Astrophys Space Sci
DOI 10.1007/s10509-013-1682-0

ORIGINAL ARTICLE

PyWiFeS: a rapid data reduction pipeline for the Wide Field Spectrograph (WiFeS)

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Received: 12 September 2013 / Accepted: 19 October 2013

Abstract We present PyWiFeS, a new Python-based data reduction pipeline for the Wide Field Spectrograph (WiFeS). PyWiFeS consists of a series of core data processing routines built on standard scientific Python packages commonly used in astronomical applications. Included in PyWiFeS is an implementation of a new global optical model of the spectrograph which provides wavelengths solutions accurate to ∼0.05 Å (RMS) across the entire detector. The core PyWiFeS package is designed to be scriptable to enable batch processing of large quantities of data, and we present a default format for handling of observation metadata and scripting of data reduction.

Keywords Methods: data analysis · Instrumentation: spectrographs

1 WiFeS and PyWiFeS: an introduction

The Wide Field Spectrograph (WiFeS—Dopita et al. 2007, 2010) is an image-slicing integral field spectrograph built at the Research School of Astronomy and Astrophysics (RSAA) of the Australian National University (ANU). WiFeS is continuously mounted on the ANU 2.3 m telescope at Siding Spring Observatory (SSO) in New South Wales, Australia. The medium wavelength resolution and wide field of view of WiFeS make it ideal for a multitude of studies such as galaxy kinematics, radial velocity measurements of stars hosting planets (Bakos et al. 2013; Bayliss et al. 2013), spatially-resolved emission line measurements in galaxies undergoing star-formation (Green et al. 2010) or gas-rich mergers (Vogt et al. 2013), and the study of narrow emission lines from supernovae interacting with a circum-stellar medium (Fraser et al. 2013; Inserra et al. 2013).

The first data reduction pipeline for WiFeS was developed for use with the NOAO IRAF software and was modeled on the data reduction package for the Near-IR Integral Field Spectrograph (NIFS—McGregor et al. 2003). A need was identified for a rapid data reduction pipeline which could yield fully processed data in nearly real time, thereby adding the capability of real-time classification of astrophysical transients. The PyWiFeS data reduction package was developed to meet this new criterion.

PyWiFeS is designed to make use of existing Python libraries commonly used in astronomical research. The only core requirements are the NumPy, SciPy, and PyFITS packages, with one non-required but strongly recommended dependency on Matplotlib. PyWiFeS is written as a series of data processing routines (functions) that operate on data stored in Flexible Image Transport System (FITS) format and produce output which is also stored in FITS files, without the need for complex new data classes. It is thus intended to be a flexible package which can be run directly via function calls in the Python interpreter, or scripted to perform batch data reduction.

Much effort was expended to make data formats described by abstract variables as much as possible, so that the pipeline is not tailored specifically to WiFeS except where absolutely necessary. The code is open source and could potentially be adapted for reduction of data from fu-

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Published online: 12 November 2013