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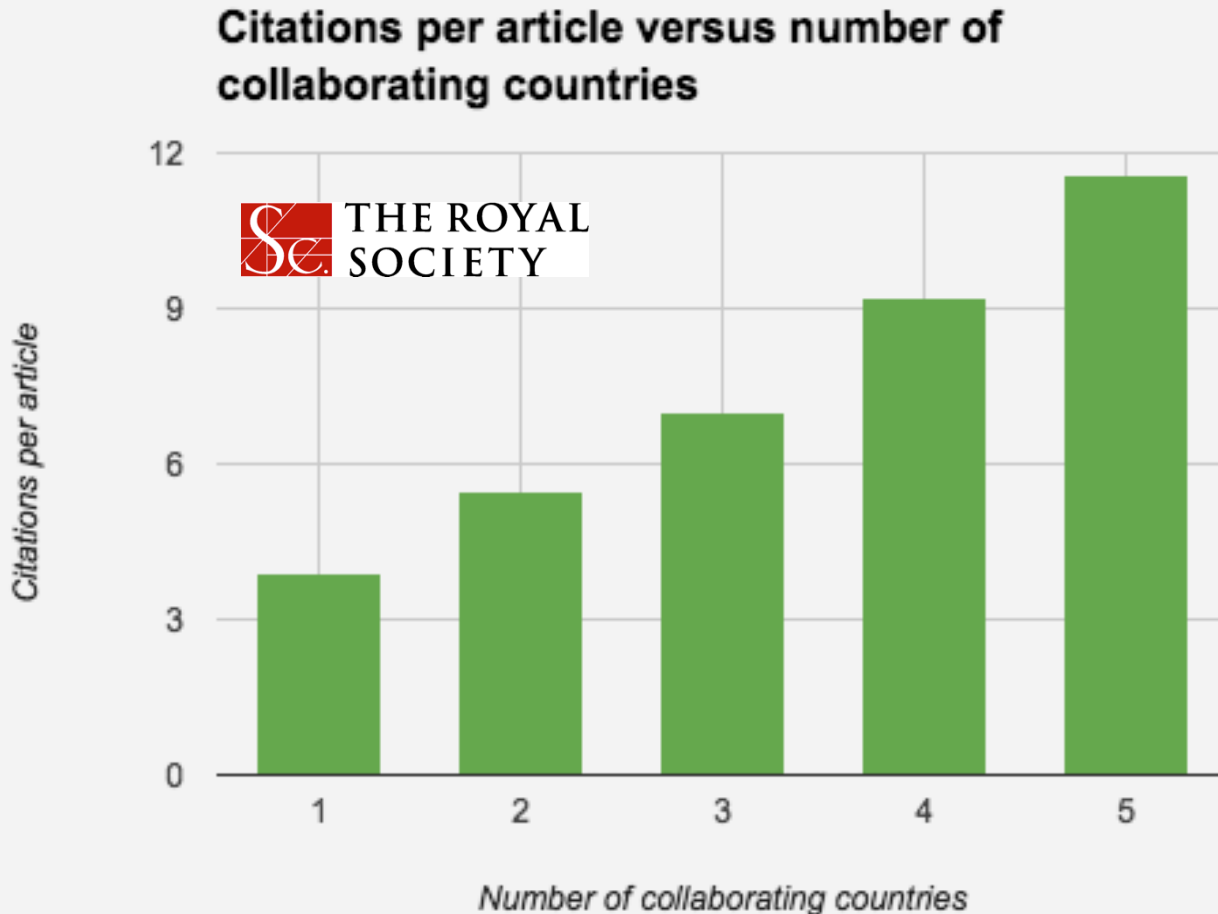
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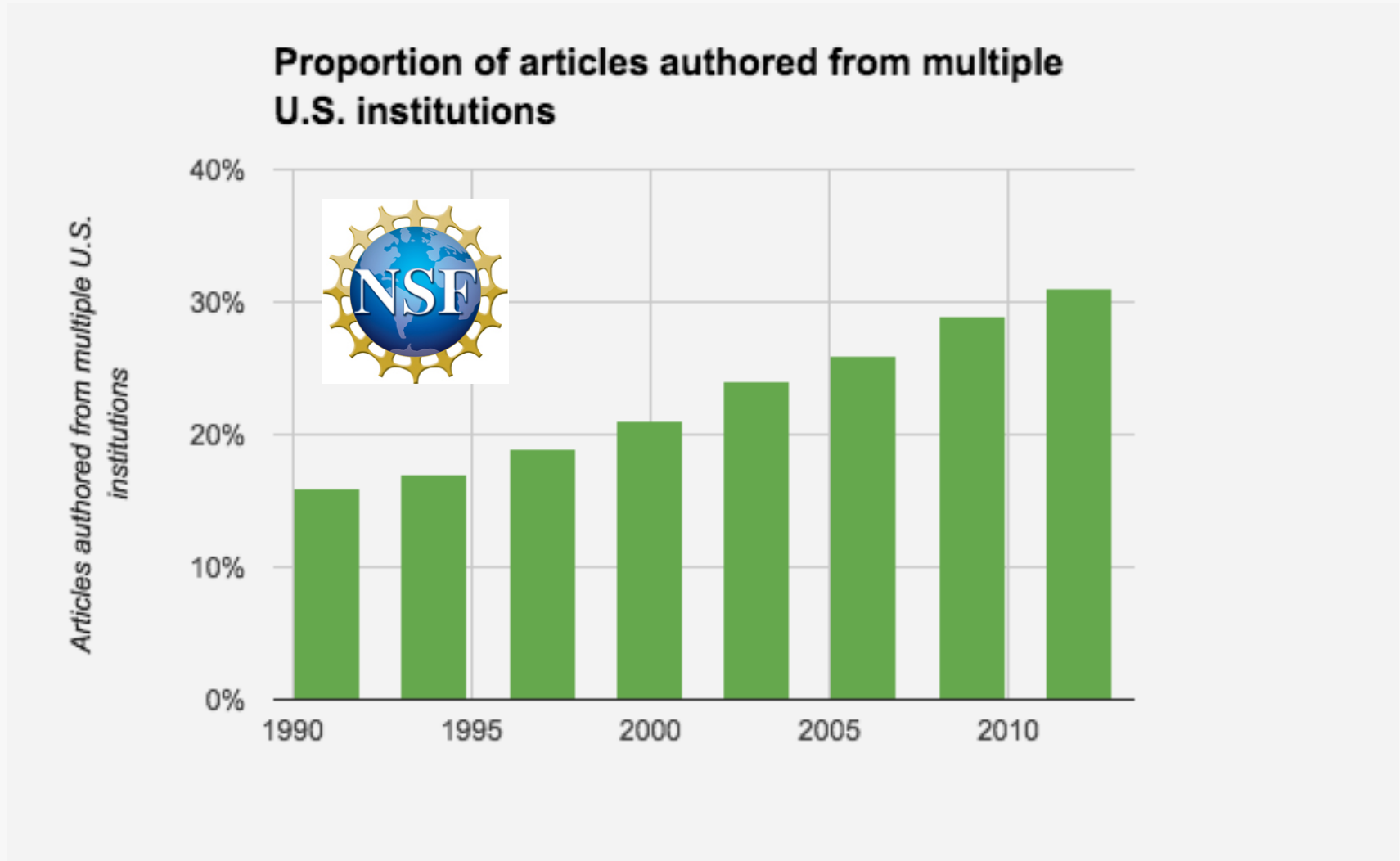
