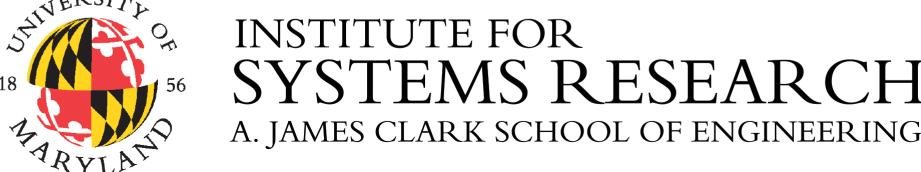


# Targeting NanoTherapies to the Ear, Tooth & Brain

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# 1985-2015 THIRTY YEARS OF SYSTEMS RESEARCH EXCELLENCE



Recent research in preventing hearing loss and tinnitus following trauma pointed to the need for localized delivery of therapy *to the inner ear only.*

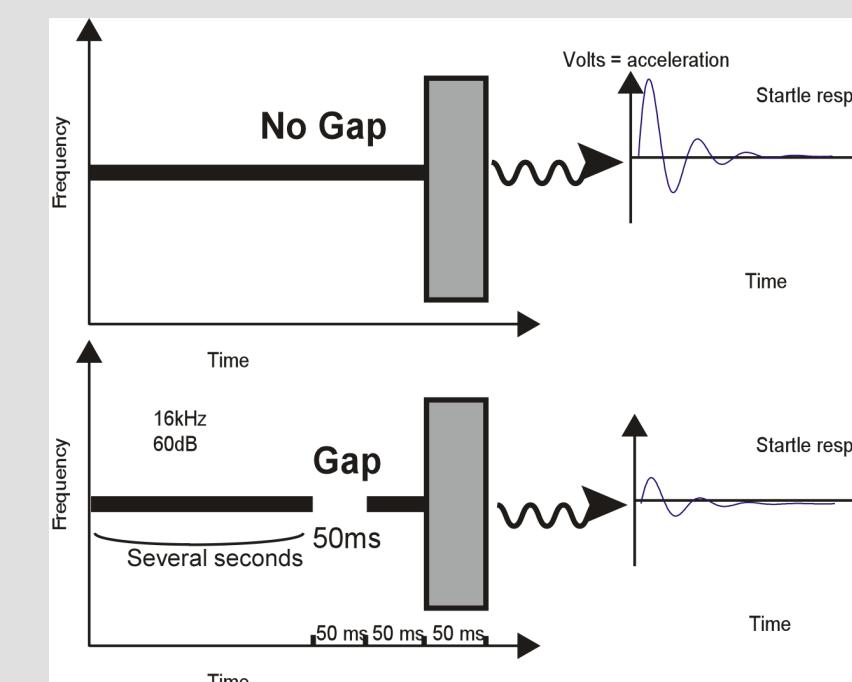
# Rat model of noise trauma-induced tinnitus



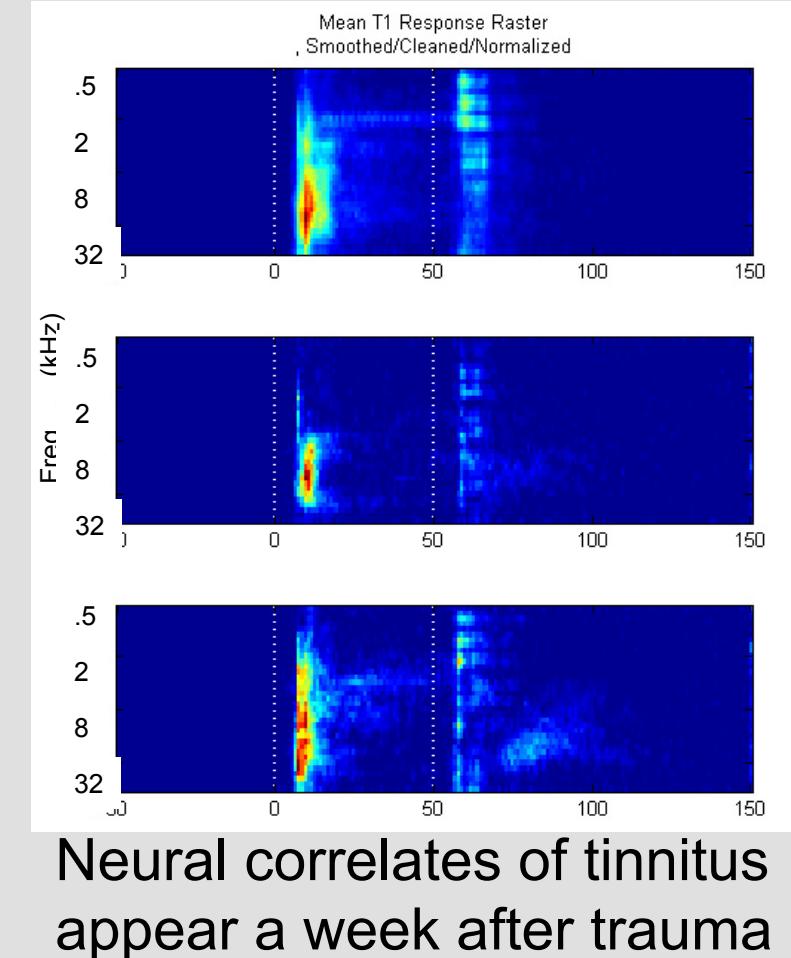
Previous studies allowed us to measure neural correlates of tinnitus, while delivering a variety of drugs systemically via a jugular catheter.

