Scientific Writing in Astrophysics – Tips and Tricks

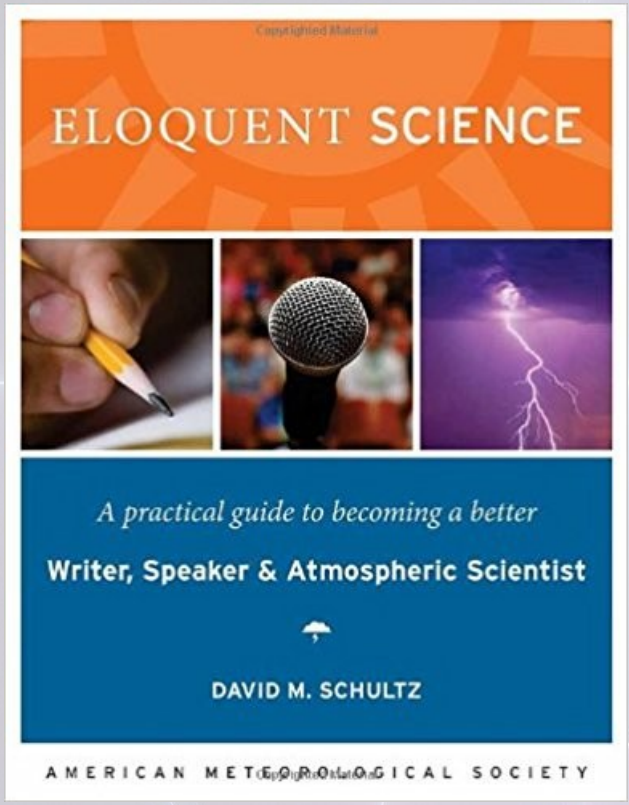
Dorottya Szécsi

Birmingham, 22 Nov. 2017

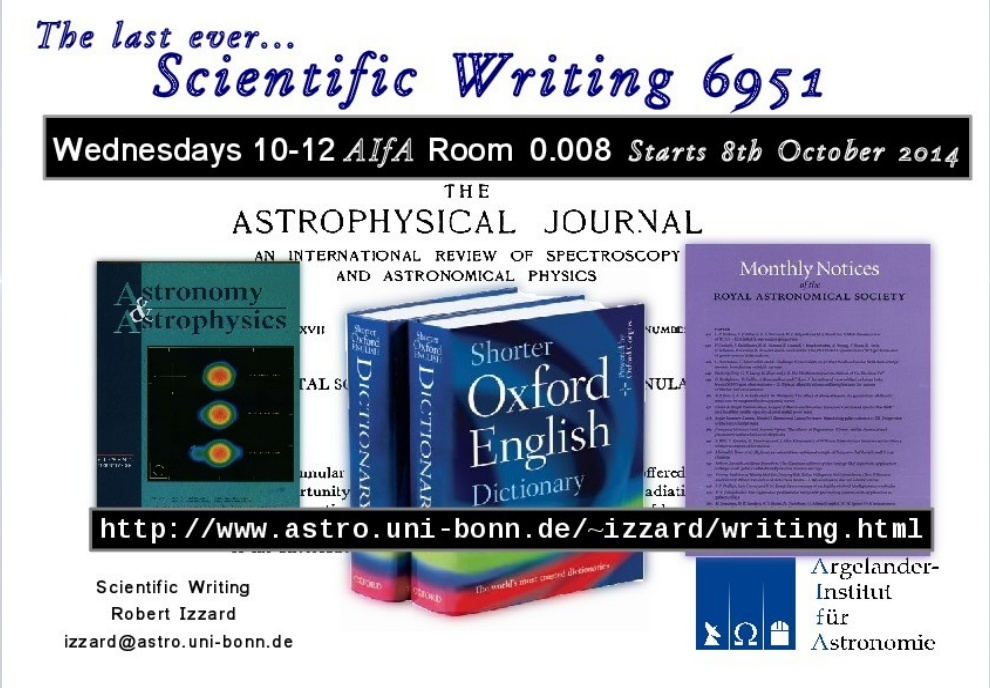
“Writing is linking up information in a logical, flowing manner.”

David M. Schultz

My Resources



Eloquent Science - A Practical Guide to Becoming a Better Writer, Speaker and Scientist – by **David M Schultz**



The Scientific Writing course of **Rob Izzard** (Bonn, 2014-ish)

Class/Book on Scientific Writing...

- **1 Some introduction**
- **2 Reading and the logical structure of articles**
- **3 Abstracts**
- **4 Before you start writing: planning, brainstorming**
- **5 The body of an article**
- **6 Figures, tables, equations.**
- **7 Language and Style 1: Sentences to paragraphs**
- **8 Language and Style 2: Verbs and punctuation**
- **9 Language and Style 3: Style, common mistakes**
- **10 Information sources, citations, plagiarism and ethics.**
- **11 Criticism and peer review**
- **12 Tools for writing, other topics, summary**

Class/Book on Scientific Writing...

- **1 Some introduction**
- **2 Reading and the logical structure of articles**
- **3 Abstracts**
- **4 Before you start writing: planning, brainstorming**
- **5 The body of an article**
- **6 Figures, tables, equations.**
- **7 Language and Style 1: Sentences to paragraphs**
- **8 Language and Style 2: Verbs and punctuation**
- **9 Language and Style 3: Style, common mistakes**
- **10 Information sources, citations, plagiarism and ethics.**
- **11 Criticism and peer review**
- **12 Tools for writing, other topics, summary**

Paragraphs

- One theme!
  - focused
  - coherent
- Topic sentence (1st sentence)
  - defines the theme
  - Tip: maybe write only 1st sentences first?
  - connects previous info to new info
- Stress sentence (last sentence)
  - new information to be emphasized

Paragraphs

- One theme!
  - focused
  - coherent
- Topic sentence (1st sentence)
  - defines the theme
  - Tip: maybe write only 1st sentences first?
  - connects previous info to new info
- Stress sentence (last sentence)
  - new information to be emphasized

Coherence

Coherence

1) by enumeration

Coherence

1) by enumeration

2) by transition (...)

Coherence

1) by enumeration

2) by transition (...)

3) by repetition

Coherence

1) by enumeration

2) by transition (...)

3) by repetition

This is because (1) massive stars rotate fast, and (2) they experience mass loss.

Examples are (i) supernovae, (ii) gamma-ray bursts and (iii) gravitational waves.

