

**Capitalization
and Acronyms
in Physics**

Celia M. Elliott
Department of Physics
University of Illinois
cmelliot@illinois.edu

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Today we'll look at conventions for capitalization and the use of acronyms in technical writing.

The basic rules of capitalization—proper nouns are capitalized and common nouns are not—generally apply in science writing, except for some special cases. (There are *always* “special cases” in English and physics.) Today, we'll look at them.



**Adjectives taken from proper names
are capitalized, nouns are not**

Proper noun (name) used as an adjective en dash
Fermi energy or Fermi–Dirac statistics

**New class of things named after a person or place
(common nouns) are not capitalized**
fermion (particle), **fermi** (unit)

Capitalize only the proper noun in compound nouns
**Bohr radius, Avogadro’s number,
Debye temperature, Newtonian mechanics**

Noun exceptions:
Hamiltonian, Lagrangian

If a proper noun is used as an adjective, it’s *always* capitalized.

For *Hamiltonian* and *Lagrangian*, the “function” is implied but unstated, so the “adjective” rule still applies. These are the only two examples that I’ve been able to think of where a word derived from a proper noun is still capitalized when it’s used as a noun, but there are probably others. (Pesky mathematicians!)

Note that only the proper noun (name) is capitalized in a compound noun; the common noun is written lower case (e.g., Compton scattering)

If you’re not sure whether a word should be capitalized or written lower case, consult a scientific dictionary (I recommend *The Oxford Dictionary for Scientific Writers and Editors*) or the AIP Style Guide, Appendix B, (posted on the course website). You can buy a good used copy of the Oxford for about \$10.

An en dash (think of it as a super-hyphen) is used to join two proper nouns to make a combined adjective. We’ll talk more about dashes later in the semester.

**Units of measure are capitalized only
when they are abbreviated**



Examples: watt (W), joule (J), tesla (T), volt (V)

“Powers” follow the same rule

**megawatt (MW), terahertz (THz)
mega-electron-volt (MeV)**

Note: “kilo” (1000) is *never* capitalized:

kV, keV, kg, kA, kHz, k Ω , \$100k

And—abbreviations for units are always singular

45 mm, 10 GeV, 3.6×10^7 n s cm

Even though we think (and say) “45 millimeters” when we see “45 mm,” the unit is written as a singular.

And remember, the unit is always abbreviated when it is associated with an exact number (measured or calculated); it is written out as a word only when it refers to an approximate number. Thus: “7 kg” and “a few kilograms”

For more rules on writing numbers, see
<http://people.physics.illinois.edu/Celia/Lectures/Numbers.pdf>.

Names of elements are never capitalized when written as words, only when they are abbreviated



argon (Ar)

silicon (Si)

curium (Cm)

californium (Cf)

And while we're on the subject of elements...

^{60}C

mass number

$^{14}\text{N}_2$

number of atoms in molecule

Ca^{2+}

state of ionization

$^{110}\text{Ag}^m, ^{14}\text{N}^*$

excited state

In general, common nouns are not capitalized when they're written out as words, but the abbreviations are ALWAYS capitalized—whether they're units, elements, or acronyms.

Elements, even those derived from proper names (curium, francium), are always written lower case when they are written out as words. Only the abbreviations are capitalized, and just the first letter of the abbreviation is capitalized.

The notation shown for chemical elements is the convention adopted by the International Union of Pure and Applied Physics in the 1970s. While you'll see "He-3" written in older papers (and by older authors), use ^3He now.



**Particle names are always written
lower case**
quarks, muons, neutrinos

...even when they are derived from names
fermions, baryons

**...except when the proper name is used
as an adjective**
Higgs boson

Although not used much by physicists, the names of minerals are never capitalized either, e.g., dolomite, diamond, even when derived from a proper name (fosterite, smithsonite).



Theories are not capitalized
quantum chromodynamics
second law of thermodynamics
Einstein's theory of general relativity

Phenomena are not capitalized
sonoluminescence
superfluidity
Bose–Einstein condensation

**Experimental apparatus and techniques
are not capitalized**
scanning tunneling microscope
molecular beam epitaxy
Auger electron spectroscopy
↳ **except when it's somebody's name**

In these examples, “Einstein’s,” “Newton’s,” “Bose–Einstein,” and “Auger” *are* capitalized because they are proper nouns (names) used as adjectives.

Protected brand names are capitalized



tempered glass

Plexiglas

epoxy

Stycast

simulation software

Mathematica

**The trademark (™) or registered trademark (®)
symbol is not necessary; the capitalization alone
indicates that the name is a protected trade name**

If used, the trademark and registered trademark symbol appear immediately after the trade name (no spaces) and are superscripted.