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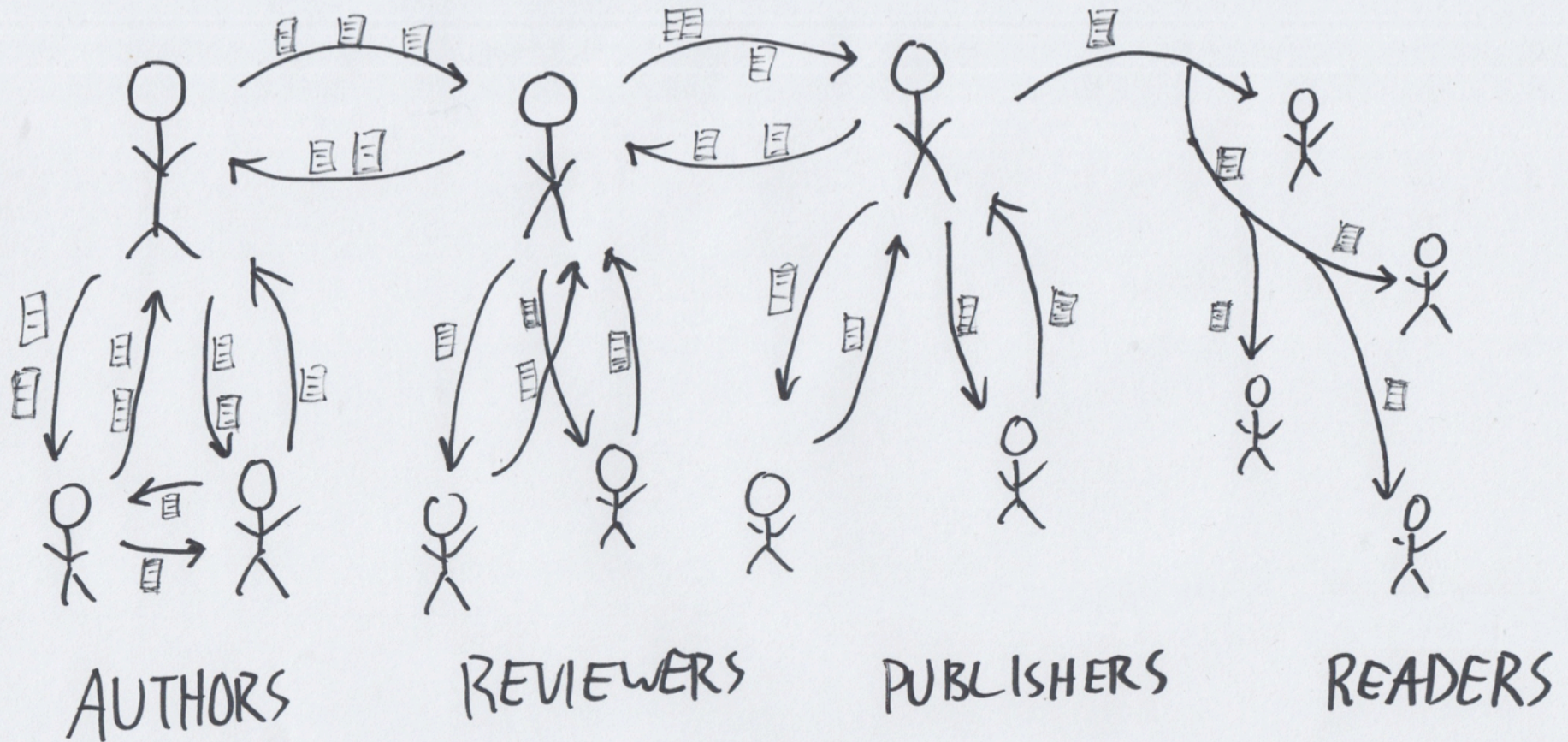
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Modeling of Trap Induced Dispersion of Large Signal Dynamic Characteristics of GaN HEMTs