Listing the possible outcomes (?):

- ► *expansion*
- ► *re-bounce*
- ► *accelerated expansion*

Coherence

1) by enumeration

2) by transition (…)

3) by repetition

This is because (1) massive stars rotate fast, and (2) they experience mass loss.

Examples are (i) supernovae, (ii) gamma-ray bursts and (iii) gravitational waves.

Listing the possible outcomes (?):

- ► *expansion*
- ► *re-bounce*
- ► *accelerated expansion*

the “chain-rule”

Coherence by repetition: “chain-rule”

Coherence by repetition: “chain-rule”

The star’s iron core **collapses** and falls in due to **gravity**. One may recall that this is how the usual textbook-explanation of a (core-**collapse**) supernova explosion continues (Fryer 2004): the iron core gets denser and denser, and eventually a **proto neutron star (NS) forms** in the middle. The material that is still falling in suddenly **bounces** back from the surface of the **newly formed proto-NS**. The outward **bouncing** gives rise to a shock-wave which may reach the surface and produce an **emission** of photons. This **emission** is what we may observe as a supernova lightcurve. If the iron core was more massive than ~20 Msun, its self-**gravity** will very soon overcome the proto-NS’s internal pressure, creating a compact object with such a strong **gravitational** field that nothing, not even particles and electromagnetic radiation, can escape from it. A black hole is formed.

Coherence

1) by enumeration

2) by transition!

3) by repetition

Coherence by transition

Coherence by transition

- **Sequence**

  again, and, besides, then, further, **furthermore**, next, moreover, in addition, first, second, third, etc.; (a), (b), (c), etc.; 1), 2), 3), etc.; following this, subsequently, to enumerate, also, another, last, plus

- **Comparison and contrast**

  at the same time, on the contrary, in contrast, **nevertheless**, notwithstanding, nonetheless, conversely, like, unlike, even so, in the same way, as, unless, whether, though, even though, regardless, irrespective, otherwise, in comparison to, even when, to the contrary, but, or, nor, yet, inasmuch, contrary to, comparing, alternatively, rather, despite, ironically

- **Examples**

  for example, for instance, in the case of, in general, especially, if, specifically, **in particular**, generally, on this occasion, in this situation, to illustrate, to demonstrate, as an illustration, as a demonstration, unless, such as, provided that, once again, another example, a further example, a further complication, in such cases, in this way, in some of these cases, for these reasons, one way, another way, as discussed, using, particularly, that is, more specifically, except

- **Time**

  while, since, simultaneously, presently, meanwhile, thereafter, thereupon, afterwards, at the same time, next, sometimes, in the meantime, eventually, **following this**, later, usually, occasionally, concurrently, preceding this, as, presently, at the time of this writing, often, rarely, throughout, by, at, during, continuing

- **Cause and effect**

  therefore, thus, consequently, as a consequence, for this reason, hence, accordingly, because, due to, in spite of, despite

- **Emphasis**

  surprisingly, **indeed**, interestingly, curiously, in fact, of course, naturally, evidently, certainly, clearly, obviously, apparently, fortunately, especially, significantly, perhaps, from my perspective, if possible, if so, basically, in reality, essentially

- **Concluding**

  finally, therefore, in summary, to conclude, in conclusion, **to summarize**, as I have shown, hence, thus, in other words, as said earlier, in any case, as a result, at least, as mentioned above, as said previously, thereby, in the present article, simply put

Coherence by transition

The challenge with low-metallicity massive stars is, **however**, that it is hard observe them directly as individual objects. There are individual detections only down to 0.1 Z_sun. **But** at metallicities below 0.1 Z_sun, there are no direct observations of individual massive stars. **Although** such stars might have been contributing to our Galaxy's chemical composition in the past, **even so**, they do not exist here anymore.

It has been suggested **therefore** to look at local star-forming dwarf galaxies with low-metallicity. **Still**, even in dwarf galaxies it is hard to resolve massive stars individually since they are embedded in dense and gaseous OB-associations. What we may be able to observe in these environments, is the combined effect of *populations* of massive stars.

The scientific potential of understanding massive stars at low-metallicity is **nonetheless** high. (And here I shall explain why... etc.)

Length of paragraphs?

- 4-8 sentence
- shorter: emphasis
- longer: split it up! :)

Length of sentences?

- rhythm...

- rhythm…

"Vary your sentence length. In technical writing there is often the temptation, even amongst the best writers, to include long, convoluted sentences in order to fully describe a complicated idea and include all the relevant details, but these can be hard to read, both because of the complexity of their structure, which may require significant mental effort to unpack, and because by the time they finally conclude, the reader has forgotten the initial topic of the over-long, rambling sentence. Brevity gives impact. Shorter sentences are easier to understand. Breaking up your ideas helps the reader. Short sentences also get boring. They seem repetitive. They are tiring to read. They can send your reader to sleep. It is, therefore, better to have a range of sentence lengths. Include some short. In addition to these, have some longer sentences, as these allow you to join up your ideas."

Christopher Berry
https://cplberry.com/2014/10/26/right-good/

- rhythm...

Whenever you can start a new sentence, you should.

Whenever you can start a new sentence, you should.

Class/Book on Scientific Writing...

- **1 Some introduction**
- **2 Reading and the logical structure of articles**
- **3 Abstracts**
- **4 Before you start writing: planning, brainstorming**
- **5 The body of an article**
- **6 Figures, tables, equations.**
- **7 Language and Style 1: Sentences to paragraphs**
- **8 Language and Style 2: Verbs and punctuation**
- **9 Language and Style 3: Style, common mistakes**
- **10 Information sources, citations, plagiarism and ethics.**
- **11 Criticism and peer review**
- **12 Tools for writing, other topics, summary**

Common mystakes

As far as xyz is concerned	As for xyz
At an early date	Soon
At the present time	Now
Attention is called	*Meaningless*
Cannot be overemphasized	
The reason was because	Because
By means of	By
In order to	To
of a serious nature	serious
red in colour	red
repeated again and again	repeated
In most cases	Mostly
In the vicinity of	Near
It was evident that	Evidently
As to whether	Whether
is suggestive of	suggests

