Strong Coherent Coupling of Many Levels Across the Ionization Limit Via 17 & 36 GHz Microwave Fields

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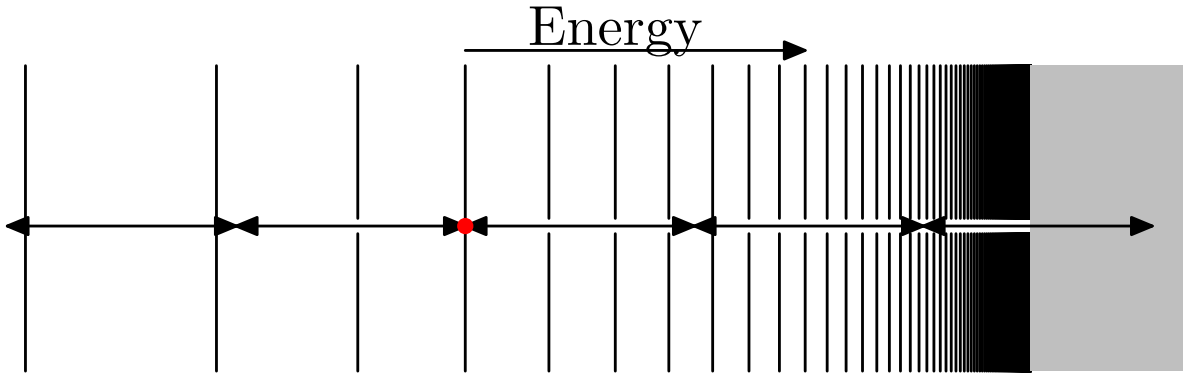
MW Ionization as Dynamical Anderson Localization

How does microwave ionization in Rydberg atoms occur as we approach the photoionization limit?

Anderson Localization - Destructive interference between many multiphoton paths localizes the electronic wave function, and ionization occurs when electron transport diffuses over the limit.



Schelle *et al.* - Anderson Localization crossing over to Fermi's Golden Rule

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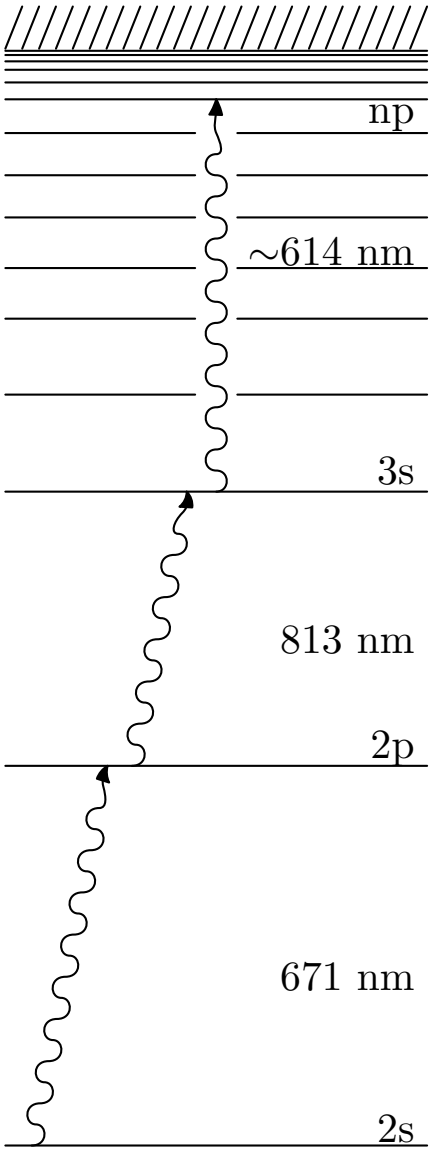
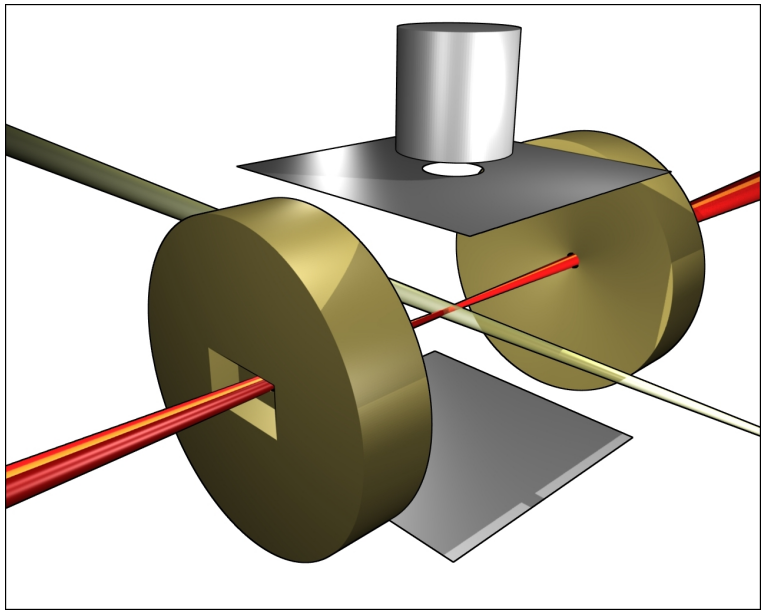
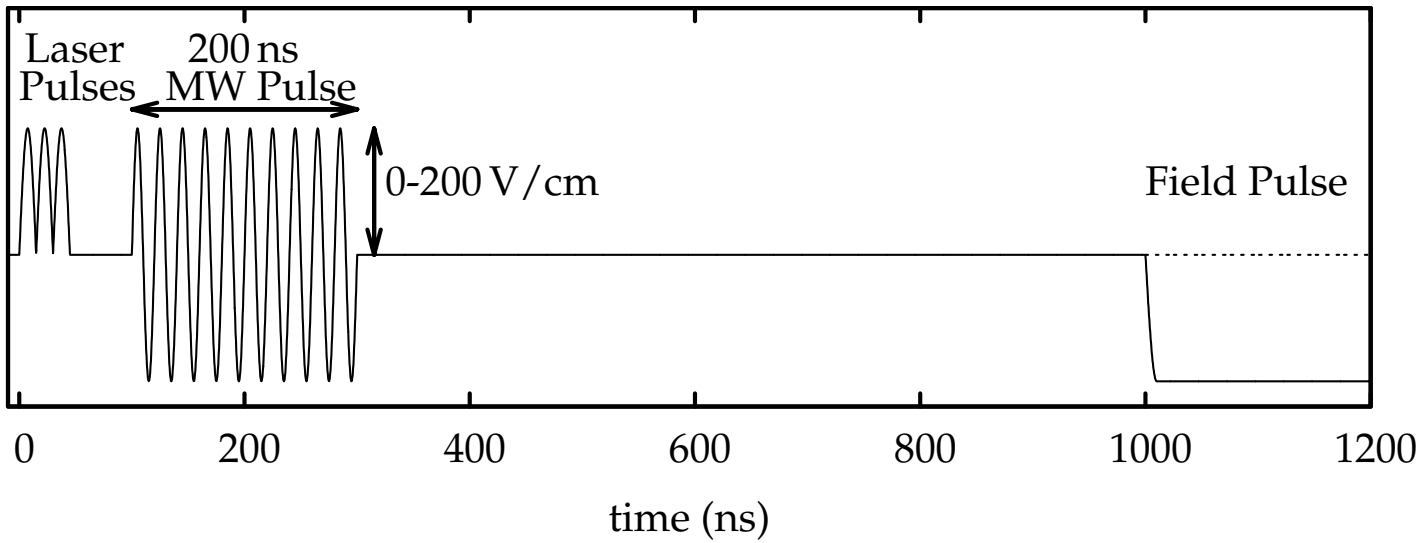
Schelle, Delande, and Buchleitner, *PRL* 102 (2009).

