



1. 引言

elsarticle.cls 是一个彻底重写的文档类, 提交至 Elsevier 期刊的 L^AT_EX 文档均可使用它来重新规范格式. 本文档类使用 L^AT_EX 内核已定义的环境和命令, 但不对签名进行任何更改, 这最大限度地减少了与其他常见 L^AT_EX 包的冲突, 它们包括但不限于 hyperref.sty, preview-latex.sty 等等. elsarticle.cls 主要基于默认的 article.cls 进行构建. 因以下宏包的恰当功能, 此文档类可依赖于他们:

1. natbib.sty 用于处理引用;
2. geometry.sty 用于设置页面;
3. fleqn.clo 用于左对齐公式;
4. graphicx.sty 用于插图;
5. txfonts.sty 可选的字体宏包, 如果要使用 Times 字体和与之兼容的数学字体来处理文档格式;
6. hyperref.sty 可选宏包, 如果文档中需要超链接;
7. endfloat.sty 可选宏包, 如果浮动体需要置于 PDF 结尾处.

上述所有宏包 (一些可选宏包除外) 都是所有标准 L^AT_EX 安装的一部分. 因此用户无需担心下载任何额外的包来编译本文档类. 此外, 用户可以根据需要来自由使用 AMS 数学包, 例如 amsmath.sty, amsthm.sty, amssymb.sty, amsfonts.sty 等. 所有这些宏包都可与 elsarticle.cls 无缝协作.

2. 主要区别

以下是 elsarticle.cls 与其前身包 elsart.cls 的主要区别:

- elsarticle.cls 构建在 article.cls 之上然而 elsart.cls 并非如此. elsart.cls 重新定义了 L^AT_EX 类或内核中的许多命令, 这可能会导致与其他常见 L^AT_EX 宏包的惊人冲突;



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- 默认情况下提供预打印文档格式，并可根据 Elsevier 期刊的最终样式，如 1+, 3+ 和 5+，有选择地规范文档格式；
- 提供了一些更简单的方法来给定 `list` 和 `theorem` 环境的格式，而用户仍然可以使用 `amsthm.sty` 宏包；
- `natbib.sty` 是主要的引用处理宏包，它可以全面处理各种引用，并可与 `hyperref.sty` 完美结合；
- 在预打印和最终格式中正确处理长标题页面。

3. 安装

本宏包可在 Elsevier 的作者资源页面获得 (<http://www.elsevier.com/locate/latex>)。它还可以在任意 Comprehensive T_EX Archive Network (CTAN) 节点处寻得，其中一个基本节点是 <http://tug.ctan.org/tex-archive/macros/latex/contrib/elsarticle/>。请下载 `elsarticle.dtx`，它是一个带有文档和 `elsarticle.ins` 的复合类。`elsarticle.ins` 是 L^AT_EX 安装程序文件。当用户使用 L^AT_EX 编译 `elsarticle.ins` 时，它通过从 `*.dtx` 文件中抽取所需文档来提供文档类，即文件 `elsarticle.cls`。该文档类通常会被移动或复制到 `$TEXMF/tex/latex/elsevier/`，或一个在文档编译过程中被 L^AT_EX 读取的文件夹。在移动或复制文档类文件后，T_EX 文件数据库需要更新。通常用户可使用诸如 `mktexlsr` 或 `texhash` 的命令，它们依赖发行版和操作系统。

4. 用法

本文档类有如下使用命令：

```
\documentclass[<options>]{elsarticle}
```

其中 `options` 包括：

`preprint` 投稿至 Elsevier 期刊的文档的默认格式选项。

`review` 类似于 `preprint` 选项，但增加了 `baselineskip`，这为修改文章提供了方便。



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1p 将文章调整为 1+ 模式期刊的最终格式. 这通常是单列样式.

3p 将文章调整为 3+ 模式期刊的最终格式. 如果期刊是双栏的, 请一并使用 **twocolumn** 选项.

