AUSTRIAN ACADEMY OF SCIENCES
ACOUSTICS RESEARCH INSTITUTE

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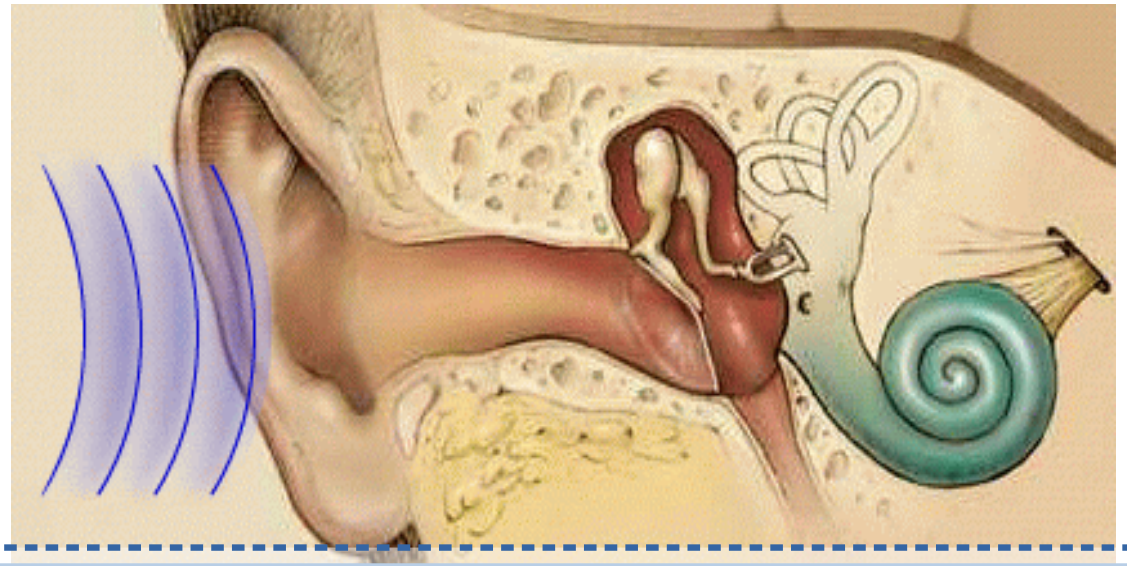
The 4th AMT Workshop

