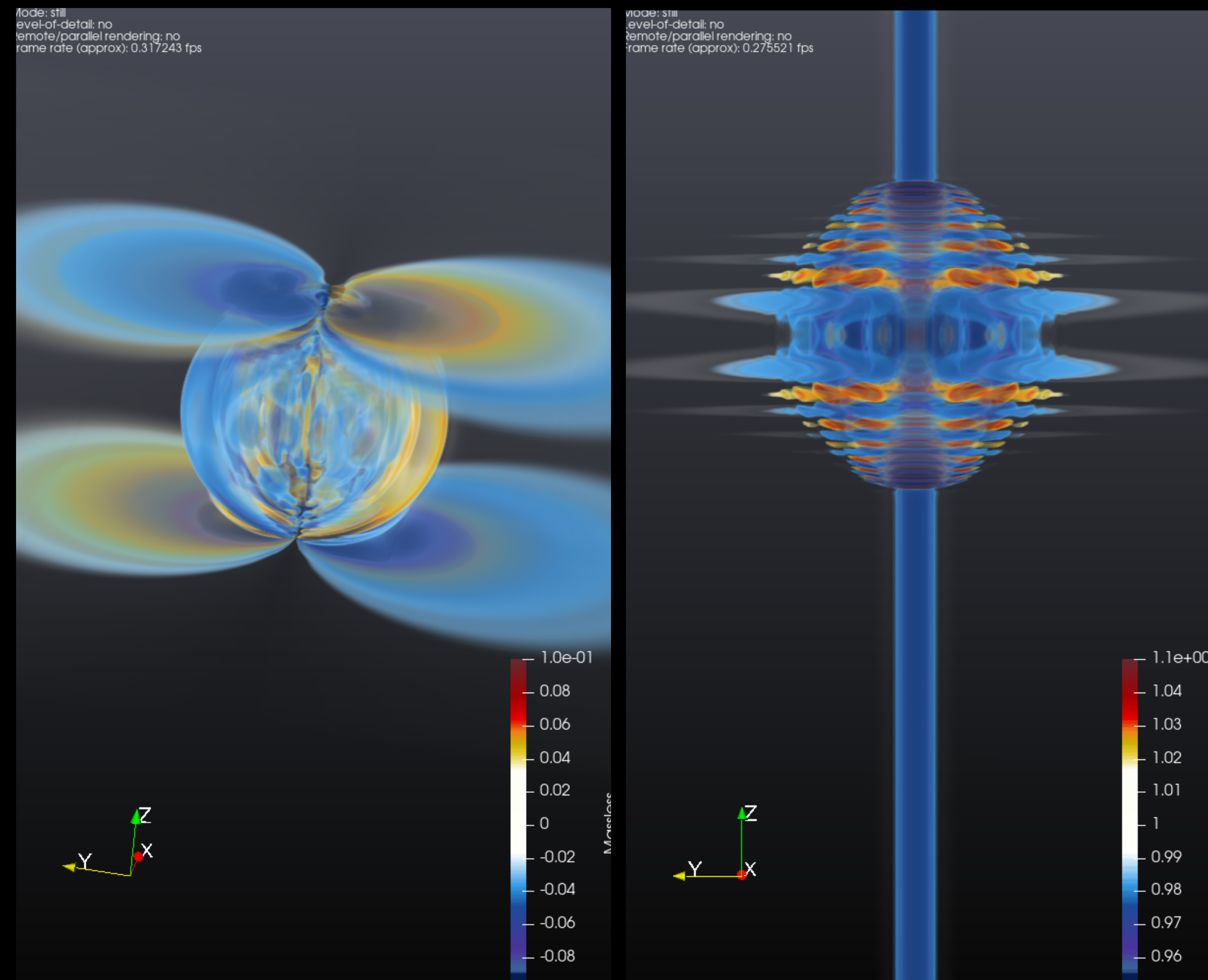
Burst Signals from Axion String Travelling Wave Collisions



Amelia Drew, 15th May 2024
Junior Research Fellow, Homerton College/DAMTP,
University of Cambridge

