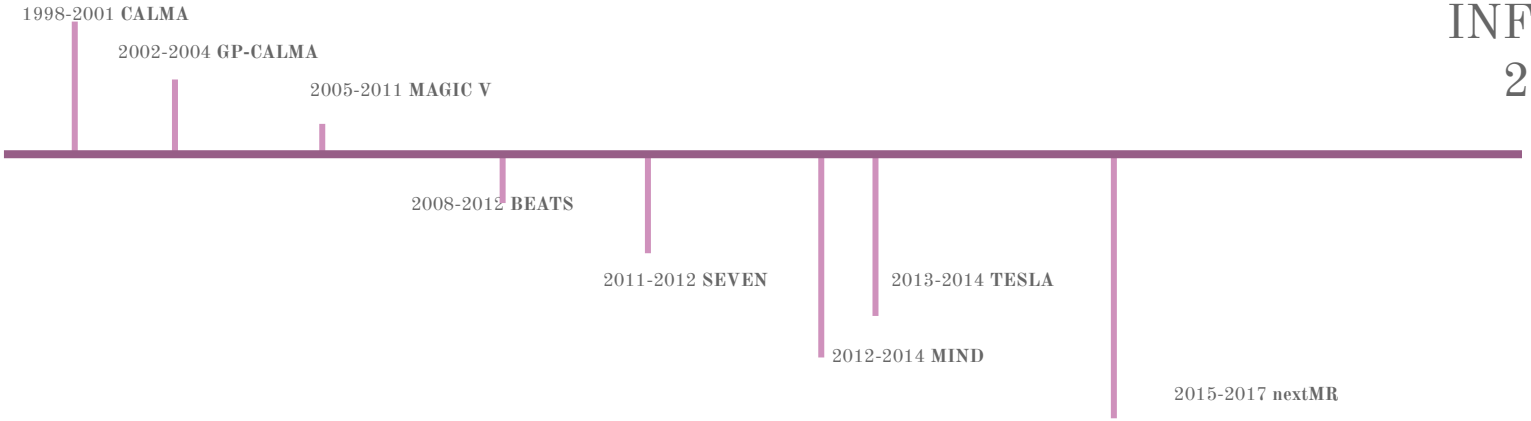
Artificial **I**ntelligence in **M**edicine

AIM



INFN - CSN5
2019-2021

AIM in short

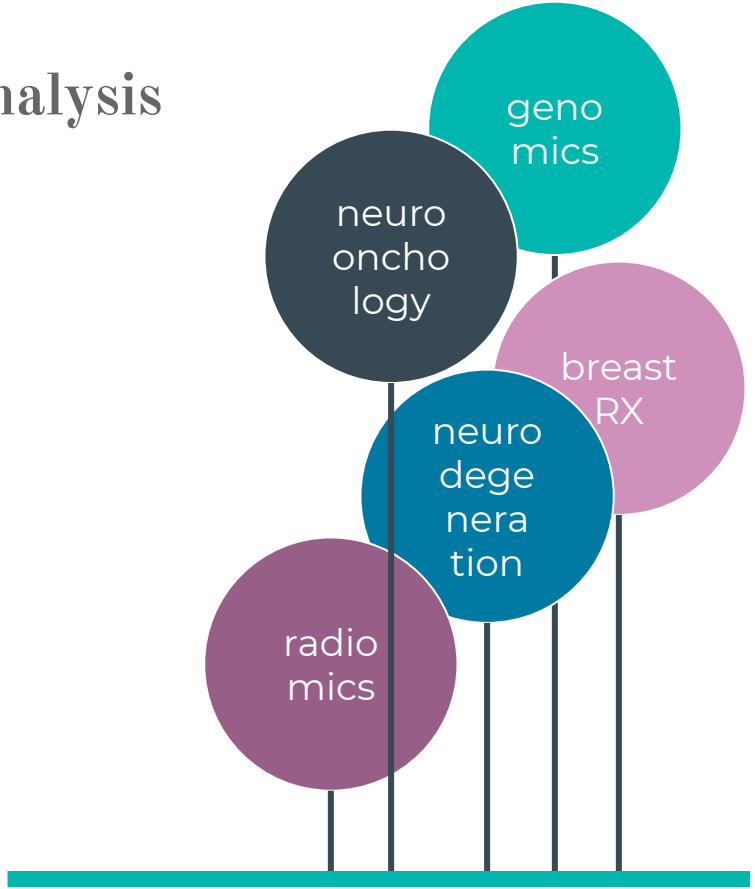
- a **network of expertise** in applied **data analysis**
  - focus on medical data & radiomics