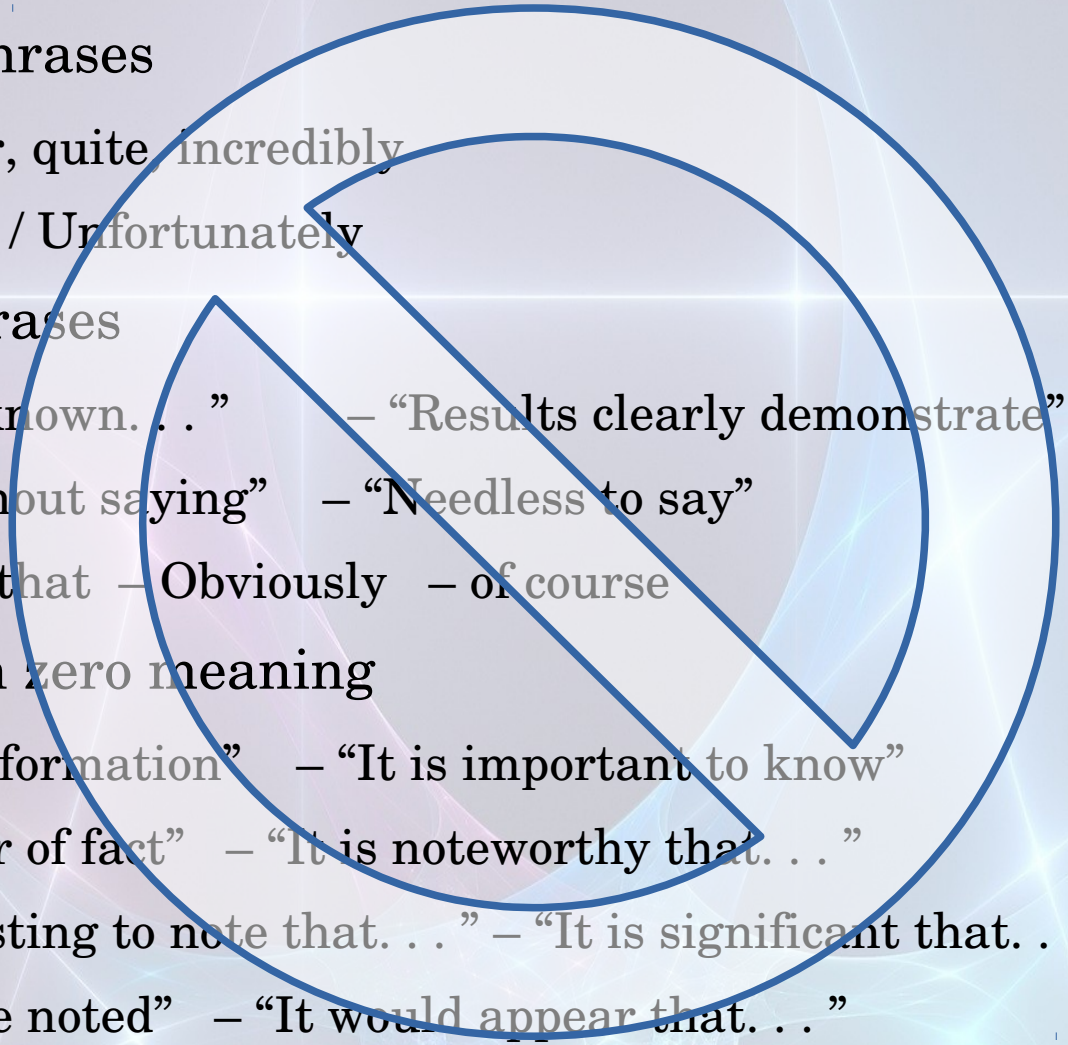
Common mistakes

As far as xyz is concerned	As for xyz
At an early date	Soon
At the present time	Now
Attention is called	*Meaningless*
Cannot be overemphasized	
The reason was because	Because
By means of	By
In order to	To
of a serious nature	serious
red in colour	red
repeated again and again	repeated
In most cases	Mostly
In the vicinity of	Near
It was evident that	Evidently
As to whether	Whether
is suggestive of	suggests

Useless phrases

- Subjective phrases
  - Very, rather, quite, incredibly
  - Fortunately / Unfortunately
- Arrogant phrases
  - “As is well known. . . ” – “Results clearly demonstrate”
  - “It goes without saying” – “Needless to say”
  - It is known that – Obviously – of course
- Phrases with zero meaning
  - “For your information” – “It is important to know”
  - “As a matter of fact” – “It is noteworthy that. . . ”
  - “It is interesting to note that. . . ” – “It is significant that. . . ”
  - “It should be noted” – “It would appear that. . . ”

Useless phrases



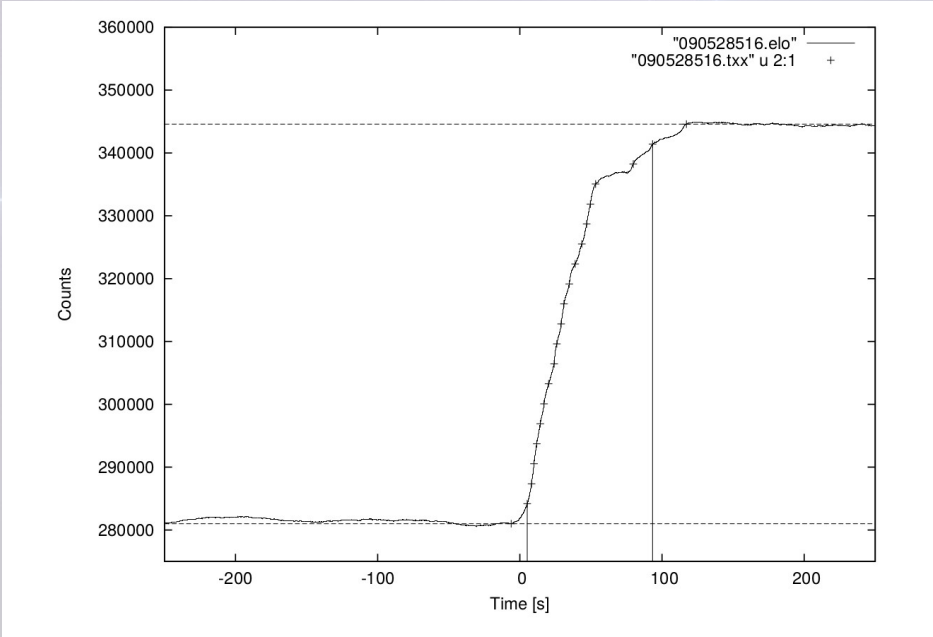
- Subjective phrases
  - Very, rather, quite, incredibly
  - Fortunately / Unfortunately
- Arrogant phrases
  - "As is well known. . . " – "Results clearly demonstrate"
  - "It goes without saying" – "Needless to say"
  - It is known that – Obviously – of course
- Phrases with zero meaning
  - "For your information" – "It is important to know"
  - "As a matter of fact" – "It is noteworthy that. . . "
  - "It is interesting to note that. . . " – "It is significant that. . . "
  - "It should be noted" – "It would appear that. . . "

