FMUSP Labs for INFIERI Summer School 2017

Welcome and Save the date: 28/01/2017

Hospital das Clínicas HC-FMUSP

Main objectives of our labs

- Allow you to get to know different research facilities in Medical Imaging at FMUSP
- Basic concepts of the different equipements (hardware)
- Basic concepts of image formation (contrast, signal to noise ratio, resolution)

Medical Imaging: MRI lab session

Where: PISA core facility at FMUSP
with 7T whole body scanner

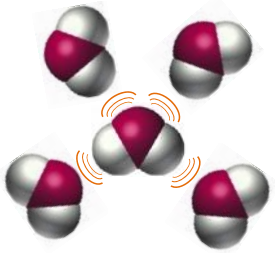
Khallil Chaim

Maria Otaduy

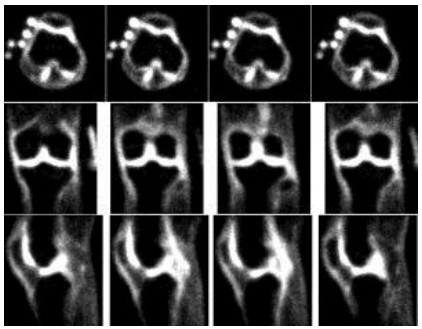
Ultrahigh Field MRI – Whole-Body

Larmor frequency (resonance)

$$\omega_0 = \gamma \cdot B_0$$



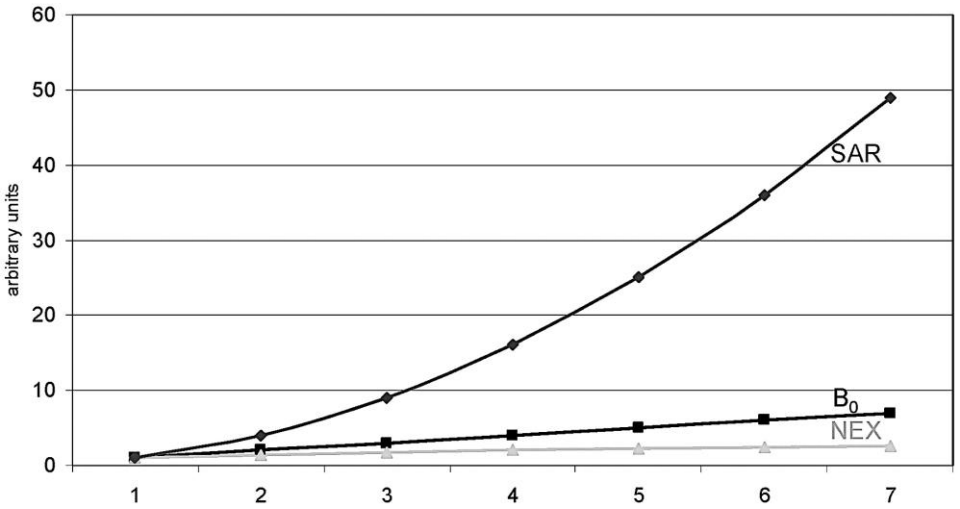
Água Livre

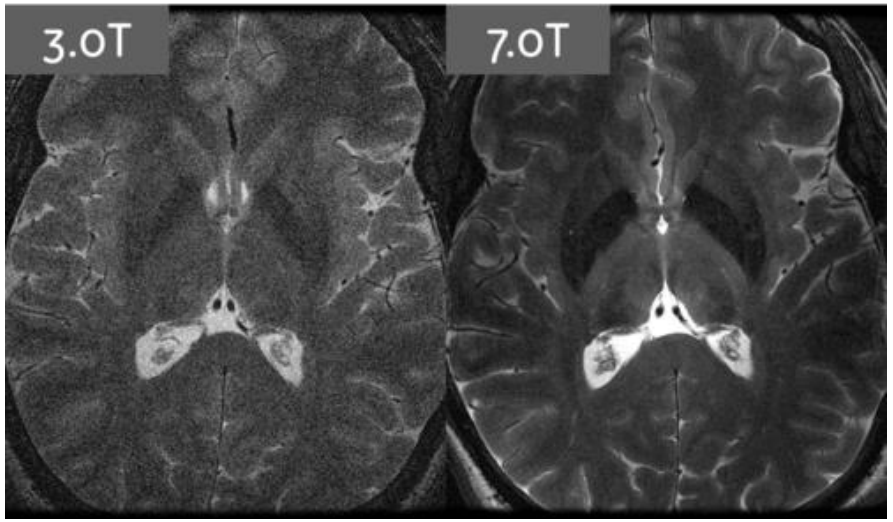


MRI do Joelho @ 7T

	1.5 T	3 T	7 T	Abundância Natural	Abundância Biologica
^{1}H	63.87	127.73	298.04	99.985%	63%
^{2}D	9.81	19.62	45.77	0.015%	
^{6}Li	9.40	18.80	43.86	7.5%	0%
^{7}Li	24.82	49.64	115.84	92.5%	
^{12}C	--	--	--	98.9%	9%
^{13}C	16.06	32.13	74.96	1.1%	
^{14}N	4.62	9.23	21.54	99.63%	2%
^{15}N	6.48	12.95	30.22	0.37%	
^{16}O	--	--	--	99.76%	26%
^{17}O	8.66	17.32	40.42	0.04%	
^{23}Na	16.90	33.81	78.88	100%	0.04%
^{31}P	25.88	51.75	120.76	100%	2.4%

