TRANSIENT ANNULAR STRUCTURES IN EXPLODING GALAXIES*

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Abstract. The explosive events going on in the central parts of some galaxies are related to a very high mass concentration. As an explosion is actually a drastic rearrangement of the concerned masses with energy release, the binding energy of the central core will change and, correspondingly, its effective gravitational mass. A test particle far from the nuclear region, although within the galaxy, will be moving accordingly in a variable-mass Newtonian gravitational field.

On the other hand the observations suggest that explosions in galaxies have axial symmetry, so we are concerned with the global properties of the motion of a particle in a variable mass axisymmetric gravitational field. In order to get rid of the mass variation a space-time conformal transformation is made, which, after imposing some not very restrictive conditions, leads to a conservative potential in the new variables. This new potential has additional terms due to the elimination of the variable mass. The equations of motion in the new variables provide the motion of the test particle *relative* to an expanding or contracting background which depends on the choice of the transformation and the law of the mass variability. The problem is, at this point, formally similar to Hill's. It is possible to write an equation for the relative energy (a generalization of Jacobi's integral) and also to define surfaces of zero relative velocity for the infinitesimal particle. The general topological properties of these surfaces require singular points along the symmetry axis (analogous to the collinear Eulerian points) and also a dense set in a circumference on a plane perpendicular to the symmetry axis (analogous to the Lagrangian points). The latter one is the main feature characterizing the topology of the zero relative velocity surfaces. Even when we lift some of the restrictive conditions, the Lagrangian ring preserves its properties, as for example, the one of being the only region where zero-velocity curves and equipotentials coincide when the configuration evolves in time (in the transformed space-time).

It is easy to understand that the topology of the surfaces is kept when we reverse the transformation and go back to physical space-time. If the dust, gas or stars in the system has definite upper limits for its Jacobian constants, spatial segregation of them will arise, as is the case in radio-galaxies such as NGC 5128, NGC 1316, etc. where ringlike dust structures are observed.

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