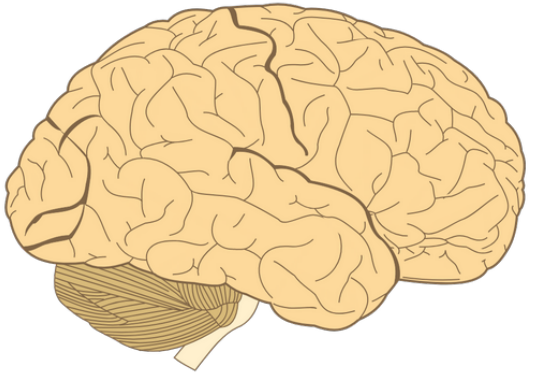
Using models

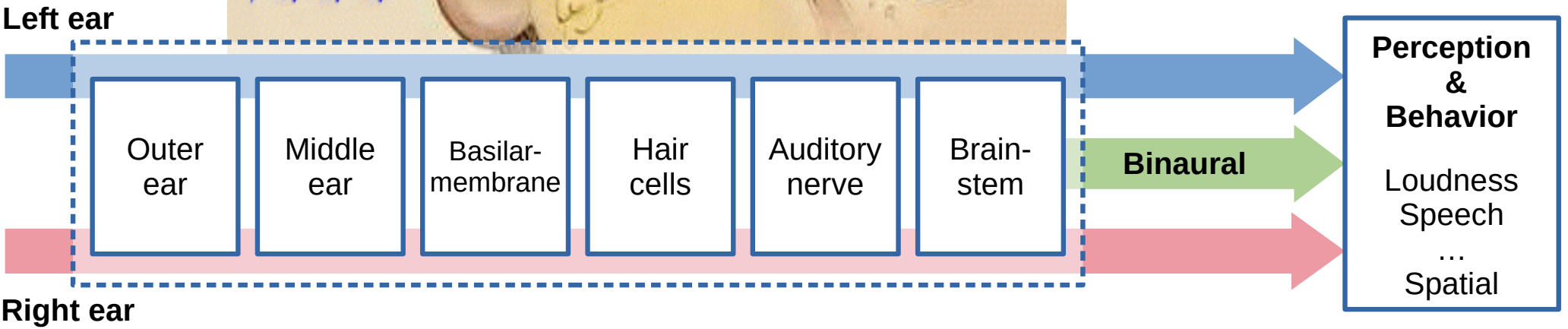
Graz, 5.9.2026

Version: 04.09.2026

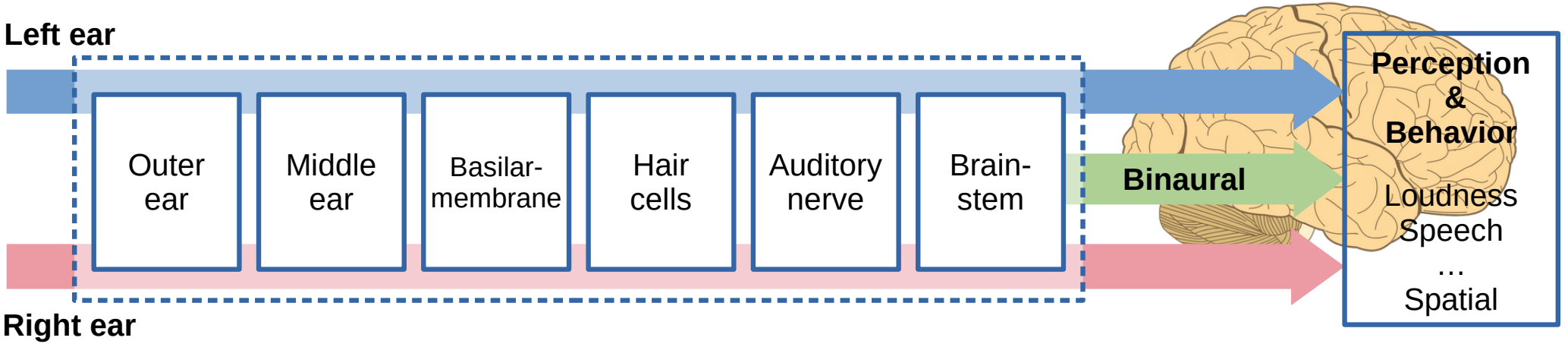
Hearing






Left ear
Outer ear
Middle ear
Basilar-membrane
Hair cells
Auditory nerve
Brain-stem
Binaural
Perception & Behavior
Loudness
Speech
…
Spatial
Right ear

