**Department of Physics**
**Parks College of Engineering and Aviation**
**Saint Louis University**
**3450 Lindell Blvd**
**St. Louis, MO 63103-1110**

Professor N. Paver
Coordinatore del Collegio di Dottorato di Ricerca in Fisica
Dipartimento Di Fisica
Universita' di Trieste
Via Valerio 2,
Trieste 34100
Italy

Dear Professor Paver,
I have studied the doctoral thesis "Supersymmetry in 1-Dimensional Systems", by Enrico Deotto. This thesis contains a detailed investigation of various aspects and extensions of a path integral formulation of classical mechanics I shall refer to as the CPI. In evaluating this thesis I shall comment on the originality and scope of the contribution, the mastery of the subject mater, the clarity of presentation and the impact on the field.

- Originality and Scope of Contribution: This thesis contains several original contributions to the study of the symmetries inherent in the CPI. First, it demonstrates various ways that the global N=2 supersymmetry of the CPI can be made local, and shows how one locally supersymmetric theory is connected with the concept of equivariant cohomology of the Hamiltonian flow. Second, constraints are added to the CPI to obtain a theory of motion on constant energy surfaces. This theory has an N=1 supersymmetry, which may turn out to be a more a more agile tool for studying mechanical problems. Third, the thesis investigates locally supersymmetric and time reparametrization invariant extensions of the CPI that resemble W. Siegels's theory of *K*-symmetry. One version of this theory yields physical states that are functions of constants of motion and this may be of some relevance in classical mechanics. Fourth, this thesis finds a new symmetry that rescales the CPI action. It is a symmetry that involves the Grassmannian partners of time. A simililar symmetry was discovered by Gozzi in 1985 for the action of the quantum path-integral, and in that case the symmetry was nonlocal in the time variable. In this thesis Deotto starts an investigation of the connection between the two rescalings mentioned above. This analysis may in the future shed light on the important issue of quantization. Finally the thesis presents a new superconformal theory based on the CPI.
- Mastery of the Subject Matter: This thesis demonstrates a mastery of the theory of global and local supersymmetry in one-dimensional systems, the classical theory of constrained systems and the BFV-BRS procedure for handling them, the algebraic structure of the CPI, conformal and superconformal theories, and some knowledge of general relativity. The thesis also demonstrates considerable knowledge of the literature, with more than 60 references.
- Clarity of Presentation: The thesis gives a clear, pedagogical presentation of the subject matter.
- Impact on the Field: This thesis opens up new avenues for research into the rich structures associated with the CPI. These avenues could include
    a) the connection between supersymmetry and equivariant cohomology which, following the detailed analysis of the thesis, one would be tempted to extend to two, three, and four dimensions, shedding light on the geometrical nature of supersymmetry;
    b) the study of the geometry of the space of classical orbits even in the case of Hamiltonian evolution with fixed points, using the geometrical tools provided by the susy/equivariant cohomology techniques;
    c) the study of the deep interplay between non-local time rescaling and quantization.

My overall evaluation is that the thesis is very good.

Sincerely,

William D. Thacker, Ph. D.
Professor of Physics