

L^AT_EX – A TOOL FOR SCIENTIFIC WRITING

includegraphics Σ eqnarray pdf_{αβγδεζηθλμνξπ} latex
tabular Σ LaTeX
bib_⊕ tex TeX



What is \LaTeX ?



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\LaTeX is a document preparation system to create publication quality scientific documents.



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It is not an alternative to Word.



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Author: Leslie Lamport, available to public since 1984



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FREE!



How to install \LaTeX ?






 Windows	Go to https://miktex.org/download and download the basic installer. For detailed instructions, refer to https://miktex.org/howto/install-miktex .
 Linux	Install <i>texlive</i> and use your favourite editor.
 android	Install VerbTeX.



How to install L^AT_EX?



 Windows	Go to https://miktex.org/download and download the basic installer. For detailed instructions, refer to https://miktex.org/howto/install-miktex .
 Linux	Install <i>texlive</i> and use your favourite editor.
 android	Install VerbTeX.

Or, go to <https://www.overleaf.com>.



The simplest T_EX file

```
\documentclass{article}  
\begin{document}  
Let's learn \LaTeX.  
\end{document}
```



The simplest T_EX file

Input

```
\documentclass{article}  
\begin{document}  
Let's learn \LaTeX.  
\end{document}
```

Output

Let's learn L^AT_EX.

Compiled using *pdflatex*.



Essential parts of a T_EX file

Preamble	<code>\documentclass[<i>optional arguments</i>]{<i>article/letter/book/...</i>}</code>
Body	<code>\begin{document}</code> <i>Body of the document</i> <code>\end{document}</code>



Adding some basic stuff

```
\documentclass[a4paper,12pt]{article}
\title{My Laws}
\author{Isaac Newton}
\date{January 1, 1687}
\begin{document}
\maketitle
\section{First Law}
A body at rest will continue to be at rest and
a body in uniform motion will stay in uniform
motion unless acted upon by an external force.
\section{Second Law}
The rate of change of momentum is directly
proportional to the impressed force.
\section{Third Law}
Every action has an equal and opposite
reaction.
\end{document}
```



My Laws

Isaac Newton

January 1, 1687

1 First Law

A body at rest will continue to be at rest and a body in uniform motion will stay in uniform motion unless acted upon by an external force.

2 Second Law

The rate of change of momentum is directly proportional to the impressed force.

3 Third Law

Every action has an equal and opposite reaction.



Subsections, text formatting etc

```
\documentclass{article}
\begin{document}
\section{Optics}
This section is about {\bf optics}.
\subsection{Geometrical Optics}
This is the {\em small wavelength limit}.

\subsection{Physical Optics}
Here, we will discuss \underline{physical optics}.
\subsubsection{Diffraction}
\paragraph{Fraunhofer Diffraction}
Sources and screens are \textsc{far away}.
\paragraph{Fresnel Diffraction}
Sources and/or screens are nearby.
\end{document}
```



Input

```
\documentclass{article}
\begin{document}
\section{Optics}
This section is about {\bf optics}.
\subsection{Geometrical Optics}
This is the {\em small wavelength limit}.

\subsection{Physical Optics}
Here, we will discuss \underline{physical optics}.
\subsubsection{Diffraction}
\paragraph{Fraunhofer Diffraction}
Sources and screens are \textsc{far away}.
\paragraph{Fresnel Diffraction}
Sources and/or screens are nearby.
\end{document}
```

Output

1 Optics

This section is about **optics**.

1.1 Geometrical Optics

This is the *small wavelength limit*.

1.2 Physical Optics

Here, we will discuss physical optics.

1.2.1 Diffraction

Fraunhofer Diffraction Sources and screens are FAR AWAY.

Fresnel Diffraction Sources and/or screens are nearby.