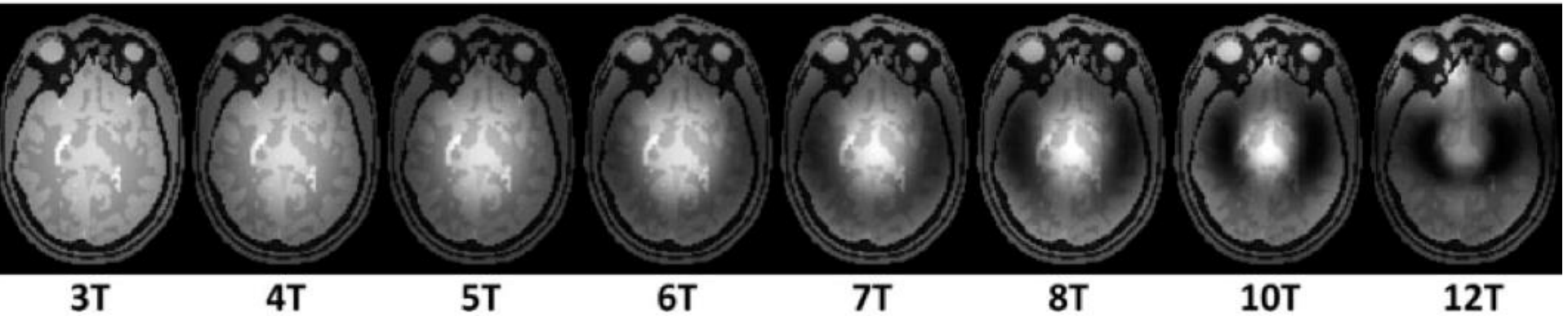
MRI BASIC PRINCIPLES AND APPLICATIONS, 3ed., Mark A. Brown & Richard C. Semelka
Journal of Magnetic Resonance Imaging Volume 30, Issue 3, pages 606-614, 26 AUG 2009 DOI: 10.1002/jmri.21881





High magnetic field is not all advantages, we have big challenges: strong SAR effects and strong dielectric effects. This implies in different hardware strategies for high field MRI (i.e. parallel transmission)

Campo	Freq. Larmor (aprox.)	Comp. de onda (aprox.)
0.5 T	21 MHz	141 cm
1.2 T	50 MHz	47 cm
1.5 T	63 MHz	59 cm
3.0 T	126 MHz	24 cm
7.0 T	294 MHz	10 cm



MRI lab tasks

- 1st task: after listening to some instructions you will have to answer some questions about MRI safety
- 2nd: After positioning MRI resolution phantom you will have to change image resolution (FOV, matrix and slice thickness)
- 3rd task: After positioning contrast phantom (different T1 and T2) you will have to observe how the image changes with TE, TR and with echo acquisition mode (gradient-echo vs. spin-echo)
- 4th task: After positioning MRS phantom you will have to describe how signal changes from time domain to frequency domain. Observe important characteristics of the final signal, and how does this signal change with a good B0 shimming (you will have to try out different shimming techniques).

