

# The linop package v0.1

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## 1. INTRODUCTION

There exist already many packages to help you typeset common and less common mathematical notation with ease. Yet, to the best of my knowledge, there does not yet exist a package that provides an easy way to typeset operators as they appear for example in many body physics, quantum (field) theory or linear algebra. The aim of this package is to provide two simple commands and many options to easily write operators in any of the ways they commonly appear.

Besides providing easy to use macros, this package also ensures consistent spacing for subscript and superscript. To illustrate this point, compare the normal way for typesetting operators with the macros provided by this package.

$$\begin{array}{ll} \hat{a}_{in}\hat{a}_{in}^{\dagger} & \hat{a}_{in}\hat{a}_{in}^{\dagger} \\ \op{a}{in}\hc{a}{in} & \hat{a}_{in}\hat{a}_{in}^{\dagger} \end{array}$$

Typesetting the `\dagger` and a subscript simultaneously pushes the subscript down, this is no longer the case with the here defined macros.

### 1.1. REQUIRED PACKAGES

As these are simple macros, you only need the `xparse` package.

## 2. LIST OF COMMANDS

The two macros defined in this package are `\op` and `\hc` as well as their starred versions.

$$\begin{array}{l} \backslash\text{op}[superscript\ spacing]\{operator\}\{subscript\}\{superscript\}\{supersuperscript\} \\ \backslash\text{hc}[superscript\ spacing]\{operator\}\{subscript\}\{superscript\}\{supersuperscript\} \end{array}$$

These macros typeset an operator and the Hermitian conjugate respectively. Only the *operator* argument is mandatory, all other arguments can either be empty or be skipped entirely if no subscript or superscript is desired. The optional argument *superscript spacing* only applies to the starred versions. Supersuperscripts are implemented to distinguish between e.g. the order in some expansion and the square of the operator.

$$\begin{array}{ll} \backslash\text{op}\{a\}\{\text{in}\}\{0\} & \hat{a}_{in}^0 \\ \backslash\text{op}\{a\}\{\}\{(1)\}\{2\} & \hat{a}^{(1)^2} \\ \backslash\text{hc}\{b\}\{\text{out}\}\{0\} & \hat{b}_{out}^\dagger \\ \backslash\text{hc}\{b\}\{\text{out}\}\{\}\{2\} & \hat{b}_{out}^{\dagger 2} \end{array}$$

The defaults style is to typeset all operators with a hat. The none starred versions use `\hat` and are only appropriate for single symbol operators. The starred version use `\widehat` which scales with the width of the operator and can therefore be used for wider symbols. The `\widehat` often overlaps with the superscripts however, so the starred version insert a `\>` before the superscripts and a `\:` for the Hermitian conjugate superscript. Controlling the spacing of the superscript for individual operators can be done with the optional *superscript spacing* argument.

$$\begin{array}{ll} \backslash\text{op}*\{A\}\{\text{in}\}\{0\} & \widehat{A}_{in}^0 \\ \backslash\text{hc}*\{ab\}\{\text{out}\} & \widehat{ab}_{out}^\dagger \\ \backslash\text{hc}*\{\kern4pt\}\{\mathcal{L}\} & \widehat{\mathcal{L}}^\dagger \end{array}$$

## 3. LIST OF OPTIONS

### 3.1. BOLD

Some prefer to use bold letters for operators instead of hats. This can be achieved by using the `bold` option when loading the package. When using this option, the starred versions will produce the same result as the none starred versions.

$$\begin{array}{ll} \backslash\text{op}\{a\}\{\text{in}\}\{0\} & \mathbf{a}_{in}^0 \\ \backslash\text{hc}\{b\}\{\text{out}\} & \mathbf{b}_{out}^\dagger \end{array}$$

### 3.2. BMBOLD

The `bmbold` option achieves the same effect as `bold`, but instead uses the bold math font provided by the `bm` package.

$$\begin{array}{ll} \backslash\text{op}\{a\}\{\text{in}\}\{0\} & \mathbf{a}_{in}^0 \\ \backslash\text{hc}\{b\}\{\text{out}\} & \mathbf{b}_{out}^\dagger \end{array}$$

### 3.3. NOHAT

The option `nohat` typesets the operators without a `\hat`. This also applies to the starred versions.

$$\begin{array}{ll} \backslash\text{op}\{a\}\{\text{in}\}\{0\} & \mathbf{a}_{in}^0 \\ \backslash\text{hc}\{b\}\{\text{out}\} & \mathbf{b}_{out}^\dagger \end{array}$$

### 3.4. WIDE

With the wide option, all operators will use `\widehat`, regardless of whether you're using the starred or non starred versions.

### 3.5. STAR

The `star` options typesets the Hermitian conjugate with a star instead of a dagger.

$$\backslash\text{hc}\{b\}\{\text{out}\} \quad \hat{\mathbf{b}}_{out}^*$$

### 3.6. COMPACT

The consistent spacing is provided by using `\mathstrut` in both the subscript and superscript. As the misalignment is caused by using a `\dagger` in the superscript, the same effect can be achieved by using a `\phantom{\dagger}` in the superscript of the non Hermitian conjugated operator. This turns out to be slightly more compact than using `\mathstrut`, though the effect is minimal<sup>1</sup>.

$$\begin{array}{lll} \backslash\text{op}\{a\}\{\text{in}\}\backslash\text{hc}\{a\}\{\text{in}\} & \hat{\mathbf{a}}_{in} \hat{\mathbf{a}}_{in}^\dagger & \text{using } \backslash\text{mathstrut} \\ \backslash\text{op}\{a\}\{\text{in}\}\backslash\text{hc}\{a\}\{\text{in}\} & \hat{\mathbf{a}}_{in} \hat{\mathbf{a}}_{in}^\dagger & \text{using } \backslash\text{phantom}\{\backslash\text{dagger}\} \end{array}$$

$$\hat{\mathbf{a}}_{in} \hat{\mathbf{a}}_{in}^\dagger$$

FIGURE 1

Illustrating the difference between `\mathstrut` and `\phantom{\dagger}`. The light grey letters are the compact version that used `\phantom{\dagger}`.

<sup>1</sup> This is because `\mathstrut` is defined as `\def\mathstrut{\vphantom{()}}` and `()` turns out to be slightly larger than `\dagger`.

### 3.7. SQUARE

To help distinguish between the operator and the indices, the subscript and superscripts can be given in square brackets as well when using the `square` option.

$$\begin{array}{ll} \backslash\text{op}\{a\}[\text{in}] [0] & \hat{a}_{in}^0 \\ \backslash\text{hc}\{b\}[\text{out}] & \hat{b}_{out}^\dagger \end{array}$$

## 4. ADVANCED CONTROL

All the options above are set by renewing some custom commands which are

command	default value	description
<code>\linopstyle</code>	<code>\hat</code>	style of operators
<code>\linopstylewide</code>	<code>\widehat</code>	style of starred operators
<code>\linopconjugate</code>	<code>\dagger</code>	symbol used for Hermitian conjugate
<code>\linospacewide</code>	<code>\&gt;</code>	spacing in superscript of <code>op*</code>
<code>\linospacewidehc</code>	<code>\:</code>	spacing in superscript of <code>hc*</code>
<code>\linopsubscript</code>	<code>\mathstrut</code>	equal spacing in subscript
<code>\linopsuperscript</code>	<code>\mathstrut</code>	equal spacing in superscript of <code>op</code>
<code>\linopsuperscripthc</code>	<code>\mathstrut</code>	equal spacing in superscript of <code>hc</code>

These can be changed with `\renewcommand` for even further control.