# 物理系ピアレビュージャーナルと オープンアクセス

植田憲一 電通大レーザー新世代研究センター SPARC Japan セミナー 2008年4月22日

## 自己紹介

専門分野:量子エレクトロニクス、核融合、重力波天文学、 レーザー何でも

- <2000 Topical Editor of Applied Optics, OSA board of Director 応用物理学会、国内学会ジャーナル
- 2000 IPAP 創立に参加
- 2002 Laser Physics Letters (RAS)創刊 Associate Editor
- 2003 Editor-in-Chief of Optical Review
- 2006 日本物理学会
- 2007 IUPAP WG on Communication in Physics
- 2008 新IPAP運営委員

### 学会ジャーナル、論文誌出版

学問の目的: 純科学 → 知識、認識 抽出、体系化、法則化

応用科学 → 同様+経験の蓄積、流通

### 日本から情報発信をする科学ジャーナルの必要性

ジャーナル出版は学問、科学研究活動の"結晶"

☆出版がなければ、知識を定着させる事ができない。

☆Peer Review Journalの必要性

☆学問における文化背景と独自の尺度の必要性。
国際学会と国内学会の関係
学問におけるmonopoly 独占の弊害
中国、エジプト、アラブ、ギリシャ、欧州、米国

デジタルアーカイブ問題

☆アレキサンドリア図書館とGlobal Physics Database

☆arXiv.org (LANL -> Cornell Univ)