Medical Imaging: PET lab session

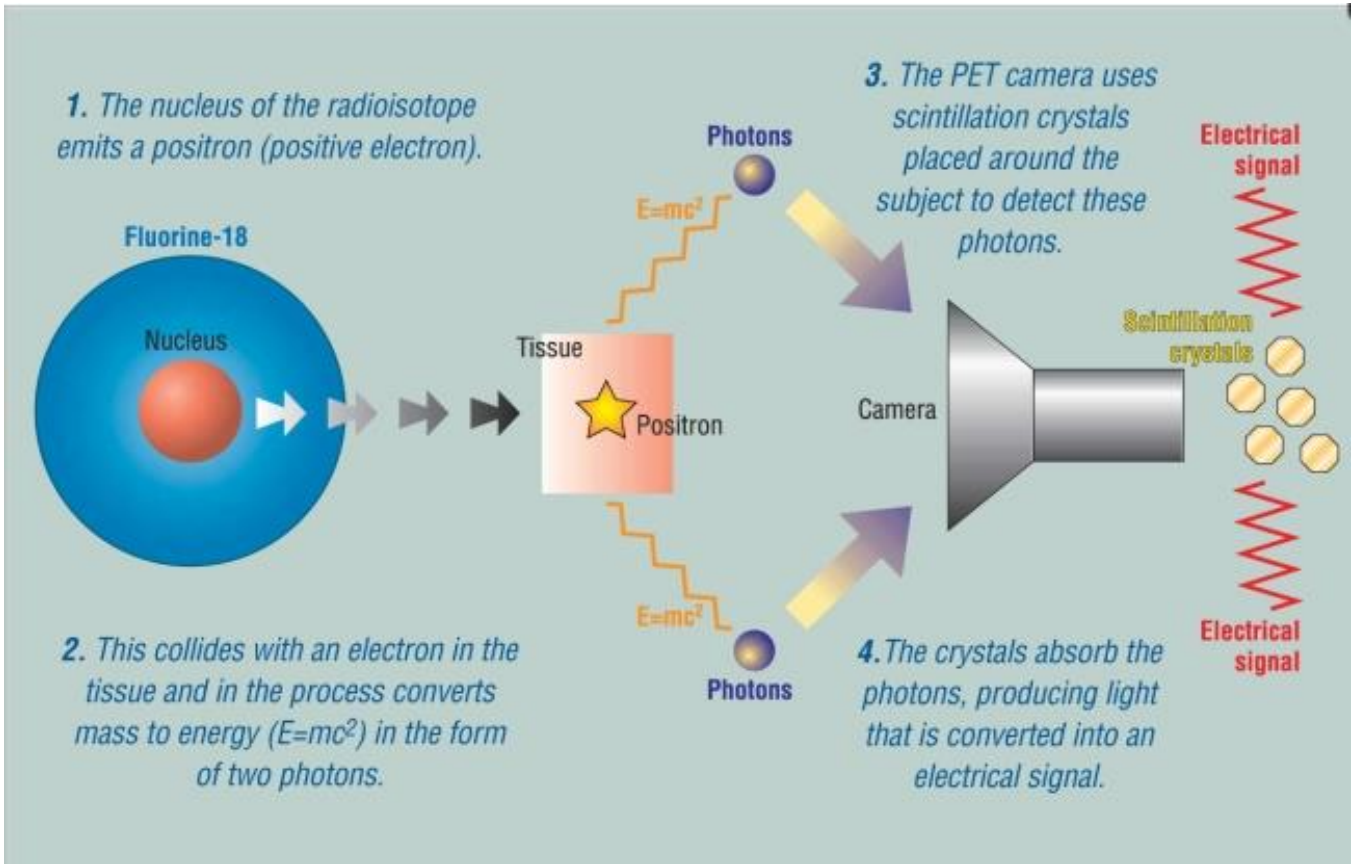
Alexandre Garcez

Bruno Pastorello

Where: Nuclear Medicine unit at InRad

PET/MRI (3T) scanner

PET basic steps



Ziegler S, Nuclear Physics, 2005

Biological radioactive nuclei: oxygen-15, fluorine-18, carbon-11, or nitrogen-13
Most used: 18-fluorodeoxyglucose (FDG) for glucose consumption, which is higher in tumors
A PET scan measures also important body functions, such as blood flow, oxygen use, and sugar (glucose) metabolism.

PET/MRI lab tasks

- 1st task: After accompanying the calibration process of the equipment, list 4 calibration parameters and indicate the purpose of the calibration.
- 2nd task: After observing how the phantom is filled, state the purpose of having spheres of different diameters.
- 3rd task: After reconstructing the images using several parameters, describe what you observed in relation to the quality of the images.
- 4th task: After analyzing the phantom images, list your results in terms of the contrast of the "hot" and "cold" spheres and compare with the values published by the manufacturer.

Do not worry with radioactivity!!

- There will be no exposure for students
- For some procedures a simulator will be used to mock the real process

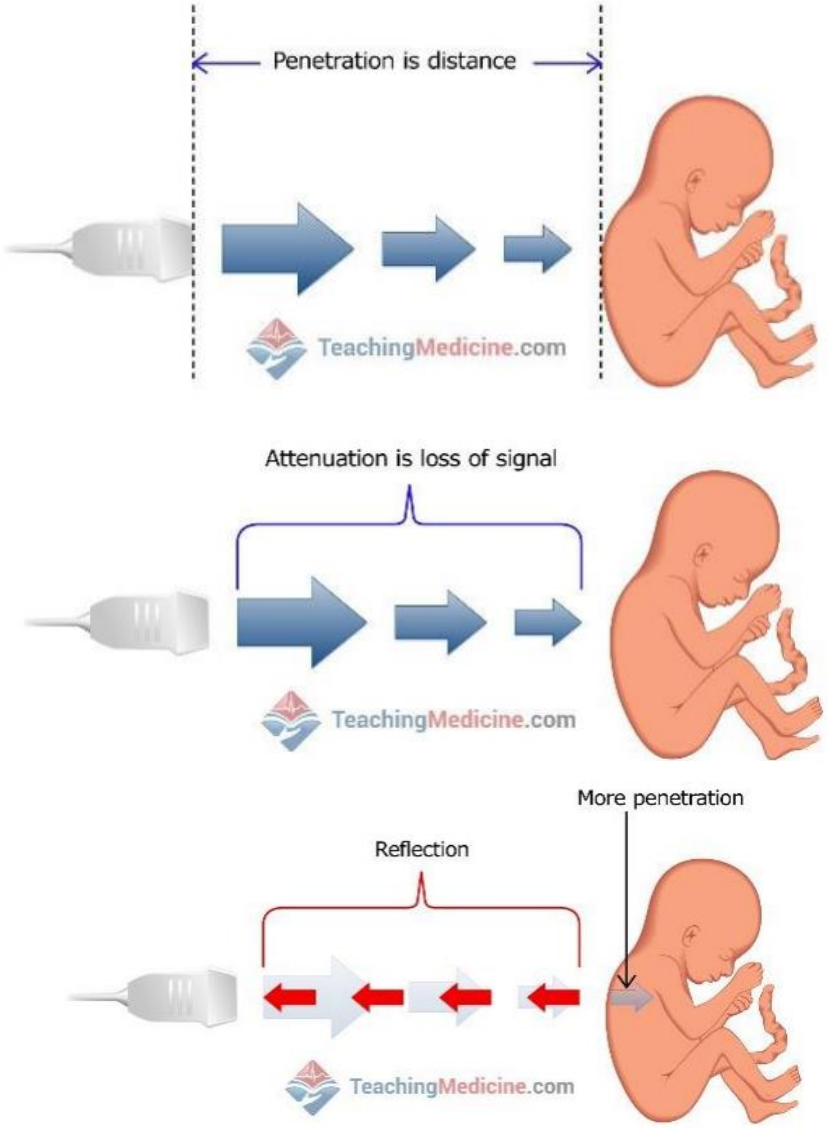
Medical Imaging: Ultrasound Lab

Where: InRad, Portaria 6 (convênio).

