



Frequency Doubler

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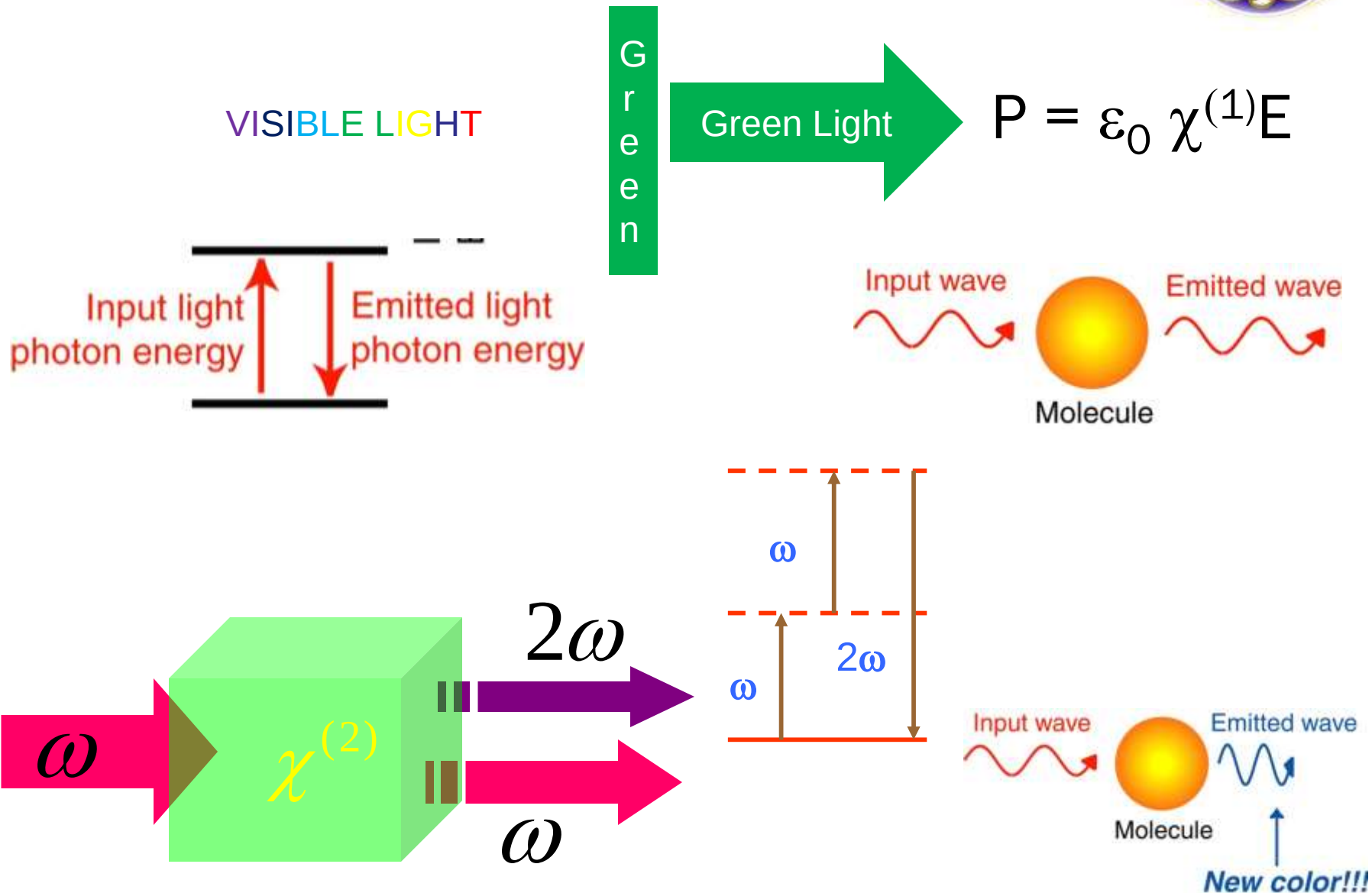


Is it possible to change the color of a monochromatic light?





