MEG装置のための
ヘリウム循環装置の開発

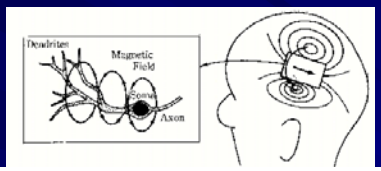
東京大学　大学院新領域創成科学研究科
複雑理工学専攻　生体複雑学研究室
教授　武田常広

最近の脳計測法

脳の形態計測法
- X線—CT（X線断層画像）
- MRI（核磁気共鳴イメージング）

脳の機能計測法
- PET（陽電子放射断層画像）
- fMRI（機能的MRI）
- NIRS（近赤外線反射による代謝計測）
- OR（電圧感受性染料による計測）
- MEG（脳磁計）

MEG（脳磁計）計測



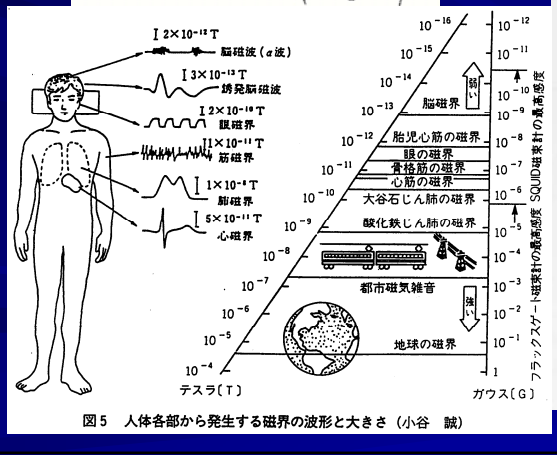
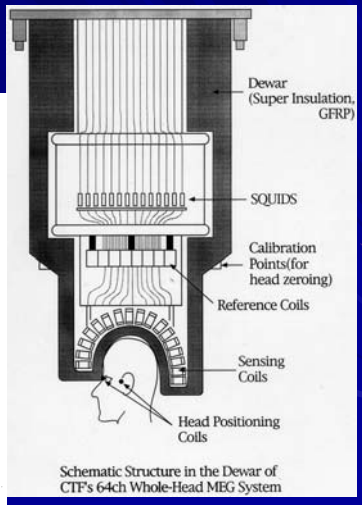
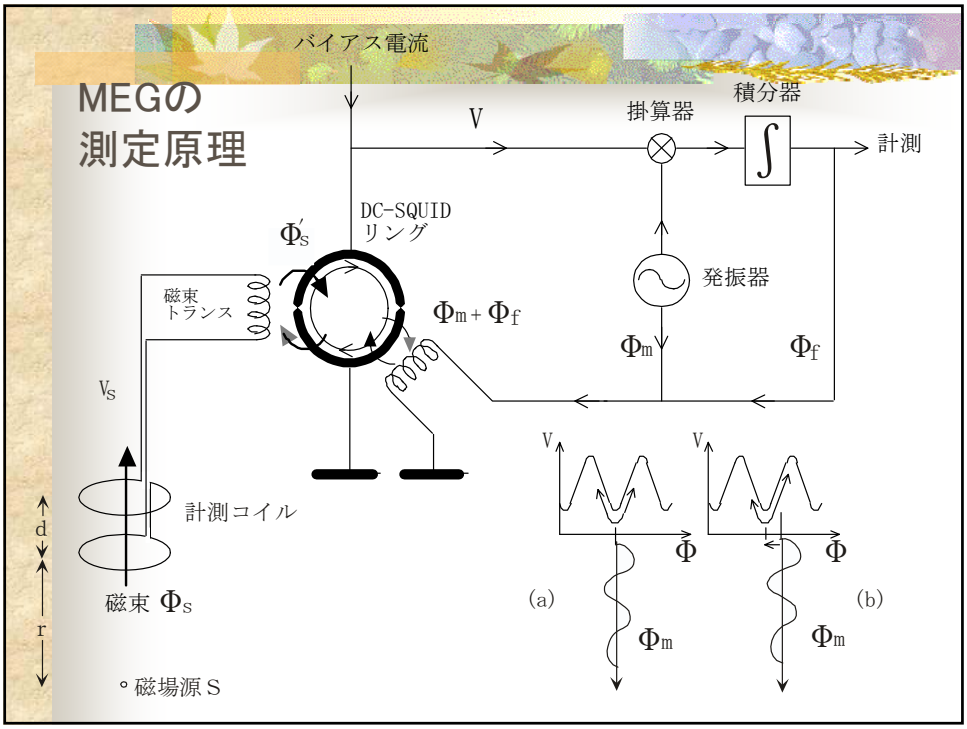


