

Carbon in the sky: a few remarkable carbon stars

A carbon star is a late type star similar to a red giant whose atmosphere contains more carbon than oxygen. The two elements combine in the outer layers of the star, forming carbon monoxide, which consumes all the oxygen in the atmosphere. These usually deep-red stars are good objects to look at. Here is the list of the most interesting and bright carbon stars published for northern observers.

Carbon stars are evolved cool giants (and sometime dwarf) with circumstellar shells or clouds of carbon dust material. It's a late stage in the evolution of a star on its way to death. The typical surface temperature is between 2000K and 3000K. The apparent color of this stars is deep red and all are irregular or semi-regular variables. They have quite distinctive spectral characteristics, and were first recognized by their spectra by Angelo Secchi in the 1860s, a pioneering time in astronomical spectroscopy.

The Henry Draper catalogue produced at Harvard by Annie J. Cannon and her assistants, was the primary source of data on carbon stars until the 1940s. Starting with the pioneering work of Lee et al. (1940), low-dispersion objective-prism spectra have been widely used for the identification of red stars. Regular stars, like our Sun, have atmospheres which is richer in oxygen than carbon. This fact makes it possible to search for specific lines in stellar spectra and recognize carbon stars reliably.

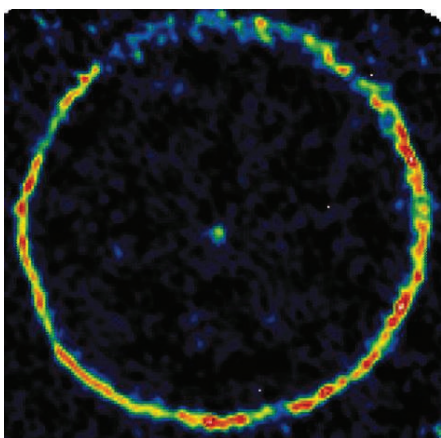
By 1989, *A General Catalog of Cool Galactic Carbon Stars, 2nd ed.* (GCCS2) compiled by Stephenson at the Warner and Swasey Observatory, included 5987 carbon stars. The third edition of this catalog (2001) includes 6891 entries. Carbon stars are asymptotic giant branch (AGB) stars. AGB classification derives three main types, based on their atmospheric composition: carbon-rich, oxygen-rich and S-type.

When astronomers developed the spectral classification of the carbon stars, they faced a difficulty in trying to correlate the spectra to the stars' effective temperatures. The reason is that the atmospheric carbon hiding the absorption lines in the spectra. These lines are normally used as temperature indicators for stars.

Some presumed giant C stars were seen to have high proper motions, and coupled with low luminosity, were determined to be the elusive dwarf carbon (dC) star. To get more information on dwarf carbon stars please refer to Paul Green's articles.

Angelo Secchi

(1818 – 1878) – an Italian astronomer. He was Director of the Observatory at the Pontifical Gregorian University for 28 years. Secchi is known for pioneering an astronomical spectroscopy and valuable contribution to the field of Sun study. special interest was the Sun. Angelo was one of the first scientists to state authoritatively that the Sun is a star. He also revised Struve's catalog of double stars, compiling data for over 10,000 binaries, and discovered three comets.