Linear and Nonlinear Effect





Is it possible to change the color of a monochromatic light?

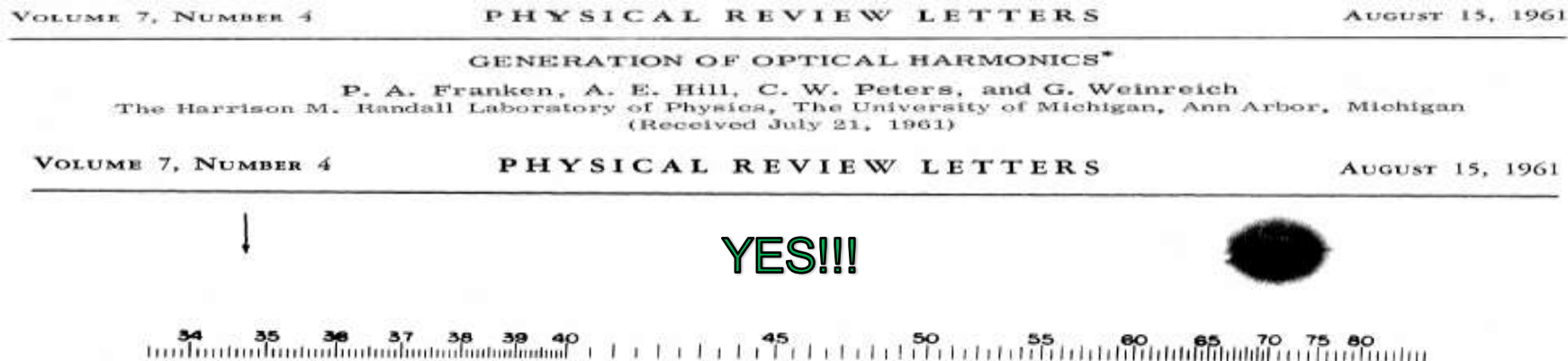


FIG. 1. A direct reproduction of the first plate in which there was an indication of second harmonic. The wavelength scale is in units of 100 Å. The arrow at 3472 Å indicates the small but dense image produced by the second harmonic. The image of the primary beam at 6943 Å is very large due to halation.

When $E = E_0 \cos \omega t$

$$P = \frac{1}{2} \epsilon_0 \chi^{(2)} E_0^2 + (\chi^{(1)} + \frac{3}{2} \chi^{(3)} E_0^2) \epsilon_0 E_0 \cos(\omega t) + \frac{1}{2} \epsilon_0 \chi^{(2)} E_0^2 \cos(2\omega t) + \frac{1}{4} \epsilon_0 \chi^{(3)} E_0^3 \cos(3\omega t)$$