Mateus Aranha

Eugenio Martinetto

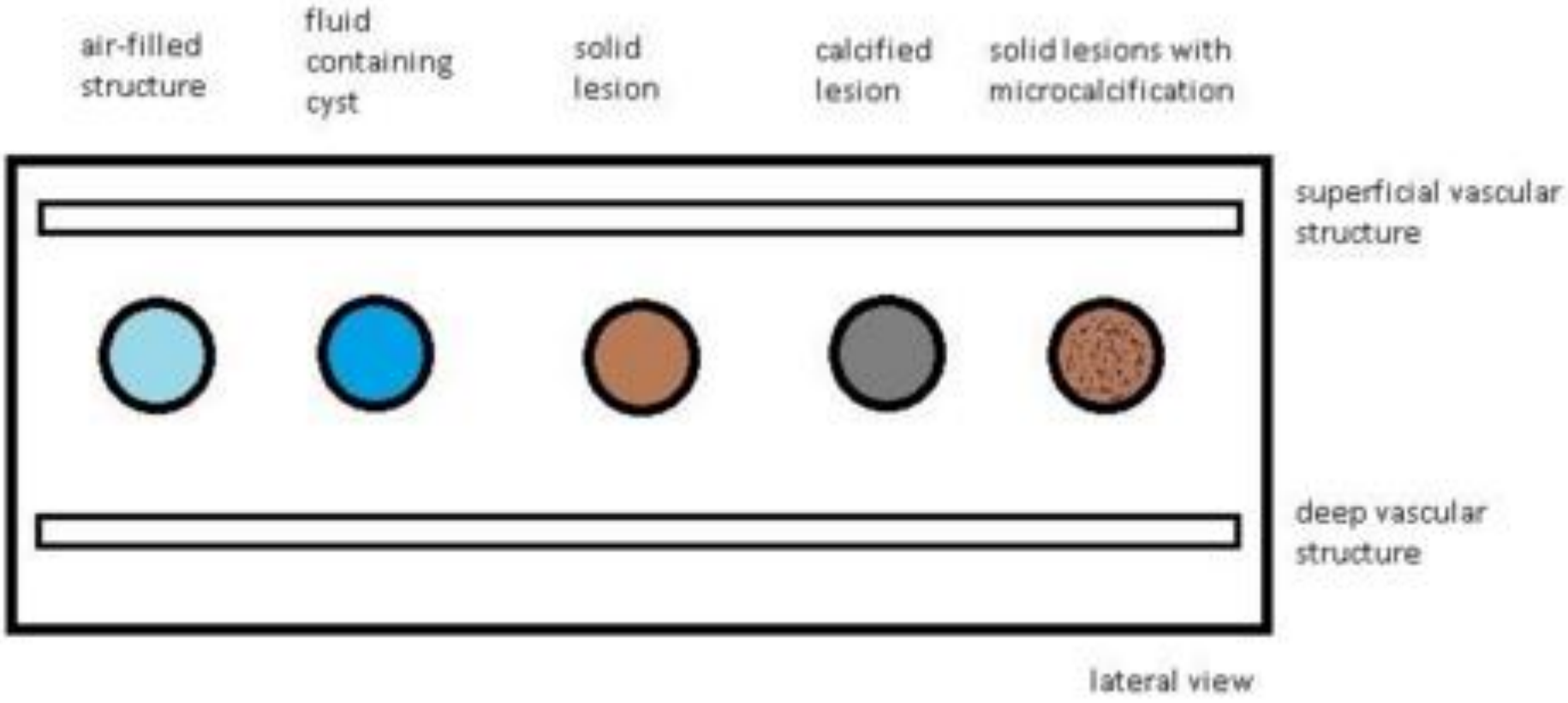
US: interaction with sound waves penetration, attenuation and reflection



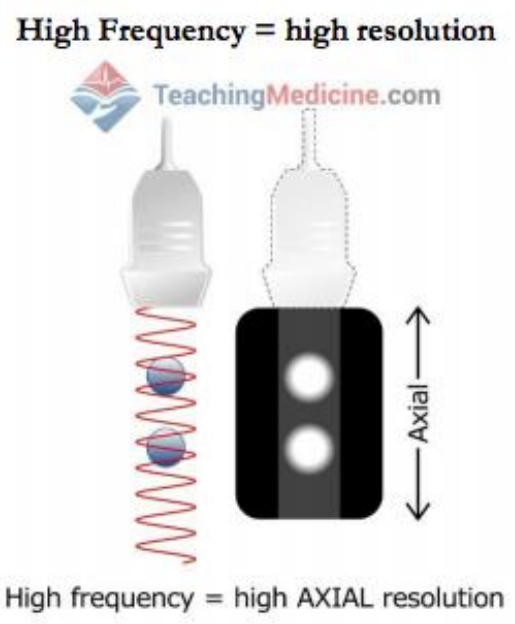
- As sound **penetrates** all tissues, the signal becomes attenuated.
- The further the sound penetrates, the greater the **attenuation** (objects far away are harder to see)
- **Reflection** is required for the US probe to receive a signal to analyze (no reflection, no signal)

