LSST DESC Notes

LSST DESC Style Guide

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1 Credit

The LSST DESC Style Guide borrows extensively, with permission, from the "Style Guide for *Planck* Papers," by C. R. Lawrence, T. J. Pearson, D. Scott, L. Spencer, and A. Zonca.[1] We are very grateful to these authors for allowing us to distribute our adaptation under the CC-BY License.[2] The TEX source was provided to DESC by C. R. Lawrence and the LaTEX repository for the DESC Guide was developed by Adam Mantz.

2 Purpose

This Style Guide is intended to help authors of DESC collaboration papers prepare high-quality manuscripts in a uniform style, and to make the process of internal reviewing more efficient. It supplements the instructions to authors provided by the journals. The advice in this guide is applicable to other DESC products, such as DESC Notes and conference papers, but some content is specific to journal papers.

Related references:

- DESC Publication Policy
- Astronomy & Astrophysics author guide
- Astrophysical Journal author guide
- MNRAS author guide

A&A also has a useful English usage guide.

3 TEX Stuff

3.1 `desc-tex` and `lsst-texmf`

LaTEX support files useful and specific to DESC papers are found in the `desc-tex` GitHub project. It provides common macros, the standard portion of the DESC Acknowledgments, a bibliography file of DESC papers, and class and style files for common journals. The `desc-tex` documentation explains how to use these resources, including the `lsstdesc_macros.sty` file referred to elsewhere in this guide. `lsst-texmf` provides similar utilities for LSST Project publications, most notably a bibliography of Project documents.

3.2 `start_paper`

The `start_paper` project is intended to make the process of starting to write a DESC paper or note, and later transforming notes into papers, as simple as possible. It includes templates in various formats (LaTEX, Jupyter notebook, Markdown, and reStructuredText). It incorporates `desc-tex`, as well as utilities for generating author and contribution lists formatted for various journals.

[1] The Style Guide for *Planck* Papers can be downloaded from the Planck Archive at `https://www.cosmos.esa.int/web/planck/publications`

[2] A copy of the CC-BY License may be obtained from this document's repository at `https://github.com/LSSTDESC/Style_Guide`

3.3 Active hyperlinks

To include active hyperlinks in the output .pdf file, include `\usepackage{hyperref}` at the beginning of the LaTeX file and use `\url{}`, e.g., `\footnote{\url{http://www.asdc.asi.it/fermibsl/}}`.

Occasionally, LaTeX will fail because of a hyperlink being split across a page break (often the error message does not identify this as the underlying problem). In such cases, then simplest solution is to find the offending link and enclose it within `\mbox{}`. Note that the `hypperref` package has a 'draft' option that will disable all linking; this can be useful to get a draft paper to compile when LaTeX has split such a link. This is a better solution while a paper is in development, since the offending link may no longer fall on a page break once all material has been added to the paper.

4 How to Refer to DESC and LSST

- DESC should be spelled out at the first use (in both the abstract and the main text of the paper) and a footnote added with the URL for the DESC Web site, `\footnote{\url{http://lsst-desc.org}}`.
- Depending on the context, you may also want to cite the DESC white paper, or have a footnote to the DESC Science Roadmap via `\footnote{\url{http://lsst-desc.org/sites/default/files/DESC_SRM_V1.pdf}}`, although both documents are somewhat dated.
- LSST should be spelled out at the first use (in both the abstract and the main text of the paper) and a footnote provided to the LSST Web site, `\footnote{\url{http://www.lsst.org}}`

4.1 The possessive form

Do not write LSST's or DESC's. Instead write, e.g., the DESC weak lensing pipeline.

5 Dates

Use Year Month Day format, UTC.

6 Acronyms

Use acronyms where appropriate, but define them when they are first used (in both abstract and main text). If they are used only once or twice, write them out in full. Do not use an acronym if it makes the sentence harder to read aloud.

The choice of indefinite article (i.e., "a" or "an") before an acronym is determined by how the acronym is conventionally pronounced, so it is "an SFR estimate," but "a UFO." Although most acronyms are pronounced as a series of letters, there are exceptions, which can also affect the article, e.g., "a NASA mission."

7 Title

Key papers will have standardized titles following a **TBD** convention, possibly involving a sequence number; otherwise, sequence numbers (papers I, II, III, etc.) are to be avoided.

8 Authors and Acknowledgments

Guidelines for defining author lists and the text for the Acknowledgments section, including contribution statements, are presented in the DESC Author Guide. The Publication Policy is fairly prescriptive on each of these topics.

9 Abstract

The abstract is a summary of the paper, not part of the paper. Here are some "do's" and "don'ts":

- **Do** include all significant or important conclusions of the paper including numerical results (with uncertainties or confidence levels) when appropriate.
- **Do** write the abstract as a single paragraph, if not using the "structured" A&A format.
- **Do** be concise.
- **Don't** include anything in the abstract that is not also included (usually at greater length) in the text of the paper.
- **Don't** treat the abstract as an introduction to the paper; the paper should make sense without the abstract and vice versa.
- **Don't** include references in the abstract if you can avoid it.
- **Don't** use vague statements such as "We discuss the implications of the observations."
- **Don't** define acronyms unless they are used again in the abstract.

10 Units

1. Units should *always* be in a roman font, *never* in italics! For example, $g = 9.8\,\mathrm{m\,s^{-2}}$ is correct, but $g = 9.8\,m\,s^{-2}$ is **wrong**. It may take extra work to keep the units out of math mode, or control the font inside math mode, but it must be done! Commands for many common units are defined in `lsstdesc_macros.sty` so that they can be used in or out of math mode, producing the correct (roman) fonts in either case.
2. Units should *always* be singular, *never* plural. For example, "erg," not "ergs" (but see #3, next).
3. When units are written out in text (as they should be when used without a numerical value), they are not capitalized even if formed from a proper name, and the plural is always formed by adding an "s." For example, "the flux density values were converted to janskys," not "janskies."
4. Units should be separated from numbers (and from other units) by a "thinspace," available in LaTeX in both math and non-math modes as "`\,`".
5. Avoid units in subscripts — it's better to define an appropriate notation at the first use, e.g., "the flux density at 70 GHz, S_{70}, ..."
6. Write $\mathrm{km\,s^{-1}}$, *not* km/s. This applies to all compound units, e.g., $\mathrm{MJy\,sr^{-1}}$, rather than MJy/sr. For convenience, macros for several common compound units are provided by `lsstdesc_macros.sty`.
7. Write "s," *not* "sec."