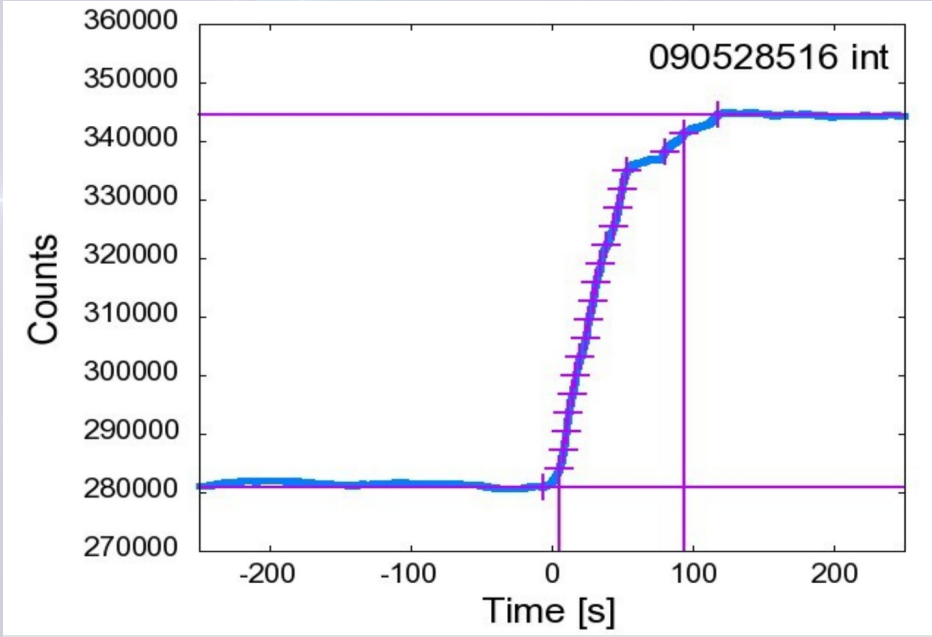
Useless phrases

- Subjective phrases
  - Very, rather, quite, incredibly
  - Fortunately / Unfortunately
- Arrogant phrases
  - "As is well known. . . " – "Results clearly demonstrate"
  - "It goes without saying" – "Needless to say"
  - It is known that – Obviously – of course
- Phrases with zero meaning
  - "For your information" – "It is important to know"
  - "As a matter of fact" – "It is noteworthy that. . . "
  - "It is interesting to note that. . . " – "It is significant that. . . "
  - "It should be noted" – "It would appear that. . . "

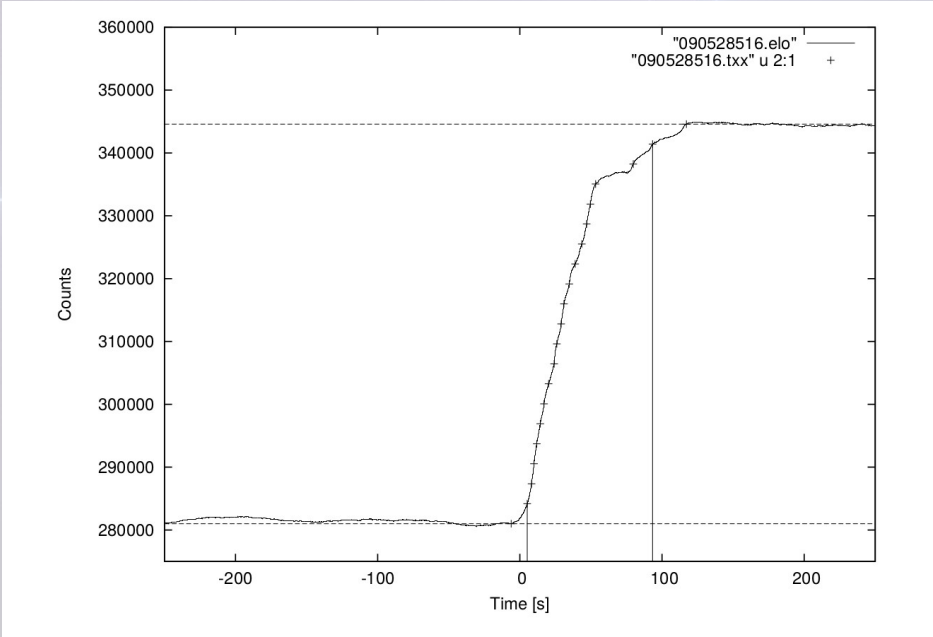
*A&A encourages authors to avoid directly addressing the reader. For example, "**Note that**" can be deleted completely or replaced with "**We note that**".*

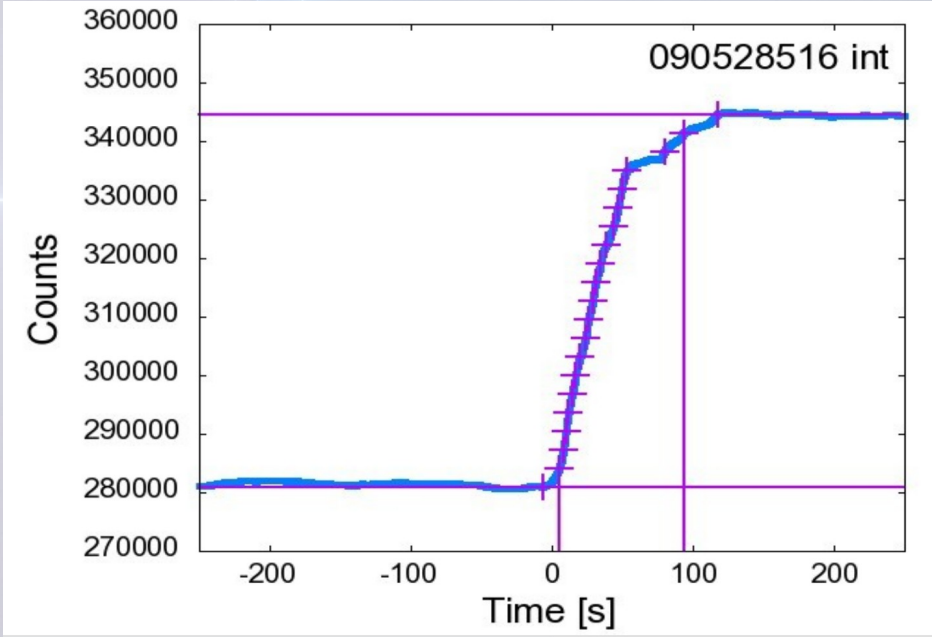
Can you spot the difference? ☺





Can you spot the difference? ☺





Please make the font **LARGE**!