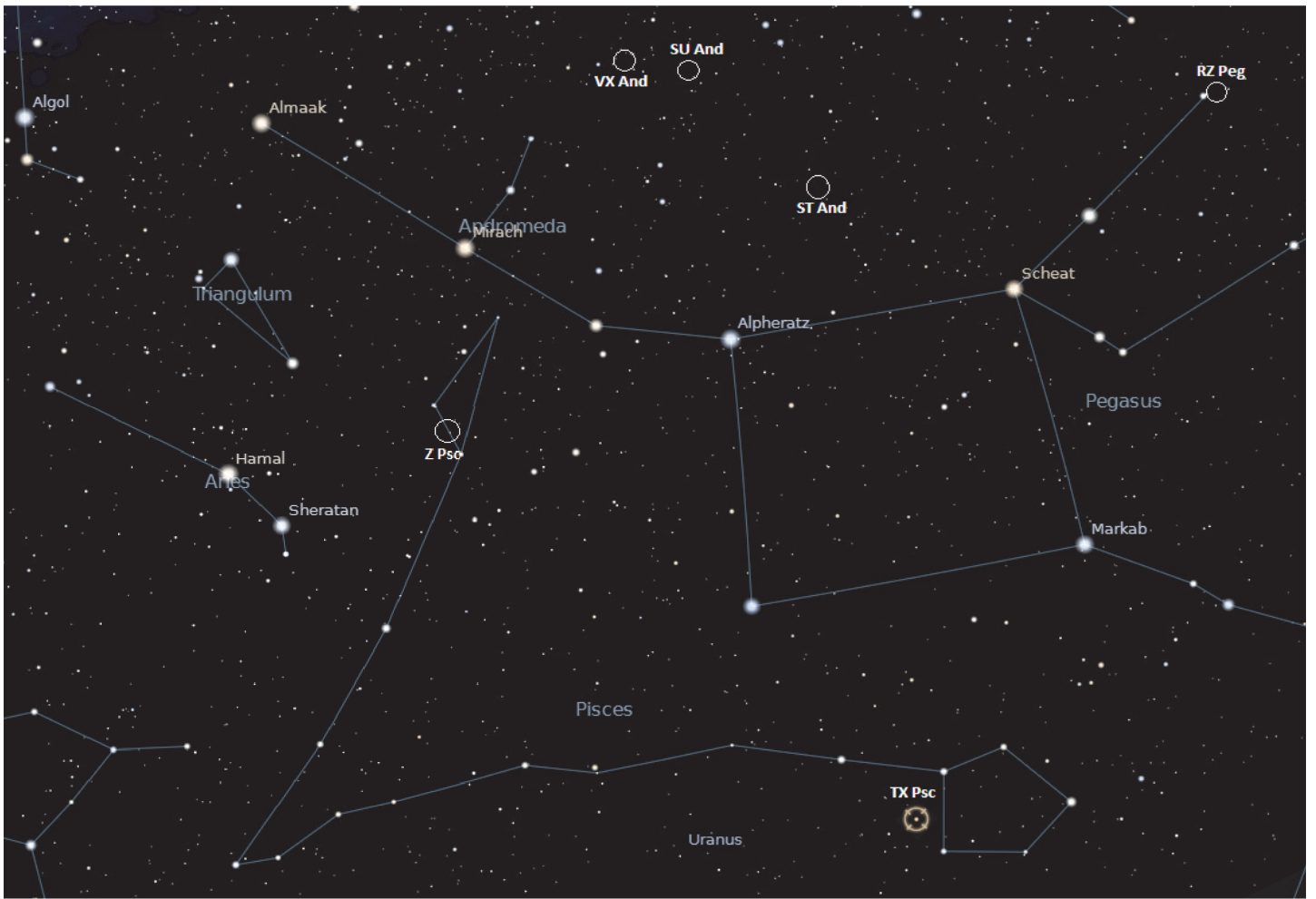
TT Cygni. A carbon star.

Credit & Copyright: H. Olofsson (Stockholm Observatory) et al.

Due to the insensitivity of night vision to red and a slow adaption of the red sensitive eye rods to the light of the stars, amateur astronomers making magnitude estimates of red variable stars, especially carbon stars, have to know how to deal with the Purkinje effect in order not to underestimate the magnitude of the observed star.

One of the interesting carbon stars is *TT Cygni*. This is a cool red giant star with a wind. This false-color picture (left) of TT Cyg was made using an array of millimeter wavelength radio telescopes and shows radio emission from carbon monoxide (CO) molecules in the surrounding gas.

Carbon stars may be fascinating objects to look at even for backyard stargazers. There are dozens bright of them to see in binocular and even with a naked eye. Below there is a list of the most bright and interesting carbon stars for northern observers.



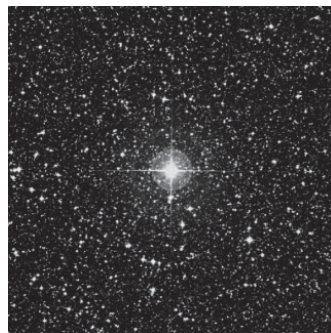
The constellation of Pisces, Pegasus, Andromeda.
Carbon stars to look at: **TX Psc** (19 Psc), **Z Psc**, **RZ Peg**, **VX And**, **SU And**, **ST And**.

