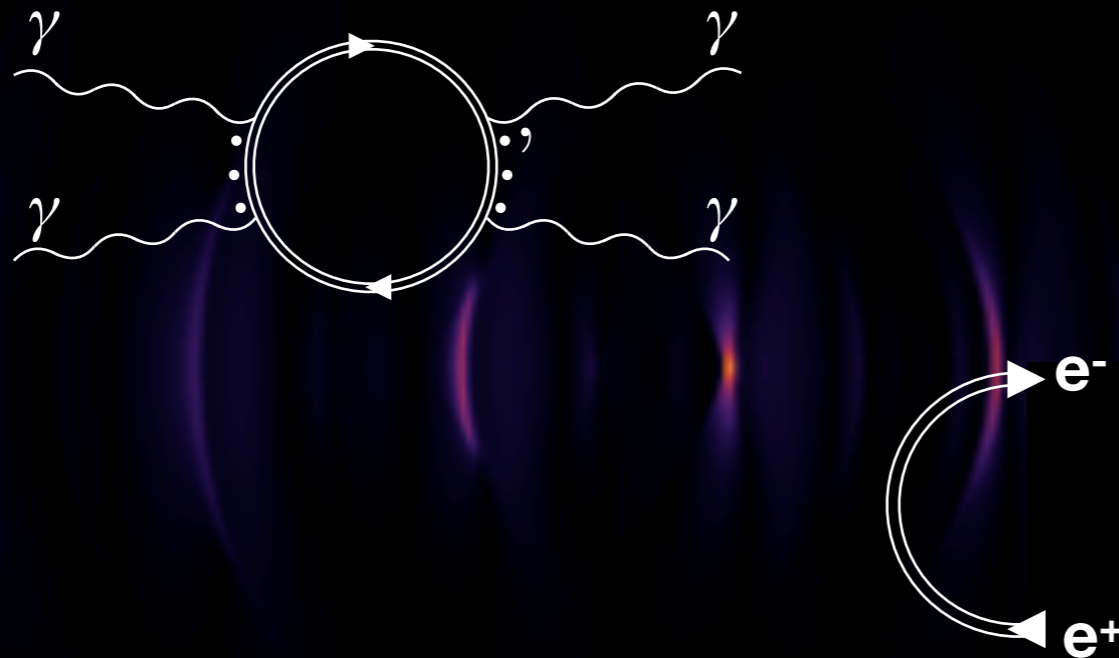

Vacuum strong-field QED

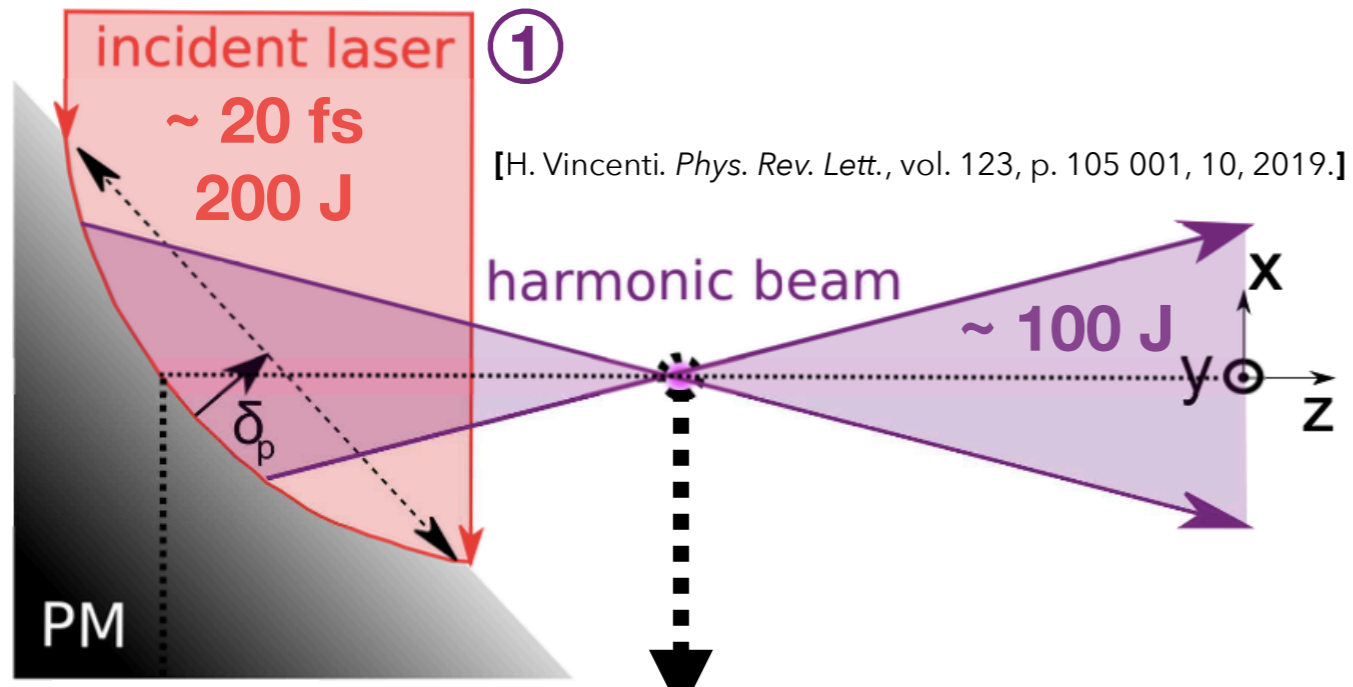
in the extremely intense light
of relativistic plasma mirrors



