Atomic physics with resonant coherent excitation by crystal field

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【Outline of survey】

When fast ions travel through a periodic field, namely a single crystal, they feel a temporally oscillating electric field. The frequency of this field matches the internal transition energy of the ions, they have a chance to be resonantly excited. This process often called resonant coherent excitation allows us to access the atomic level transition of $10^{18\text{-}19}$ Hz, that is the x-ray region, making use of high energy heavy ions of several tens GeV and the crystal periodic structure of the Å order. It is regarded as a unique virtual photon source of the x-ray energy region equipped with high coherency and polarization, which enables quantum manipulation of atomic systems without photon. Moreover, it serves as a new tool for high-precision atomic spectroscopy. Thus, (1) we will observe the dressed atom through pump and probe experiments by developing a double resonance technique in the x-ray region, and (2) we will try a stringent test of quantum electrodynamics under the strong electric field.

【Expected results】

(1) Through observation of Rabi oscillation due to the intense coupling of the atomic levels with the oscillating fields as a direct evidence of the coherent process, quantum dynamics of an atom with the inner structure interacting with a periodic crystal field will be newly revealed.

(2) Through measurements of the inner shell transition of uranium ions, which possesses the highest nuclear charge among the stable ones, the theory of QED (quantum electrodynamics) under the strong field will be verified in higher precision, compared with traditional optical spectroscopic methods.

【References by the principal investigator】

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【Homepage address】	http://atom.phys.metro-u.ac.jp/