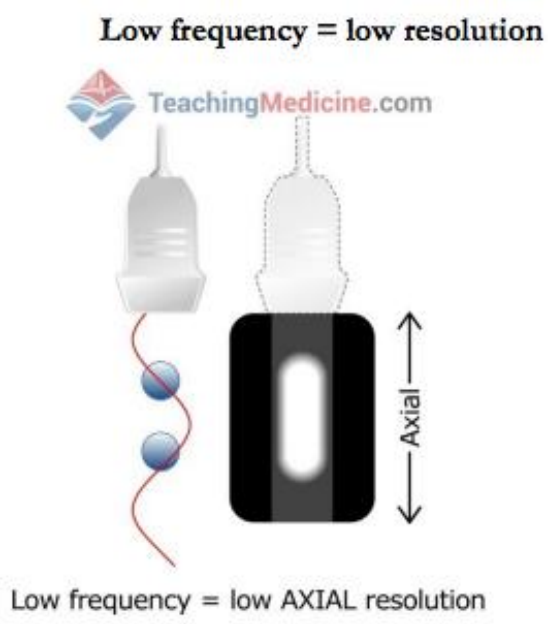
1st task: How looks US signal on phantom below

Different tissues have different degrees of penetration, attenuation and reflection (US contrast)

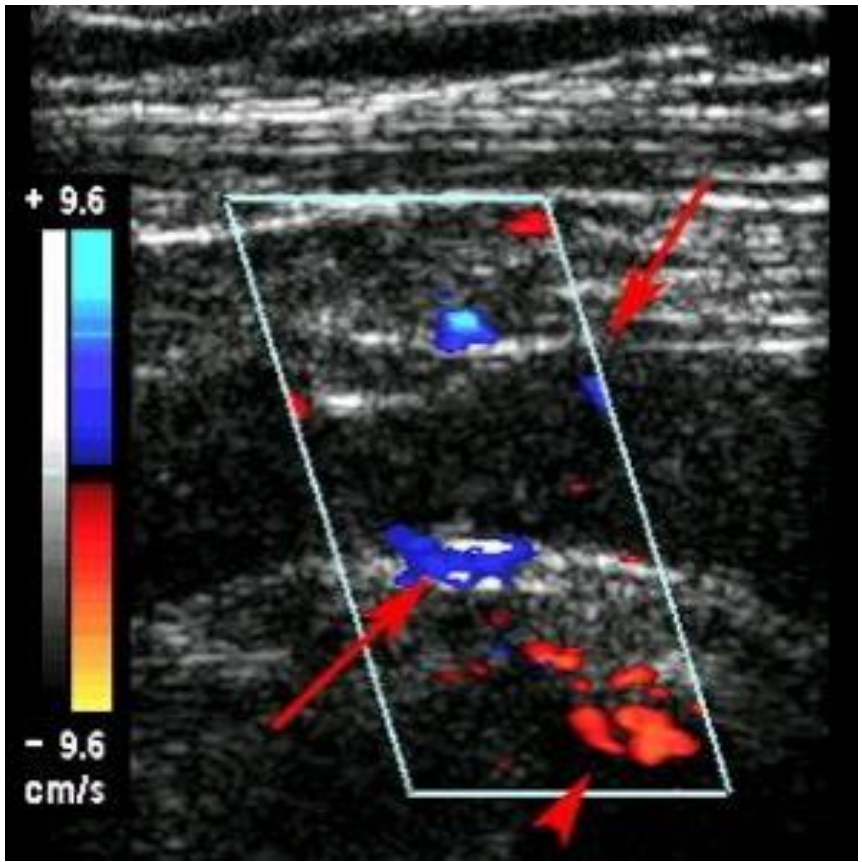


2nd task: What happens changing frequency, probe and angulation?