Auditory models



Typical stages of an auditory model

Left ear

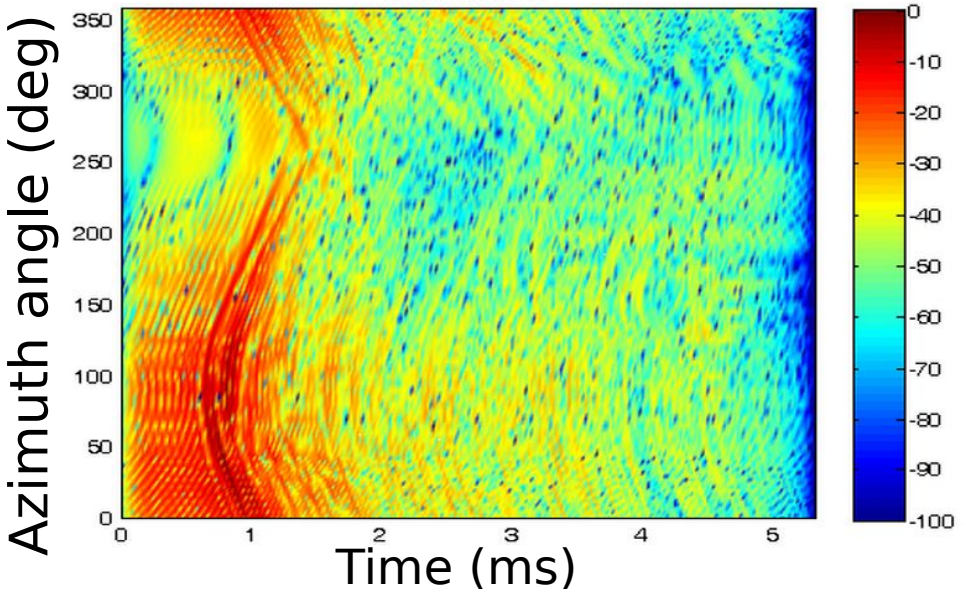
Outer ear

Binaural

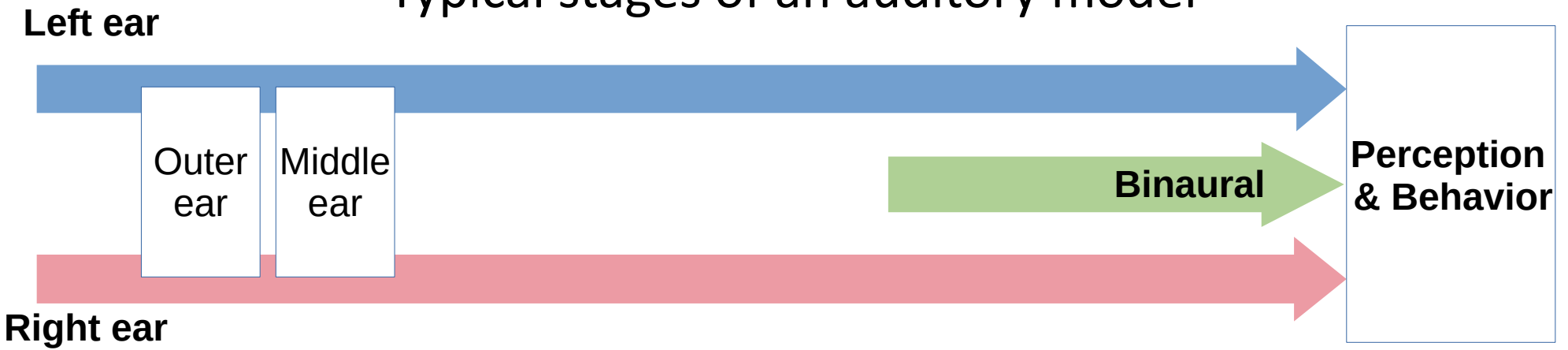
Perception & Behavior

Right ear

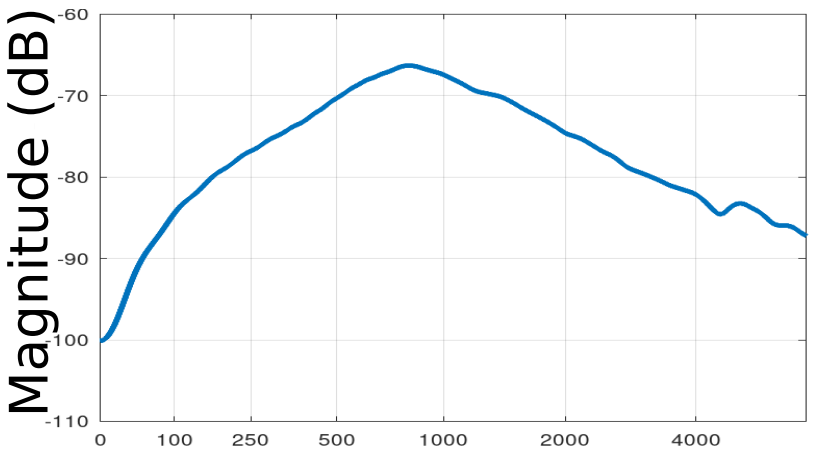
Outer ear



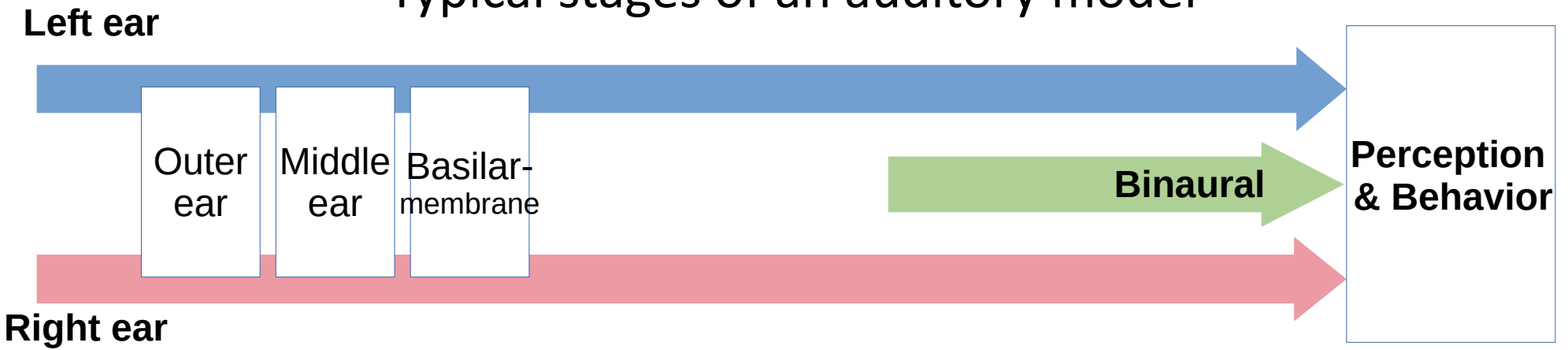
Typical stages of an auditory model



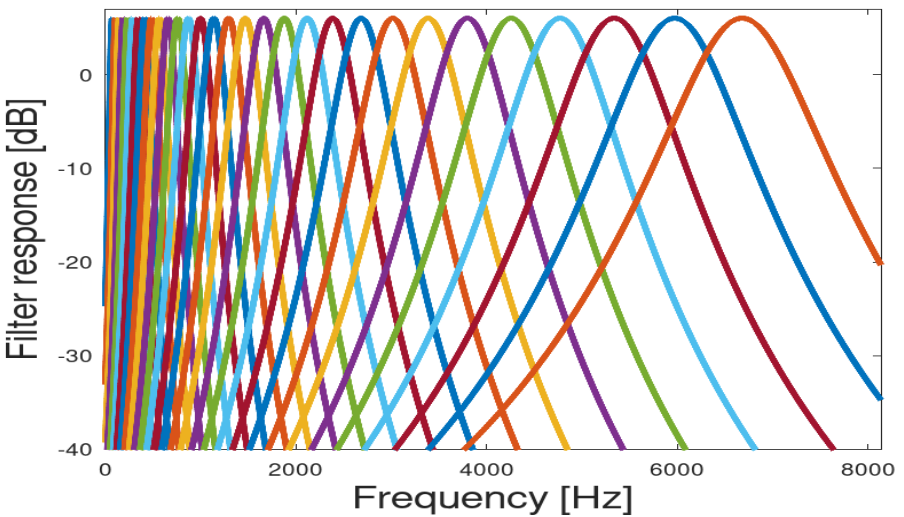
Middle ear



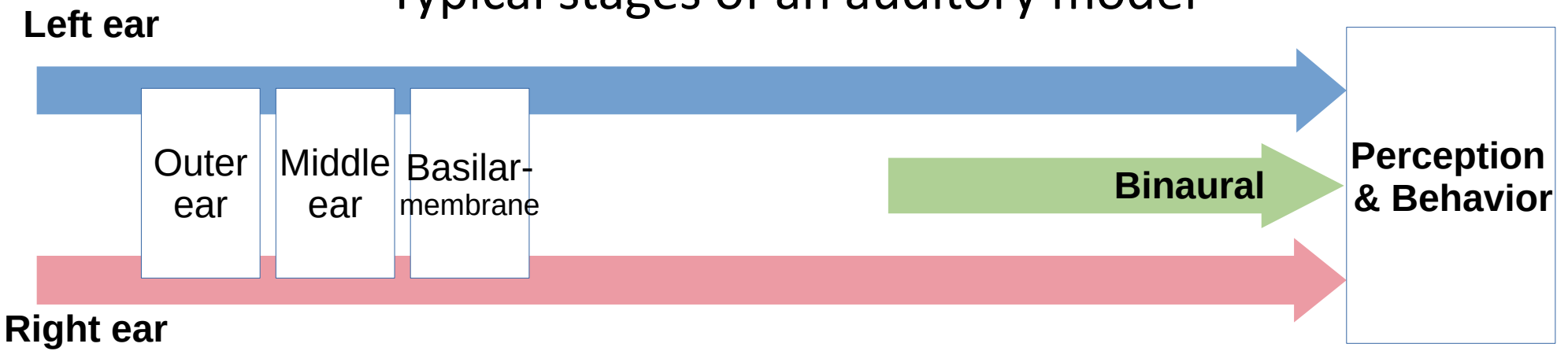
