- Name: Kai Yang.
- Status: PhD student.
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- Advisors: Svetlana Roudenko and Yanxiang Zhao.
- Research Interest: Numerical study of solutions' behavior in the nonlinear dispersive equations.

Direction 1:

The focusing NLKG in d dimensions

The nonlinear Klein-Gordon equation:

$$\begin{cases} u_{tt} - \Delta u + u = u^p, \quad (x,t) \in \mathbb{R}^d \times \mathbb{R}^+ \\ u(x,0) = u_0, \\ u_t(x,0) = u_1, \quad (u_0, u_1) \in H^1 \times L^2(\mathbb{R}^d). \end{cases}$$

- I am interested in long-term behavior of solutions (as $t \to \infty$ or $t \to T^\star$).
- Numerically, we can understand the behavior of the gaussian-type initial data and perturbations of ground state and excited states (when available).
- We can identify scattering regions, and blow-up regions.
- We want to understand the behavior of solutions for large data.

Direction 2:

Numerical calculations of the bound states

We consider the the radially symmetric solutions to:

$$-\Delta Q + Q - Q^3 = 0, \qquad Q \in H^1_{rad}(\mathbb{R}^3).$$

We study:

- bound/excited states.
- Q_0, Q_1, Q_2... are real radial solutions and the index indicates the number of intersections with x-axis.
- Numerical simulations indicate that Q_i's are unique.
- We can get profiles of such Q_i's up to $i = 7$.
- We can obtain the number of negative eigenvalues for the linearized operators L^i_+, L^i_- corresponding to each Q_i.
- We are studying spectral properties of $Q_i's$.

Direction 3:

Blow up behaviors for generalized Hartree equation

The Hartree equation:

$$\begin{cases} iu_t + \Delta u + (\frac{1}{|x|^2} * |u|^2)u = 0, \quad (x,t) \in \mathbb{R}^d \times \mathbb{R}^+ \\ u(x,0) = u_0, \quad u_0 \in H^1(\mathbb{R}^d). \end{cases}$$

And the generalized Hartree equation:

$$\begin{cases} iu_t + \Delta u + (\frac{1}{|x|^b} * |u|^p)|u|^{p-2}u = 0, \quad (x,t) \in \mathbb{R}^d \times \mathbb{R}^+ \\ u(x,0) = u_0, \quad u_0 \in H^1(\mathbb{R}^d), \end{cases}$$

where $0 < b < d$, and $p \geq 2$.

- Currently, we are studying the long time behavior of both Hartree and gHartree in the L^2-critical & L^2-supercritical cases.