Debian Astro: An open computing platform for astronomy

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Abstract. Debian Astro is a Debian Pure Blend that aims to distribute the available astronomy software within the Debian operating system. Using Debian as the foundation has unique advantages for end-users and developers such as an easy installation and upgrading of packages, an open distribution and development model, or the reproducibility due to the standardized build system.

1. Introduction

In the last years, the amount and quality of software for astronomy raised significantly. Many traditional software packages got a significant push. With Astropy (Astropy Collaboration et al. 2013), a new and coordinated approach of software development in astronomy was established. However, there is still much legacy software in use, partly based on outdated dependencies and sometimes even not maintained anymore.

Keeping up a consistent integration of astronomical software into a single usable framework is difficult, as it is to manage the packages, their requirements and to provide sensible defaults to the users. Debian Astro integrates tested software packages, maintained by a group of volunteers. Along with the packaging, we also provide a web site with detailed description and status of all packages.

The Debian Astro Pure Blend is completely integrated into Debian, so that the packages are directly installable on any Debian installation from the regular software repositories.

2. Packaging for Debian

Debian as a free software distribution has a number of strict rules for the inclusion of packages. The Social Contract (Perens et al. 2004) contains the Debian Free Software Guidelines with licensing requirements, limiting the software to Open Source. In exceptional cases, non-free software or software with non-free dependencies may be included in the “contrib” and “non-free” areas, which are however not an official part of Debian.

All technical requirements for Debian packages are described in the Debian Policy (Jackson & Schwarz 2016). There are rules on the package names, shared libraries, dependency declaration and so on. The rules are derived from the common practice in software development and ensure a consistent packaging.

1https://blends.debian.org/astro
Debian is not only available for Linux at x86 processors, but for a variety of kernels and CPU types. Aside from the instruction set, the architectures differ by word width (32 or 64 bit), byte order and other properties.

Although many Debian packages are maintained by a single person, it is encouraged to maintain the packages within a team. Teams exist for packaging software of specific languages, but also by topic, like the Debian Science team. In 2014, the Debian Astro team was founded, dedicated to maintain packages that are relevant to astronomy and astrophysics. The team is organized by a mailing list\(^2\). To join the team it is not required to be a Debian developer, anyone can contribute here. Uploads of non-developers must be sponsored by a Debian developer from the team.

The packaging work is organized in git repositories located on the Debian development server\(^3\). About 40 people signed up to directly contribute to the development, and 15 of these signed to be responsible for the maintenance of one or more packages. There is no dedicated Packaging Policy for the Debian Astro team; mainly the Debian Science Policy (Prinz & Ledru 2013) is used as a guide.

### 3. Contents

The packages are organized into 18 sections, where each section is represented by a Debian meta-package, triggering the installation of the contained packages as recommendations or suggestions. Selected packages are:

- Base libraries: cfitsio, ccfits, qfits, wcslib, westools, ESO cpl, Starlink AST, PAL, healpix, erfa, giza
- Common science: fft, cminpack, lapack, numpy, scipy
- Data Reduction: Astrometry.net, ESO pipelines, Astromatic software

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\(^2\)https://lists.debian.org/debian-astro
\(^3\)https://alioth.debian.org
• Python (2 and 3): Astropy and its affiliated packages, sunpy
• Virtual Observatory: MOC (Java+Python), Savot, Samp, Aladin, pyvo
• Radio Astronomy: Casacore, cassbeam, aoflagger, wsclean, purify
• Viewers: SAOImage DS9, Fv, Ginga, Glue, QFitsView, Skycat, yt
• Legacy: ESO-MIDAS, Tcl/Tk, GDL Astrolib
• Education and amateur astronomy: Stellarium, kstars, Indi, Gcx

IRAF is not included in Debian for two reasons: First, it contains code from the Numerical Recipes book, which is not distributable (Press et al. 1993). This effectively makes IRAF non-free software, despite its licensing claims. Also the internal structure of IRAF makes it difficult to follow Debian standards in terms of compilation, file system hierarchy and portability.

4. Advantages of packaging for Debian

Creating official Debian packages has a benefit not only for the users getting the software in a comfortable way. The major advantage for the developer is that the software and its integration into the operating system is extensively tested. Usually, software packaged for Debian will be built automatically on all 22 available platforms with different kernels and CPU types, which is an extensive test of the software for portability. If the software contains build time tests, they are executed on each platform as well. Even if the use of non-x86 platforms is currently small, this ensures reliability to future hardware development.

For each package, continuous integration tests can be setup, which are then executed within the Debian infrastructure on every dependency change. Currently, the majority of the packages in the Debian Astro Pure Blend uses these CI tests, which give an early warning on incompatible changes of the whole software ecosystem. Also there are frequent rebuilds of the whole Debian archive from source. Several Debian specific QA tests are continuously applied to the whole archive, reporting issues from spelling errors to important compiler warnings. The results from all these tests can be propagated back to the upstream authors and help managing a good quality of their software.

Due to the highly standardized packaging, Debian is also a popular system among software engineers doing research in topics like quality assurance, software metrics, compilers. This leads to very detailed bug reports, which also can help upstream to improve the software.

Packages in Debian are tightly coupled to the development of the Debian distribution. Dependencies are automatically recognized. For example, if a shared library changes the binary interface in a new version, all dependent packages are automatically recompiled against the new library. The dependency system also avoids a silent removal of packages if they are needed by other packages. This is especially important for astronomy software, since it may depend on very specific and sometimes ancient code which otherwise could be erased from the distribution.

Since Debian is the base for a family of Linux distributions, all packages that are included in Debian are automatically migrated to the derivative distributions. In
this way, Debian Astro and its packages will be available on Ubuntu, Mint, and other important Linux distributions.

Uploading packages to Debian has a self-magnifying effect: a strong Debian Astro Pure Blend will attract other people to contribute their own packages. Debian follows a “Bazaar” development style (Raymond 1999). The development is open and transparent, so everyone can follow and contribute with bug reports, bug fixes or patches.

When a package cannot be maintained by its original maintainer, it will still get some attention: First, the Debian Astro team will try to keep the package in a good shape. The package can then be adopted by another maintainer. Even when a package is completely orphaned, it will get some maintenance: Debian developers can directly upload fixes if the package has a release critical error. And Debian has a dedicated quality assurance team that fixes the most urgent problems.

In the past, there were several attempts to build Debian packages for required software locally. Often this results in the duplication of work and technical conflicts due to the uncoordinated development. Building official Debian packages helps to create a homogeneous software base which is usable for the whole community.

5. Release

Since the Debian Astro Pure Blend is integrated into Debian, there are no separate releases of Debian Astro. We plan to release the first regular version of the Debian Astro Pure Blend as part of Debian 9.0 (“Stretch”). It is estimated that Debian Stretch will be released in 2017. We plan to allow the selection of Debian Astro already during the installation of the distribution.

Ubuntu and other distributions deriving from the developer version of Debian include snapshots of Debian Astro since 2016 (Ubuntu release 16.04 LTS “Xenial Xerus”).

6. Acknowledgments

We thank all contributors to Debian Astro and Debian in general. This includes the upstream authors as well as the maintainers of the packages, but also those who reported bugs, submitted patches or otherwise donated their resources to the project.

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