Autumn sky provides a nice view of the Pegasus Square area and its neighbor constellations. There are a number of fairly bright carbon stars to observe there. Some of them are presented in the table below.

Object Designation		RA (J2000)	DEC (J2000)	Sp. Type	Period	Mag. Range
SU And	HIP 363, HD 225217	00 04 36.4	+43 33 05	C6,4	Irr.	8.0 - 8.5
VX And	HIP 1593, HD 1546	00 19 54.2	+44 42 34	N7;C4,5	367	7.8 - 9.5
Z Psc	SAO 74593, HIP 5914, HD 7561	01 16 04.7	+25 46 08	N0;C7,3	144	6.7 - 7.9
RZ Peg	HIP 109089, HD 209890	22 05 52.9	+33 30 24	Ne;C9,1e	439	7.6 - 13.5
ST And	HIP 116681, HD 222241	23 38 45.2	+35 46 26	R3e;C6,4e	328	8.2 - 11.8
TX Psc	19 Psc, SAO 128374, HIP 117245	23 46 23.5	+03 29 11	N0;C7,2	Irr.	5.3 - 6.0



VX Andromedae, HIP 1593



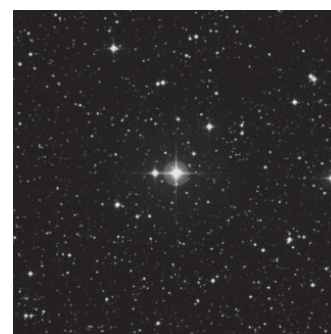
V Aquilae, SAO 142985



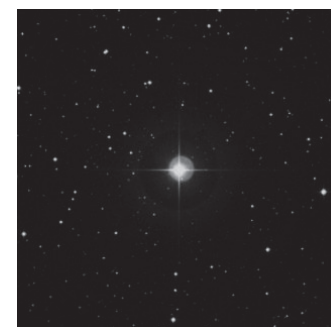
UU Aurigae, SAO 59280



U Cygni, SAO 49477



WZ Cassiopeia, SAO 21002



S Cephei, SAO 10100

The constellation of Cepheus and Cassiopeia. Carbon stars to look at: **WZ Cas**, **S Cep**.

The following table lists more bright carbon stars in the sky to see with a binocular or telescope. More detailed descriptions of the stars are out of the scope of the article though.

Object Designation	RA (J2000)	DEC (J2000)	Sp. Type	Period	Mag. Range	
WZ Cas	SAO 21002, HIP 99, HD 224855	00 01 15.7	+60 21 19	N1p;C9,2	186	6.9 - 11.0
S Cep	SAO 10100, HIP 106583	21 35 13.1	+78 37 25	N8e;C7,4e	487	7.5 - 12.9
FU Aur	SAO 58449, HIP 27398	05 48 08.2	+30 37 54	N0;C7,2		~8.3
R Lep	SAO 150058, <i>Hinds Crimson Star</i>	04 59 36.3	-14 50 48	N6e;C7,6e	427	5.9 - 11.0
W Ori	SAO 112406, HIP 23680	05 05 23.7	+01 10 40	N5;C5,4	210	6.5 - 10.0
UU Aur	SAO 59280, HIP 31579	06 36 32.9	+38 26 42	N3;C5,3		~6.2
V Aql	SAO 142985, HIP 93666	19 04 24.4	-05 41 06	N6;C6,4	350	6.5-8.1
U Cyg	SAO 49477, HIP 100219	20 19 36.4	+47 53 39	Npe;C9,2e	463	6.7-12.0
V Hya	SAO 179278, HIP 53085	10 51 37.3	-21 15 0	C9I	18y/530d	7.0 – 11.5
Y Cvn	SAO 44317, <i>La Superba</i>	12 45 08.0	+45 26 25	N3;C5,5	158	4.8-6.4
T Lyr	SAO 67087, HIP 90883	18 32 19.0	+36 59 50	R6;C6,5	Irr.	7.5-9.3
U Cam	SAO 12870, HIP 17257	03 41 47.8	+62 38 57	N5;C5,4		~6.9
X Cnc	SAO 98230, HIP 43811	08 55 22.9	+17 13 51	N3;C5,4	195	5.6-7.5

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