The challenge with low-metallicity massive stars is, **however**, that it is hard observe them directly as individual objects. There are individual detections only down to 0.1 Z_sun. **But** at metallicities below 0.1 Z_sun, there are no direct observations of individual massive stars. **Although** such stars might have been contributing to our Galaxy's chemical composition in the past, **even so**, they do not exist in our Galaxy anymore.

It has been suggested **therefore** to look at local star-forming dwarf galaxies with low-metallicity. **Still**, even in dwarf galaxies it is hard to resolve massive stars individually since they are embedded in dense and gaseous OB-associations. What we may be able to observe in dwarf galaxies at metallicities below 0.1 Z_sun, is the combined effect of *populations* of massive stars.

The scientific potential of understanding massive stars at low-metallicity is **nonetheless** high. (And here I shall explain why... etc.)

References!

The challenge with low-metallicity massive stars is, **however**, that it is hard observe them directly as individual objects. There are individual detections only down to 0.1 Z_sun. **But** at metallicities below 0.1 Z_sun, there are no direct observations of individual massive stars. **Although** such stars might have been contributing to our Galaxy's chemical composition in the past, **even so**, they do not exist in our Galaxy anymore.

It has been suggested **therefore** to look at local star-forming dwarf galaxies with low-metallicity. **Still**, even in dwarf galaxies it is hard to resolve massive stars individually since they are embedded in dense and gaseous OB-associations. What we may be able to observe in dwarf galaxies at metallicities below 0.1 Z_sun, is the combined effect of *populations* of massive stars.

The scientific potential of understanding massive stars at low-metallicity is **nonetheless** high. (And here I shall explain why... etc.)

References!

The challenge with low-metallicity massive stars, however, that it is hard observe them directly as individual objects. We have individual detections only down to 0.1 Z_sun. **But** at metallicities below 0.1 Z_sun, there are no direct observations of individual massive stars. **Although** such stars might have been contributing to our Galaxy's chemical composition in the past, **even so**, they do not exist in our Galaxy anymore.

Reference!

It has been suggested **therefore** to look at local star-forming dwarf galaxies with low-metallicity. **Still**, even in dwarf galaxies it is hard to resolve massive stars individually since they are embedded in dense and gaseous OB-associations. What we may be able to observe in dwarf galaxies at metallicities below 0.1 Z_sun, is the combined effect of *populations* of massive stars.

The scientific potential of understanding massive stars at low-metallicity is **nonetheless** high. (And here I shall explain why... etc.)

References!

The challenge with low-metallicity massive s…ver, that it is hard observe them directly as individual o…re individual detections only down to 0.1 Z_sun. **But** at metallicities below 0.1 Z_sun, there are no direct observati…al massive stars. **Although** such stars might ha…buting to our Galaxy's chemical composition in the past, **even so**, they do not exist in our Galaxy anymore.

Reference!

Reference!

It has been suggested **therefore** to look at local star-forming dwarf galaxies with low-metallicity. **Still**, even in dwarf galaxies it is hard to resolve massive stars individually since they are embedded in dense and gaseous OB-associations. What we may be able to observe in dwarf galaxies at metallicities below 0.1 Z_sun, is the combined effect of *populations* of massive stars.

The scientific potential of understanding massive stars at low-metallicity is **nonetheless** high. (And here I shall explain why... etc.)

References!

The challenge with low-metallicity massive s… …ver, that it is hard observe them directly as individual o… …are individual detections only down to 0.1 Z_sun. But at metallicities below 0.1 Z_sun, there are no direct observati… …al massive stars. Although such stars might ha… …buting to our Galaxy's chemical composition in the past, even so, they do not exist in our Galaxy anymore.

Reference!

Reference!

Reference!

It has been suggested therefo… …look at local star-forming dwarf galaxies with low-metallicity. Still, even in dwarf galaxies it is hard to resolve massive stars individually since they are embedded in dense and gaseous OB-associations. What we may be able to observe in dwarf galaxies at metallicities below 0.1 Z_sun, is the combined effect of *populations* of massive stars.

The scientific potential of understanding massive stars at low-metallicity is nonetheless high. (And here I shall explain why... etc.)

References!

The challenge with low-metallicity massive s…ever, that it is hard observe them directly as individual o…are individual detections only down to 0.1 Z_sun. **But** at metallicities below 0.1 Z_sun, there are no direct observati…al massive stars. **Although** such stars might ha…buting to our Galaxy's chemical composition in the past, **even so**, they do not exist in our Galaxy anymore.

Reference!