### 科学技術における情報発信とコミュニケーション

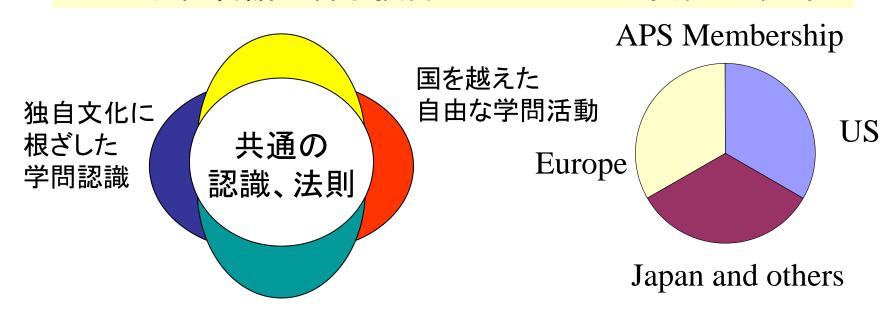
科学における情報発信とコミュニケーション

☆英語は科学における国際語

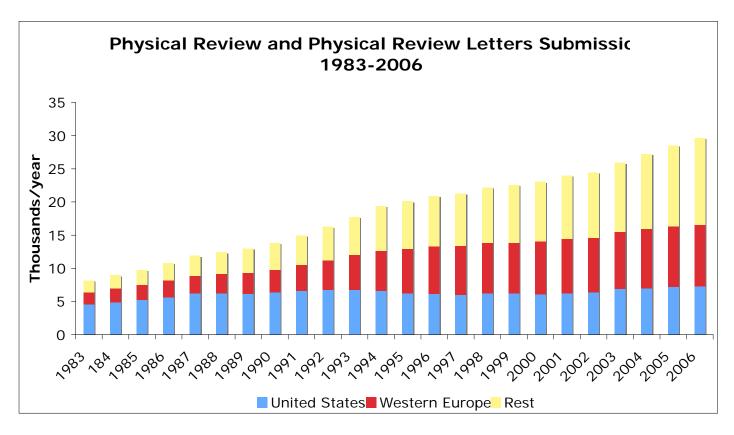
☆真の科学言語は、物理、化学の法則、方法論そのもの

☆理学系論文誌は、世界共通スタンダードの価値基準 純粋な国際競争の世界

☆工学、技術は社会、産業と無関係に存在し得ない。 自国言語の科学技術ジャーナルの必要性がある。



APSジャーナルでは、世界は3つの地域に分けられており、 伸長著しいのは、米国、西欧を除く他の3極である。 そして、その中心はアジア・太平洋地区である。



By G. Sprouse

### 研究活動

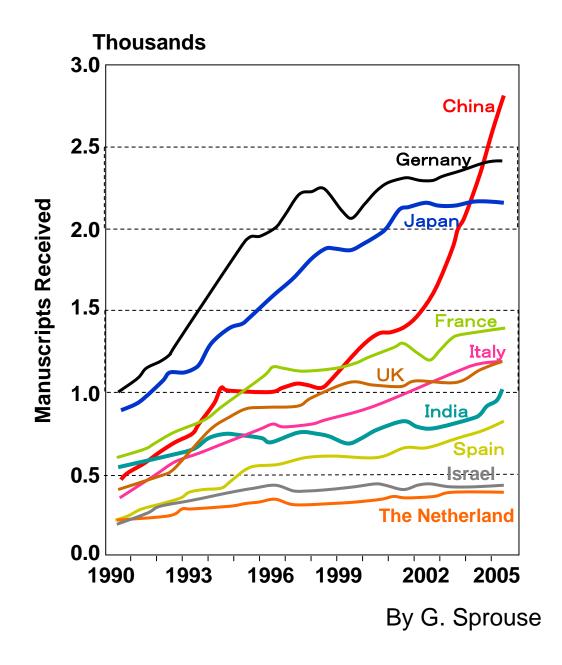
中でも、中国、インドが今後の中心となることは確実である。

アジア物理ジャーナルはどう なるのか?という世界からの 問いかけ

### ジャーナル市場

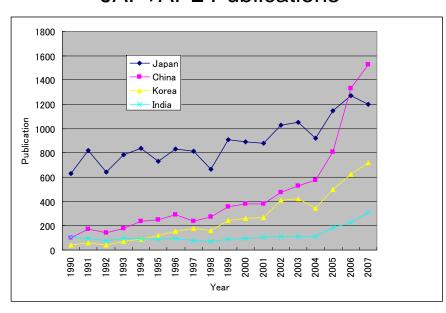
中国の大学図書館契約が 大幅に増加 2009年度 APSジャーナル -4%図書館価格を下げる 予定