Frequency Doubler - Kurtz Powder SHG Test

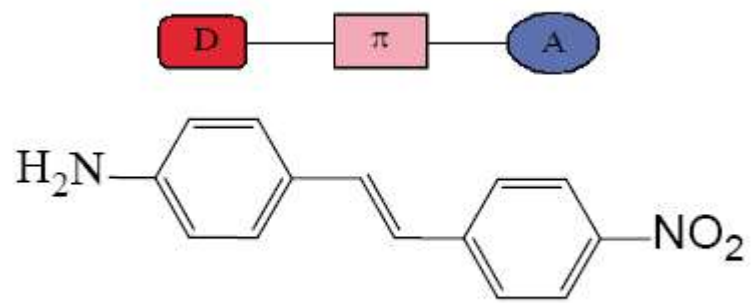
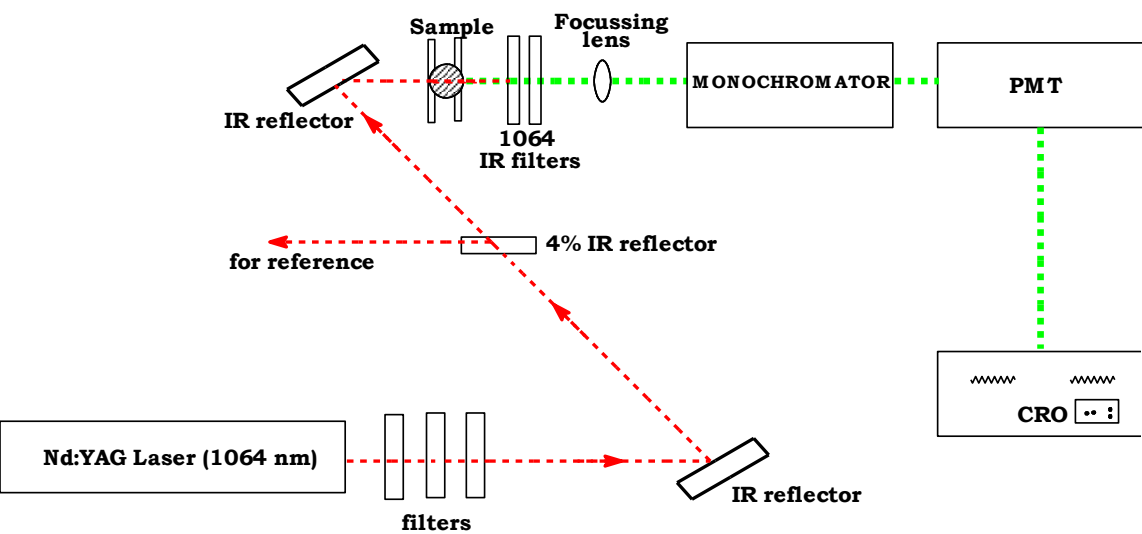
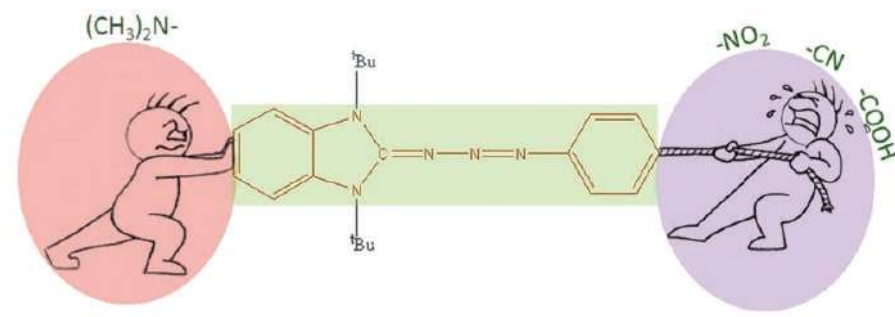
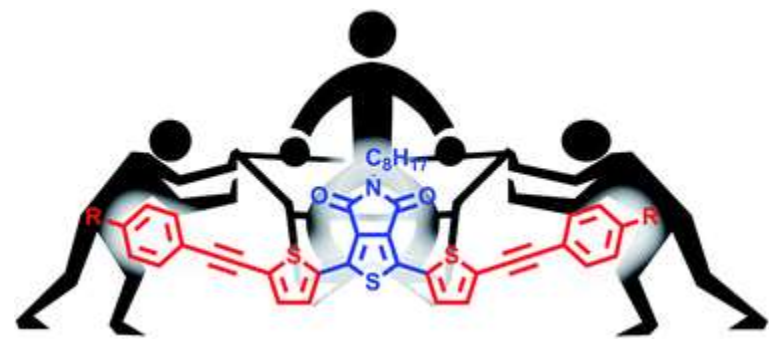