Typical stages of an auditory model



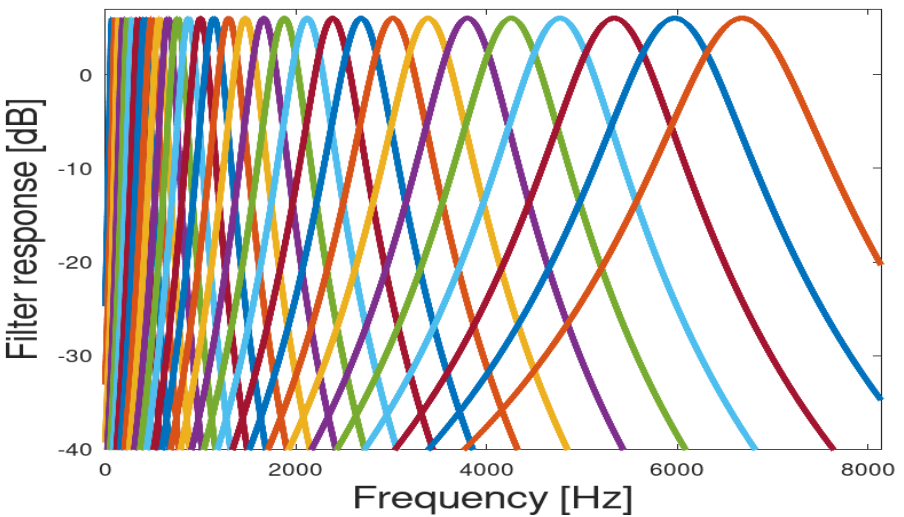
Basilar membrane



Typical stages of an auditory model



Basilar membrane

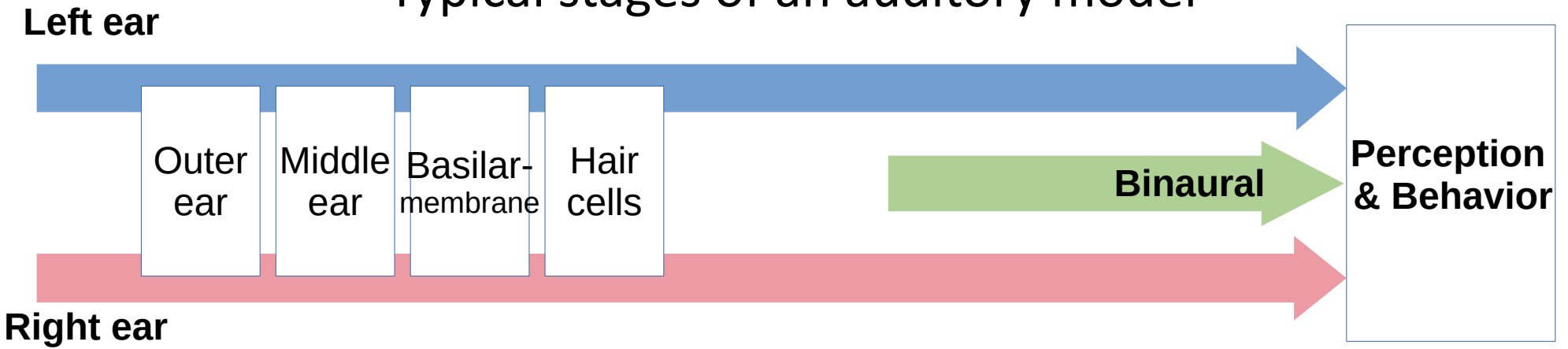


Model: hohmann2002

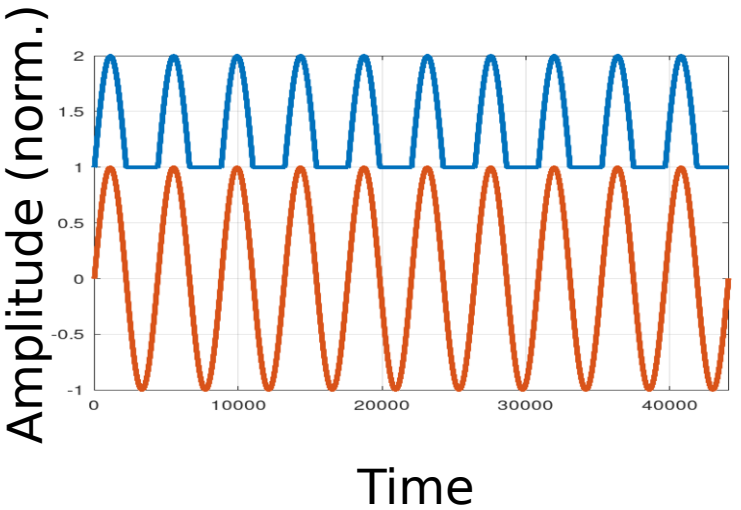
My first filterbank

- Idea: Processing a sound through a model of the human cochlea
- Input: An impulse, a sound
- Model: `hohmann2002`
- Output: Filtered sound for multiple center frequencies
- How to start:
  - Go to http://amtoolbox.org → Resources → Workshops
  - Download from the link `hohmann2002`
  - Save in your `AMT/experiments` directory
  - *This file is `exp_workshop2026graz_hohmann2002.m`*
  - *It can also be found in the workshop branch of the AMT code repository: https://sourceforge.net/p/amtoolbox/code/ci/workshop/tree/*

