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SAMPLE LATEX FILE FOR THE JOURNAL OF MODERN DYNAMICS THAT INCLUDES A TITLE WHICH IS TOO LONG FOR RUNNING HEADS

MARY JANE SMYTHE, CASSANDRA MILLER, JEMIMA OGLETHORPE, JONATHAN DOE, JAMES MILLER, ETHELDREDA FINGER AND GIUSEPPE VERDI [1]
(Communicated by John Doe)

1: OK to index Mary Jane Smythe as "Smythe, Mary Jane"? OK to index Cassandra Miller as "Miller, Cassandra"? OK to index Jemima Oglethorpe as "Oglethorpe, Jemima"? OK to index James Miller as "Miller, James"? OK to index Etheldreda Finger as "Finger, Etheldreda"?

ABSTRACT. This fictitious paper is meant to serve as the template for the AIMS journal *Journal of Modern Dynamics*.

1. INTRODUCTION

Here are instructions on how to prepare your final TEX files.

The jmd document class is designed to be compatible with the usage of the amsart document class as much as possible; conversion from amsart to jmd should be easy.

This document class can be used for preprints; the option [preprint] turns off all references to the Journal of Modern Dynamics while keeping all features. The option [final] turns off marginal comments and black boxes for overfull lines.

1. **\UseLinks** should immediately follow the last \usepackage{...}. It replaces \usepackage{hyperref}, which must be omitted.
2. Key words and at least one 2010 AMS subject classification are required. Use of \Subjclass{...}{...} instead of \subjclass{...} is requested
3. Pictures should **NOT** be in eps or ps format; the Journal of Modern Dynamics uses PDFLATEX. Pictures should be scalable or adapted to a text width of 5 inches. See Section 4 for pertinent helpful information.
4. Please minimize the usage of "newtheorem" and "newcommand" and use equation numbers only in situations where they provide essential convenience.
5. Try to avoid defining your own macros.
6. All formulas and pictures must be within the 5 inch width limit.
7. An abstract is needed and should not exceed 200 words.

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MJS: Supported by a chair.
JD: Affiliated with AIMS.
JM: Affiliated with PSU.

8. If **and only if** the full title does not fit in the running heads, an abbreviated title should be provided for running heads; this would go in the brackets in \title[...]{...}.
9. If **and only if** the full names of all authors do not fit in the running heads, abbreviated names (i.e., with initials instead of first names) should be provided for running heads; this would go in the brackets in \author[...]{...}. Full names **only** should be provided by default.
10. **Acknowledgements** should be formatted with the \acknowledgement macro as at the end of this sample paper. Generally, they should appear at the end of the paper (rather than in the introduction), just as in this sample.

2. SPECIAL FEATURES

\begin{document} must precede the first author.

\thanks can be used multiple times as follows: Once before the first \author; this is for thanks pertinent to *all* authors, and once after each \author; this is for thanks by the immediately preceding \author.

The **\issueinfo** macro at the beginning of the LaTeX file for this sample provides the volume, issue and startpage numbers. (The latter is always odd. The ending page is suppplied automatically via the .aux file and will be correct after the second run of LaTeX. The same goes for the author information at the end of the paper.)

The **\bibitem** macro allows optional links to Mathematical Reviews; just insert the MR number in parentheses right after the name of the item as illustrated with [3, 13] below. The number could be the purely numerical running MR number (without spaces!) or the traditional MR number, such as 96c:58055 (but not the really old number with a #). For compatibility, bibitems with or without "[...]" are allowed, but JMD produces numerical labels in either case. Moreover, links to electronic documents with a digital object identifier are possible as well; check the LaTeX code for [16] for an example:

```
\bibitem[Rees]{rees} (MR1149864) [10.1007/BF02392976]
```

The **\arXiv** macro makes links to arXiv (see [7]) and a **\url** macro formats URL's properly and makes links; see [8].

Within mathematics, the AMSLaTeX equation layout macros are strongly recommended for complex equations, that is, the align, gather and multline mechanisms; these produce much better results than the LaTeX mechanisms such as \eqnarray. Indeed, *\eqnarray is discouraged in the strongest possible terms.*

\dfn produces ":=", which defines the left-hand side of the equation, and **\nfd** produces "=:", which defines the right-hand side.

A **\eurologo** macro inserts the European currency symbol €.

Note that \qedhere provides a useful way to end a proof on a displayed equation; this is illustrated in (3).

