

# Recovery of a cubic non-linearity in the wave equation in the weakly non-linear regime

Plamen Stefanov<sup>1</sup>, Antônio Sá Barreto<sup>2</sup>

<sup>1</sup> Purdue University

<sup>2</sup> Purdue University

We study the inverse problem of recovery a compactly supported non-linearity in the semilinear wave equation  $u_{tt} - \Delta u + \alpha(x)|u|^2u = 0$ , in two and three dimensions. We probe the medium with complex-valued harmonic waves of wavelength  $h$  and amplitude  $h^{-1/2}$ , then they propagate in the weakly non-linear regime; and measure the transmitted wave when it exits  $\text{supp } \alpha$ . We show that one can extract the Radon transform of  $\alpha$  from the phase shift of such waves, and then one can recover  $\alpha$ . We also show that one can probe the medium with real-valued harmonic waves and obtain uniqueness for the linearized problem.