8. Degrees, arcminutes, and arcseconds are generally typeset as symbols, °, ′, ″, which can be obtained with `$^\circ$` (or `\degree` in `lsstdesc_macros.sty`), `$'$`, and `$''$`. Macros for these symbols are also often provided by journal styles (e.g., `\arcmin` and `\arcsec` in `aastex`). Non-integer values should place the symbol over the decimal point. Spacing is a bit tricky because of the different shapes of the digits 0–9, but the commands `\pdeg`, `\parcm`, and `\parcs` in `lsstdesc_macros.sty` work well. **Bug: these macros don't exist yet in `lsstdesc_macros.sty`, but can be copied in.**

9. It is good practice to try to avoid ambiguity by making sure that units apply to both values and uncertainties, e.g., $x = (3 \pm 1)\,\mathrm{m}$, not $x = 3 \pm 1\,\mathrm{m}$. Similarly write "we use the 70% and 80% masks" rather than "we use the 70 and 80 % masks."

11 Notation

1. The acronym for cosmic microwave background is "CMB," not "CBR," "CMBR," or anything else.

2. Use ℓ, obtained with `$\ell$`, for the multipole index only. Galactic longitude is written "l," obtained with `$l$`.

3. The plural of C_ℓ (`$C_\ell$`) should be written C_ℓs (`$C_\ell$s`), *not* C_ℓ's (`$C_\ell$'s`).

4. When using the percent symbol "%" rather than "per cent" or "percent" following a number, include a thin space (`\,`) before the % sign (e.g., 73 %). But in a phrase such as "a few percent", always write out the words. Note that some journal styles prohibit the "%" sign (e.g., MNRAS style specifies "per cent").

5. Write solar mass and luminosity as $M_\odot$ (`$M_\odot$`) and $L_\odot$ (`$L_\odot$`). These are abbreviated as either `\Msolar` or `\Msun` (and similarly for L) in `lsstdesc_macros.sty`.

6. Avoid the use of excessive numbers of digits when presenting numerical results. See Sec. 18 for more details.

7. Ordinal numbers should be written 17th, rather than 17-th or 17^{th}. The same applies to variables, e.g., ith.

8. Use "γ-ray" not "gamma-ray" (and mixing them in the same paper is even worse!). It should always be hyphenated, even when used as a noun, just as in "X-ray."

12 Punctuation, Abbreviations, and Capitalization

1. The abbreviations "i.e." and "e.g." should be in roman font and should always be followed by a comma, e.g., "i.e., something." The question of capitalization is irrelevant, because "i.e." and "e.g." should not be used at the beginning of a sentence.

2. When using expressions such as "cf." or "vs." (or if defying the previous rule), a normal-sized space must be explicitly placed afterwards, to avoid LaTeX deciding that the sentence has ended and accordingly using an extra-large space. Compare cf. some paper (`cf. some paper`) with cf. some paper (`cf.\ some paper`).

3. The IAU formally recommends that the initial letters of the names of individual astronomical objects should be printed as capitals (see the IAU Style Manual, *Trans. Int. Astron. Union*, vol. 20B, 1989, Chapt. 8, p. S30); e.g., Earth, Sun, Moon, etc. "The Earth's equator" and "Earth is a planet in the Solar System" are examples of correct spelling according to these rules. However, "zodiacal" and "ecliptic" should *not* be capitalized.

4. Capitalize "Galactic" and "Galaxy" when referring to the Milky Way, e.g., "Galactic plane."

   Capitalize "Universe" when referring to the cosmos in which we live, reserving "universe" for different theoretical possibilities.

5. Software program names should generally be set in the fixed-width "tt" font (`HEALPix`), or small-caps "sc" font (HEALPIX), depending on the journal.

6. Words describing directions, such as "north," "southwest," and "eastern," should not be capitalized unless they are part of a proper noun (like "North America").

7. "Gaussian" should be capitalized.

8. Italics should be reserved for emphasis. Don't use italics for expressions in Latin (or other languages). Italics should also not be used for special phrases; it is better to define a special phrase using quotations the first time it is introduced, and leave it at that.

   The correct way to italicize for emphasis in LaTeX is using `\emph`: *this* and *this* (`\emph{this}` and `{\it this}`) may all be typset identically, but text-to-speech software may well interpret them differently. Note that *this* (`$this$`) is not even typeset, let alone pronounced, correctly.

9. Itemized lists should be properly punctuated. This is achieved through one of two possibilities. The first is a list (usually of fairly short statements) introduced using a colon and with the items separated by semi-colons, so the entire list is read as a single sentence. The second is a list of longer entries, *not* introduced with a colon, each item of which should start with a capital letter and end with a period.

   Here's an example of the first kind of itemized list:

   - this is the first item;
   - this is the second item;
   - and here's the third item, which can be long, but can only consist of a single sentence in order to ensure the punctuation is consistent.

   Here's an example of the second kind of itemized list, which is *not* introduced with a colon.

   - This is the first item, which should start with a capital letter and end with a full stop.
   - This is another item, which might be longer than any items in the first kind of list.
   - This is one more item, which can be long. Items in this sort of list can consist of multiple sentences and hence couldn't be part of a semi-colon-separated list.

   Whether these are numbered or unnumbered lists is a matter of choice, but numerical lists are preferred when the order is important, or if specific items are going to be referred to in the text. The particular bullet symbol used is generally dictated by the journal style. If the items in a list are essentially whole paragraphs, then it may be better to use the `\paragraph{...}` environment, which gives a separate heading for each item.

10. Precise rules for the use of commas are complicated. As a rough guide, if adding a comma would help the reader to take a brief pause, which would avoid ambiguities and make the sentence easier to understand, then definitely the comma should be added. However, in many instances the inclusion of a comma is a matter of taste. See also the next item.

11. Inserting commas can be helpful for making sentences readable. However, there are cases when it is wrong to use commas, for example, the following two phrases are both correct but mean different things:

    - My brother, John, is 27.
    - My brother John is 27.

    The latter would be applicable if I had more than one brother and wanted to distinguish which one, the first if I had only one brother. More obviously,

    - Let's eat Grandma.
    - Let's eat, Grandma.

    mean different things!!