5p 将文章调整为 5+ 模式期刊的最终格式. 这通常是双栏样式.

authoryear natbib.sty 的 author-year 引用格式. 如果用户打算增加额外的 **natbib.sty** 选项, 可以使用 **biboptions** 命令, 将选项以逗号分隔. 例如:

```
\biboptions{longnamesfirst,angle,semicolon}
```

number 数字引用样式. 额外选项可以使用 **\biboptions** 进行设置.

sort&compress 将数字引用排序并压缩. 例如, 引用 [1,2,3] 将显示为 [1–3].

longtitle 如果前置部分长得不同寻常, 使用此选项将拆分标题页, 并在第一页中正确放置标题和作者脚注.

times 读取 **txfonts.sty**, 如果系统允许使用 Times 字体和其相容的数学字体.

reversenotenum 使用字母作为作者-机构链接标签并使用数字作为作者脚注. 默认情况下, 数字将用作作者-机构链接标签和作者脚注使用字母.

lefttitle 将标题和作者、机构内容居左. **centertitle** 是产生居中的默认选项.

endfloat 将所有浮动体置于文档最末位置.

nonatbib 不读取 **natbib.sty**.

doubleblind 隐藏作者姓名、机构、电子邮件等信息. 它主要是为双盲评审使用.

article.cls 的所有选项都可以用于本文档类.

文档类的默认选项是 **a4paper, 10pt, oneside, onecolumn** 和 **preprint**.



5. 前置内容

前置内容为用户提供了两种样式来给出作者和地址:

- (1) 每个作者都带有一个标签, 这个标签将连接作者和他的地址; 因此, 可以先列出所有作者, 之后再列出地址;
- (2) 列出相同地址的作者, 然后给出这个地址.

下面提供了第一种样式的示例代码.

```
\title{This is a specimen title\tnoteref{t1,t2}}
\tnotetext[t1]{This document is the results of the research
project funded by the National Science Foundation.}
\tnotetext[t2]{The second title footnote which is a longer
text matter to fill through the whole text width and
overflow into another line in the footnotes area of the
first page.}
```

```
\author[1]{Jos Migchielsen\corref{cor1}%
\fnref{fn1}}
\ead{J.Migchielsen@elsevier.com}

\author[2]{CV Radhakrishnan\fnref{fn2}}
\ead{cvr@sayahna.org}

\author[3]{CV Rajagopal\fnref{fn1,fn3}}
\ead[url]{www.stmdocs.in}
```



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```
\cortext[cor1]{Corresponding author}
\fntext[fn1]{This is the first author footnote.}
\fntext[fn2]{Another author footnote, this is a very long
footnote and it should be a really long footnote. But this
footnote is not yet sufficiently long enough to make two
lines of footnote text.}
\fntext[fn3]{Yet another author footnote.}

\address[1]{Elsevier B.V., Radarweg 29, 1043 NX Amsterdam,
The Netherlands}
\address[2]{Sayahna Foundations, JWRA 34, Jagathy,
Trivandrum 695014, India}
\address[3]{STM Document Engineering Pvt Ltd., Mepukada,
Malayinkil, Trivandrum 695571, India}
```

上面的 \TeX 代码的输出效果如 Clips 1 和 2 所示. 标题页的页首见 Clip 1, 而脚注部分见 Clip 2.

Clip 1: Header of the title page..

This is a specimen a_b title^{★,★★}

Jos Migchielsen^{a,1,*}, CV Radhakrishnan^{b,2}, CV Rajagopal^{c,1,3}

^aElsevier B.V., Radarweg 29, 1043 NX Amsterdam, The Netherlands

^bSayahna Foundations, JWRA 34, Jagathy, Trivandrum 695014, India

^cSTM Document Engineering Pvt Ltd., Mepukada, Malayinkil, Trivandrum 695571, India

Clip 2: Footer of the title page..

*This document is the results of the research project funded by the National Science Foundation.

**The second title footnote which is a longer text matter to fill through the whole text width and overflow into another line in the footnotes area of the first page.

^{*}Corresponding author

Email addresses: J.Migchielsen@elsevier.com (Jos Migchielsen), cvr@sayahna.org (CV Radhakrishnan)

URL: www.stmdocs.in (CV Rajagopal)

¹This is the first author footnote.

²Another author footnote, this is a very long footnote and it should be a really long footnote. But this footnote is not yet sufficiently long enough to make two lines of footnote text.

³Yet another author footnote.



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诸如 `\title`, `\author`, `\address` 等大多数命令都是自解释的. 如果需要为它们添加注释, 那么注释和各部分将依赖于标签引用机制相互连接. 例如, 标题脚注由 `\tnotetext` 给出, 而 `\tnotetext` 的 `<label>` 字符串会生成一个脚注标记, 该标记将用于连接脚注和标题. 这种将脚注和各部分相连接的命令是: `\tnoteref` (将脚注连接到标题); `\corref` (将脚注连接到相应的通讯作者); `\fnref` (将脚注连接到相关作者). T_EX 需要两次编译来解决前置内容中的脚注对应关系. 下面给出了各种脚注引用和脚注文本的语法.