This style compiles in draft mode by default, which shows overfull boxes. The option "final" suppresses this—this will be done at production time anyway, so submissions to JMD should not use this option.

3. INTERNAL REFERENCING

For internal referencing an additional macro \Label for theorem-like environments (theorems, definitions, lemmas, etc.) is provided. Using this instead of \label allows the use of the macro \Ref to refer to this item in a way that includes the category of the statement; in this sample this is *illustrated with Theorem 2*—the preceding reference was typeset with "illustrated with \Ref{result1}". In the end stages of preparation this is hardly more useful than \label and \ref, but if this style is used in the early stages of writing and an author wishes to rename a "Theorem" to "Proposition", say, then with this mechanism in use there would be no need to correct any internal references. This feature does not affect the use of \label or \ref in any way.

4. POSTSCRIPT FIGURES

PostScript figures are not used in production of the Journal of Modern Dynamics. The LaTeX compilation with TeXLive automatically converts them to PDF. However, this leaves the need to address some related legacy PostScript issues.

4.1. **pstricks.**

TikZ is the PDF counterpart to the pstricks packages. However, many authors have nice pictures that were made with pstricks. To convert these to PDF, one can compile the file (preferably after conversion to the jmd documentclass) via LaTeX, dvips, and a conversion to PDF and then use a suitable program (Preview on a Macintosh is good enough) to copy the picture out of the resulting PDF file. The copied picture should include the full text width (no matter how much white space) and as little height as possible. Such a PDF can then be used to render the picture in the right location with \includegraphics[width=\textwidth]{...}.

4.2. **psfrag.**

This is an ingenious package for text substitutions in PostScript pictures, and it is unfortunate that there is no comparable counterpart for PDF. Any picture that uses this feature should be made into a PDF as described above and again here:

Compile the file *after conversion to the jmd documentclass* to ensure correct fonts in the substitution via LaTeX, dvips, and a conversion to PDF and then use a suitable program (Preview on a Macintosh is good enough) to copy the picture out of the resulting PDF file. The copied picture should include the full text width (no matter how much white space; this averts unintentional resizing) and as little height as possible. Such a PDF can then be used to render the picture in the right location with \includegraphics[width=\textwidth]{...}.

5. SAMPLE OF MATHEMATICS

5.1. **Pinching.**

Recall that for a flow ϕ_t on a space V the *upper Lyapunov exponent* $\bar{\lambda}(x,\xi)$ of $\xi \in T_xV$ is $\bar{\lambda}(x,\xi) = \overline{\lim}_{t\to\infty} \frac{1}{t} \log\|d\phi_t(\xi)\|$. If the limit exists, it is called the *Lyapunov exponent* and is written $\lambda(x,\xi)$.

DEFINITION 1. Let ϕ_t be an Anosov flow on a compact space V and $A \subset V$ a dense set. Say that the upper Lyapunov exponents are $\frac{1}{2}$-*pinched* on A if

$$\sup_{x\in A} \frac{\max\{|\bar{\lambda}| : \bar{\lambda} \text{ is a nonzero upper Lyapunov exponent at } x\}}{\min\{|\bar{\lambda}| : \bar{\lambda} \text{ is a nonzero upper Lyapunov exponent at } x\}} \leq 2. \tag{1}$$

A. Katok asked in [12] whether a C^∞ contact perturbation of the geodesic flow on the unit tangent bundle of a compact negatively curved locally symmetric space of non-constant negative curvature which is $\frac{1}{2}$-pinched on the set of periodic points must be smoothly conjugate to the locally symmetric geodesic flow; this would be a local dynamical analogue to the geometric $\frac{1}{4}$-pinching rigidity theorems of Gromov [10], Hernández [11], and Corlette [6], which imply that any $\frac{1}{4}$-pinched metric on a compact quotient of a symmetric space of nonconstant negative curvature is isometric to the locally symmetric metric. We show that this proposed dynamical analogue does not hold.

