Quiescent state Nova Project

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Introduction

Here we look for the equations of the system itself as binary stars, either for recurrent or classical novae, with the Roche potential, the equations of motion and fundamental concepts about the mechanism that drives the TNR, as we can work this observationally and theoretically, the observations will be left for the observational insight and here we will look just for equations and models.

Types of binaries and equations of movement

First, if we want to see what a test particle feels while it is close to the binary system, we have to take care for the non inertial forces involved, and for the gravitational forces, and that lead us to the classical equations with the Roche potential:

$$\vec{a} = -\vec{\nabla}\Phi_R - 2\vec{\omega} \times \vec{v}$$

with:

$$\Phi_R(\vec{r}) = -\frac{GM_1}{|\vec{r} - \vec{r}_a|} - \frac{GM_2}{|\vec{r} - \vec{r}_b|} - \frac{1}{2}\omega^2 r_\perp^2$$

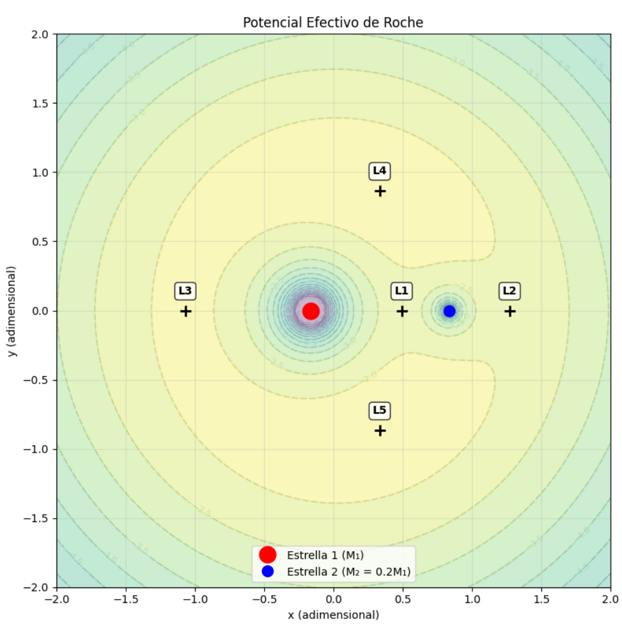

Figure 1: Graphic of the Roche lobe potential with the Lagrange Points

So with the potential around the stars the next step is to note that we can have three different configurations of the binaries, we have: **Detached**, this means there is no significant mass flow in the system, so they have no contact. **Semi detached**, In this case we have one Roche lobe filling star, and that is precisely the kind of system we have in SyRNe. **Contact**, in this configuration the two stars have filled their lobe Roche so the material is in contact.

As we can see in figure 1 the Roche lobe depends on the masses of our stars that we typically note with the q parameter, and also does the inner Lagrangian point L1 where the mass transfer occurs. Here we most note that the mass transfer can occur via different mechanism, we can have Roche Lobe Overflow (RLOF) or wind accretion, which is usually called Bondy-Hoyle Capture. This processes depend on the configuration of the system, that is:

- **Masses of the components** The mass ratio q is the shape parameter of the Roche potential, so it is essential to understand the configuration of the system.

- **Separation a** This is the scale parameter,this parameter only modify the size of the lobes, but it is different to fill a much larger lobe, if stars are at a large distance, than if they are closer.
- **Kind of star** Perhaps the most important in order to determine the mechanism of mass transfer is the type of companion for the WD (thinking in the case of SyRNe) we can have MS stars for classical novae, and for SyRNe RG companions.

We will not focus our study in the accretion disk and the mass transfer process but it is important to note that we need to precise the configuration of the system and the mass transfer mechanism in order to understand what lead us to the accumulation of mass that drives the TNR, so we have the RLOF and the WRLOF, because we now that there is wind involved on the mass transfer and also as we will see in the next section this is a very particular wind that we will want to study with a little detail in order to get to the point of our investigation: study the interaction of the wind with the ejecta of the nova.

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ref: Carrol-Ostlie; Frank, kink and Raine Further work:

- have a brief description of the mass transfer and the accretion disk (also there are observational features for this)
- Indentify the mass transfer mechanism of T CrB and RS Oph
- Describe the wind equations