VARIABLE STAR TYPE DESIGNATIONS IN VSX

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For an alphabetical list of variable star types used in VSX, click **here**.

Based on the General Catalog of Variable Stars (GCVS) **document** of variable star type designations (Samus et al., 2009) with expansions, clarifications, corrections, and additions from the literature and surveys.

This list includes all variability types found in the AAVSO International Variable Star Index (VSX). Most of them come from the GCVS, but we have added new types recognized in the literature and types used in lists published in other studies and surveys.

CONVENTIONS USED IN THIS DOCUMENT

A pipe character (|) between two different types signifies a logical *OR*; the classification is uncertain and all possible types are indicated. An example of this is **ELL|DSCT**, where the star may be an ellipsoidal binary system or a **DSCT**-type pulsating variable with half the given period.

A plus character (**+**) signifies a logical *AND*; two different variability types are seen in the same star or system. An example of this would be **ELL+DSCT**, where one of the components of an ellipsoidal binary system is a **DSCT**-type pulsating variable.

A slash character (/) indicates a subtype. In the case of binary systems (eclipsing, ellipsoidal or reflection variables) it is used to help describe either the physical properties of the system (**E**/**PN** or **EA**/**RS**), the luminosity class of the components (**EA**/**DM**), or the degree of filling of their inner Roche lobes (**EA**/**SD**). This is the GCVS classification system. In cataclysmic variables, slash characters are used to indicate some properties of the system, as in the degree of polarization (**NA**/**DQ**) or the nature of their components (**UG**/**IBWD**). In some cases, these subtypes also constitute an independent main variable star type, because the main type of variability they are usually associated with is not present. There are non-eclipsing RS CVn stars (**RS**), eruptive single Wolf-Rayet stars (**WR**) and cataclysmic binary subtypes showing variability but no outbursts (**DQ**, **IBWD**). In X-ray binaries, the subtypes indicate which kind of behavior the binary displays, as in X-ray bursts (**XB**), large amplitude outbursts also in the visual (**XN**), reflection effect (**XR**) or it may also indicate something about the object's nature, as in a compact object which is a pulsar (**XP**). Finally, the subtypes of **NL** (nova-like; **NL**/**V** and **NL**/**VY**) are shown as independent classes, since these subtypes do not apply to a class other than **NL**.

Some variability classes show more than one type of variation, but they have been classified in the group that includes their more important type of variability. For example, **SDOR** stars show both eruptions and pulsations, but they have been included in the eruptive group only. The type definition explains their behavior. **RCB** stars also pulsate, but since their main feature is deep fadings, they are also included in the eruptive group only. The same is valid for the **DYPer** stars. **DPV** variables show periodic orbital variability, but they experience mass loss and what defines them is the presence of a long period lasting about 33 times the orbital period. They are therefore also included in the eruptive group only. The origin of variability of the λ Eri type variables (**LERI**) is not clear: they may be due to rotation or non-radial pulsation. They have been included in the class of rotating variables only.

Survey types are classifications taken as they appear in the original published lists from the survey owners/analysts. They are included under separate heading in this document because they are not actual types, per se, but are usually the result of less specific classification due to the automated nature of the analysis. These types should eventually be replaced by the conventional types.
Variable type designation used in VSX but not currently used in the GCVS are highlighted in the main listings of this document by the accompanying ✔ icon.

I. MAIN VARIABILITY GROUPS

A first distinction has to do with the nature of the variations:

Extrinsic

Variability is due to eclipse of one star by another or the effect of stellar rotation
Extrinsic variable stars are divided into three groups:

Eclipsing

Orbital plane coincident with our line of sight

Rotating

Spots, reflection, or ellipsoidal shape

Microlensing events

Intrinsic

Variation is due to physical changes in the star or stellar system

Intrinsic variable stars are divided into four groups:

Pulsating

Contraction and expansion

Eruptive

Mass ejection or chromospheric activity

Cataclysmic

Interacting binary systems with white dwarfs or stars showing large amplitude outbursts

X-ray

Binary systems with neutron stars or black holes

II. VARIABLE TYPES WITHIN MAIN GROUPS

1. ECLIPSING

Main types

E

Eclipsing binary systems. These are binary systems with orbital planes so close to the observer's line of sight (the inclination of the orbital plane to the plane orthogonal to the line of sight is close to 90 deg.) that the components periodically eclipse each other. Consequently, the observer finds changes of the apparent combined brightness of the system with the period coincident with that of the components' orbital motion.

EA

β Persei-type (Algol) eclipsing systems. Binaries with spherical or slightly ellipsoidal components. It is possible to specify, for their light curves, the moments of the beginning and end of the eclipses. Between eclipses the light remains almost constant or varies insignificantly because of reflection effects, slight ellipsoidality of the components, or physical variations. Secondary minima may be absent. An extremely wide range of periods is observed, from 0.2 to ≥10000 days. Light amplitudes are also quite different and may reach several magnitudes.

EB

β Lyrae-type eclipsing systems. These are eclipsing systems having ellipsoidal components and light curves for which it is impossible to specify the exact times of onset and end of eclipses because of a continuous change of the system's apparent combined brightness between eclipses; secondary minimum is observed in all cases, its depth usually being considerably smaller than that of the primary minimum; periods are mainly longer than 0.5 days. The components generally belong to early spectral types (B-A). Light amplitudes are usually <2 mag. in *V*.

EP

Stars showing eclipses by their planets.
Prototype: ***V376 Peg***.

EW

W Ursae Majoris-type eclipsing variables. These are eclipsers with periods usually shorter than 1 day, consisting of ellipsoidal components almost in contact and having light curves for which it is impossible to specify the exact times of onset and end of eclipses. The depths of the primary and secondary minima are almost equal or differ insignificantly. Light amplitudes are usually <0.8 mag. in *V*. The components generally belong to spectral types F-G and later.

Survey types

EC

Contact binaries in ASAS-3. Both components filling or close to filling their Roche lobes. These are mostly **EW** variables.

ED

Detached eclipsing binaries (**EA**) in ASAS-3.

ESD

Semi-detached eclipsing binaries (**EA** or **EB**) in ASAS-3.

Subtypes

AR

Detached systems of the AR Lacertae type. Both components are subgiants not filling their inner equipotential surfaces.

D

Detached systems, with components not filling their inner Roche lobes.

DM

Detached main-sequence systems. Both components are main-sequence stars and do not fill their inner Roche lobes.

DS

Detached systems with a subgiant. The subgiant also does not fill its inner critical surface.

DW

Systems similar to W UMa systems in physical properties (**KW**), but not in contact.

GS

Systems with one or both giant and supergiant components; one of the components may be a main sequence star.

K

Contact systems, both components filling their inner critical surfaces.

KE

Contact systems of early (O-A) spectral type, both components being close in size to their inner critical surfaces.

KW

Contact systems of the W UMa type, with ellipsoidal components of F0-K spectral type. Primary components are main-sequence stars and secondaries lie below and to the left of the main sequence in the (MV, B-V) diagram.

PN

Binary systems having, among their components, nuclei of planetary nebulae.
Example: ***UU Sge***.

SD

Semi-detached systems in which the surface of the less massive component is close to its inner Roche lobe.

WD

Binary systems with at least one white-dwarf component, or a single rotating white dwarf.

2. ROTATING

Main types

ACV

α^2 Canum Venaticorum variables. These are main-sequence stars with spectral types B8p-A7p and displaying strong magnetic fields. Spectra show abnormally strong lines of Si, Sr, Cr, and rare earths whose intensities vary with rotation. They exhibit magnetic field and brightness changes (periods of 0.5-160 days or more). The amplitudes of the brightness changes are usually within 0.01-0.1 mag. in *V*.

BY

BY Draconis-type variables, which are emission-line dwarfs of dKe-dMe spectral type showing quasi-periodic light changes with periods from a fraction of a day to 120 days and amplitudes from several hundredths to 0.5 mag. in *V*. The light variability is caused by axial rotation of a star with a variable degree of non-uniformity of the surface brightness (spots) and chromospheric activity. Some of these stars also show flares similar to those of **UV Ceti stars**, and in those cases they also belong to the latter type and are simultaneously considered eruptive variables.