#### **Selected PR & PRL Receipts by Country**



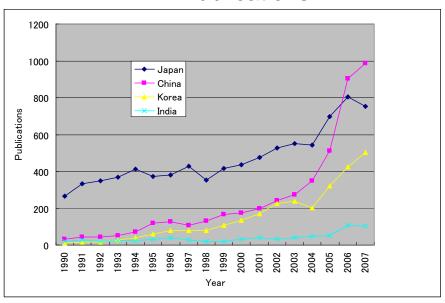
### この傾向は応用物理分野ではさらに顕著である。

#### JAP+APL Publications

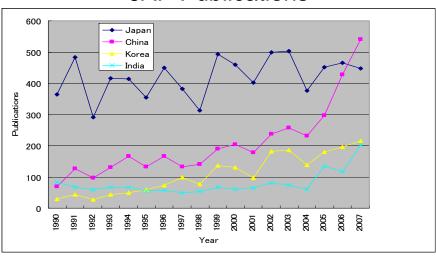


アジア地区の研究は活性化しているが、 同時に、論文の欧米流出は当然ながら 大きい。日本と同じ問題が議論され始 めた。

#### **APL Publications**

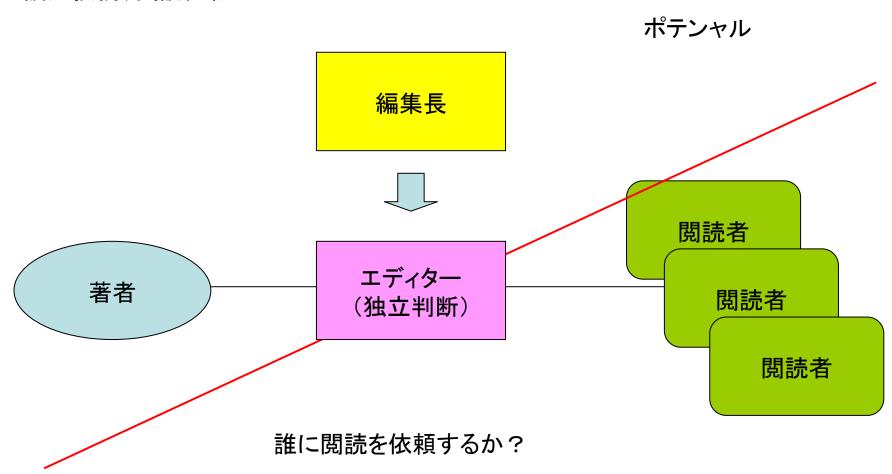


#### JAP Publications



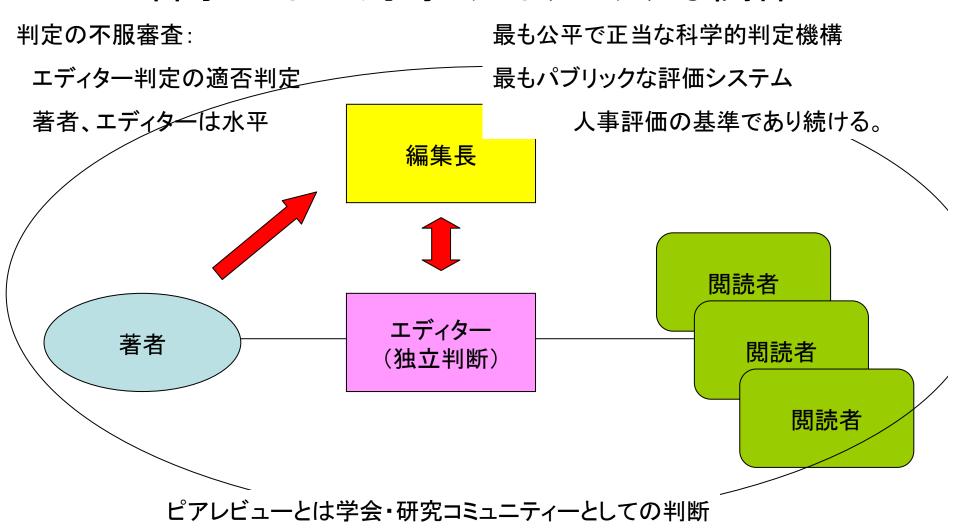
# ピアレビュージャーナル ボランティアベースの公益的活動

論文投稿、閱読依頼



現役の研究者:競争者、自己利益より科学的真理に規準を!

# ピアレビュージャーナル 科学の下の対等・ダイナミックな関係

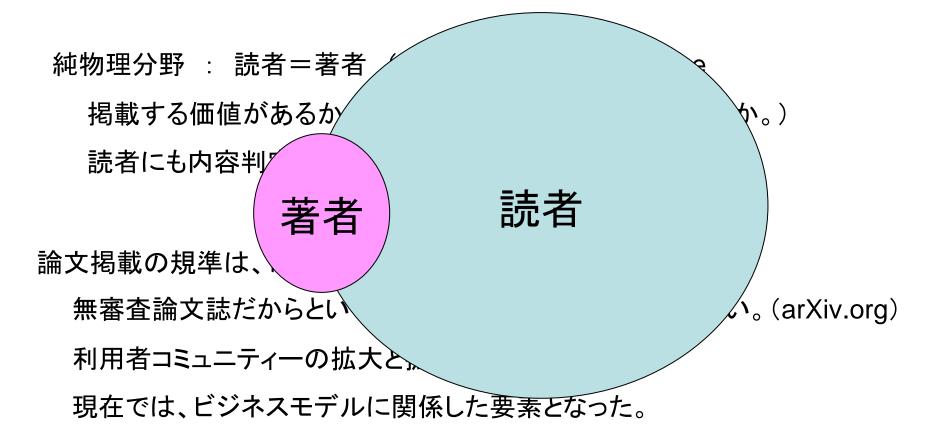


協同意識が重要

# 論文掲載の規準は、 コミュニティーの質に依存する。

工学、応用物理分野 : 読者>>著者 experience

読者(利用者)は、ジャーナルに掲載された論文に、"正しさの保証"を求める。



## Peer-Reviewは検閲か?

After 1989 Schwinger took a keen interest in the research of low-energy nuclear fusion reactions (AKA cold <u>fusion</u>). He wrote eight theory papers about it. He resigned from the American Physical Society after their refusal to publish his papers. He felt that cold fusion research was being suppressed and academic freedom violated. He wrote: "The pressure for conformity is enormous. I have experienced it in editors' rejection of submitted papers, based on venomous criticism of anonymous referees. The replacement of impartial reviewing by censorship will be the death of science."



朝永振一郎 J. Schwinger R. Feynman 1965年ノーベル物理学賞

学問的自由と閲読、出版許可

発想そのものの出版

間違った閲読結果

JOSA広告ページ論文

# arXiv.org(LANL->Cornell Univ.)

Astrophysics (astro-ph new, recent, find) Condensed Matter (cond-mat new, recent, find) includes: Disordered Systems and Neural Networks; Materials Science; Mesoscopic Systems and Quantum Hall Effect: Other: Soft Condensed Matter: Statistical Mechanics, Strongly Correlated Electrons, Superconductivity General Relativity and Quantum Cosmology (gr-qc new, recent, find) High Energy Physics - Experiment (hep-ex new, recent, find) High Energy Physics - Lattice (hep-lat new, recent, find) High Energy Physics - Phenomenology (hep-ph new, recent, find) High Energy Physics - Theory (hep-th new, recent, find) Mathematical Physics (math-ph new, recent, find) Nuclear Experiment (nucl-ex new, recent, find) Nuclear Theory (**nucl-th** new, recent, find) Physics (physics new, recent, find) includes (see <u>detailed description</u>): <u>Accelerator Physics</u>; <u>Atmospheric and Oceanic</u> Physics, Atomic Physics, Atomic and Molecular Clusters, Biological Physics, Chemical Physics: Classical Physics: Computational Physics: Data Analysis, Statistics and Probability: Fluid Dynamics: General Physics: Geophysics: History of Physics: Instrumentation and Detectors; Medical Physics; Optics; Physics Education; Physics and Society: Plasma Physics: Popular Physics: Space Physics Quantum Physics (quant-ph new, recent, find)

