

# FUNDING PROGRAM FOR NEXT GENERATION WORLD-LEADING RESEARCHERS

**Project Title:** Molecular imaging based on magnetic resonance of chiral molecules

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## 1. Background of research

Chiral molecules are a category of molecule, often found in pharmaceutical drugs, which exist in two forms, each being a mirror image of the other. Despite the similarity between the two molecular forms, the physical and chemical characteristics are often very different. In the case of drugs, these differences may lead to one form of the chiral molecule being therapeutically beneficial, while the other form may be physiologically harmful.

## 2. Research objectives

The goal of this project is to develop an imaging method that can visualize both forms of chiral molecules in small animals simultaneously.

## 3. Research characteristics (incl. originality and creativity)

The key feature of this project is to chemically label the target chiral molecules with markers containing unpaired electrons. Energy absorption by the unpaired electrons can be used to distinguish the two forms of labeled molecules. Visualization of the time dependent distribution of labeled chiral molecules will be performed in small animals.

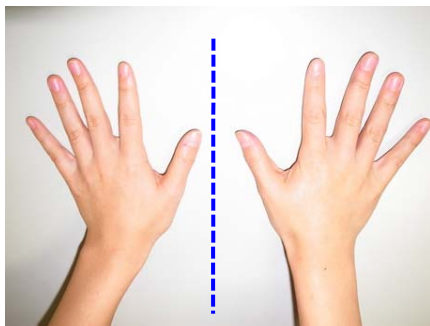
## 4. Anticipated effects and future applications of research

Since chiral molecules are often used as drugs, the ability to visualize their behavior in living tissues, would be of great benefit in the fields of biology, medicine, and pharmaceutical science.

Chirality of drugs can determine their therapeutic properties



How does chirality of molecules affect their pharmacokinetics in living animals?



### What is chirality?

A molecular characteristic most often caused by the inclusion of a non-symmetric carbon atom.

### What is a chiral molecule?

Molecules which exist in two non-superimposable forms like a mirror image, similar to the hands in the photo above.

We need a method to simultaneously visualize two forms of a chiral molecule

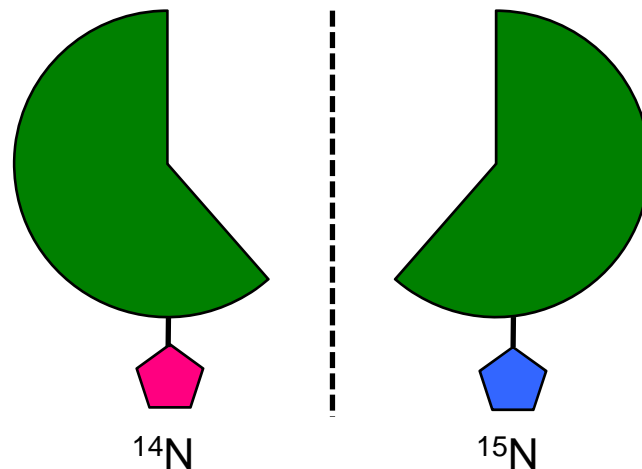
How to visualize two kinds of molecules?



Labels with unpaired electrons are attached to the target molecules, and the labels can be visualized.

Example of two chiral molecules labeled with unpaired electron markers

Mirror images



Markers shown in red and blue.

## Novel concept



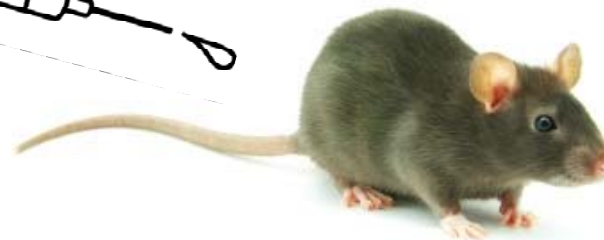
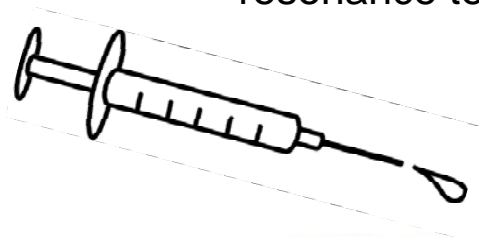
(2) Chemical labeling of chiral molecule pairs with unpaired electron markers and confirmation of chiral molecule properties

Medicinal chemistry

Visualization technologies

Small animal imaging

(1) General concept – The simultaneous imaging of chiral molecules using magnetic resonance techniques



(3) Simultaneous imaging of the pharmacokinetics of two forms of labeled chiral molecules

### Innovation

Imaging of chiral drug distribution in living organisms

Future applications

- New drug developments
- Study of diseases
- Instruments of biomedical studies