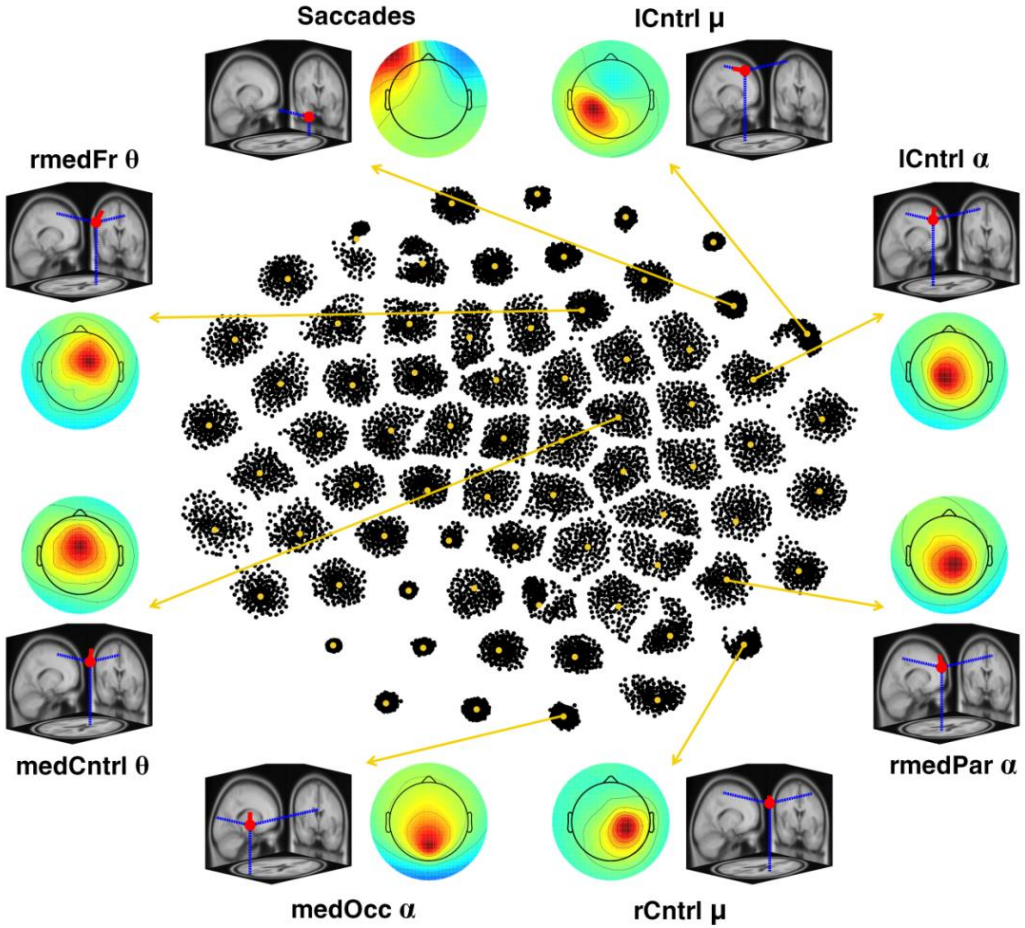
RELICA: ESTIMATING THE RELIABILITY OF INDEPENDENT COMPONENTS



Fiorenzo Artoni
EEGLAB Workshop XXI, April 4-8, 2016, Italy – RELICA
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Overview and aims

- **Increase** the **robustness** of **EEG** processing so that the EEG can be regarded as a true spatially- and temporally-**resolved** cortical **imaging** modality.
- Reliable Independent components at a single-subject level and disentangle information from noise by helping in the selection of the source modeling complexity
- Statistical **Reliability**
- Physiological **Plausibility**

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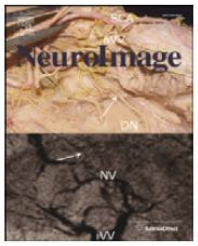

RELICA: A method for estimating the reliability of independent components

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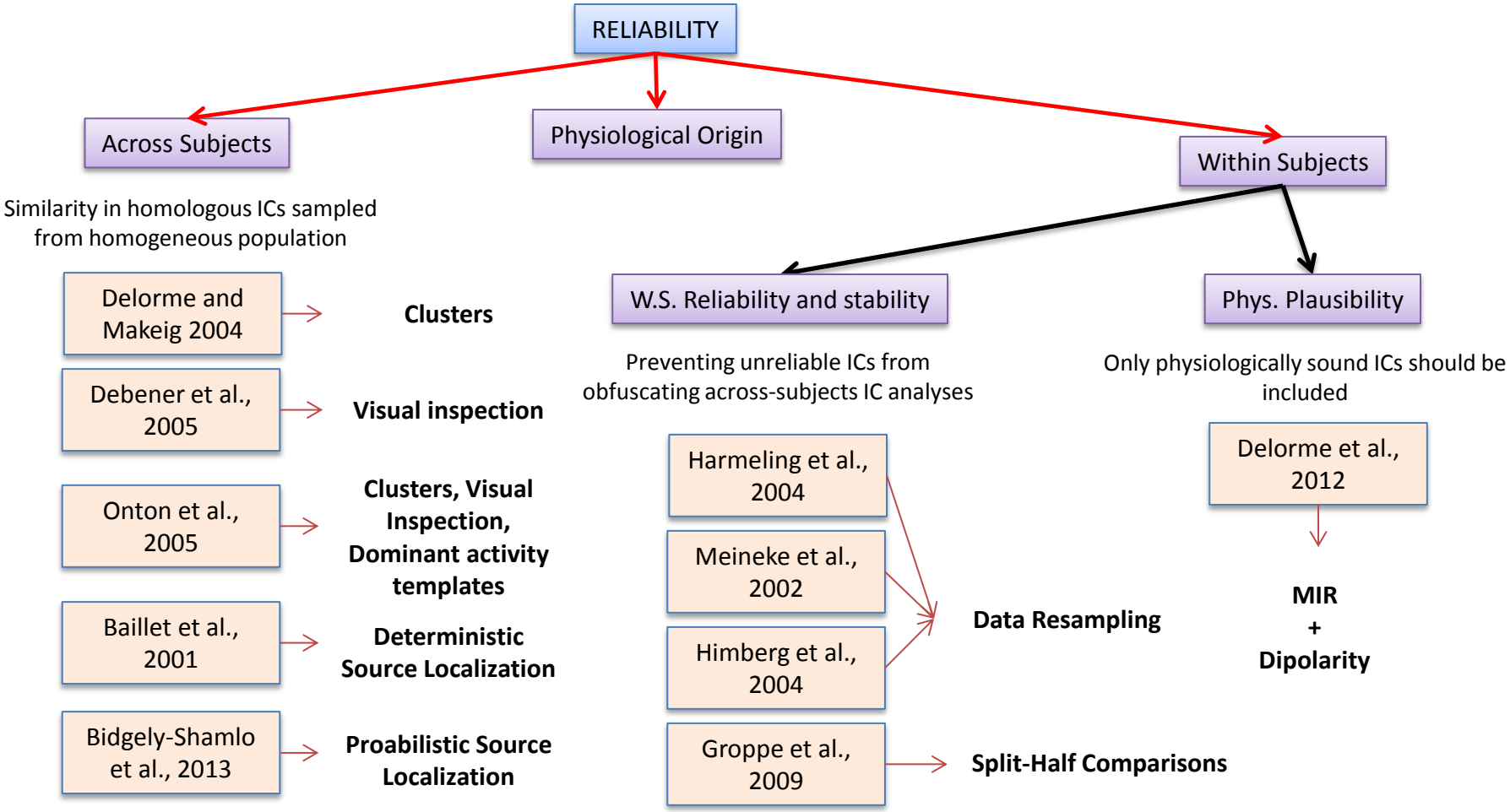
The Need of statistical reliability and physiological plausibility



1. **Wrongful interpretation**
2. **Inadequate data sampling (short recording, n. channels)**
3. **Inadequate pre-processing**
4. **Algorithm deficiencies (convergence, local minima …)**
5. **Noise (electrodes, recording system)**

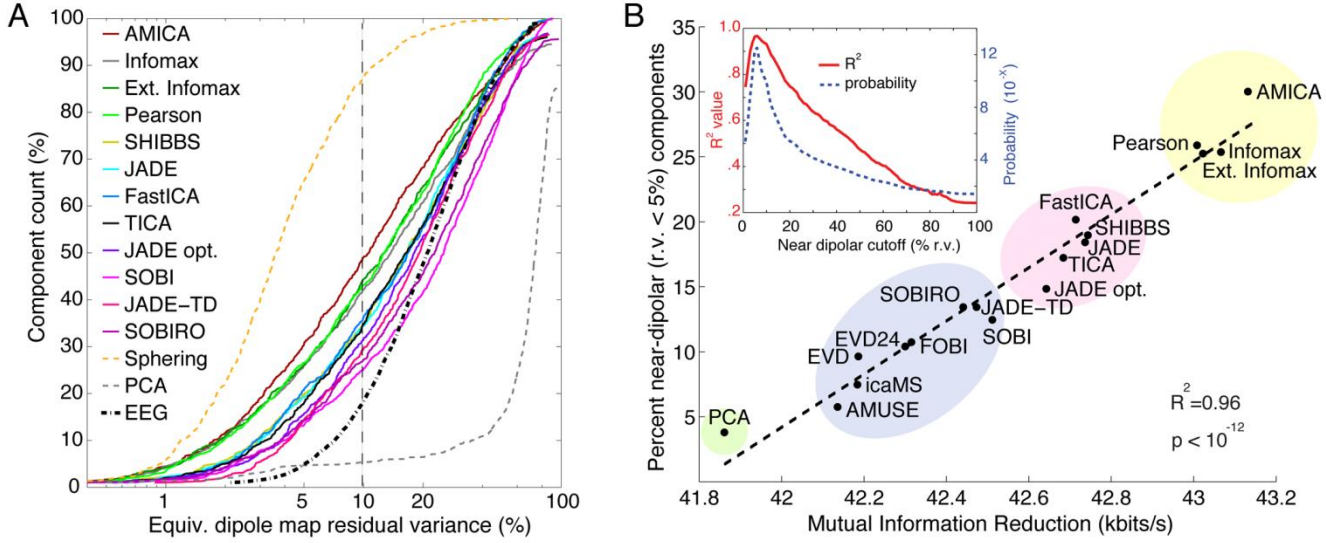
RELICA
Artoni et al., 2014

Himberg et al., 2004

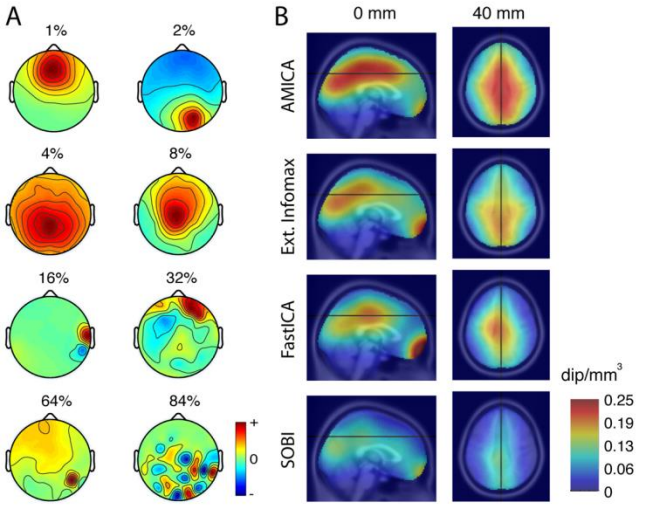
Delorme et al., 2012

MIR And dipolarity go well together

MIR



DIPOLARITY



The dipolarity is defined within RELICA framework as 100(1-resvar)%

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PLoS one

Independent EEG Sources Are Dipolar

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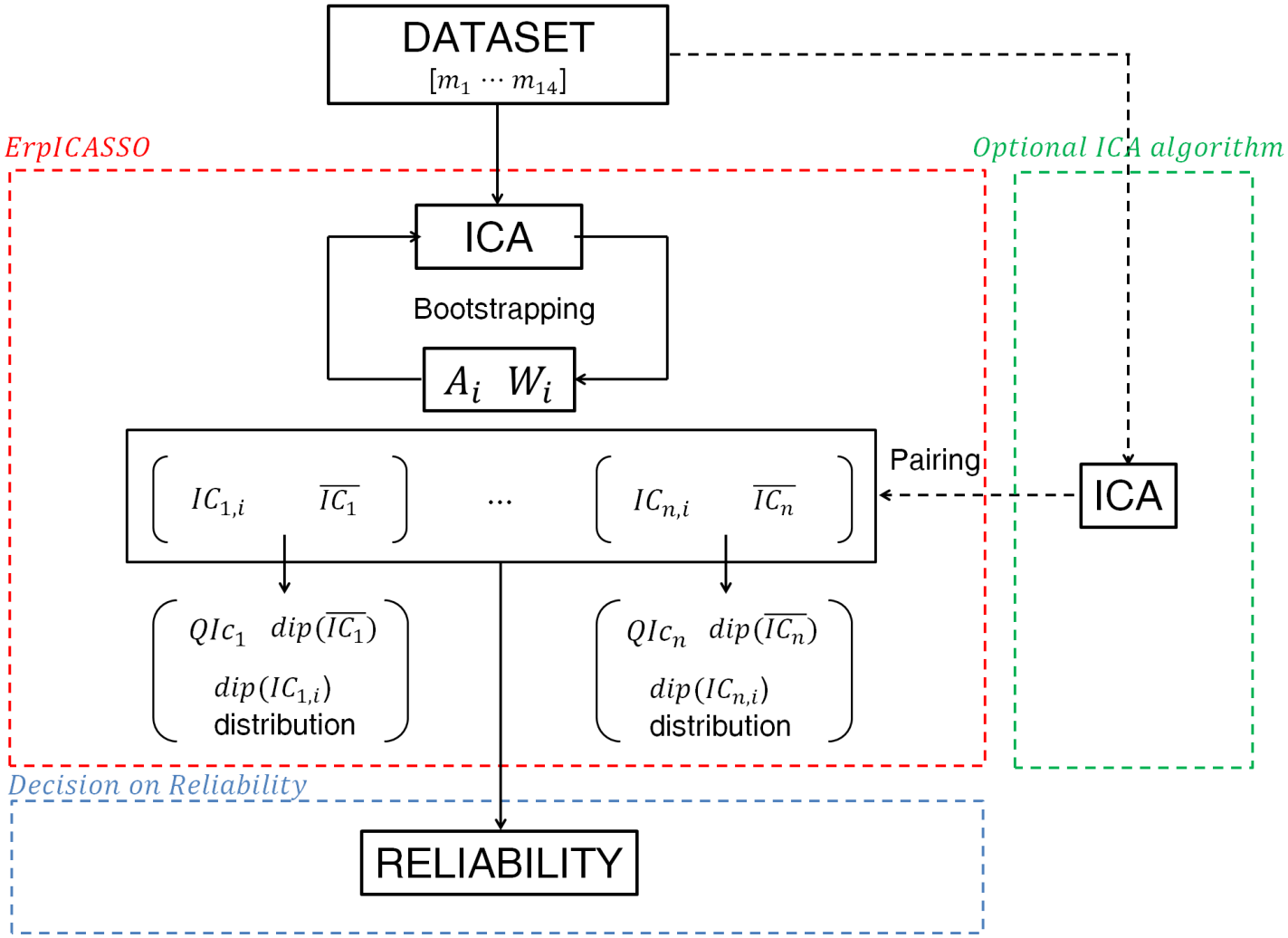
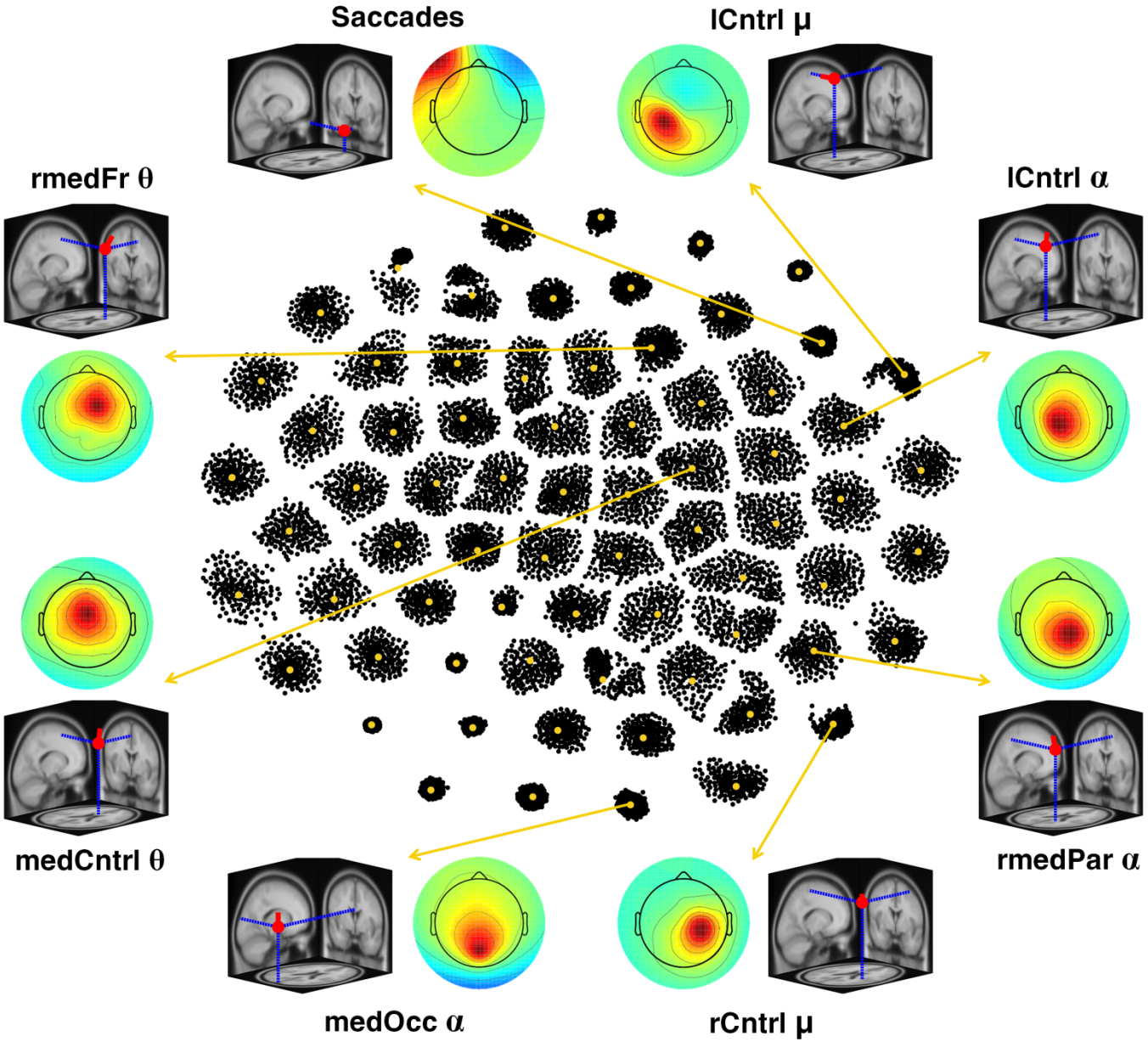
RELICA Outline



1. **Selection of ICA algorithm**
    1. BeamICA
    2. CudaICA
    3. FastICA
2. **Bootstrapping with ERPs**
    1. Data Resampling
    2. Clustering
    3. CCA projection
    4. Quality Index
    5. Mutual Information
    6. Dipolarity
    7. Distribution of dip and QIc
3. **IC reliability criteria**
    1. On dipolarity
    2. On stability
4. **Optional Pairing between ICA algorithms**
    1. E.g., AMICA

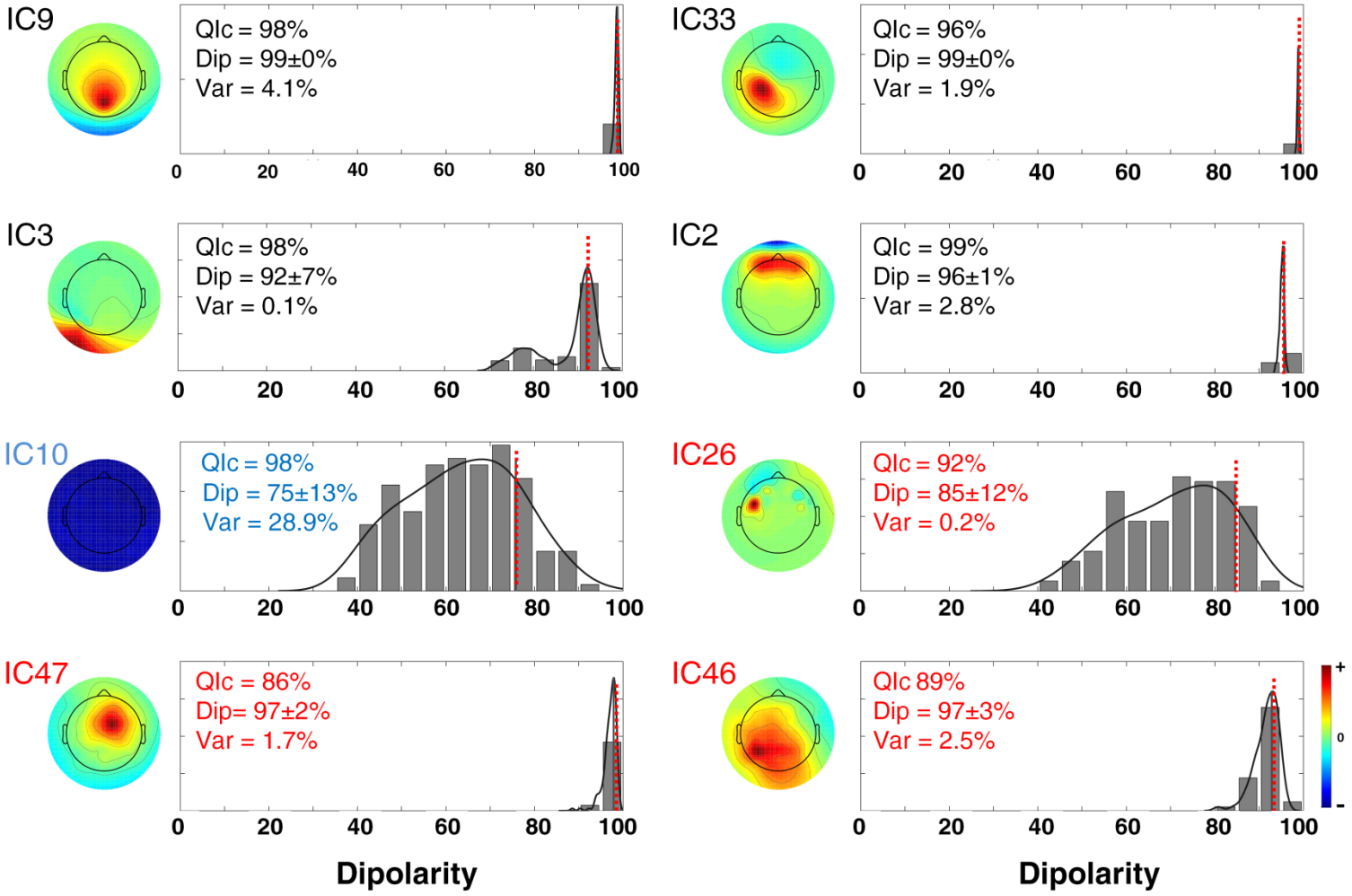
$$QIc = \frac{1}{|C_m|^2} \sum_{i,j \in C_m} \sigma_{ij} - \frac{1}{|C_m||C_{-m}|} \sum_{i,j \in C_m} \sum_{i,j \in C_{-m}} \sigma_{ij} \qquad \sigma_{ij} = WR_{ij}W^T$$

Clustering results example



Within-cluster reliability

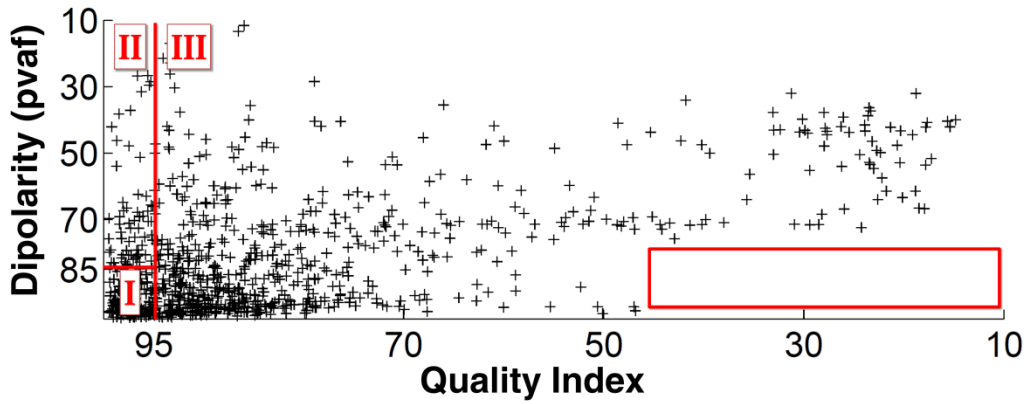
The distribution of dipolarity within the cluster helps assessing the **quality** and characteristics of Independent Components



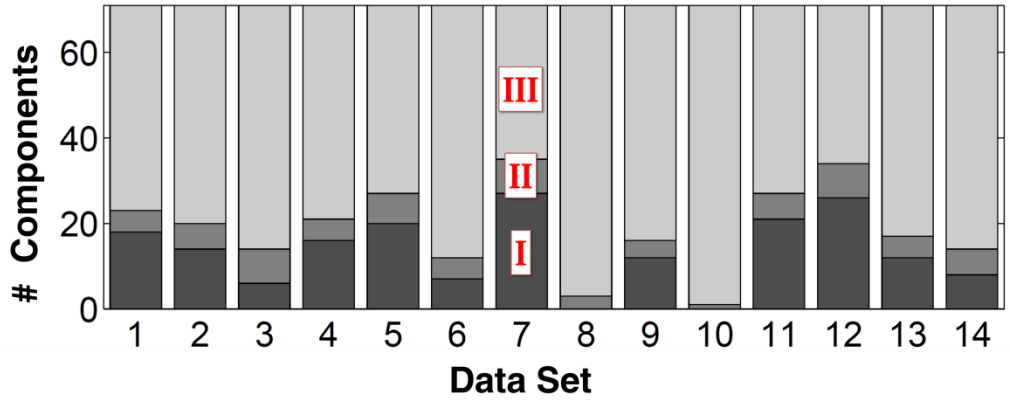
Reliability criteria and the rv<15%

First justification why we should select an **r.v <15%** for components to include in further analyses: there is a forbidden region underlined in red, that indicates the absence of

A



B



CLASS I

Quality Index and Dipolarity above Retention threshold: **Good**

CLASS II

Quality Index above threshold, dipolarity below: **artifact** or mixing of multiple processes

CLASS III

Quality Index below retention threshold

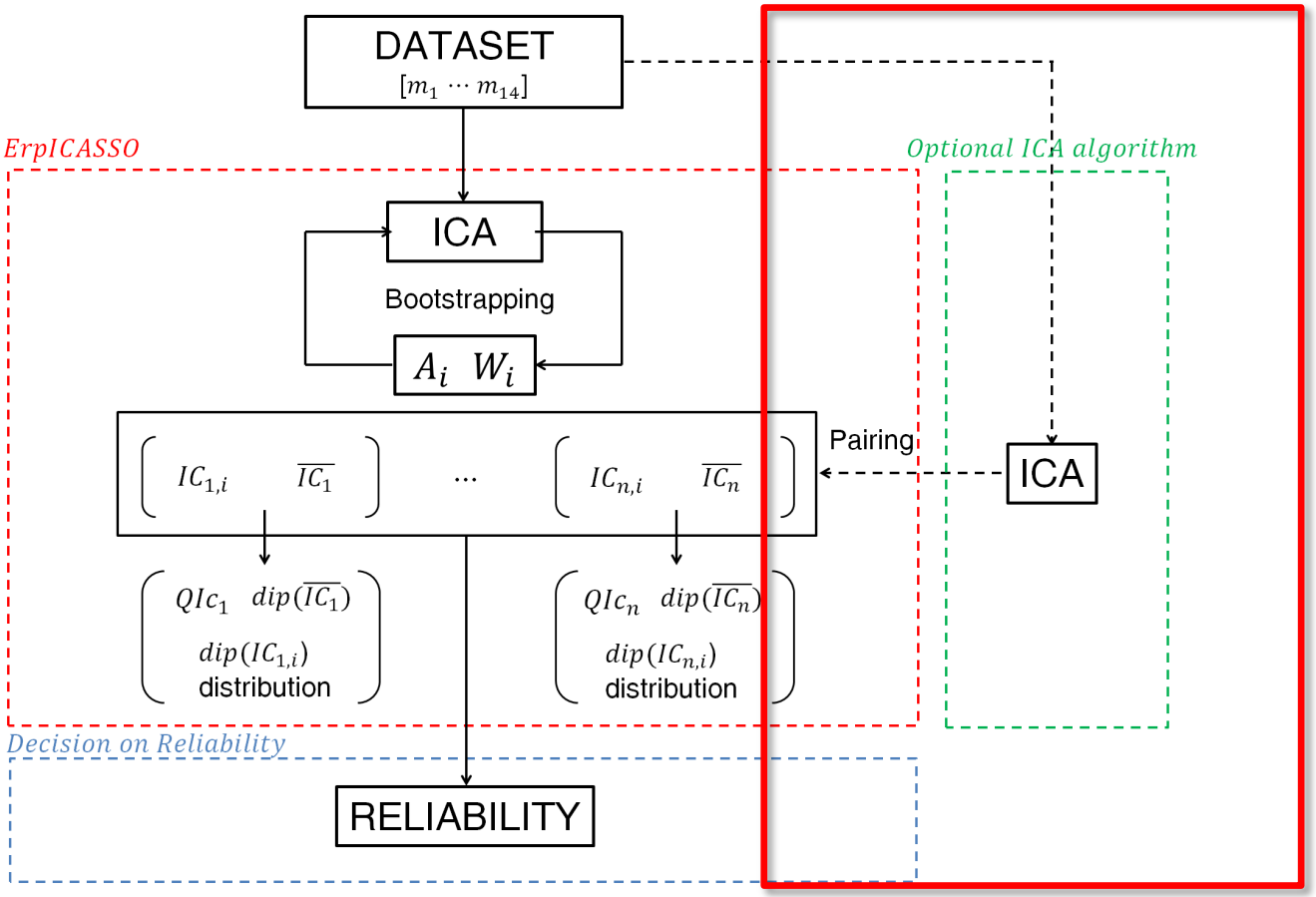
$dip \pm std > th$

Probable Inseparable noise: variance explained useful or **multiple subject confirmation**

$dip \pm std < th$

Discard

Pairing with a different algorithm



STABILITY

By resampling

PLAUSIBILITY

By dipolarity

QUALITY

By pairing

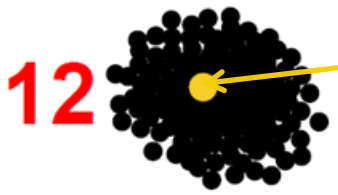
SPEED

By algorithms comparison

STATISTICS

By Component Adaptation Analysis

DO AMICA, THEN DO A QUICK ALGORITHM, FINALLY PAIR

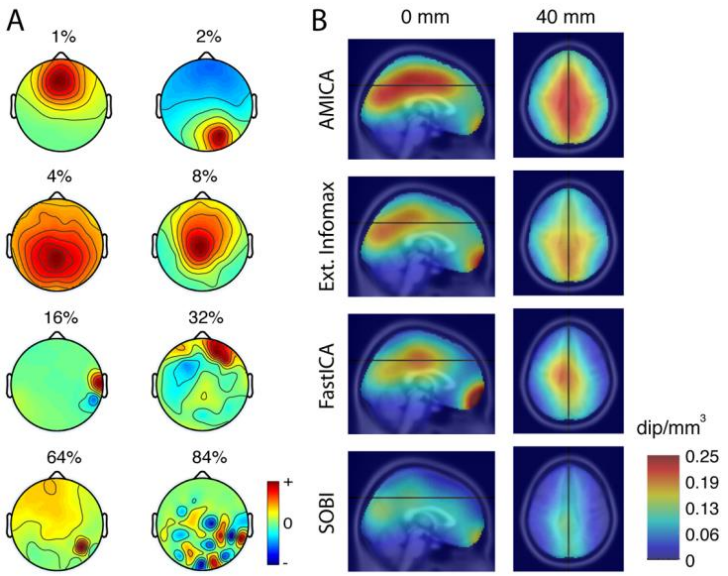


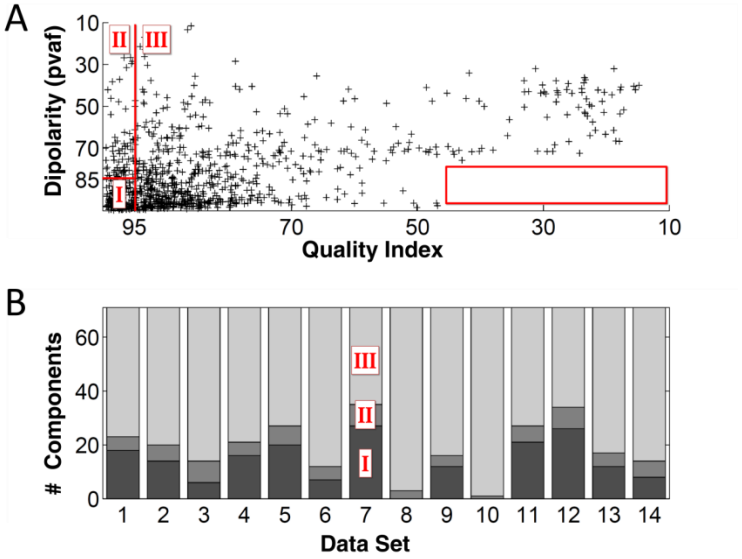
AMICA

BEAMICA/CUDAICA

TO CONCLUDE: TAKE HOME MESSAGES

1. SELECT RV<15%





2. With RELICA you avoid mistaking a component for good when it is not