## **Behavioral measurement**

- Modified “prepulse inhibition of startle reflex”
  - If rat detects silent gap in tone, startle reflex is inhibited



## Midbrain results



Future research aims at delivering novel therapeutics such as peptides

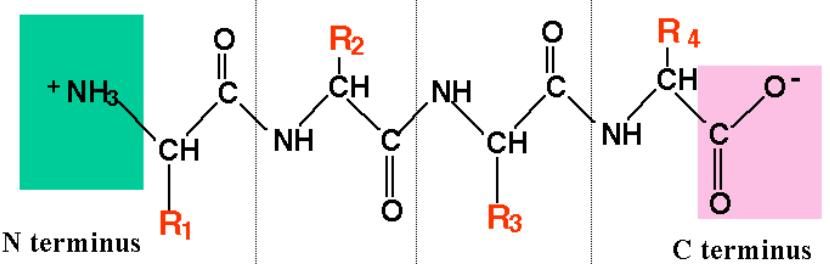
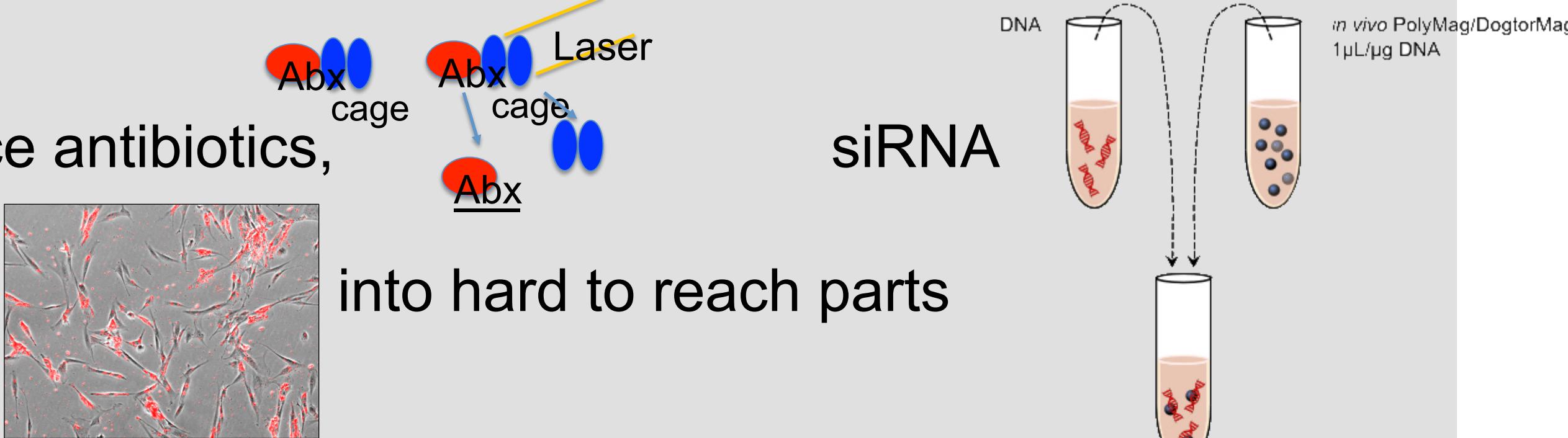


photo-releasable drugs, for instance antibiotics,<sup>cage</sup>

and other molecules or stem cells



## Abx

of the body, with high target specificity, using nanoparticles or liposomes.

This can only be accomplished in a multidisciplinary environment, involving highly productive collaborations with doctors and health professionals.

We developed a method using magnetic nanoparticles to deliver steroids to the organ of hearing (the cochlea). We found the platform to be universal at delivering a variety of drugs, molecules, and stem cells to a variety of hard to reach parts of the body.

Target	Inner Ear	Middle Ear	Teeth	Eye	Brain	Others (liver etc)
<b>Indications</b>	-Sudden hearing loss -Cisplatin ototoxicity -Tinnitus	-Ear infections (acute and chronic) -Glue ear	-Fillings -Sensitivity -Root canals	-Uveitis -Diabetic retinopathy	-Essential tremors -Glioblastoma	-Tumors -Hyperthermia
<b>Advantage</b>	Micromolar, uniform drug concentration. Levels are elevated for days.	-Antibiotic in middle ear only. -No MRSA -No “ear tube”	-Stronger restorations -No root canal -Remains sterile	-No intraocular injection -No associated infections	-Targeting of deep brain structures without surgery	-Case dependent
<b>Examples</b>	<p><b>Drug distribution in cochlea</b></p> <p>Cochlea, top view</p> <p>Concentration of Along Cochlea</p> <p>Standard of Care</p> <p>Magnetic Nanoparticle Treatment</p> <p>Concentration within volume sample (nM)</p> <p>Cross-section of the Cochlear Compartment</p> <p>Samples taken along the cochlea</p> <p>Scalar Tympani</p> <p>Scalar Vestibuli</p> <p>Semicircular Canal</p> <p>1 2 3 4 5 6</p> <p>0 2000 4000 6000 8000 10000</p> <p>0 2000 4000 6000 8000 10000 12000 14000 16000</p> <p>Y (<math>\mu</math>m)</p> <p>X (<math>\mu</math>m)</p> <p>Therapeutic steroid levels can be achieved within an hour of magnetic injection.</p>	<p><b>Teeth</b></p> <p>Biocompatible Nanoparticles</p> <p>Magnetic Forces</p> <p>3</p> <p>Magnetic</p> <p>Fluorescence</p> <p>N S</p>	<p><b>Brain</b></p> <p>Immunohistochemistry</p> <p>Cortex Thalamus</p> <p>40 <math>\mu</math>m</p>	<p><b>Liver</b></p> <p>Without &amp; with magnetic chaining</p>		

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