    Gowers's "Complete Plain Words" distinguishes "defining" and "commenting" clauses; there are no commas for defining clauses, but commas for commenting ones. The following example is given:

    - Pilots, whose minds are dull, do not usually live long.

    This is a defining clause, not a commenting one, and commas are incorrect in this case. In our field, we should distinguish, for example,

    - The parameter $n_{\rm s}$ is poorly constrained

    (a defining clause, giving which parameter) from

    - The scalar power-law index, $n_{\rm s}$, is poorly constrained

    (a commenting clause, since "$n_{\rm s}$" can be omitted without changing the meaning).

    As a closing remark, Gowers also says "The use of commas cannot be learned by rule."

13 Content

1. A common mistake is to include too much background material in the introduction. Journal articles are not review articles. Cite all closely-related papers and any papers yours depends on, but don't review the whole history of the subject.

2. In the case of multiple citations for the same topic, the references should be cited in chronological order; if there's some reason to cite them out of order, the reason should be explained in the text. An exception is that multiple references to the same authors in a list get grouped together, as in (Wood-Vasey et al. 2001; Mantz et al. 2003, 2010; Peiris et al. 2006).

3. There will be many DESC papers and we will fatigue readers if we reproduce the same description of LSST in every one. There is no requirement to use a "standard paragraph," but it is still appropriate to cite *all* instrument and product papers on which a new paper depends. Refer (once) to the relevant LSST or DESC product papers (see Section 16), and summarize as briefly as possible any characteristics of the instrument that the reader needs to know to understand the present paper.

4. There should be no text before the beginning of Section 1 of a paper. It is fine to have a brief block of introductory text at the beginning of a section (Section 3, say), but if this isn't short it is probably a good idea to give it a numbered sub-section (i.e., call it Section 3.1); this makes it easier to refer to that part of the paper. A section should not contain a single sub-section, i.e., if there's Section 7.1,

but no Section 7.2, then either rename the introductory material as Section 7.1 (and the sub-section as Section 7.2) or remove the sub-section heading, making the whole thing just Section 7.

5. The concluding section of the paper should be precisely that: a concise statement of the conclusions. It is not necessary to repeat material from the abstract or introduction.

6. New material should not be introduced in a section headed "Conclusions." Use a "Discussion" section for that.

7. Be concise.

14 Use (and Misuse) of the English Language

1. *Noise* as it will be used in DESC papers is a singular noun. "The **noises** of the images" is not correct.

2. *Significance* is similarly used as a singular noun, so that **significances** is incorrect. If necessary write "levels of significance."

   Use of the word "significant" when *not* discussing statistical significance can be confusing. Be careful, or don't do it. Synonyms that can be usefully substituted include "considerable," "sizable," and "substantial."

3. *Allow* is a transitive verb, and requires an object.

   - "The accuracy of this model **allows us** to remove the effects of thermal fluctuations from the data directly" is correct.
   - "The accuracy of this model **allows removal of** the effects of thermal fluctuations from the data directly" is correct.
   - "The accuracy of this model **allows to remove** the effects of thermal fluctuations from the data directly" is incorrect, because **to remove** is not an object.

4. *Permit* is also a transitive verb. See item 3 above.

5. One of the weirdnesses of English usage, that sometimes verbs are followed by an infinitive while at other times they are followed by a gerund, is explained quite well at

   http://www.englishpage.com/gerunds/index.htm.

6. "*Modelisation*" (or "modelization") is not a word, at least not yet. Don't use it. "Model" or "modelling" are probably what you want.

7. *"Associated to"* is usually incorrect in English, and should be "associated with."

8. All sentences must have a verb; subject and verb must match in number.

9. *That* and *which* should be used as explained in this paragraph from the A&A English Guide:

   > "That" (not in phrases such as "enough ... that ...") is never preceded by a comma, because it introduces a restrictive clause. If tempted to use a comma there, then check that "which" is not more appropriate (=non-restrictive). That "that" is already used for so many functions makes it all the more necessary to keep to the conventions. Even though standard English allows "which" to be used for the restrictive dependent clause,

scientific articles prefer to keep the difference to the non-restrictive even clearer by using only "that" without comma or "which" with a comma when non-restrictive. Example: "Both metallicity components appear to have a common origin, which is different from that of the dark-matter halo." vs. "Both metallicity components appear to have a common origin that is different from that of the dark-matter halo."

If that doesn't all make sense, concentrate on the example, and remember that no comma should precede "that," but a comma should always precede "which."

10. "Between A and B," "from A to B," or "in the range A–B" are OK. "Between A to B," "from A–B," and "between A–B" are not. Note that the dash is an en-dash (`--`) and **not** a math mode minus sign (`$-$`).

11. It is better to use the term "uncertainties" than "errors." When giving uncertainties, state the confidence interval and its probability content, e.g., 68.3% or 99.5%. Avoid using, e.g., $2\,\sigma$ or $3\,\sigma$, especially if the underlying distribution is non-Gaussian or asymmetric. An uncertainty introduced by "±" (e.g., $x \pm y$) is taken to be a symmetric 68.3% confidence interval ($[x - y,\ x + y]$) unless otherwise stated. Upper limits need careful explanation.

12. After introducing an acronym, use only the acronym.

13. Use active voice when suitable, particularly when necessary for correct syntax (e.g., "To address this possibility, we constructed a λ Zap library...," not "To address this possibility, a λ Zap library was constructed..."). But see Sect. 8 on abstracts.

14. Write concisely (e.g., "even though," not "in spite of the fact that").

15. When two or more similar terms are used throughout text, either make the usage consistent or clarify the distinctions(s), as appropriate.

16. Avoid using terms such as "novel," "first," or "our laboratory has pioneered..." to describe the present work. The novelty should be apparent without being highlighted. Similarly try to minimize claims that a result is "interesting," "important," or "critical."

17. "A and B" or variants such as "A together with B" are plural subjects and need a plural verb, e.g., "A and B are...."

18. Avoid using "systematic" or "systematics" as a noun. Use "systematic errors" (or "uncertainties"!) or "systematic effects."

19. The names of things don't usually need to be capitalized, e.g., "orthomode transducer," not "Orthomode Transducer," even when defining an acronym, e.g., "active galactic nucleus (AGN)," not "Active Galactic Nucleus (AGN)," and "cosmic microwave background (CMB)," not "Cosmic Microwave Background (CMB)."

