

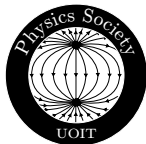
# Introduction to $\text{\LaTeX}$

## A Method for Scientific Writing

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# Introduction

Why should you use L<sup>A</sup>T<sub>E</sub>X?

## A Comparison of Environmental Modelling Approaches on the Case-study of the Chalk River Laboratories Site

M. Tzivaki, H. Graham, E. Waller

**Abstract**—Robust and speedy assessment of radiological impact on non-human biota is crucial for the nuclear industry and the public. In order to show regulatory compliance, accurate dosimetric data must be calculated from the concentration of radionuclides in water measured at sites in question. This work compares frequently used environmental modelling techniques for dose estimation in aquatic biota on the practical case-study of the Chalk River Laboratories (CRL) site. Water concentration data from the Annual Environmental Monitoring Report were processed with the RESRAD-BIOTA and ERICA software, applied to two aquatic environments at CRL. Additionally, the absorbed dose is estimated with an analytic calculation combining the point-source-dose-distribution model and rescaled absorbed fractions for the appropriate geometries. A detailed MCNP dosimetry model of the studied biota is used to assess error. Deviations between the applied methods are observable at the derived tissue and soil concentrations, which become increasingly prominent in dose calculations. Furthermore, comparative analysis reveals deficiencies and strengths in the investigated tools, mostly overestimating the absorbed dose because of intrinsic constraints and therefore showing the need for adaptation and further analysis in order to ensure their reliability.

### I. INTRODUCTION

#### A. Absorbed Dose to Biota

Dose-based standards are in place to ensure environmental radiological protection, in Canada 10 mGy/d are the standard for aquatic animals. In order to show regulatory compliance, accurate dosimetric data must be calculated from the concentration values sampled usually only for water at the sites in question. Starting from a typical environmental report a reliability assessment of some methods for this task will be performed.

Assessing the impact of radiation on the natural environ-

In addition to that, calculating the absorbed dose from the available radionuclide concentrations requires knowledge of the organism-specific dose conversion coefficients (DCCs), defined as an absorbed dose rate per source activity. DCCs have been calculated by Monte-Carlo Methods for a set of Reference Animals and Plants of the FASSET project [5]. The internal and external dose rates for discrete energies are defined in terms of DCCs over the absorbed fractions in Eq. 2.

$$D_{int} = C_{int} \cdot \sum_{\nu} \sum_i E_i Y_i \Phi_{\nu}(E_i) = C_{int} \cdot DCC \quad (1)$$

$$D_{ext} = C_{ext} \cdot \sum_{\nu} \sum_i E_i Y_i (1 - \Phi_{\nu}(E_i)) = C_{ext} \cdot DCC \quad (2)$$

where  $\Phi_{\nu}$  is the absorbed fraction and of the radiation type  $\nu$  and  $E_i$  and  $Y_i$  are energy and yield of the radiations per decay of the radionuclide. It has to be noted that the equation for external exposure holds only if the body and the surrounding medium are of the same density and composition.

For any radionuclide full absorption represents the upper bound for the internal DCC with  $E$  the energy of the source averaged over the emission spectrum.

$$DCC_{\infty} \approx 5.76 \cdot 10^{-4} E \quad (3)$$

Numerous screening tools like RESRAD-BIOTA, ERICA, EPIC, DosDimEco to name just a few are in place. Using analytical equations in combination with computed dose conversion coefficients (DCCs) [ref] they are a quick and effective method to perform an analysis of the environment

# Introduction

## Common Problems in Typesetting Documents with Word or LibreOffice

- Poor typographic control (kerning and leading, missing ligatures).
- Poor font control (Bold or italic instead of changing to the appropriate version of the font family).
- "Badness" is difficult to resolve.
- Image embedding (instead of external links) and limited image editing options.
- Unexpected surprises when using external text.
- Unprofessional look.
- All those weird things that happen during auto-correction, style change, formatting and by just looking at it.