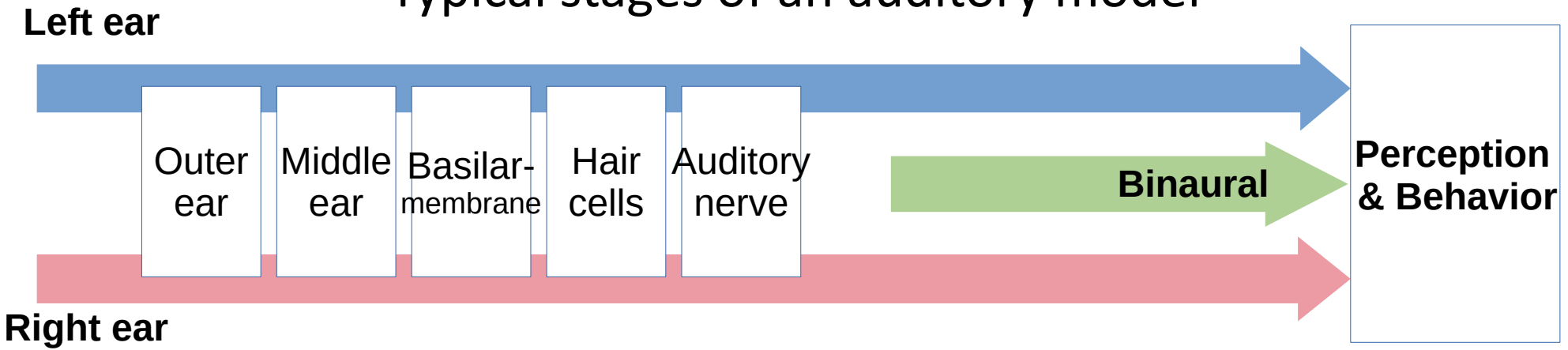
Typical stages of an auditory model



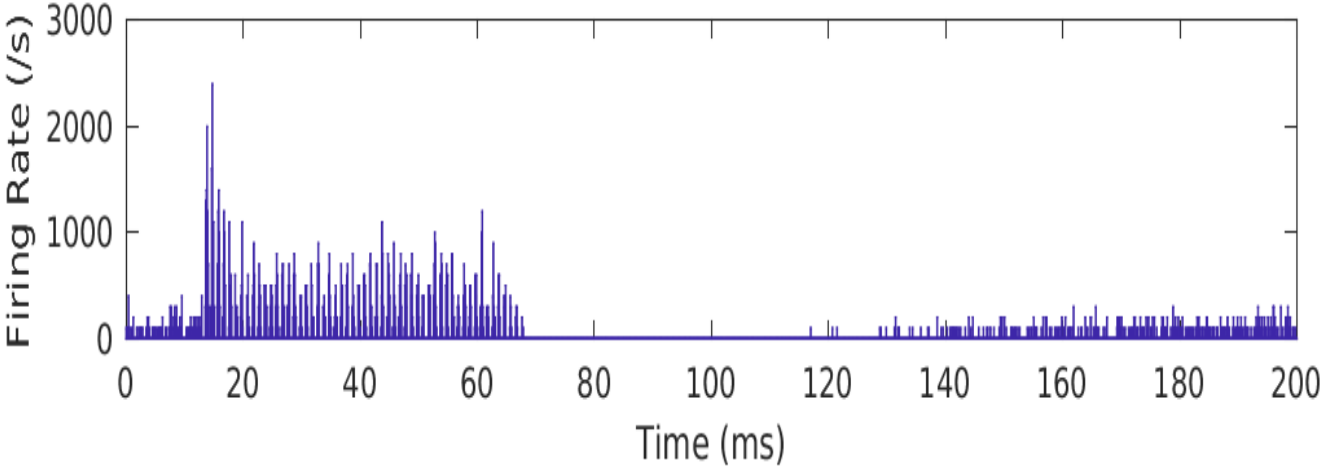
Hair cells



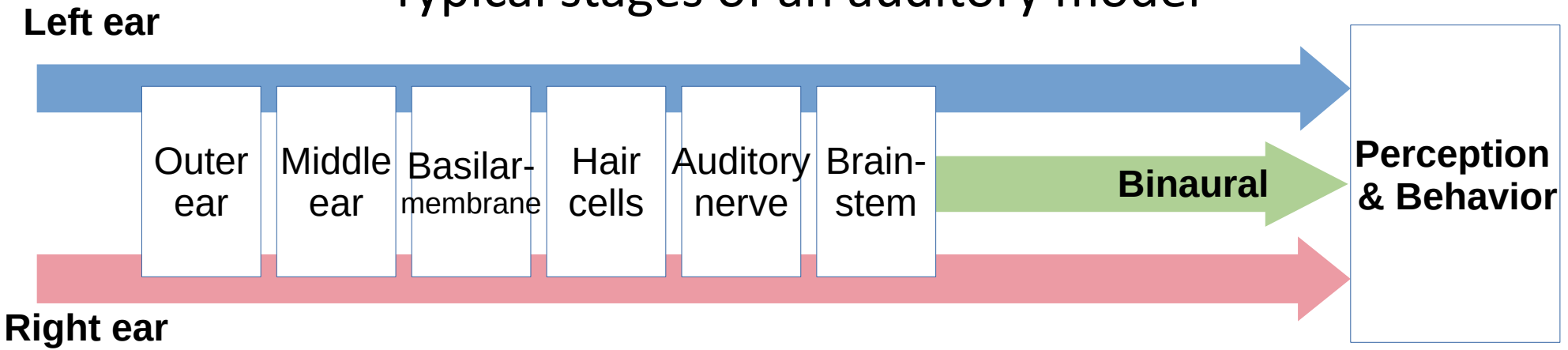
Typical stages of an auditory model



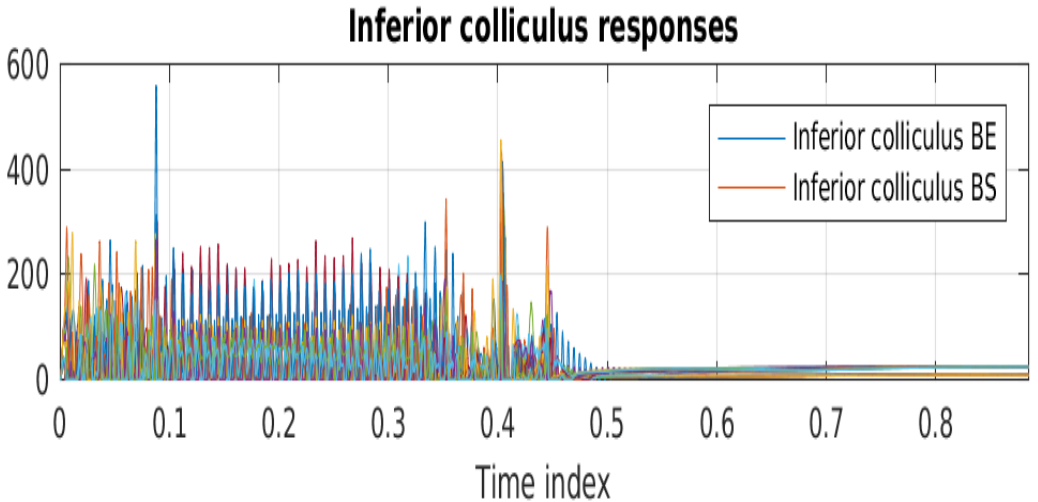
Auditory nerve



Typical stages of an auditory model

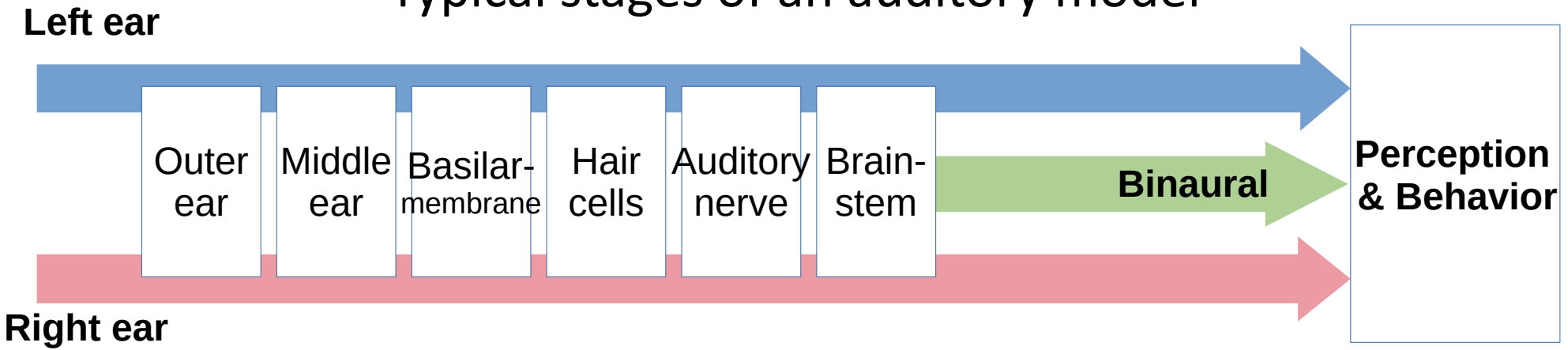


Brain-stem



Model: `carney2015`

Typical stages of an auditory model



Brain-stem → Modeled as the modulation filterbanks → Model: `dau1997`

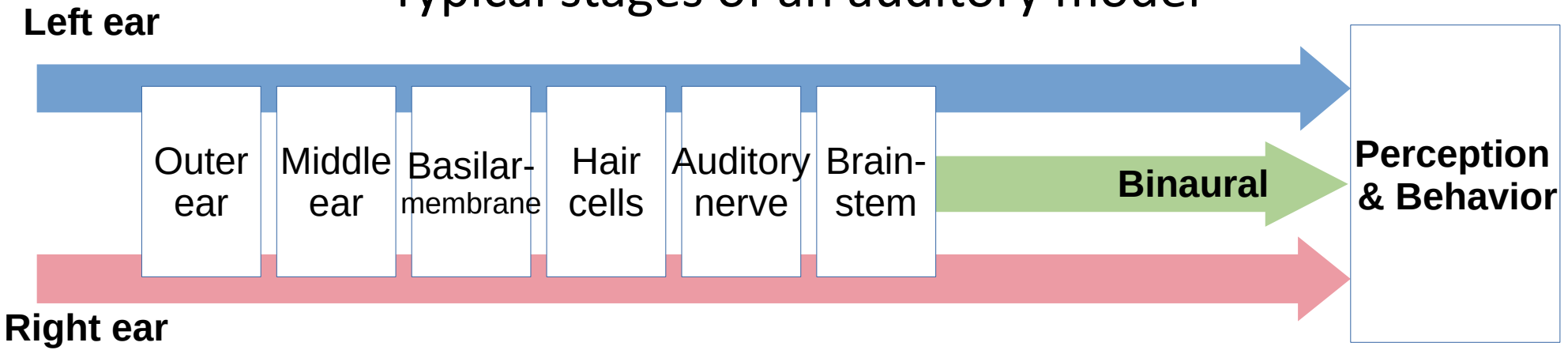
My first modulation filterbank

- Idea: Processing a sound through a model of the inferior colliculus
- Input: An impulse, a sound
- Model: `dau1997`
- Output: Modulation filterbanks for multiple center frequencies