### 学術研究はオンライン出版のパイオニア

1. インターネット: 科学情報ネットワークから出発



2. WWW:セルンの国際加速器機構の研究者

Berners-Lee, T.J., Information Management: A Proposal, Document at CERN, 1990 (Original document to propose the idea of the World Wide Web. A copy of this document is available at Timothy Berners-Lee's homepage.)

3. ロスアラモス・プレプリントサーバー

Open Policy Freedom

データベースについては化学系に伝統あり。

1. Chemical Abstract

### SCIENTIFIC PUBLISHING IN THE EUROPEAN RESEARCH AREA

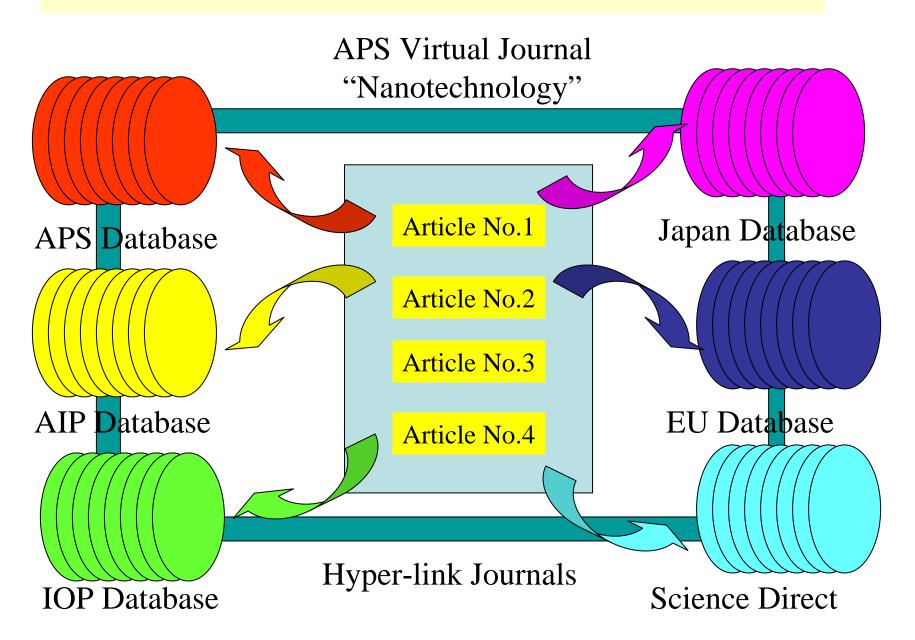
#### Conference, Brussels, 15-16 February 2007

http://ec.europa.eu/research/science-society/document\_library/pdf\_06/conference-proceeding-022007\_en.pdf

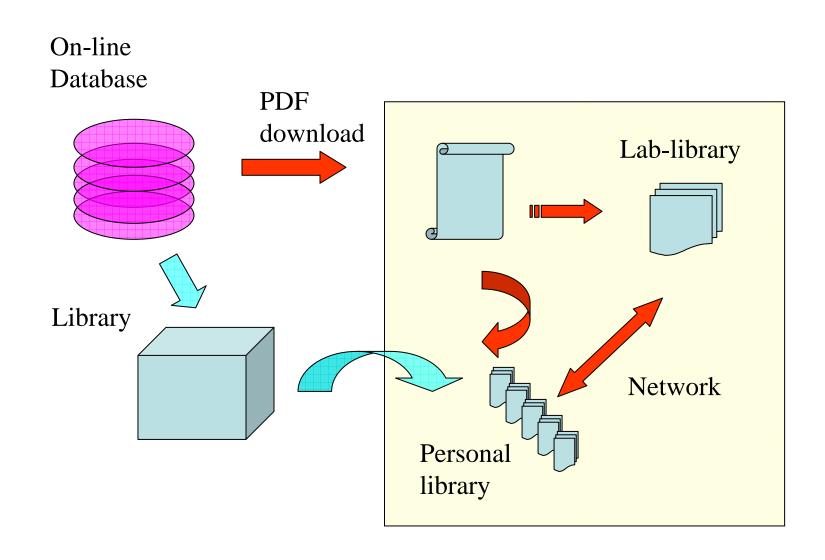
Nobel laureate Sir John Sulston, "ensuring the outputs of research are freely available to all is the best way to maximize its utility".