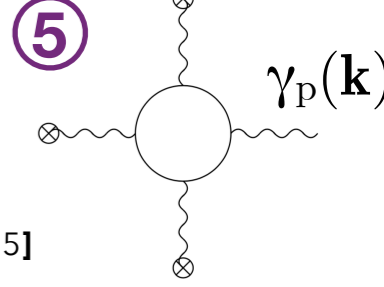
Antonin Sainte-Marie

CEA, IRAMIS, LIDyL, « Physics at high intensity » group — Saclay, France

2nd year Ph.D., dir. H. Vincenti

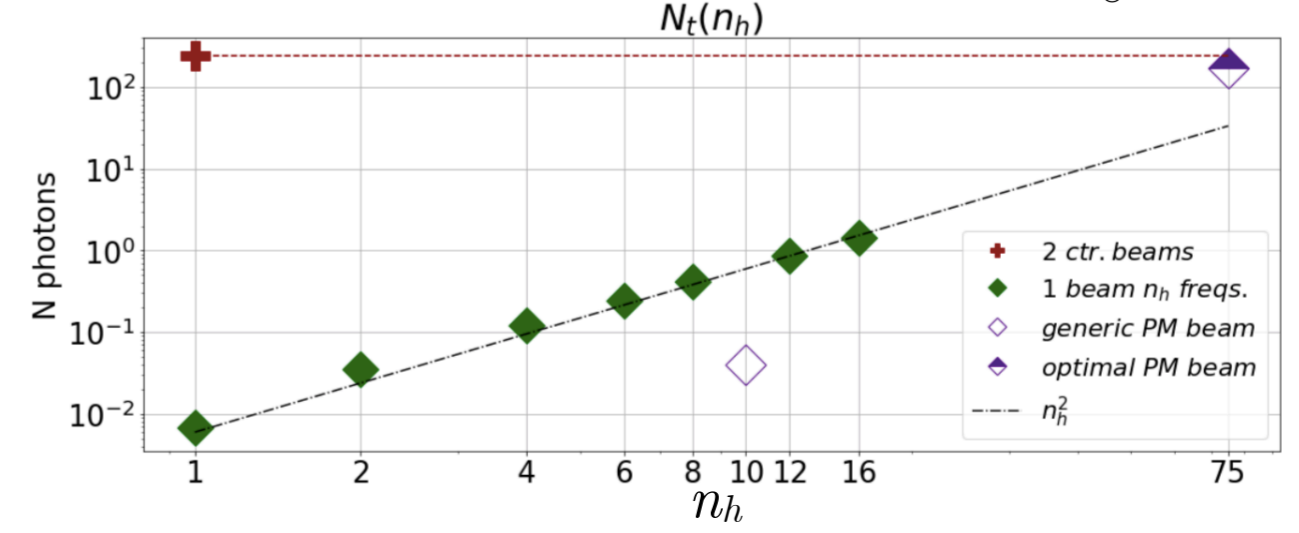


I - Photon-photon scattering