```
\tnoteref{<label(s)>}
\corref{<label(s)>}
\fnref{<label(s)>}
\tnotetext[<label>]{<title note text>}
\cortext[<label>]{<corresponding author note text>}
\fntext[<label>]{<author footnote text>}
```

其中 `<label(s)>` 可以是一个或多个逗号分隔的字符串. 连接作者和其所在地址的标签需写在 `\author` 命令和 `\address` 命令的可选参数中. 同样地, `\tnotetext`, `\fntext`, `\cortext` 的可选参数也是其各自的标签, 而注释文本本身是其强制参数.

以下是第二种作者-单位样式的示例代码.



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```
\author{Jos Migchielsen\corref{cor1}%
       \fnref{fn1}}
\ead{J.Migchielsen@elsevier.com}
\address{Elsevier B.V., Radarweg 29, 1043 NX Amsterdam,
         The Netherlands}

\author{CV Radhakrishnan\fnref{fn2}}
\ead{cvr@sayahna.org}
\address{Sayahna Foundations, JWRA 34, Jagathy,
         Trivandrum 695014, India}

\author{CV Rajagopal\fnref{fn1,fn3}}
\ead[url]{www.stmdocs.in}
\address{STM Document Engineering Pvt Ltd., Mepukada,
         Malayinkil, Trivandrum 695571, India}
```

```
\cortext[cor1]{Corresponding author}
\fntext[fn1]{This is the first author footnote.}
\fntext[fn2]{Another author footnote, this is a very long
             footnote and it should be a really long footnote. But this
             footnote is not yet sufficiently long enough to make two lines
             of footnote text.}
```

以上 T_EX 源码的输出效果如 Clip 3 所示.



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Clip 3: Header of the title page...

This is a specimen a_b title^{★,★★}

Jos Migchielsen^{1,*}

Elsevier B.V., Radarweg 29, 1043 NX Amsterdam, The Netherlands

CV Radhakrishnan²

Sayahna Foundations, JWRA 34, Jagathy, Trivandrum 695014, India

CV Rajagopal^{1,3}

STM Document Engineering Pvt Ltd., Mepukada, Malayinkil, Trivandrum 695571, India

Clip 4 显示了在 doubleblind 选项下的输出内容.

Clip 4: Double blind article.

This is a specimen a_b title

Abstract

In this work we demonstrate a_b the formation Y_1 of a new type of polariton

前置内容还有其他环境, 如摘要和关键字. 这些可以通过以下方式给出:

```
\begin{abstract}
```

In this work we demonstrate the formation of a new type of polariton on the interface between a

```
\end{abstract}
```

```
\begin{keyword}
```

quadruple exiton \sep polariton \sep WGM

```
\end{keyword}
```

每个关键词需要用 \sep 进行分隔. msc 分类需要在关键词环境中给出, 相



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关命令为 \MSC. \MSC 允许一个可选参数来兼容未来版本, 例如 \MSC[2008].
默认值为 2000.

5.1. 新页

有时用户可能需要中止本页, 并在标题、作者或摘要后另起一页. 以下代码可以实现这个目的.

```
\newpageafter{title}  
\newpageafter{author}  
\newpageafter{abstract}
```

\newpageafter{title} 将标题单独列在一页.

\newpageafter{author} 将标题和作者细节列在一页.

\newpageafter{abstract} 将标题、作者和摘要以及关键字列在一页.

