

# <sup>1</sup> rushlight - Python-based Forward Modelling of <sup>2</sup> Coronal Plasma Models

<sup>3</sup> **Sabastian Fernandes**  <sup>1\*</sup>  and **Ivan Oparin**  <sup>1\*</sup>

<sup>4</sup> **1** Center For Solar-Terrestrial Research, New Jersey Institute of Technology, Newark, NJ 07102, USA   
<sup>5</sup> Corresponding author \* These authors contributed equally.

DOI: [10.xxxxxx/draft](https://doi.org/10.xxxxxx/draft)

## Software

- [Review](#) 
- [Repository](#) 
- [Archive](#) 

Editor: [Open Journals](#) 

Reviewers:

- [@openjournals](#)

Submitted: 01 January 1970

Published: unpublished

## License

Authors of papers retain copyright and release the work under a <sup>16</sup> Creative Commons Attribution 4.0 International License ([CC BY 4.0](#))<sup>17</sup>.  
<sup>18</sup>

## <sup>6</sup> Summary

<sup>7</sup> The rushlight Python package provides a framework for creating synthetic images of plasma  
<sup>8</sup> structures for model-to-data comparisons with coronal events. It handles the projection and  
<sup>9</sup> alignment of 3D simulated datasets to user-defined locations and orientations relative to the  
<sup>10</sup> sun. The produced observables are comparable to observations made by instruments such as  
<sup>11</sup> the Hinode X-Ray Telescope (XRT) and the Solar Dynamics Observatory Atmospheric Imaging  
<sup>12</sup> Assembly (AIA). rushlight aims to integrate into the growing community of Python-based  
<sup>13</sup> astrophysics software such as Astropy, SunPy and XRTPy.  
<sup>14</sup>

## Statement of need

rushlight is a Python package which performs forward modelling of simulated 3D plasma datasets in the coronal environment. Its core functionality lies in creating synthetic observables in Soft X-Ray filter bands produced by XRT, and Ultraviolet / Extreme Ultraviolet filter bands produced by AIA.  
<sup>15</sup>

<sup>19</sup> rushlight adapts some of the core functionality of the FORWARD package, written in the  
<sup>20</sup> Interactive Data Language (IDL) ([Gibson et al., 2016](#)). It is under active development, and  
<sup>21</sup> aims to be continually improved as to implement more of FORWARD's features.  
<sup>16</sup>

<sup>22</sup> Part of rushlight's core motivation is to make EUV / SXR forward modelling more accessible  
<sup>23</sup> to the growing company of astrophysicists who utilize the python language to develop and  
<sup>24</sup> share scientific software. To this effect, rushlight has been developed as to be both compatible  
<sup>25</sup> and scalable with release versions of other astrophysics open-source software, such as Astropy  
<sup>26</sup> (?), SunPy ([Mumford et al., 2020](#)), and XRTPy ([Velasquez et al., 2024](#)).  
<sup>17</sup>

## <sup>27</sup> Mathematics

<sup>28</sup> Test

## <sup>29</sup> Acknowledgements

<sup>30</sup> Test

## <sup>31</sup> References

<sup>32</sup> Test

- 33 Gibson, S. E., Kucera, T. A., White, S. M., Dove, J. B., Fan, Y., Forland, B. C., Rachmeler,  
34 L. A., Downs, C., & Reeves, K. K. (2016). FORWARD: A toolset for multiwavelength  
35 coronal magnetometry. *Frontiers in Astronomy and Space Sciences, Volume 3 - 2016*.  
36 <https://doi.org/10.3389/fspas.2016.00008>
- 37 Mumford, S. J., Freij, N., Christe, S., Ireland, J., Mayer, F., Hughitt, V. K., Shih, A. Y.,  
38 Ryan, D. F., Liedtke, S., Pérez-Suárez, D., Chakraborty, P., K, V., Inglis, A., Patnaik, P.,  
39 Sipőcz, B., Sharma, R., Leonard, A., Stansby, D., Hewett, R., ... Murray, S. A. (2020).  
40 SunPy: A python package for solar physics. *Journal of Open Source Software, 5(46)*, 1832.  
41 <https://doi.org/10.21105/joss.01832>
- 42 Velasquez, J., Murphy, N. A., Reeves, K. K., Slavin, J., Weber, M., & Barnes, W. T. (2024).  
43 XRTpy: A hinode-x-ray telescope python package. *Journal of Open Source Software,*  
44 9(100), 6396. <https://doi.org/10.21105/joss.06396>

DRAFT