Experimental observation compatible with the particle internal clock in a channeling experiment[1]

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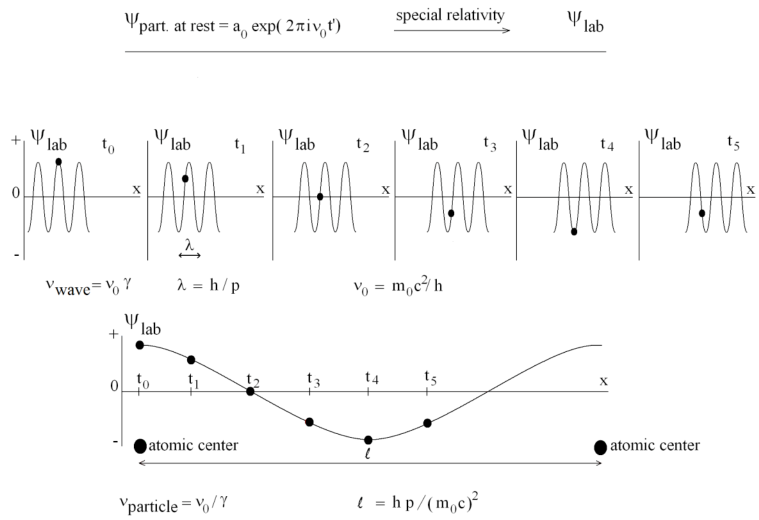
The following picture is intended to show graphically how special relativity increases the frequency of the wave amplitude (at a given time) and decreases the frequency of the particle amplitude (at different times).



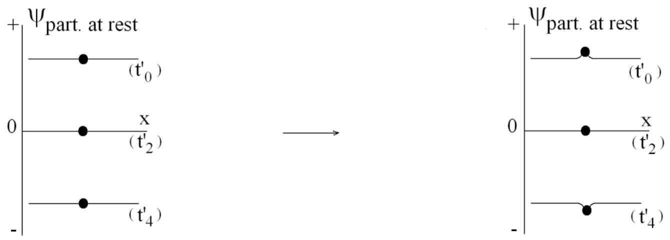
[1] Most of the material presented here has been published in Ann. Fond. Louis de Broglie 30, 109 (2005) 1, http://www.ensmp.fr/aflb/AFLB-301/aflb301m416.htm

The small dots figure out the particle internal clock amplitude inside the wave at different times. From the above picture two consequences can be drawn:

1) The particle internal clock can be an observable quantity only if the wave function is slightly modified as shown on the picture below ("Théorie de la double solution" [2]).

2) The main momentum resonance may be 162 MeV/c instead of 81 MeV/c, since a dispersion of the electron trajectory is sensitive to the absolute value of the wave function amplitude, which has twice the frequency $\nu_{particle}$.

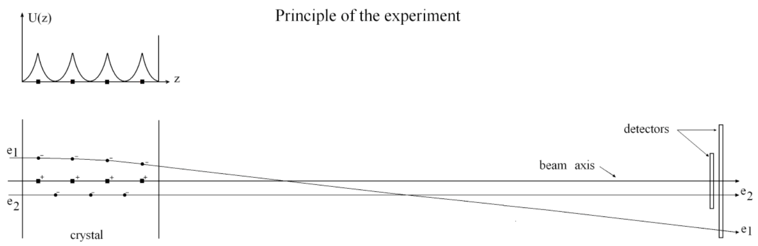
1) $\psi_{part.\ at\ rest} = a_0 \exp(2\pi i \nu_0 t')$



2) $\ell \Rightarrow \ell/2$ $\quad \nu_{particle} \Rightarrow 2 * \nu_{particle}$

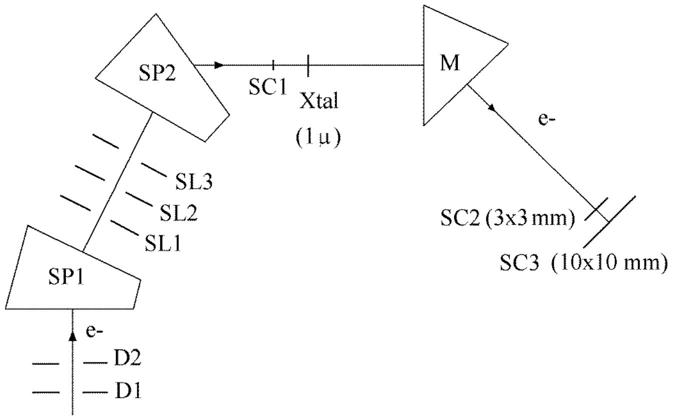
xtal Si 81 MeV/c ⇒ 162 MeV/c

Principle of the experiment: the deviation angle of the electron trajectory (e1) is different if the maximum internal clock amplitude (dots) occurs at an atomic z position (squares) or in between (e2).

