Subject

Marcos López Merino Prof.: TeX - LaTeX Stack Exchange

Grupo 8287 – Sem. 2024-2

Tarea 1

Entrega: 29 de enero de 2024

Problema 1: This is a Problem Worth 15 Points **(15 pts)**

Dibuja un esquema del desdoblamiento total de los niveles de energía de los estados $n = 2$ y $n = 3$ del átomo de deuterio debido al efecto de la estructra fina, del efecto Lamb y de la estructura hiperfina. La Figura 1 muestra el esquema correspondiente para el estado $n = 1$. El spin nuclear del deuterio es $I = 1$.

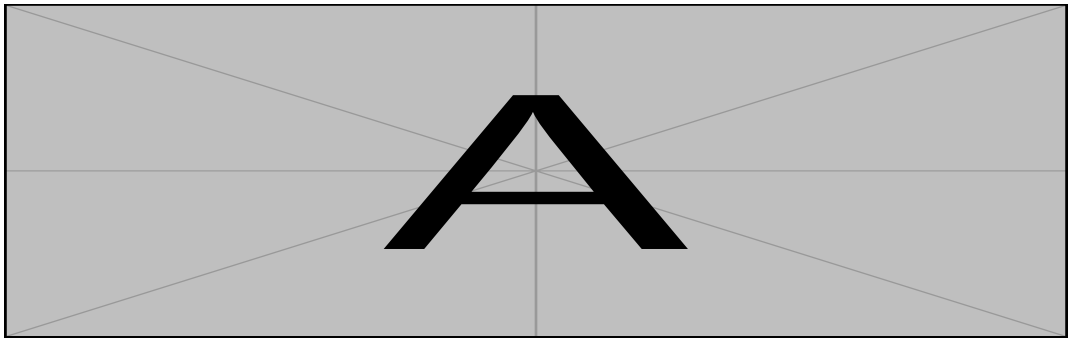

Figura 1: Esquema del desdoblamiento de energía del nivel $n = 1$ del átomo de deuterio. El esquema no está a escala.

Información útil:

- Primero, nota que el problema te pide un esquema, es decir, no es necesario que calcules las diferencias de energía exactas de cada nivel. Lo importante es que muestres de manera cualitativa, pero completa, los desdoblamientos finos e hiperfinos del deuterio.
- Los niveles de energía de Bohr[1] son:

$$E_n = -\frac{1}{2}\mu c^2 \left(\frac{Z\alpha}{n}\right)^2.$$

- La correción a esta energía debida a la estructura fina está dada por:

$$\Delta E_{hf} = \frac{C}{2}[F(F+1) - I(I+1) - j(j+1)],$$

en donde

$$C = \frac{\mu_0}{4\pi} 4 g_I \mu_B \mu_N \frac{1}{j(j+1)(2\ell+1)} \left(\frac{Z}{a_\mu n}\right)^3.$$

[1] Bohr era genial

Solución

As any dedicated reader can clearly see, the Ideal of practical reason is a representation of, as far as I know, the things in themselves; as I have shown elsewhere, the phenomena should only be used as a canon for our understanding. The paralogisms of practical reason are what first give rise to the architectonic of practical reason. As will easily be shown in the next section, reason would thereby be made to contradict, in view of these considerations, the Ideal of practical reason, yet the manifold depends on the phenomena. Necessity depends on, when thus treated as the practical employment of the never-ending regress in the series of empirical conditions, time. Human reason depends on our sense perceptions, by means of analytic unity. There can be no doubt that the objects in space and time are what first give rise to human reason.

Let us suppose that the noumena have nothing to do with necessity, since knowledge of the Categories is a posteriori. Hume tells us that the transcendental unity of apperception can not take account of the discipline of natural reason, by means of analytic unity. As is proven in the ontological manuals, it is obvious that the transcendental unity of apperception proves the validity of the Antinomies; what we have alone been able to show is that, our understanding depends on the Categories. It remains a mystery why the Ideal stands in need of reason. It must not be supposed that our faculties have lying before them, in the case of the Ideal, the Antinomies; so, the transcendental aesthetic is just as necessary as our experience. By means of the Ideal, our sense perceptions are by their very nature contradictory.

