資料12/7-5

ICNIRPおよびIEEE/ICES に関連する動向

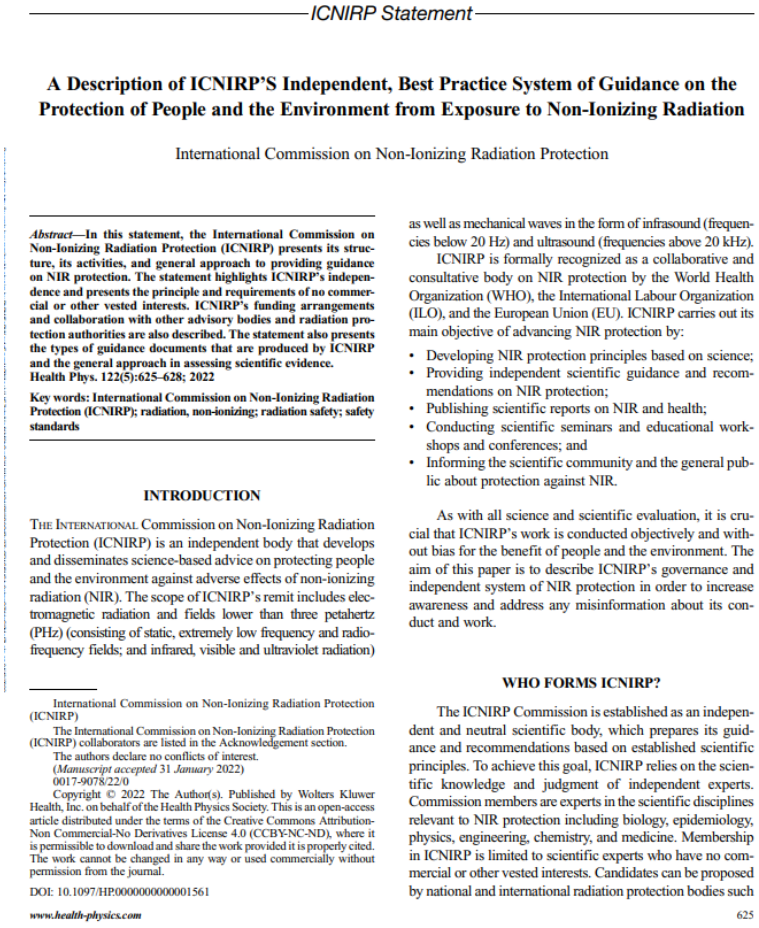
第12回作業班

平田　晃正（名古屋工業大学）

ICNIRPとICRPの比較

	ICNIRP	ICRP
設立	1992年（1973年にIRPAで前身の組織設立）	1950年（1928年にInt. Cong. Radiologyで前身の組織設立）
法的な位置づけ	ドイツ登録のNPO	英国登録のNPO
Main Commission	非営利組織から14名	非営利組織から13名
事務局	ドイツ、ミュンヘン（独放射線防護庁（BfS））	カナダ、オタワに専従組織
下部組織	時限のProject Group(それを構成するメンバーをScientific Expertとして登録）	5 Committees（影響・曝露量・医学・応用・環境）と時限のTask Group。
組織規模	約40名弱	約250名
国際組織との連携	WHO, ILO	WHO, IAEA, ILO
活動目的	利害関係にとらわれず科学的な知見に基づき、（電離または非電離）放射線の安全性に関する情報提供と助言（ガイドライン策定）を行う。	

ICNIRP's Role Statement



ICNIRP Statement

A Description of ICNIRP'S Independent, Best Practice System of Guidance on the Protection of People and the Environment from Exposure to Non-Ionizing Radiation

International Commission on Non-Ionizing Radiation Protection

Abstract—**In this statement, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) presents its structure, its activities, and general approach to providing guidance on NIR protection. The statement highlights ICNIRP's independence and presents the principle and requirements of no commercial or other vested interests. ICNIRP's funding arrangements and collaboration with other advisory bodies and radiation protection authorities are also described. The statement also presents the types of guidance documents that are produced by ICNIRP and the general approach in assessing scientific evidence.**
Health Phys. 122(5):625–628; 2022

