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Photon Absorption, Emission, Reflection, Extinction, and Transmission in Matter: A Classical Reappraisal Under AND Theory

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Abstract: ***This work presents a unified, physically grounded reinterpretation of light–matter interaction phenomena — absorption, emission, reflection, transmission, and extinction — through the framework of Augmented Newtonian Dynamics (AND). Departing from probabilistic and field-based quantum descriptions, AND theory proposes that photons are real, discrete entities interacting with electrons in matter via time-bound, mechanically governed processes. Electrons do not permanently absorb photons; rather, they engage in a rapid cycle of absorption followed by recoil and elastic re-emission, maintaining energy continuity and directional coherence. This mechanism accounts for the colour of objects, the transmission of light through transparent media, and its extinction in opaque substances where elastic passage is not feasible. Reflection is interpreted in keeping with classical laws, as the result of electron recoil occurring at specific angles, conserving momentum and preserving the incoming photon's energy and frequency. Emission is not spontaneous or random but arises from well-defined energy exchanges, with recoil effects that obey Newtonian action–reaction principles. Finally, extinction is treated not as a loss of the photon per se, but as a redistribution of its energy into thermal motion via inelastic encounters. By aligning with core classical principles — conservation of energy, momentum, and quantized photon energy (E = hν) — this approach offers a consistent and intuitively accessible model of light behavior, eliminating the need for metaphysical constructs and reinforcing the explanatory power of classical physics extended by virtual photon dynamics.***

Keywords: Augmented Newtonian Dynamics (AND), photon-electron interaction, light transmission, photon extinction, elastic scattering, photon absorption, photon emission, reflection, virtual photon aether, classical physics, energy conservation, recoil dynamics, transparent media, opaque materials, real photons, electromagnetic propagation.

1. Introduction

The interaction of photons with matter lies at the heart of many physical phenomena, including optics, atomic transitions, and thermal radiation. The conventional quantum mechanical approach models these processes through probabilistic interpretations involving discrete energy levels, wavefunction collapse, and operator formalism. However, the explanatory gap between physical intuition and abstract mathematical models has remained an issue of philosophical and practical concern. In this paper, we present a classical reinterpretation rooted in the (Augmented Newtonian Dynamics) AND theory, which proposes a continuous, causally traceable photon–electron interaction mediated through a virtual photon field.

To provide a consistent foundation, we begin with a historical reappraisal of angular momentum quantization, showing how early quantum assumptions, originally introduced *ad hoc*, can be deduced classically through energy conservation and frequency matching. This sets the stage for AND theory's reformulation of photon absorption, emission, and transmission.

2. Revisiting Orbital Quantization

The concept of orbital quantization marked a pivotal shift in the understanding of atomic structure, forming the bridge between classical mechanics and early quantum theory. While the notion was instrumental in explaining discrete spectral lines and atomic stability, its origins were largely heuristic, relying on imposed rules rather than derivations from first principles. In this section, we reassess the development of orbital quantization through a classical lens, tracing its emergence from empirical observations to its reinterpretation within the AND framework. The goal is to uncover whether quantization arises naturally from classical dynamics when guided by energy-frequency considerations.

2.1 Classical Conflict and the Emergence of Quantization

Bohr's early atomic model (1913) was built to explain the discrete spectral lines observed in hydrogen. By assuming that an electron revolves around a positively charged nucleus under Coulomb attraction, classical mechanics gives the centripetal force condition:

$$\frac{e^2}{4\pi\varepsilon_0 r^2} = \frac{m \times v^2}{r} \tag{1}$$

Solving for the electron's kinetic energy:

$$E_k = \frac{1}{2} m_e v^2 \tag{2}$$

The corresponding potential energy is:

$$E_p = -e^2 4\pi\varepsilon_0 r \tag{3}$$

Hence, the total mechanical energy of the electron is:

$$\frac{e^2}{8\pi\omega_0 r} E = E_k + E_p = -\frac{e^2}{8\pi\omega_0 r} \tag{4}$$

This shows the electron's energy is inversely proportional to its orbital radius. Without additional constraints, all values of r are allowed, implying a continuous energy spectrum — contrary to the observed quantized spectra.