In principle, as Michael Mabe of the International Association of Scientific, Technical and Medical Publishers put it, this means that a single copy of a scientific paper might serve the whole planet. So calls for open access to the literature, free of institutional or financial constraints, can now readily be met, at least in technical terms.

### Virtual Journals: Databaseの2次利用



### ネットワーク時代の論文利用 研究室ライブラリー



# コピー権の発生と変遷 I

- 1. 印刷機の発明以前 (筆写、拓本) 著作物と著作権が不可分の時代 著者から独立した著作権は不可能 流通が成立していない。
- 2. グーテンベルグによる大量印刷技術の発明 著作という作業と書籍流通の分離が発生 著作権の出版業者への委譲契約 依然として、専門業者の問題

# コピー権の発生と変遷 Ⅱ

- 3. ゼロックスによるコピー機の発明 一般の読者がコピーを作成可能に 現代的な意味のコピー権の成立 しかし、紙出版からのコピーが前提
- 4. オンライン出版とインターネット配信

著者への回帰

- 一般の著者、読者がコピー作成、配信可能にデジタルコピーでは、オリジナルとコピーの差がない。
- 一般読者と専門業者の間に、配信に関する技術差はない。インターネットは本質的にオープンで平等なシステムである。

研究者の矛盾 著者として、学会の構成員として 科学論文の著者は無料で情報配信したい。 論文誌の質をキープすることの重要性は認識している。

### 紙を持たないオンラインジャーナル

#### [著者サイドからの利点]

- 1. 製本・印刷が不要 (経費上の利点+迅速出版の利点(最大1ヶ月)
- 2. 毎日出版が可能 (迅速出版、論文出版日の競争)
- 3. カラー印刷が無料 (パワーポイント発表との整合性、写真掲載)
- 4. 動画配信が普通

#### [製作サイドからの利点]

著者によるupload原稿の作成

即日配信

#### 「即日配信サービス」

論文掲載につき、掲載日時証明付きのPDF配信(別刷りサービスに代わり)

### SISSA online publishing

Journals by scientists for scientists

科学者が自ら立ち上がったオープンアクセスジャーナル
Nuclear Physicsなどジャーナルの価格高騰に対抗
10名のスタッフで5誌を刊行、高度に電子化した出版システム

JCAP Journal of Cosmology and Astroparticle Physics

JCOM Journal of Science Communication

Jekyll Online journal produced by the Master in Science Communication

JHEP Journal of High Energy Physics

JSTAT Journal of Statistical Mechanics: Theory and Experiment.

低価格出版ノウハウなどについて、トレーニングを含めて協力可能 持続可能性?

# Linked to ArXiv.org and Journal server

## J-HEP



#### Published by Institute of Physics Publishing for SESA

Patricians Survey & MV7

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1. Introduction

#### Holograph 2. MR z tring on AdS # X 5\*

Makoto Sakagu

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ABSTRACT: WA

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B. A heuristic interpretation of the

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D. Wilson loop expansion at the sec

E. Superzymmetry of deformed Will

#### tem inaction t REWORDS: A Azinga

#### 1. Introduction

One of the most important subjects in a which gives a realization of holography will discover proof of it. An important issue to AdS(HS. Although it is shown to be don issue non-linear that this difficult to quant The solution (2.4) is normalizable with (2.5) if and only if  $\lambda$  is real and  $\lambda>-4/9$ . In particular, the scaling of  $\lambda$  is equivalent to the Breitenloh

$$m^2 \ge \frac{1}{4}$$

Furthermore by imposing the unitarity  $\lambda$  can be furth condition in  $\lambda>0$  . Thus we will take  $\lambda>0$   $\Delta$ 

The quantization can be performed by following the the field  $\phi(\xi,\rho)$  is expanded as

$$\phi^{\Delta}(\ell,\rho) = \sum_{n=0}^{\infty} \alpha_n \phi_n^{\Delta}(\ell,\rho) + \sum_{n=0}^{\infty} \alpha_n^{\dagger} \rho$$

where the rath mode is defined as

$$\phi_n^{\Delta}(\xi,\rho)\equiv d(\Delta)\sqrt{\frac{rd}{\Gamma(rs+2\Delta)}}e^{-2(rs+d)/(6+\theta)/2}($$

The normalization constant  $d(\Delta)$  is defined as

$$d(\Delta) \equiv \frac{T(\Delta) 2^{\Delta-2}}{\sqrt{\pi}}$$

and it has been fixed by the following conditions:

$$(\phi_{n}^{\Delta}, \phi_{n}^{\Delta}) = \phi_{n,n}, \quad (\phi_{n}^{\Delta}, \phi_{n}^{\Delta}) = -\phi_{n,n},$$

Note that the normalizable modes are decaying as appr shown from the behavior of the Gegenbauer polynomials

$$C_n^A(z) = \frac{\Gamma(n+2\Delta)}{\Gamma(2\Delta)nz}$$
.