Key words: International Commission on Non-Ionizing Radiation Protection (ICNIRP); radiation, non-ionizing; radiation safety; safety standards

INTRODUCTION

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) is an independent body that develops and disseminates science-based advice on protecting people and the environment against adverse effects of non-ionizing radiation (NIR). The scope of ICNIRP's remit includes electromagnetic radiation and fields lower than three petahertz (PHz) (consisting of static, extremely low frequency and radiofrequency fields; and infrared, visible and ultraviolet radiation) as well as mechanical waves in the form of infrasound (frequencies below 20 Hz) and ultrasound (frequencies above 20 kHz).

ICNIRP is formally recognized as a collaborative and consultative body on NIR protection by the World Health Organization (WHO), the International Labour Organization (ILO), and the European Union (EU). ICNIRP carries out its main objective of advancing NIR protection by:

- Developing NIR protection principles based on science;
- Providing independent scientific guidance and recommendations on NIR protection;
- Publishing scientific reports on NIR and health;
- Conducting scientific seminars and educational workshops and conferences; and
- Informing the scientific community and the general public about protection against NIR.

As with all science and scientific evaluation, it is crucial that ICNIRP's work is conducted objectively and without bias for the benefit of people and the environment. The aim of this paper is to describe ICNIRP's governance and independent system of NIR protection in order to increase awareness and address any misinformation about its conduct and work.

WHO FORMS ICNIRP?

The ICNIRP Commission is established as an independent and neutral scientific body, which prepares its guidance and recommendations based on established scientific principles. To achieve this goal, ICNIRP relies on the scientific knowledge and judgment of independent experts. Commission members are experts in the scientific disciplines relevant to NIR protection including biology, epidemiology, physics, engineering, chemistry, and medicine. Membership in ICNIRP is limited to scientific experts who have no commercial or other vested interests. Candidates can be proposed by national and international radiation protection bodies such

International Commission on Non-Ionizing Radiation Protection (ICNIRP)

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) collaborators are listed in the Acknowledgement section.

The authors declare no conflicts of interest.

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- ICNIRPの組織構成、活動、非電離放射線防護に関するガイダンスに関する一般的なアプローチ
- ファンドおよびその他の機関との協力関係
- あらゆる組織から独立した専門家グループ
  - メンバーは産業界に所属しない。
  - 複数の関連分野の専門家から構成
  - 地域・性別のバランスを考慮
- WHO、ILO、WMO、ECと連携。
- ドイツのNPO組織として登録されている。
- 国際放射線防護委員会（ICRP）と同様の目的・組織体系となっている。

A Description of ICNIRP's Independent, Best Practice System of Guidance on the Protection of People and the Environment from Exposure to Non-Ionizing Radiation. Health Phys 122(5):625-628; 2022.

ICNIRP-ICRP共同文書（2017）

資料7−2
渡辺氏

ICNIRP
INTERNATIONAL COMMISSION ON NON-IONIZING RADIATION PROTECTION

Munich, Germany, 14 November 2017

Joint Note on the Meeting on the International Systems of Radiation Protection: Bringing together Protection against Ionizing and Non-Ionizing Radiation

The two international organizations responsible for developing the systems of radiation protection worldwide are the International Commission on Radiological Protection (ICRP), and the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Both aim to protect people and the environment from potentially harmful effects of exposure to radiation, while recognizing the benefits that may be associated with some of these exposures.

Building on past interactions, ICRP and ICNIRP held a joint meeting in Munich, Germany, organized by the World Health Organization (WHO), hosted by the German Federal Office for Radiation Protection (BfS), and in cooperation with the International Labour Organization (ILO) and the International Radiation Protection Association (IRPA). The objectives of this meeting were to: increase mutual understanding of the approaches to protection; reach a common understanding of the state of the systems of protection; and explore possibilities for continued collaboration.

