



Global dynamics of a virus model with invariant algebraic surfaces

Fabio Scalco Dias¹ · Jaume Llibre² · Claudia Valls³

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Abstract

In this paper by using the Poincaré compactification in \mathbb{R}^3 we make a global analysis for the virus system

$$\dot{x} = \lambda - dx - \beta xz, \quad \dot{y} = -ay + \beta xz, \quad \dot{z} = ky - \mu z$$

with $(x, y, z) \in \mathbb{R}^3$, $\beta > 0$, λ, a, d, k and μ are nonnegative parameters due to their biological meaning. We give the complete description of its dynamics on the sphere at infinity. For two sets of the parameter values the system has invariant algebraic surfaces. For these two sets we provide the global phase portraits of the virus system in the Poincaré ball (i.e. in the compactification of \mathbb{R}^3 with the sphere \mathbb{S}^2 of the infinity).

Keywords Invariant algebraic surfaces · Poincaré compactification · Phase portrait · Dynamics at infinity · Virus model

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✉ Fabio Scalco Dias
scalco@unifei.edu.br

Jaume Llibre
jllibre@mat.uab.cat

Claudia Valls
cvalls@math.ist.utl.pt

¹ Instituto de Matemática e Computação, Universidade Federal de Itajubá, Avenida BPS 1303, Pinheirinho, Itajubá, MG CEP 37.500–903, Brazil

² Departament de Matemàtiques, Universitat Autònoma de Barcelona, 08193 Bellaterra, Barcelona, Spain

³ Departamento de Matemática, Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisbon, Portugal