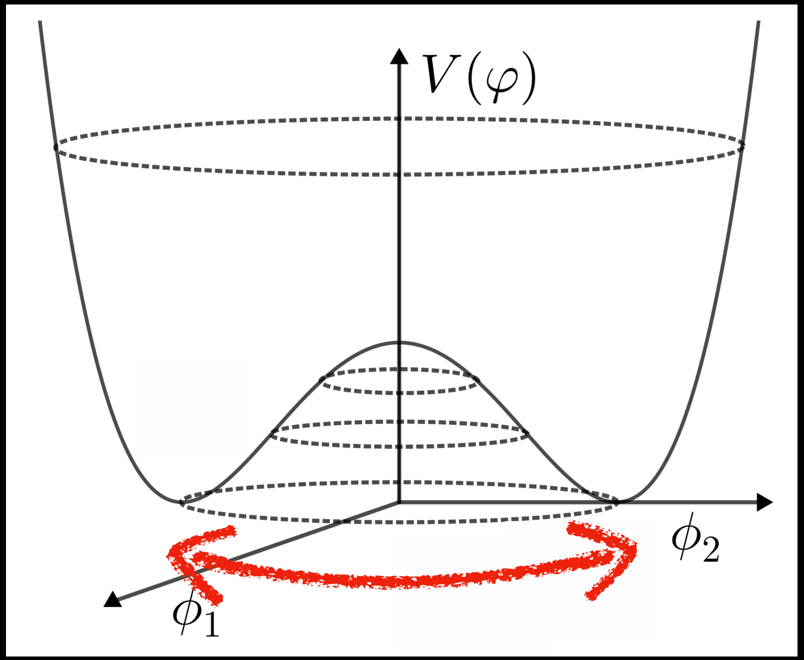
Motivation

- Spontaneous $U(1)$ symmetry breaking of complex scalar field ϕ in BSM theory → axion strings
- Strings radiate axions, massive particles and gravitational waves
- String tension $\mu \sim 2\pi f_a^2 \ln(R\sqrt{\lambda} f_a)$ depends on its curvature R
- Balance of energy emission between channels depends on R → important for axion mass and GW predictions

$$\phi = |\phi| e^{i\theta(x^\mu)}$$

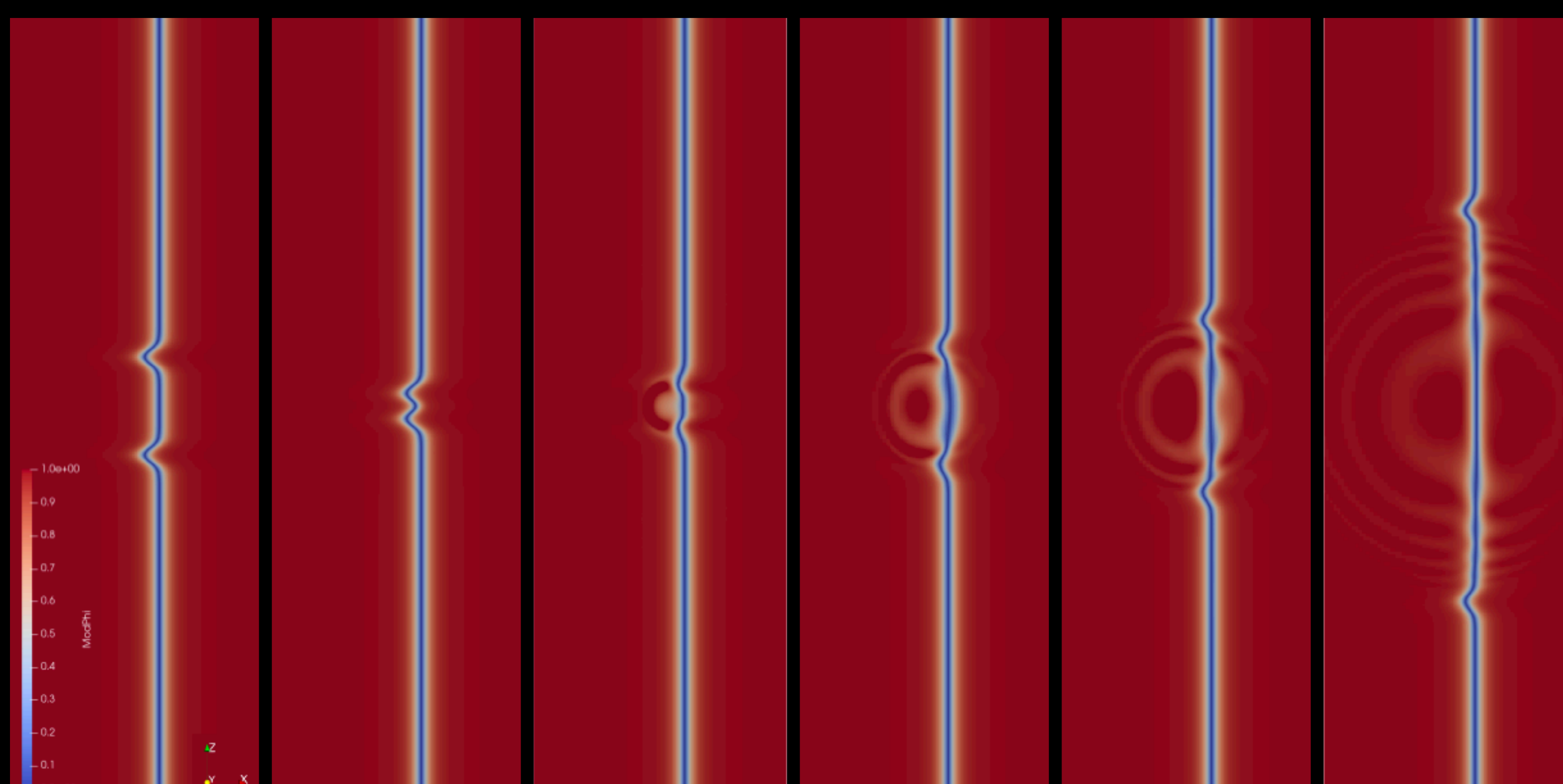
$$\mathscr{L} = \partial^\mu \bar{\phi}\, \partial_\mu \phi - V(\phi)$$