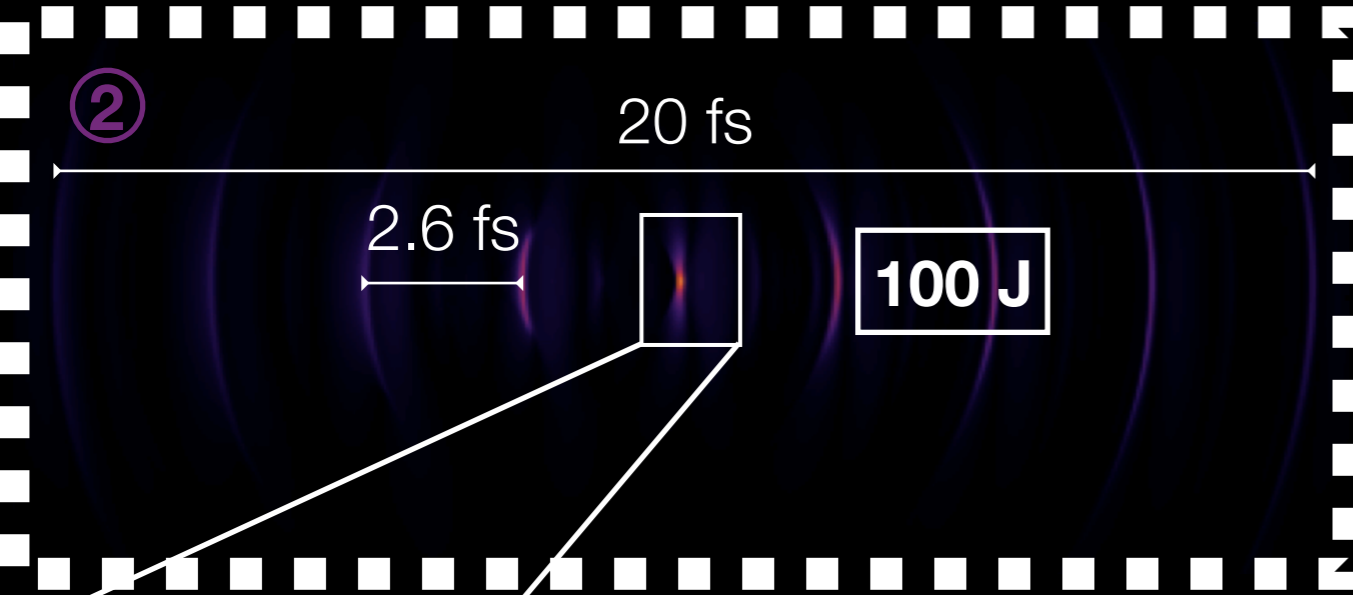


$$S_p(\mathbf{k}) = \langle 1_{\mathbf{k},p} | \Gamma_{\text{int}}^{(1)} [A] | 0 \rangle$$

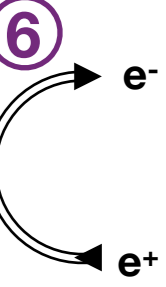
[F. Karbstein and R. Shaisultanov. *Phys. Rev. D*, 91 :113002, 2015]