CTTS/ROT ✔

Classical **T Tauri stars** showing periodic variability due to spots. They have extensive disks that result in strong emission lines (EW(Hα) ≥ 10Å).
GCVS types **INT** and ***IT***.

ELL

Rotating ellipsoidal variables. These are close binary systems with ellipsoidal components, which change combined brightnesses with periods equal to those of orbital motion because of changes in emitting areas toward an observer, but showing no eclipses. Light amplitudes usually do not exceed 0.1 mag. in *V*.
Examples: ***b Per***

FKCOM

FK Comae Berenices-type variables. These are rapidly rotating single G and K-type giants with nonuniform surface brightnesses. Their photometric behaviour is similar to that of **RS CVn** systems but the absorption lines and Ca II reversals exhibit extreme rotational broadening, with a projected equatorial velocity of 100-160 km/s. They have strong magnetic activity and X-ray emission and contain the hottest coronal plasmas among active stars. Periods of light variation (up to several days) are equal to rotational periods, and amplitudes are several tenths of a magnitude. It is not excluded that these objects are the product of further evolution of **W UMa** close binary systems (binary coalescence).
Examples: ***FK Com***, ***YY Men***.

LERI ✔

λ Eri type variables. Be stars with the light variation caused by rotational modulation or non-radial pulsations. Their light curves are usually double-waved and with changing amplitude. Periods in the order of 0.3 - 3 d.

PSR

Optically variable pulsars, which are rapidly rotating neutron stars with strong magnetic fields, radiating in the radio, optical, and X-ray regions. Pulsars emit narrow beams of radiation, and periods of their light changes coincide with rotational periods (from 0.004 to 4 s), while amplitudes of the light pulses reach 0.8 mag.
Example: ***CM Tau***.

R

Close binary systems characterized by the presence of strong reflection (re-radiation) of the light of the hot star illuminating the surface of the cooler companion. Light curves are sinusoidal with the period equal to P_{orb}, maximum brightness coinciding with the passage of the hot star in front of the companion. The eclipse may be absent. The range of light variation may reach 1 mag. in *V*.
Example: ***KV Vel***.

ROT ✓

Spotted stars that weren't classified into a particular class. All the SPOTTED stars in the UNSW list and the very small amplitude spotted stars found by Kepler are included here. Also, some stars that don't fit the current subtypes due to their physical properties have been classified as such (brown dwarfs and white dwarfs with spots). It may be used as a subtype when a T Tauri star shows rotational variability (**TTS**/**ROT**, **CTTS**/**ROT** or **WTTS**/**ROT**).

RS

RS Canum Venaticorum-type binary systems. A significant property of these systems is the presence in their spectra of strong Ca II H and K emission lines of variable intensity, indicating increased chromospheric activity of the solar type. These systems are also characterized by the presence of radio and X-ray emission. Their light curves look like sine waves outside eclipses, with amplitudes and positions changing slowly with time. The presence of this wave (often called a distortion wave) is explained by differential rotation of the star, its surface being covered with groups of spots; the period of the rotation of a spot group is usually close to the period of orbital motion but still differs from it, which is the reason for the slow change (migration) of the phases of the distortion wave minimum and maximum in the mean light curve in the case of the eclipsing binaries (**E**/**RS**). The variability of the wave's amplitude (which may be up to 0.5 mag. in *V*) is explained by the existence of a long-period stellar activity cycle similar to the 11-year solar activity cycle, during which the number and total area of spots on the star's surface vary.

SXARI

SX Arietis-type variables. These are main-sequence B0p-B9p stars with variable-intensity He I and Si III lines and magnetic fields. They are sometimes called helium variables. Periods of light and magnetic field changes (about 1 day) coincide with rotational periods, while amplitudes are approximately 0.1 mag. in *V*. These stars are high-temperature analogs of the **ACV** variables.

TTS/ROT ✓

T Tauri stars showing periodic variability due to spots, but not yet classified as Classical (**CTTS**/**ROT**) or Weak-lined (**WTTS**/**ROT**).

WTTS/ROT ✓

Weak-lined **T Tauri stars** showing periodic variability due to spots. A T Tauri star that lacks strong emission lines in its optical spectrum (EW(Hα) < 10Å), and lacks both strong stellar winds and a circumstellar accretion disk. Also known as naked T Tauri star.
GCVS types **INT** and ***IT***.

Survey types

NSIN ELL

Designation in the OGLE catalogues for stars with strictly periodic light curves, which are evidently non-sinusoidal and are likely to be ellipsoidal variables.

Subtypes

PSR

Binary systems having a pulsar as the compact object that strongly irradiates a low mass companion. Example: ***QX Sge*** (**E**/**PSR**).

ROT ✓

T Tauri stars showing periodic variability due to spots. For those members of this class where special features are well known, the subtype classifications of **CTTS**/**ROT** or **WTTS**/**ROT** may be applied. Where not precisely known, the subtype of **TTS**/**ROT** is used.

RS

Used as a subtype for eclipsing or ellipsoidal systems showing chromospheric activity (RS-type variability).

3. PULSATING

Main types

ACEP ✓

Anomalous Cepheids. Stars with periods characteristic of comparatively long-period **RRAB** variables (0.4 to 2 days), but considerably brighter by luminosity. They are more massive (1.3 to 2.2 solar masses) than **RR Lyrae stars**. They are metal-poor A and early F-type stars.
GCVS type ***BLBOO***.

ACYG

Variables of the α Cygni type, which are non-radially pulsating supergiants of Bep-AepIa spectral types. The light changes with amplitudes of the order of 0.1 mag. often seem irregular, being caused by the superposition of many oscillations with close periods. Cycles from several days to several weeks are observed.

BCEP

Variables of the β Cephei type (***β Cep***, ***β CMa***), which are non-superigiant pulsating O8-B6 stars with light and radial-velocity variations caused by low-order pressure and gravity mode pulsations. Periods are in the range of 0.1 - 0.6 days and light amplitudes go from 0.01 to 0.3 mag. in *V*. The light curves are similar in shape to average radial-velocity curves but lag in phase by a quarter of the period, so that maximum brightness corresponds to maximum contraction, i.e., to minimum stellar radius. The majority of these stars probably show radial pulsations, but some display nonradial pulsations; multi-periodicity is characteristic of many of these stars.
Example: ***V469 Per***.

BCEPS

A short-period group of **β Cep variables**. The spectral types are B2-B3 IV-V; periods and light amplitudes are in the ranges 0.02 - 0.04 days and 0.015 - 0.025 days, respectively, i.e., an order of magnitude smaller than the normally observed ones. Elimination of this type proposed by GCVS.

BXCIR ✓

Hydrogen-deficient B stars (Extreme Helium stars) showing low-amplitude variations in light (0.1 mag. in *V*) and radial velocity due to radial pulsations driven by the κ (kappa) mechanism through Z-bump instability. They show a unique and very regular period of around 0.1 days.
Examples: ***BX Cir***, ***V652 Her***.

CEP

Cepheids. Radially pulsating, high luminosity (classes Ib-II) variables with periods in the range of 1-135 days and amplitudes from several hundredths to 2 mag. in *V* (in the *B* band, the amplitudes are greater). Spectral type at maximum light is F; at minimum, the types are G-K. The longer the period of light variation, the later is the spectral type. The maximum of the surface-layer expansion velocity almost coinciding with maximum light. There are several subtypes (see **DCEP**, **DCEP(B)**, **DCEPS**, **DCEPS(B)**, **CWA**, **CWB** and **ACEP**). Some **DCEP** and **CW** stars are quite often called Cepheids because it is often impossible to discriminate between them on the basis of the light curves for periods in the range 3 - 10 days. However, these are distinct groups of entirely different objects in different evolutionary stages. One of the significant spectral differences between W Virginis stars and Cepheids is the presence, during a certain phase interval, of hydrogen-line emission in the former and of Ca II H and K emission in the latter.