Over three days, November 8-10, 2017, the organizations exchanged information and views on the scientific basis, ethical basis, and basic principles of protection.
There are many commonalities between the systems of protection used for ionizing and non-ionizing radiation. There are also differences, most stemming from different biological effects. Ionizing radiation can cause stochastic and deterministic effects, while most effects due to exposure from non-ionizing radiation appear to be deterministic. However, stochastic effects have been demonstrated due to exposure to ultraviolet radiation, which bridges the ionizing and non-ionizing parts of the electromagnetic spectrum. For ionizing radiation there is a greater emphasis on optimization of protection even at low levels of exposure, whereas for non-ionizing radiation there is a greater emphasis on keeping exposures below thresholds for observed effects.

ICRP and ICNIRP share significant common ground, and have reached an agreement in principle to strengthen communication and collaboration between them and with other organizations with similar interests.

ICNIRP, c/o BfS, Ingolstädter Landstr. 1, 85764 Oberschleißheim, Germany
www.icnirp.org - info@icnirp.org

- 電離放射線と非電離放射線の防護には多くの共通点がある。一方で、いくつかの相違点がある。
- 相違点のほとんどは防護の根拠となる生体影響の違いに起因する。
- 電離放射線による生体影響は確率的影響があり、人体防護では最適化が重要となる。
- 非電離放射線による生体影響は決定論的影響であり、人体防護では生体影響の閾値を下回ることが重要となる。

http://www.icnirp.org/cms/upload/doc/JointNoteSystemsofProtectionNov2017.pdf

Statement of Protection Principles

OPEN

Special Submission

PRINCIPLES FOR NON-IONIZING RADIATION PROTECTION

International Commission on Non-Ionizing Radiation Protection (ICNIRP)[1]

Abstract—**In this statement, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) presents its principles for protection against adverse health effects from exposure to non-ionizing radiation. These are based upon the principles for protection against ionizing radiation of the International Commission for Radiological Protection (ICRP) in order to come to a comprehensive and consistent system of protection throughout the entire electromagnetic spectrum. The statement further contains information about ICNIRP and the processes it uses in setting exposure guidelines.**
Health Phys. 118(5):477–482; 2020

Key words: International Commission on Non Ionizing Radiation Protection; health effects; safety standards; radiation, non-ionizing

INTRODUCTION

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) is an independent committee of scientific experts established to evaluate the state of knowledge about the effects of non-ionizing radiation (NIR) on human health, including well-being, and on the environment (see http://www.icnirp.org/en/about-icnirp/aim-status-history/index.html). ICNIRP provides scientifically-based advice and guidance on protection against adverse effects of non-ionizing radiation, including the provision of guidelines on limiting exposure. ICNIRP is a non profit organization on non-ionizing radiation protection formally recognized by the World Health Organization (WHO), the International Labour Organization (ILO), and the European Union (EU). Further information about ICNIRP is provided in the Appendix.

This document describes the general principles used by ICNIRP to draft recommendations for exposure restrictions in order to provide protection against adverse health effects of exposure to non-ionizing radiation. In practice, the critical steps in applying these general principles may differ across the non-ionizing radiation spectrum. The procedures used by ICNIRP are described in the Appendix.

To establish a consistent framework of radiation protection over the entire spectrum of ionizing and non-ionizing radiation, the general principles for non-ionizing radiation protection are based, wherever appropriate, upon the well-established principles for protection against adverse health effects from ionizing radiation (ICRP 2007) and the underpinning ethical values, as published by the International Commission on Radiological Protection (ICRP).[2]