図5　人体各部から発生する磁界の波形と大きさ（小谷　誠）

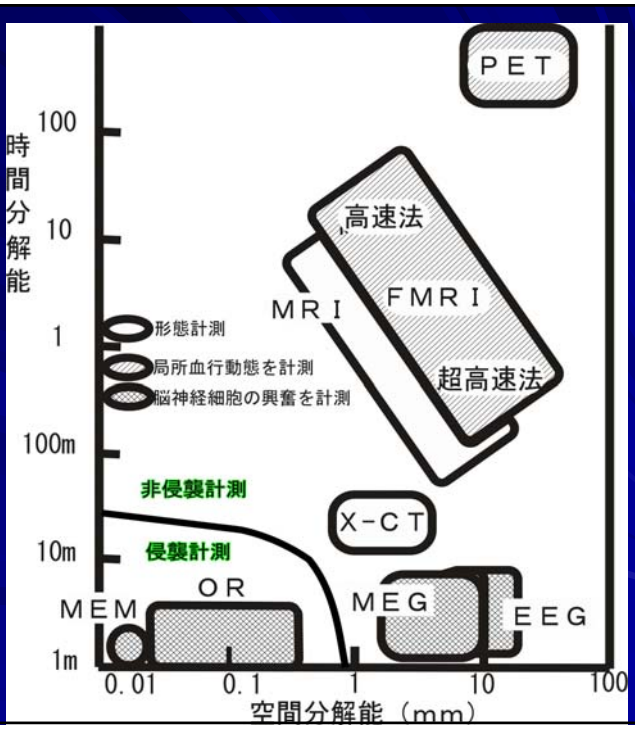


Schematic Structure in the Dewar of CTF's 64ch Whole-Head MEG System

MEGの測定原理



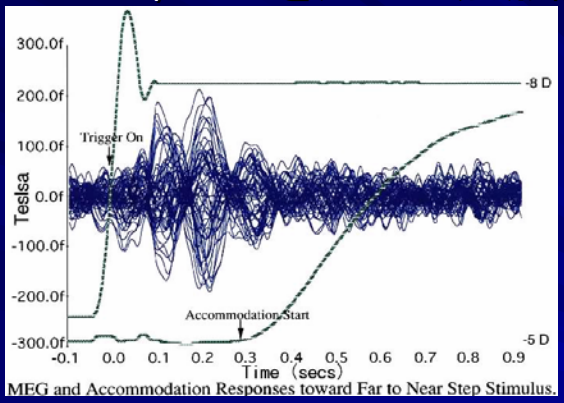
脳計測法の時空間分解能



MEG Measurement Systems in the World

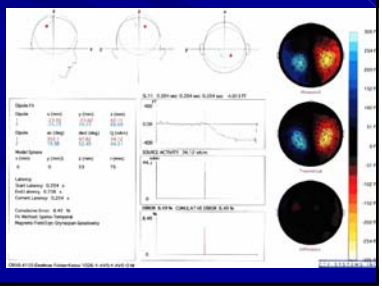
Generation	Year	Sensors Channels	Type	User Institutions
First	1972~	1, 3, 5	Laboratory	MIT, ~30 Inst.
Second	1985~	7, 14, 24	Commercial(BTi)	~20 Inst., New York Uni., NTT Okazaki, Kyusyu Uni., Munster Uni., New York Uni., Nurnberg Uni. Kyoto Pref. Uni.
	1990~	37(φ100)		
	1996~	43x3	3D Coils,(Shimazu)	Tokyo Elect. Uni.
Third (Whole-Head Type)	1994~	64	Axial (CTF)	Tokyo Univ. (Dept. Eng.), NIBH, Ohsaka Uni., Sakai Hospital, Los Angeles.
	1995~	61x2	Planar(Neuromag)	Helsinki Uni.(Fin.), Kyoto Uni., ETL, NTT, Los Alamos(USA), Tohoku, Shinsyuu, Tokyo(Dept. Med.), Hiroshima, Hokkaido Uni., 4 Hospitals
	1996~	143	Axial (CTF)	Vienna Uni.
	1998~	151	Axial (CTF)	Paris Uni., Tubingen, Riken, Birmingham,Toronto, Arkansas
	1998~	148	Magnetometer(BTi)	CRL, Max Plank., Tokyo Med. Den. Univ.
	1998~	60x3	3D Coils (Shimazu)	Tokyo Elect. Univ.
	1999~	100x3	Planar(Neuromag)	Tokyo Dental Uni.
	2002~	262	Axial (CTF)	NIH

TDO,MEGを用いた焦点調節応答の計測



MEG and Accommodation Responses toward Far to Near Step Stimulus.