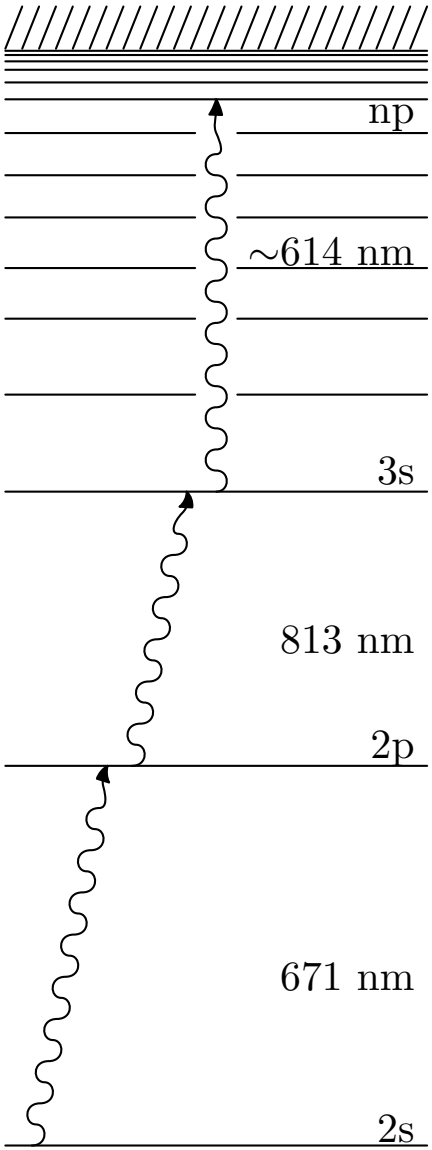
Experimental Setup

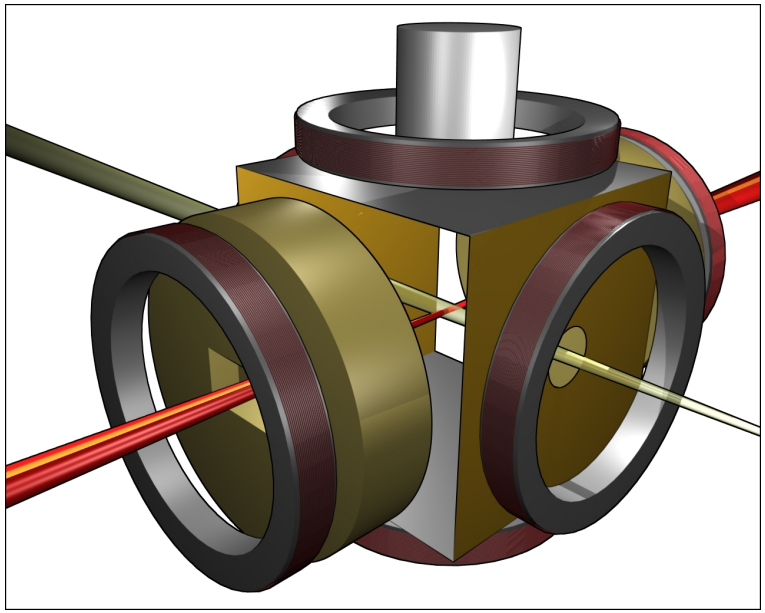


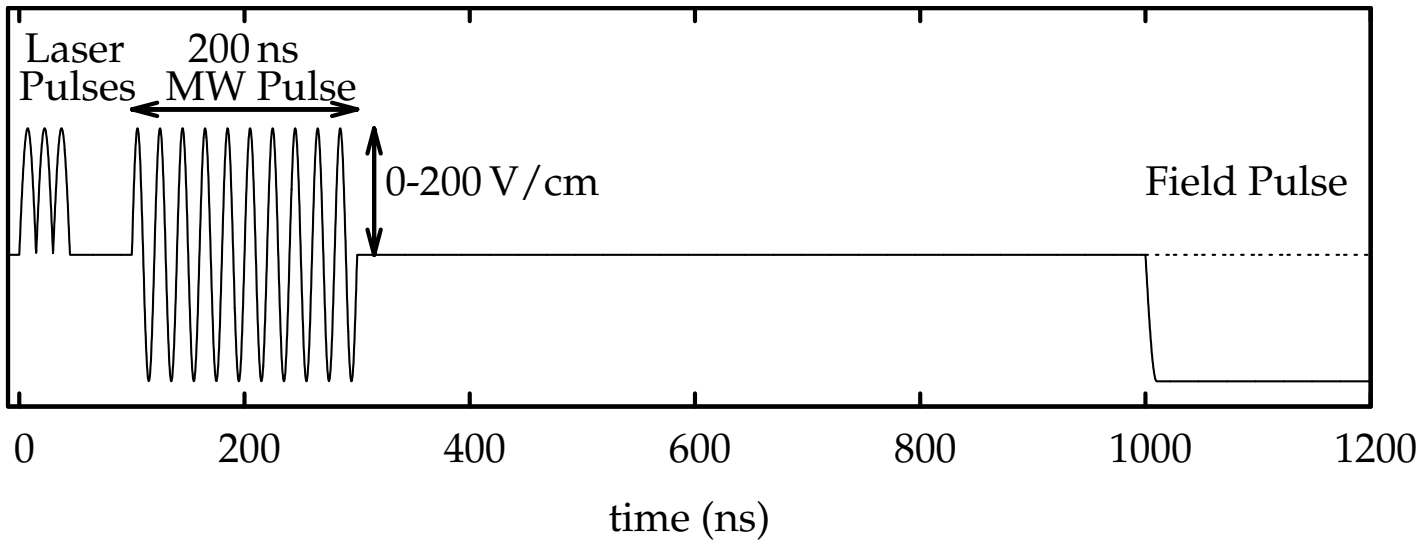




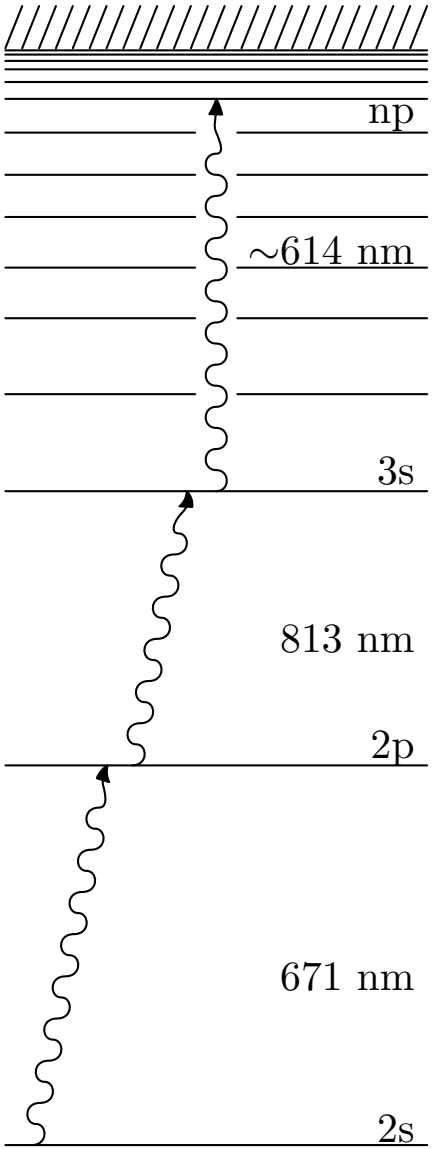