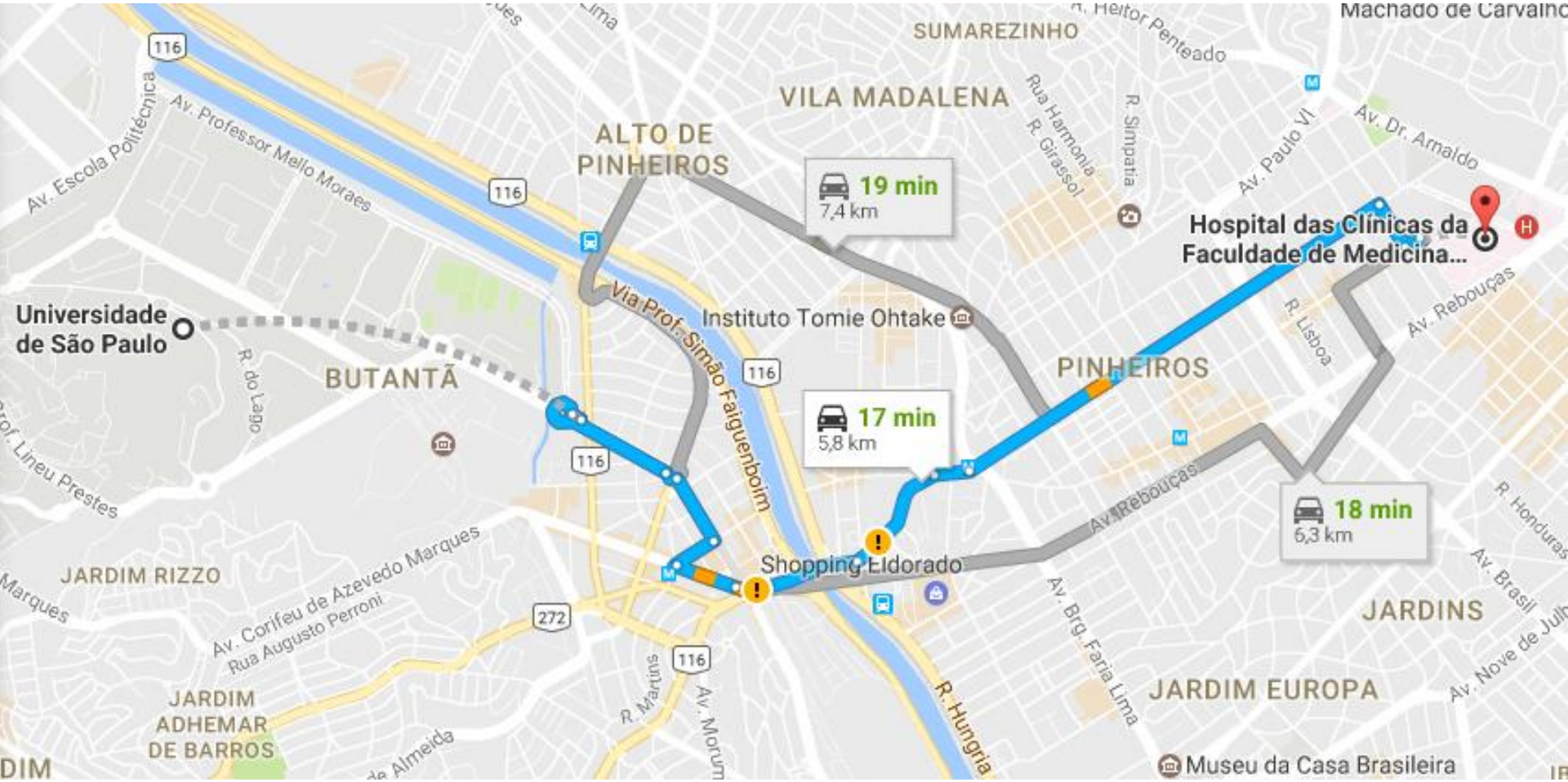


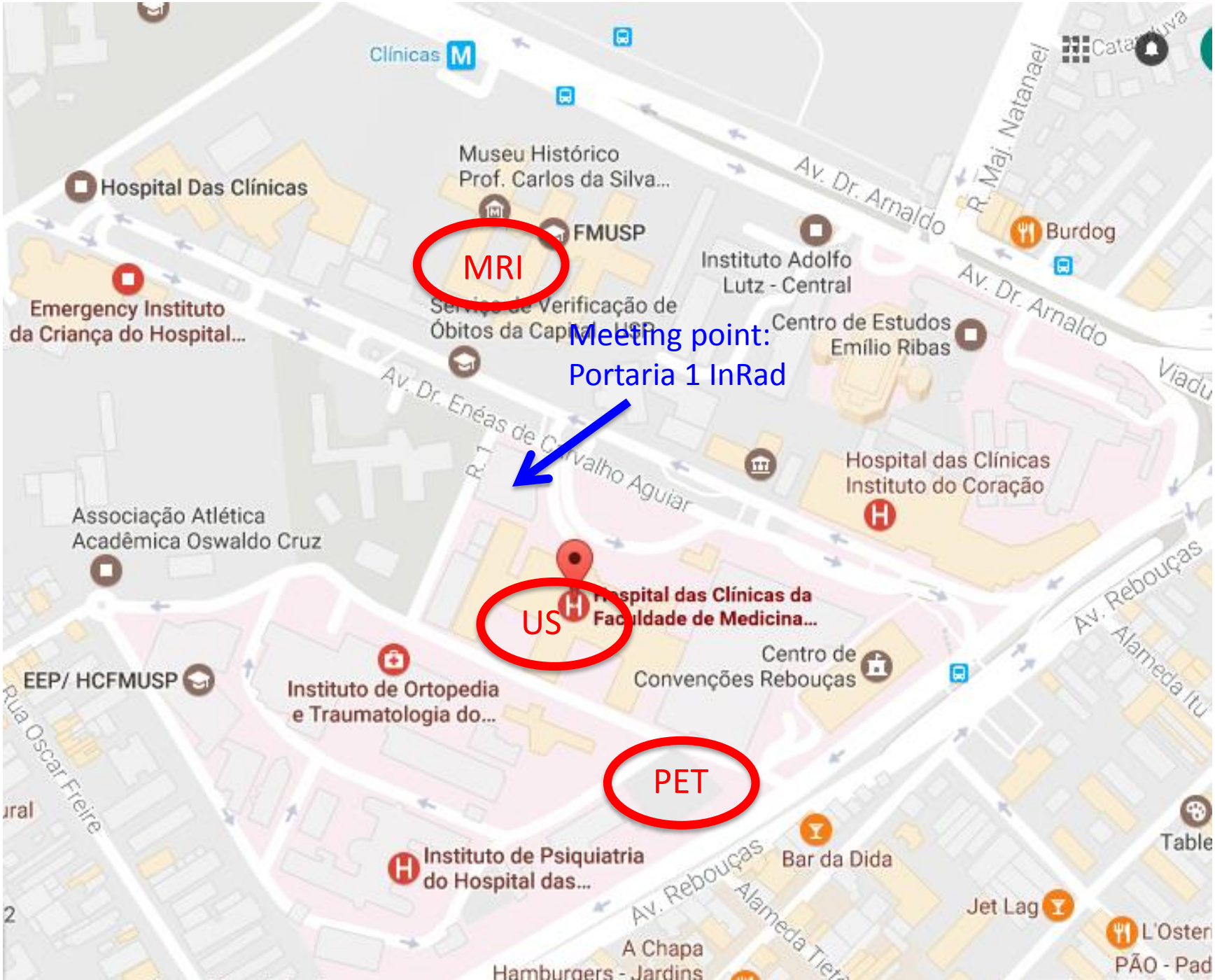


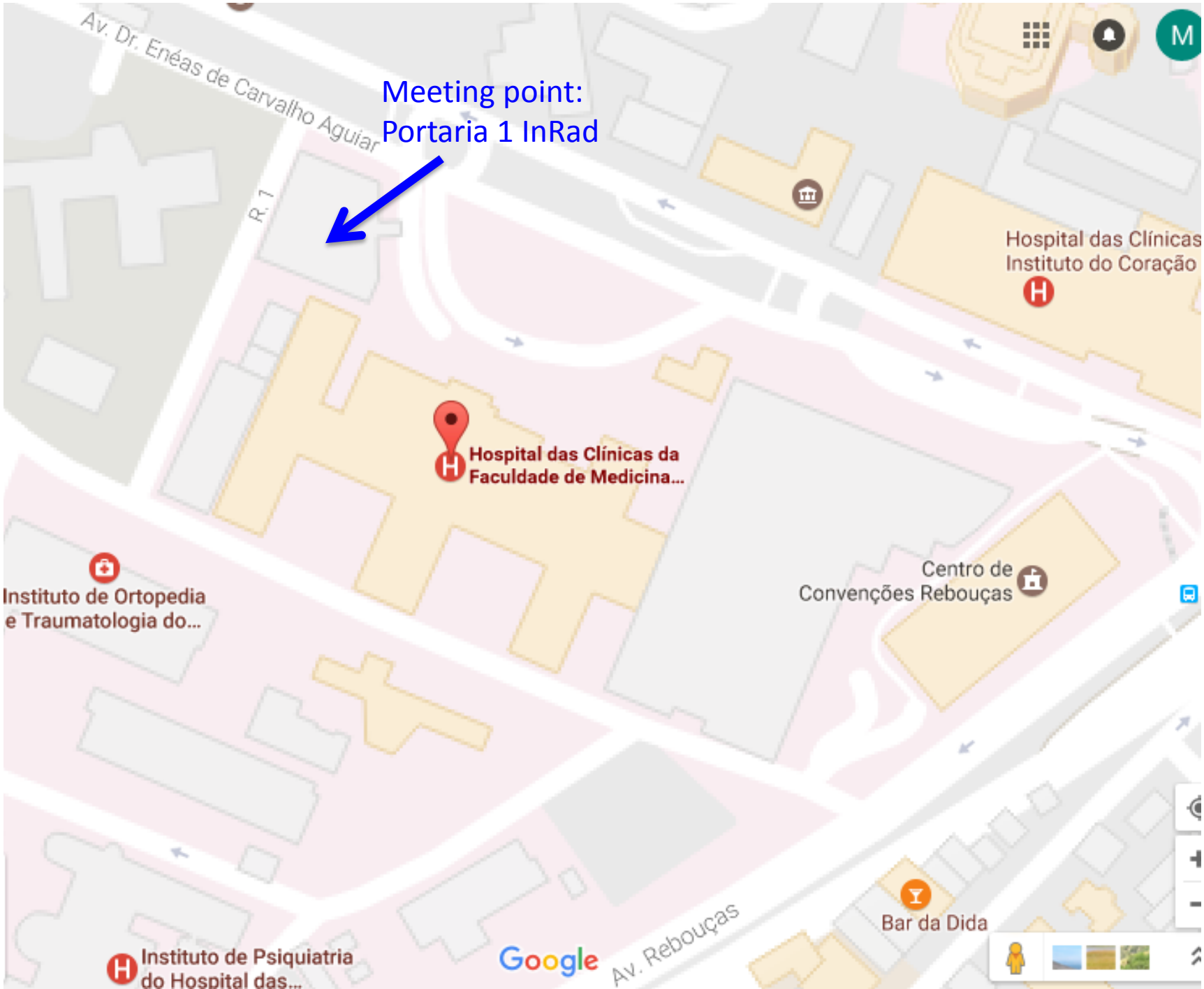
- 3rd task: Identify possible sources of artifact
  - (refraction, shadowing, enhancement, reverberation, and mirroring)
- 4th task: Describe Doppler-effect and its clinical use in US



Plan your time to come to FMUSP




Clínicas
Museu Histórico
Prof. Carlos da Silva...
Hospital Das Clínicas
FMUSP
MRI
Instituto Adolfo
Lutz - Central
Av. Dr. Arnaldo
R. Maj. Natanael
Burdog
Emergency Instituto
da Criança do Hospital...
Serviço de Verificação de
Óbitos da Capital - HSP
Meeting point:
Portaria 1 InRad
Centro de Estudos
Emílio Ribas
Av. Dr. Enéas de Carvalho Aguiar
Hospital das Clínicas
Instituto do Coração
Associação Atlética
Acadêmica Oswaldo Cruz
US
Hospital das Clínicas da
Faculdade de Medicina...
Av. Rebouças
Alameda Itu
Centro de
Convenções Rebouças
EEP/ HCFMUSP
Instituto de Ortopedia
e Traumatologia do...
Rua Oscar Freire
PET
Instituto de Psiquiatria
do Hospital das...
Bar da Dida
Jet Lag
A Chapa
Hamburgers - Jardins


Meeting point:
Portaria 1 InRad
Av. Dr. Enéas de Carvalho Aguiar
R. 1
Hospital das Clínicas
Instituto do Coração
Hospital das Clínicas da
Faculdade de Medicina...
Instituto de Ortopedia
e Traumatologia do...
Centro de
Convenções Rebouças
Bar da Dida
Instituto de Psiquiatria
do Hospital das...
Google
Av. Rebouças