- INFN-wide collaboration
  - PI / GE / CA / BO / BA / FI

Seeks to grow and develop existing and new curriculum in applied data science

Developments are CNTT-oriented

(e.g. DORIAN [A. Chincarini], R4I 2018)



partners & dataset

Clinical partners

- IRCCS S. Martino (GE)
- IRCCS Stella Maris (PI)
- IRCCS Gaslini (GE)
- IRCCS Centro S. G. di Dio (BS)
- IRCCS G.Paolo II (BA)
- IRCCS SDN (NA)
- AOUP (PI)
- Policlinico (BA)
- Meyer (FI)

EU / consortia

- IMAGO7 (Fondazione di Ricerca)
- EADC (EU)
- ADNI (US)
- ABIDE (EU/US)
- ENIGMA (WW)

AIM: Project Implementation

AIM+: Networking and Continuous Training

AIM+.T1 - Annual workshop on Methods, Algorithms and Computing Resource Operability, including training for new members (MACRO workshop). [Task expected duration: 3 years; starting month: 1]
AIM+.T2 - Annual workshop on applications (APP workshop). [Task expected duration: 2.5 years; starting month: 7]

AIM 1: Data harmonization

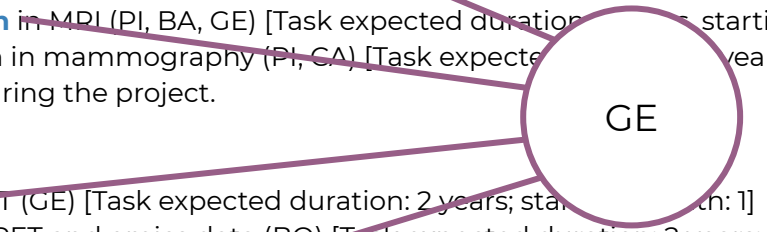
AIM1.T1 - Multi-site **data harmonization** in MRI (PI, BA, GE) [Task expected duration: [illegible] starting month: 1]
AIM1.T2 - Multi-site data harmonization in mammography (PI, CA) [Task expected [illegible] years; starting month: 1]
... AIM1.Tn - future tasks to be added during the project.

AIM 2: Quantification

AIM2.T1 - **Quantification models** in PET (GE) [Task expected duration: 2 years; start [illegible] th: 1]
AIM2.T2 - Integrated quantification of PET and omics data (BO) [Task expected duration: 2 years; starting month: 6]
... AIM2.Tn - future tasks to be added during the project.

AIM 3: Predictive models

AIM3.T1 - **Predictive models** for Radiation Therapy treatments (FI, GE) [Task expected duration: 3 years; starting month: 1]
AIM3.T2 - Predictive models for mammography and CESM (PI, CA, BA) [Task expected duration: 3 years; starting month: 1]
AIM3.T3 - Predictive models for transcranial-MR-guided Focused Ultrasound Surgery (tcMRgFUS) (CT) [Task expected duration: 3 years; starting month: 1]
AIM3.T4 - Predictive models for Systems Medicine (BO) [Task expected duration: 2 years; starting month: 1]
... AIM3.Tn - future tasks to be added during the project.



people & facilities

Nome	FTE
E. Peira	0.5
F. Sensi (RL)	1.0
M. Corosu	0.2

Richieste ai servizi

Nessuna

spin-off tecnologico

DORIAN

evolving neuroimaging

background

NIA-AA (2018)