# Introduction

## What is $\text{\LaTeX}$ ?

$\text{\TeX}$  is a low-level markup and programming language created by Donald Knuth to typeset documents attractively and consistently.

$\text{\LaTeX}$  is a macro package based on  $\text{\TeX}$  created by Leslie Lamport. Its purpose is to simplify  $\text{\TeX}$  typesetting. Many later authors have contributed extensions, called packages or styles.

# Introduction

## Why $\text{\LaTeX}$ ?

- $\text{\LaTeX}$  is the standard for mathematical typesetting
- $\text{\LaTeX}$  is turning into the standard everywhere else and especially on the web (google docs, wordpress...)
- $\text{\LaTeX}$  is free (as in free speech not free beer)

# Introduction

## Why L<sup>A</sup>T<sub>E</sub>X for Me?

- Separation of editing and processing
- Sources are simple text files
- Fast and easy uniformity
- Emphasis on content
- Facilitates collaborative working
- Very good pdf support
- Consistency and transparency of layouts and fonts
- Easy typesetting for scientific requirements
- Good handling of citations
- You are forced to structure your documents correctly

**AND...**

# Introduction

## Why L<sup>A</sup>T<sub>E</sub>X for Me?

... It looks great.



# Distributions and Editors

## Requirements

**System:** The combination of the language and the macros.

**Distribution:** The collection of packages and programs that enable you to typeset without having to manually fetch files and configure things.

**Engine:** An engine is an executable that can turn your source code to a printable output format. (pdf<sub>l</sub>atex, latex)

⇒ Distributions are an easy way to install what you need to use the engines and the systems you want.



# Distributions and Editors

## Distributions

**T<sub>E</sub>XLive:** A cross-platform T<sub>E</sub>X distribution

**MacT<sub>E</sub>X:** A T<sub>E</sub>XLive based distribution for Mac

**MiK<sub>T</sub>E<sub>X</sub>:** A T<sub>E</sub>X distribution for Windows

# Distributions and Editors

## Editors

- **Cross-Platform:** **T<sub>E</sub>Xmaker**, gedit (latex-plugin), T<sub>E</sub>Xworks, Lyx (WYSIWYG), (Vim, emacs)
- **Windows:** T<sub>E</sub>XnicCenter, WinShell
- **Linux:** Kile, L<sup>A</sup>T<sub>E</sub>Xila, Gummi (WYSIWYG)
- **Mac:** T<sub>E</sub>XShop, T<sub>E</sub>Xnicle
- **Web-based:** L<sup>A</sup>T<sub>E</sub>XLab, MonkeyT<sub>E</sub>X, **Overleaf**

# Installation

## On Windows, Linux and Mac

- **Windows:** Install MiKTeX or T<sub>E</sub>XLive. *After* that install your favourite editor. Configure the path to provide the editor with the exact location of the MiKTeX software.
- **Linux:** Make sure to have the full version of T<sub>E</sub>XLive, install your favourite editor (use the package manager).
- **Mac:** Install the MacT<sub>E</sub>X package (<http://tug.org/mactex/>). Either use the editor that comes with it (T<sub>E</sub>XShop) or install your favourite editor.

### Hint:

If MiKTeX is not working try a different server.

# Basics

## Getting Started

```
\documentclass[a4paper]{article}
```

```
%my first hello world document
```

```
\begin{document}
```

```
hello world!
```

```
\end{document}
```

# Basics

## Environments, Commands, Comments

### Environments:

```
\begin{environmentname} text influenced \end{environmentname}
```

### Commands:

```
\command_name[option1,option2,...]{argument1}{argument2}
```

### Comments:

```
% this is a comment
```

### Groups:

```
{ \command Inside the group.} Outside the group.
```

# Components

## Document Format

**Header:** Determines the formatting

- Document class: *article*, *book*, *report*, *letter* with options for fonts and printing (equivalent KOMA Skript classes: scr)

```
\documentclass[options]{class}
```