CW

Variables of the W Virginis type. These are pulsating variables of the galactic spherical component (old disk) population with periods of approximately 0.8 to 35 days and amplitudes from 0.3 to 1.2 mag. in *V*. They obey a period-luminosity relation different from that for δ Cep variables (see **DCEP**). For an equal period value, the W Vir variables are fainter than the δ Cep stars by 0.7 - 2 mag. The light curves of W Vir variables for some period intervals differ from those of δ Cep variables for corresponding periods either by amplitudes or by the presence of humps on their descending branches, sometimes turning into broad flat maxima. W Vir variables are present in globular clusters and at high galactic latitudes. They may be separated into the subtypes **CWA** and **CWB**.

CWA

W Virginis variables with periods longer than 8 days. The longer period ones start showing different minima getting mixed with the **RVA** class.

CWB

W Virginis variables with periods shorter than 8 days. Also known as BL Herculis variables. The shorter period ones are similar to **RRAB** stars.

DCEP

These are the classical Cepheids, or δ Cephei-type variables. Comparatively young objects that have left the main sequence and evolved into the instability strip of the Hertzsprung-Russell (H-R) diagram, they obey the well-known Cepheid period-luminosity relation and belong to the young disk population. **DCEP** stars are present in open clusters. They display a certain relation between the shapes of their light curves and their periods.

DCEP(B) ✓

Cepheids displaying the presence of two or more simultaneously operating pulsation modes (usually the fundamental tone with the period P_0 and the first overtone P_1). The periods P_0 are in the range from 2 to 7 days, with the ratio P_1/P_0 = 0.70-0.71.
GCVS type ***CEP(B)***.
Examples: ***TU Cas***, ***V367 Sct***.

DCEPS

These are δ Cep variables having light amplitudes <0.5 mag. in *V* (<0.7 mag. in *B*) and almost symmetrical light curves (M-m approx. 0.4 - 0.5 periods); as a rule, their periods do not exceed 7 days. They are first-overtone pulsators.

DCEPS(B) ✓

First/second overtone double-mode Cepheid variables. Period ratio P_2/P_1 = 0.80.
GCVS type ***CEP(B)***.

DSCT

Variables of the δ Scuti type. These are pulsating variables of spectral types A0-F5 III-V displaying light amplitudes from 0.003 to 0.9 mag. in *V* (those with amplitudes larger than 0.2 mag. are designated **HADS**) and periods from 0.01 to 0.2 days. The shapes of the light curves, periods, and amplitudes usually vary greatly. Radial as well as non-radial pulsations are observed. The variability of some members of this type appears sporadically and sometimes completely ceases, this being a consequence of strong amplitude modulation with the lower value of the amplitude not exceeding 0.001 mag. in some cases. The maximum of the surface layer expansion does not lag behind the maximum light for more than 0.1 periods. DSCT stars are representatives of the galactic disk (flat component), **SXPHE** stars are halo objects.

DSCTC

Low-amplitude group of δ Scuti variables (light amplitude <0.1 mag. in *V*). The majority of this type's representatives are stars of luminosity class V; objects of this subtype generally are representative of the δ Sct variables in open clusters. In the VSX catalog, this type is only applied to stars with extremely small amplitudes (< 0.03 mag.) since the original amplitude limit includes virtually all of the **DSCT** stars.

DWLYN ✓

Hybrid sub-dwarf pulsators showing both **V1093HER** and **V361HYA**-type variability.

GDOR

γ Doradus stars. They are high order g-mode non-radial pulsators, dwarfs (luminosity classes IV and V) from spectral types A7 to F7 showing one or multiple frequencies of variability. Amplitudes do not exceed 0.1 mag. and periods usually range from 0.3 to 3 days.

HADS ✓

High Amplitude **δ Scuti stars**. They are radial pulsators showing asymmetric light curves (steep ascending branches) and amplitudes >0.15 mag.

HADS(B) ✓

First/second overtone double-mode δ Scuti variables. Period ratios P_1/P_0 = 0.77 and P_2/P_1 = 0.80.

L

Slow irregular variables. The light variations of these stars show no evidence of periodicity, or any periodicity present is very poorly defined and appears only occasionally. Stars are often attributed to this type because of being insufficiently studied. Many type **L** variables are really semi-regulars or belong to other types.

LB

Slow irregular variables of late spectral types (K, M, C, S); as a rule, they are giants. This type is also ascribed, in the GCVS, to slow red irregular variables in the case of unknown spectral types and luminosities.
Example: ***CO Cyg***.

LC

Irregular variable supergiants of late spectral types having amplitudes of about 1 mag. in *V*.
Example: ***TZ Cas***.

M

o (omicron) Ceti-type (***Mira***) variables. These are long-period variable giants with characteristic late-type emission spectra (Me, Ce, Se) and light amplitudes from 2.5 to 11 mag. in *V*. Their periodicity is well pronounced, and the periods lie in the range between 80 and 1000 days. Infrared amplitudes are usually less than in the visible and may be <2.5 mag. For example, in the K band they usually do not exceed 0.9 mag.

PPN ✓

Yellow supergiant post-AGB stars embedded in protoplanetary nebulae and displaying SRD variability with periods ranging from 35 to 200 days. They are early F to late G-type supergiants with infrared excess at high Galactic latitudes.

PVTEL

Variables of the PV Telescopii type. These are hydrogen-deficient supergiants. They were subdivided in three types (**I**, **II** and **II**) in IBVS 5817.

PVTELI ✓

Hydrogen-deficient A or late-B supergiants showing low-amplitude quasi-periodic light variations due to radial pulsations driven by strange-mode instability on a time-scale of 5 - 30 days; radial velocity variations are also seen.

PVTELII ✓

Hydrogen-deficient O or early-B supergiants showing low-amplitude quasi-periodic light variations due to non-radial g-mode pulsations driven by strange-mode instability on a time-scale of 0.5 - 5 days; radial velocity and line-profile variations are also seen.

PVTELIII ✓

Hydrogen-deficient and carbon-rich F or G supergiants showing low-amplitude quasi-periodic light variations on a time-scale of 20 - 100 days but not deep minima like the **RCB** stars; radial velocity variations are also seen.

roAm ✓

Rapidly oscillating Am variables. Pulsation periods are in the range of 60 to 170 cycles/day (8-22 min.), while amplitudes of light variation caused by the pulsation are less than 0.01 mag. in *V*.

roAp ✓

Rapidly oscillating Ap variables. These are pulsating variables oscillating in high-overtone, low-degree, non-radial pressure modes. Pulsation periods are in the range of 0.003-0.015 days (4-21 min.), while amplitudes of light variation caused by the pulsation are about 0.01 mag. in *V*. The pulsational variations are superposed on those caused by rotation.
GCVS type ***ACVO***.

RR

Variables of the RR Lyrae type, which are radially-pulsating giant A-F stars having amplitudes from 0.2 to 2 mag. in *V*. Cases of variable light-curve shapes as well as variable periods are known. If these changes are periodic, they are called the "Blazhko effect". The majority of these stars belong to the spherical component of the Galaxy; they are present, sometimes in large numbers, in some globular clusters, where they are known as pulsating horizontal-branch stars. Like Cepheids, maximum expansion velocities of surface layers for these stars practically coincide with maximum light.

RRAB

RR Lyrae variables with asymmetric light curves (steep ascending branches), periods from 0.3 to 1.2 days, and amplitudes from 0.5 to 2 mag. in *V*. They are fundamental mode pulsators.

RRC

RR Lyrae variables with nearly symmetric, sometimes sinusoidal, light curves, periods from 0.2 to 0.5 days, and amplitudes not greater than 0.8 mag. in *V*. They are overtone pulsators.
Example: ***SX UMa***.

RRD ✓

Double-mode **RR Lyrae stars** which pulsate in the fundamental mode as well as in the first overtone with a period ratio of 0.74 and a fundamental period near 0.5 days (or in the first and second overtones with a period ratio of 0.80).
GCVS class ***RR(B)***.

RV

Variables of the RV Tauri type. These are radially pulsating supergiants having spectral types F-G at maximum light and K-M at minimum. The light curves are characterized by the presence of double waves with alternating primary and secondary minima that can vary in depth so that primary minima may become secondary and vice versa. The complete light amplitude may reach 3-4 mag. in *V*. Periods between two adjacent primary minima (usually called formal periods) lie in the range 30-150 days (these are the periods appearing in the Catalogue). Two subtypes, **RVA** and **RVB**, are recognized.