Meeting logistics

- Hospital environment. Security controls. Needs to register one day in advance.
- Until 14.00 at meeting point: Portaria 1 InRad (Institute of Radiology)-Av. Dr. Enéas de Carvalho Aguiar 255.
- Direct contact with Lab Organizers:
  - MRI 7T maria.otaduy@hc.fm.usp.br or khallil.chaim@hc.fm.usp.br
  - US mateus.aranha95@gmail.com or emarinetto@hggm.es
  - PET alexandre.garcez@hc.fm.usp.br or bruno.pastorello@hc.fm.usp.br

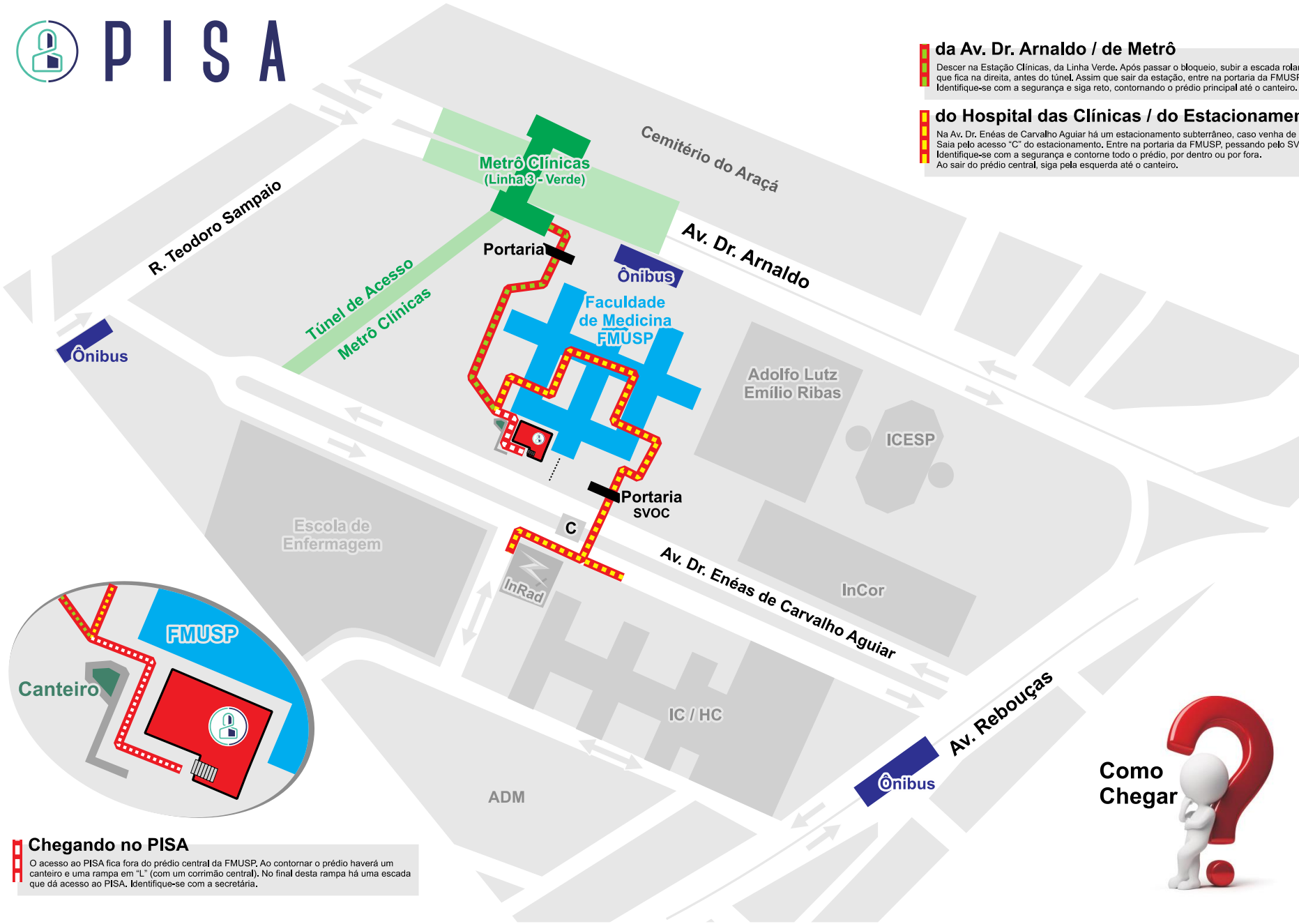
PISA

da Av. Dr. Arnaldo / de Metrô

Descer na Estação Clínicas, da Linha Verde. Após passar o bloqueio, subir a escada rolante que fica na direita, antes do túnel. Assim que sair da estação, entre na portaria da FMUSP. Identifique-se com a segurança e siga reto, contornando o prédio principal até o canteiro.

do Hospital das Clínicas / do Estacionamento

Na Av. Dr. Enéas de Carvalho Aguiar há um estacionamento subterrâneo, caso venha de carro. Saia pelo acesso "C" do estacionamento. Entre na portaria da FMUSP, pessando pelo SVOC. Identifique-se com a segurança e contorne todo o prédio, por dentro ou por fora. Ao sair do prédio central, siga pela esquerda até o canteiro.



Chegando no PISA

O acesso ao PISA fica fora do prédio central da FMUSP. Ao contornar o prédio haverá um canteiro e uma rampa em "L" (com um corrimão central). No final desta rampa há uma escada que dá acesso ao PISA. Identifique-se com a secretária.