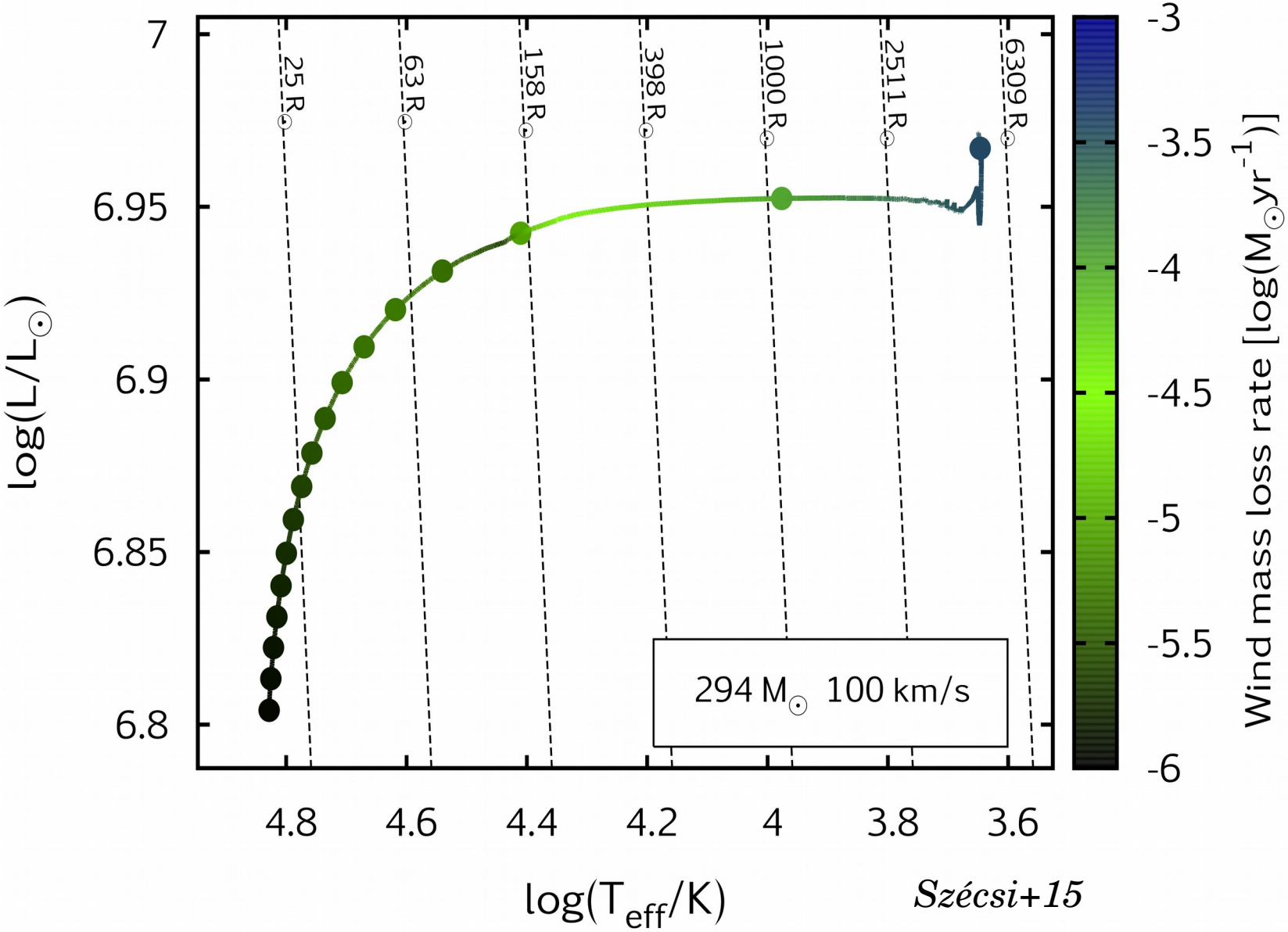
Reference!

It has been suggested **therefo**…look at local star-forming dwarf galaxies with low-metallicity. **Still**, even in dwarf galaxies it is hard to resolve massive stars individually since they are embedded in dense and gaseous OB-associations. What we may be able to observe in dwarf galaxies at …below 0.1 Z_sun, is the combined effect of *populations* …ars.

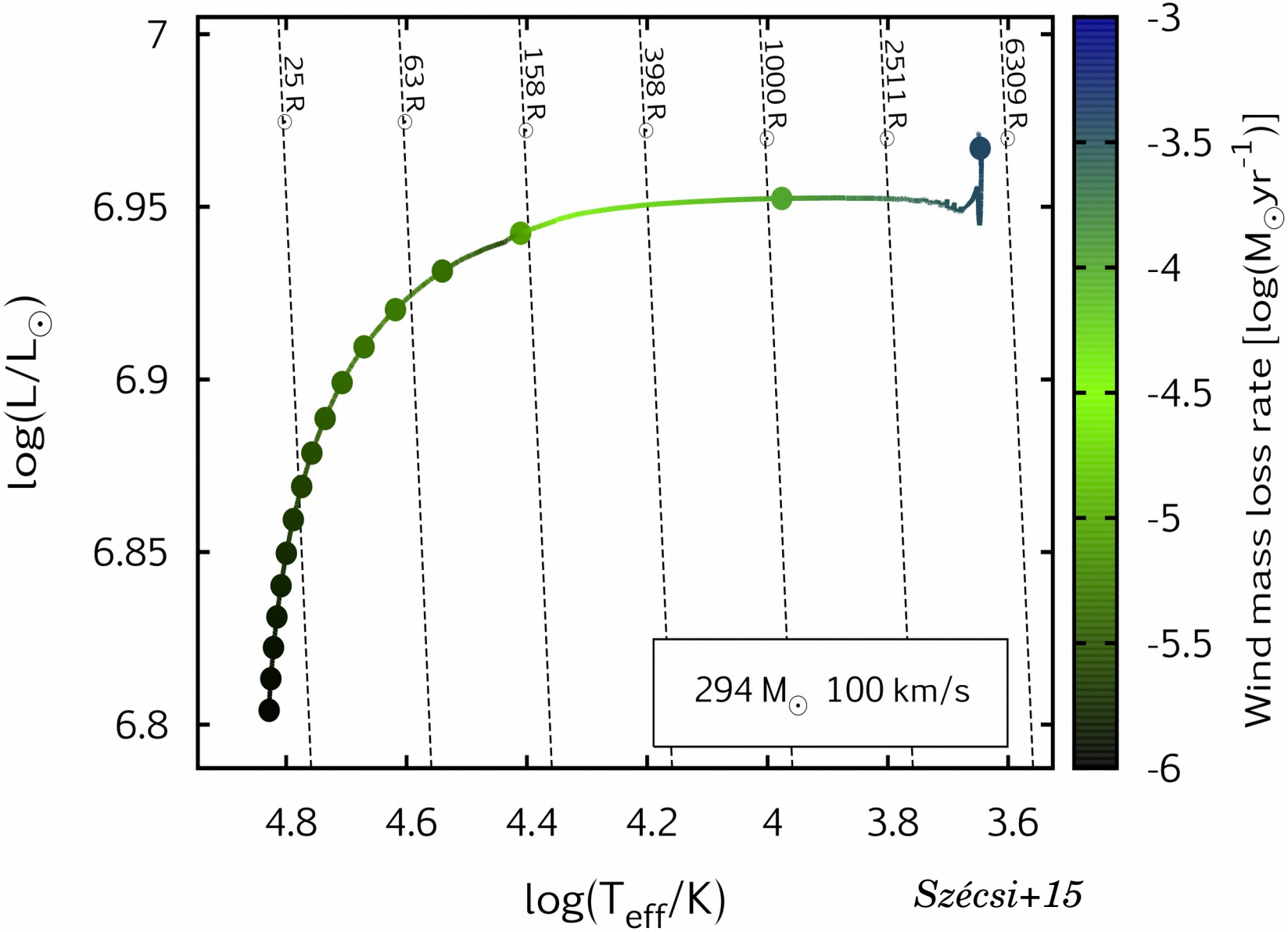
Reference!

The scientific potential of understanding massive stars at low-metallicity is **nonetheless** high. (And here I shall explain why... etc.)