Two Dipole Estimation



440CH Vector Type MEG System

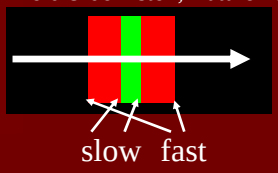
World largest sensor channels

Introduced in 2004 at Kashiwa Campus

World First Whole head Type MEG at Tokyo Uni. in 1994.

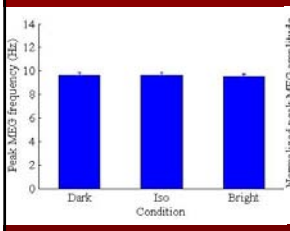
α波の起源は何？

Arnold & Johnston, Nature 2003

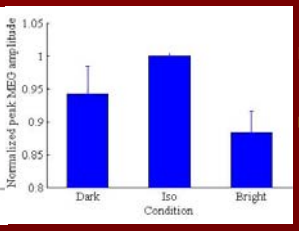


N=9

MEG frequency

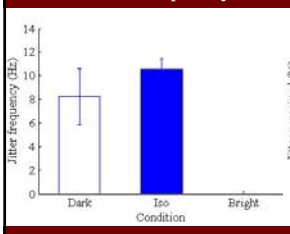


MEG amplitude

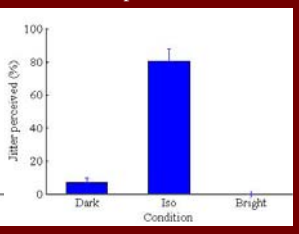


- Peak MEG frequency was about 10Hz
- Normalized MEG amplitude at around 10Hz was larger in the iso-luminant condition than in the other two conditions

Jitter frequency



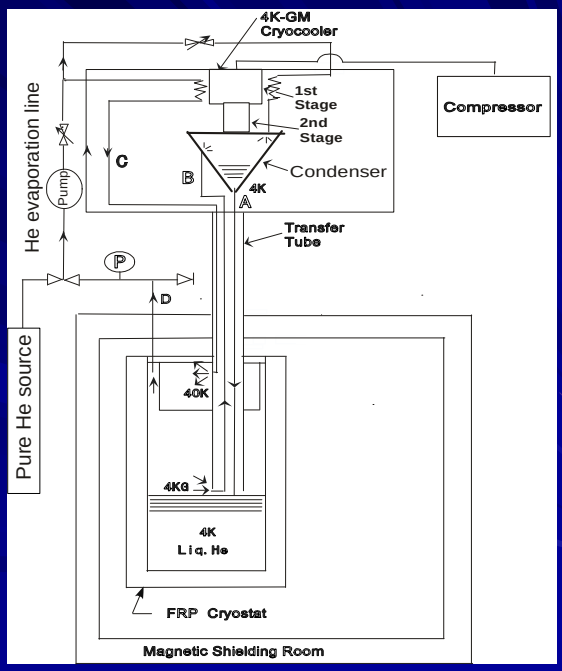
Jitter perceived ratio

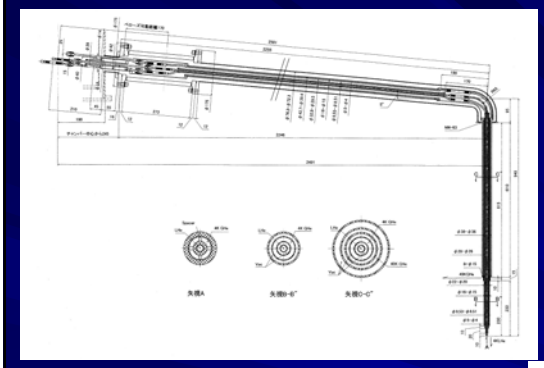


- Perceived jitter frequency was very close to the peak MEG frequency
- MEG responses around 10Hz were enhanced with the illusory jitter perception

He再循環システムの開発 Development of Helium Circulation systems

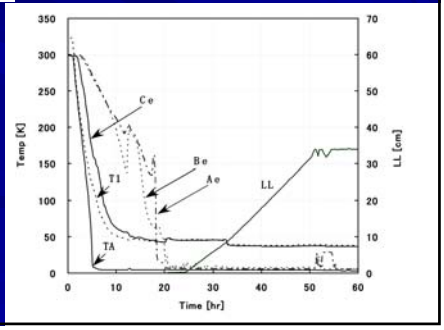
ランニングコスト
保守費用の低下
使用時間の増加
省資源、省エネ化





7重管TT

試験デュワによる
液化過程



Results

Increment of Liquid Helium

HCS on Exp. Dewar : 5.0 l/D
HCS on MEG : 2.2 l/D

Continuous Operation

Experimental HCS : 9 Months
HCS on MEG : 2.5 Months

Continuous operation is aimed to extend to 1 year and more from present 9 months. No need to add any Helium Gas throughout a year.

Noise is virtually no problem.