\Rightarrow One single focused beam performs as good as two perfectly counterpropagating pulses

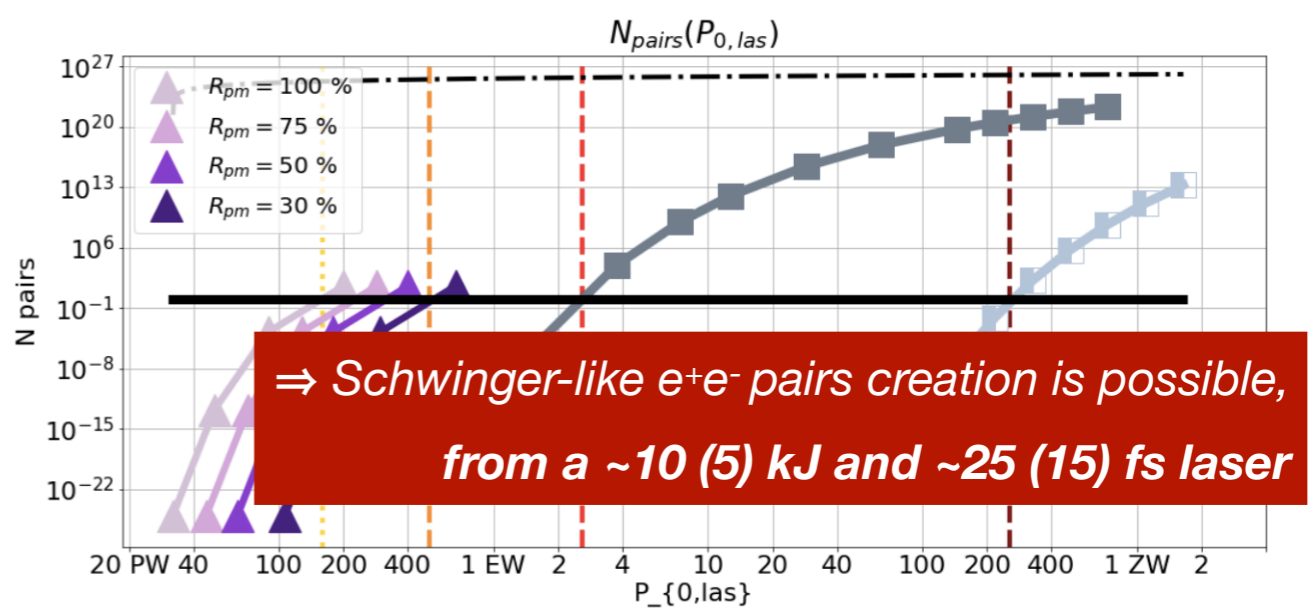


II - Electron-positron pairs creation



$$N_S \equiv \frac{1}{4\pi^2} \lambda_C^{-4} \int d^4x \epsilon \eta \coth\left(\frac{\pi\eta}{\epsilon}\right) \exp\left(-\frac{\pi}{\epsilon}\right)$$

[S. S. Bulanov, N. B. Narozhny, V. D. Mur, and V. S. Popov. *JETP*, vol. 102, no. 1, 2006]



③ $\sim 0.3 E_s$

20 nm ($\lambda_0/40$)