- How to start:
  - Go to http://amtoolbox.org → Resources → Workshops
  - Download from the link `dau1997`
    - *File:* `exp_workshop2026graz_dau1997.m`
  - Save in your `AMT/experiments` directory

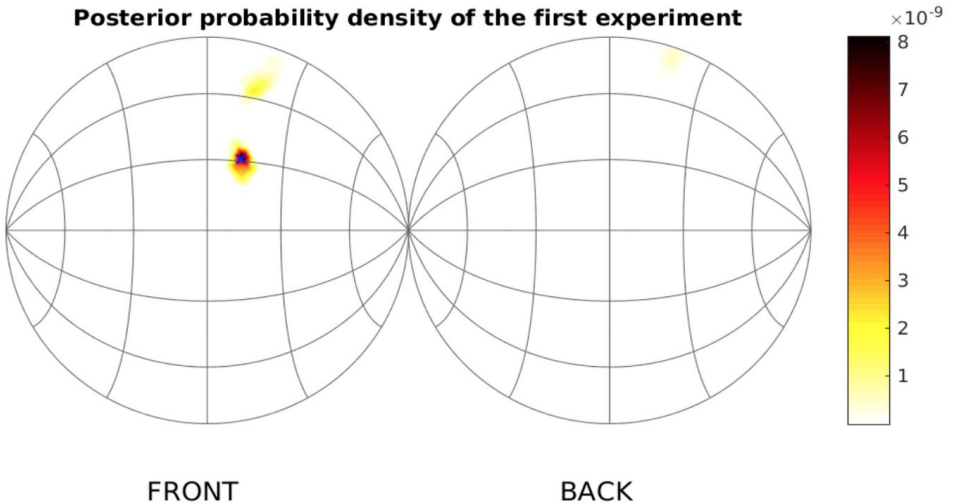
Parameters

- Default call: `[outsig, fc, mfc] = dau1997(insig, fs);`
- Key-value pairs (keyvals):
  `[outsig,fc,mfc] = dau1997(insig, fs, 'flow', 200, 'fhigh', 4000);`
- Flags: `[outsig,fc,mfc] = dau1997(insig, fs, 'outerear', 'middleear');`
- Groups: `[outsig,fc,mfc] = dau1997(insig, fs, 'mfb_dau1997');`
- Source of all these parameters:
  - `dau1997`
  - `defaults/arg*`:
    - `arg_auditoryfilterbank, arg_ihcenvelope, arg_adaptloop, arg_modfilterbank`
- General handling: `ltfatarghelper`

Typical stages of an auditory model



Perception

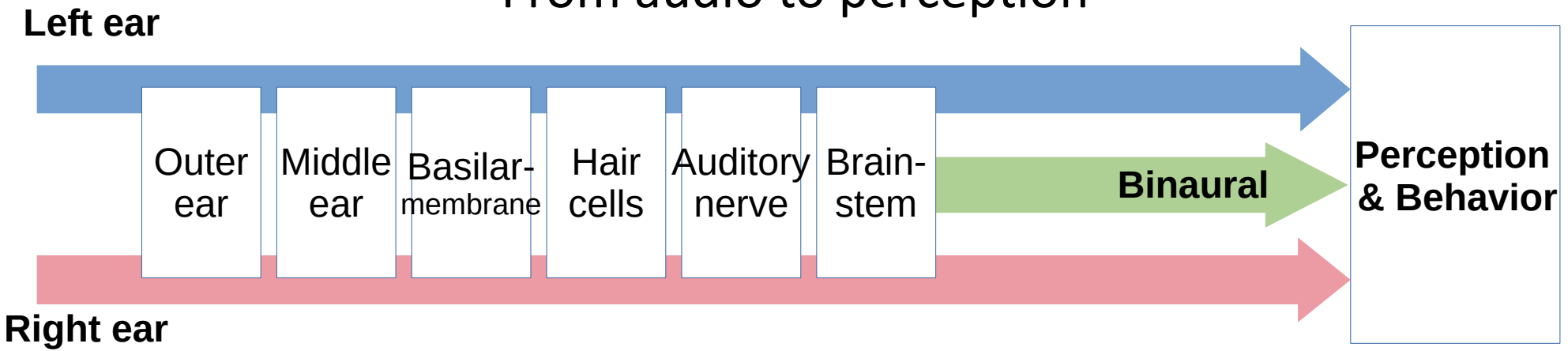


Model:
`barumerli2023`

My first localization experiment

- Idea: Predict sound localization with own and others' ears
- Input: HRTFs (own, others)
- Model: `barumerli2023`
- Output: Plot of the predicted probabilities
- How to start:
  - Go to http://amtoolbox.org → Resources → Workshops
  - Download from the link `barumerli2023`
  - Save in your `AMT/experiments` directory
    - *This file is* `exp_workshop2026graz_barumerli2023.m`
- Used AMT functionality:
  - Auxiliary data: `amt_load`
  - Model stage: `barumerli2023_featureextraction`
  - Plot: `plot_reijniers2014`

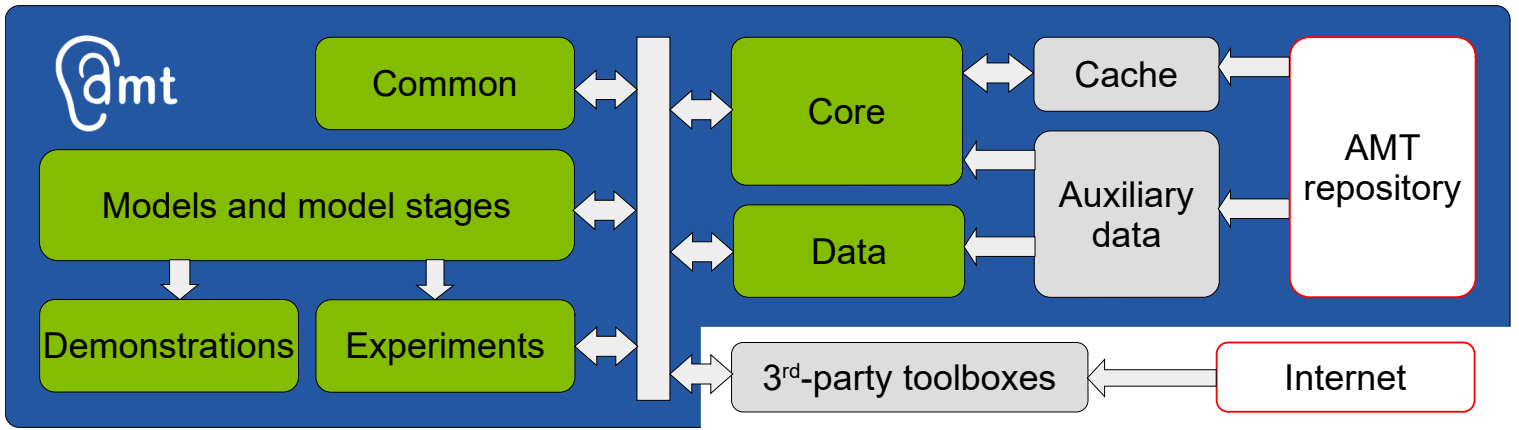
From audio to perception



Perception

- Other type of models outputting behavioral responses:
  - Binaural masking level differences
  - Loudness (monaural, binaural)
  - Loudness considering hearing loss
  - Speech intelligibility (monaural, binaural)
  - HRTF-based features (ITD, time of arrival)
  - Sound localization and externalization

The Auditory Modeling Toolbox (AMT): The Core



- The core functions: `amt_*`
  - `amt_start`: In the AMT root directory
  - All other amt_ functions: In the `/core` directory
- Cheat sheet: http://amtoolbox.org

Summary of the Core functions

- Path handling: `amt_start` and `amt_stop`
  - Starting options: `amt_start(..)`
- Beyond Matlab/Octave: `amt_mex`, `amt_extern`
- Data functions and auxiliary data: `amt_load`
- The cache: `amt_cache`
- Licensing and configuration: `amt_info`, `amt_version`
  (`amt_configuration`, `amt_basepath`, `amt_auxdatapath`, `amt_auxdataurl`)
- Handling default parameters: `ltfat_arghelper`
- Displaying information: `amt_disp`
- Simulating experiments: `amt_emuexp`

Summary: The AMT 1.x

- An open-source and open-access toolbox for auditory modeling
- A framework for application of models with verified components
- A framework for development of new models with a clear structure
- Many models available in a common programming language
  - Environment: Matlab/Octave
  - Supported: C, C++, Python
  - Extendable to any language*
- Released under GPL v3 with support for multiple software licenses
- Community work: Most of the models “donated” to the AMT

* but BrainFuck

Summary

- AMT version 1.6 released in September 2024
  - 74 models available
  - Over 40 GB of auditory data available
- Next release planned for winter 2026
- More resources:
  - http://amtoolbox.org

- Many thanks to all contributors:
  - https://amtoolbox.org/contributors.php

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