6. 浮动体

插图可以使用命令 \includegraphics 来完成, 用户可以通过添加或者删除它的可选参数进一步控制图像. \includegraphics 由 graphic[s,x].sty 提供, 它是任意标准 L^AT_EX 发行版的一部分. 本模板默认引用 graphicx.sty. L^AT_EX 接受 postscript 图片格式, 而 pdfL^AT_EX 接受 *.pdf, *.mps (metapost), *.jpg 和 *.png 格式. pdfL^AT_EX 无法接受 postscript 格式的图片文件.

table 环境用于处理表格. 如果用户想使用 multirow.sty, array.sty 等来控制或者拓展表格功能, 非常欢迎他们根据自己的选择来引用这些宏包, elsarticle.cls 能够很好地与这些宏包一同工作.

7. 定理与类定理环境

elsarticle.cls 提供了一些便于使用的定理与类定理环境. 在所有的命令中, \newtheorem 的选项都可以通过同样的方式来发挥作用. elsarticle.cls 还提供了三个定理和类定理环境:



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```
\newtheorem{thm}{Theorem}
\newtheorem{lem}[thm]{Lemma}
\newdefinition{rmk}{Remark}
\newproof{pf}{Proof}
\newproof{pot}{Proof of Theorem \ref{thm2}}
```

\newtheorem 命令指定定理格式为 L^AT_EX 的默认样式, 即意大利体的内容, 粗体的定理抬头和置于抬头右端的数字. 它还提供了可选参数, 可选参数的内容将写入在定理抬头右端的括号中.

```
\begin{thm}
For system (8), consensus can be achieved with
$|T_{\omega z}|$

...
\begin{eqnarray}\label{10}
....\\
\end{eqnarray}
\end{thm}
```

Clip 5 将向用户展示以上代码的一个实例.

Clip 5: \newtheorem.

Theorem 2. For system (8), consensus can be achieved with $\|T_{\omega z}(s)\|_\infty < \gamma$ if there exist a symmetric positive definite matrix $P \in \mathcal{R}^{(n-1) \times (n-1)}$ and a scalar $\mu > 0$ satisfying

$$\Gamma = \begin{bmatrix} -\bar{L}^T P - P\bar{L} + U_1^T U_1 + \mu\bar{E} & PU_1^T E_1 & PU_1^T \\ E_1^T U_1 P & -\mu I & 0 \\ U_1 P & 0 & -\gamma^2 I \end{bmatrix} < 0, \quad (10)$$

where $\bar{L} = U_1^T L U_1$ and $\bar{E} = U_1^T E_1^T E_2 U_1$.

\newdefinition 命令在所有方面都与 \newtheorem 对应相同, 除了字体使用罗马体而非斜体. \newdefinition 和 \newtheorem 两个命令都为所定义的环境自动生成计数器.



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Clip 6: \newdefinition.

Remark 3. We remark that; when the ratio h/λ tends to 0, the expression $\lambda L(r,s) = -(s-r)/(4(\frac{h}{\lambda})^2 + (r-s)^2)$ tends to $1/(r-s)$ which is a singular function. This means that the expression $\lambda L(r,s)$ is not well behaved for the small values of h/λ . Consequently, for the solution to converge, the integrals of (10) and (11) must be evaluated with a large number of nodes. In our numerical applications (cf. section 5), we use 100 nodes to evaluate these integrals. With the smallest value of $h/\lambda = 0.02$, the convergence is good with $N = 20$.

\newproof 命令使用直立字体定义了证明环境, 并且不生成计数器.

Clip 7: \newproof.

Proof of Theorem 2. Proof follows straightforward from Lemma 3 and Theorem 1. However, it should be emphasized that all possible $\tilde{L}_{\sigma(t)}$ should share a common Lyapunov function $V(\delta) = \delta^T(t)P\delta(t)$ (see the proof of Lemma 3 in Appendix A). \square

用户也可以使用 `amsthm.sty`, 它覆盖了上述提到的所有默认定义.

8. 有序列表和无序列表

elsarticle.cls 扩展了列表指令, 该指令比 L^AT_EX 中默认的列表指令更易于使用. \begin{enumerate} 命令可带可选参数, 该可选参数可以更改列表计数器类型及其属性.