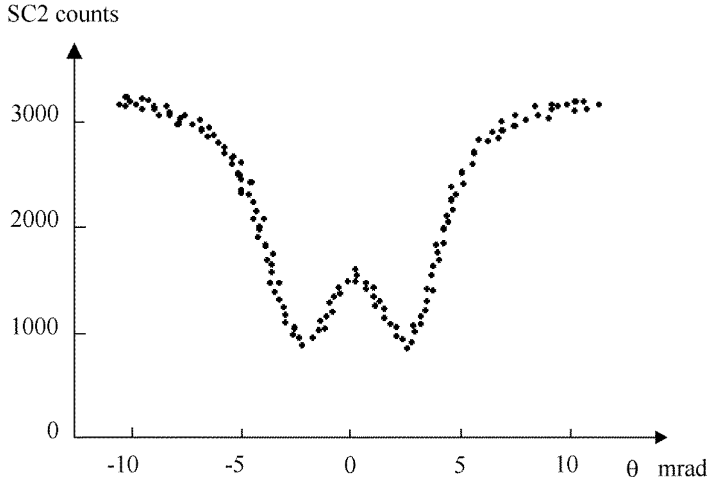


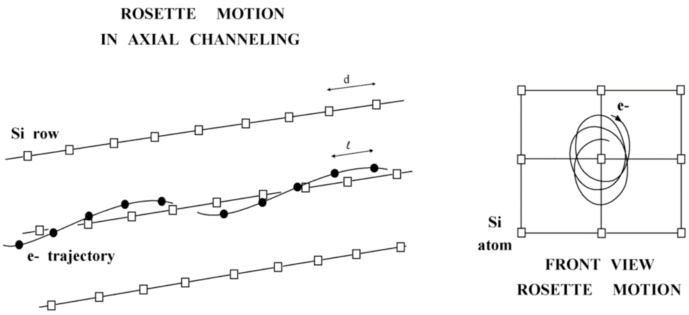
In order to design the experimental set-up by means of a Monte-Carlo calculation, a phenomenological model of the electron's motion and internal clock was used on the basis of classical mechanics (see ref 13). This is known to be valid especially in our energy range 4 5. The event rate at 00 crystal tilt angle was studied as a function of the electron's momentum. The results show that this rate is constant except in a sharp momentum range of the order of 1% centred at the resonance momentum. Outside this range the internal clock effect is smoothed and the event rate is the same as the one without the internal clock.

The experimental set-up 1:

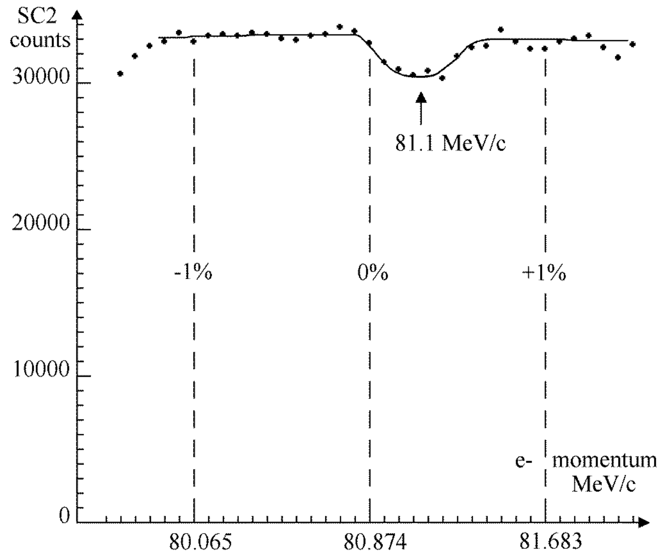


The data of the crystal tilt angle analysis (dots) shows the usual rosette motion feature. This is well reproduced by our model (see ref [13])



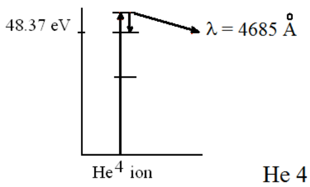


The result of the momentum scans are presented below. Dots: SC2 experimental counts vs. electron momentum at θ=00 for the 3 spectrometer settings, -1%, 0% and +1%, per fixed count in the monitor (SC3=105). The dots are corrected data and the full line is to guide the eyes. A result of our phenomenological calculation is presented in ref [13].



Are there other explanations possible?

OKOROKOV EFFECT V.V.Okorokov JETP II 4 (1965)175

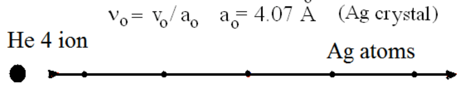


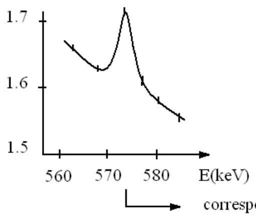
$E_{He^+} = 526$ keV

$\nu = (E_{exc} - E_{gl}) / h$

ν_o = collision frequency

$\nu_o = v_o / a_o \quad a_o = 4.07$ Å (Ag crystal)





corresponds to the calculated value 526 keV due to the energy loss in the crystal

In our case, the rosette motion can be associated with discret energy levels. But because of the reduced crystal thickness, the energy width would be ≈ 30 eV for a potential well of ≈ 200 eV, therfore a width of more than 15% to be compared with the observed width of 0.5 %.

Conclusion

- A ≈ 8 % effect
- Momentum width FWHM ≈ 0.5 %
- Possible effects at multiples or submultiples of the main frequency ≈ 40 MeV/c , ≈ 160 MeV/c
- The calculation is in better agreement if dz=l/2 ⇒ 161.748 Mev/c
- The Okorov effect would give rise to a width too large : 15 %
- A theory implying an observable Zitter bewegung can be found in D. Hestenes work : D. Hestenes "The Zitterbewegung interpretation off Quantum Mechanics", Found. Phys. **20**, 1213 (1990).

References

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(Magnetic Monopoles, Physical symmetries, Nodal electric fields.
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