O. Jardel¹, S. Laurent², T. Reveyrand², R. Quere², P. Nakkala², A. Martin²
S. Piotrowicz¹, M. Campovecchio², S.L. Delage¹
1III-V Lab, route de Nozay, 91461 Marcoussis Cedex, France
2XLIM, 7 rue Jules Valles, 19100 Brive-la-gaillarde, France
olivier.jardel@3-5lab.fr

Abstract

We propose here a non-linear GaN HEMT model for CAD including a trapping effects description consistent with both small-signal and large-signal operating modes. It takes into account the dynamics of the traps and then allows to accurately model the modulated large signal characteristics that are encountered in telecommunication and radar signals. This model is elaborated through low-frequency S-parameter measurements complementary to more classical pulsed-IV characterizations. A 8x75μm AlInN/GaN HEMT model was designed and particularly validated in large-signal pulsed RF operation. It is also shown that thermal and trapping effects have opposite effects on the output conductance, thus opening the way for separate characterizations of the two effects.

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Index Terms—Trappings effects, thermal effects, low frequency S-parameters, CAD non-linear model, RF pulsed operation.

I. INTRODUCTION

Gallium Nitride (GaN) High Electron Mobility Transistors (HEMT) on SiC are now recognized as good candidates for the development of a number of RF applications and notably Power Amplifiers (PA) for telecommunications and radars, due to their high breakdown voltage, their high cut-off frequency as well as their high temperature capabilities. However they are still subject to parasitics effects such as thermal effects and especially trapping effects. Those trapping effects have been extensively studied using a number of techniques such as pulsed measurements, load-pull measurements as well as frequency dispersion measurements. At the same time, models have been proposed that take those effects into account [1], [2], [3], and while the effects of traps are well taken into account in CW conditions, their impacts on dynamic large signal characteristics remain difficult to understand. They manifest themselves under modulated signals such as RF pulses or telecommunications signals. Memory effects are the main consequence of those trapping effects. In this paper we propose to investigate the dynamics of these trapping effects using large

II. IMPACT OF TRAPS ON LARGE SIGNAL CHARACTERISTICS

One convenient way to identify the impact of trapping effects is to monitor the average drain current of the transistor versus an increasing RF input power. It has already been reported in [1] and [3] that this drain current under class-AB conditions decreases as the input power increases, contradicting the expected characteristics. Clearly this behavior cannot be explained by thermal behavior as far as the channel temperature sinks when the power increases and would leads, at least for moderate powers, to an average drain current enlargement.

Fig. 1. Representation of the mechanism induced by traps on the average drain current.