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2.2 Bohr's Postulate

To resolve this, Bohr postulated that the electron's angular momentum is quantized:

$$L = m_{evr} = nh \qquad n = 1, 2, 3, \ldots \tag{5}$$

Though effective, this was introduced without classical justification. Earlier, Haas (1910) attempted to connect atomic structure to Planck's quantization by treating the atom as a harmonic oscillator, yielding:

$$r_0 = \frac{h^2}{2e^2 m_e} \tag{6}$$

This applied only to the ground state and relied on classical analogies.

2.3 Rotational Quantization and insight

Bjerrum considered quantized rotational energy as:

$$\frac{1}{2}I\omega^2 = \frac{1}{2}(2\pi f)^2 = nhf, (n = 1,2,3 \ldots) \tag{7}$$

Later refined to:

$$\frac{1}{2}I\omega^2 = \frac{1}{2}nhf \tag{8}$$

where I is the moment of inertia and f is the rotational frequency. Using L = Iω, this leads to:

$$L = n\hbar \tag{9}$$

Thus, quantized angular momentum appeared in different contexts as a consequence of energy–frequency relationships.

2.4. Classical Derivation of Angular Momentum Quantization

The total energy of an electron in circular orbit is:

$$E = \frac{1}{2}m_e v^2 \tag{10}$$

Using v = 2πfr, where f is the orbital frequency:

$$E = 2\pi^2 m_e r^2 f^2 z \tag{11}$$

Differentiating with respect to f:

$$\frac{dE}{df} = 4\pi^2 m_e r^2 f = 2\pi L \tag{12}$$

Since $L = m_e vr = 2\pi m_e r^2 f$ compare with Planck's radiation:

$$E = nhv \Rightarrow \frac{dE}{dv} = nh \tag{13}$$

Assuming $f = v$, equating (12) and (13):

$$2\pi L = nh \Rightarrow L = nh \tag{14}$$

This classical derivation aligns with AND theory, which views electron motion as maintaining resonance or orbital stability through continuous energy exchange with the photon field.

2.5 Implications for AND Theory

AND theory presents a clear, classical reinterpretation of light–matter interactions, grounded in real photon exchange and the presence of a pervasive virtual photon field — understood here as a reinterpretation of dark matter. In this view, electrons regulate their internal energy continuously by interacting with this field, emitting and absorbing virtual photons as part of a dynamic stabilizing process. These interactions do not violate energy conservation because they occur below the threshold of detectability, in compliance with classical time scales.

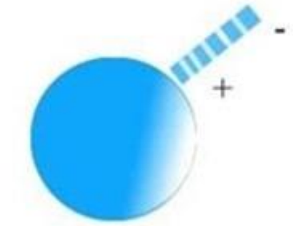
When it comes to observable light phenomena:

- **Absorption** occurs when the energy of an incoming real photon provides an exact energy match with the bound electron
- **Emission** is not a random event but a structured recoil-driven release of energy, occurring along aligned paths within the virtual photon sea.
- **Transmission** results when electrons relay the energy of a photon elastically, without permanent uptake.
- **Extinction** happens when a photon fails to find a receptive electron state, and its energy is dispersed into vibrational or thermal modes.

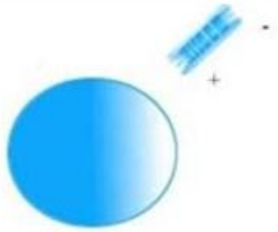
Quantization here is not probabilistic but arises from the discrete structure of energy exchanges. The virtual photon field — as an unseen but ever-present backdrop — helps explain how electrons maintain stability, while visible phenomena remain governed by classical laws. This restores continuity and causality to light–matter interactions: no spontaneous emissions, no wavefunction collapse, no abstract jumps — only time-bound, mechanical events.

3. The Physical Nature of the Photon

According to AND Theory, the photon is not an excitation of an abstract electromagnetic field but a real, discrete, and structured packet of energy. It originates directly from within the electron, which emits it as part of its natural self-regulating behavior. Each photon possesses a dipole character—that is, it has a directional structure defined by separated charges or field components—and retains this structure during its propagation. The photon is formed through the emission of discrete pulses of electric energy by the electron, these pulses of energy form into an electric dipole as a consequence of the electron emitting more powerful electric pulses initially than those emitted subsequently. The formation and emission of a photon takes place on the order of 10^{-16} s approx.. The pulses of emitted energy are separated by a dielectric filled gap, leading to a stable dipole configuration as seen in Figure 1 & 2.



