Recognition of unresolved binaries on Gaia color index diagrams

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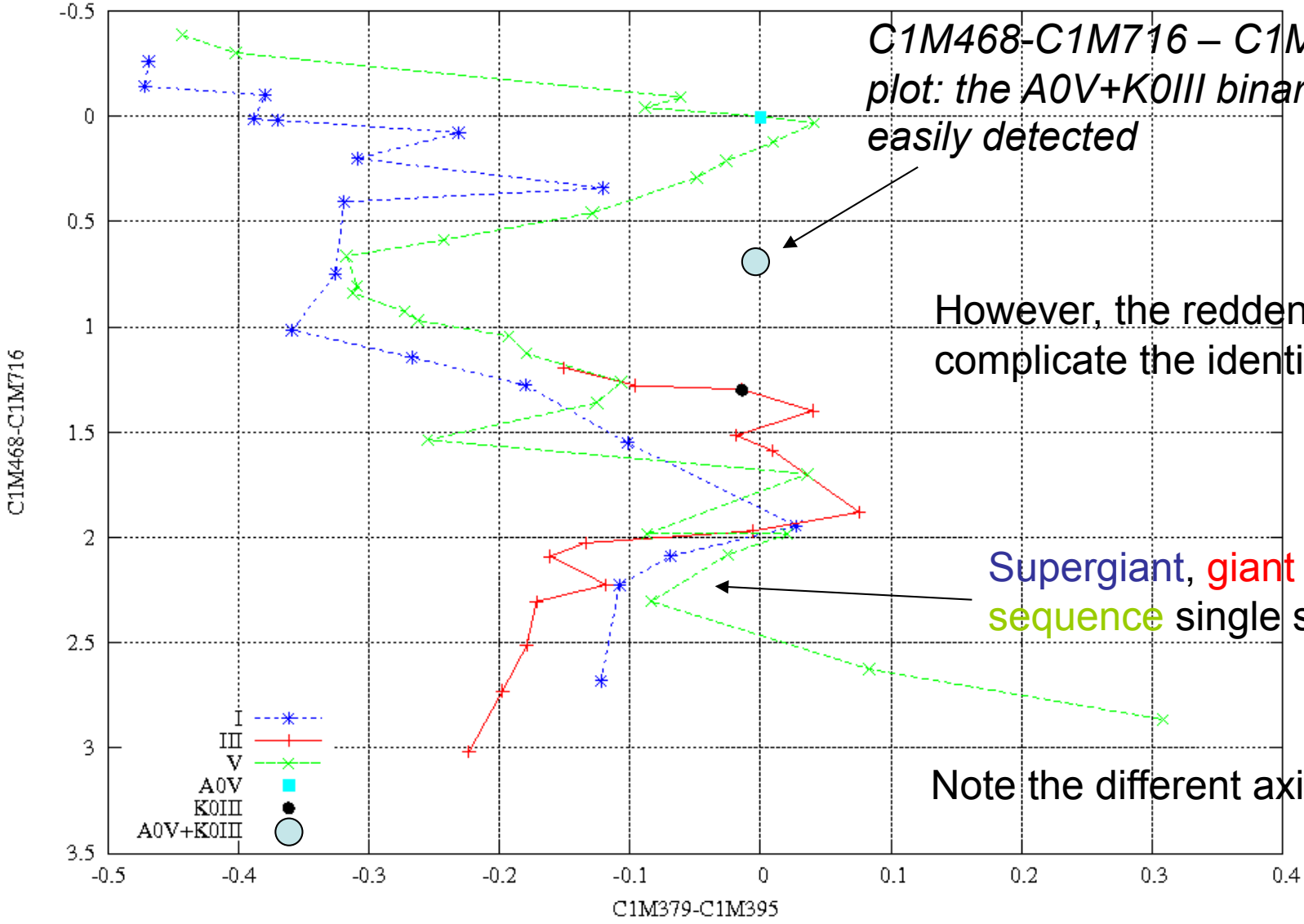
The task

- Some photometrically unresolved binaries exhibit colors different enough from ones of single stars.
- Such binaries can be separated from single stars in some color index diagrams.
- The goal of the current presentation is to specify those binaries and those Gaia color index diagrams.
- To simulate binaries, Pickles (1998) spectral library, Gaia response curves and Fluks et al. (1994) interstellar extinction law A_λ / E_{B-V} are used