Experimental Setup

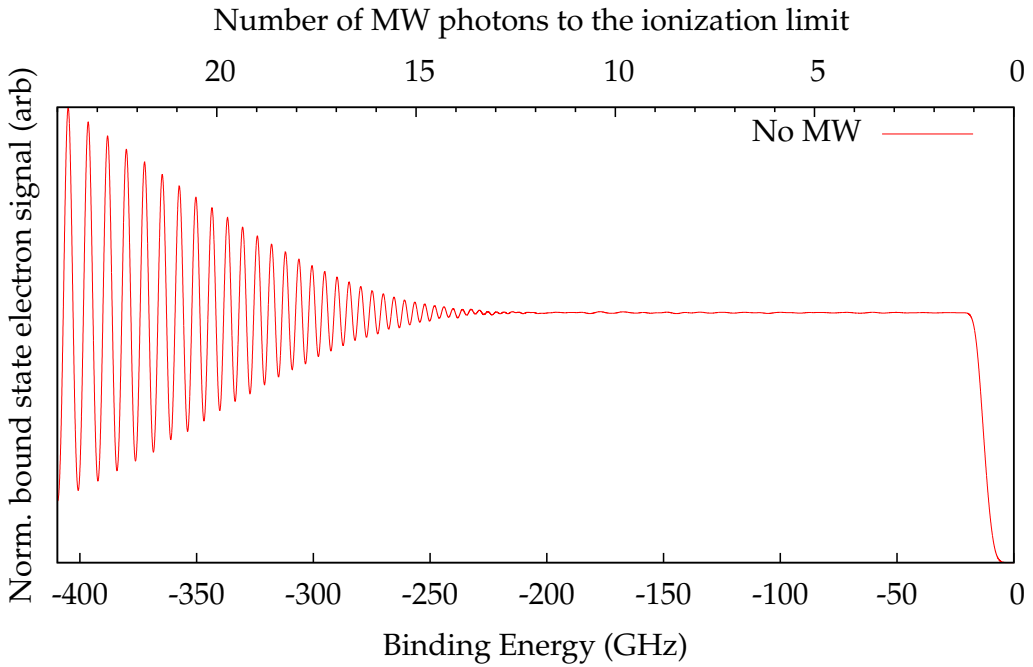


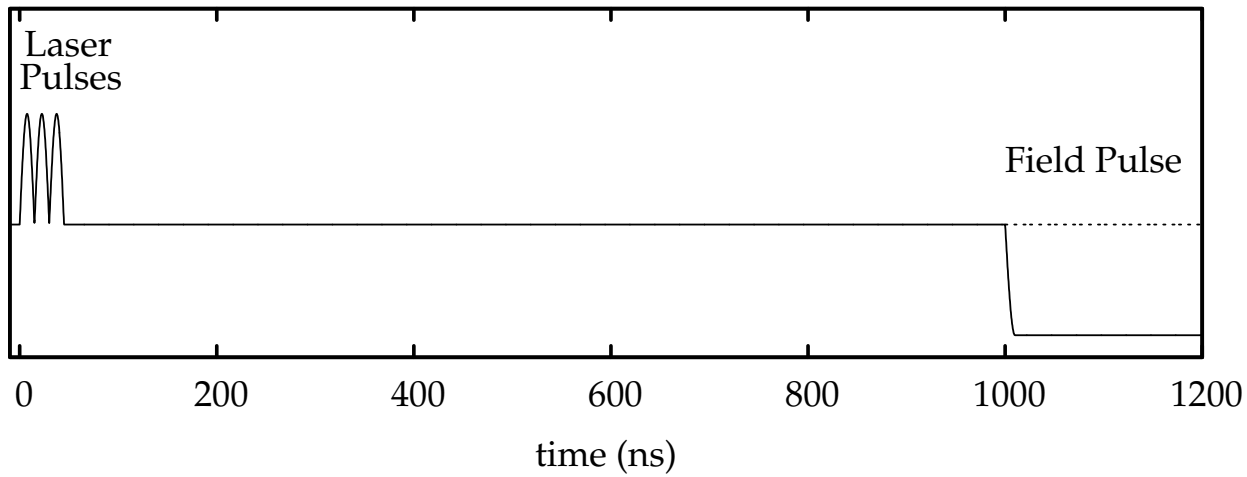




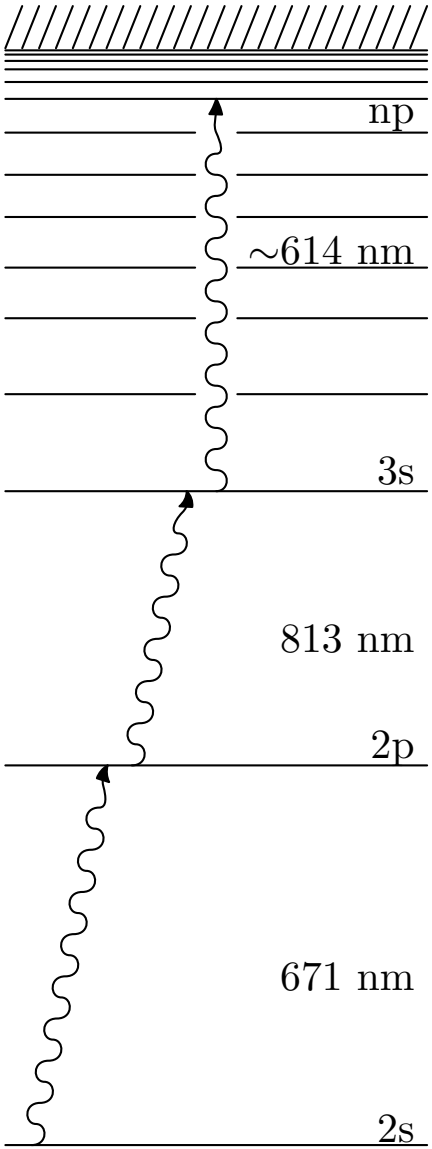