20. "Nonlinear" should not be hyphenated. Furthermore, "stray light" should be written as two words. The rules of hyphenation can be daunting because there are so many cases (see, e.g., `http://en.wikipedia.org/wiki/English_compound`), but most of them involve nouns used as adjectives in multiple combinations, affecting a relatively small number of cases. If in doubt, don't hyphenate.

21. One hyphenation guideline is clear, namely that a hyphen is included in adjectival phrases but not in nouns. So it is "the power-law spectrum," but "a power law was fit" and "the high-ℓ behaviour," but "an effect seen at high ℓ."

22. Nouns used adjectivally are **never** plural in English, not even once! For example, "the galaxy redshifts" is correct, even although there are multiple galaxies, but "the clusters masses" is incorrect.

23. The ampersand, "&," is not acceptable in a sentence. Write, e.g., "using the 100 and 143 GHz channels," not "using the 100 & 143 GHz channels." An exception is when the & is specified by citation style, as in "Author1 & Author2 (2017)."

24. Spell out numbers up to and including ten; use digits above ten except at the beginning of a sentence.[3] However, numbers with units are always written with digits, including things like "5 σ."

    Similarly, quantities that are multiplicative factors (even if they happen to be integers) will often be better written using digits, e.g., "5 times higher" or "a factor of 2."

25. Sentences should not start with numbers or variables. Rewrite the sentence if necessary.

26. Use "data set" rather than "dataset" or "data-set."

27. The word "data" is always plural (e.g., "these data show"), while "none" can be singular (e.g., "none of the sky is masked") *or* plural (e.g., "none of the galaxies were spirals").

28. The common abbreviation for "root mean square" should be "rms," rather than "r.m.s." or "RMS."

29. It often sounds more elegant to avoid using the word "do," but instead to use "perform" or "carry out." For example, "we carried out the calibration procedure" rather than "we did the calibration procedure."

30. As the word "as" can be used as an adverb or preposition, as well as as a conjunction (note this example!), then sentences can sometimes be difficult to parse. Substitution of "since" or "because" for "as" where appropriate (particularly as a conjunction) may avoid confusion. Note that "since" has a connotation of relative time and may be more appropriate in that context.

31. In comparisons, "greater" and "smaller" are preferable to "higher" and "lower" unless you are in fact comparing heights.

32. The word "comprised" is sometimes misused in the phrase "is comprised of," which should be replaced with the more grammatically correct "is composed of" (or perhaps "comprises").

33. The correct word is "publicly," not "publically." However, in common examples, there is often a better way to express the same meaning without using the word at all.

34. "Non" is a prefix, not a word, and hence a hyphen is required in words such as "non-Gaussian" and "non-relativistic."

35. A reference to a paper `\citet{Author17}` is shorthand for a group of people, not a paper. Thus, one refers to previous work reported **by** Author et al. (2017), never **in** Author et al. (2017).

36. The use of British or American spelling depends on the journal. Table 1 summarizes the differences.

[3] And don't ask about the pathological case of ranges like "seven to 11!"

Table 1: British and American Spelling Conventions[a] and Examples

	British	American
Words ending in -re British English words that end in *-re* often end in *-er* in American English.	centre (centred, centring) fibre litre metre theatre	center (centered, centering) fiber liter meter theater **or** theatre
Words ending in -our British English words ending in *-our* usually end in *-or* in American English.	colour flavour humour labour neighbour	color flavor humor labor neighbor
Words ending in -ize or -ise Verbs in British English that can be spelled with either *-ize* or *-ise* at the end are always spelled with *-ize* at the end in American English.	apodize **or** apodise apologize **or** apologise ionize **or** ionise minimize **or** minimise normalize **or** normalise organize **or** organise polarize **or** polarise realize **or** realise recognize **or** recognise summarize **or** summarise	apodize apologize ionize minimize normalize organize polarize realize recognize summarize
Related nouns follow the same convention.	apodization **or** apodisation ionization **or** ionisation normalization **or** normalisation polarization **or** polarisation	apodization ionization normalization polarization
However, there are some exceptions, which never take the *-ize* form in either variant of English.[b]	arise comprise revise surprise	arise comprise revise surprise
Words ending in -yse Verbs in British English that end in *-yse* are always spelled *-yze* in American English.	analyse	analyze
Words ending in a vowel plus l In British spelling, verbs ending in a vowel plus *l* double the *l* when adding endings that begin with a vowel. In American English, the *l* is not doubled.	*fuel* fuelled fuelling *model* modelled modelling *travel* travelled travelling traveller	*fuel* fueled fueling *model* modeled modeling *travel* traveled traveling traveler
Nouns ending with -ence Some nouns that end with *-ence* in British English are spelled *-ense* in American English.	defence licence offence pretence	defense license offense pretense
Nouns ending with -ogue Some nouns that end with *-ogue* in British English end with either *-og* or *-ogue* in American English. The distinctions here are not hard and fast. The spelling *analogue* is acceptable but not very common in American English; *catalog* has become the US norm, but *catalogue* is not uncommon; *dialogue* is still preferred over *dialog*.	analogue catalogue dialogue	analog **or** analogue catalog **or** catalogue dialog **or** dialogue
Other examples A few more British versions	artefact disc (except for a computer disk) formulae grey manoeuvre towards **or** toward halos	artifact disk formulas gray maneuver toward **or** towards haloes

[a] Mostly from `http://oxforddictionaries.com/words/british-and-american-spelling`

[b] And note that "noise" is never "noize," so you can't simply do a global search and replace for *-ise* words!

15 Typesetting Mathematics in LaTeX and TeX

1. *Paragraphs*. Always indicate the start of a new paragraph by a blank line in the TeX code. Special layout commands such as `\vskip` and `\noindent` are not generally required; the journal-supplied LaTeX styles will take care of layout.

2. *Blank lines*. Don't leave a blank line before or (particularly) after a displayed equation in your input file unless you want a new paragraph. If you want some visual separation between displayed equations and text in your input file, use comment lines, e.g.,

```
Text blah blah blah
%
\begin{equation}
E=mc^2,
\end{equation}
%
where $c$ is the speed of light in vacuum.
```

3. *Quotation marks*. In LaTeX, use "`` and "'', not the double-quote character found on English keyboards above the apostrophe. A comma or period goes inside the quotation marks, not outside, e.g., "DESC is an international collaboration."