RVA

RV Tauri variables that do not vary in mean magnitude.
Example: ***AC Her***.

RVB

RV Tauri variables that periodically (with periods from 600 to 1500 days and amplitudes up to 2 mag in V) vary in mean magnitude.
Examples: ***DF Cyg***, ***RV Tau***.

SPB ✓

Slowly pulsating B stars showing both light and line profile variability. Main sequence B2-B9 stars (3-9 solar masses) that pulsate in the high radial order low degree g-modes. Periods may be multiple and range from 0.4 to 5 days and amplitudes are smaller than 0.1 magnitudes. Also known as **53 Persei stars**.
GCVS type ***LPB***.
Examples: *ι (iota) Her*, ***V469 Per***, ***V539 Ara***.

SR

Semi-regular variables, which are giants or supergiants of intermediate and late spectral types showing noticeable periodicity in their light changes, accompanied or sometimes interrupted by various irregularities. Periods lie in the range from 20 to >2000 days, while the shapes of the light curves are rather different and variable, and the amplitudes may be from several hundredths to several magnitudes (usually 1-2 mag. in *V*).

SRA

Semi-regular late-type (M, C, S or Me, Ce, Se) giants displaying persistent periodicity and usually small (<2.5 mag. in *V*) light amplitudes. Amplitudes and light-curve shapes generally vary and periods are in the range of 35-1200 days. Many of these stars differ from Miras only by showing smaller light amplitudes.
Example: ***Z Aqr***.

SRB

Semi-regular late-type (M, C, S or Me, Ce, Se) giants with poorly defined periodicity (mean cycles in the range of 20 to 2300 days) or with alternating intervals of periodic and slow irregular changes, and even with light constancy intervals. Every star of this type may usually be assigned a certain mean period (cycle), which is the value given in the catalog. In a number of cases, the simultaneous presence of two or more periods of light variation is observed.
Examples: ***RR CrB***, ***AF Cyg***.

SRC

Semi-regular late-type (M, C, S or Me, Ce, Se) supergiants with amplitudes of about 1 mag. and periods of light variation from 30 days to several thousand days.
Example: ***μ Cep***.

SRD

Semi-regular variable giants and supergiants of F, G, or K spectral types, sometimes with emission lines in their spectra. Amplitudes of light variation are in the range from 0.1 to 4 mag. and the range of periods is from 30 to 1100 days.
Examples: ***U Lup***, ***SV UMa***.

SRS

Semi-regular pulsating red giants with short periods (several days to a month), probably high-overtone pulsators.
Prototype: ***AU Ari***.

SXPHE

Phenomenologically, these resemble **HADS** variables but they are pulsating sub-dwarfs of the spherical component, or old disk galactic population, with spectral types in the range A2-F5. They may show several simultaneous periods of oscillation, generally in the range 0.04-0.08 days, with variable-amplitude light changes that may reach 0.7 mag. in *V*. These stars are present in globular clusters.

SXPHE(B)

Old population analogs to the double-mode **HADS(B)** stars.

V361HYA ✓

Very rapidly pulsating hot sub-dwarf B stars with periods between 90 and 600 seconds exhibiting pressure-mode pulsations. Amplitudes are within several hundredths of a magnitude. Also known as EC 14026 variables.
GCVS class ***RPHS***.
Prototype: ***V361 Hya = EC 14026-2647***.

V1093HER ✓

Slowly pulsating sub-dwarf B stars with periods between 45 and 180 minutes exhibiting gravity-mode pulsations. Also known as **PG 1716** variables.

ZZ

ZZ Ceti variables. These are non-radially pulsating white dwarfs that change their brightnesses with periods from 30 s. to 25 min. and amplitudes from 0.001 to 0.2 mag. in *V*. They usually show several close period values. Flares of 1 mag. are sometimes observed; however, these may be explained by the presence of close **UV Ceti** companions.

ZZA

ZZ Cet-type variables of DA spectral type (**DAV** stars) having only hydrogen absorption lines in their spectra.

ZZB

ZZ Cet-type variables of DB spectral type (**DBV** stars) having only helium absorption lines in their spectra. Also known as **V777 Herculis** stars.

ZZO

ZZ Cet type variables of the DO spectral type (**DOV** stars) showing HeII and and CIV absorption lines in their spectra. Also known as GW Virginis stars.

ZZLep ✓

ZZ Leporis stars: variable central stars of planetary nebulae. These are hot stars (spectral type O) with temperatures less than 50000 K and with hydrogen-rich spectra, showing variations on the order of hours and of days. The most plausible mechanisms for the variability are pulsation or variations in the stellar mass loss rate, or both. Reference: **2003ASPC..292..183H**.

Survey types

LPV

Long Period Variables (red stars) of unspecified type (survey type).

CW-FO

First Overtone **CW** stars in ASAS-3. All of the stars originally classified as first overtone pulsators of the CW class in ASAS have been found to be in error, as this type of star does not exist.

CW-FU

Fundamental mode **CW** stars in ASAS-3.

DCEP-FO

First Overtone classical Cepheids (**DCEPS**) in ASAS-3.

DCEP-FU

Fundamental mode classical Cepheids (**DCEP**) in ASAS-3.

DSCTr

δ Scuti subtype in ASAS-3. They show larger amplitudes but most of them are actually contact binaries with twice the period given in the ASAS catalogue.

PULS

Pulsating variables of unspecified type.

Subtypes

(B)

It means "beat" and it refers to double-mode pulsators of the types **BCEP(B)**, **DSCT(B)**, **HADS(B)**, **SXPHE(B)**, **DCEP(B)**, and **DCEPS(B)**.

4. ERUPTIVE

Main types

BE

GCVS-type for Be stars that show variability but no light outbursts (**GCAS** variables). Most of them may be **LERI** variables.

cPNB[e] ✓

Compact proto-planetary and planetary nebulae B[e] stars.

CTTS ✓

Classical **T Tauri stars**. They have extensive disks that result in strong emission lines (EW(Hα) ≥ 10Å).
GCVS types **INT** and ***IT***.

DPV ✓

Double Periodic Variables. They are semi-detached interacting binaries (with a B-type component) with optically thick disks around the gainer, that experience regular cycles of mass loss into the interstellar medium and are characterized by orbital photometric variability (ellipsoidal, **DPV**/**ELL** or eclipsing, **DPV**/**E**) in time scales of few days and a long photometric cycle lasting roughly 33 times the orbital period.

DYPer ✓

Hydrogen-deficient stars that show unpredictable fading events but slower declines and roughly symmetric recoveries rather than the rapid decline and slow recovery observed in **RCB** stars. The amplitude of the declines is smaller than those of **RCB** stars. Spectroscopically they seem to be normal C-type stars with evidence for C_{13} in their spectra, whereas one of the

defining characteristics of **RCB** stars is the lack of this isotope of carbon. At maximum they show semiregular behaviour with periods typical of SR stars and longer than the pulsations seen in **RCB** stars. They are also 10 times fainter on average.
Example: ***DY Per***.

EXOR ✓

Named after EX Lupi, and collectively known in the literature as EXors, these are eruptive T Tauri stars that show brightening episodes of several magnitudes in time scales of several months or a few years. The EXor stage appears to follow the FUor one, more than being a less evident manifestation of the same phase. They are less luminous and present different emission-line spectra than those of FUors (which are dominated by absorption features). They also show repetitive outbursts instead a unique major one. Also known as Subfuors.
Examples: ***EX Lup***, ***V1118 Ori***, ***V1143 Ori***.

FSCMa ✓

B[e]-type stars that exhibit much stronger Hydrogen emission lines than those seen in classical Be stars and also exhibit forbidden (low excitation) lines of FeII, [FeII], [NII], [OI] and strong IR excesses, which are indicative of compact dust envelopes. They are also not fast rotators like the Be stars. They are most likely binary systems that currently undergo or have recently undergone a phase of a rapid mass exchange, associated with dust formation. The secondaries are typically 2-3 magnitudes fainter than their primaries. Complex structure of the circumstellar environments significantly veils the underlying stars and requires multitechnique investigation. They are located outside star formation regions and they probably main sequence stars (not supergiants). Their light curves show irregular long-term variations with long term (years) mean magnitude changes up to 2 magnitudes in *V*. Most of the stars in this group were previously considered as Unclassified B[e] stars.
Examples: ***FS CMa***, ***V0743 Mon***.