Pulses of electrical energy emitted from electron are polarised



Solenoidal field takes shape around pulses of energy forming a photon

Figures 1 & 2 Showing how a photon is formed into a stable configuration from pulses of electric energy emitted by the electron

Crucially, this structure gives the photon a definable spatial size, estimated at approximately 10^{-16} meters in diameter. This size is not arbitrary but reflects the scale of the bound electron itself and the atomic environment it operates within. Because of this, photon interactions are inherently **size-compatible**: a photon can only be absorbed by an electron whose receptive field matches this spatial configuration. This simple geometric condition immediately excludes diffuse or unfocused interactions and provides a **classical criterion for absorption**.

By grounding the photon in physical space and attributing to it real size and orientation, AND Theory removes the abstraction typically associated with field-based models, and instead treats photon behavior as a direct consequence of electron activity and structure.

3.1 The rectilinear propagation of photons and the inverse square law:

In this theory, photons are composed of pulses of electric energy stabilized into a neutral, massless configuration. Their propagation depends on interaction with the virtual photon field — a dipole medium, possibly identical to dark matter, that permeates the entire Universe, including all matter. In its undisturbed state, this field consists of randomly oriented dipoles. When a real photon is emitted, these dipoles align to form a directional line of force, enabling the photon's energy to travel in a straight path. This alignment explains the rectilinear propagation of light, while the lateral transfer of energy across adjacent dipoles gives rise naturally to the inverse square law. Interactions with surfaces — which disturb or redirect this alignment — account for reflection and, consequently, the perceived color of objects.

3.2 Classical Timing of Photon-Electron Interaction in AND Theory showing reflection and frequency properties:

In this section, we analyze the behavior of an electron interacting with a stream of 450 nm photons from a purely classical standpoint, following the principles of Augmented Newtonian Dynamics (AND Theory). The electron absorbs and emits photons elastically, with directional recoil (angle of incidence equals angle of reflection), and the entire cycle repeats in step with the frequency of the incoming radiation.

Photon Frequency and Arrival Time

The wavelength of the incoming photon is:
λ=450 nm = 4.50×10^{-7} m

The frequency of the photon is calculated as:

$$f = \frac{c}{\lambda} = \frac{3.00\times10^{8}}{4.50\times10^{-7}} = 6.67\times10^{14}\text{Hz} \tag{15}$$

Thus, the time between successive photon arrivals is:

$$f = \frac{1}{6.67\times10^{14}} = 1.50\times10^{-15}\text{ seconds} \tag{16}$$

Energy of a Single Photon

The energy of each photon is given by Planck's relation:

$$\begin{aligned} E = hf &= (6.626\times10^{-34})\times(6.67\times10^{14}) \\ &= 4.42\times10^{-19}\text{ Joules} \end{aligned} \tag{17}$$

Translational Velocity of the Electron

Assuming the photon's energy is converted into kinetic energy of the electron:

$$\frac{1}{2}mv^2 = E \Rightarrow v = \sqrt{\frac{2E}{m}}, v = \sqrt{\frac{2\times4.42\times10^{-19}}{9.11\times10^{-31}}} \tag{18}$$

$$= 3.11\times10^{6}\text{ m/s}$$

Round-Trip Distance and Time

Let the recoil displacement of the electron be approximately one atomic diameter, taken a

$$d = 2.5\text{ x }10^{-10}\text{ m} \tag{19}$$

So, the total round-trip distance is:

$$L = 2d = 5.0\text{ x }10^{-10}\text{ m} \tag{20}$$

Time taken for the recoil-emission-return cycle is:

$$t = \frac{L}{v} = \frac{5.0\times10^{-10}}{3.11\times10^{6}} = 1.61\times10^{-16}\text{ seconds} \tag{21}$$

Timing Comparison

Comparing the time required by the electron to complete one full cycle with the time between photon arrivals:

$$\frac{T}{t} = \frac{1.50\times10^{-15}}{1.61\times10^{-16}} \approx 9.3:1 \tag{22}$$

Conclusion: Demonstrating the Feasibility of Photon Emission and Absorption at Frequencies Above 10^{14} Hz