Pulsed DE measurements were performed under DC bias on

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22 Dynamic Characteristics of GaN HEMTs}
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26 S. Laurent\authorrefmark{2},
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37 XLIM, 7 rue Jules Valles, 19100 Brive-la-gaillarde, France
38 \olivier.jardel@3-5lab.fr}}
39
40 \maketitle
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42 \begin{abstract}
43 We propose here a non-linear GaN HEMT model for CAD including a
44 trapping effects description consistent with both small-signal
45 and large-signal operating modes. It takes into account the
46 dynamics of the traps and then allows to accurately model the
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48 telecommunication and radar signals. This model is elaborated
49 through low frequency S-parameter measurements complementary to
```

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account the dynamics of the traps. Finally we conclude and draw some perspectives.

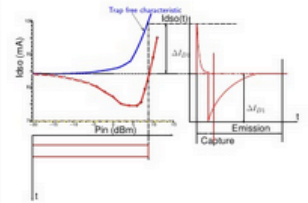


Figure 1. Representation of the mechanism induced by traps on the average drain current.

Pulsed RF measurements were performed under DC bias on AlGaN/GaN and InAlN/GaN HEMTs of 8x75x0.25 μm^2 for a large number of output loads. For all devices, we obtain the same shape of the average drain current which is schematized in Figure 1. The average current decrease is due to the trap capture, which increases alike to the gate and drain voltage excursions versus the input power for a CW measurement. Indeed, the number of ionized traps is roughly proportional to the maximum value of the drain-source voltage, because of the dissymmetry of the capture and emission time constants

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The interface is split into two main panels: 'Current version' on the left and 'Compared version (read only)' on the right.