```
\begin{enumerate}[1.]  
  \item The enumerate environment starts with an optional  
        argument '1.', so that the item counter will be suffixed  
        by a period.  
  \item You can use 'a)' for alphabetical counter and '(i)' for  
        roman counter.  
  \begin{enumerate}[a)]  
    \item Another level of list with alphabetical counter.  
    \item One more item before we start another.  
  \end{enumerate}  
\end{enumerate}
```



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Clip 8: List – Enumerate.

1. The enumerate environment starts with an optional argument '1.' so that the item counter will be suffixed by a period.
2. You can use '(a)' for alphabetical counter and '(i)' for roman counter.
 - a) Another level of list with alphabetical counter.
 - b) One more item before we start another.
 - (i) This item has roman numeral counter.
 - (ii) Another one before we close the third level.
 - c) Third item in second level.
3. All list items conclude with this step.

此外, 增强的列表环境允许用户将诸如 “step” 的字符串作为所有项目号的前缀.

```
\begin{enumerate}[Step 1.]  
  \item This is the first step of the example list.  
  \item Obviously this is the second step.  
  \item The final step to wind up this example.  
\end{enumerate}
```

Clip 9: List – enhanced.

- Step 1. This is the first step of the example list.
- Step 2. Obviously this is the second step.
- Step 3. The final step to wind up this example.

9. 交叉引用

在电子出版物中, 文章内部可以带有超链接. 超链接由文章中正确的交叉引用生成. 例如, Fig. 1 只会是普通的文本, 而正确的交叉引用 `\ref{tiger}` 将会变成图形本身的超链接: Fig. 1. 同样地, Ref. [1] 不会成为超链接; 正确



地交叉引用是 `\cite{Knuth96}`. 对于节、子节、公式、图、表和参考文献, L^AT_EX 都允许进行交叉引用.

10. 数学符号和公式

标准 L^AT_EX 中提供的少数数学符号无法满足许多物理、数学学科用户的需求, 他们需要更多的数学符号. 支持额外符号的一个有用的宏包是美国数学学会开发的 `amssymb`, 这个包包含了常见的符号, 如 \lesssim (`\lessapprox`), \gtrsim (`\gtrapprox`) 或 \hbar (`\hbar`). 注意到用户的 T_EX 系统应该已安装了 `msam` 和 `msbm` 字体. 如果用户仅仅需要少量符号, 例如 \square (`\Box`), 那么可以尝试 `latexsym` 宏包.

需要用户注意的另一点是长公式换行. 当用户使用 `elsarticle.cls` 在 `preprint` 模式下处理投稿格式时, 文档将呈现单栏模式, 文字行宽为 384pt 或 5.3in. 当文档最终定稿, 并且期刊要求以双栏模式来处理格式时, 文字行宽缩减为 224pt (3+ 期刊双栏模式或 5+ 期刊). 在这种情况下, 作者为实现公式换行而进行的所有漂亮微调都会被浪费掉. 因此, 用户需要检查这个问题, 在最终定稿时重新排版他们的待提交文档, 在调用文档类时选择适合的参数, 用户可以查看他们的公式是否在适当的位置进行了换行, 这些在 4. 用法 中有解释. 这允许用户在投稿前修正任何公式的换行问题. `elsarticle.cls` 支持用户以不同形式的定稿模式来提交文档. 这将在 12. 终稿打印 中进一步讨论.

行间公式和双栏期刊

许多 Elsevier 期刊使用双栏打印. 由于预印本的页面使用更宽的文字栏, 因此公式在正式打印时会过宽. 这里提供一个例子, 见 equation 6, 它在单栏模式中很完美:



Clip 10: See equation (6).

Here e, m are the electron charge and mass; \mathbf{p} is the electron momentum. For the quadrupole $1S$ transition in cuprous oxide the energy of interaction can be written as:

$$\sum_{i=0}^{\infty} A_n \int dx \frac{F_n(x)}{A_n + B_n} = B^n C^n \int dx \int dy \frac{G_n(x, y)}{A_n x + B_n y} + \frac{G_n(x, y)}{A_n x + B_n y} \quad (5)$$

Here we introduced the initial state of the system, which transforms as irreducible representation ${}^1\Gamma_1^+$ of the cubic centered group O_h . The final state is the *ortho*-exciton state which transforms as ${}^3\Gamma_{5,xz}^+$ in Cartesian system or as ${}^3\Gamma_{5;1,2}^+$ in the corresponding spherical basis.

Hence, using (1, 3, 4, 5), one can deduce that the coupling of the spherical harmonic compared to the plane wave ($\hbar g_{1,2} = 124 \mu eV$) is resonantly enhanced:

$$\frac{g_{1,39}}{g_{1,2}} = -i0.06 b_{1,39}(kr_0) A_{1,39}^{1,2}(r_0 + \delta r) \quad (6)$$