4. *Dashes*. Distinguish hyphen (-), produced with a single dash (`-`) and used for compound words (e.g., "free-free") and word breaks; en-dash (–), produced with two dashes (`--`) and used for a range; em-dash (—), produced with three dashes (`---`) and used (infrequently) as a punctuation mark; and minus (−), produced by a dash in math mode (`$-$`). **Note that minus signs can only be typeset in math mode (including in tables!). Conversely, hyphens, en dashes, and em dashes cannot be typeset in math mode.** Always set the complete mathematical expression in math-mode, e.g., "`$-17.2\pm0.3$`" rather than "`$-$17.2$\pm$0.3`" in order to get correct spacing. The former gives -17.2 ± 0.3, while the latter gives -17.2 ± 0.3.

5. *Commas*. To avoid adding extra space in math mode, a comma may be put in brackets. Compare the result of `$a{,}b$` (a,b), with the result of `$a,b$` (a, b).

6. *More commas*. In English, a comma is never used for a decimal point.

7. *Symbols*. Use italics (the default in math mode) for all single-letter symbols that represent variables (i.e., quantities that have a numerical value). For example, use `$H_0$`, not `H$_0$` (H_0, not H_0). Similarly, the redshift z should always be in italics, including in such expressions as "high-z" (obtained with `high-$z$`).

8. *Mixing symbols and words*. Use relational symbols ($=$, $<$, $\simeq$, etc.) in equations, not in text. Write an equation, or use words. For example, write "frequencies of 30 GHz and above," rather than "frequencies $\geq$ 30 GHz." Similarly, write "an average factor of about 1.8," rather than "an average factor of $\simeq$ 1.8."

9. *Approximations*. Use "about," "around," and "approximately" in preference to "$\sim$," but use all sparingly! They are often almost meaningless, and their use is a bad and annoying habit on the part of the writer. If the uncertainty in a numerical value cannot be represented reasonably by the number of significant digits, specify the uncertainty explicitly. A special microlevel of hell is reserved for those who write "about $\sim$."

Don't use "$\sim$" when you mean "$\propto$."

Don't use both "$\simeq$" (`\simeq`) and "$\approx$" (`\approx`) in the same paper unless you explicitly mean something different. If in doubt, use "$\approx$" (and see the point above!).

For "less (and greater) than approximately" either use journal-supplied macros or the `lsstdesc_macros.tex` macros `\ltsim` (and `\gtsim`) **[to be added]**, but don't mix them.

Avoid using the "$O(x)$" or "$\mathcal{O}(x)$" notation except for describing asymptotic behavior or scaling. Instead just say "about 10^{-6}" or "approximately 10^{120}."

10. *Superscripts*. Use roman fonts for tags or labels in subscripts, e.g., $n_{\rm e}$, $z_{\rm rec}$, and for multi-letter operators. This avoids ambiguities by always explicitly distinguishing variables from abbreviations. For example, z_i (obtained with `$z_i$`) might be the ith redshift under consideration, while $z_{\rm i}$ (obtained with `$z_{\rm i}$`) might be defined as the reionization redshift.

    An exception is made for labels that are *also* variables, e.g., "the x-component of vector $\mathbf{V}$ is V_x."

    Particle physicists sometimes write particle names in italics, e.g., n_e instead of $n_{\rm e}$. But some typesetters always use italics for a single-letter symbol, perhaps because they don't know if it is a variable or a tag. The important thing is that multi-letter symbols should be in roman to avoid the confusion of whether "em" is a single symbol or "e" times "m."

11. *Functions*. Always use the standard TeX commands for operators, `\log`, `\cos`, `\sin`, `\ln`, etc. Right: `$\log{S}$`. Wrong: `log($S$)`, or `${\rm log} S$`, or anything else. Using the TeX commands will also preclude capitalization of these operators, which is almost always incorrect.

12. *Brackets*. The usual ordering of brackets is $\{[(\ldots)]\}$. Only deviate if this if there is good reason, and never use the same type for adjacent brackets.

    Distinguish angle brackets (`$\langle$, $\rangle$` producing $\langle$ and $\rangle$), often used to denote expected value) from the inequality operators $<$ and $>$. Note that "`<`" and "`>`" must never be used outside math mode.

13. *Acronyms*. Try to avoid using an acronym as a variable (e.g., "$SFR = 10\,M_\odot\,{\rm yr}^{-1}$"), because it is cumbersome. Define a new symbol instead (e.g., "the star formation rate, $\mathcal{R}$").

    If you *do* use a multi-letter symbol for a variable, it **must** be in roman, e.g., "$\rm SFR = 10\,M_\odot\,yr^{-1}$," obtained with "`${\rm SFR} = 10\,\Msolar\,yr$^{-1}$`."

14. *Long equations*. Don't try to make equations fit by using `\small`! Instead use `\eqnarray` or something similar to break lines.

15. *Tall equations*. It looks ugly when in-line equations contain expressions or brackets that are high enough to force TeX to insert extra space between the lines of text. As a general guide, if it increases the line spacing, then it's time to use a displayed equation.

16. $N_{\rm side}$. Write "$N_{\rm side}$" (`$N_{\rm side}$`), not "nside."

17. χ^2. Write χ^2 rather than "chi-square." Whether giving χ^2 or reduced χ^2, always give $N_{\rm dof}$.

18. *Equation, Figure, and Table references*. Use `\label` to identify each equation, figure, and table, and refer to them with `\ref` only. Journals may not require equations to be numbered, but even if you don't intend to refer to the equation elsewhere in the paper, other people might want to do so (e.g., the referee).

19. *Punctuation and equations.* Punctuate an equation (displayed or in-line) as ordinary text. This means that displayed equations should usually be followed by a comma or period, which generally look better preceded by a thin space `\,` or a medium space `\>`.

20. *Spacing of exponents.* Now and then, depending on characters, exponents come out too close to the exponentiated symbol, e.g., ν^{β}. Space can be added with, e.g., `$\nu^{\,\beta}$`, giving $\nu^{\,\beta}$ or (better) `$\nu^{\hbox{\hglue 0.7pt}\beta}$`, giving $\nu^{\hbox{\hglue 0.7pt}\beta}$, which makes it easy to "tune" the space.

21. *Writing "σ".* Write `$5\,\sigma$` ($5\,\sigma$) or possibly `5\sigma` (5σ), but never `5-$\sigma$` (5-σ), and *especially* never `$5-\sigma$` ($5-\sigma$).