An example: Gaia colors for A0V+K0III



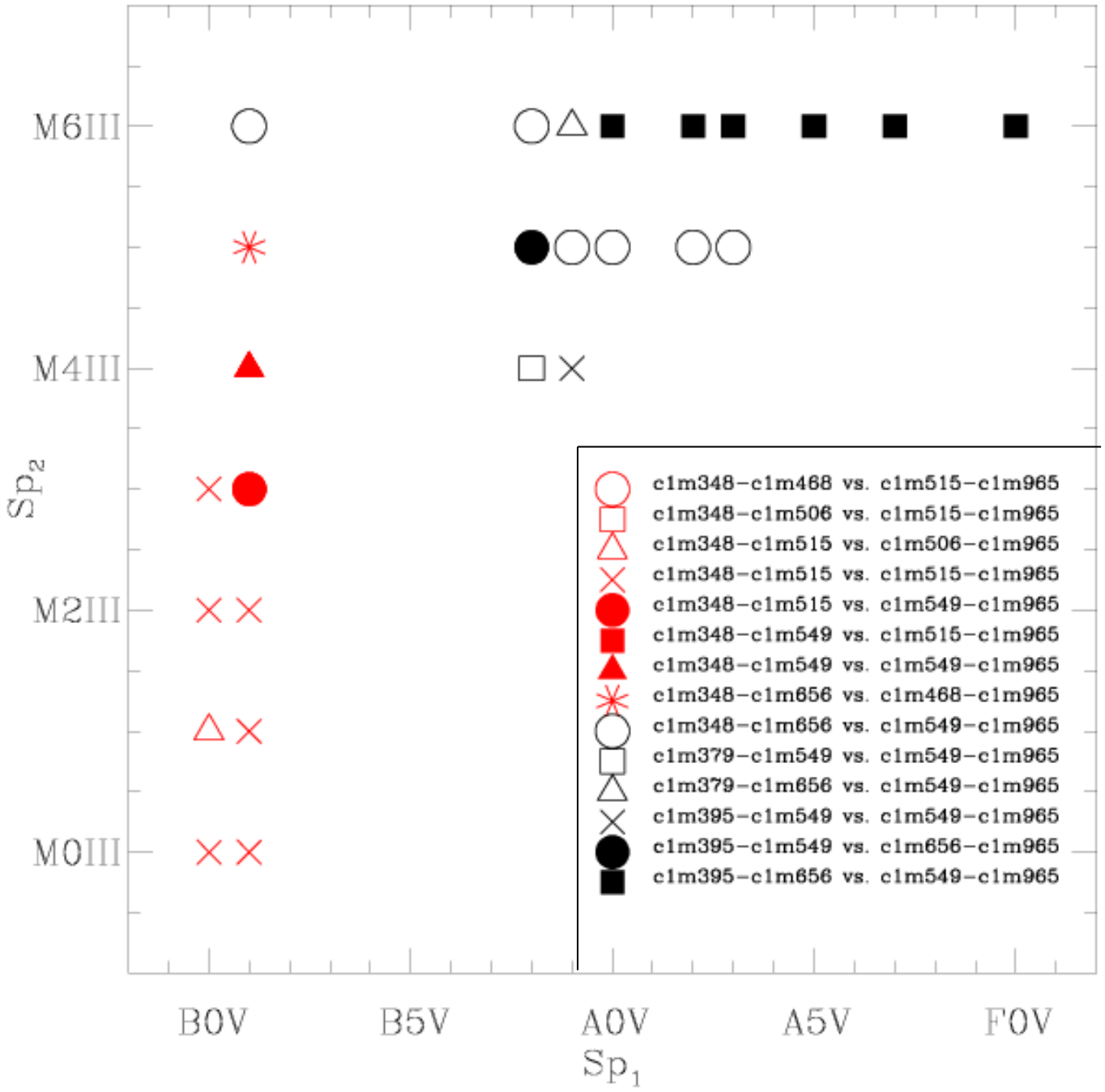
The following pairs can be unfiled:

- Evolutionary meaningless pairs.
- Pairs with components of very different luminosity ($\Delta m > 3^m$).
- Pairs with components of similar temperature (Sp<½ spectral type, this approximately gives $\log T_{eff} < 0.1$ for hot stars, and < 0.02 for cool stars). *However, such pairs are recognizable on color-magnitude plots, as they have an increased luminosity for a given color.*

For remaining ~420 types of pairs, “best” Gaia color index diagrams are found

For every possible couple of spectra a two-color Gaia diagram can be found, where a separation of such a binary from the nearest single star is a maximum:

Binary star	Best two-color diagram for separation	Separation from the nearest single star, mag
1. B0V+F5I	c1m348-c1m515 – c1m861-c1m965	0.1
2. B8V+M3III	c1m395-c1m549 – c1m549-c1m965	0.9
3. A0V+M6III	c1m395-c1m656 – c1m549-c1m965	1.4
...	...	...
419. K3V+M1V	c1m410-c1m549 c1m716-c1m747	0.1