$$V(\phi) = \frac{\lambda}{4}(|\phi|^2 - f_a^2/2)^2$$

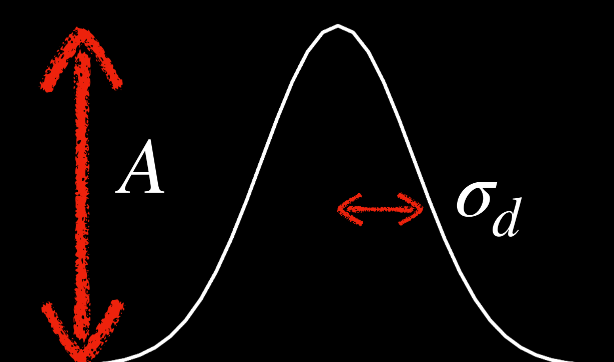


Investigation

- We investigate the effect of R on different energy loss channels for burst signal sources [AD, Kinowski, Shellard (2023)]
- Implement colliding travelling wave ICs [Vachaspati, Vachaspati (1990)] and evolve:



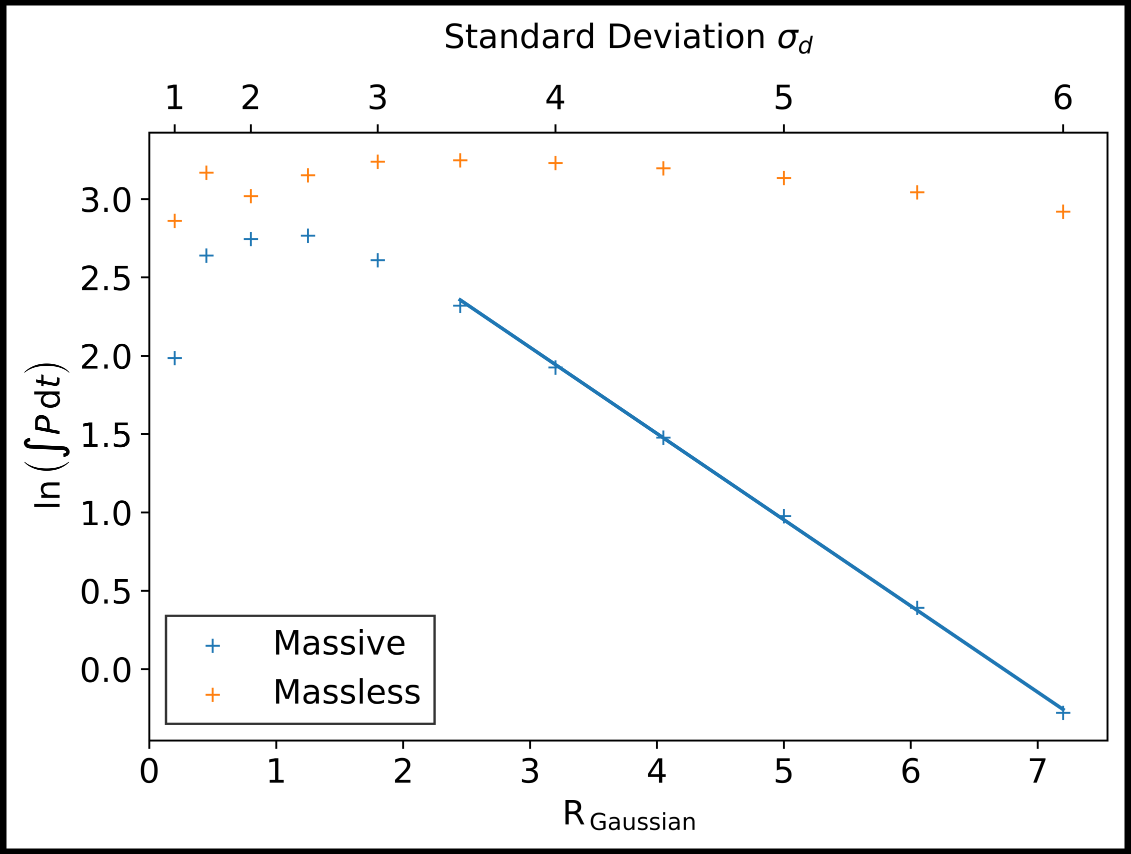
$$R_{\text{max}} \sim \frac{\sigma_{\text{d}}^2}{A}$$