THEOREM 2. *There exist compact quotients M of complex hyperbolic space and $0 \neq [\alpha] \in H^1(SM, \mathbb{R})$ such that, for X^0 the geodesic flow on SM, the time-changed flow $Y = \frac{X^0}{1+\alpha(X^0)}$ is a C^∞ contact perturbation of X^0 whose upper Lyapunov exponents are everywhere $\frac{1}{2}$-pinched, but Y is not smoothly conjugate to X^0.*

Benoist, Foulon, and Labourie [2] classified contact Anosov flows possessing C^∞ Anosov splitting, finding that they are precisely of the form as the time changes in Theorem 2. That these time changes all have C^∞ Anosov splitting thus suggests a reformulation of Katok's problem:

PROBLEM (Asymptotic Pinching Rigidity)**.** *Let Y be a C^∞ contact perturbation of the locally symmetric geodesic flow X^0 on the unit tangent bundle of a compact quotient of a locally symmetric space of non-constant negative curvature. Show that if the upper Lyapunov exponents for Y are $\frac{1}{2}$-pinched on a dense set $A \subset SM$, then Y has C^∞ Anosov splitting.*

5.2. **Entropy.** A recent result of Besson, Courtois, and Gallot [3], [4] implies that among all metrics of negative curvature on a negatively curved compact locally symmetric space, the locally symmetric geodesic flow uniquely minimizes topological entropy (normalized by the volume). A dynamical generalization of this is to ask whether the locally symmetric geodesic flow continues to minimize topological entropy in the larger class of contact Anosov flows (normalized by the contact volume). In support of this dynamical analogue, we show that deformations through the time changes considered above increase normalized topological entropy.

THEOREM 3. *Let M be a negatively curved compact locally symmetric space, (X^0, ϕ_t^0) its geodesic flow on SM, and $0 \neq [\alpha] \in H^1(SM, \mathbb{R})$. If $(\phi_t^\varepsilon, \theta_\varepsilon)$ is the contact flow generated by $\frac{X^0}{1+\varepsilon\alpha(X^0)}$, then for small ε,*

$$h_{top}(\phi_t^0)^n \int_{SM} \theta_0 \wedge d\theta_0^{n-1} < h_{top}(\phi_t^\varepsilon)^n \int_{SM} \theta_\varepsilon \wedge d\theta_\varepsilon^{n-1}.$$

FIGURE 1. Partition of the plane determined by the orbits

6. PROOFS

We begin with a lemma relating the upper Lyapunov exponents for any C^1 time change of the locally symmetric flow X^0 to the Lyapunov exponents for X^0 (which are defined everywhere).

LEMMA 4. *Let (X^0, ϕ_t^0) be the geodesic flow on the unit tangent bundle of a compact locally symmetric space M of negative curvature. Let $Y = fX$ be a C^1 time change of X^0 by an everywhere positive C^1 function f. Denoting the flow for Y by ψ_t, the upper Lyapunov exponents $\bar{\lambda}(x,\xi)$ for Y are a constant times those for X^0, where the constant (which depends on x but not on ξ) is $\overline{\lim}_{t\to\infty} \frac{1}{t}\int_0^t f(\psi_s(x))\,ds$.*

Proof of Theorem 2. The work of D. Kazhdan ([14] §4) implies that there are compact quotients M of complex hyperbolic space $\mathbb{C}\mathscr{H}^n$ by arithmetic lattices whose first cohomology group is not trivial. When $n \geq 2$ then the Gysin sequence for sphere bundles [5] gives that this first cohomology group is isomorphic to that of the unit tangent bundle SM. Given a non-zero representative β of an element of $H^1(SM)$, we can scale it by a small number ε to ensure that $1+\varepsilon\beta(X^0) > 0$ and then set $\alpha = \varepsilon\beta$. We know from Lemma 1 that the upper Lyapunov exponents for $Y = \frac{X^0}{1+\alpha(X^0)}$ are the constant $\overline{\lim}_{t\to\infty}\frac{1}{t}\rho_t(x)$ times those for X^0. Thus the ratio of upper exponents for Y is the same as the ratio for X^0, and since the ratio for X^0 is exactly 2, it follows that Y is also $\frac{1}{2}$-pinched. One can check that Y is a contact flow preserving the contact form $\eta = \theta_0 + \alpha$. It only remains to see that the flow for Y is not smoothly conjugate to that for X^0, which is a consequence of the theorem of Benoist, Foulon, and Labourie [2]. □

REMARK 5. Observe that one cannot replace complex hyperbolic space by quaternionic hyperbolic space in the statement of Theorem 2, since it is known [15] that quaternionic hyperbolic space does not possess compact quotients with nonzero first cohomology group.