National Institute on Aging—Alzheimer's Association

AT(N) profiles	Biomarker category	
A-T-(N)-	Normal AD biomarkers	
A+T-(N)-	Alzheimer's pathologic change	Alzheimer's continuum
A+T+(N)-	Alzheimer's disease	
A+T+(N)+	Alzheimer's disease	
A+T-(N)+	Alzheimer's and concomitant suspected non Alzheimer's pathologic change	
A-T+(N)-	Non-AD pathologic change	
A-T-(N)+	Non-AD pathologic change	
A-T+(N)+	Non-AD pathologic change	

Pathological accumulation of amyloid in the brain is the main biomarker for the **early** and **differential** diagnosis of neurodegeneration of Alzheimer type. **Amyloid-PET** scans are appropriate

HOWEVER

in-vivo assessment of brain amyloidosis is not trivial. To-date, only a **visual** binary scale is applied !

neg ? pos

challenge


Symptoms


Neurological examination


Neuroimaging (MRI)


Neuroimaging (FDG-PET)


Neuroimaging (amy-PET)


Appropriate treatment


Lifestyle and medical actions

today


DMT expert panel
Clinical evaluation
Biomarkers

medical actions & monitoring depend on **quantifiable independent information**

HELP WANTED !

HOW?

tomorrow


general population


Asymptomatic at risk


amyloid blood screening


Neuroimaging (amy-PET)


anti-amyloid treatment

~ 1 - 2 y

follow-up

vision

- Methodological development towards a **di**agnosis-**or**iented **an**alysis
- Data analysis & ML techniques tuned to Robust Reliable Quantification
- Extensive validation on both research and clinical dataset

DORIAN
evolving neuroimaging

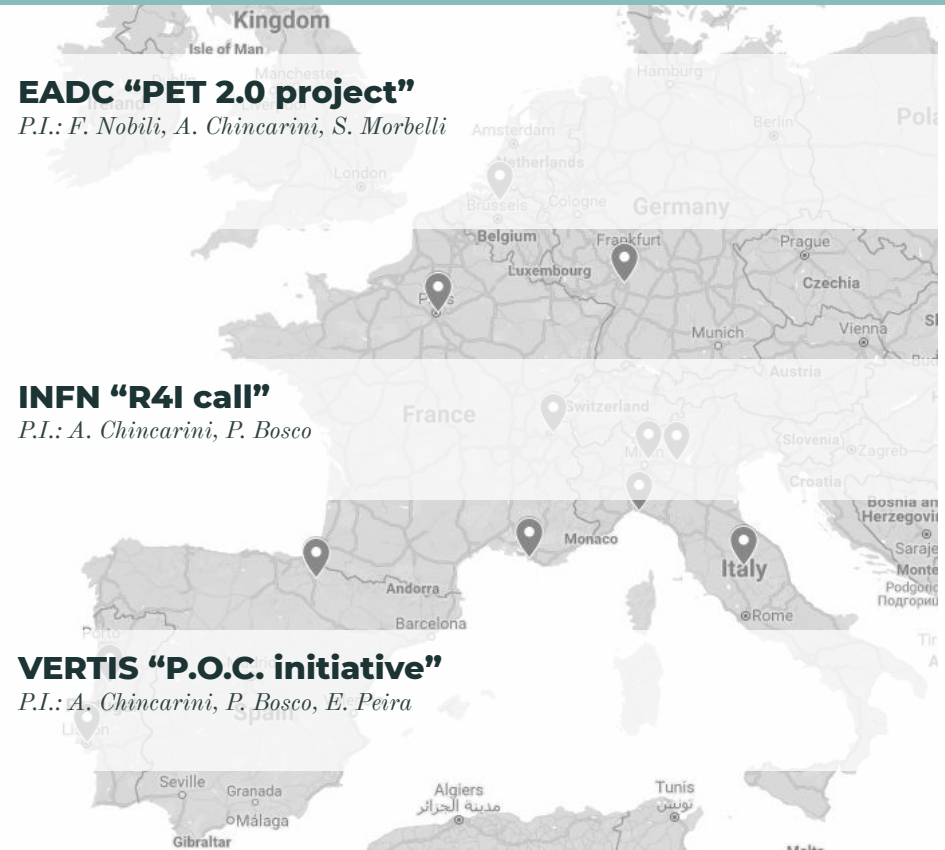
accurate quantification

medical research / risk factors

training

- GDPR compliant
- Analysis-As-Service
- Naturally embedded in the clinical practice