- Usepackages: Activation of special macros

```
\usepackage[parameters]{package}
```

**Main Body:** The content of the document that is being formatted by the header

**Special Pages:** Bibliography, appendix commands

# Components

## Picking a Title

```
\documentclass[a4paper]{article}

\begin{document}

\title{My first LaTeX Document}
\author{You \and Me}
\date{\today}
\maketitle

\end{document}
```

# My first LaTeX Document

You            Me

February 22, 2015

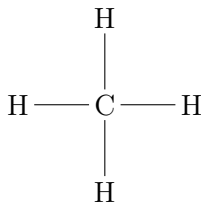


# Basic Layout

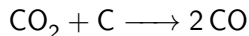
## Working with Text

- `tiny: \tiny{text}`
- `footnotesize:`  
`\footnotesize{text}`
- `small: \small{text}`
- `Large:`  
`\Large{text}`
- `Huge:`  
`\Huge{text}`
- *Italic:* `\textit{text}`
- **Bold:** `\textbf{text}`
- Small Caps:  
`\textsc{text}`
- Underline:  
`\underline{text}`
- **Color:**  
`\textcolor{color}{text}`
- Sans serif:  
`\textsf{text}`

## Common Elements



7C0	hexadecimal
3700	octal
11111000000	binary
1984	decimal



$$\exp(x) = \sum_{n=0}^{\infty} \frac{x^n}{n!} = \lim_{n \rightarrow \infty} \left(1 + \frac{x}{n}\right)^n$$

- ① first item
- ② second item

# Lists

## Sorted and Unsorted

sorted lists: `\begin{enumerate} \item[] \end{enumerate}`

- ➊ first item
- ➋ second item

unsorted lists: `\begin{itemize} \item[] \end{itemize}`

- first item
- second item

# Floats

## Concept and Problem-Solving

Floats are containers for things in a document that cannot be broken over a page → they float (graphs, tables)

### Hint:

If many floats occur in rapid succession,  $\text{\LaTeX}$  stacks them all up and prints them together or leaves them to the end in protest.

### Managing Floats:

- Placement specifiers `\begin{float}[h!,t,b]`
- `\usepackage{float}` provides the placement specifier `[H]`
- `\usepackage{placeins}` use with `\FloatBarrier`

# Floats

## Formatting Tables

- Tabular environment:

```
\begin{tabular}[pos]{table spec}...\end{tabular}
```

- Introducing tables in float environment:

```
\begin{table}...tabular...\end{table}
```

```
\begin{tabular}{ l | c | r }
  1 & 2 & 3 \\ \hline
  4 & 5 & 6 \\ \hline
\end{tabular}
```

1	2	3
4	5	6

Also...

For more control over tables: `\usepackage{tabularx}`,  
`\usepackage{booktabs}`, `\usepackage{tabu}`

# Floats

## Graphics: Import and Placement

- `\usepackage{graphicx}`  
`\graphicspath{{'path'}}`
- Insert files in text: `\includegraphics*[parameters]{mypicture}`
- Introducing graphics in float environment:  
`\begin{figure}...graphics...\end{figure}`

### Hint:

You should always prefer vector graphics if possible (EPS, PDF).

# Floats

## Including Pictures

```
\begin{figure}[htb]  
\centering  
\includegraphics[width=0.8\textwidth]{image.png}  
\caption{Awesome Image}  
\label{fig:awesome_image}  
\end{figure}
```

# Mathematical Symbols

## Symbols and Equations

```
\usepackage{amsmath}
```

- Math environment:

```
\begin{equation}...equation...\end{equation}
```

- Inline math environment:  $...equation...$$

```
\frac{\alpha^2}{\beta^2}
```

$$\frac{\alpha^2}{\beta^2}$$

**Manage correct spacing for units** `\usepackage{siunitx}` is used with `\SI{'number'}{'unit'}`

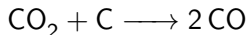


# Constitutional Formulas and Equations

```
\usepackage[version=3]{mchem}
```

Chemical Equations: `\ce{...equation...}`

```
\ce{CO2+C -> 2CO}
```



Also...