Here we utilized the fact that $B_{1,39}^{1,2} \ll A_{1,39}^{1,2}$. While the resonant enhancement is provided by the $b_{1,39}$ Mie coefficient here, the translational coefficient reduces the effect. That is why if one tries to couple the evanescent light to the dipole transition the effect is much weaker as $A_{1,39}^{0,1} \ll A_{1,39}^{1,2}$.

当文档在双栏的 3+ 模式期刊中被排版时,一旦公式没有在适当的位置分行,就会跨到第二栏中。

Clip 11: See equation (6) overprints into second column.

Their explicit expression can be found, for instance, in [12, 9] and are explicitly listed in the Appendix.

The bulk (incident) and evanescent polaritons in cuprous oxide are formed through the quadrupole part of the light-matter interaction:

$$H_{int} = \frac{ie}{m\omega_{1S}} \mathbf{E}_{i,s} \cdot \mathbf{p}$$

Here e, m are the electron charge and mass; \mathbf{p} is the electron momentum. For the quadrupole $1S$ transition in cuprous oxide the energy of interaction can be written as:

$$\sum_{i=0}^{\infty} A_n \int dx \frac{F_n(x)}{A_n + B_n} = B^n C^n \int dx \int dy \frac{G_n(x, y)}{A_n x + B_n y} + \frac{G_n(x, y)}{A_n x + B_n y} \quad (5)$$

Here we introduced the initial state of the system, which transforms as irreducible representation ${}^1\Gamma_1^+$ of the cubic centered group O_h . The final state is the *ortho*-exciton

Figure 1: The evanescent light - $1S$ quadrupole coupling ($g_{1,l}$) scaled to the bulk exciton-photon coupling ($g_{1,2}$). The size parameter kr_0 is denoted as x and the PMS is placed directly on the cuprous oxide sample ($\delta r = 0$, See also Fig.2).

3. Results and discussion

In this section let us utilize the above calculated WGM-QE interaction to obtain the evanescent polariton (EP) dispersion in the framework of the coupled oscillator model that has been widely used for describing coupled atom-photon or exciton-photon modes in microcavity systems [13]. Near the resonance between WGM and the quadrupole exciton $\omega_{1l} \approx \omega_{1S}$ the EP branches are given by the eigenvalues of the following Hamiltonian:

$$H/\hbar = \omega_{1l} a_x^\dagger a_x + \omega_{1S} b_x^\dagger b_x + g_{1l}(x) (a_k^\dagger b_x + a_x b_x^\dagger), \quad (7)$$

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11. 参考文献

本模板提供了三种参考文献样式文件 (*.bst) – elsarticle-num.bst, elsarticle-num-names.bst 和 elsarticle-harv.bst – 第一种用于数字格式, 第二种用于附加 natbib.sty 选项的数字格式. 第三种适用于作者-年代格式.

在 L^AT_EX 中, 参考文献列于 `thebibliography` 环境. 每条参考文献都是一个 `\bibitem` 条目, 而每个 `\bibitem` 都有一个标签, 通过标签, 他们可以在正文中被引用:

`\bibitem[Elson et al. (1996)]{ESG96}` 被引用为 `\citet{ESG96}`. 考虑到交叉引用和未来可能的超链接, 将超过一个文献条目收集在一个 `\bibitem` 中并不是一个好主意. 所谓的 Harvard 或者作者-年代参考文献样式被 L^AT_EX 的宏包 `natbib` 支持. 通过这个宏包, 参考文献可以被如下引用:

- 插入式: `\citetp{WB96}` 生成 (Wettig & Brown, 1996).
- 文本式: `\citet{ESG96}` 生成 Elson et al. (1996).
- 附件式: `\citetp[e.g.][]{Ch. 2}{Gea97}` 生成 (e.g. Governato et al., 1997, Ch. 2).

在数字引用格式中, `\cite{<label>}` 被使用, 而 `\citet` 或 `\citetp` 在数字格式中不再有相关性. `natbib` 宏包被 `elsarticle` 调用, `numbers` 是其默认选项. 用户可以将其改为作者-年代或者 harvard 格式, 只需添加 `authoryear` 选项至文档类. 如果用户打算使用更多的 `natbib` 宏包选项, 可以使用 `\biboptions` 命令, 它在 4. 用法 中有过说明. 更多关于 `natbib` 宏包选项的细节, 请用户查阅 `natbib` 手册, 它也是任何标准 L^AT_EX 安装中的一部分.

除了以上标准的 `.bst` 文件, 还有 10 个期刊特有的 `.bst` 可供使用. 使用这些 `.bst` 的介绍可参阅 <http://support.stmdocs.in>

12. 终稿打印

作者可以将待提交文档按照他们首选期刊的页面大小和边距进行排版. `elsarticle` 为同一个文件提供了 4 种文档选项. 但这并不意味着, 使用这些选项, 用户可以模拟最终打印副本的确切页面布局.



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<http://www.latexstudio.net>

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3p: 3+ 期刊的文字区域为 468pt × 622pt 或 16.45cm × 21.9cm 或 6.5in × 8.6in, 单栏样式.

twocolumn: 可以和 3p 选项一同使用, 如果期刊是 3+ 并与上述文字区域相同, 但它是双栏样式.