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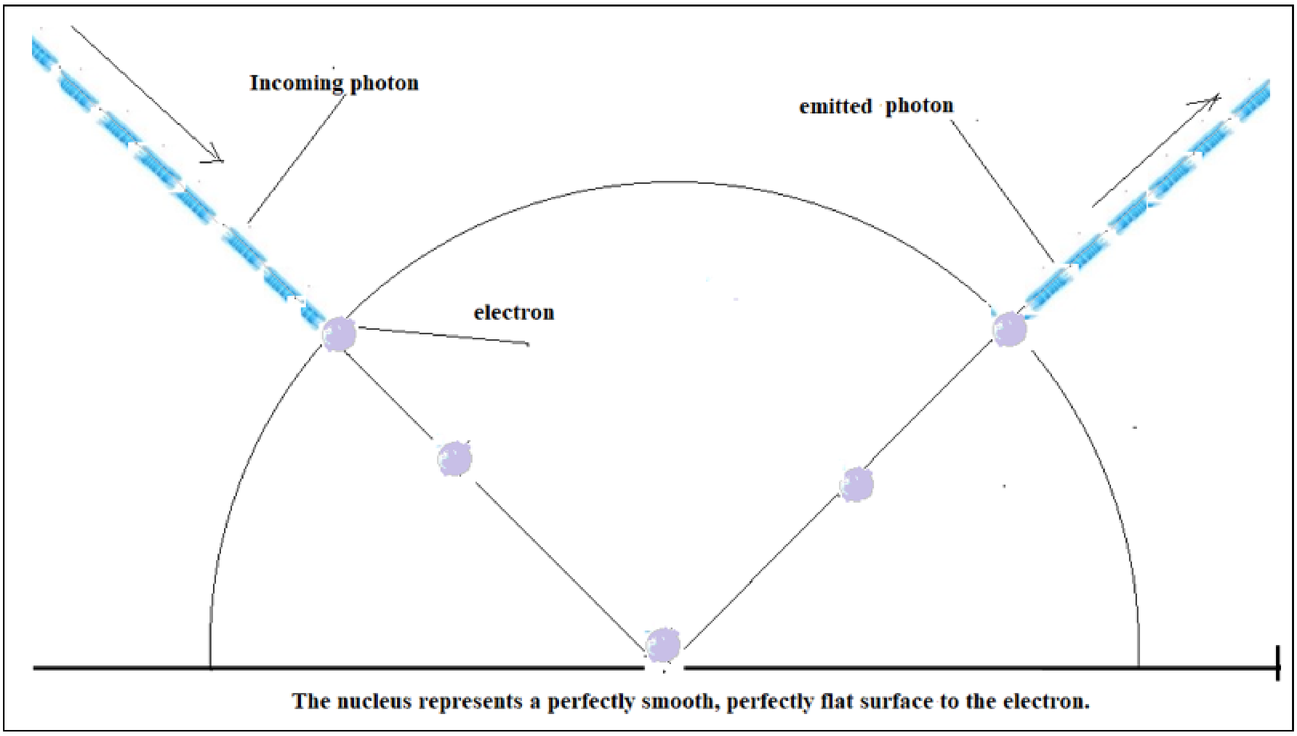

Figure 3: The manner in which photons interact with electrons to be absorbed and emitted at rates of 10^14 per second or more. To the electron the nucleus represents a perfectly flat perfectly smooth surface off which it recoils in keeping with classical laws of reflection.

This calculation shows that even at frequencies above 10^{14} Hz, the electron has sufficient time to complete a full, symmetric interaction cycle before the arrival of the next photon. According to AND Theory, this cycle begins with the absorption of a photon, — in response to the photon's momentum, the electron recoils off the nucleus in keeping with θ i = θ r and continues on this path until it reaches a specific energy level (e.g., $n = 3$), at which point it emits an identical photon. This emission triggers a second inward recoil, returning the electron to its original position (also at n = 3). The fact that this round-trip motion occurs within a fraction of the time between incoming photons strongly supports the AND Theory claim that electrons interact continuously and rhythmically with radiation — not through abrupt jumps and transitions, but through smooth, self-regulating cycles of energy exchange.

Example 2 – Absorption of a 650 nm Photon (Red Light)
This example mirrors the previous logic but with a lower-energy photon in the red region of the spectrum. We'll track the process step-by-step and number the equations from (23) onward.