FUOR ✓

Variables of the FU Orionis type, which are collectively known in the literature as FUors. Characterized by a unique major gradual increase in brightness by about 4-6 mag. following which they show a complex absorption spectrum much like that of a F or G-type supergiant star, a powerful shortward-shifted P Cyg-like absorption component at Hα and a strong Li I λ6707 absorption line. They may stay constant at maximum brightness or decline slowly by 1-2 mag. several months after the initial rise. These variables probably mark one of the evolutionary stages of **T Tauri-type stars** as evidenced by an outburst of one member, ***V1057 Cyg***, but its decline (2.5 mag. in 11 years) commenced immediately after maximum brightness was attained. All presently known FUors are coupled with reflecting cometary nebulae.
GCVS type ***FU***.

GCAS

Eruptive irregular variables of the γ Cassiopeiae type. These are rapidly rotating O9-A0 III-Ve stars with mass outflow from their equatorial zones. The formation of equatorial rings or disks is accompanied by a temporary brightening (pole-on stars like ***ω CMa***) or fading (equator-on stars like ***Pleione***). Light amplitudes may reach 1.5 mag. in *V*.

I

Poorly studied irregular variables with unknown features of light variations and spectral types. This is a very inhomogeneous group of objects. It is usually applied to young stellar objects (**YSO**), if they are evolved red giants they are given the type **L**.

IA

Poorly studied irregular variables of early (O-A) spectral type.

IB

Poorly studied irregular variables of intermediate (F-G) to late (K-M) spectral type.

IN

Orion variables. Irregular, eruptive variables connected with bright or dark diffuse nebulae or observed in the regions of these nebulae. Some of them may show cyclic light variations caused by axial rotation. In the Spectrum-Luminosity diagram, they are found in the area of the main sequence and subgiants. They are probably young objects that, during the course of further evolution, will become light-constant stars on the zero-age main sequence (ZAMS). The range of brightness variations may reach several magnitudes.

INA

Orion variables of early spectral types (B-A or Ae). They are often characterized by occasional abrupt Algol-like fadings.
Example: ***T Ori***.

INAT

INT-type stars with abrupt fadings (**INA** type).

INB

Orion variables of intermediate and late spectral types, F-M or Fe-Me (BH Cep, AH Ori). F-type stars may show Algol-like fadings similar to those of many **INA** stars; K-M stars may produce flares along with irregular light variations.

INS

IN stars showing rapid light variations (up to 1 mag. in 1-10 days).

INSA

ISA stars observed in nebulosity.

INSB

ISB stars observed in nebulosity.

INST

INT stars showing rapid light variations.

INT

Orion variables of the T Tauri type observed only in diffuse nebulae. Stars are assigned to this type on the basis of the following (purely spectroscopic) criteria: spectral types are in the range Fe-Me. The spectra of most typical stars resemble the spectrum of the solar chromosphere. The feature specific to the type is the presence of the fluorescent emission lines Fe II 4046, 4132 Å (anomalously intense in the spectra of these stars), emission lines [Si II] and [O I], as well as the absorption line Li I λ6707. Known as **CTTS** (Classical T Tauri Stars).

IS

Rapid irregular variables having no apparent connection with diffuse nebulae and showing light changes of about 0.5 - 1.0 mag. within several hours or days.

ISA

Rapid irregular variables of the early spectral types, B-A or Ae. UX Orionis (**ISA** in the GCVS) is the prototype of a subgroup of Herbig Ae/Be stars knows as **UXOR** that show irregular variations with a wide range of amplitudes from barely detectable to more than 4 mag. in *V*. Large-amplitude variability is confined to stars with spectral types later than B8. There are two principal components: (1) irregular variations on time-scales of days around a mean brightness level that changes on a much longer time-scale (typically years), sometimes in a quasi-cyclic fashion, and (2) occasional episodes of deep minima, occurring at irregular intervals but more frequently near the low points of the brightness cycles.
Examples: ***UX Ori***, ***CQ Tau***, ***BF Ori***.

ISB

Rapid irregular variables of the intermediate and late spectral types, F-M and Fe-Me.

RCB

Variables of the R Coronae Borealis type. These are hydrogen-deficient, carbon- and helium-rich, high-luminosity stars belonging to the spectral types Bpe-C, which are simultaneously eruptive and pulsating variables. They show slow non-periodic fadings by 1-9 mag. in *V* lasting from a month or more to several hundred days. These events show a rapid decline and slow recovery and are superposed on cyclic pulsations with amplitudes up to several tenths of a magnitude and periods in the range 30-100 days. These stars may be the result of a merger of a helium and a carbon white dwarfs or -less likely- the result of a final He-flash in a post-AGB star (Example: ***FG Sge***). Some post-AGB objects, especially carbon stars showing fadings, may show RCB properties but they don't share the same origin and they have been classified as **DY Per stars**.
Examples: ***R CrB***, ***RY Sgr***.

SDOR

Variables of the S Doradus type. These are eruptive, high-luminosity Bpec-Fpec stars showing irregular (sometimes cyclic) light changes with amplitudes in the range 1-7 mag. in *V*. They belong to the brightest blue stars of their parent galaxies. As a rule, these stars are connected with diffuse nebulae and surrounded by expanding envelopes.
Examples: ***P Cyg***, ***η Car***. Also known as **LBV**. The **SDOR** variability is known in the literature as an aspect of the **LBV** phenomenon, consisting of photospheric pulsations with time scales of hundreds to thousands of days and excursions to the redder part of the HR-diagram when the star is brighter (**SDOR** phases). Besides, they also display micro-variations, stochastic variability and eruptions.

TTS

T Tauri Stars. When their properties are well-known, they are classified in two sub-groups: **CTTS** (Classical) and **WTTS** (Weak-lined).
GCVS types ***IT*** and **INT**.

UV

Eruptive variables of the UV Ceti type, these are K Ve-M Ve stars sometimes displaying flare activity with amplitudes from several tenths of a magnitude up to 6 mag. in *V*. The amplitude is considerably greater in the ultraviolet spectral region. Maximum light is attained in several seconds or dozens of seconds after the beginning of a flare; the star returns to its normal brightness in several minutes or dozens of minutes.

UVN

Flaring Orion variables of spectral types Ke-Me. These are phenomenologically almost identical to **UV Ceti** variables observed in the solar neighborhood. In addition to being related to nebulae, they are normally characterized by being of earlier spectral type and greater luminosity, with slower development of flares (Example: ***V389 Ori***). They are possibly a specific subgroup of **INB** variables with irregular variations superimposed by flares.

UXOR

UX Orionis stars, which are collectively known in the literature as UXors. Subgroup of **Young Stellar Objects** that show irregular variations with a wide range of amplitudes from barely detectable to more than 4 mag in *V*. Most of them are Herbig Ae/Be stars but there are some **T Tauri stars** with later spectral types also showing the same behaviour. Large-amplitude variability is confined to stars with spectral types later than B8. There are two principal components: (1) irregular variations on time-scales of days around a mean brightness level that changes on a much longer time-scale (typically years), sometimes in a quasi-cyclic fashion, and (2) occasional episodes of deep minima, occurring at irregular intervals but more frequently near the low points of the brightness cycles. UXors show increased polarization when the optical light of the star becomes fainter (presence of clumps in our line of sight) and redder, while in extreme visual minima there is a color reversal. Currently mixed among the **ISA**, **INA** or **INSA** classes in the GCVS.
Examples: ***UX Ori***, ***CQ Tau***, ***BF Ori***.

WR

Eruptive Wolf-Rayet variables. Stars with broad emission features of He I and He II as well as C II-C IV, O II-O IV, and N III-N V. They display irregular light changes with amplitudes up to 0.1 mag. in *V*, which are probably caused by physical processes, in particular, by non-stable mass outflow from their atmospheres.