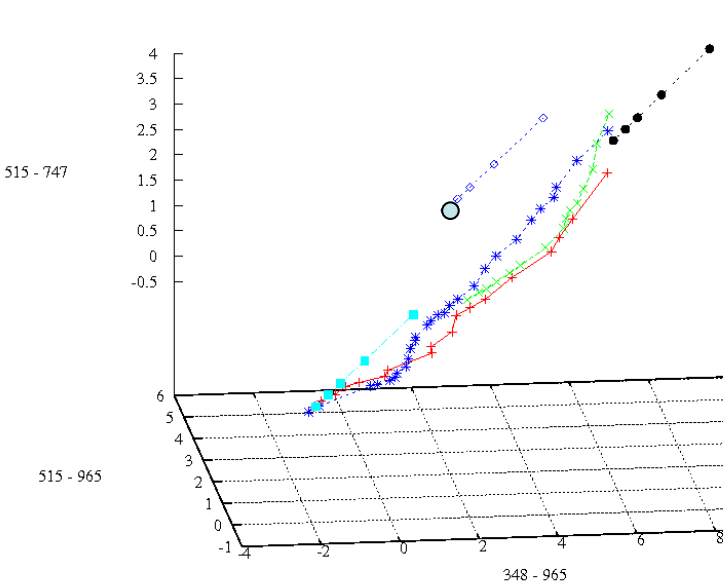


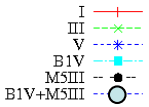
Primary vs. secondary spectrum plot (fragment): best two-color diagram for every binary is indicated

Only pairs are indicated, where separation from single stars > 1^m can be reached

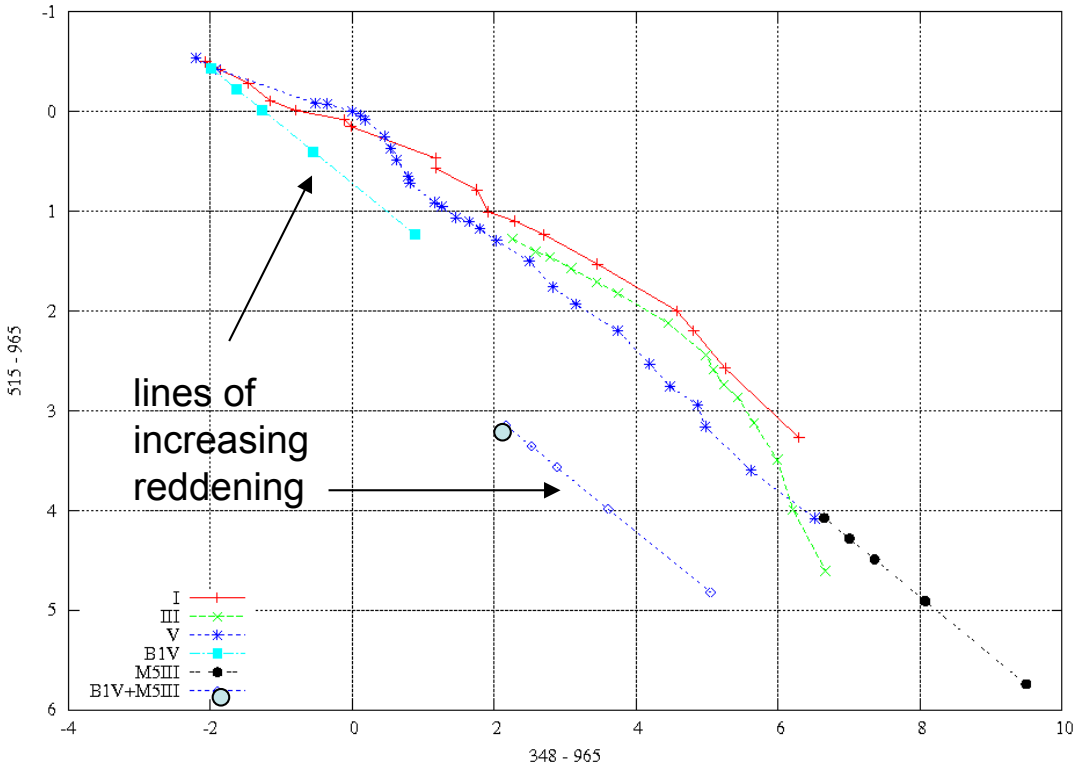
Note the importance of extreme (m348 and m985) bands!

Another example: B1V+M5III, Gaia photometry





Here interstellar extinction does not prevent to discover the pair



Note: this pair was/is not a detached binary, as the more evolved component is the less massive one: mass(B1V)=15m_o, mass(M5III)=1m_o

Summary

- A tool for simulation of color index diagrams is constructed.
- Gaia color indices, suitable for single-binary star separation, are found.
- Gaia photometry can be used for [*even reddened*] single-binary star separation and for parameterization of stars.

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