We can considerly quantize  $\phi(\xi,\rho)$  and the creation z on extings the commutation relationer

$$[a_n, a_n^{\dagger}] = (a_n, a_n) = [a_n^{\dagger}, a_n^{\dagger}] = [a_n^{\dagger}, a_n^{\dagger}]$$

Then the Fock vocuum is defined as

$$a_n(0)=0 \qquad (\forall m=0,1,\cdots$$

and the Rick space 🚈 is spanned as

$$\mathcal{S}^{\Delta} = \bigoplus_{i \in \mathcal{I}_{i}} \Phi_{i} \circ J_{i} \cdots \circ J_{i} \circ I$$

-5-

The normalizable modes on  $AdS_2$  in the coordinates (1: with the help of supersymmetries. By using them an effect



Figure 1: The potentials for N and Lo.

R is and word to compute the energy spectrum of X becominimum and the spectrum is continuous. Hence according to [0] of the algebra from (X,D,X) to (R,D,S), where R and S are d

$$R \equiv \frac{i}{2} \left( \diamond X + \frac{i}{\diamond} X \right), \qquad \mathcal{S} \equiv \frac{i}{2} \left( \rightarrow X + \frac{i}{\diamond} A \right)$$

Here wie a constant process star with dimension of length-equand as a more parameter of the theory described by  $M_{\rm p}(n)$ . When Hamiltonian, the potential has a minimum and its spectrum behapper of the potential see Figure 1.

Than the new algebraic given by

$$[\mathcal{D},\mathcal{B}]=i\mathcal{S},\quad [\mathcal{S},\mathcal{B}]=-i\mathcal{D},\quad [\mathcal{S},\mathcal{L}]=-il$$

This is nothing but the SO(3,4) algebra and the generalis R o motion  $V(4) \subset SO(3,4)$ . The others describe hyperbolic noncontact of  $AdS/\nabla F T_1$  the one-dimensional conformal group SO(2,4). Then the compact rotations are small group SO(3,4). Then the compact rotation examination symmetry with respect to the global AdS time  $X_{MB} = \frac{4}{3}(R_0 + X_M)$  ( $R_0 = X_M$ ) as secoth components of terms, and the property of the AdS and AdS times AdS and AdS times AdS and AdS times AdS times AdS to AdS times AdS to AdS times AdS times AdS to AdS times AdS

#### 3.2 Discrete eigen-tallus problem

Next let us consider the energy eigenvalue problem:

$$S\varphi_n = \Sigma_n\varphi_n$$
  $(n = 0, 1, ..., )$ .

The energy for the normalizable ground state, Σο, is given by

$$\Sigma_0 = \frac{1}{9} + \frac{1}{9}\gamma$$

and the energy eigen-value  $\mathcal{Z}_n$  is

 $\Sigma_0 = \Sigma_0 + ra$ 



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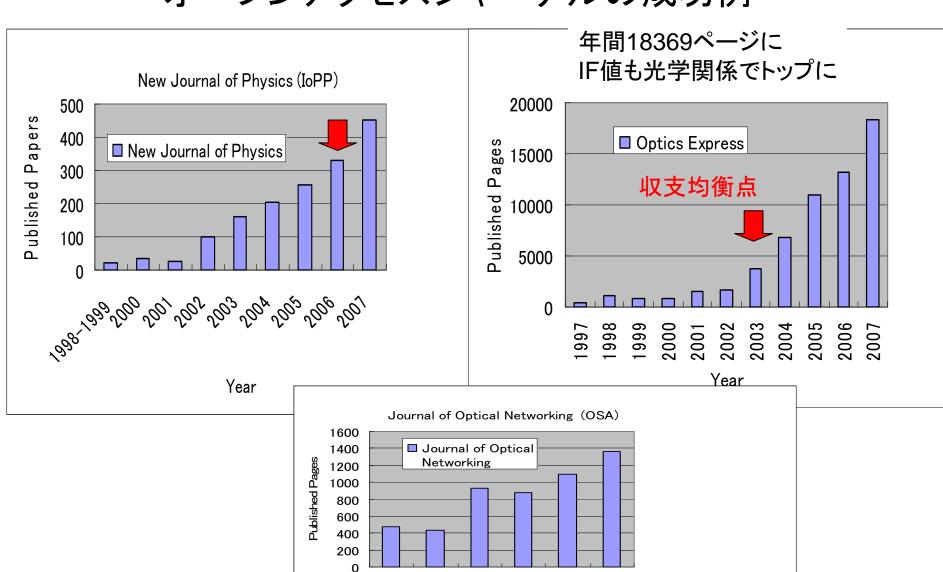
N = 4 report Portga-Malfo, JHEP 04 (2002) 013 h ep-th/0202024].

