What Makes the Atmospheric Window Work Is Not Its Width but Its Position

— At 288 K the Wien peak of blackbody radiation is at 10.061708 μm, only 0.438292 μm from the centre of the window (8 to 13 μm) — the separator is whether one asks about the width of the window or its overlap with the peak — [Paper 829]

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— From thinking to syncing. —

Abstract

The infrared "atmospheric window" is explained as a band where absorbing molecules have few lines.This paper counts, as shares of blackbody radiation, that what makes it work is its position rather than its width.No new theorem or law is claimed. First, the peak of surface radiation lies inside the window——at 288 K it is at 10.061708 μm, 0.438292 μm from the window's centre at 10.5 μm (Section 2). **Second, and this is the core. A band 5 μm wide passes three tenths of the radiation——8 to 13 μm passes 0.311640** (Section 2). **Third, that is more than its neighbours——1.658521 times the 0.187903 of 13 to 17 μm and 2.610675 times the 0.119371 of 4 to 8 μm** (Section 3). **Fourth, it keeps working as the temperature moves——0.270310 at 255 K with the peak at 11.363812 μm and 0.329209 at 310 K with the peak at 9.347651 μm** (Section 3). **Fifth, so "the window is wide" is not the main reason——a band of similar width away from the peak passes only 0.119371** (Section 3). **Sixth, the separator is whether one asks about width or about overlap with the peak——move the position and the same width passes less than half as much** (Section 4). **Keywords**: atmospheric window, blackbody radiation, Wien's displacement law, wavelength band, share, position.

Scope of this paper (scope note): **No new theorem or law is claimed——Planck's law, Wien's displacement law and the naming of 8 to 13 μm as the atmospheric window are all known.Counted as a blackbody——the surface emissivity is taken as 1; differences between land and sea are not included.Absorption is not discussed——the positions and strengths of water-vapour and carbon-dioxide lines, and the continuum, are not treated; the edges at 8 and 13 μm are a representative cut.No radiative transfer——layers of atmosphere, clouds and scattering are not included.Climate is not argued——only shares by band are counted; changes in climate are not entered.Relation to earlier papers**: **Paper 788 showed that incoming and outgoing light part at 4.245712 μm and that the dividing line does not depend on the choice of variable——this paper stands beside it: there the parting of two radiations, here the overlap of the outgoing peak with the window.Paper 222 showed that the Sun peaks in the green, the orange and the infrared——that warning about the peak moving with the choice of variable applies here too, so everything is counted per wavelength.Paper 300 showed that whether two things share a root is decidable——"wide" and "overlapping the peak" are distinct roots.**What is added is **counting the window's share as 0.311640**, **measuring the ratios 1.658521 and 2.610675 against neighbouring bands**, **showing the share staying between 0.270310 and 0.329209 from 255 to 310 K**, and **placing the separator on width versus position**.

1. Notation and the Question

Setting: **a blackbody at temperature T radiates per wavelength according to Planck's law, and the whole integral is σT^4.**

$$B_\lambda(T) = \frac{2\pi hc^2}{\lambda^5}\frac{1}{e^{hc/\lambda k_B T}-1}, \qquad \int_0^\infty B_\lambda \, d\lambda = \sigma T^4$$

The share passing a band $[\lambda_1, \lambda_2]$ is the ratio of these integrals.Wien's law puts the peak at $2.897772 \times 10^{-3}/T$.

Question: **does the atmospheric window work because of its width or because of its position?**

2. The Peak and the Window

Computation 2.1: **at 288 K, the peak and the share were computed.**

measured	value
Wien peak	**10.061708** μm
distance from the window's centre at **10.5** μm	**0.438292** μm
share passing the window	**0.311640**

Observation 2.2

this is the core. A band 5 µm wide passes three tenths.The peak sits near the middle of the window——the same width away from the peak would pass less.

3. Neighbours, and Moving the Temperature

Computation 3.1: **three bands were compared at 288 K.**

band	share	window / band
8--13 µm (the window)	**0.311640**	**1**
13--17 µm	**0.187903**	**1.658521**
4--8 µm	**0.119371**	**2.610675**

Computation 3.2: **the temperature was varied.**

temperature	Wien peak	share passing the window
255 K	**11.363812** µm	**0.270310**
288 K	**10.061708** µm	**0.311640**
310 K	**9.347651** µm	**0.329209**

Observation 3.3

it keeps working as the temperature moves.From 255 to 310 K the peak runs from 11.363812 to 9.347651 µm while the share stays between 0.270310 and 0.329209——over the range of temperatures a surface can take, the peak does not leave the window.

4. The Separator

> **Observation 4.1**
>
> **the separator is whether one asks about width or about overlap with the peak.The band 4 to 8 µm is 4 µm wide yet passes only 0.119371, one 2.610675th of the window——at a similar width, a different position passes less than half as much.**

> **Observation 4.2**
>
> **placed beside Papers 788, 222 and 300.Paper 788 showed that incoming and outgoing light part at 4.245712 µm independently of the choice of variable——the window here lies on the outgoing side of that parting.Paper 222 showed the Sun's peak moving with the choice of variable——so everything here is counted per wavelength.Paper 300 showed that sharing a root is decidable——"wide" and "overlapping the peak" are distinct roots.**

> **Observation 4.3**
>
> **what is not said.Absorption lines, radiative transfer, clouds and climate are not treated——what is shown is that the value of a band is set by its position.**

5. Census and Closing

1. **peak 10.061708 µm at 288 K** (Computation 2.1): **inside the window.**
2. **0.438292 µm from the centre** (Computation 2.1): **near the middle.**
3. **share 0.311640** (Computation 2.1): **the core; three tenths in 5 µm.**
4. **13–17 µm: 0.187903** (Computation 3.1): **the neighbour.**
5. **ratio 1.658521** (Computation 3.1): **the window passes more.**
6. **4–8 µm: 0.119371** (Computation 3.1): **a similar width.**
7. **ratio 2.610675** (Computation 3.1): **position halves it.**
8. **0.270310 at 255 K** (Computation 3.2): **peak 11.363812 µm.**
9. **0.329209 at 310 K** (Computation 3.2): **peak 9.347651 µm.**

10. **width or position** (Observation 4.1): **the separator; Papers 788, 222, 300.**

Closing: **What makes the atmospheric window work is not its width but its position.At 288 K the Wien peak is at 10.061708 µm, only 0.438292 µm from the window's centre, and a band 5 µm wide passes 0.311640 of the radiation——because the peak sits inside it.The neighbouring 13 to 17 µm passes 0.187903 (one 1.658521th) and 4 to 8 µm passes 0.119371 (one 2.610675th), so a similar width in a different place passes less than half as much——and moving the temperature from 255 to 310 K leaves the share between 0.270310 and 0.329209.The separator is whether one asks about the width of the window or its overlap with the peak.Placed among the earlier papers——standing on the outgoing side of Paper 788's parting, following Paper 222's warning by counting per wavelength, and keeping Paper 300's discipline between width and position.To be honest——these are blackbody shares, with neither absorption lines nor radiative transfer included.**

References

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