16 References

- Use the LaTeX bibsty bibliography style file provided by the journal, and/or refer to the bibliography guidelines of the journal. For several journals, these are also available in `desc-tex`. For some journals, `desc-tex` provides modified bibsty files that display arXiv numbers instead of the egregious "Arxiv e-prints" and/or include hyperlinks to ADS (given the appropriate bibitem entries).

- The `desc-tex` GitHub repository includes `lsstdesc.bib`, a bibliography of recommended and commonly cited references in DESC papers. These will include DESC product papers. (`lsstdesc.bib` will become more useful over time; currently it is more or less a placeholder.) The `lsst-texmf` repository similarly provides a bibliography of LSST Project publications.

If for some reason you **do not** use a bibsty file, you will need to manually keep track of the bibliography and conformance with the formatting conventions of the journal. Needing to fix errors at the copy-editing stage, when you have lost control of the paper source, is annoying and time consuming.

- Cite software according to the journal's style, which generally dictates the typeface to be used for the names of codes (or the use of a macro to accomplish the same, e.g. `\software` in AASTeX); often a footnote providing the URL of the software's webpage or source code repository is recommended. DESC software should also be cited with a reference to the publication presenting it, where available. Note that the specific release (version) used by a given work should always be explicitly cited. For example,

```
To calculate X, we used the DESC software package \software{code name} version 1.0
\citep{code paper}.\footnote{\url{code website}}
```

17 Figures

17.1 Colors

Color can be a very useful way to distinguish different types of data in figures, but care should be taken to ensure that figures are interpretable by the color blind (or to those who print papers in black and white). For scatter and line plots, this means that color should not be the only distinguishing feature used – different line styles/weights and different plot symbols should be used to distinguish different types of data *even if they also use different colors.* Also avoid using very light greens and yellows, which can be challenging for anyone to see, whether on screens or in print.

In addition, colors used in figures should be chosen such that, at a minimum, the figure can be understood by those with deuteranopia (green deficiency, the most common form of red-green colorblindness), and ideally also by those with protanopia or tritanopia (red and blue deficiencies, respectively). This is an

issue of accessibility, equivalent to the requirement that DESC papers contain clear, understandable prose. The guidelines below should cover most cases.

To check how clear your figures are to those with different forms of color blindness, we recommend the following very cool tools:

- http://colororacle.org/: installed software that alters the appearance of your entire desktop.
- http://www.vischeck.com/vischeck/vischeckImage.php: web-based interface or installed software to convert individual figures.
- http://www.color-blindness.com/coblis-color-blindness-simulator/: web interface for individual figures.

For those who want more information or ideas, a longer narrative discussion on how to design figures for color blind people can be found at
http://www.somersault1824.com/tips-for-designing-scientific-figures-for-color-blind-readers/.

17.1.1 Color recommendations for scatter and line plots

- 1 color: black or dark blue
- 2 colors: blue and red
- >2 colors: one of the palettes shown in Figure 1. The 8-color palette (left) is from http://jfly.iam.u-tokyo.ac.jp/color/ and corresponds to the sequence #000000, #E69F00, #56B4E9, #009E73, #F0E442, #0072B2, #D55E00, #CC79A7 (and the RGB/CMKY codes shown).[4] The 10-color palette shown is from the tableau package for Python. Example Python code showing how to use these two palettes appears below.

```
import matplotlib.pyplot as pl

# first palette
colors = ["#000000", "#E69F00", "#56B4E9", "#009E73", "#F0E442", "#0072B2", \
 "#D55E00", "#CC79A7"]

# second palette
import palettable
colors = palettable.tableau.ColorBlind_10.mpl_colors

ax = pl.subplot(221)
ax.set_color_cycle(colors)
```

17.1.2 Color recommendations for shading and filled contour plots

For simple shading, the same advice as for line and scatter plots applies. For more complex cases, e.g. parameter constraint plots where pairs of similar colors (for 1σ and 2σ contours) are desired, more care is needed. One collection of color pairs that works reasonably well is illustrated in Figure 2 and enumerated as RGB triplets in Table 2. In addition to choosing appropriate color combinations, consider doing the following.

[4] RGB tuples or hex codes can be used in place of, e.g., 'k' or 'b' to specify colors in `matplotlib`; see this webpage.

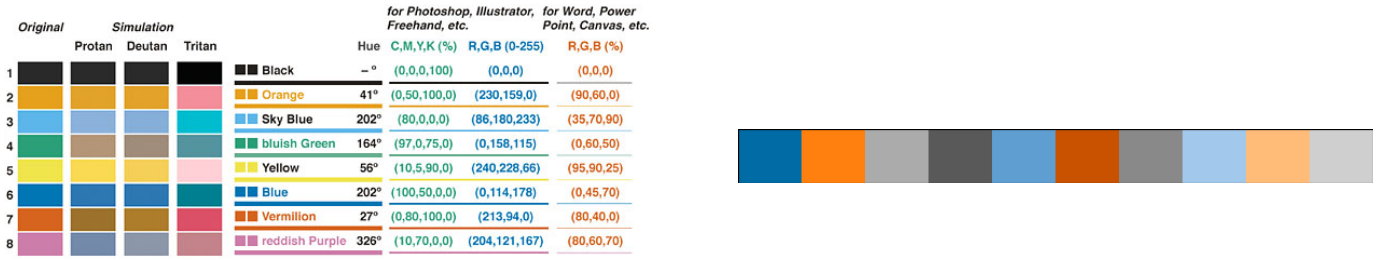

Figure 1: Recommended color palettes for scatter and line plots with several types of data. Credit: Masataka Okabe and Kei Ito (left panel).