WTTS

Weak-lined **T Tauri stars**. A T Tauri star that lacks strong emission lines in its optical spectrum (EW(Hα) < 10Å), and lacks both strong stellar winds and a circumstellar accretion disk. Also known as naked T Tauri star.
GCVS types **INT** and ***IT***.

Survey types

YSO

Young stellar Object of unspecified variable type. Pre-main sequence star, likely **TTS**.

Subtypes

WR

Binary systems with at least one Wolf-Rayet component.

(YY)

When this suffix is added to any of the **YSO**-type eruptive variables (prototype YY Orionis) it indicates the presence of absorption components on the redward sides of emission lines, which is a sign of the infall of matter toward the stars' surfaces.

5. CATACLYSMIC

Main types

AM

AM Herculis-type variables; close binary systems consisting of a dK-dM type dwarf and a superstrong magnetic white dwarf primary, in which the magnetic field of the primary not only prevents the formation of an accretion disk but also synchronizes the primary's rotation with its orbital period. They are characterized by variable linear and circular polarization of light. The total range of light variations may reach 4-5 mag. in *V*. Also known as polars.

CBSS ✓

Close-binary supersoft source. Super soft X-rays are believed to be produced in high luminosity close binary systems by steady nuclear burning on the surface of an accreting white dwarf (WD). Orbital periods range from 0.15 to 4 d. The high mass transfer rate has been suggested to be caused by dynamical instability, expected when the donor star is more massive than the accreting object. When the orbital period is smaller than ~6 hours, this mechanism does not work and the CBSS with such periods are believed to be fed by a distinct mechanism: the wind-driven accretion. Their spectra show high-ionization species like O VI and N V; the emission of He II λ4686 is stronger than twice the strength of Hβ. There may be indication of jets. The orbital light curve can have shapes of either double eclipse or sine wave.
Examples: ***QR And***, ***MR Vel***.

CBSS/V ✓

V Sagittae-type stars. They belong to the CBSS class but are not detected as supersoft X-ray emitters. In V Sge stars, lines are usually stronger and broader when compared to the rest of the CBSS but this might be a selection effect associated with chemical abundance. Environments and stars with low chemical abundance have weaker winds so supersoft X-rays can escape and not be absorbed by the interstellar medium or the stellar wind. This is the case of the Magellanic Clouds. The opposite happens in stars and environmets with high chemical abundance where the soft photons are either absorbed by the stellar wind or by the interstellar medium (or both).
Examples: ***V Sge***, ***WX Cen***.

DQ ✓

DQ Herculis type. Magnetic cataclysmic variables with a red dwarf secondary and a white dwarf primary component that generates a magnetic field weaker than the field associated with AM Herculis stars and that is not strong enough to synchronize the orbits of the rotating white dwarf with the orbital period of the system. Also known as intermediate polars (**IP**).

IBWD ✓

Interacting Binary White Dwarfs . Close binary systems with ultra short periods (5-70 minutes). Also known as AM CVn-type stars or Helium dwarf novae because they lack hydrogen lines in their spectra.

N

Novae. Close binary systems with orbital periods from 0.05 to 230 days. One of the components of these systems is a hot white dwarf star that suddenly, during a time interval from one to several dozen or several hundred days, increases its brightness by 7-19 mag. in *V*, then returns gradually to its former brightness over several months, years, or decades. Small changes at minimum light may be present. Cool components may be giants, subgiants, or dwarfs of K-M type. The spectra of novae near maximum light resemble A-F absorption spectra of luminous stars at first. Then broad emission lines (bands) of hydrogen, helium, and other elements with absorption components indicating the presence of a rapidly expanding envelope appear in the spectrum. As the light decreases, the composite spectrum begins to show forbidden lines characteristic of the spectra of gas nebulae excited by hot stars. At minimum light, the spectra of novae are generally continuous or resemble the spectra of Wolf-Rayet stars. Only spectra of the most massive systems show traces of cool components. Some novae reveal pulsations of hot components with periods of approximately 100 s. and amplitudes of about 0.05 mag. in *V* after an outburst. Some novae eventually turn out to be eclipsing systems. According to the features of their light variations, novae are subdivided into fast (**NA**), slow (**NB**), very slow (**NC**), and recurrent (**NR**) categories.

NA

Fast novae displaying rapid light increases and then, having achieved maximum light, fading by 3 mag. in 100 or fewer days.
Example: ***GK Per***.

NB

Slow novae that fade after maximum light by 3 mag. in ≥ 150 days. Here the presence of the well-known "dip" in the light curves of novae similar to T Aur and DQ Her is not taken into account: The rate of fading is estimated on the basis of a smooth curve, its parts before and after the "dip" being a direct continuation of one another.
Example: ***RR Pic***.

NC

Novae with a very slow development and remaining at maximum light for more than a decade, then fading very slowly. Before an outburst these objects may show long-period light changes with amplitudes of 1-2 mag. in *V*; cool components of these systems are probably giants or supergiants, sometimes semi-regular variables, and even Mira variables. Outburst amplitudes may reach 10 mag. High excitation emission spectra resemble those of planetary nebulae, Wolf-Rayet stars, and symbiotic variables (they are called "symbiotic novae"). The possibility that these objects are planetary nebulae in the process of formation is not excluded.
Example: ***RR Tel***.

NL

Nova-like stars. Cataclysmic variables where the mass transfer rate is above a certain limit and their accretion disks are stable because they are nearly fully ionized to their outer (tidal cut off) boundary and this condition suppresses dwarf nova outbursts. Also known as **UX** (UX Ursae Majoris stars).

NL/VY ✔

Anti-dwarf novae. VY Sculptoris stars. They are cataclysmic binary systems with a hot (35,000-65,000 K) and luminous white dwarf that occasionally undergo fadings of more than 1 magnitude (up to several magnitudes) due to a low rate of mass transfer. These fadings might last from days to years. At maximum they vary up to 1 magnitude. They show no outbursts even though at minimum they fall into the dwarf novae instability strip. This could be caused by the possible magnetic nature of the white dwarf. Orbital periods usually range between 0.12 and 0.18 d.
Examples: ***VY Scl***, ***MV Lyr***.

NR

Recurrent novae, which differ from typical novae by the fact that two or more outbursts (instead of a single one) separated by 10-80 years have been observed.
Examples: ***T CrB***, ***T Pyx***.

SN

Supernovae. Stars that increase, as a result of a final explosion, their brightnesses by 20 mag and more, then fade slowly. The spectrum is characterized by the presence of very broad emission bands, their widths being several times greater than those of the bright bands observed in the spectra of novae. The expansion velocities of **SN** envelopes are in the thousands of km/s. According to the light curve shape and the spectral features, supernovae are subdivided into types I and II.
Examples: ***B Cas***, ***CM Tau***.

SN I

Type I supernovae. Absorption lines of Ca II, Si, etc., but no hydrogen lines are present in the spectra. The expanding envelope almost lacks hydrogen. During 20-30 days following maximum light, the brightness decreases by approximately 0.1 mag per day, then the rate of fading slows and reaches a constant value of 0.014/day.

SN Ia

CO white dwarf accreting matter from (or merging with) a companion till it reaches the Chandrasekhar limit. No hydrogen. Silicon and iron lines. Mv -19.3. Detonation, no remnant.

SN Iax ✔

CO white dwarf accreting matter from a nondegenerate He star that lost its outer hydrogen envelope. Mv -14.2/-18.9. The white dwarf is likely not destroyed (partial deflagration). Prototype: *SN 2002cx*

SN Ib

Intermediate mass WN progenitor. He lines. "Stripped core-collapse supernovae".

SN Ic

WC or WO progenitors. No H and He. O, Mg and Ca lines. Mv -18/-20. "Stripped core-collapse supernovae".

SN II

Type II supernovae. Lines of hydrogen and other elements are apparent in their spectra. The expanding envelope consists mainly of H and He. Light curves show greater diversity than those of type I supernovae. Usually after 40-100 days since maximum light, the rate of fading is 0.1 mag per day.

