

# Possibility of Prolific Pair Production with High-Power Lasers

A. R. Bell, John G. Kirk, PRL **101**, 200403 (2008)

Notebook: Óscar Amaro, December 2022 @ GoLP-EPP

## **Introduction**

In this notebook we reproduce some results from the paper.

# Figure 1

```

In[263]:= Clear[λμm, I24, η, a, χ, τtr, τ, αf, Nγ, γ, η5]
λμm = 1;
αf =  $\frac{1}{137}$ ;

η5[I24_] := NSolve[I24 == 2.75 η4 + 0.28  $\frac{\eta}{\lambda\mu m}$ , η, Reals][[2, 1, 2]]
(* eq 5, implicit relation *)

χ[I24_] := 0.42 η5[I24]3/2 Sqrt[I24 λμm] (* after eq 6*)

τtr[I24_] := 0.06 (I24 λμm2)1/2 η5[I24]1/4 Exp[- $\frac{8}{\sqrt{3 \eta5[I24]}}$ ];
(* in-text, before eq 7 *)

τ[I24_] := 12.8 (I24 λμm2) Exp[- $\frac{4}{3 \chi[I24]}$ ]; (* in-text,
after eq 7. this is the expression for χ<<1 *)

γ[I24_] :=  $\frac{328 \text{Sqrt}[\eta5[I24] \lambda\mu m]}{0.511}$ ; (* in-text, after eq 6 *)
Nγ[I24_] := 6.42 αf γ[I24]; (* in-text, after eq 7 *)

Plot[{Log10[η5[10LogI-24]], Log10[χ[10LogI-24]], Log10[τtr[10LogI-24]],
  Log10[τ[10LogI-24]], Log10[Nγ[10LogI-24]]}, {LogI, 22, 25},
  PlotRange -> {-6, 2}, FrameLabel -> {"Log[I[W cm-2]]", "Log[η, τtr, χ, τ, Nγ]"},
  Frame -> True, AspectRatio -> 1.2, ImageSize -> Medium,
  PlotStyle -> {{Red, Dashed}, {Blue, Dashed}, {Red}, {Blue}, Cyan}, FrameTicks ->
  {{-6, -5, -4, -3, -2, -1, 0, 1, 2}, Automatic}, {{22, 23, 24, 25}, Automatic}},
  PlotLegends -> {"η", "χ", "τtr", "τ", "Nγ"}] // Quiet

```