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JHEP02 (2008) 09

# 著者負担 オンラインのみ オープンアクセスジャーナルの成功例



2002 2003

2004

2005

Year

2006 2007

# オープンアクセスジャーナル Optics Express 1997- OSA

# Composite Yb:YAG/Cr<sup>4+</sup>:YAG ceramics picosecond microchip lasers

Jun Dong<sup>1\*</sup>, Ken-ichi Ueda<sup>1</sup>, Akira Shirakawa<sup>1</sup>, Hideki Yagi<sup>2</sup>, Takagimi Yanagitani<sup>2</sup>, and Alexander A. Kaminskii<sup>3</sup>

<sup>1</sup>Institute for Laser Science, University of Electro-Communications, 1-5-1 Chofugaoka, Chofu, Tokyo 182-8585, Japan <sup>2</sup>Konoshima Chemical Co., Ltd., 80 Kouda, Takuma, Mitoyo-gun, Kagawa 769-1103, Japan <sup>3</sup>Institute of Crystallography, Russian Academy of Sciences, Leninskii Prospekt 59, Moscow 119333, Russia \*Corresponding author: jundong 99@yahoo.com

**Abstract:** Efficient laser-diode pumped picosecond self-Q-switched all-ceramic composite Yb:YAG/Cr<sup>4+</sup>:YAG microchip lasers with 0.72 MW peak power has been developed. Lasers with nearly diffraction-limited beam quality ( $M^2 < 1.09$ ), oscillate at stable single- and multi- longitudinal-modes due to the combined etalon effects in the Yb:YAG and Cr<sup>4+</sup>:YAG parts of its binary structure.

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OCIS codes: (140.3380) Laser materials; (140.3480) Lasers, diode-pumped; (140.3540) Lasers, Q-switched; 140.5680 (Rare earth and transition metal solid-state lasers)

Maximum average output power of 610 mW was measured when the absorbed pump power was 3.28 W, corresponding to the optical-to-optical efficiency of 19%. There is no coating damage occurrence with further increase of the pump power, owing to the decrease of the intracavity energy fluence with high transmission of output coupler used. The transverse focus are shown in inset (b) of Fig. 2. Near diffrac  $M_x^2$  of 1.09 and  $M_y^2$  of 1.07, respectively, was ac near the output mirror was measured to be 100 µm

output beam profile is shown in inset (a) of Fig. 2 single-longitudinal-mode oscillation could be obtained by increasing the pump beam diameter transverse electromagnetic mode (TEM<sub>00</sub>). Measu incident on the laser ceramic at higher pump power.

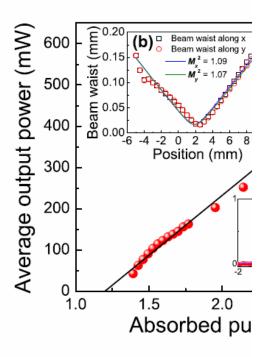
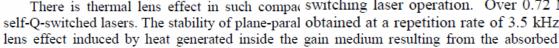


Fig. 2. Average output power as a function of composite Yb:YAG/Cr4+:YAG self-Q-switched mi beam profile and transverse beam profile and (b) sho



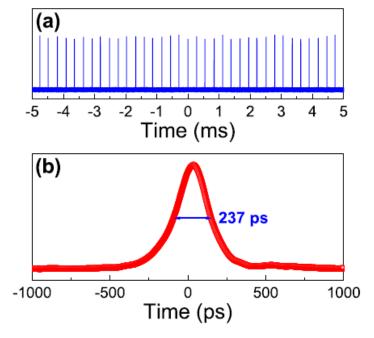


Fig. 4. (a) Oscilloscope trace of self-Q-switched all-ceramic composite Yb:YAG/Cr4+:YAG microchip laser pulse trains; (b) self-Q-switched laser pulse with 237 ps pulse width (FWHM) and 172 µJ pulse energy, corresponding to peak power of over 0.72 MW.