Font sizes

```
0 {\tiny 1 \scriptsize 2 \footnotesize 3 \small 4 \normalsize 5  
  \large 6 \Large 7 \LARGE 8 \huge 9 \Huge 10} 11
```



Font sizes

```
0 {\tiny 1 \scriptsize 2 \footnotesize 3 \small 4 \normalsize 5  
  \large 6 \Large 7 \LARGE 8 \huge 9 \Huge 10} 11
```

0 1 2 3 4 5 6 7 8 9 10 11



New commands/Macros

```
\newcommand{\myname}{Saurish Chakrabarty}
```



New commands/Macros

```
\newcommand{\myname}{Saurish Chakrabarty}
```

This can be put in the preamble.



New commands/Macros

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\newcommand{\myname}{Saurish Chakrabarty}
```

This can be put in the preamble.

I am `\myname`.



New commands/Macros

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\newcommand{\myname}{Saurish Chakrabarty}
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This can be put in the preamble.

I am `\myname`.

I am Saurish Chakrabarty.



New commands/Macros

```
\newcommand{\myname}{Saurish Chakrabarty}
```

This can be put in the preamble.

I am `\myname`.

I am Saurish Chakrabarty.

```
\newcommand{\lastnamefirst}[2]{\textsc{#2}, {\em #1}}
```



New commands/Macros

```
\newcommand{\myname}{Saurish Chakrabarty}
```

This can be put in the preamble.

I am `\myname`.

I am Saurish Chakrabarty.

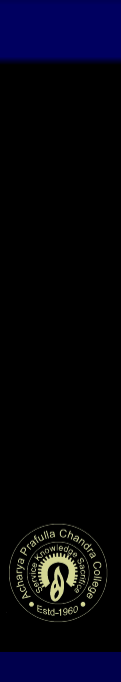
```
\newcommand{\lastnamefirst}[2]{\textsc{#2}, {\em #1}}
```

```
\lastnamefirst{Satyendra Nath}{Bose} \\
```

```
\lastnamefirst{Albert}{Einstein}
```

BOSE, *Satyendra Nath*

EINSTEIN, *Albert*



- Comments: *%This is a comment. It will not appear in the pdf file.*



- Comments: `%This is a comment. It will not appear in the pdf file.`
- Using reserved symbols: `%, &, #, {, }`, etc can be printed using the backslash character.

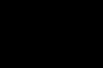
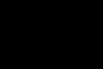
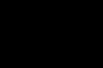


Some more things

- Comments: `%This is a comment. It will not appear in the pdf file.`
- Using reserved symbols: `%, &, #, {, }`, etc can be printed using the backslash character. *E.g.*, `100\%` prints 100%.



MATHEMATICAL EXPRESSIONS



Inline:

`\(x=\pi^2\)`



Inline:

`\(x=\pi^2\)` becomes $x = \pi^2$



Inline:

`\(x=\pi^2\)` becomes $x = \pi^2$

The same can be done using `$x=\pi^2$`





Inline:

`\(x=\pi^2\)` becomes $x = \pi^2$

The same can be done using `$x=\pi^2$`

Displayed equation/formula:

```
\[ n_{\vec{k}} =
\frac{1}{e^{\beta(E_{\vec{k}} - \mu)} \pm 1}
\]
```

$$n_{\vec{k}} = \frac{1}{e^{\beta(E_{\vec{k}} - \mu)} \pm 1}$$





Inline:

`\(x=\pi^2\)` becomes $x = \pi^2$

The same can be done using `$x=\pi^2$`

Displayed equation/formula:

`\[n_{\vec{k}} =`

`\frac{1}{e^{\beta(E_{\vec{k}} - \mu)} \pm 1}`

`\] \]`

$$n_{\vec{k}} = \frac{1}{e^{\beta(E_{\vec{k}} - \mu)} \pm 1}$$

`\begin{equation}`

`-\frac{\hbar^2}{2m}\psi'' + V\psi = E\psi`

`\end{equation}`

$$-\frac{\hbar^2}{2m}\psi'' + V\psi = E\psi \quad (1)$$



Calligraphic fonts, ellipsis, and some more symbols in math mode

`\mathcal{A,B,C,\ldots,X,Y,Z}`

$\mathcal{A}, \mathcal{B}, \mathcal{C}, \dots, \mathcal{X}, \mathcal{Y}, \mathcal{Z}$



Calligraphic fonts, ellipsis, and some more symbols in math mode

`\mathcal{A,B,C,\ldots,X,Y,Z}`

$\mathcal{A}, \mathcal{B}, \mathcal{C}, \dots, \mathcal{X}, \mathcal{Y}, \mathcal{Z}$

`\sum_{n=1}^N n = \frac{N(N+1)}{2}`

$$\sum_{n=1}^N n = \frac{N(N+1)}{2}$$



Calligraphic fonts, ellipsis, and some more symbols in math mode

`\mathcal{A,B,C,\ldots,X,Y,Z}`

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`\sum_{n=1}^N n = \frac{N(N+1)}{2}`

$$\sum_{n=1}^N n = \frac{N(N+1)}{2}$$

`\frac{1}{\sigma\sqrt{2\pi}} \int_{-\infty}^{\infty} \exp\left[-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right]`

$$\frac{1}{\sigma\sqrt{2\pi}} \int_{-\infty}^{\infty} \exp\left[-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right]$$



Calligraphic fonts, ellipsis, and some more symbols in math mode

`\mathcal{A,B,C,\ldots,X,Y,Z}`

$\mathcal{A}, \mathcal{B}, \mathcal{C}, \dots, \mathcal{X}, \mathcal{Y}, \mathcal{Z}$

`\sum_{n=1}^N n = \frac{N(N+1)}{2}`

$$\sum_{n=1}^N n = \frac{N(N+1)}{2}$$

`\frac{1}{\sigma\sqrt{2\pi}} \int_{-\infty}^{\infty} \exp\left[-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right]`

$$\frac{1}{\sigma\sqrt{2\pi}} \int_{-\infty}^{\infty} \exp\left[-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right]$$



Multiple equations

```
\begin{eqnarray}
```

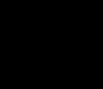
```
A x = B \\
```

```
\Rightarrow x = A^{-1}B
```

```
\end{eqnarray}
```

$$Ax = B \quad (2)$$

$$\Rightarrow x = A^{-1}B \quad (3)$$



Multiple equations

```
\begin{eqnarray}
```

```
A x = B \\
```

```
\Rightarrow x = A^{-1}B
```

```
\end{eqnarray}
```

$$Ax = B \quad (2)$$

$$\Rightarrow x = A^{-1}B \quad (3)$$

```
\begin{eqnarray}
```

```
\mu = \langle x \rangle \\
```

```
\Rightarrow \sigma^2 =
```

```
\left\langle x^2 \right\rangle - \mu^2
```

```
\label{variance}
```

```
\end{eqnarray}
```

$$\mu = \langle x \rangle \quad (4)$$

$$\Rightarrow \sigma^2 = \langle x^2 \rangle - \mu^2 \quad (5)$$



Multiple equations

```
\begin{eqnarray}
```

```
A x = B \\
```

```
\Rightarrow x = A^{-1}B
```

```
\end{eqnarray}
```

$$Ax = B \quad (2)$$

$$\Rightarrow x = A^{-1}B \quad (3)$$

```
\begin{eqnarray}
```

```
\mu &=& \langle x \rangle \\
```

```
\Rightarrow \sigma^2 &=&
```

```
\left\langle x^2 \right\rangle - \mu^2
```

```
\label{variance}
```

```
\end{eqnarray}
```

$$\mu = \langle x \rangle \quad (4)$$

$$\Rightarrow \sigma^2 = \langle x^2 \rangle - \mu^2 \quad (5)$$

```
\nonumber suppresses the equation number.
```



Arrays in math mode

```
A=\left(
\begin{array}{ccc}
11 & 12 & 13\\
21 & 22 & 23\\
31 & 32 & 33\\
\end{array}
\right)
```

$$A = \begin{pmatrix} 11 & 12 & 13 \\ 21 & 22 & 23 \\ 31 & 32 & 33 \end{pmatrix}$$



Arrays in math mode