(23) Energy of a 650 nm photon

$$E = \frac{hc}{\lambda} = \frac{6.626 \times 10^{-34} \times 3.00 \times 10^{8}}{650 \times 10^{-9}} = 3.06 \times 10^{-19}\ \text{J}$$

(24) Photon frequency

$$f = \frac{c}{\lambda} = \frac{3.00 \times 10^{8}}{650 \times 10^{-9}} = 4.62 \times 10^{14}\ \text{Hz}$$

(25) Time between photon arrivals

$$\Delta t = \frac{1}{f} = \frac{1}{4.62 \times 10^{14}} = 2.16 \times 10^{-15}\ \text{s}$$

(26) Photon momentum

$$p = \frac{E}{c} = \frac{3.06 \times 10^{-19}}{3.00 \times 10^{8}} = 1.02 \times 10^{-27}\text{kg·m/s}$$

(27) Electron's recoil velocity after absorbing the photon

$$v_e = \frac{p}{m_e} = \frac{1.02 \times 10^{-27}}{9.11 \times 10^{-31}} = 1.12 \times 10^{3}\ \text{m/s}$$

(28) Assumed orbital distance for recoil motion (say, n=3)

$$r_3 = n^2 a_0 = 9 \times 5.29 \times 10^{-11} = 4.76 \times 10^{-10}\text{m}$$

(29) Inward travel time to nucleus

$$t_{\text{in}} = \frac{r_3}{v_e} = \frac{4.76 \times 10^{-10}}{1.12 \times 10^{3}} = 4.25 \times 10^{-13}\ \text{s}$$

(30) Total round-trip time (absorb → recoil inward → emit → recoil outward)

$$t_{\text{round-trip}} = 2 \times t_{\text{in}} = 8.50 \times 10^{-13}\ \text{s}$$

(31) Comparison with available time between photon arrivals

$$t_{\text{round-trip}} \ll \Delta t = 2.16 \times 10^{-15}\ \text{s}$$

(This calculation shows there is plenty of time for absorption-recoil-emission)

(32) Kinetic energy gained by electron during recoil

$$E_k = \frac{1}{2} m_e v_e^2 = \frac{1}{2} \times 9.11 \times 10^{-31} \times (1.12 \times 10^{3})^2 = 5.71 \times 10^{-25}\ \text{J}$$

(33) Elastic trajectory: angle of incidence equals angle of reflection

θ in = θ out

A postulate in keeping with classical laws of reflection and accounts for the rectilinear propagation of light

4. Extinction of Light: Not absorption

In conventional quantum mechanics, the absorption of a photon occurs when its energy matches the difference between two quantized electronic states. The electron, described by a probability wave function, absorbs the photon's entire energy, causing a transition to a higher energy level. This process is inherently probabilistic and does not specify a definite trajectory or mechanism for energy transfer. The excited electron may later return to a lower energy state, releasing a photon in a spontaneous emission event. By contrast, Augmented Newtonian Dynamics (AND) treats this interaction deterministically. A photon is absorbed only if a suitable electron exists that can physically accept its full energy in a direct, mechanical transfer — one that includes recoil and subsequent stabilization. If such a condition is not met — for instance, if the electron cannot undergo a transition corresponding to the photon's energy — the photon is not absorbed in any conventional sense. Instead, it undergoes extinction, wherein its coherent structure disintegrates and its energy disperses into the surrounding medium. This dispersed energy typically appears as heat or vibrational energy in the lattice, rather than being stored in an electronic excitation.

Unlike in conventional quantum theory, where absorption involves probabilistic jumps between quantized levels, AND describes this process deterministically: if no receptive electron transition exists, the photon simply ceases to exist as a coherent unit of energy.