Figure 1. Push-Pull model

push-pull-push type

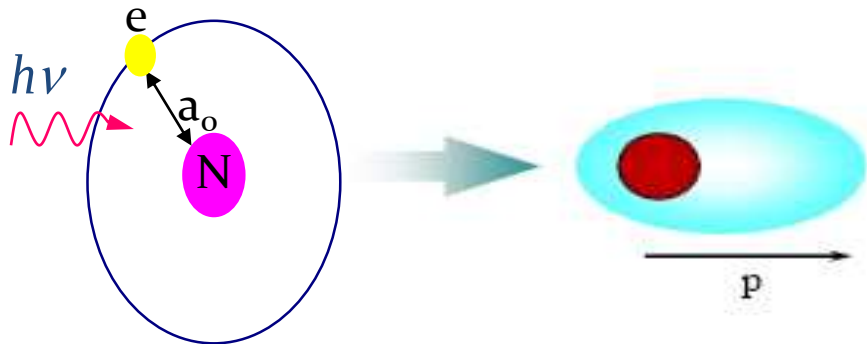


donor- π -acceptor type vinyl coupled triazene derivatives (VCTDs)

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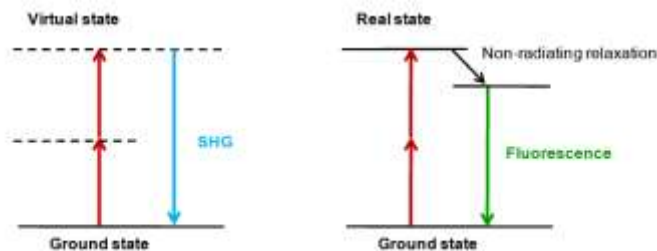


Nonlinearity at Nano Scale

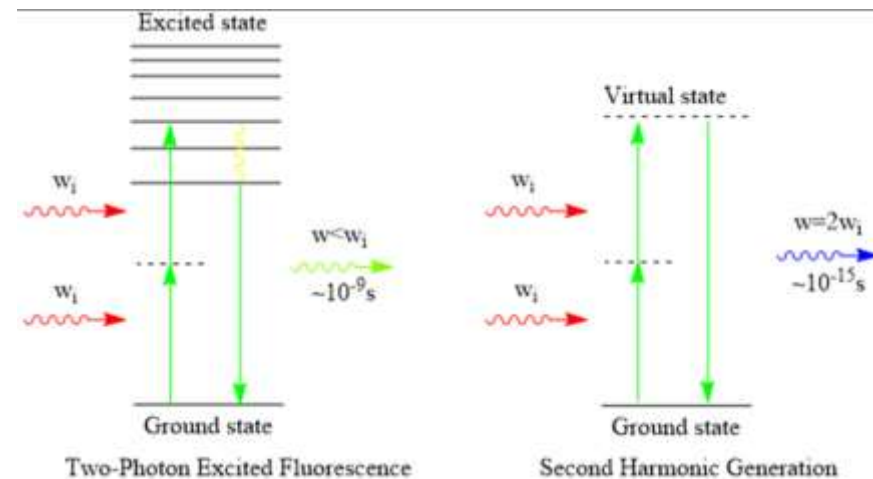
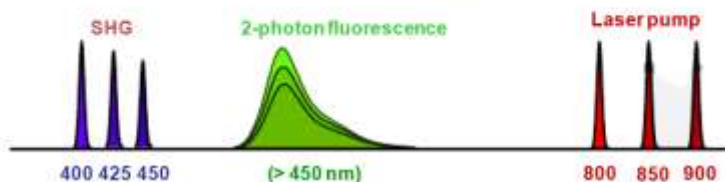


$$P = \epsilon_0 \chi^{(1)} E + \epsilon_0 \chi^{(2)} E^2 + \epsilon_0 \chi^{(3)} E^3 + \dots$$

Optical Susceptibility changes with size and shape of nanoparticles- Strong nonlinear polarization (EM Force dominant)- Bio-Imaging