```
A=\left(
\begin{array}{ccc}
11 & 12 & 13\\
21 & 22 & 23\\
31 & 32 & 33\\
\end{array}
\right)
```

$$A = \begin{pmatrix} 11 & 12 & 13 \\ 21 & 22 & 23 \\ 31 & 32 & 33 \end{pmatrix}$$

```
\Theta(x)=\left\{
\begin{array}{l}
0, & \mbox{if } x < 0, \mbox{ and,} \\
1, & \mbox{if } x \ge 0
\end{array}
\right.
```

$$\Theta(x) = \begin{cases} 0, & \text{if } x < 0, \text{ and,} \\ 1, & \text{if } x \geq 0 \end{cases}$$



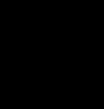
Use of AMSmath package

- `\usepackage{amsmath}`



Use of AMSmath package

- `\usepackage{amsmath}`
- Check out *multiline*, *gather*, *align*, and, *alignat*.



- `\usepackage{amsmath}`
- Check out *multiline*, *gather*, *align*, and, *alignat*.
- For matrices, amsmath has *matrix*, *pmatrix*, *bmatrix*, *vmatrix*, *Vmatrix*, and, *smallmatrix*.



- `\usepackage{amsmath}`
- Check out *multiline*, *gather*, *align*, and, *alignat*.
- For matrices, amsmath has *matrix*, *pmatrix*, *bmatrix*, *vmatrix*, *Vmatrix*, and, *smallmatrix*.

```
\begin{matrix}
1&0\\
0&1\\
\end{matrix}
```

$$\begin{matrix} 1 & 0 \\ 0 & 1 \end{matrix}$$


- `\usepackage{amsmath}`
- Check out *multiline*, *gather*, *align*, and, *alignat*.
- For matrices, amsmath has *matrix*, *pmatrix*, *bmatrix*, *vmatrix*, *Vmatrix*, and, *smallmatrix*.

```
\begin{pmatrix}
1&0\\
0&1\\
\end{pmatrix}
```

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$


- `\usepackage{amsmath}`
- Check out *multiline*, *gather*, *align*, and, *alignat*.
- For matrices, amsmath has *matrix*, *pmatrix*, *bmatrix*, *vmatrix*, *Vmatrix*, and, *smallmatrix*.

```
\begin{vmatrix}
1&0\\
0&1\\
\end{vmatrix}
```

$$\begin{vmatrix} 1 & 0 \\ 0 & 1 \end{vmatrix}$$


Referring to equations

Equations can be labeled using the `\label{}` command and can be referred to using the `\ref{}` command.



Referring to equations

Equations can be labeled using the `\label{}` command and can be referred to using the `\ref{}` command.

Equation `\ref{variance}` can be used to calculate the variance.



Equations can be labeled using the `\label{}` command and can be referred to using the `\ref{}` command.

Equation `\ref{variance}` can be used to calculate the variance.

→ Equation 5 can be used to calculate the variance.





```
\begin{tabbing}
  \hspace{40pt} \= Chess \= Ludo \= Carrom \= Bridge \\\
  Pieces \> 32 \> 17 \> 20 \> 52\\
  Players \> 2 \> 4 \> 4 \> 4\\
\end{tabbing}
```

	Chess	Ludo	Carrom	Bridge
Pieces	32	17	20	52
Players	2	4	4	4



```
\begin{tabular}{|c|c|c|c|}  
  \hline  
  Particle & electron & proton & neutron\\  
  \hline  
  Mass & 0.5 & 935 & 935\\  
  Charge & -1 & +1 & 0\\  
  \hline  
\end{tabular}
```