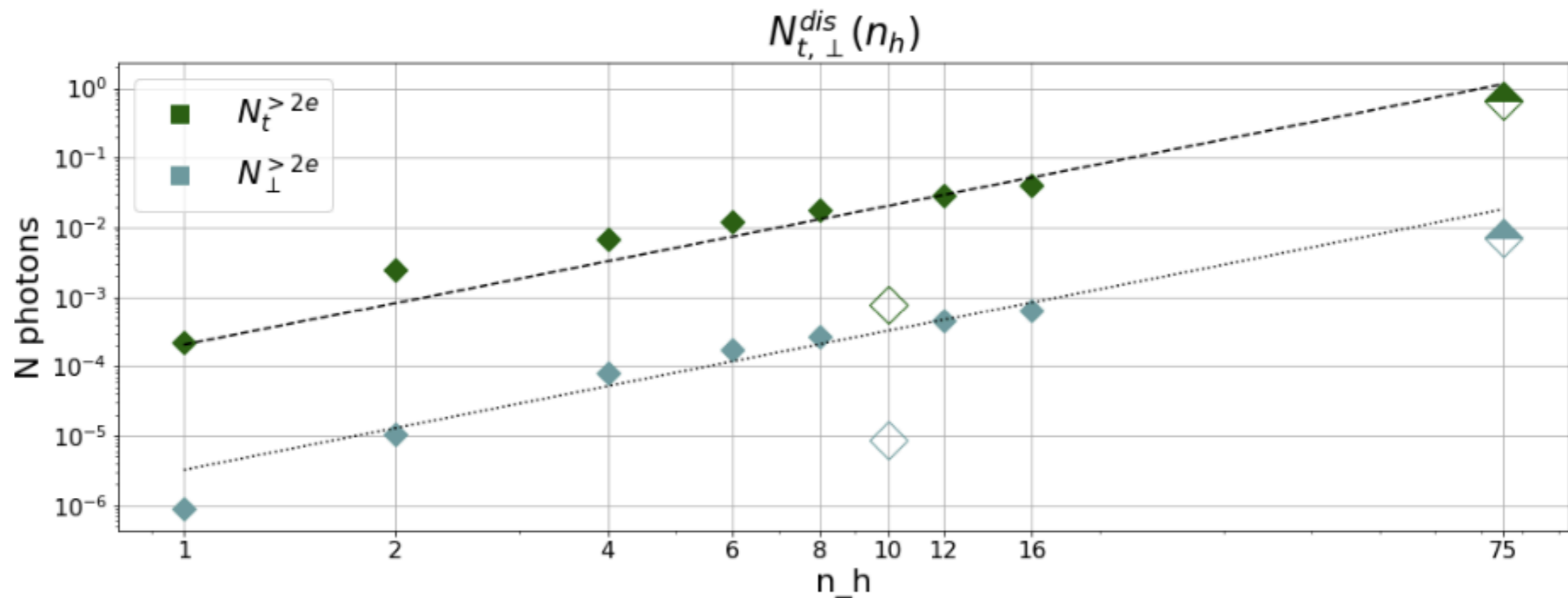
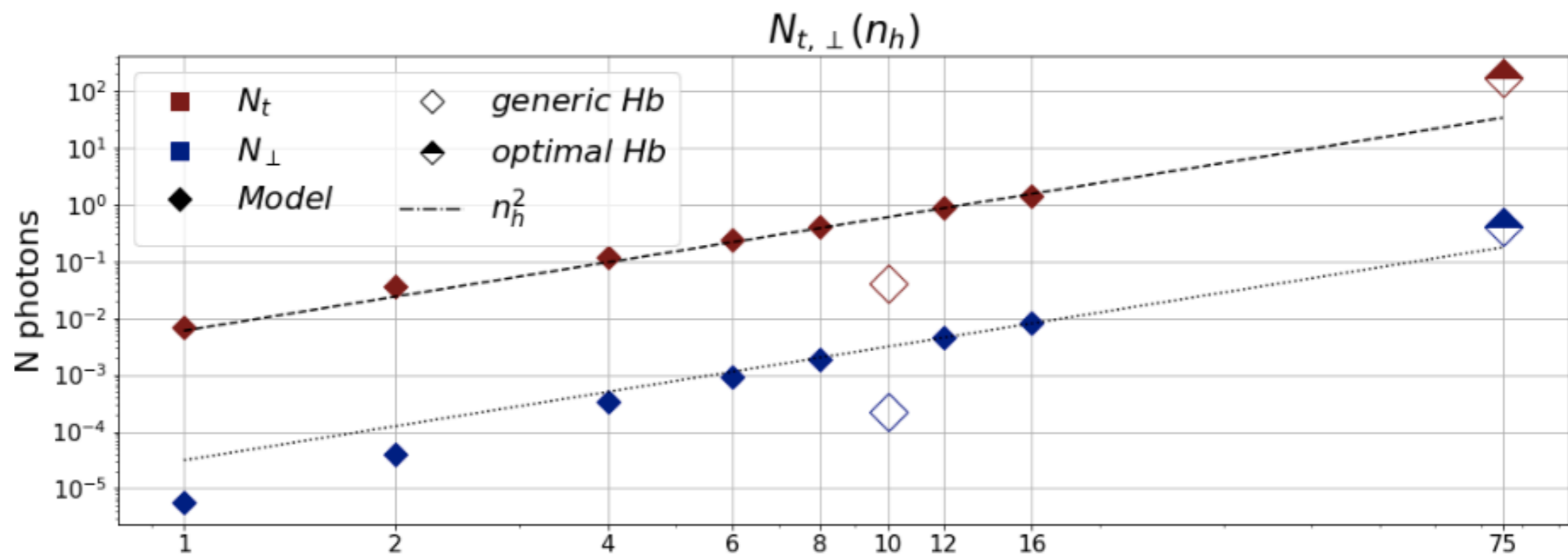
33 as ($\lambda_0/80$)

