# ⊕ IceCube South Pole Neutrino Observatory

# Multimessenger Astronomy
## an icebreaker game

## Learning goals

Understand the basic principle of multimessenger astronomy: detecting several types of particles from the same source (steady or transient) to better understand it.

Encounter the key players: sources, messengers, and detectors: especially those the hosting group is involved with.

Learn about the missing puzzle pieces in our multi-messenger view of the universe: often we are hoping for a detection.

These specific learning goals stand next to the more general, social goals of the game: to lower the threshold for talking with each other and the group members, to start conversations, encourage curiosity and seed questions.

## What's needed

### Basic variant

One detector/source badge per student with the personal information on the front and instructions on the back. The split between detectors and sources should be about equal. If there are more students than badges, it's possible to make duplicates.

You can chose to use badge holders of 90mm x 60mm dimensions. If you have holders that are smaller, you will need to adapt the layout size in `header.tex`. Else it's totally valid to just use transparent tape. You can also print on sticky-sided paper, but in this case it's better to print the instructions separately.

One physicist badge per group member, with their name and languages spoken. In addition to that, blank physicist badges so that those outside the group who might be around can participate.

The instruction sheet for every group member to read beforehand.
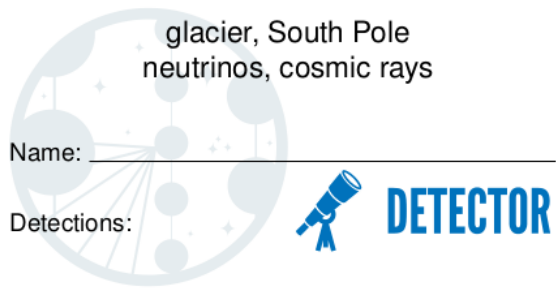
## Forced interaction

In the "forced interaction" variant, print the blank badges. Print the "complete" badges on regular paper.

# List of contents

The contents of the game should have been delivered with this file. If not, you can find them here.

- `detectors.pdf`
  Badges for students playing detectors. These include neutrino, gravitational wave, cosmic rays, gamma-rays and other wavelengths. These figures show an example of their front, and the explanation on the back:

### IceCube

glacier, South Pole
neutrinos, cosmic rays

Name: _____

Detections:                    🔭 DETECTOR

**How to play this game:**
You are a detector, an experiment patiently waiting for signals from outer space. **First**, write your name on the front. Then check the info about yourself and start looking for **sources** whose messengers you can detect. Count how many you have detected like so: ⅢⅠ. And any time you're wondering what all these crazy words actually mean, just ask one of the **physicists**.
Welcome to the IceCube Masterclass!

- `sources.pdf`
  Badges for students playing astrophysical sources. These figures show an example of their front, and the explanation on the back:

### Black Hole merger

gravitational waves

Name: _____

Detections:                    ✦ SOURCE

**How to play this game:**
You are what they call a source, a massive object somewhere deep in space, sending out its signals. **First**, write your name on the front. Then check the info about yourself and start looking for **detectors** that can detect your messengers. The messengers in *italics* haven't really been seen yet from that source, but we will play as if they have. Count how many times you've been detected like so: ⅢⅠ. And any time you're wondering what all these crazy words actually mean, just ask one of the **physicists**.
Welcome to the IceCube Masterclass!

- `physicists.pdf`
  Pre-printed name badges to show the students who is there to answer questions.
  This also contains a set of blank nametags for your colleagues who just happen to be
  around to write their names.

- `instructions/coordinator_instructions.pdf`
  This document, meant as a guide for those who organize this activity.

- `instructions/reference.pdf`
  A short reference to use by the physicists joining the game.

# Activity proposal

This is a role-playing game where participants take the part of detectors and sources, trying
to make multimessenger observations. Since it doesn't require any particular combination
of these "characters", the activity can start up gradually, for example as students are
arriving to a masterclass breakfast. The end of the game is similarly open. In case you
played for a defined time, you can tally up the scores and crown winners.

## Basic variant

Each student receives a badge with their character. Because this is an icebreaker game,
the badge also serves as a name tag, so ask them to write their name on the front. On the
back they will be able to read the rules of the game. If you are using sticky-backed paper,
they can keep the peeled-off instructions in their pocket. Else, the badge should be fixed
loosely (with a safety pin, a single piece of tape, or in a badge holder) so they can re-read
the rules later.

**As a detector**, the students know which messengers they can detect and are looking
for sources that emit one of them.

**As a source**, the students know which messengers they emit and are looking for detectors that can observe them. Some of the messengers are listed as hypotheticals. These
haven't yet been observed from this source in real life, but are of great interest and so we
will play as if they have. The students know this, but be prepared to explain it if they ask.

Each time a source and detector find each other, they increase the tally of their detections on the front of their badge. This is meant to encourage a friendly competition that
enhances engagement in the game.
The mass of technical terms is intentionally left unexplained in the beginning. Instead the
students are encouraged to ask questions to the physicists, who signal their availability by

wearing the **physicist** badge. This is meant to help the students lose their shyness in front of scientists and keep asking questions as the day progresses.

There are two variants to this game. You can adapt the game to them by uncommenting the relevant sections in the TeX files (see: "Customising the actvity").

## Variant A: Forcing interaction

If you expect the students to be extremely shy and simply copy off from each others' badges, this variant can help. The usual badges are still printed, with the instructions on the back, but the students keep those cards secret. In addition, print badges that only indicate their role and name for them to wear. The students then approach each other, and need to ask the other to show their badge. At this point, the game proceeds like in the basic variant.

## Variant B: Strict multimessenger

Detections (a connection source-messenger-detector) are only made when there is a team of detectors seeing the same source in several different messengers. For example, a group of detectors just has to find one source between them to each make a detection. That source will have to find several detectors, but can make a detection with each of them.

# Customising the activity

You can use the PDF files as they are provided. However, the activity is set up to make it easy to customise for your group: it's all written in LaTeX, and contents and layout/style are separated. First, you will want to write your own names into `latex/physicists.tex`. This is easy to do collaboratively by setting up a Google Sheet with rows formatted as
`\badge{Name} {First line} {Second line}`,
letting everyone add themselves, and finally copying the entire block from there. In the same way, you might adapt the selection of detectors (`latex/detectors.tex`) and sources (`latex/sources.tex`) to match what you yourself are working on. That way, once the students start asking questions the conversations you'll will be a lot more engaging! The file `latex/header.tex` contains definitions of the layout and is commented. It also contains macros you can use to e.g. insert a page of explanations, a page of blank badges, or a en entirely blank page into the documents.
To make any of these changes, just edit the TeX files and re-compile (`cd latex;make`). The embedded graphics are found in `latex/graphics`.