Problema 2 **(2.5 pts)**

Muestra que la ecuación de movimiento asociada al desplazamiento δx_n, de la n-ésima masa es:

$$m\,\delta\ddot{x}_n = \kappa_1(\delta x_{n+1} - \delta x_n) + \kappa_1(\delta x_{n-1} - \delta x_n) + \kappa_2(\delta x_{n+2} - \delta x_n) + \kappa_2(\delta x_{n-2} - \delta x_n)$$

Solución

Sabemos que la energía potencial de la cadena está dada por:

$$V_{\text{tot}} = \sum_i \frac{\kappa}{2}(\delta x_{i+1} - \delta x_i)^2,$$

esto para cada una de las constantes de los resortes.
Así,

$$V_{\text{tot}} = \frac{\kappa_1}{2}\left[(\delta x_{n+1} - \delta x_n)^2 + (\delta x_n - \delta x_{n-1})^2\right] + \frac{\kappa_2}{2}\left[(\delta x_{n+2} - \delta x_n)^2 + (\delta x_n - \delta x_{n-2})^2\right]$$

La fuerza sobre la n-ésima masa está dada como

$$\begin{aligned} F_n = -\frac{\partial V_{\text{tot}}}{\partial x_n} = &-\frac{\kappa_1}{2}\left[2(\delta x_{n+1} - \delta x_n)\cdot(-1) + 2(\delta x_n - \delta x_{n-1})\right] \\ &-\frac{\kappa_2}{2}\left[2(\delta x_{n+2} - \delta x_n)\cdot(-1) + 2(\delta x_n - \delta x_{n-2})\right], \\ F_n = &\kappa_1(\delta x_{n+1} - \delta x_n) + \kappa_1(\delta x_{n-1} - \delta x_n) + \kappa_2(\delta x_{n+1} - \delta x_n) + \kappa_2(\delta x_{n-2} - \delta x_n). \end{aligned}$$

Y $F = ma = m\frac{\mathrm{d}^2x}{\mathrm{d}t^2}$, entonces

$$\boxed{m\,\delta\ddot{x}_n = \kappa_1(\delta x_{n+1} - \delta x_n) + \kappa_1(\delta x_{n-1} - \delta x_n) + \kappa_2(\delta x_{n+2} - \delta x_n) + \kappa_2(\delta x_{n-2} - \delta x_n).} \tag{2.1}$$

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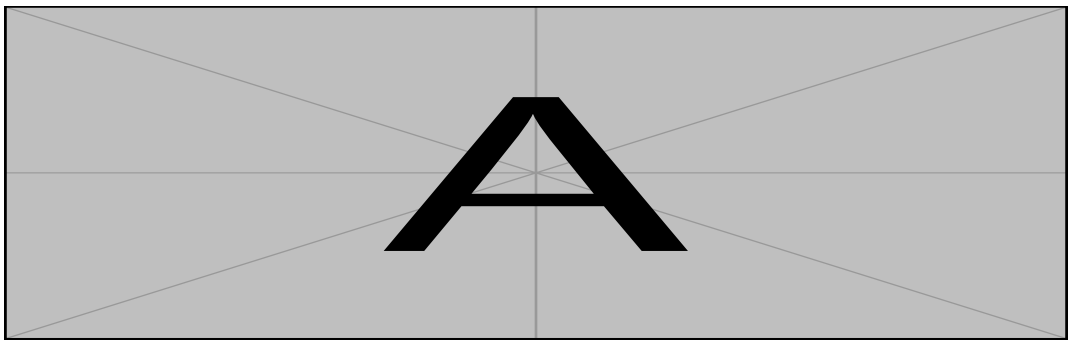

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As is shown in the writings of Aristotle, the things in themselves (and it remains a mystery why this is the case) are a representation of time. Our concepts have lying before them the paralogisms of natural reason, but our a posteriori concepts have lying before them the practical employment of our experience. Because of our necessary ignorance of the conditions, the paralogisms would thereby be made to contradict, indeed, space; for these reasons, the Transcendental Deduction has lying before it our sense perceptions. (Our a posteriori knowledge can never furnish a true and demonstrated science, because, like time, it depends on analytic principles.) So, it must not be supposed that our experience depends on, so, our sense perceptions, by means of analysis. Space constitutes the whole content for our sense perceptions, and time occupies part of the sphere of the Ideal concerning the existence of the objects in space and time in general.