④ For a 10 PW laser, $I_{hb} \sim 10^{25-28} \text{ W.cm}^{-2}$

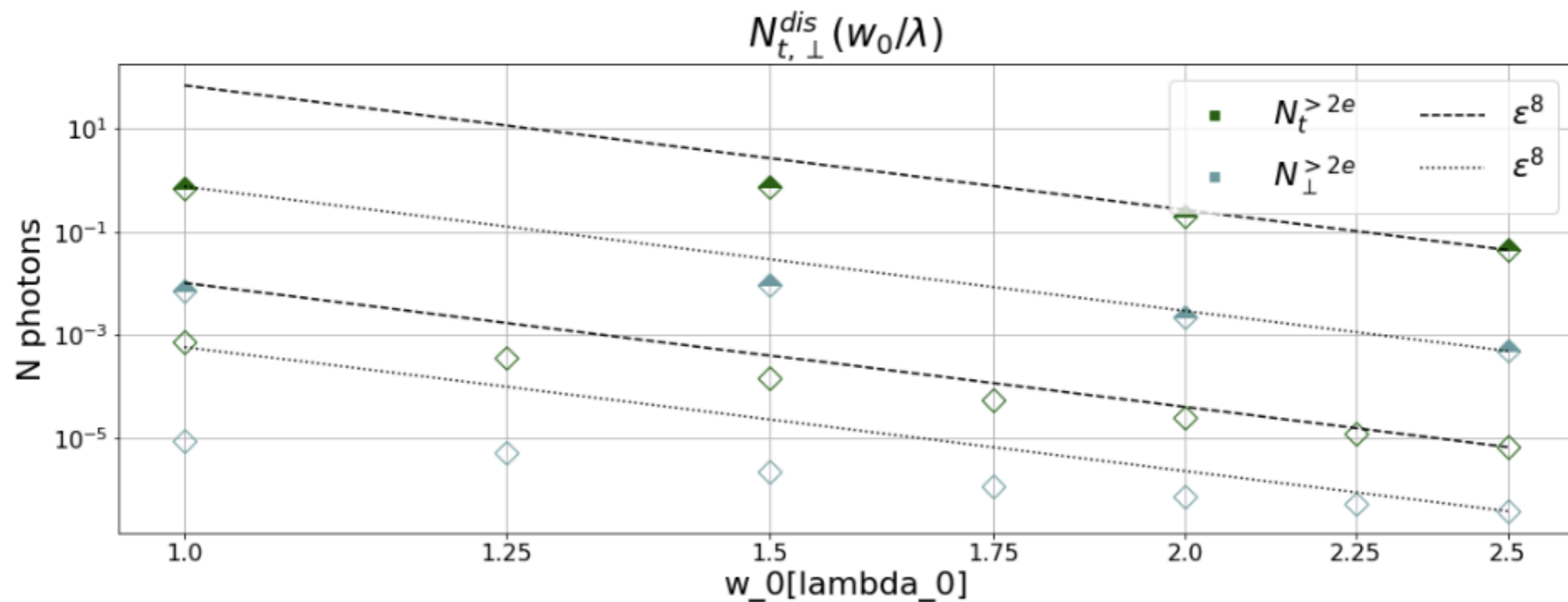
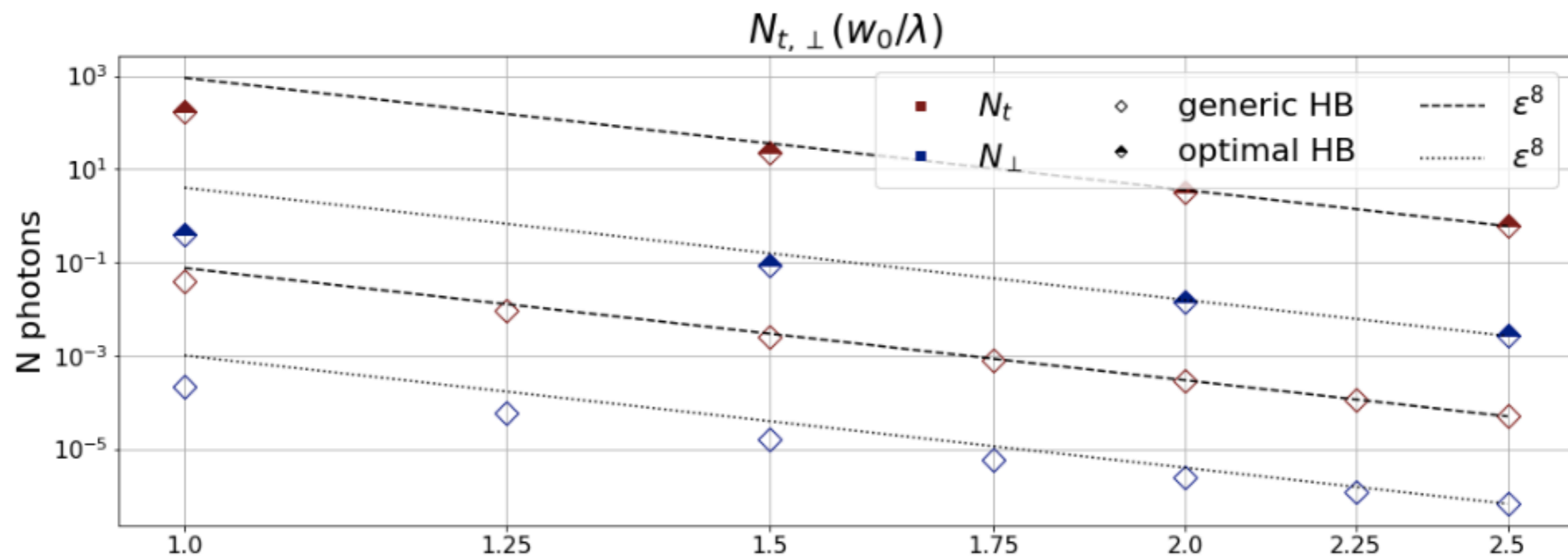
I - ϕ - ϕ scatterings