Integral	Initial	Time average	Std. Dev.
E	1.0000	1.0004	0.02%
H_C	0.024613	0.024603	0.03%
A	0.031031	0.031031	2×10^{-5} %
E_M	0.50000	0.56045	6.35 %

TABLE 1. An Example of a Table

Proof of Theorem 3. Let $N(\varepsilon)$ be the normalized topological entropy functional $N(\varepsilon) = h_{top}(\phi_t^\varepsilon)^n \int_{SM} \theta_\varepsilon \wedge d\theta_\varepsilon^{n-1}$. We will show that $N'(0) = 0$ and $N''(0) > 0$. First, notice that the contact volume $\int_{SM} \theta_\varepsilon \wedge d\theta_\varepsilon^{n-1}$ is independent of ε:

$$\begin{aligned}\theta_\varepsilon \wedge d\theta_\varepsilon^{n-1} &= (\theta_0 + \varepsilon\alpha) \wedge (d(\theta_0 + \varepsilon\alpha))^{n-1} \quad \text{since } d\alpha = 0\\ &= (\theta_0 + \varepsilon\alpha) \wedge (d\theta_0)^{n-1} + \theta_0 \wedge d\theta_0^{n-1} - \varepsilon d(\alpha \wedge \theta_0 \wedge d\theta_0^{n-2})\\ &\quad + \theta_0 \wedge d\theta_0^{n-1} + \varepsilon\alpha \wedge d\theta_0^{n-1}\\ &= \theta_0 \wedge d\theta_0^{n-1} - \varepsilon d(\alpha \wedge \theta_0 \wedge d\theta_0^{n-2}),\end{aligned}$$

compared with

$$\begin{aligned}\theta_\varepsilon \wedge d\theta_\varepsilon^{n-1} &= (\theta_0 + \varepsilon\alpha) \wedge (d(\theta_0 + \varepsilon\alpha))^{n-1} \quad \text{since } d\alpha = 0\\ &= (\theta_0 + \varepsilon\alpha) \wedge (d\theta_0)^{n-1} + \theta_0 \wedge d\theta_0^{n-1} - \varepsilon d(\alpha \wedge \theta_0 \wedge d\theta_0^{n-2})\\ &\quad + \theta_0 \wedge d\theta_0^{n-1} + \varepsilon\alpha \wedge d\theta_0^{n-1}\\ &= \theta_0 \wedge d\theta_0^{n-1} - \varepsilon d(\alpha \wedge \theta_0 \wedge d\theta_0^{n-2}),\end{aligned} \tag{2}$$

and so

$$\int_{SM} \theta_\varepsilon \wedge d\theta_\varepsilon^{n-1} = \int_{SM} \theta_0 \wedge d\theta_0^{n-1}$$

by Stokes' Theorem. Hence to compute the derivatives of $N(\varepsilon)$ we need only worry about the derivatives of the entropy $h_{top}(\phi_t^\varepsilon)$. For this we use the following result of M. Pollicott; in the statement of the theorem, f_ε is the velocity change given by structural stability, that is, the function so that $f_\varepsilon \cdot \phi_t^0$ is conjugate to ϕ_t^ε. For fixed ε the function is generally only Hölder continuous, but de la Llave *et al.* [9] show that in ε we can expand it $f_\varepsilon = 1 + \varepsilon f^{(1)} + \frac{\varepsilon^2}{2} f^{(2)} + \cdots$.

On the other hand, we can easily derive the following equality:

$$\begin{aligned}\int_0^T |u_0(t)|^2\, dt \le \delta^{-1}\Big[\int_0^T (\beta(t) + \gamma(t))\, dt\\ + T^{\frac{2(p-1)}{p}}\Big(\int_0^T |\dot{u}_0(t)|^p\, dt\Big)^{\frac{2}{p}} + T^{\frac{2(p-1)}{p}}\Big(\int_0^T |\dot{u}_0(t)|^p\, dt\Big)^{\frac{2}{p}}\Big].\end{aligned} \tag{3}$$ □

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MARY JANE SMYTHE

CASSANDRA MILLER

JEMIMA OGLETHORPE

JONATHAN DOE <`doe@aaa.edu`>: Department of Mathematics, ABC University, College Town, AA 12345 *URL*: `http://www.math.aaa.edu/doe`

Current address: Department of Mathematics, CBA University, College City, BB 54321

JAMES MILLER <`miller@def.edu`>: Department of Mathematics, DEF University, University City, XX 12345 *URL*: `http://www.math.def.edu/miller`

Current address: Department of Mathematics, FED University, College Town, BB 54321

ETHELDREDA FINGER

GIUSEPPE VERDI