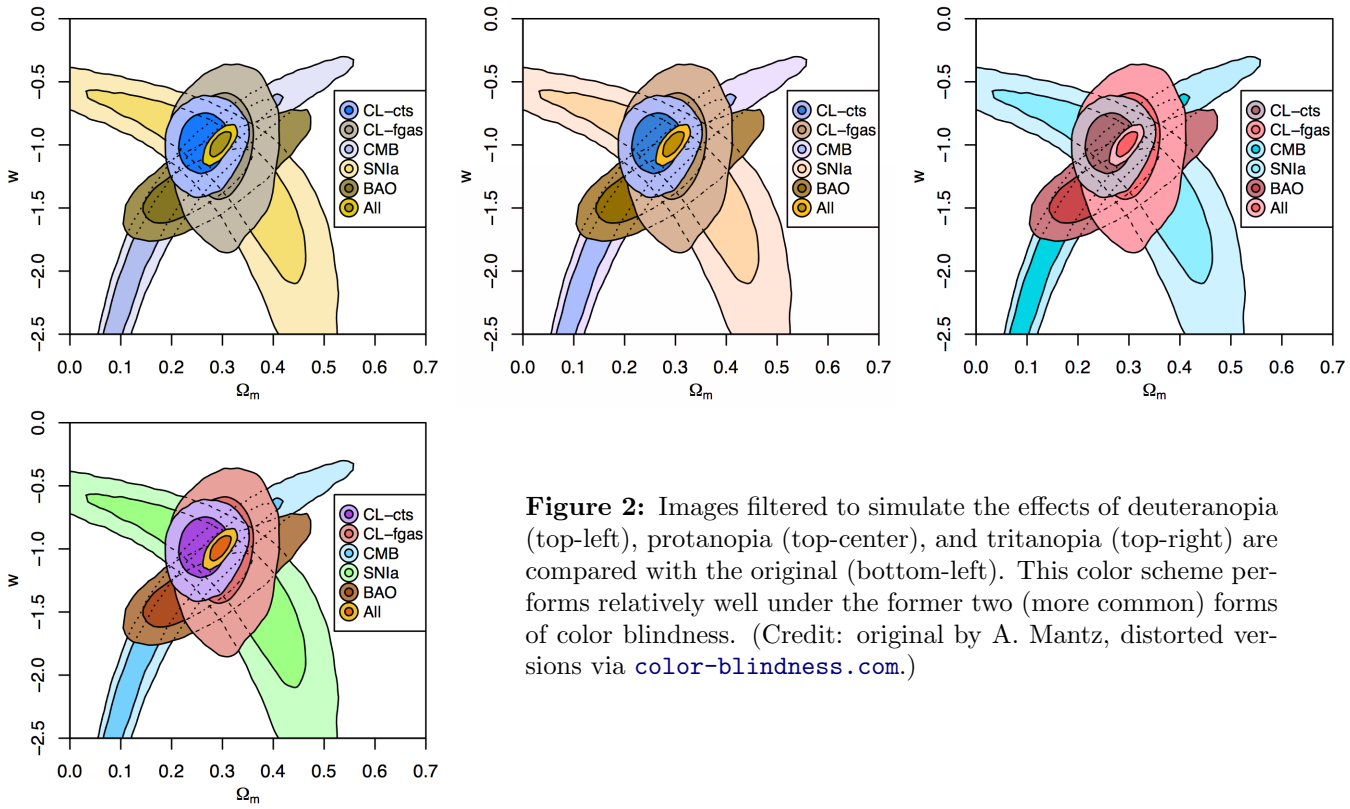

Figure 2: Images filtered to simulate the effects of deuteranopia (top-left), protanopia (top-center), and tritanopia (top-right) are compared with the original (bottom-left). This color scheme performs relatively well under the former two (more common) forms of color blindness. (Credit: original by A. Mantz, distorted versions via `color-blindness.com`.)

- Avoid transparency – it looks fancy, but can easily result in unnecessary color confusion. "Faux transparency," accomplished by using dashed/dotted outlines (as in Figure 2) is often preferable.
- Place labels directly on or adjacent to (with arrows as needed) shaded areas rather than using a legend (*unlike* Figure 2).

17.1.3 Color recommendations for continuous color maps

We expect to streamline this section in the future, with the benefit of experience. In the meantime, here are some options:

- Single-color gradients are, of course, acceptable.
- The `b` and `rainbow` color maps in DS9 appear to be relatively robust.

Table 2: RGB triplets on the range $[0, 1]$, corresponding to the colors used in Figure 2.

Color	Dark variant	Light variant
Blue	(0.026, 0.818, 1.000)	(0.714, 0.936, 1.000)
Brown	(0.784, 0.294, 0.098)	(0.784, 0.502, 0.294)
Gold	(1.000, 0.400, 0.000)	(1.000, 0.753, 0.000)
Green	(0.333, 1.000, 0.492)	(0.670, 1.000, 0.761)
Purple	(0.737, 0.275, 0.890)	(0.831, 0.686, 0.976)
Red	(1.000, 0.443, 0.442)	(1.000, 0.642, 0.610)

- One- and two-color gradient maps based on the Okabe & Ito palette (left panel of Figure 1) can be easily used in Python thanks to the `nesanders/colorblind-colormap` project on GitHub. The GitHub page includes example code.

17.2 Plots

1. *Format*. Whenever feasible figures should be in EPS, PDF, or another vector format compatible with the LaTeX `\includegraphics` command. Vector graphics can be rendered at any zoom level without pixilation, and (usually) require less disk storage. This is not necessarily the case for images or plots with a very large number of points (e.g., 10's of thousands), however; such graphics should be saved in raster rather than vector format (e.g., PNG, JPEG, TIFF) at print-quality resolution.

2. *Line widths for axes, tick marks, etc.* Line widths in the range 0.5–0.8 pt work well. Lines of width 1 pt are a bit too heavy for the boundary box of a figure, although heavier lines can be used when appropriate for important figure elements to make a clear presentation.

3. *Axes*. The figure should be enclosed in a frame on all four sides, labelled with tick marks, numerical values, and axis labels. Text labels should not overlap.

4. *Background grid*. If a grid is needed, it should be drawn with thin lines (0.5pt?) or grey lines, not dashed or dotted lines.

5. *Legends*. A legend within the plot identifying colors and symbols should be included when necessary. The legend should not obscure data.

17.3 Images

Astronomical images are in general "pseudocolor" maps, that is, they map intensity or another quantity onto a color scale chosen to highlight the features of interest.

Making a pseudocolor map of a quantity z involves several considerations.

- *Range*. Choose the minimum and maximum values to display, z_1 and z_2 (values outside this range should be replaced by the minimum or maximum as appropriate, or replaced by an "undefined" value).

- *Transfer function*. Apply a linear or nonlinear transformation to map the range from z_1 to z_2 to an integer range of colour indices (often 0 to 255; 256 different color levels is usually sufficient, although a larger range can be useful in some cases if the software supports it). One very nonlinear transfer function is "histogram equalization;" while this may be useful for a first look at a map, it is only very rarely appropriate for publication.