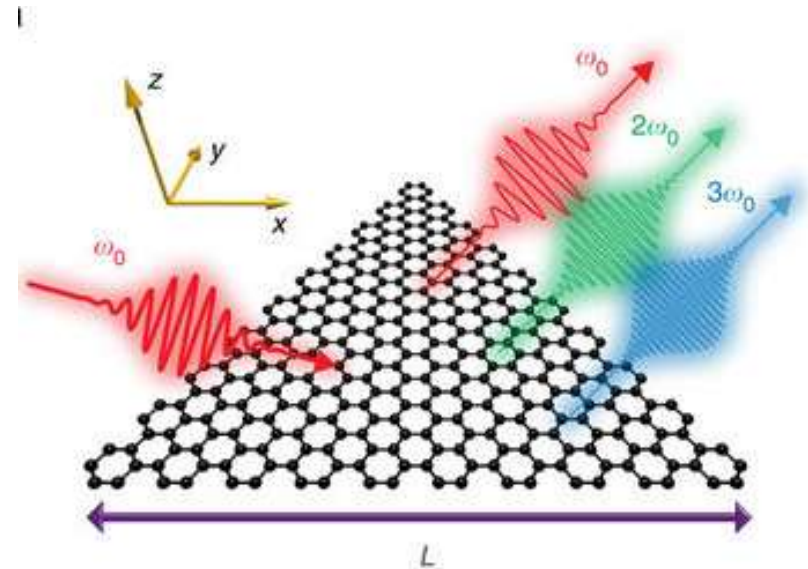
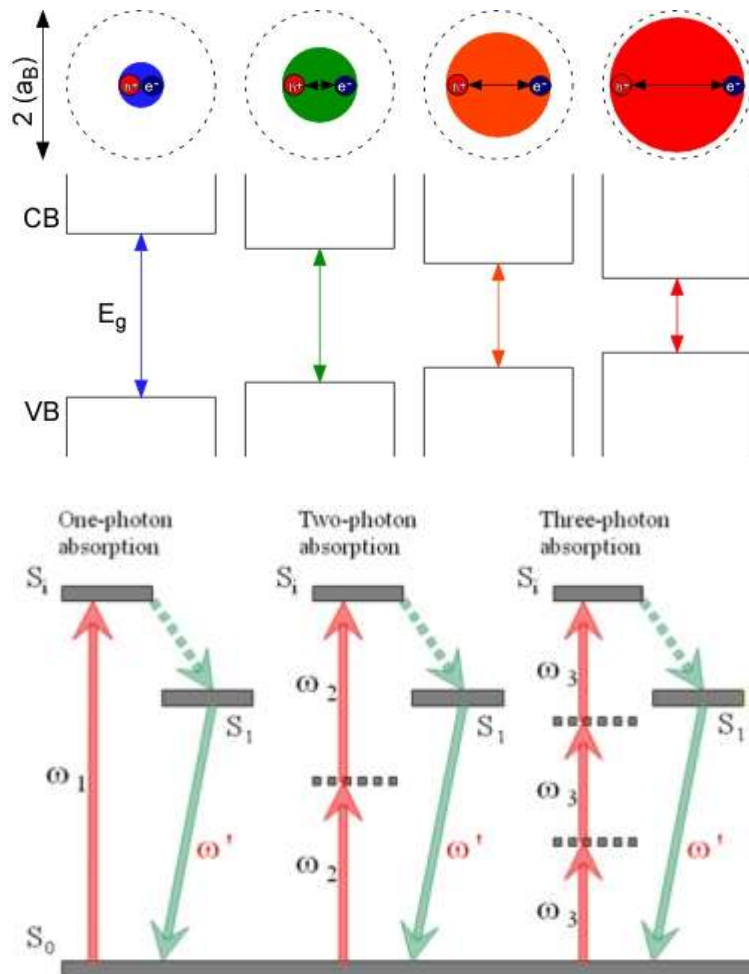


Excitation and emission spectra





Nonlinearity at Nano Scale



Electrically tunable nonlinear plasmonics in graphene nanoislands

Tunable electronic states – Different optical transitions – Broadband nonlinearity