Exercise #1: Figure caption

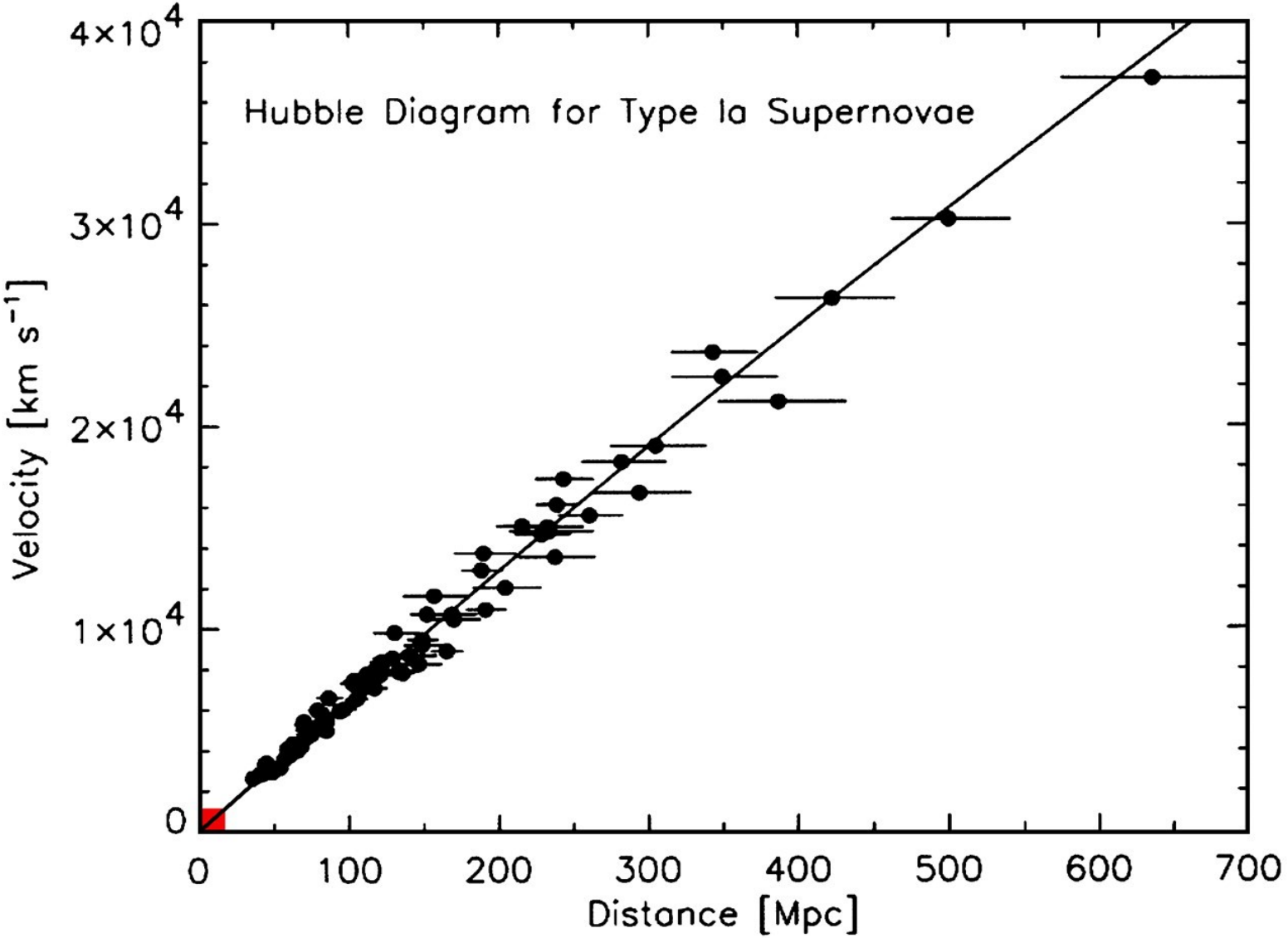


Exercise #1: Figure caption



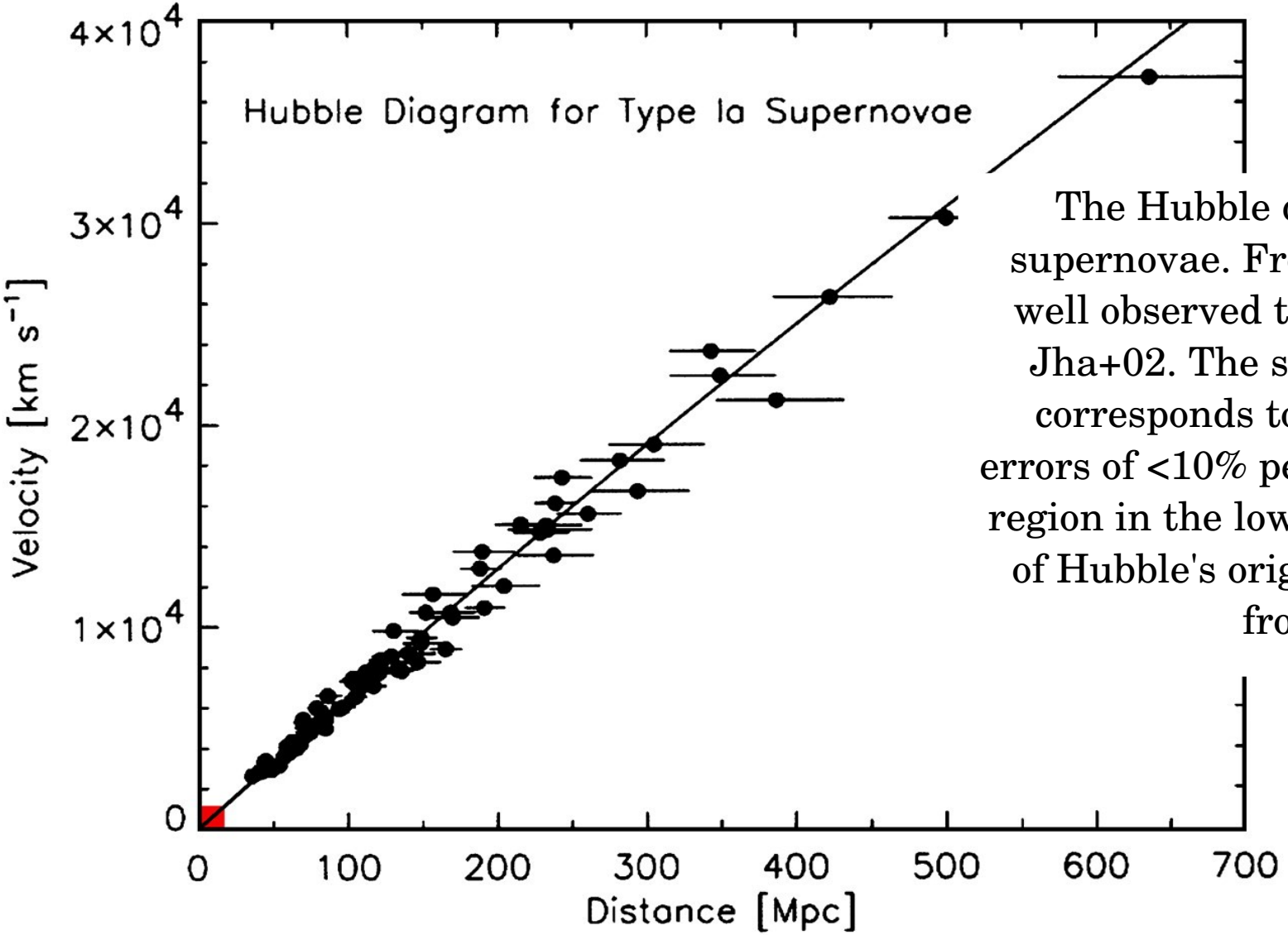
Evolutionary track of a stellar model with M=294 Msun and v=100 km/s in the HR diagram. Dots mark every 10^5 years of evolution. The stellar wind mass-loss rate is colour coded; black dashed lines of constant radii are labelled according to their radius value.
The star becomes a cool supergiant during the last 15% of its main-sequence evolution.