`\usepackage{chemfig}` for chemical graphics:

```
\chemfig{<atom1><bond type>[parameters]<atom2>}}
```

# Citing Literature

## BibTeX

BibTeX provides for the storage of all references in an external, flat-file database.

- **Environment:** `\bibliography{bibfile}`
- **Two options:**
  - Type every entry manually
  - Use a database that produces BibTeX code (strongly recommended!)

# Literature Databases

- JabRef
- EndNote (does not import BibT<sub>E</sub>X)
- Citavi
- Mendeley
- CiteULike
- RefWorks (web based)

Check out also [http://en.wikipedia.org/wiki/Comparison\\_of\\_reference\\_management\\_software](http://en.wikipedia.org/wiki/Comparison_of_reference_management_software) for the complete list.

## Hint:

Google scholar and most paper-search websites (like SciVerse) can export BibT<sub>E</sub>X entries.

# Citing

## Basics and Styles

```
\bibliographystyle{style}
```

```
\bibliography{mybibliography1,mybibliography2}
```

Various styles available: plain, abstract, named ...

Standard  $\LaTeX$  bibliography: numeric style of citations

For alternative options (journal or research specific) use the package:

```
\usepackage[options]{natbib}
```

# Citing

## BibT<sub>E</sub>X Entries

```
\cite{citation_key1}
```

```
\cite{citation01,citation02,citation03}
```

### BibT<sub>E</sub>X entry:

```
@article{greenwade93,  
  author   = "George D. Greenwade",  
  title    = "The {C}omprehensive {T}ex {A}rchive  
             {N}etwork ({CTAN})",  
  year     = "1993",  
  journal  = "TUGBoat",  
  volume   = "14",  
  number   = "3",  
  pages    = "342--351"  
}
```

# Building a document

## Main Body and Table of Contents

```
\begin{document}
```

```
\tableofcontents
```

```
\section{Title of the First Section}
```

```
... text ...
```

```
\subsection{Title of the First Subsection}
```

```
... text ...
```

```
\subsubsection{Title of the First Subsubsection}
```

```
... text ...
```

```
\subsubsection*{Title of the Second Subsubsection}
```

```
\addcontentsline{toc}{subsubsection}{Something Else}
```

```
\end{document}
```

# Contents

<b>1</b>	<b>Title of the First Section</b>	<b>1</b>
1.1	Title of the First Subsection . . . . .	1
1.1.1	Title of the First Subsubsection . . . . .	1
	Something Else . . . . .	1

## 1 Title of the First Section

... text ...

### 1.1 Title of the First Subsection

... text ...

#### 1.1.1 Title of the First Subsubsection

... text ...

#### Title of the Second Subsubsection

# Troubleshooting

What to do if it just doesn't work

- 1 Compile often
- 2 Check the log file for a detailed error message or line number
- 3 Check for missing or surplus brackets
- 4 Check for problems in closing an environment
- 5 Delete all temporary files and compile again
- 6 Copy and paste the error message in your browser
- 7 For MikTeX related issues: Don't start installing packages manually unless you are sure you know what you are doing!



# Advanced Topics

## What now?

Now the interesting part begins! 5 reasons to use L<sup>A</sup>T<sub>E</sub>X in a scientific environment.

- Special documents
  - Presentation
  - Poster
  - CV and cover letter
  - Teaching stuff
- Modular documents
- Version control
- Controlling external graphs
- Creating graphics

# Modular Documents

## Introducing Order

Very useful strategy for long  $\text{\LaTeX}$  documents: split in several files.

Best practice:

- main document (main.tex)
- style document (style.sty)
- latex files folder
- pictures folder

include documents with `\include{filename}`

### Hint:

To compile the child documents separate from the mother document use `\usepackage{subfiles}`.