```
\begin{tabular}{|c|c|c|c|}  
  \hline  
  Particle & electron & proton & neutron\\  
  \hline  
  Mass & 0.5 & 935 & 935\\  
  Charge & -1 & +1 & 0\\  
  \hline  
\end{tabular}
```

Particle	electron	proton	neutron
Mass	0.5	935	935
Charge	-1	+1	0





```
\begin{tabular}{|c|c|c|c|}  
  \hline  
  Particle & electron & proton & neutron\\  
  \hline  
  Mass & 0.5 & 935 & 935\\  
  Charge & -1 & +1 & 0\\  
  \hline  
\end{tabular}
```

Particle	electron	proton	neutron
Mass	0.5	935	935
Charge	-1	+1	0

Column options

l: left aligned, *r*: right aligned, *c*: centered,

p{ $\langle width \rangle$ }: justified to specified width.



Tables (adding a caption and a label)

```
\begin{table}
  \begin{tabular}{|c|c|c|c|}
    \hline
    Particle & electron & proton &
              neutron\\
    \hline
    Mass & 0.5 & 935 & 935\\
    Charge & -1 & +1 & 0\\
    \hline
  \end{tabular}
  \caption{Properties of elementary
    particles}
  \label{chargeMass}
\end{table}
```

Table `\ref{chargeMass}` contains some properties of some elementary particles.



Tables (adding a caption and a label)

```
\begin{table}
  \begin{tabular}{|c|c|c|c|}
    \hline
    Particle & electron & proton &
              neutron\\
    \hline
    Mass & 0.5 & 935 & 935\\
    Charge & -1 & +1 & 0\\
    \hline
  \end{tabular}
  \caption{Properties of elementary
    particles}
  \label{chargeMass}
\end{table}
```

Table [\ref{chargeMass}](#) contains some properties of some elementary particles.

OUTPUT

Particle	electron	proton	neutron
Mass	0.5	935	935
Charge	-1	+1	0

Table 1: Properties of elementary particles

Table 1 contains some properties of some elementary particles.



Pictures

```
\usepackage{graphicx}
```

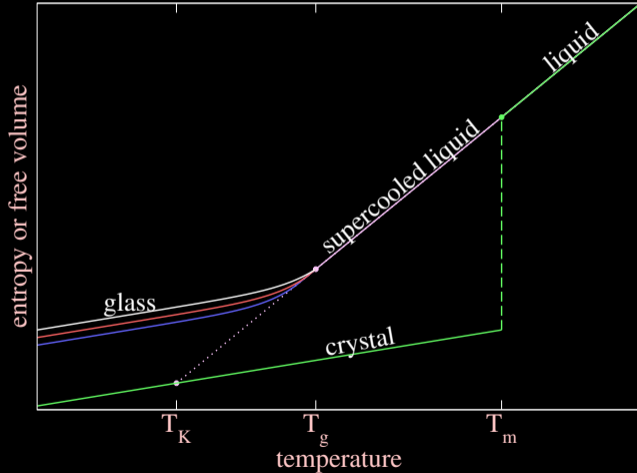


Pictures

```
\usepackage{graphicx}  
\includegraphics[width=width]{filename}
```



```
\usepackage{graphicx}  
\includegraphics[width= $\langle width \rangle$ ]{ $\langle filename \rangle$ }
```



Pictures (adding a caption and a label)

```
\begin{figure}  
<includegraphics>  
\caption{<caption>}  
\label{landscapes}  
\end{figure}
```

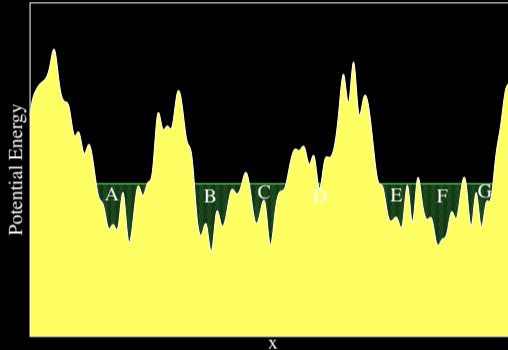


Figure 1: Energy landscapes of supercooled liquids



Pictures (adding a caption and a label)

