

# The Mass Profile of Boson Stars

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## *Definition:*

*A boson star is a star made out of bosons.*

# What are Bosons?



Figure: Satyendra Bose

## *Definition:*

*Bosons are particles that can simultaneously exist in the same quantum state.*

## Are Boson stars boring?

- No Boson stars have been discovered yet.
- Boson stars could be composed of an unknown type of Boson.
- Boson stars might lead to new insight into particle physics and cosmology.

F. E. Schunck and E. W. Mielke, "General relativistic boson stars," *Class. Quant. Grav.* 20 (2003) R301–R356, arXiv:0801.0307 [astro-ph].

# How can we find Boson stars?

- Boson stars might be transparent.\*
- No boson stars have been found yet.
- But gravitational wave detectors provide new way to search for boson stars.

\*F. E. Schunck and E. W. Mielke, “General relativistic boson stars,” *Class. Quant. Grav.* 20 (2003) R301–R356, arXiv:0801.0307 [astro-ph].

# What are we doing?

- We are calculating the gravitational waves of a boson star circling a super-massive black hole.
- To do that, we need to know how mass is distributed in the star.
- To figure that out, we need to solve the Einstein-Klein-Gordon equations for various scalar field configurations.

## What am I doing?

- The Einstein-Klein-Gordon equations must be solved as a boundary-value problem.
- One method for solving boundary-value problems is shooting.
- I worked on implementing the relaxation method.

# What am I doing?

- The biggest challenge right now is finding the ground state.

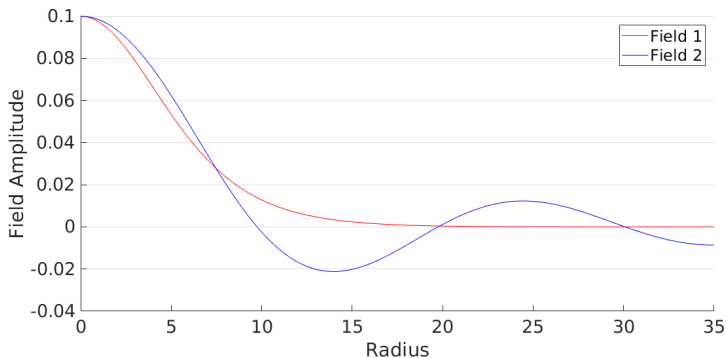


Figure 1: A solution to the EKG system for two scalar fields