# Special Documents

## Presentation

```
\documentclass{beamer}
```

L<sup>A</sup>T<sub>E</sub>X provides various themes along with colors:

```
\usetheme{'theme'} and \usecolortheme{'theme'}
```

Additional to the traditional sections hierarchy, beamer class comes with "frames" corresponding to the individual slides.

```
\begin{frame}...text...\end{frame}
```

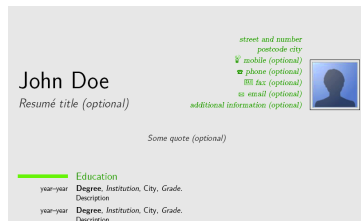
### Hint:

At [http://deic.uab.es/~iblanes/beamer\\_gallery/index.html](http://deic.uab.es/~iblanes/beamer_gallery/index.html) all available basic themes can be looked up.

# Special Documents

## Curriculum Vitae

```
\documentclass[options]{moderncv}
\moderncvstyle{"style"}
\moderncvcolor{"color"}
```



# Layout

## Page Style

`\pagestyle{'style'}` and `\thispagestyle{'style'}`

- **empty:** Header and footer are cleared
- **plain:** Header is clear, but the footer contains the page number in the center
- **headings:** Footer is blank, header displays information according to document class and page number top right
- **myheadings:** Page number is top right, and it is possible to control the rest of the header
- **fancy:** For better control over the headers and footers  
`\usepackage{fancyhdr}`

# Formatting

## Page Size and Structure

- $\text{\LaTeX}$  comes with predefined page and margin sizes for every style and document class
- For manipulation: `\usepackage[options]{geometry}`
- The landscape format is an option of the geometry package
- Text in multiple columns:  
`\begin{multicols}{#}...lots of text...\end{multicols}`

### Warning!

As  $\text{\LaTeX}$  is a globally recognized set of typesetting defaults, additional page formatting should be done not without reason and always with great care.

# Formatting

## Colors

`\usepackage{color}` and `\usepackage[options]{xcolor}`

- Define colors: `\definecolor{'name'}{'model'}{'color-spec'}`
- Coloring text: `\textcolor{declared-color}{text}`
- Coloring the background: `\colorbox{declared-color}{text}`

# Formatting

## Fonts

Various font styles, shapes and sizes are available.

Font encoding can be modified with

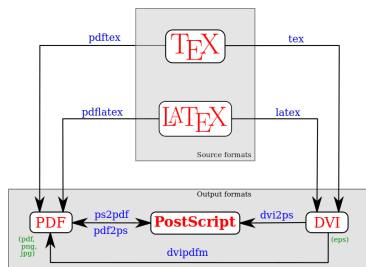
```
\usepackage['encoding']{fontenc}
```

### Warning!

For the sake of consistent typography playing a lot with fonts is highly discouraged. This is the work of font and class designers, not end users.



# Compiling L<sup>A</sup>T<sub>E</sub>X



## Warning!

The only important file types are .tex, .cls and .sty, .bib and .bst. They are not temporary and should not be deleted.

# More Options

... for more convenience!

- More Special Documents: letters, cover letters, exams, assignments
- Version control: backups, collaborative work, non-destructive editing
- External graphs typesetting: control gnuplot graphs
- Creating graphics: with the `tikz` package

# Questions?



## ... and Answers

- The not so short introduction:  
<http://tobi.oetiker.ch/lshort/lshort.pdf>
- A great book: <https://en.wikibooks.org/wiki/Latex>
- Forum for any kind of problem and any kind of solution:  
<http://tex.stackexchange.com/>
- The T<sub>E</sub>X Archive Network <http://www.ctan.org/>
- The L<sup>A</sup>T<sub>E</sub>X Community: <http://www.latex-community.org/>
- DeT<sub>E</sub>Xify: <http://detexify.kirelabs.org/classify.html>