2$009.Theseplumeshavebeenattributedtotheactionofgiantconvectioncells.ThermalinfraredVLT(λ =
8−
20μm
100$R_\star$
2.5
$_2$011, whileHerschelimagesshowachaoticdustdistributionfaroutinthecircumstellarenvelope, i.e., beyond$_\star$
>
15
$_2$012.Aconclusionthatcanbedrawnfromthesestudiesistheconstantpresenceofinhomogenitiesinthecircumstellarenviron
$_2$006isamillimeterinterferometerlocatedatCedarFlatineasternCaliforniaatanelevationof2200 m.Thearrayconsistso
115GHz(3mm)and215−
270GHz(1.3mm).Eightadditional3.5mantennasknownastheSunyaev−
Zel′dovichArray(SZA)canalsobeaddedtoCARMAforcontinuumobservationsat26−
36GHz(1cm)and85−
115GHz(3mm).ThedifferentsizesoftheCARMAantennasmakesitaheterogeneousarraywithatotalcollectingareaequi
elementCARMAarrayhas3differentprimarybeams), therearea numberofadvantages.Suchanarraysamplesshorterspa

$_t$emplate/3/carma$_c$onfigs.ps[CARMAarrayconfigurationsused]ThethreeCARMAarrayconfigurationsusedtostudyt
66
mid-
dle
B_{max} =
148
right
B_{min} =
370

$_t$emplate/3/carma$_l$ayout.ps[LayoutofantennapadsforCARMA]ThelayoutofantennapadsforCARMAandavisualofth
??
??
ν
50×
(230 GHz/ν)
30×
(230 GHz/ν)
B_{max}
B_{min}
θ_{HPBW}
θ_{LAS}
θ_{HPBW} 50 × (230 GHz/ν)
template/3/carma$_s$ig.ps[MajorcomponentsinthesignalpathforCARMA]Majorcomponentsinthesignalpaththrought
θ_{HPBW} 30 × (230 GHz/ν)
$_2$004forthe1mmband, andsingle−
polarizationSISreceiversforthe3mmband.Thetuningrangesofthe1 mmand3 mmreceiversareGHzandGHz, respective
ν_{IF}
ν_{LO1}
ν_{RF}

$$\nu_{IF} = \nu_{RF} \pm \nu_{LO1}. \quad (1)$$

$G_{RF}(\nu_{RF})$
$G_{IF}\nu_{IF}$

$$\nu_{BB} = \nu_{IF} \pm \nu_{LO2}. \quad (2)$$

$_2$009.Thepowermeasurement,$_{sys}$
^{1216}J =
??
$_3$
2.1
4.4
0.9
32
α
α
a
a
1.3$km\,s^{-1}$
0.65$km\,s^{-1}$
2.5
18
2.5
ζ
$_1$970; baade$_1$996; eaton$_2$008; crowley$_2$008).Eventhoughthesesystemsofferusthebestopportunitytoobtaininformationont
λ
$_1$999.Inordertoavoidtheassumedadditionalcomplexitiesofacompanion, wehaveselectedtwosingleluminosityclassIIIre
Arcturus(α
α
??
F_ν
??
0.14
7$R_\star$

?
H
K
h
k
OAO-3
Coper-ni-cus
8000
$T_{min}/T_{eff} \sim 0.77$
IUE
?
$10,000-20,000$
IUE
?
k
IUE
??
2×10^{-10}
$M_{\odot}$
$^{-1}$

$_{t}emplate/3/drake_{m}g.ps[IUEMgiiklineandDrakemodels]IUEMgiiklineprofileforArcturusover-plottedwiththemodele$

IUE
λ
6×10^{4}
$\sim$
1×10^{5}
HST
3σ
$_{2}003.ItappearsthatArcturushasbeenabletosustainamodestlevelofmagneticactivity.Threemeasurementsforthemeanlon$
$\pm 0.26, 0.43\pm 0.16,$
-0.23 ± 0.20
$_{2}011, andamagneticcyclewithaperiodof \geq 14$
$_{2}008.$