Expected Results

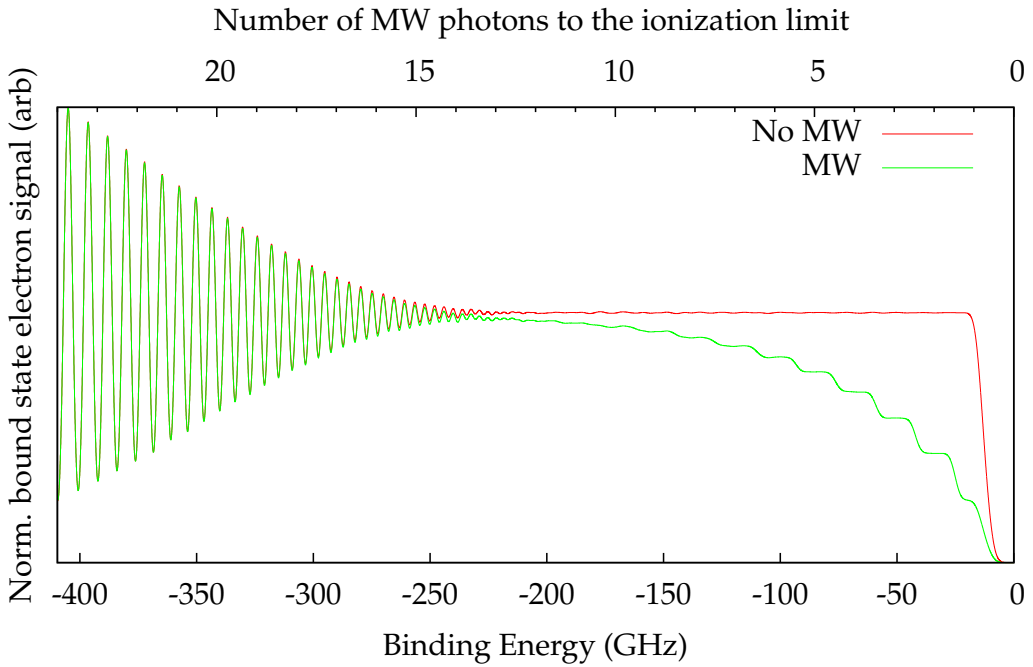


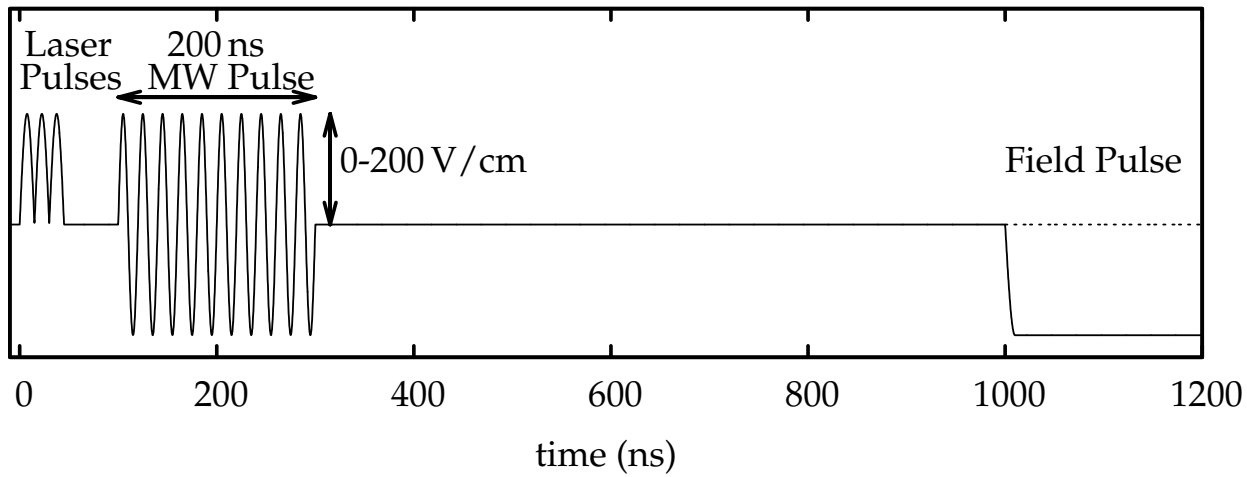




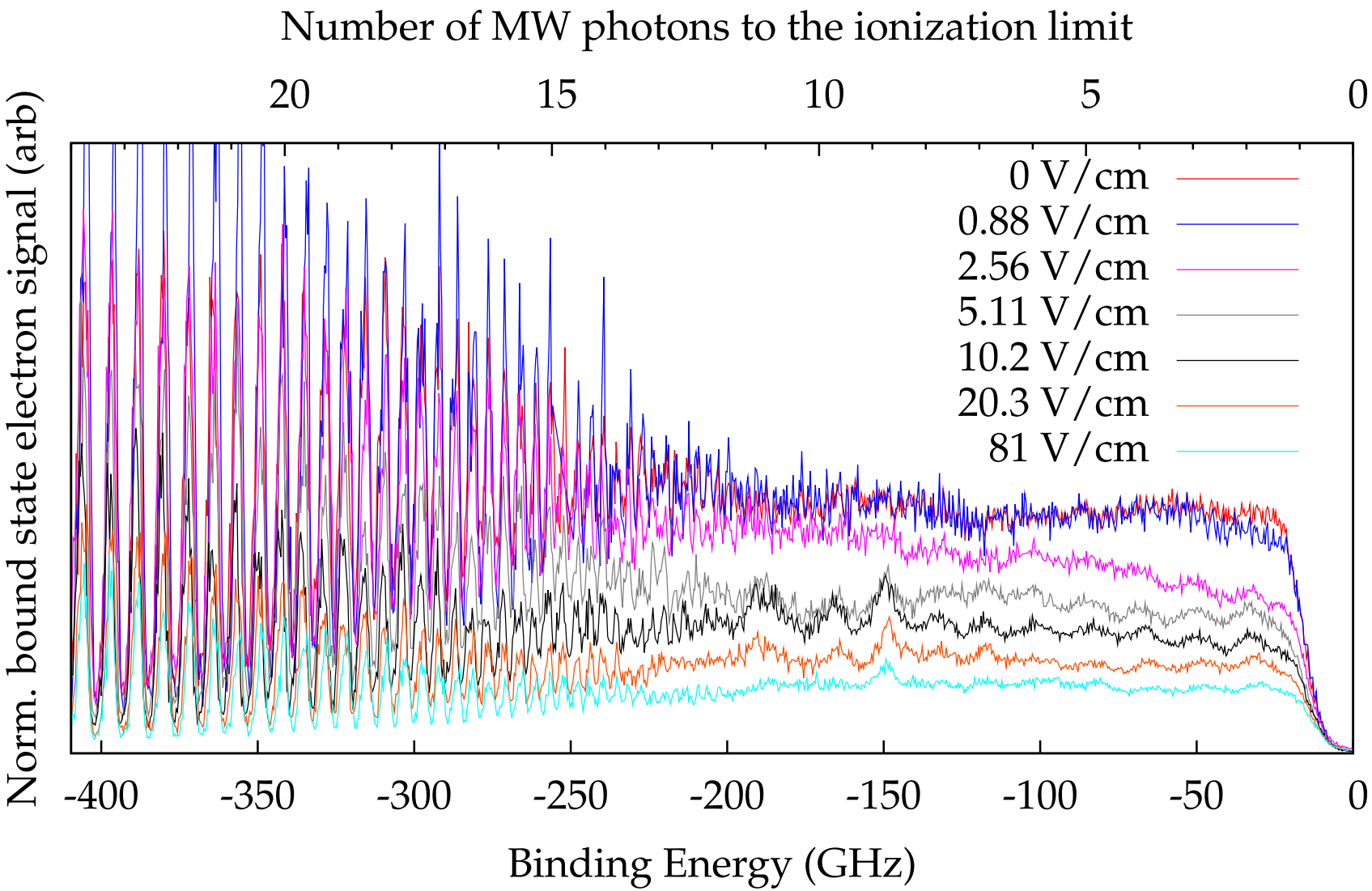
Expected Results