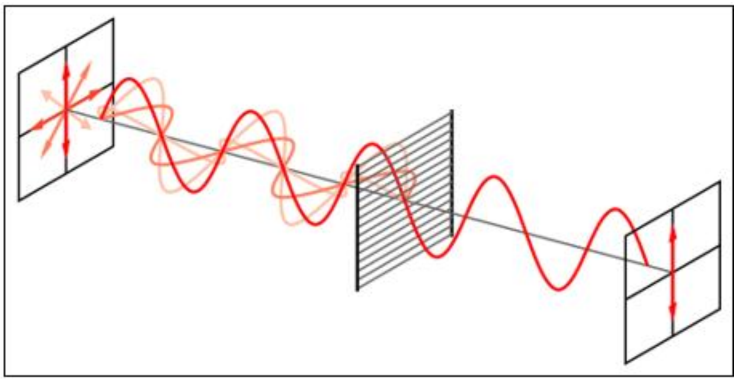

Figure 4: Some of the light is extinguished when it finds no viable interaction through the polarising filter and its energy is dissipated locally contributing to thermal energy in the filter material

A clear real-world demonstration of this principle is the phenomenon of polarisation. When unpolarised light encounters a polarising filter, only those electric field vectors aligned with the filter's axis are transmitted. The rest are extinguished — not reflected or scattered — because they are not allowed to interact in the required direction with the electrons in the polarising medium. These unaccepted photons dissipate their energy locally, contributing to thermal energy in the filter material. Similarly, when a black box is placed in sunlight, it warms up not by absorbing photons in the quantum sense, but because most incoming photons are extinguished, their energy transferred into molecular motion. Yet the box remains visible: a small fraction of photons encounter receptive electrons and are elastically reflected. Thus, black surfaces are not perfectly absorptive; they are simply poor reflectors, as only a small proportion of photons interact suitably. This reflection, like all reflection under AND theory, results from electron recoil.

In this framework, extinction replaces the need for abstract quantum mechanical "absorption." Light either:

- Propagates via elastic recoil (in keeping with $\theta_i = \theta_r$).
- propagates via transmission (if the material is amorphous),
- or is extinguished altogether, contributing to the thermal energy of matter.

This gives a complete and physically grounded account of how photons behave in real-world interactions, without invoking probabilistic collapse or non-classical descriptions.

No jumps, no leaps, no transitions, no storing of energy for later release through spontaneous emission.

5. Transmission of Light Through Transparent Substances

In the framework of Augmented Newtonian Dynamics (AND), the transmission of light is not the result of unimpeded travel, but rather a continuous, high-frequency relay of photon energy by electrons through a medium. At the core of this process is the electron's capacity to absorb and elastically re-emit photons without undergoing a permanent energy transition. This rapid absorption–recoil–emission cycle happens at rates on the order of $\geq 10^{14}$ Hz, allowing photons to pass through matter at the speed of light, but in a stepwise fashion, always mediated by electrons.

In transmission, photons pass through a material with a large band gap when their energy is insufficient to shift electrons to the conduction band. The electrons are not dislodged or freed and instead interact elastically with the incoming photons. The photons are absorbed and re-emitted without delay or energy loss, allowing them a continuous path — a process identified as transmission. This mechanism explains the transparency of materials like silicon dioxide, whose wide band gap (~8–9 eV) allows almost all of visible light to be transmitted.

It is this uninterrupted succession of elastic interactions — not the absence of interaction — that enables transparency. The photons do not traverse the material unaided; rather, they are passed forward by electrons that are free to respond to a wide range of frequencies. Where there is no available electron state at the incoming photon's energy (as is the case in wide-bandgap materials), there is no permanent absorption — only this continuous, oscillatory handover.

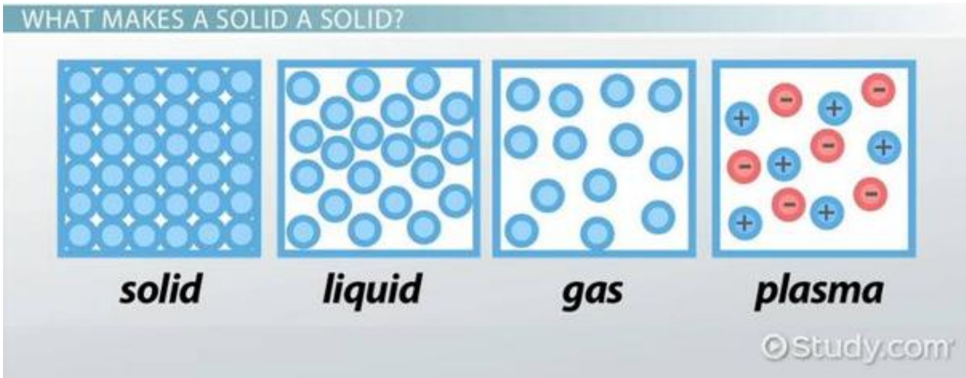

Figure 5: In amorphous substances with a sufficiently large band gap, transmission of visible light can take place