```
\begin{figure}  
<includegraphics>  
\caption{<caption>}  
\label{landscapes}  
\end{figure}
```

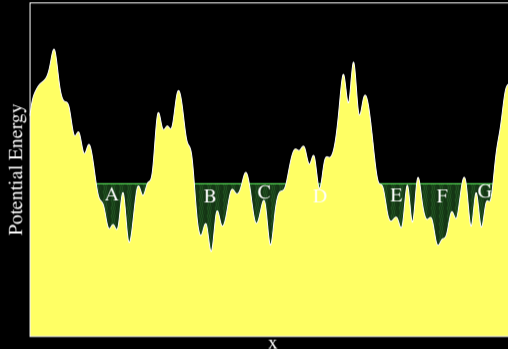


Figure 1: Energy landscapes of supercooled liquids

The energy landscape is drawn in Fig. `\ref{landscapes}`.



Pictures (adding a caption and a label)

```
\begin{figure}  
<includegraphics>  
\caption{<caption>}  
\label{landscapes}  
\end{figure}
```

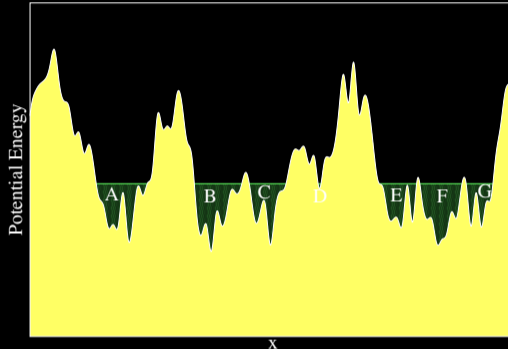


Figure 1: Energy landscapes of supercooled liquids

The energy landscape is drawn in Fig. `\ref{landscapes}`.

→ The energy landscape is drawn in Fig. 1.





```
\begin{itemize}
```

```
\item Classical Mechanics
```

```
\item Thermodynamics
```

```
\item Statistical Mechanics
```

```
\item Electrodynamics
```

```
\item Quantum Mechanics
```

```
\end{itemize}
```

- Classical Mechanics
- Thermodynamics
- Statistical Mechanics
- Electrodynamics
- Quantum Mechanics



```
\begin{itemize}
\item Classical Mechanics
\item Thermodynamics
\item Statistical Mechanics
  \begin{itemize}
\item Classical Statistical Mechanics
\item Quantum Statistical Mechanics
  \begin{itemize}
\item Bose-Einstein statistics
\item Fermi-Dirac statistics
\end{itemize}
\end{itemize}
\end{itemize}
\item Electrodynamics
\item Quantum Mechanics
\end{itemize}
```

- Classical Mechanics
- Thermodynamics
- Statistical Mechanics
 - Classical Statistical Mechanics
 - Quantum Statistical Mechanics
- Bose-Einstein statistics
- Fermi-Dirac statistics
- Electrodynamics
- Quantum Mechanics

```
\begin{enumerate}
\item Classical Mechanics
\item Thermodynamics
\item Statistical Mechanics
  \begin{enumerate}
\item Classical Statistical Mechanics
\item Quantum Statistical Mechanics
  \begin{enumerate}
\item Bose-Einstein statistics
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\end{enumerate}
\end{enumerate}
\end{enumerate}
\item Electrodynamics
\item Quantum Mechanics
\end{enumerate}
```

- 1 Classical Mechanics
- 2 Thermodynamics
- 3 Statistical Mechanics
 - 1 Classical Statistical Mechanics
 - 2 Quantum Statistical Mechanics
- 4 Electrodynamics
- 5 Quantum Mechanics



```
\documentclass{article}
\begin{document}
In vacuum, nothing can travel faster
than light.\cite{einsteinSTR} In some
medium, Cherenkov observed emission of
radiation when a charged particle
moved faster than the speed of light
in that medium.\cite{cherenkov}
\bibliography{sample}
\bibliographystyle{plain}
\end{document}
```