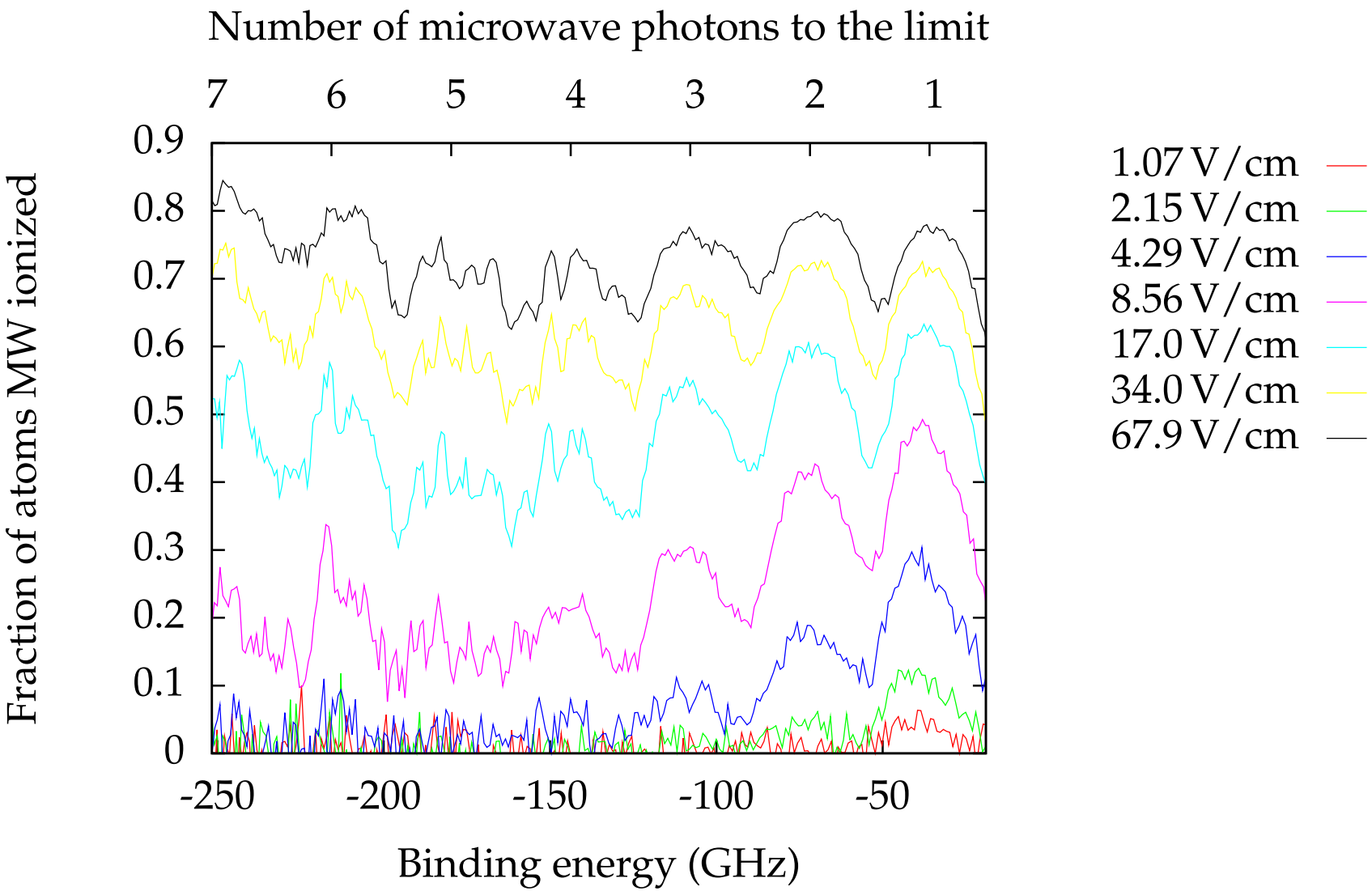




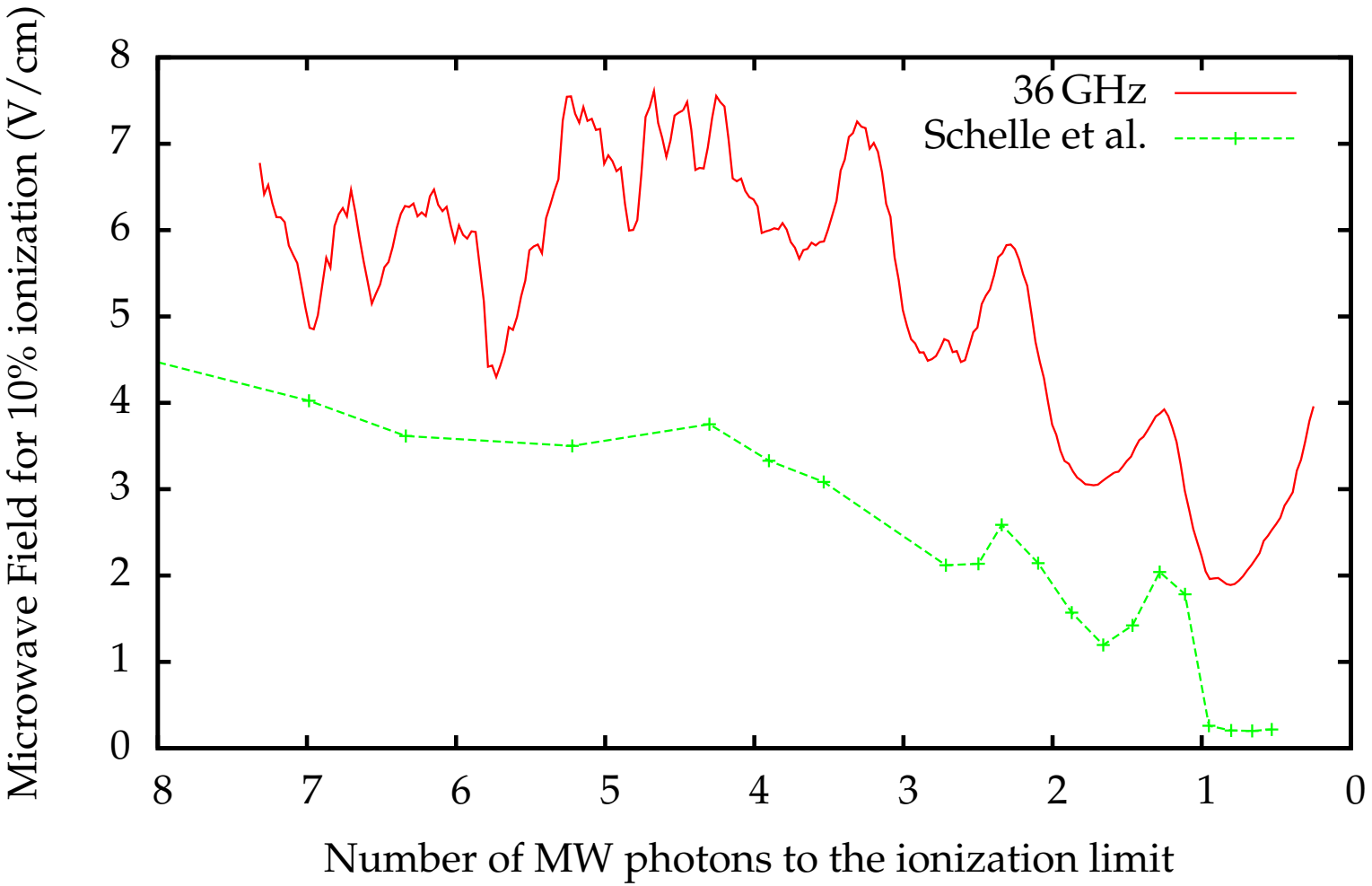
Microwave Ionization Steps - 17 GHz



Microwave Ionization Steps - 36 GHz

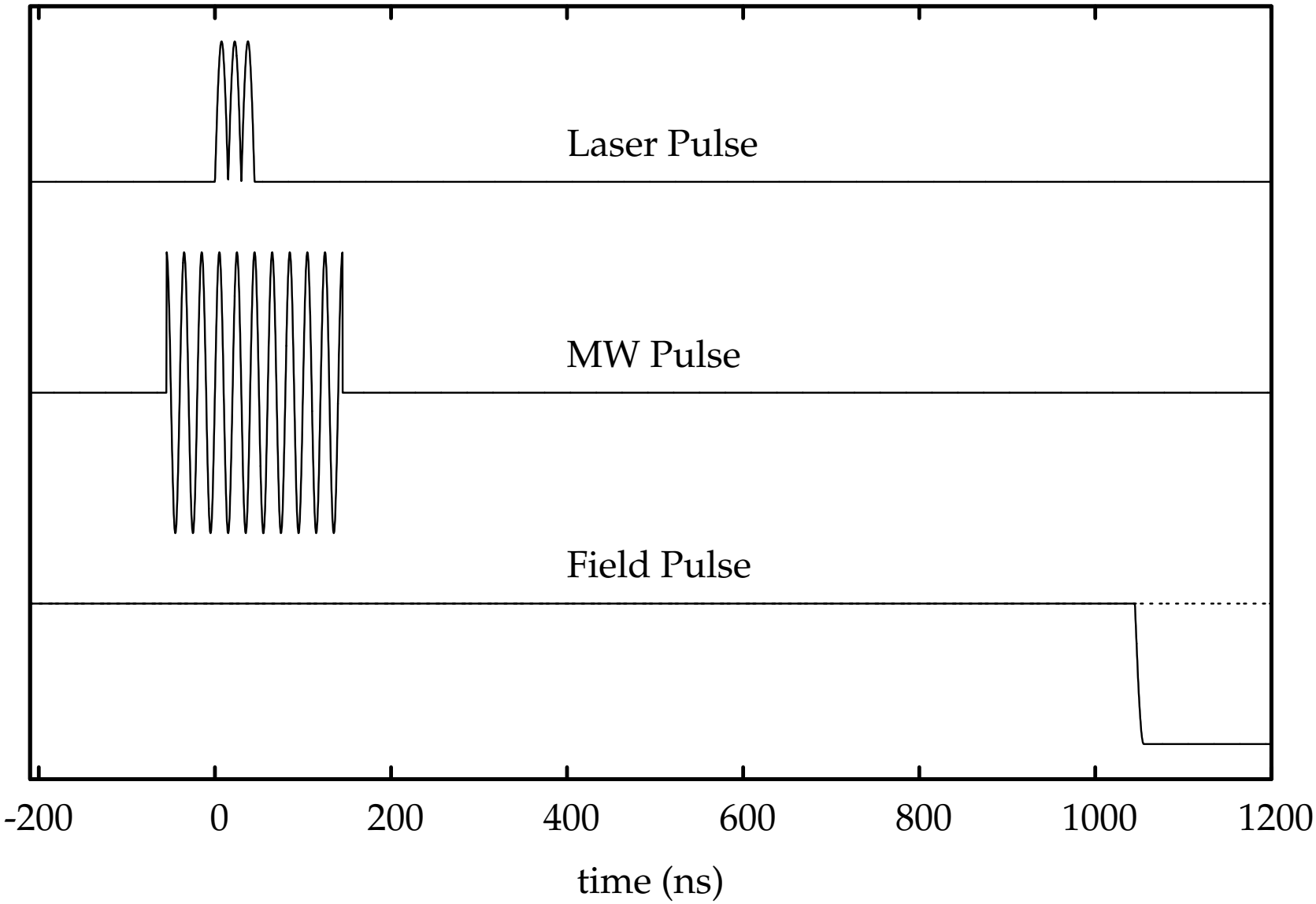