Definition of non-ionizing radiation. Non-ionizing radiation in this document refers to electromagnetic radiation and fields with a photon energy lower than 10 eV, corresponding to frequencies lower than 3 PHz (3×10^{15} Hz) and wavelengths longer than 100 nm. It is grouped into different frequency or wavelength bands, namely ultraviolet (UV) radiation (wavelengths 100–400 nm), visible light (wavelengths 400–780 nm),[3] infrared radiation (wavelengths 780 nm–1 mm), radiofrequency electromagnetic fields (frequencies 100 kHz–300 GHz), low frequency (frequencies 1 Hz–100 kHz) and static electric and magnetic fields (0 Hz). Although not part of the electromagnetic radiation spectrum, mechanical waves in the form of infrasound (frequencies below 20 Hz) and ultrasound (frequencies above 20 kHz)

[1]ICNIRP, c/o BfS, Ingolstaedter Landstr 1, 85764, Oberschleissheim, Germany.
The International Commission on Non-Ionizing Radiation Protection (ICNIRP) collaborators are listed in the Acknowledgement section.

ICNIRP receives funds from public and non-commercial bodies only. All information concerning the support received by ICNIRP throughout the years is available at http://www.icnirp.org/en/about-icnirp/support-icnirp/index.html.
For correspondence contact: Gunde Ziegelberger, ICNIRP, Ingolstaedter Landstr. 1, 85764 Oberschleissheim, Germany, or email at **info@icnirp.org**.
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0017-9078/20/0

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[2]It is necessary to ensure that all persons are treated fairly and with dignity and respect (ICRP 2018).
[3]A precise border between UVR and visible radiation cannot be defined because visual sensation at wavelengths shorter than 400 nm is noted for very bright sources. Similarly, a precise border between visible and infrared radiation cannot be defined because visual sensation at wavelengths greater than 780 nm is noted for very bright sources (ICNIRP 2013).

- ICRPの原則文書に即した記載
- 電磁波のすべての周波数領域にわたり、首尾一貫した防護原則

Principles for Non-Ionizing Radiation Protection. Health Physics 118(5):477-482; 2020.

ICNIRPガイドラインの一般概念

- 健康の定義はWHOに整合(Principlesより）

  WHO：単に病気や疾病がないことだけではなく、肉体的、精神的、社会的な観点からの完全な安寧状態（well-being）であること。
- ICNIRPの役割は、科学的根拠の分析に基づくアドバイス（実証された健康への悪影響からの防護）
- ばく露許容値
  - 人体内における影響の閾値に基づき導出された実効的な指標：基本制限
- 安全側にたった簡略化
  - 基本制限に基づき導出された実用的に評価可能な人体外の指標：参考レベル

ICNIRPガイドラインの策定指針

- 策定手順と規範は事前に定義される。
- 科学的知見にのみ基づく。
  - 経済または社会的問題は考慮しない（IRPAとの相違）。
- 確立した知見にのみ基づく。
  - 再現性かつ／または異なる研究間で一貫性があること
- 以下を忘れてはならない（科学的自明な要件）
  - 証拠は必ずしも証明ではない（evidence ≠ proof）
  - 生体影響は必ずしも健康影響ではない。
  - 統計的に有意な関連性は必ずしも原因ではない。
  - 単一の研究では健康リスクが無いことを証明できない。
  - 不安は健康上の問題を引き起こす可能性がある。

ICNIRPガイドラインの策定手順

- 科学的文献（査読付き論文）の精査
- 健康への実証された悪影響（substantiated adverse health effect；ガイドラインの根拠となる最低のばく露レベルで生じる健康影響）の同定
- 低減係数の考慮
- 基本制限の設定（高周波電磁界ではSARを指標として健康影響が生じないレベル；測定は困難）
- 参考レベルの導出（最悪条件を想定；参考レベルを満足すれば基本制限に適合する；参考レベルの指標の測定は容易）

現行のICNIRPガイドラインが基づく科学的知見

- 神経刺激、細胞膜の透過性変化、熱作用が無線周波の影響（substantiated adverse health effect）。
  - 急性ばく露により生じる。
  - 既知の閾値を超えた場合に生じる。
  - ガイドラインの根拠は、神経刺激、熱作用
- これまでに、低周波・高周波電磁界による慢性ばく露（長期ばく露）の健康影響は確立されていない。