Amorphous materials such as common glass (amorphous SiO_2) also allow light transmission, despite lacking a periodic atomic structure. While the energy bands are less sharply defined than in crystals, the wide band gap (~8–9 eV) still prevents visible photons from causing lasting excitation. Electrons remain largely unengaged in specific transitions and are free to interact elastically with incoming photons recoiling off the nucleus and being absorbed by a subsequent electron as in the case of reflection with the exception that almost all the visible component of light makes it through, enabling transmission without absorption or extinction. Electrons respond just as in the crystalline case — no leaps, no jumps, no transitions — just transmission.

In sum, AND theory presents a unified mechanism of transmission across materials: photons are absorbed and re-emitted via instantaneous recoil by electrons. Photons pass through a material when the photon energy is insufficient to shift the electron to the conduction band. Instead, the interaction is elastic: the photon is momentarily absorbed and re-emitted, enabling transmission. This applies not just to traditional "transparent" substances, but to any material in which electrons are not energetically receptive at the incoming photon frequency. For visible light, this condition is met in materials with band gaps greater than ~3.6 eV, such as silicon dioxide, but not in materials like pure silicon. The result is a direct, frequency-governed distinction between opacity and transparency, grounded not in classical wave propagation but in high-frequency elastic electron-photon exchange. In certain wide band gap crystals, structural rigidity limits electron receptivity, preventing or restricting photon interactions.

Integration with Planck's Quantization

One of the most compelling strengths of this reinterpretation lies in how naturally it aligns with Planck's discovery that energy is quantized in discrete packets, each proportional to the frequency of radiation, expressed as $E = h\nu$. In conventional quantum theory, this relation often appears as a starting axiom, detached from any underlying mechanism. In contrast, the framework developed here provides a physical basis for this quantization, emerging directly from real photon interactions with electrons and their associated recoil dynamics.

Crucially, the structure attributed to the photon in this model mirrors the properties of Planck's quantum: the photon has no mass, is electrically neutral, conserves its energy, and distributes it according to the inverse square law. Thus, the AND model not only upholds Planck's core insight, but also provides the physical scaffolding beneath it — showing how quantization emerges from tangible interactions rather than imposed postulates. In doing so, it replaces abstraction with mechanism, and restores Planck's discovery to the domain of classical causality.

According to the Augmented Newtonian Dynamics (AND) model, electrons absorb and re-emit photons through a real, continuous interaction cycle. For this cycle to initiate, the photon's entire energy E must be delivered to the electron in full — no partial or fractional transfer is sufficient to trigger recoil and subsequent emission. Quantization, in this view, does not arise from abstract probabilistic rules, but from the mechanical requirement of complete energy transfer. Since photon energy is inherently tied to its frequency, this explains why energy exchange follows the relationship $E = h\nu$: frequency becomes the operational driver of the interaction.

This perspective also explains why only certain frequencies interact meaningfully with matter. As Planck observed in his study of blackbody radiation, not all frequencies are absorbed equally. In the AND framework, this selectivity is a direct consequence of electron receptivity and timing constraints: unless a photon carries exactly the right energy — and arrives within the precise time window governed by electron recoil dynamics — it is not absorbed but instead extinguished or transmitted.

6. Conclusion

This work presents a cohesive and physically grounded reinterpretation of how light interacts with matter, based not on abstract probabilities but on real-time, observable interactions between photons and electrons. Within the framework of Augmented Newtonian Dynamics (AND), transmission, reflection, and extinction are explained as time-bound, elastic processes — governed by conservation laws, not spontaneous leaps.

There are no jumps, no transitions, no wavefunction collapses. No spontaneous emissions or probabilistic uncertainties. Every photon interaction is accounted for in real time: photon in → electron recoil → photon out. Transparent media allow this relay; opaque materials interrupt it, extinguishing the photon and dispersing its energy as heat.

This theory requires no exotic entities. It preserves Planck's quantization, respects classical conservation principles, and restores mechanical clarity to light–matter interaction. Most importantly, it reframes well-known observations in a way that is simple, testable, and logically complete — offering a path forward rooted in classical coherence, not quantum mysticism.

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