Exercise #2: Another figure caption



Kirshner'04

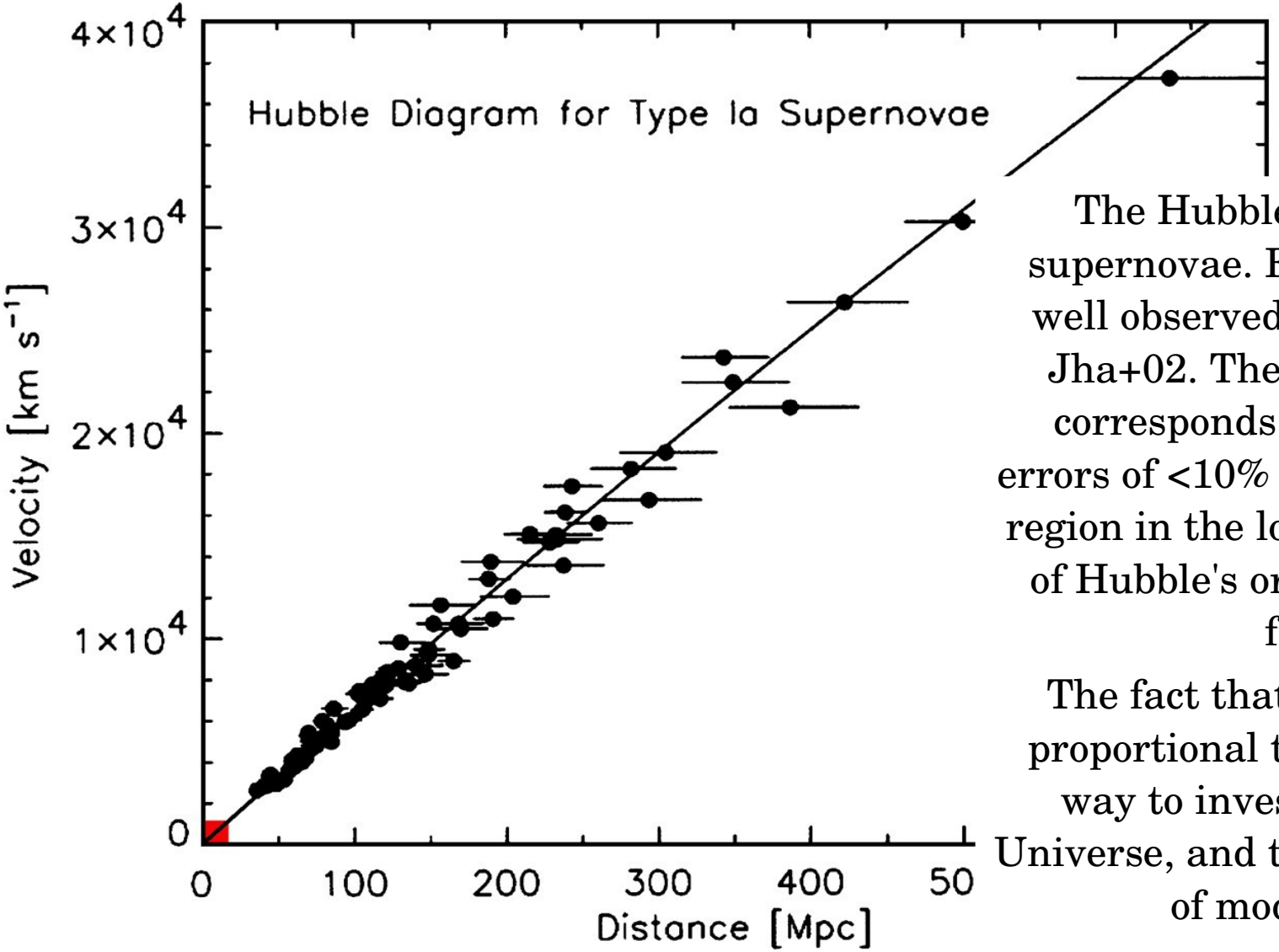
Exercise #2: Another figure caption



Kirshner'04

The Hubble diagram for type Ia supernovae. From the compilation of well observed type Ia supernovae by Jha+02. The scatter about the line corresponds to statistical distance errors of <10% per object. The small red region in the lower left marks the span of Hubble's original Hubble diagram from 1929.

Exercise #2: Another figure caption



Kirshner'04

The Hubble diagram for type Ia supernovae. From the compilation of well observed type Ia supernovae by Jha+02. The scatter about the line corresponds to statistical distance errors of <10% per object. The small red region in the lower left marks the span of Hubble's original Hubble diagram from 1929.

The fact that a galaxy's distance is proportional to its redshift opens the way to investigate the expanding Universe, and thus constitutes the basis of modern cosmology.

Tips:

Guide your reader.

Anticipate how your audience will interpret your writing.

Tips:

Guide your reader.

Anticipate how your audience will interpret your writing.

THANK YOU!