Towards critical and supercritical electromagnetic fields

M. Marklund, T. G. Blackburn, A. Gonoskov, J. Magnusson, S. S. Bulanov, A. Ilderton, arXiv:2209.11720v1 (2022)
Notebook: Óscar Amaro, January 2023 @ GoLP-EPP

Introduction

In this notebook we reproduce some results from the paper.

Figure 2

```
In[•]:= Clear[χ, a0, f, λ, P, αχ23, χa03, fχ3, γ0, ϵ0]
       Clear[A, R, Dnm]
       LogLogPlot[{A (Abs[(r + ct)/R]^1.5 + 1)^(-1) (Abs[ct/Dnm] + 1)^(-1) /.
         {A → 130, R → 0.2, Dnm → 0.3, ct → 0, r → coor 10^3},
         A (Abs[r/Dnm] + 1)^(-1) /. {A → 130, R → 0.2, Dnm → 0.3, r → coor 10^3}},
         {coor, 10^-5, 10^1}, PlotRange → {10^-6, 10^2.1},
         PlotLegends → {"t=0", "|x|+ct=0"}]
```


Out[•]=
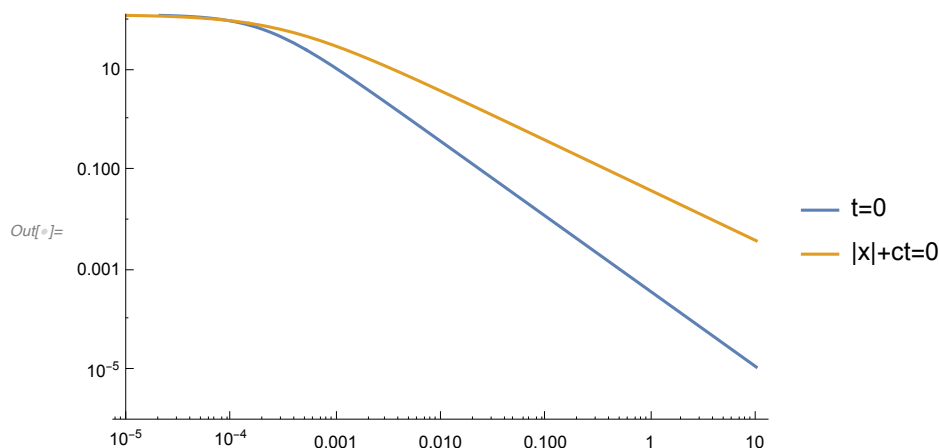
Appendix A

```
In[54]:= Clear[χ, a0, f, λ, P, αχ23, χa03, fχ3, γ0, ϵ0]


χ = 3.7 ϵ0 P^0.5 / λ; (*[]*)
a0 = 780 P^0.5;
f = 3.6 × 10^-6 P / λ^2;
αχ23 = 0.017 ϵ0^(2/3) P^(1/3) / λ^(2/3);
χa03 = 7.8 × 10^-9 ϵ0 / P / λ;
fχ3 = 7 × 10^-8 λ / ϵ0^3 / P^0.5;


γ0 = 2 × 10^4;
ϵ0 = γ0 0.511 × 10^-3; (* [GeV] *)


imgsz = 250;
GraphicsRow[{
  LogLogPlot[{χ /. {λ → 0.8}, χ /. {λ → 0.8 / 3}, χ /. {λ → 0.8 / 10}},
   {P, 0.01, 100}, AspectRatio → 2, ImageSize → imgsz, Frame → True,
   PlotLabel → "χ", FrameLabel → {"input power [PW]", ""},
   PlotRange → {2, 9000}, PlotStyle → {Red, Orange, Blue}],
  LogLogPlot[{a0 /. {λ → 0.8}, a0 /. {λ → 0.8 / 3}, a0 /. {λ → 0.8 / 10}},
   {P, 0.01, 100}, AspectRatio → 2, ImageSize → imgsz, Frame → True,
   PlotLabel → "a0", FrameLabel → {"input power [PW]", ""},
   PlotRange → {60, 10^4}, PlotStyle → {Red, Orange, Blue}],
  LogLogPlot[{αχ23 /. {λ → 0.8}, αχ23 /. {λ → 0.8 / 3}, αχ23 /. {λ → 0.8 / 10}},
   {P, 0.01, 100}, AspectRatio → 2, ImageSize → imgsz, Frame → True,
   PlotLabel → "αχ^2/3", FrameLabel → {"input power [PW]", ""},
   PlotRange → {0.01, 2}, PlotStyle → {Red, Orange, Blue}],
  LogLogPlot[{χa03 /. {λ → 0.8}, χa03 /. {λ → 0.8 / 3}, χa03 /. {λ → 0.8 / 10}},
   {P, 0.01, 100}, AspectRatio → 2, ImageSize → imgsz, Frame → True,
   PlotLabel → "χ/a0^3", FrameLabel → {"input power [PW]", ""},
   PlotRange → {7 × 10^-8, 2 × 10^-4}, PlotStyle → {Red, Orange, Blue}],
  LogLogPlot[{fχ3 /. {λ → 0.8}, fχ3 /. {λ → 0.8 / 3}, fχ3 /. {λ → 0.8 / 10}},
   {P, 0.01, 100}, AspectRatio → 2, ImageSize → imgsz, Frame → True,
   PlotLabel → "f/χ^3", FrameLabel → {"input power [PW]", ""},
   PlotRange → {8 × 10^-13, 5 × 10^-10}, PlotStyle → {Red, Orange, Blue}]
 }, Spacings → 0, ImageSize → 800]
```

Out[64]=