5p: 5+ 的文字区域是 522pt × 682pt 或 18.35cm × 24cm 或 7.22in × 9.45in, 仅有双栏.

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[单栏文章样例 – 点击这里]

[双栏文章样例 – 点击这里]



This is a specimen a_b title^{*,**}

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Abstract

In this work we demonstrate a_b the formation Y_1 of a new type of polariton on the interface between a cuprous oxide slab and a polystyrene micro-sphere placed on the slab. The evanescent field of the resonant whispering gallery mode (WGM) of the micro sphere has a substantial gradient, and therefore effectively couples with the quadrupole 1S excitons in cuprous oxide. This evanescent polariton has a long life-time, which is determined only by its excitonic and WGM component. The polariton lower branch has a well pronounced minimum. This suggests that this excitation is localized and can be utilized for possible BEC. The spatial coherence of the polariton can be improved by assembling the micro-spheres into a linear chain.

Keywords: quadrupole exciton, polariton, WGM, BEC

JEL: 71.35.-y, 71.35.Lk, 71.36.+c

1. Introduction

Although quadrupole excitons (QE) in cuprous oxide crystals are good candidates for BEC due to their narrow line-width and long life-time there are some factors impeding BEC [1, 2]. One of these factors is that due to the small but non negligible coupling to the photon bath, one must consider BEC of the corresponding mixed light-matter states called polaritons [3]. The photon-like part of the polariton has a large group velocity and tends to escape from the crystal. Thus,

*This document is the results of the research project funded by the National Science Foundation.

**The second title footnote which is a longer text matter to fill through the whole text width and overflow into another line in the footnotes area of the first page.

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Preprint submitted to Elsevier

June 8, 2018



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Theorem 1. *In this work we demonstrate the formation of a new type of polariton on the interface between a cuprous oxide slab and a polystyrene micro-sphere placed on the slab. The evanescent field of the resonant whispering gallery mode (WGM) of the micro sphere has a substantial gradient, and therefore effectively couples with the quadrupole 1S excitons in cuprous oxide. This evanescent polariton has a long life-time, which is determined only by its excitonic and WGM component. The polariton lower branch has a well pronounced minimum. This suggests that this excitation is localized and can be utilized for possible BEC. The spatial coherence of the polariton can be improved by assembling the micro-spheres into a linear chain.*

Therefore in this work we propose to prevent the polariton escaping by trapping it into a whispering gallery mode (WGM)⁴ of a polystyrene micro-sphere (PMS).

We develop a model which demonstrates formation of a strongly *localized* polariton-like quasi-particle. This quasi-particle is formed by the *resonant* interaction between the WGM in PMS and QE in the adjacent layer of cuprous oxide. The QE interacts with the *gradient* of the WGM evanescent field.

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⁴WGM occur at particular resonant wavelengths of light for a given dielectric sphere size. At these wavelengths, the light undergoes total internal reflection at the sphere surface and becomes trapped within the particle for timescales of the order of ns .