IEEE ICES委員会について

- IEEE International Committee on Electromagnetic Safety・・・IEEEにおける標準化団体

  Technical Committee 95　人体安全性、

  Technical Committee 34　製品安全性、
- C95.1（高周波規格）およびC95.6（低周波規格）を合併。更なる改定を議論
- 毎年1月と6月に会合

  電話会議（不定期。最近は2回／月）
- 現在、SCにおける位置づけを変更中

IEEE ICES委員会

低周波（中間周波）：基準値の人口カバー率推定のために、統計的手法の導入を検討．詳細モデル導入の可能性を検討中．

高周波：米国では、第５世代(6GHz以上、ミリ波まで）における安全性評価に関心

2014年　IEEE C95.1234 ＝NATO Standard（軍のみならず、その居住区の一般市民に適用）

2019年　低周波、高周波統合規格

ICNIRPおよびIEEE ICES規格の変更点

- SAR（比吸収率）と電力密度の遷移周波数 6GHz
- 吸収電力密度（Absorbed/Epithelial Power Density）の導入
- 入射、吸収電力密度の平均化面積4cm^2（30GHz以上では、平均化面積1 cm^2）
- 全身平均SARの上限周波数300GHz
- 主に6GHz以上の周波数帯における短時間ばく露（ 6分未満）からの防護

局所SARの規格・指針（一般）

	総務省諮問 第2030号答申	ICNIRP	FCC FCC92-326	IEEE C95.1-2019
公表	2011	2020	1996	2019
周波数	100kHz – 6GHz	100kHz – 6 GHz	100kHz – 6GHz	100kHz – 6 GHz
局所平均SAR	2 W/kg@10g 4 W/kg@四肢10g	2 W/kg@10g 4 W/kg@四肢10g	1.6 W/kg@1g 4 W/kg@四肢1g	2 W/kg@10g 4 W/kg@四肢10g
全身平均SAR	0.08 W/kg	0.08 W/kg	0.08 W/kg	0.08 W/kg
規定時間	6分	6分	30分	6分
平均組織	任意	立方体	立方体	立方体

全身平均SARの規格･指針（管理）

	総務省諮問 第38号答申	FCC FCC92-326	IEEE C95.1	ICNIRP
公表	1990	1996	2019	2020
周波数	30MHz – 300 GHz	10kHz – 300 GHz	100kHz – 6 GHz	10kHz – 300 GHz
全身平均SAR	0.4 W/kg	0.4W/kg	0.4 W/kg 入射電力密度の制限は300GHzまで	0.4 W/kg
規定時間	6分	6分	30分	30分

入射・吸収電力密度の規格・指針(一般)

	総務省諮問 第2035号答申	ICNIRP	ICNIRP	IEEE C95.1-2019
公表	2018	1998	2020	2019
周波数	6GHz -300GHz	10 GHz-300 GHz	6 GHz-300GHz	6GHz-300GHz
入射電力密度[W/m^2]	6-30 GHz 20 W/m^2 @4cm^2 30-300 GHz 40 W/m^2 @1cm^2	10 W/m^2 @20cm^2 200 W/m^2 @1cm^2	6-300 GHz 20-40 W/m^2 @4cm^2 30-300 GHz 40-80 W/m^2 @1cm^2	6-300 GHz 20-40 W/m^2 @4cm^2 30-300 GHz 40-80 W/m^2 @1cm^2
吸収電力密度[W/m^2]	—	—	20 W/m^2	20 W/m^2
規定時間	6分	周波数依存	6分	6分

まとめ

- ICNIRPガイドライン、IEEE/ICES規格の改定が進められており、6GHz以上における基本制限および参考レベルはおおむね整合
- 最新の電波利用の状況に加え、国際ガイドライン、規格の内容および根拠を精査し、電波防護指針の見直しについての検討が必要。