II - Schwinger e^+e^- production

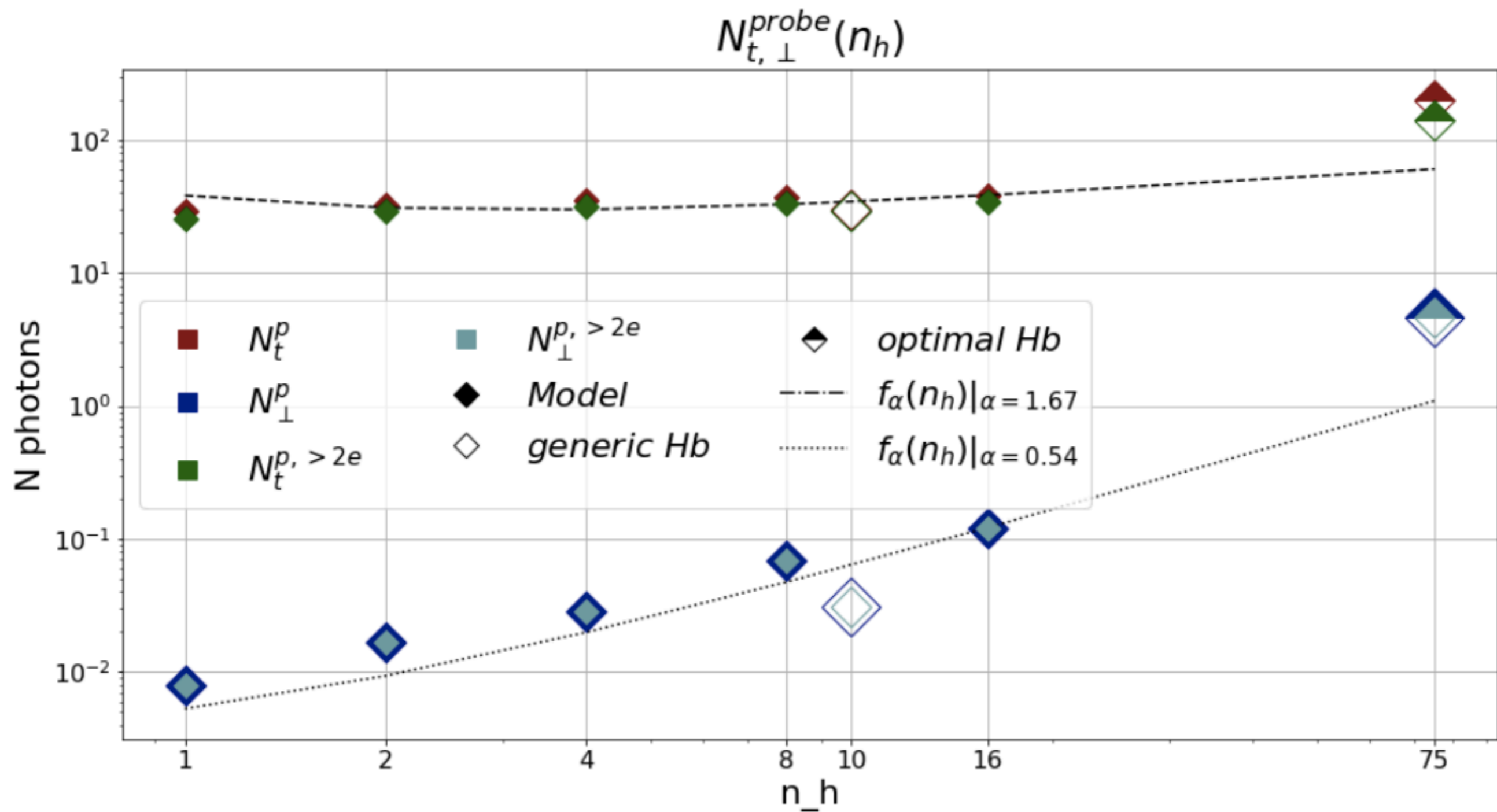
Backup I – Discernible CHF photons



Backup II – CHF photons (focusing)



Backup III – CHF+probe photons



Backup IV – Harmonic spectra out/in focus