institutions



EADC "PET 2.0 project"
P.I.: F. Nobili, A. Chincarini, S. Morbelli

INFN "R4I call"
P.I.: A. Chincarini, P. Bosco

VERTIS "P.O.C. initiative"
P.I.: A. Chincarini, P. Bosco, E. Peira

EADC
European Alzheimer's Disease Consortium

12 centers in 7 countries
450 scans to date + clinics & $\geq$2y f.up

INFN

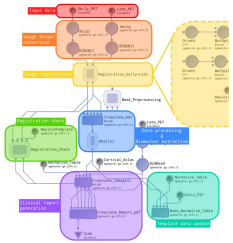
TT office Research for Innovation call

VERTIS SGR
Private Equity & Venture Capital

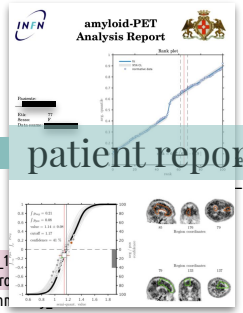
Start-up grant for the Proof Of Concept of Innovative Ideas

innovation

dockerized
cloud computing



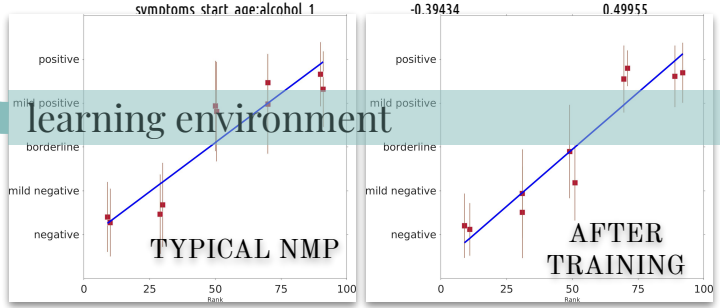
WebApp with
on-the-fly
anonymization



patient report

		pValue
tmta_z		0.0010472
diabetes_1		0.0019172
heart_disease_1		2.9126e-05
hypercholesterol		0.00052206
chronic_inflamm		0.10804
alcohol_1	38.794	0.35904
alcohol_2	-317.01	0.0027398
ssri_1	-6.3845	0.92098
[illegible]	26.43	0.00052179
tmta_z:heart_disease_1	-14.603	0.024572
mmse:chronic_inflammatory_1	-6.4262	0.046463
diabetes_1:symptoms_start_age	-4.5214	0.0016744
symptoms_start_age:alcohol_1	-0.39434	0.49955

cohort statistics



learning environment

activity 2019 - 2020

2016 - Patent [innovative quantification method]

2017 - R4I competition

2018 - VERTIS competition

2019 - Patent request

2019 - Contract signed between INFN-GE & QUIBIM for the data analysis of a pharmaceutical trial

2020 - INFN spin-off ...

Richieste ai servizi

- nessuna
  - impegno conteggiato in AIM [20% M.Corosu]

BULLKID

BULky **L**ow-threshold **K**inetic **I**nductance **D**etectors

Rivelatori criogenici di fononi atermici prodotti da rinculi nucleari
- Materia oscura “leggera”
- Scattering coerente di neutrini

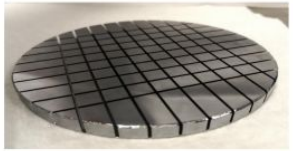
Serve una massa bersaglio di ~1kg
e una soglia in energia di 10-20 eV

Sensori: Kinetic Inductance Detectors
Già sviluppati e usati nel progetto CALDER

Massa bersaglio: wafer di silicio
diametro: 3”, spessore 5 mm

Progetto finanziato dalla CSN5 già dal 2019 (INFN-RM)
Contributo da INFN-Ge per il 2020

Attività: Supporto per il readout
Persone: S. Di Domizio (RTD-UniGe): 0.2 FTE
Richieste ai servizi: nessuna richiesta



- 5x5x5 mm^3 voxels
- ~0.3g/voxel,
- ~100 voxels/wafer (3”)
- ~30g/wafer