- *Color map*. Choose color values for each color index (R, G, B or C, M, Y, K values). Choice of a color map requires careful deliberation, depending on what features of the map are to be highlighted. "Undefined" or unmeasured pixel values should be indicated using a color that does not appear in the color map (e.g., white or grey). See Section 17.1.3 for some notes on how to make the map colorblind-friendly.

17.4 Additional points

1. *Internal links to figures*. Every internal reference to a figure (or table) should use `\ref{label}` to ensure that a hyperlink is created in the final PDF file.

2. *Sizes and proportions*. Pay particular attention to the size of characters and extraneous white space around figures. Gauging sizes and proportions is easiest when you produce figures of (or close to) the size they will have in the paper. Note that for talks, versions of figures with larger fonts and/or symbols may be useful.

3. *Captions*. Captions should never start with "This figure shows ...". Captions should be descriptive enough that the basic content and message of a figure are understandable, independent of the main text. Conversely, the main text should not excessively duplicate the information in the caption, e.g., about colors and line styles.

4. *More on fonts*. Some graphics software packages use outline or "Hershey" fonts designed for use with pen-plotters. They usually include a sans-serif font that looks similar to Helvetica, but you may need to adjust the line-thickness as well as the character height to get characters of appropriate weight. Typically the line-thickness should be about 1/10 of the character height.

5. *Tick marks and numeric labels*. Have tick marks projecting out of the frame only if it is necessary to make them visible. Use sensible (rational) tick separations. Choose units to get numbers without big exponents. Avoid overlapping labels. At least two, and preferably more than two labels should appear on each axis. Do not use more significant figures than are needed in labels (i.e., 10, not 10.00 or 9.999). It is not necessary to have the same number of decimal places in axis labels. For example, 0.01, 0.1, 1, 10, 100 is better than 0.01, 0.10, 1.00, 10.00, 100.00. Avoid unnecessary trailing zeros.

   Sky images should always have coordinates indicated by a labelled frame or graticule. Use sexagesimal notation (e.g., h,m,s of RA and d,m,s of Dec) or decimal degrees, but do not mix the two: if you refer to a source RA of $12^{\rm h}\,30^{\rm m}$ in the text or a table, do not use 187.5° in a figure!

6. *Captions and titles*. Figures have captions. They *should not* have titles or anything else above the frame of the figure.

7. *Axis labels*. Label axes with the name or description of the quantity plotted, possibly a symbol, and units if applicable, with the units in square brackets, e.g., Detector temperature $T_{\rm det}$ [μK], Multipole order ℓ, or Length [mm]. However, if logarithms are involved, log(length/mm) is preferable. Detector volts [V] is incorrect; it should be Detector reading [V] or possibly Detector voltage [V]. In labels as elsewhere (Sect. 10.8), use exponents, not fractions in units: $\rm km\,s^{-1}$, not km/s. Don't use a dot to separate units ($\rm K\,km\,s^{-1}$, not $\rm K.km\,s^{-1}$). Don't invent units for dimensionless quantities (e.g., say Normalized hit count, not Hit Count [norm.]) Capitalize labels as normal text (first letter and proper names only). Do not use " #" as a synonym for "number."

8. *Lettering in figures*. Lettering should be in lower-case type, with the first letter capitalized and no full stop. Layering type directly over shaded or textured areas and using reversed type (white lettering on a coloured background) should be avoided where possible.

9. *Consistency of style and color across figures*. Use a uniform style for figures throughout the paper. If a quantity is represented by a red dashed line in one figure, use the same style for it in other related figures.

10. *Consistency of style and color for key plots*. In some circumstances, e.g., for plots of cosmology parameter constraints, we will probably want consistent color schemes used across papers. No specifics are provided here, but the intent will be to follow conventions established in previous DESC papers for the corresponding type of plot.

11. *Multipanel figures*. For a large set of similar figures (e.g., SEDs for many objects), use a multipanel figure, which can extend over multiple pages if necessary. If there are more than two or three panels, it is usually best to identify each panel internally (e.g., with the object name) rather than in the caption. Avoid phrases like "middle of third row" or "lower right" in the text or caption. Use "(a)," "(b)," ... labels if necessary. In case two panels are referenced in the caption, use "*Left*: ...," "*Right*: ...," "*Upper*: ...," "*Lower*: ...," etc. To achieve this, type, e.g., `\emph{Left}:` .... Note that the colon is outside the brackets.

12. *Mathematical symbols in figures*. Mathematical symbols in figures should match those in the text. Use TEX/LaTEX to make the symbols and paste them into the figure if necessary.

13. *Geometric distortion*. **Do not** scale the height and width of a figure independently to make it fit a spot in a paper. The geometrical distortion introduced is unacceptable.

18 Tables

1. *Captions*. Each table should include a caption or equivalent notes that make the content understandable without having to refer to the text.

2. *Precision*. Excessive numbers of digits should not be given. In general, the number of digits used for a quantity should be driven by the uncertainty on that quantity; in many cases a single digit on uncertainties is sufficient. We will follow the specific policy of the Particle Data Group, described on page 5 of

   http://pdg.lbl.gov/2013/reviews/rpp2013-rev-rpp-intro.pdf,

   which says

   > The basic rule states that if the three highest-order digits of the error lie between 100 and 354, we round to two significant digits. If they lie between 355 and 949, we round to one significant digit. Finally, if they lie between 950 and 999, we round up to 1000 and keep two significant digits. In all cases, the central value is given with a precision that matches that of the error. So, for example, the result 0.827 ± 0.119 would appear as 0.83 ± 0.12, while 0.827 ± 0.367 would turn into 0.8 ± 0.4.

   There *may* be cases where using more precision is justified, e.g., when there is an important scientific point to make by comparing uncertainties. However, this should be the exception, and there should be a clear rationale for using increased numbers of digits.

3. *Missing values*. Missing values should be indicated by an ellipsis, "...," obtained with the `\ldots` command (or `\nodata` in ApJ articles). Don't try to produce an ellipsis with periods (full stops). The spacing will be wrong...

4. *Alignment*. When entries in a column are to be compared, align the decimal points in both the quantity and the uncertainty. Align ± symbols when possible. **Add some pointers/examples of how to do this.**