```
\documentclass{article}
\begin{document}
In vacuum, nothing can travel faster
than light.\cite{einsteinSTR} In some
medium, Cherenkov observed emission of
radiation when a charged particle
moved faster than the speed of light
in that medium.\cite{cherenkov}
\bibliography{sample}
\bibliographystyle{plain}
\end{document}
```

sample.bib

```
@article{einsteinSTR,
  title={On the electrodynamics of moving bodies},
  author={Einstein, Albert},
  journal={Annalen der physik},
  volume={17},
  number={10},
  pages={891--921},
  year={1905}
}

@article{cherenkov,
  title={Visible light from clear liquids under
the action of gamma radiation},
  author={Cherenkov, Pavel A},
  journal={Comptes Rendus (Doklady) de l'Aademie
des Sciences de l'URSS},
  volume={2},
  number={8},
  pages={451--454},
  year={1934}
}
```



Compilation order *pdfLaTeX* > *bibTeX* > *pdfLaTeX* > *pdfLaTeX*
(Ignore if you are using overleaf)



Compilation order $\text{pdfLaTeX} > \text{bibTeX} > \text{pdfLaTeX} > \text{pdfLaTeX}$
(Ignore if you are using overleaf)

In vacuum, nothing can travel faster than light.[2] In some medium, Cherenkov observed emission of radiation when a charged particle moved faster than the speed of light in that medium.[1]

References

- [1] Pavel A Cherenkov. Visible light from clear liquids under the action of gamma radiation. *Comptes Rendus (Doklady) de l'Academie des Sciences de l'URSS*, 2(8):451–454, 1934.
- [2] Albert Einstein. On the electrodynamics of moving bodies. *Annalen der physik*, 17(10):891–921, 1905.



- Colors

- `\usepackage{color}`
- `\textcolor{red}{Apple}` → **Apple**
- `\definecolor{darkRed}{RGB}{150,0,0}`



- Colors
 - `\usepackage{color}`
 - `\textcolor{red}{Apple}` → **Apple**
 - `\definecolor{darkRed}{RGB}{150,0,0}`
- Table of contents
 - Used in documentclass *book*
 - `\tableofcontents`



- Page size and margins



- Page size and margins
 - `\usepackage{geometry}`



- Page size and margins

- `\usepackage{geometry}`
- `\geometry{paperheight=14cm,paperwidth=20cm,
tmargin=-0.3in,bmargin=0.3in,
lmargin=0.5in,rmargin=0.5in}`



- Page size and margins
 - `\usepackage{geometry}`
 - `\geometry{paperheight=14cm,paperwidth=20cm,
tmargin=-0.3in,bmargin=0.3in,
lmargin=0.5in,rmargin=0.5in}`
 - `\geometry{a4paper,total={17cm,25.7cm},top=0.5cm,left=2cm}`



- Page size and margins
 - `\usepackage{geometry}`
 - `\geometry{paperheight=14cm,paperwidth=20cm,tmargin=-0.3in,bmargin=0.3in,lmargin=0.5in,rmargin=0.5in}`
 - `\geometry{a4paper,total={17cm,25.7cm},top=0.5cm,left=2cm}`
- arXiv: Download T_EX files of articles written by your favorite researcher. (They are in *tar* format. Install suitable software to untar.)

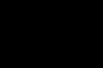


- Stefan Kottwitz, *L^AT_EX Beginner's Guide*
- Scott Pakin, *The Comprehensive L^AT_EX Symbol List*
- Overleaf – <https://www.overleaf.com>
- arXiv – <https://arxiv.org>



😊 THANK YOU 😊





😊 THANK YOU 😊

📁 Homework 😊

Create class notes of your favorite subject. Try to put at least one equation, at least one figure, at least one table and a bibliography. Share the notes with your teacher and incorporate whatever feedback you get.