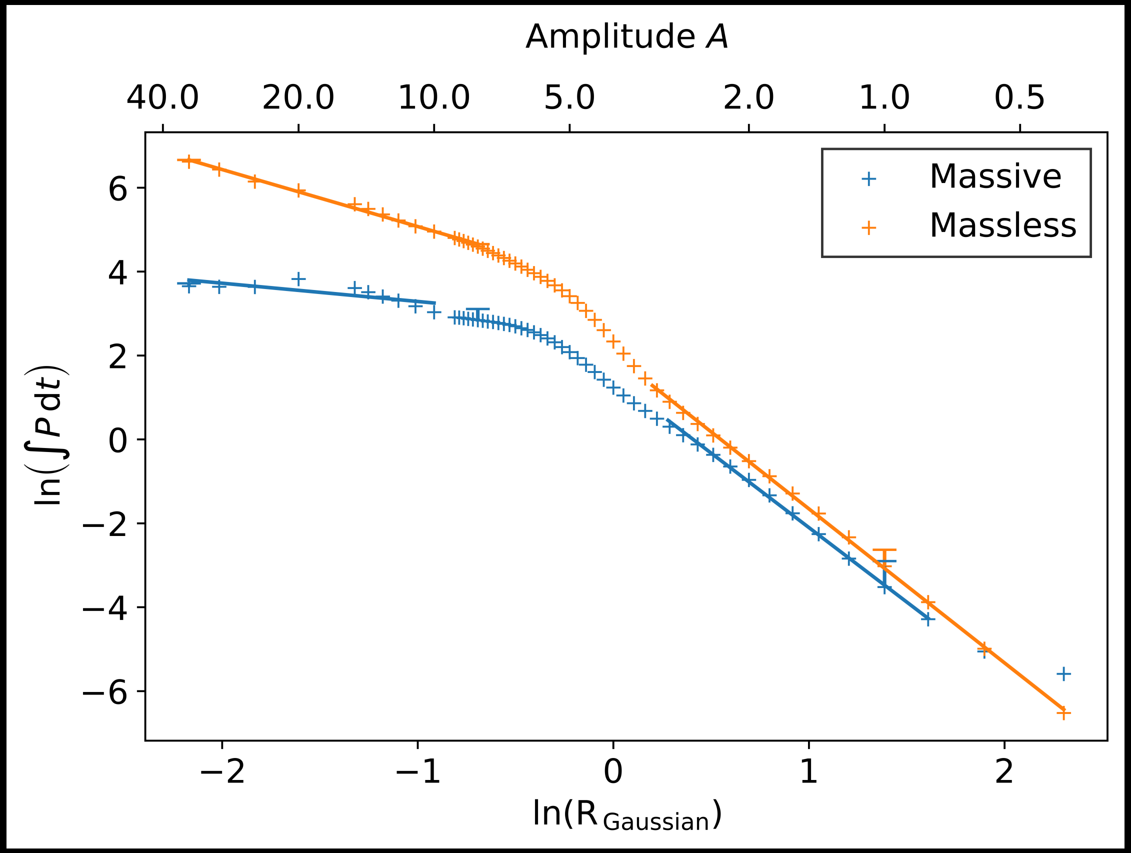


Conclusion

- Balance of energy emission between channels depends on R!
- Sparks many questions:
  - What does this mean for post-inflationary axion mass?
  - Is this useful for GW burst signal predictions?
  - Can we link this to semi-analytic models eg. velocity one-scale model (VOS)?
- Please come and find me!

$A = 5$





$\sigma_{\rm d} = 2$