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 - John Hammersley** replied about an hour ago: Yep.
 - John Lees-Miller** closed this about an hour ago.
- 33 **{Some LaTeX Examples}**
- 34
- 35 **{How to Include Figures}**
- 36
- 37

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- 17
- 18 **Abstract**
- 19 Your abstract.
- 20
- 21
- 22 **{Introduction}**
- 23
- 24 This is where you write your introduction. Some examples of commonly used commands and features are listed below, to help you get started. If you have a question, please use the help menu ('`?') on the top bar to search for help or ask us a question.
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- 26 **{Some LaTeX Examples}**
- 27
- 28 **{How to Include Figures}**
- 29
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- 31
- 32 `\begin{figure}`
- 33 `\centering`

Integrated with other services, e.g. reference managers

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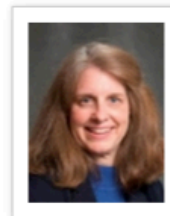
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Author



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Head of the Terman Engineering Library

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(650) 725-1012

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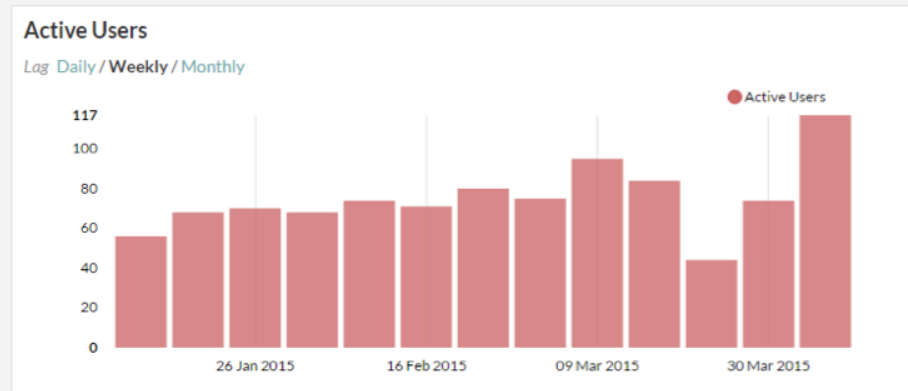
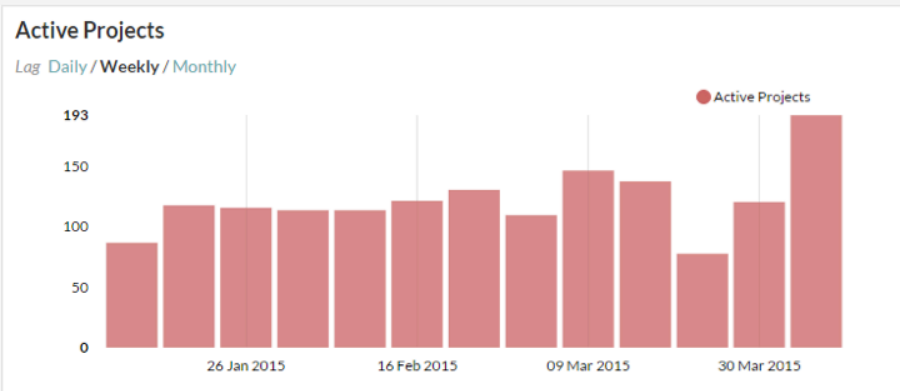
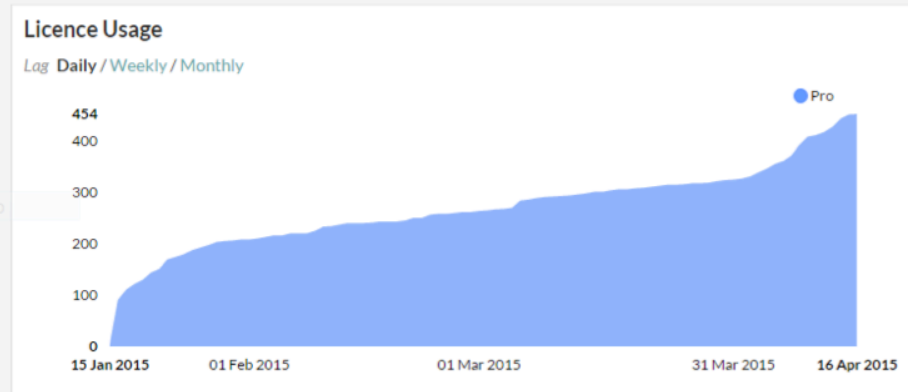
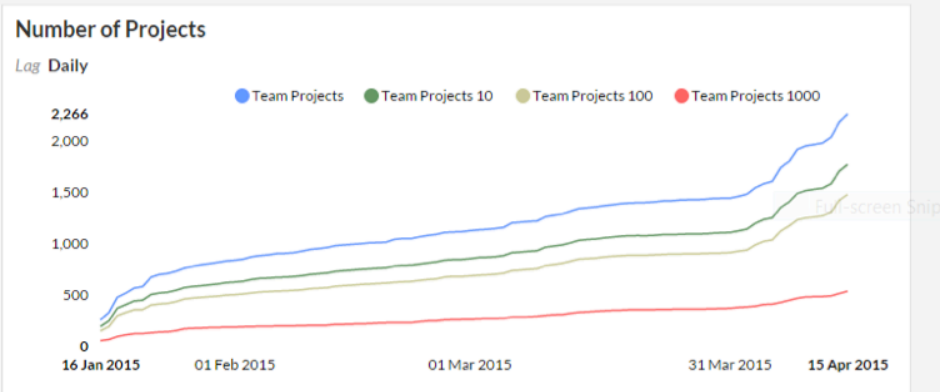
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30

31

32 {Introduction}

33

34 The format of the main body of the article is flexible: it should be concise and in the format most appropriate to displaying the content of the article.]

35

36 Some examples of commonly used commands and features are listed below, to

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US	University of California, Berkeley	468	2,842
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