Names of academic degrees are written lower case, except when abbreviated

**bachelor's degree (BS or BA)
doctorate (PhD or SciD)**

Names of academic disciplines are never capitalized (unless it's a proper noun)

**physics, chemical engineering, Japanese,
molecular biology, Scandinavian studies**

Names of courses are never capitalized (unless it's the title of a specific course [has a number])

a physics class, Physics 496

In keeping with current usage, periods are no longer recommended for the abbreviations for academic degrees (more about abbreviations soon).

In general, if a number is associated with the name of something, the resulting compound noun is considered a "title" and is capitalized.

Single words or phrases following a colon are not capitalized



“Values were obtained for two parameters: the quantum cyclotron radius and the Debye shielding radius.”

Full sentences may be capitalized

“The experimental results led to one conclusion: The fast electron mode represents an unloading of excess excitons formed during excitation.”

but they look kind of stupid—*cme*

I personally think colons are overused in scientific writing; many times they just provide an excuse for an unwieldy, run-on sentence or title. Colon surgery is highly recommended for such cases.

Lower case symbols and abbreviations are not capitalized in titles, headings, or the beginnings of sentences 

This title is okay—

New Mixed-Alkali Effect in the ac Conductivity of Ion-Conducting Glasses

This sentence is not—

ac conductivity measurements of ion-conducting glasses revealed a new mixed-alkali effect.

Recast it as—

Measurements of ac conductivity in ion-conducting glasses revealed a **previously unobserved* mixed-alkali effect.**

***The “effect” is probably not “new”; it’s likely been there all along—write precisely!**

Ms. P would quibble about this title on general principles, regardless of what is done with the abbreviation. Presumably the “effect” is not “new”—it’s probably been there since the glasses formed, but nobody ever looked before now. A more accurate title would be “Mixed-Alkali Effect Observed in ...”

Some common physics abbreviations are supposed to be written in lower case:

ac (alternating current)

bcc (body-centered-cubic)

cw (continuous-wave)

dc (direct current)

fcc (face-centered-cubic)

ir (infrared)

mp (melting point)

rf (radio-frequency)

rms (root-mean-square)

Consult the *AIP Style Guide* for a complete list of standard abbreviations.

We’ll talk more about abbreviations and acronyms later today.



Different journals have different rules for capitalizing words in a title

PRL: “Observation of Resonance Condensation of Fermionic Atom Pairs”

Phys. Rev. B: “Spin-orbit coupling and intrinsic spin mixing in quantum dots”

...even journals published by the same publisher!

No rational rules apply; just look 'em up.

There's no consistency, even among journals published by the same publisher!
Just look 'em up.

... and please AVOID ranDom CapiTaLiZation:

“Comments on Likelihood fits with Variable resolution”

Capitalize only the first word of the title (and proper nouns)

“Comments on likelihood fits **having variable resolution”**

“Comments on likelihood fits **using variable resolution”**

OR

Capitalize every word except prepositions (e.g., *in, with, from, by*), conjunctions (e.g., *and, or, but*), and articles (*a, an, the*)

“Comments on Likelihood Fits with Variable Resolution”

Double-check your titles for random capitalization. Either capitalize only the first word of the title (and proper nouns), or capitalize every word except prepositions (e.g., *in, with, from, by*), conjunctions (e.g., *and, or, but*), and articles (*a, an, the*).

Strive for witless consistency.



Which is which?

Abbreviation—shortened form of word

average = av const = constant

usually written lower case and without a terminal period (.) in physics

Acronym—pronounced as a word

NASA, MOSFET, LIGO

Initialism—pronounced letter-by-letter

STM, QCD, CMB

*“In this class, we use a lot of three-letter acronyms, or TLAs.”
—attributed to Dale Van Harlingen*

While purists make distinctions among abbreviations, acronyms, and initialisms, we'll just call them all acronyms for the purposes of this class.



Acronyms and initialisms (A&Is) must be defined at their first use

Spell out the words first, followed by the acronym in caps* in parentheses ()

Cosmic Background Imager (CBI)
density functional theory (DFT)
 $\text{Y}_2\text{Ba}_4\text{Cu}_3\text{O}_{7-x}$ (YBCO)

The American Institute of Physics (AIP) lists common physics acronyms that need not be defined

e.g., BCS, emf, NMR, dc, ir, DNA

***usually**

Tip: When in doubt, write it out!