SN IIa

CO white dwarf with a 6-7 solar masses main sequence companion. Mix of SN Ia and SN IIn. SN Ia surrounded by circumstellar matter (H) stripped from the companion. Mv -20/-21.

SN IIb

Intermediate mass WN progenitor? Massive binary? Rapidly declining light curve. Spectra evolve from strong H lines to strong He lines (Mix of II and Ib subclasses). Outer layers stripped by companion?

SN IId

SN II-L supernovae with Double P-Cygni profiles indicating the occurrence of strong wind episodes shortly before the explosion. Flattening in the light curve at later stages because of the interaction between the ejecta and the circumstellar material.

SN II-L

Intermediate mass late WN progenitor. Rapid and Linear decline in its light curve. Strong He lines. H envelope <2 SM. Mv -18.

SN IIn

LBV progenitors. Strong Narrow H-lines indicative of copious mass loss. Mv -17/-20.

SN II-P

Low mass red supergiants progenitors. Extended Plateau optical light curves. H envelope 10 SM. Mv -16/-18.

SN-pec

When a supernova resembles one of the types but shows different features (e.g. under-luminosity) the suffix **-pec** is added to the type. (**SN Ib-pec**)

UG

U Geminorum-type variables, quite often called dwarf novae. They are close binary systems consisting of a dwarf or subgiant K-M star that fills the volume of its inner Roche lobe and a white dwarf surrounded by an accretion disk. Orbital periods are in the range 0.05-0.5 days. Usually only small, in some cases rapid, light fluctuations are observed, but from time to time the brightness of a system increases rapidly by several magnitudes and, after an interval of from several days to a month or more, returns to the original state. Intervals between two consecutive outbursts for a given star may vary greatly, but every star is characterized by a certain mean value of these intervals, i.e., a mean cycle that corresponds to the mean light amplitude. The longer the cycle, the greater the amplitude. These systems are frequently sources of X-ray emission. The spectrum of a system at minimum is continuous, with broad H and He emission lines. At maximum these lines almost disappear or become shallow absorption lines. Some of these systems are eclipsing, possibly indicating that the primary minimum is caused by the eclipse of a hot spot that originates in the accretion disk from the infall of a gaseous stream from the K-M star. According to the characteristics of the light changes, U Gem variables may be subdivided into three types: SS Cyg-type (**UGSS**), SU UMa-type (**UGSU**), and Z Cam-type (**UGZ**).

UGER ✓

ER Ursae Majoris-type subclass of **UGSU** dwarf novae. These stars typically spend a third of their time in super-outburst with a super-cycle of 20-50 days. Outside of super-outburst they typically pack in a rapid succession of normal outbursts. Amplitudes are smaller (around 3 mag.) than in other dwarf novae due to a higher mass transfer rate.

UGSS

SS Cygni-type variables. They increase in brightness by 2-6 mag. in *V* in 1-2 days and in several subsequent days return to their original brightnesses. The values of the cycle are in the range 10 days to several thousand.
Examples: ***SS Cyg***, ***U Gem***.

UGSU

SU Ursae Majoris-type variables. These are characterized by the presence of two types of outbursts called "normal" and "super-outbursts". Normal, short outbursts are similar to those of **UGSS** stars, while super-outbursts are brighter by 2 mag., are more than five times longer (wider), and occur several times less frequently. During super-outbursts the light curves show superposed periodic oscillations (super-humps), their periods being close to the orbital ones and amplitudes being about 0.2-0.3 mag. in *V*. Orbital periods are shorter than 0.1 days; companions are of dM spectral type.

UGWZ ✓

WZ Sagittae type subclass of **UGSU** dwarf novae in which the interval between super-outbursts is unusually long (that is due to a very low mass-transfer rate), measured in decades, while normal outbursts are few and far between. They show re-brightenings. Orbital periods range from 0.05 to 0.08 d.

UGZ

Z Camelopardalis-type stars. These also show cyclic outbursts, differing from **UGSS** variables by the fact that sometimes after an outburst they do not return to the original brightness, but during several cycles retain a magnitude between maximum and minimum. The values of cycles are from 10 to 40 days, while light amplitudes are from 2 to 5 mag. in *V*.

V838MON ✓

Luminous red transients of the V838 Monocerotis type that become redder in outburst and are thought to be the result of the merger of a contact binary. After the outburst they get hidden in a dusty disk. The amplitudes are 9-13 mag.
Examples: ***V838 Mon***, ***V1309 Sco***, ***V4332 Sgr***.

ZAND

Symbiotic variables of the Z Andromedae type. They are close binaries consisting of a hot star, a star of late type, and an extended envelope excited by the hot star's radiation. The combined brightness displays irregular variations with amplitudes up to 4 mag. in *V*. A very inhomogeneous group of objects.

Survey types

CV

Cataclysmic Variables of unspecified type.

Subtypes

IBWD ✓

Interacting Binary White Dwarfs . Close binary systems with ultra short periods (5-70 minutes). Also known as AM CVn-type stars or Helium dwarf novae because they lack hydrogen lines in their spectra.

V ✓

V Sge subtype of the CBSS variables. They belong to the CBSS class but are not detected as supersoft X-ray emitters. In V Sge stars, lines are usually stronger and broader when compared to the rest of the CBSS but this might be a selection effect associated with chemical abundance. Environments and stars with low chemical abundance have weaker winds so supersoft X-rays can escape and not be absorbed by the interstellar medium or the stellar wind. This is the case of the Magellanic Clouds. The opposite happens in stars and environmets with high chemical abundance where the soft photons are either absorbed by the stellar wind or by the interstellar medium (or both).
Examples: ***V Sge***, ***WX Cen***.

VY ✓

VY Scl subtype of the nova-like variables. They are cataclysmic binary systems with a hot (35,000-65,000 K) and luminous white dwarf that occasionally undergo fadings of more than 1 magnitude (up to several magnitudes) due to a low rate of mass transfer. These fadings might last from days to years. At maximum they vary up to 1 magnitude. They show no outbursts even though at minimum they fall into the dwarf novae instability strip. This could be caused by the possible magnetic nature of the

white dwarf. Orbital periods usually range between 0.12 and 0.18 d.
Examples: ***VY Scl***, ***MV Lyr***.

6. X-RAY

Main types

HMXB ✓

High Mass X-ray Binaries. Systems with a massive star (usually an O or B star, a Be star or a blue supergiant) and a compact object (generally a neutron star, a black hole or a white dwarf). A fraction of the stellar wind of the normal star is captured by the compact object and produces X-rays as it falls onto it or onto an accretion disk that's surrounding it. In X-ray binaries, the subtypes indicate which kind of behavior the binary displays, like X-ray bursts (**XB**), large amplitude outbursts also in the visual (**XN**), reflection effect (**XR**) or it may also inform about the object's nature, e.g.: if the compact object is a pulsar (**XP**). Refer to the subtypes list below.

LMXB ✓

Low Mass X-ray Binaries. Systems where one of the components is either a black hole or a neutron star. The other, donor, component usually fills its Roche lobe and therefore transfers mass to the compact object. The donor can be a normal dwarf, a white dwarf, or an evolved star (red giant). X-rays are emitted as the mass falls onto the compact object or onto an accretion disk that's surrounding it. The X-ray emission is incident upon the atmosphere of the cooler companion of the compact object and is reradiated in the form of optical high-temperature radiation (reflection effect), thus making that area of the cooler companion's surface an earlier spectral type. These effects lead to quite a peculiar complex character of optical variability in such systems. In X-ray binaries, the subtypes indicate which kind of behavior the binary displays, like X-ray bursts (**XB**), large amplitude outbursts also in the visual (**XN**), reflection effect (**XR**) or it may also inform about the object's nature, e.g.: if the compact object is a pulsar (**XP**). Refer to the subtypes list below.

X

Sources of strong, variable X-ray emission which do not belong to or are not yet attributed to any other type of variable stars. Most of the X-type variables turn out to be **HMXB**, **LMXB**, **AM** or **DQ**-type binary systems. The subtypes of **HMXB** and **LMXB** systems are listed in the subtypes section.

Subtypes

XB

X-ray bursters. Close binary systems showing X-ray and optical bursts, their duration being from several seconds to ten minutes, with amplitudes of about 0.1 mag. in *V*.
Examples: ***V801 Ara***, ***V926 Sco***.

XJ

X-ray binaries characterized by the presence of relativistic jets evident at X-ray and radio wavelengths, as well as in the optical spectrum in the form of emission components showing periodic displacements with relativistic velocities. Examples: ***V1343 Aql***

XN

X-ray systems that occasionally rapidly increase in brightness by 1-9 mag. in *V* simultaneously with the X-ray range.

XP

X-ray pulsar systems. The primary component is usually an ellipsoidal early-type supergiant. The reflection effect is very small and light variability is mainly caused by the ellipsoidal primary component's rotation. Periods of light changes are between 1 and 10 days; the period of the pulsar in the system is from 1 s. to 100 min. Light amplitudes usually do not exceed several tenths of a magnitude. Example: *GP Vel (Vela X-1).*

XPR

X-ray pulsar (**XP**) systems featuring the presence of the reflection effect. The mean light of the system is brightest when the primary component is irradiated by X rays; it is faintest during a low state of the X-ray source. The total light amplitude may reach 2-3 mag. in *V*.
Example: ***HZ Her***.

XBR

X-ray bursters (**XB**) featuring the presence of the reflection effect.
Example: ***V801 Ara***.

7. OTHER OBJECTS

Main types

AGN ✓

Active Galactic Nuclei. Optically variable extragalactic objects only included for historical reasons or observing campaigns. GCVS type ***GAL***.

BLLAC

Extragalactic BL Lacertae-type objects. These are compact quasi-stellar objects showing almost continuous spectra with weak emission and absorption lines and relatively rapid irregular light changes with amplitudes up to 3 mag. in *V* or more. Sources of strong X-ray radiation and radio waves, their emission displays strong and variable linear polarization in the visible and infrared spectral regions.

QSO

Optically variable quasi-stellar extragalactic sources (quasars) that earlier were erroneously considered to be variable stars.

Microlens

Microlensing event. Symmetric brightening of a star caused by the presence of a separate gravitational influence intervening in line of sight. It may last from seconds to years. Microlensing events, which are a kind of extrinsic variables that, like supernovae, are a once in a lifetime event, and the star won't be observed as variable again.
Example: ***GSC 03656-01328***.

*

Unique variable stars outside the range of the classifications. These probably represent either short stages of transition from one variability type to another or the earliest and latest evolutionary stages of these types, or they are insufficiently studied members of future new types of variables.

CST

Non-variable stars (constant), formerly suspected to be variable and hastily designated. Further observations have not confirmed their variability.

S

Unstudied variable stars with rapid light changes.

VBD ✓

Variable brown dwarfs.

Survey types

APER

Used in the OGLE catalogues for stars that show aperiodic light variations.

MISC

Miscellaneous variable stars. Usually red variables (**L**, **SR**) or other types of irregular stars **I**, **BE**) that can't be classified more specifically by the automatic analysis made by the surveys.

non-cv

Stars that were once classified as CVs but then were found to be constant or belong to other types of variable stars or objects. Used in Downes Catalogue and Atlas of Cataclysmic Variables .

NSIN

Designation in the OGLE catalogues for stars with strictly periodic light curves, which are evidently non-sinusoidal.

PER

Periodic variable of unspecified type. Used in the OGLE catalogues for stars with a dominating periodicity, but showing also amplitude and/or phase changes or the periodic changes superimposed on the variability on a longer rime-scale. A majority of semi-regular variables fall into this category.

SIN

Designation in the OGLE catalogues for stars with sinusoidal light curves showing the evidence of a single periodicity. This category may include such variables as the mono-periodic **SPB**, **ACV**, **GDOR**, also some **ELL** (with half the orbital period) and chromospherically active stars, etc

Transient

Ultraviolet transient source. Used in the GALEX Ultraviolet Variability Catalog.

VAR

Variable star of unspecified type. Used for suspected variables lacking deeper studies.

III. REFERENCES

Published literature references

Arkhipova, V. P., Ikonnikova, N. P., Komissarova, G. V., 2010, AstL, 36, 269 **2010AstL...36..269A**

Audard, M., et al., 2004, ApJ, 617, 531 **2004ApJ...617..531A**

Bopp, B. W., Stencel, R. E., 1981, Ap. J., 247, L131 **1981ApJ...247L.131B**

Downes, R. A. et al., 2001, A Catalog and Atlas of Cataclysmic Variables: The Living Edition **2001PASP..113..764D**

Feldmeier, J. J. et al., 2011, The Burrell-Optical-Kepler-Survey (BOKS). I. Survey Description and Initial Results **2011arXiv1103.3660F**

Foley, R. J., et al., 2012, Type Iax Supernovae: A New Class of Stellar Explosion **2012arXiv1212.2209F**

Handler, G., 2003, ASPC 292, 183 **2003ASPC..292..183H**

Handler, G., et al., 2011, Variable Stars, Transactions of the IAU, Volume 28A "Reports on Astronomy", to be published by Cambridge University Press in 2012 **arXiv:1111.0846v1**

Herbig, G. H., 2007, AJ, 133, 2679 **2007AJ....133.2679H**

Herbst, W., Shevchenko, V.S., 1999, A Photometric Catalog of Herbig AE/BE Stars and Discussion of the Nature and Cause of the Variations of UX Orionis Stars, AJ, 118, 1043 **1999AJ....118.1043H**

Hrivnak, B. J., et al., 2010, AJ, 709, 1042 **2010ApJ...709.1042H**

Jeffery, C. S., 2008, IBVS No. 5817 **2008IBVS.5817....1J**

Jerzykiewicz, M., et al., 2011, Acta Astronomica, 61, 247 **2011AcA....61..247J**

Kafka, S., Honeycutt, K., Williams, B., 2012, MNRAS, 425, 1585 **2012MNRAS.425.1585K**

Kaminski, T. and Tylenda, R., 2011, A&A, 527, id.A75 **2011A&A...527A..75K**

Lamers, H. J. G. L. M., et al., 1998, An improved classification of B[e]-type stars **1998A&A...340..117L**

Lasota, J.-P. and Hameury, J.-M., Magnetic Cataclysmic Variables, IAU Colloquium 190, Proceedings of the Conference held 8-13 December, 2002 in Cape Town, South Africa. Edited by Sonja Vrielmann and Mark Cropper. ASP Conference Proceedings, Vol. 315. San Francisco: Astronomical Society of the Pacific, 2004., p.46 **2004ASPC..315...46L**

Mennickent, R. and Kolaczkowski, Z., 2010, Proceedings of a conference held June 8-12, 2009 in Brno, Czech Republic. San Francisco: Astronomical Society of the Pacific, 2010., p.283 **2010ASPC..435..283M**

Miroshnichenko, A. S., 2007, Toward Understanding the B[e] Phenomenon. I. Definition of the Galactic FS CMa Stars **2007ApJ...667..497M**

Pigulski, A., Kolaczkowski, Z., Kopacki, G., 2003, Catalog of variable stars in the OGLE-I fields from the Image Subtraction Method **2003AcA....53...27P**

Pojmanski, G., 2002, Acta Astronomica, 52, 397, The All Sky Automated Survey **2002AcA....52..397P**

Samus N.N., Durlevich O.V., Kazarovets E V., Kireeva N.N., Pastukhova E.N., Zharova A.V., et al., 2009, **General Catalog of Variable Stars**

Steiner, J. E., Diaz, M. P., 1998, PASP, 110, 276 **1998PASP..110..276S**

Sterken, C., et al., 2008, A&A, 484, 463 **2008A&A...484..463S**
Telleschi, A., Güdel, M., Briggs, K. R., Audard, M., Palla, F., 2007, A&A, 468, 425 **2007A&A...468..425T**
Tylenda, R., et al., 2011, A&A, 528, id.A114 **2011A&A...528A.114T**
Welsh, B. Y. et al., 2005, The GALEX Ultraviolet Variability Catalog **2005AJ....130..825W**

Additional resources used

Encyclopedia of Science
AM Herculis star
DQ Herculis star
ER Ursae Majoris star
WZ Sagittae star
B Stars
Weak Line T Tauri Star