Schelle, Delande, and Buchleitner Comparison

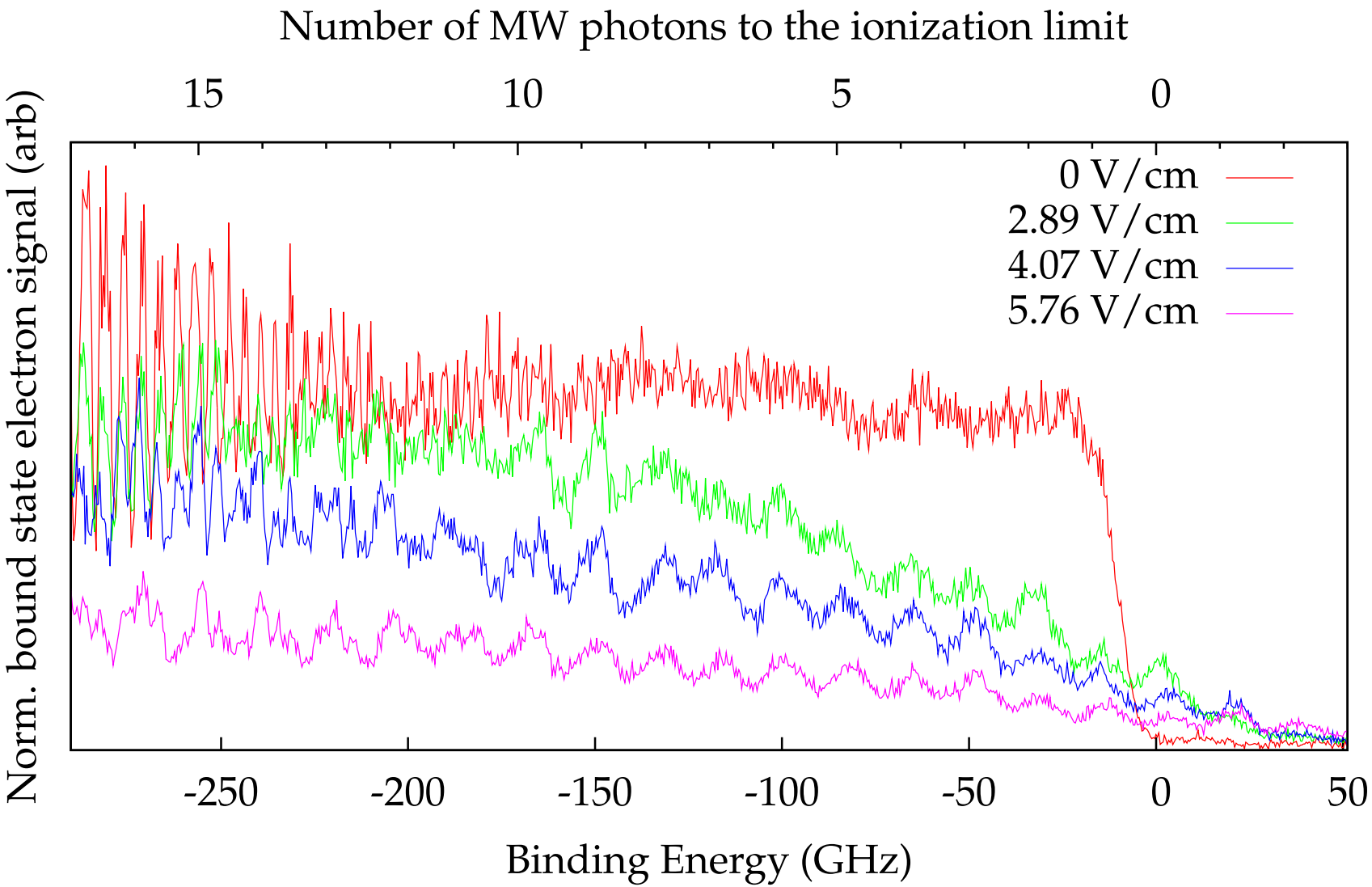


Schelle, Delande, and Buchleitner, *Phys. Rev. Lett.* 102, (2009).