You can make an acronym out of almost anything that functions as a noun or an adjective in a sentence. Generally, a compound noun or adjective-noun phrase must include at least three words to qualify for acronymization. However, you'll find some common two-word acronyms (e.g., ac, dc, rf) and some acronyms made out of single, very long words (e.g., magnetohydrodynamics [MHD]).

Some acronyms have become so widely used and recognized that they don't have to be defined at first use, but most do. Consult Oxford, *Scientific Style and Format*, or the *Chicago Manual of Style* to be sure.

When it doubt, write it out.

**A sentence may NOT begin with an acronym,
even if it has been previously defined**



**To image the surface of thin films of a
superconducting crystal, the group uses a low-
temperature scanning tunneling microscope
(STM) that they built at Illinois. STM
topographic images are correlated with X-ray
crystallographic data.**

While we're on the subject, a sentence may not begin with a symbol, chemical formula, equation, or number written in numerals, either.



Three ways to fix this sentence

Orig: “STM topographic images are correlated with X-ray crystallographic data.”

- 1. Write out “scanning tunneling microscope” again—wordy and redundant**
- 2. Add an article—“The STM topographic images...”**
- 3. Rearrange the sentence—“Topographic images obtained by STM are correlated with X-ray crystallographic data.”**

I personally prefer #3, because it emphasizes “topographic images”; the device used is probably of secondary importance.—*cme*

X-ray or x-ray?? Both are used in US English; just pick one and be consistent. British usage is X-ray.



Capitalize most A&Is

Some common A&Is are not capitalized
(q.v. *AIP Style Guide* for a complete list)

rpm	ir
ac	dc
rf	uv

**The spelled-out words are not capitalized, unless
the word is a proper name**

- magneto**hydrodynamics (MHD)
- atomic** force microscope (AFM)
- National** Academy of Sciences (NAS)
- Bose–Einstein** condensate (BEC)

Most, but not all, acronyms are capitalized. Consult the *AIP Style Guide* for the list; you'll find some surprises.

The spelled-out words that the acronym is made from are capitalized or written in lower case, depending on normal capitalization rules. So if the word is a proper noun, it's capitalized; if the word is a common noun or other part of speech (usually an adjective or adverb), it's written lower case.

The use of periods (.) in abbreviations is evolving



 **US usage has been* to put periods after one-word abbreviations (Dr., Ms.) but not after multi-word abbreviations**

APS, NASA, LIGO

 **British usage is just the opposite**

Dr, Ms, I.U.P.A.P., N.H.S.

As always, there are exceptions:

H.c., i.d.

***The CBE Manual for Authors, Editors, and Publishers, 6th ed., now recommends no periods, anywhere**

The *Chicago Manual of Style* and the *The CBE Manual for Authors, Editors, and Publishers*, 6th ed., now recommend no periods anywhere.

The *AIP Style Guide*, Appendix D, lists the exceptions to the “no periods” rule.

If you’re not sure, look it up.

If you’re sure, look it up anyway. You will learn humility.

Making acronyms plural? Just add an s



Do not use an apostrophe to make an acronym plural

AFMs, CD-ROMs, PMTs

While I'm on the subject, don't use an apostrophe to make numbers >9 plural, either expressed in 1000s, Boeing 767s

Do use apostrophes for plurals of single numbers or letters

1's and 0's, *p*'s and *q*'s

You can review the rules for writing numbers at
<http://people.physics.illinois.edu/Celia/Lectures/Numbers.pdf>.

**Select the article (*a* or *an*) by the *sound*
of the acronym it precedes**



Begins with a vowel *sound* → *an*
an STM

Begins with a consonant *sound* → *a*
a SQUID
a USDA-approved pesticide

What about Si (???)
a Si substrate
a silicon dioxide substrate
an SiO₂ substrate

How will your reader say the acronym to him- or herself when reading it?

What about acronyms in figure captions?



Figure 4. An image sequence from a dDAC experiment shows the growth of a dendritic ice-VI crystal in response to increasing compression. [1]

Good practice is to define all acronyms in captions, even if they've been previously defined in the text

Remember how scientists read papers. They usually look at the figures and captions **before** they read the text. Defining the acronym in the caption is particularly important for specialized acronyms that may be unfamiliar to the audience.

To recap...

Write whole words lower case*; capitalize abbreviations

Capitalize proper nouns when used as adjectives

Don't capitalize particles, theories, physical phenomena, apparatus and techniques*

Define acronyms at first use

Don't start a sentence with an acronym, symbol, or number written in numerals

Just add an s to make an acronym plural

When in doubt, write it out!



cmelliot@illinois.edu

<http://physics.illinois.edu/people/Celia/>

***unless it's a proper noun (name of a specific person, place, or thing)**

NOTES: