New frontiers of human neuroimaging in Pisa: technical developments and new diagnostic methods

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FONDAZIONE STELLA MARIS

PET
MR
EEG
TRImage

Alberto Del Guerra

erc
STANIB

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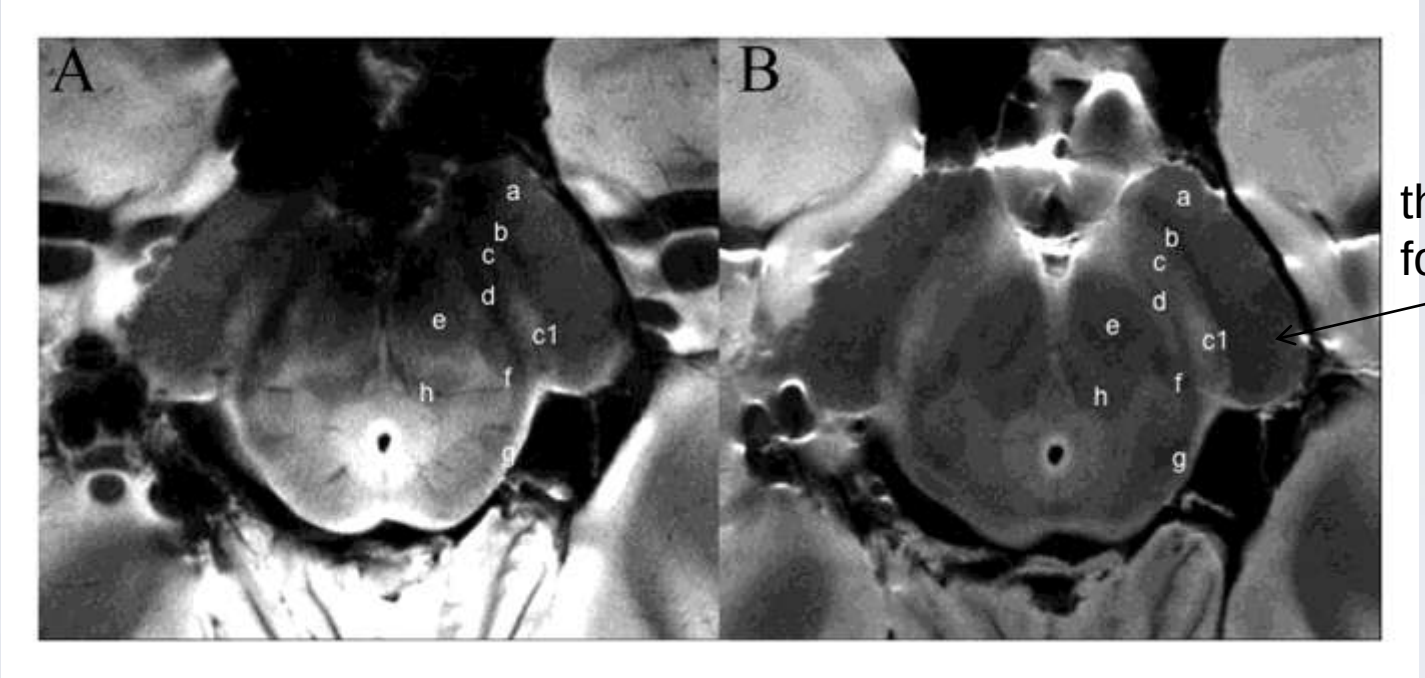
erc
ECSPLAIN

Clinical impact of ultra high-field MRI 7T in **neurodegenerative disease** diagnosis
(RF2009-1546281 Target project Italian Ministry of Health)

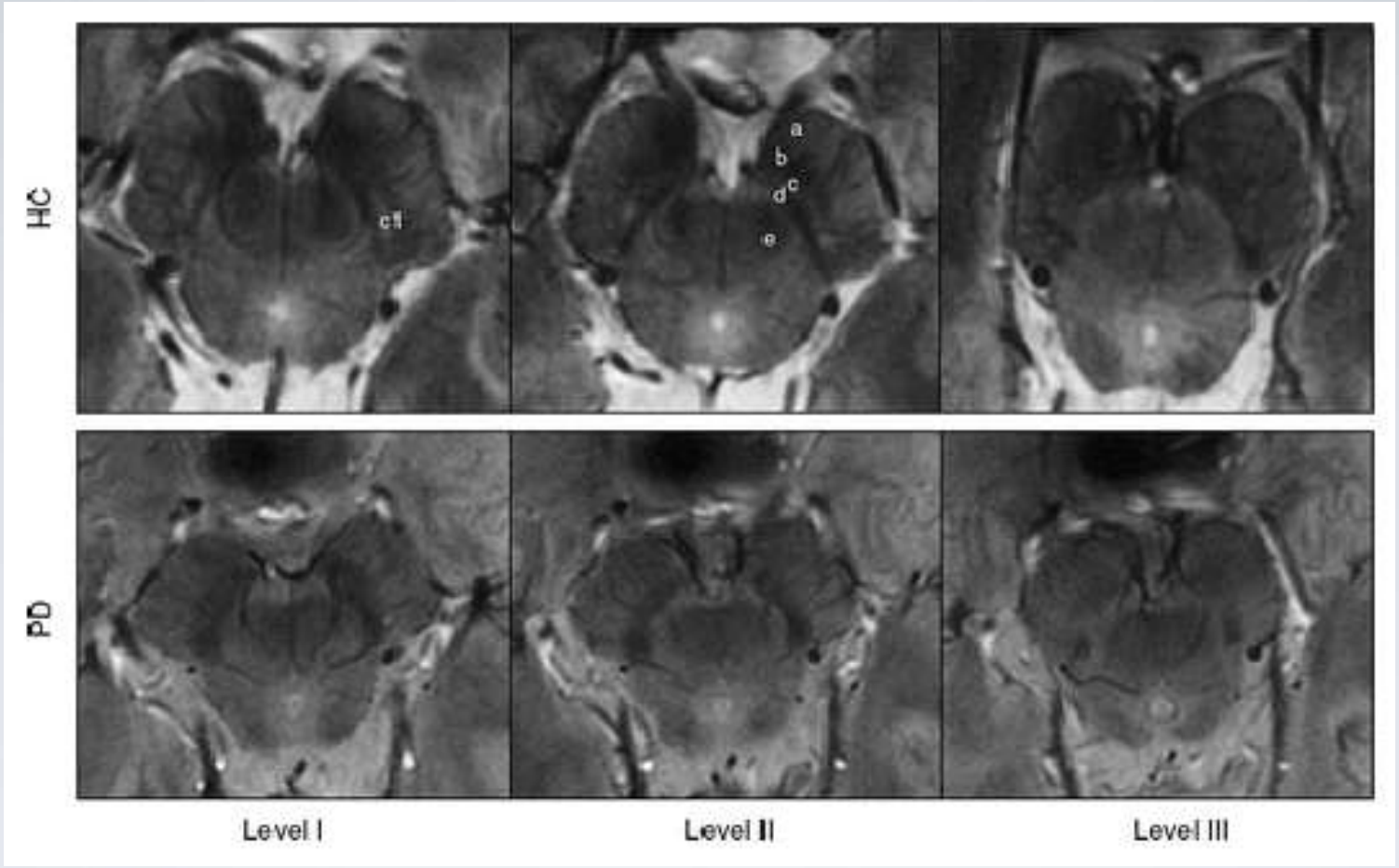
Parkinson disease: diagnostic role

Standard neuroimaging techniques fail in defining normal anatomy of *Substantia Nigra* and have only a marginal role in the diagnosis of PD



SWAN UHF-MRI allowed us to define a three layered organization of SN by distinguishing *pars compacta ventralis* (SNcv) and *dorsalis* (SNcd) from *pars reticulata* (SNr).

Parkinson disease: diagnostic role



RSNA
Radiology

Original Research
Neuroradiology

MR Imaging of the Substantia Nigra at 7 T Enables Diagnosis of Parkinson Disease

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From the IMAGO7 Foundation, Pisa, Italy (M. Cosottini, M. Costagli); Department of Translational Research and New Surgical and Medical Technologies (M. Cosottini) and Neurology Unit, Department of Clinical and Experimental Medicine (D.F., R.C., U.B.), University of Pisa, Pisa, Italy; Neuroradiology Unit, Department of Diagnostic and Interventional Radiology, Azienda Ospedaliero-Universitaria Pisana (AOUP), Pisa, Italy (I.P.); and Stella Maris Scientific Institute, Pisa, Italy (L.B., M.T.).

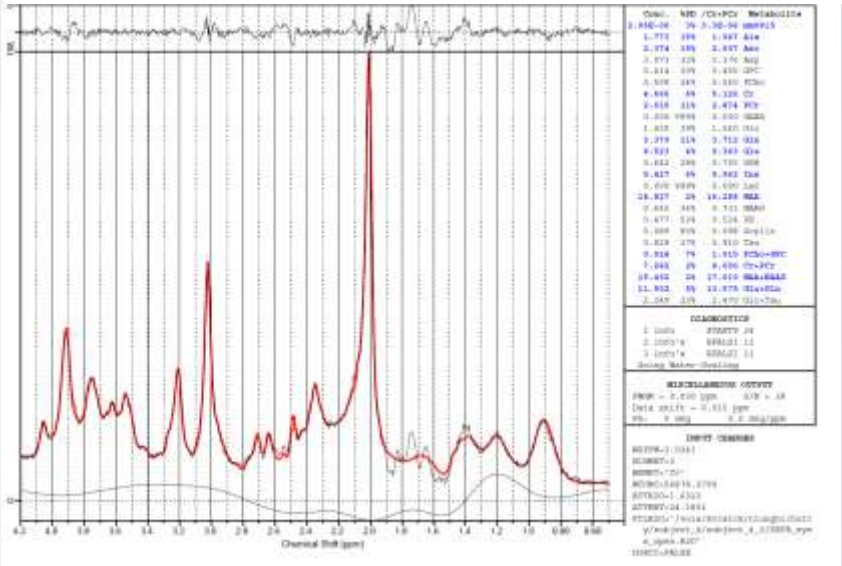
Sensory Deprivation & GABA @ 7T scanners

FMRIB – Oxford IMAGO7 – Pisa

ECSPLAIN

GABA (inhibitory neurostrasmitter) decreases in the occipital cortex following short visual deprivation

MR Spectroscopy



A specific biomarker for adult brain plasticity, potentially important for brain repair intervention!!

FP7 funded project: TRIMAGE
"An optimized trimodality (PET/MR/EEG) imaging tool for schizophrenia"
4 years = (1 dec 2013 - 30 november 2017)

Eleven Beneficiaries (7 research institutions/4 companies)

1. **UNIVERSITA' DI PISA- Department of Physics (the Coordinator - A.Del Guerra) (UNIPI)**
2. TECHNOLOGICAL EDUCATIONAL INSTITUTION OF ATHENS(**TEIA**)
3. FORSCHUNGSZENTRUM JUELICH GMBH (**JÜLICH**)
4. UNIVERSITAETSKLINIKUM AACHEN (**AACHEN**)
5. KLINIKUM RECHTS DER ISAR DER TECHNISCHEN UNIVERSITAT MUNCHEN (**TUM**)
6. UNIVERSITAET ZUERICH (**UZH**)
7. ISTITUTO NAZIONALE DI FISICA NUCLEARE (**INFN**)
8. Advansid SRL (**Advansid**)
9. WEEROC SAS (**Weeroc**)
10. raytest Isotopenmessgeraete GmbH (**raytest**)
11. RS2D (**RS2D**)

FP7 funded project: TRIMAGE
"An optimized trimodality (PET/MR/EEG) imaging tool for schizophrenia"

Rationale:

Schizophrenia is a severe mental disorder, which manifests early in life and causes a high social and economic burden on European societies. An imaging tool able to allow the diagnosis of schizophrenia during early development is strongly requested by the clinical community to improve the management of the disease.

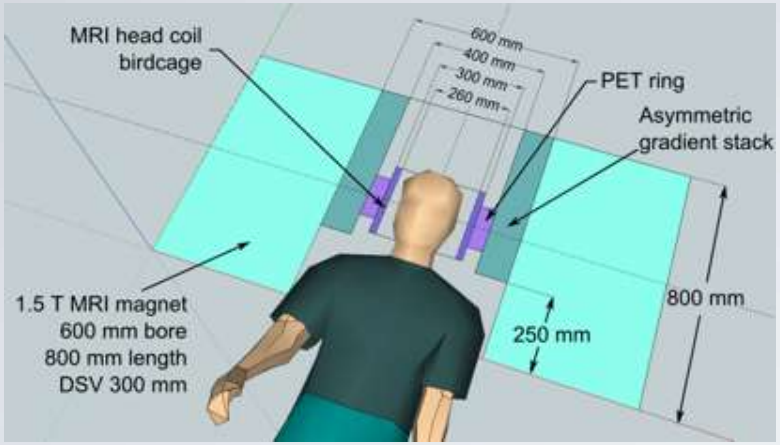
Project:

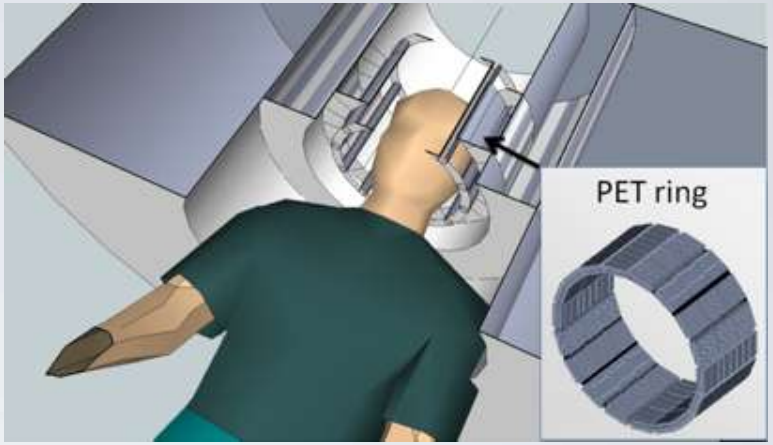
TRIMAGE aims to optimize and validate an integrated diagnostic solution for simultaneous PET/MR/EEG imaging defining specific biomarkers, to give the clinicians an effective tool for the diagnosis and choice of treatment of schizophrenia and other mental health disorders.

Outcome:

The PET/MR/EEG scanner prototype will be built by the consortium and is intended for broad distribution. It will enable effective early diagnosis of schizophrenia and possibly other mental health disorders.

A closer LOOK at the instrument





Dimensional outline (left) and artistic view (right) of the dedicated brain PET/MR/EEG system (the EEG cap is not shown).

MR (*to be built*)
-800 mm bore
-asymmetric gradient
-low field 1.5 T (non cryogenic)
EEG (*commercial*)

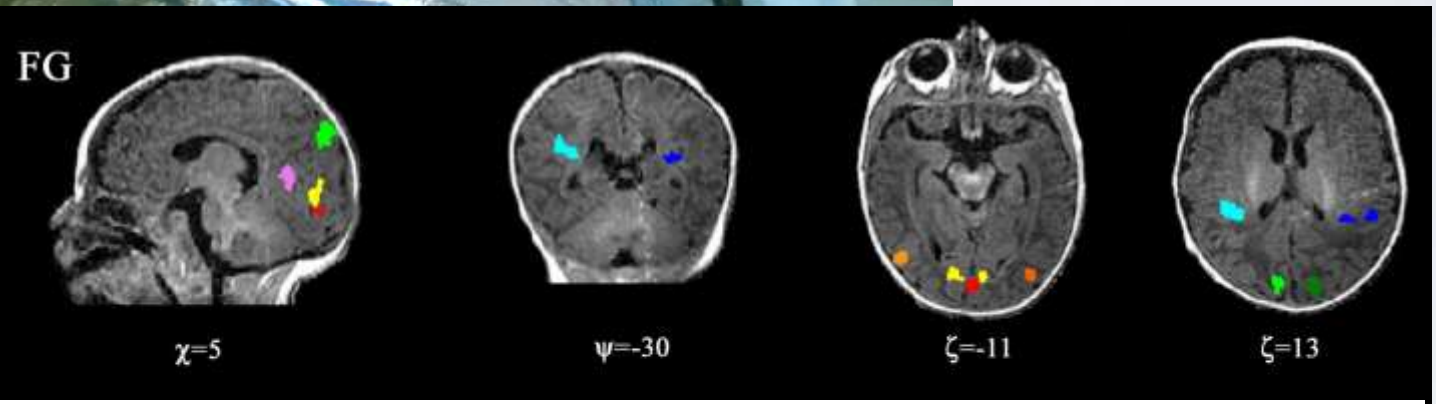
PET (*to be built*)
- Spatial res 2mm (DOI)
- High efficiency (14% at CFOV
- Axial FOV= 150mm
- Transaxial FOV=110 mm radius

Cost effective low-cost!!

Visual fMRI in 7Weeks old infants

Optimization of MR scanning procedure for alert collaborating infants (visual stimulus, eye movement recording, holding crib…)

For making these recordings routinly in neuro-radiological centers it would be important to use of a vertical MR scan.



MT
V1
V6
PIVC
Cu-PCu
occipital areas

INFANT ATLAS:
c, y , z are the distance (mm) from the AC point in the *x,y,z* directions

Infant Functional Atlas is important for:
Neurosurgery
Brain plasticity and reorganization during development
many other pathologies (Cerebral Palsy – PVL – Infant Hemianopia)

A well-established cortical network of **Visual** selectivity by **7 weeks of age**

ISTITUTO ITALIANO
DI TECNOLOGIA

RBCS

Project for 2T Vertical Scanner: Franco Bertora and Giulio Sandini