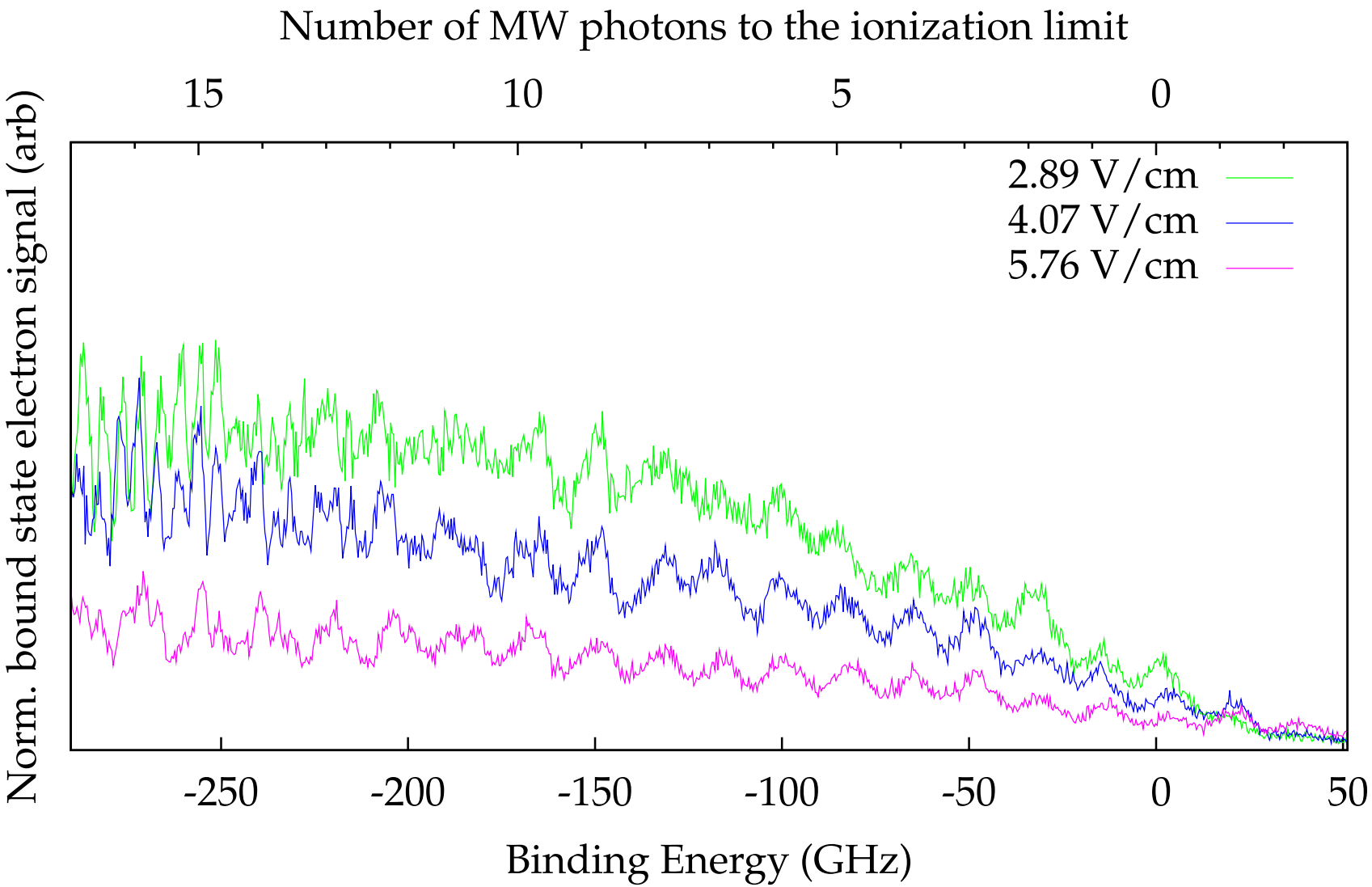
Above-Threshold Bound States - Timing



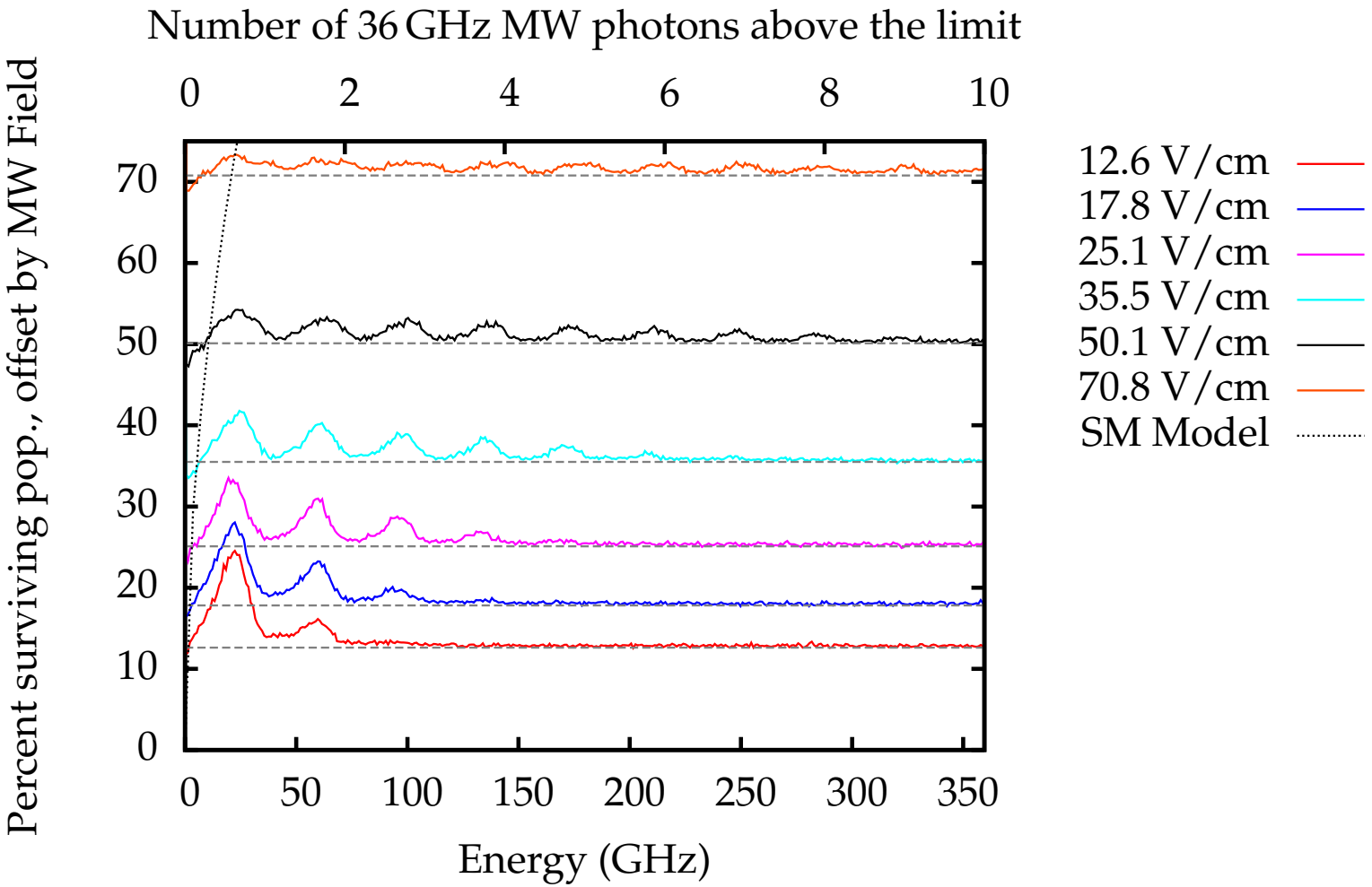
Above-Threshold Bound States



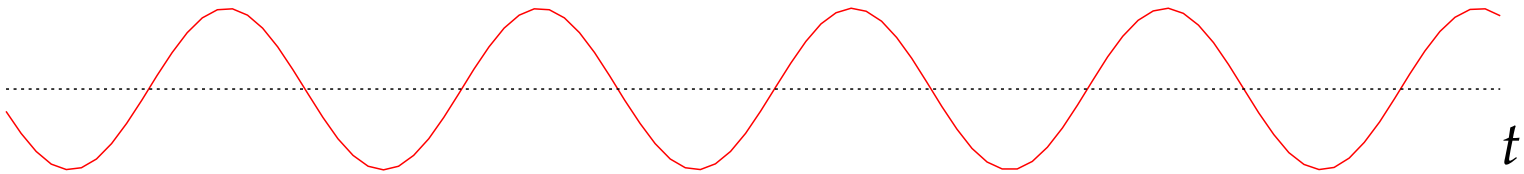
Above-Threshold Bound States



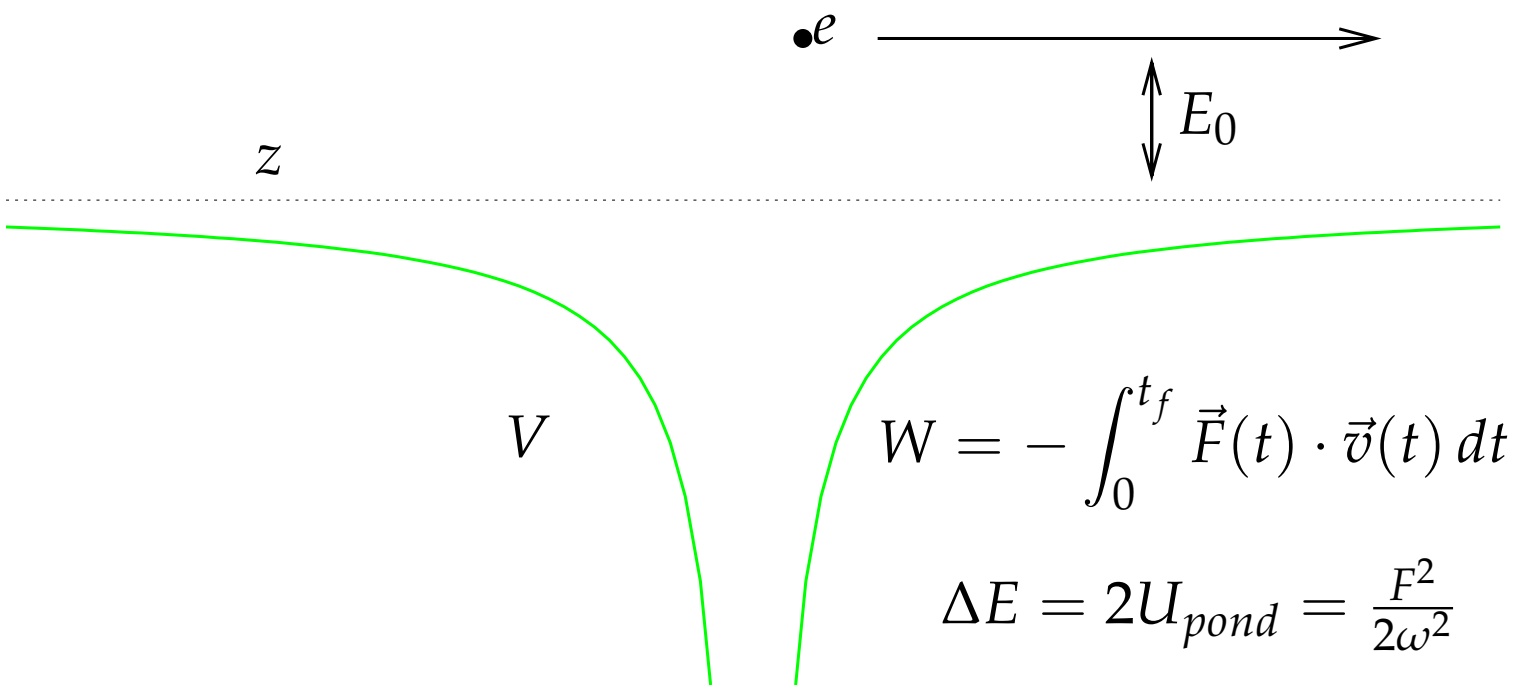
Above-Threshold Bound States



Simpleman's Model



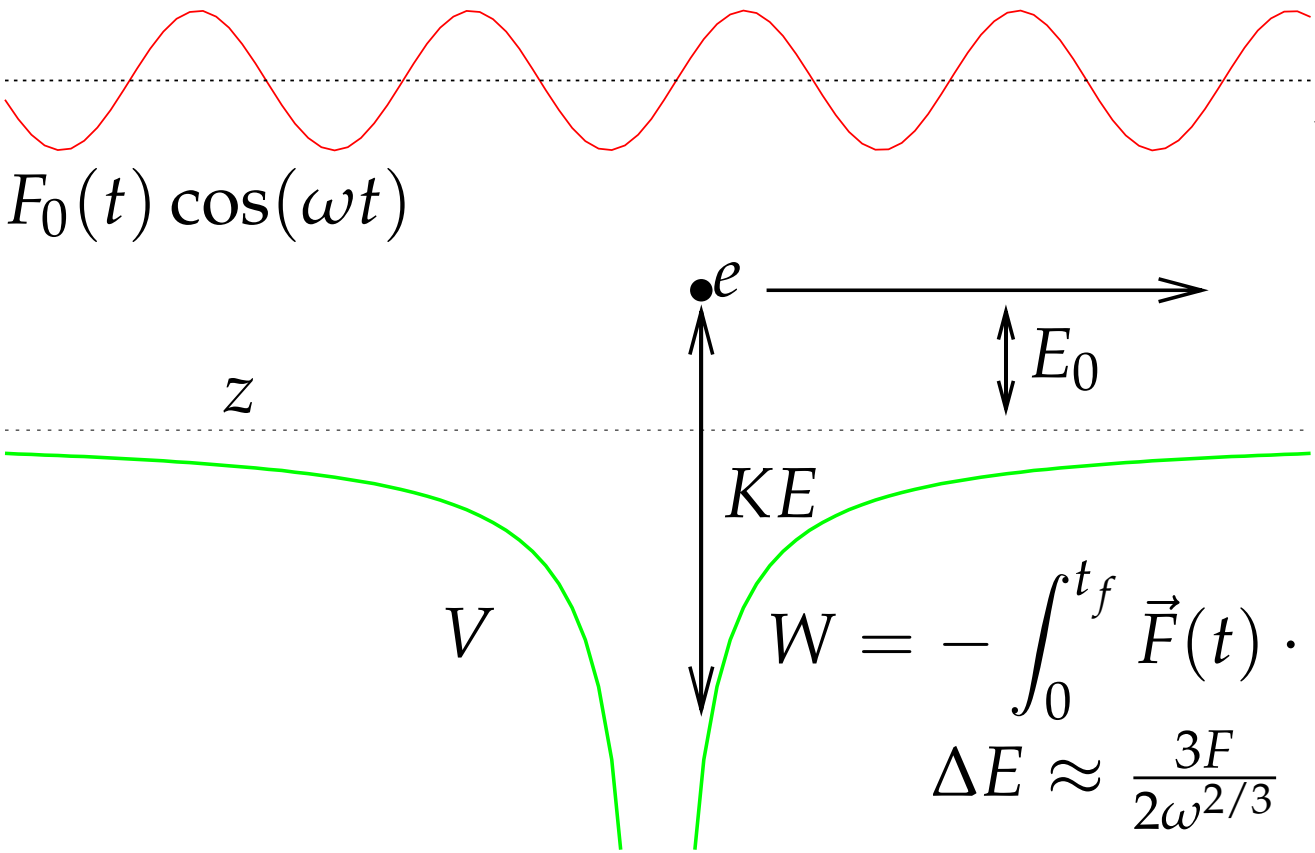
$F_0(t)\cos(\omega t)$



$$W = -\int_0^{t_f} \vec{F}(t)\cdot\vec{v}(t)\,dt$$

$$\Delta E = 2U_{pond} = \frac{F^2}{2\omega^2}$$

New Classical Model

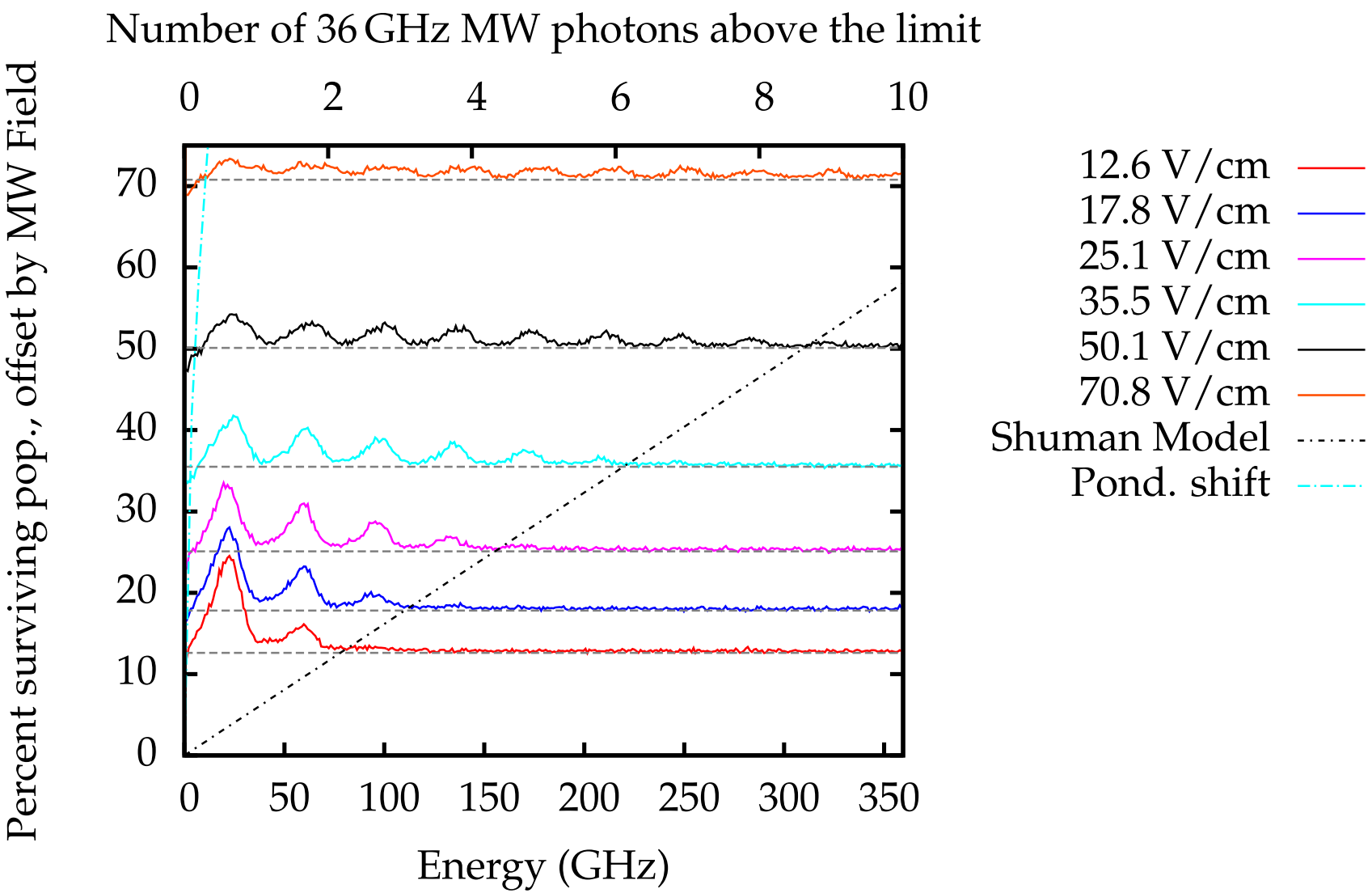


$$W = -\int_0^{t_f} \vec{F}(t) \cdot \vec{v}(t)\, dt$$

$$\Delta E \approx \frac{3F}{2\omega^{2/3}}$$

Shuman et al., *Phys. Rev. Lett.* 101, (2009).

Above-Threshold Bound States



Conclusions

- An Anderson Localization model crossing over to Fermi's Golden Rule does not match experimental results
- The coherent coupling of levels both above and below the ionization limit describes microwave ionization of Rydberg atoms near the ionization limit
- A simple classical model illustrates population transfer from above the limit to bound states