Figure 4 shows the oscilloscope trace of the pulse trains and the output pulse with 237 ps pulse width (FWHM) and 172 µJ pulse energy. The output pulse amplitudes and repetition rate fluctuation are less than 6% [as shown in Fig. 4(a)], evidencing a very stable self-Q-There is thermal lens effect in such compact switching laser operation. Over 0.72 MW laser pulses with the pulse width of 237 ps were self-Q-switched lasers. The stability of plane-paral obtained at a repetition rate of 3.5 kHz when the absorbed pump power is 3.28 W [as shown

# New Journal of Physics IOPP/DPS

# New Journal of Physics The open-access journal for physics

#### Tunable random packings

#### G Lumay and N Vandewalle

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Abstract. We present an experimental protocol that allows one to tune the packing fraction  $\eta$  of a random pile of ferromagnetic spheres from a value close to the lower limit of random loose packing  $\eta_{\rm RLP} \simeq 0.56$  to the upper limit of random close packing  $\eta_{\rm RLP} \simeq 0.64$ . This broad range of packing fraction values is obtained under normal gravity in air, by adjusting a magnetic cohesion between the grains during the formation of the pile. Attractive and repulsive magnetic interactions are found to affect stongly the internal structure and the stability of sphere packing. After the formation of the pile, the induced cohesion is decreased continuously along a linear decreasing ramp. The controlled collapse of the pile is found to generate various and reproducible values of the random packing fraction  $\eta$ .

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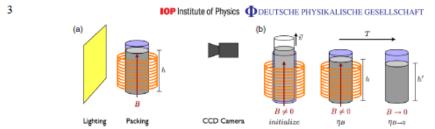


Figure 1. (a) Sketch of our experimental set-up. A high resolution camera (2048  $\times$  2048 pixels) records the top of the packing placed in a glass tube. The pile is back-illuminated by a homogeneous lighting system. (b) Illustration of the pile creation and measurement protocol. Left: a smaller bottomless tube is inserted into the main glass cylinder. Then, a magnetic B field is applied through the packing. Afterward, this small tube is filled with spherical particles (in gray). The small tube is removed at constant speed v. Center: the position h of the upper grains allows the determination of the packing fraction  $\eta_B$ . Right: the magnetic field starts to decrease linearly to zero (reached after T seconds), the packing collapses partially and the new position h' of the upper grains gives an estimate of  $\eta_{B\to 0}$ .

grains during the pile preparation in order to control the packing fraction  $\eta$  of the pile. For this purpose, we consider ferromagnetic spherical beads which are submitted to an external magnetic field. After the formation of the pile, the magnetic field is decreased continuously along a linear ramp. This method to control experimentally the packing fraction opens new perspectives in the field of granular media and in the mathematical study of sphere packings.

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#### A New Explanation for Toroidal Spin-Up of a Field-Reversed Configuration

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A new explanation regarding the toroidal spin-up of a field-reversed configuration (FRC) is provided. A physical picture showing that the poloidal flux can convert directly to kinetic angular momentum is described. Through the use of an ion orbit calculation in resistively decaying FRC plasma, toroidal rotation at both the separatrix and the field-null is found to occur.

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Keywords: field-reversed configuration, toroidal spin-up, resistive flux decay, canonical angular momentum, inductive electric field

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An n=2 rotational instability of a field-reversed configuration (FRC) plasma has been observed experimentally and reported in several papers [1–3]. This instability originates from the centrifugal force which acts on a rotating FRC plasma. The origin of toroidal spin-up has not yet

direction. Generally, the separatrix radius decreases during the decay phase. If the guiding center r is also decreased, the toroidal velocity  $v_{\theta}$  is further increased.

We can also explain FRC plasma rotation from the viewpoint of particle trajectories. In FRC plasma, a small投稿料は3,000円 (税別),掲載料は5, 000円/頁(税別)で す.

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#### TOPICAL REVIEW

#### Software package for structure analysis of quasicrystals\*

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Recently a software package for the structure analysis of quasicrystals has been released. giving a better environment for determining quasicrystal structures. Therefore we can analyze their structures if we know data collection and indexing methods and a theory of structure analysis. For the use of the package, the structure analysis method and several techniques used in the package are shortly reviewed. How to treat key inform ation in the input files of the

Keywords: software, quasicrystals, structure analysis

#### 1. Introduction

non-crystallog-aphic point groups including 3, 8, 10 or 12. octagonal, decagonal quasicrystals. These the OD so as to give a correct density and chemical fold axis, which never appear in conventional crystals. Their structure takes an ordered structure (quasiperiodic structure) diffraction patterns, however, consist of the aggregates of in a plane normal to such a periodic axis. Another one called Bragg reflections as in crystals. In the diffraction patterns, 5, an icosahedral quasicrystal has no period along any directions. 8, 10 or 12-fold rotation symmetry is found corresponding to the symmetry of quasicrystals. Most quasicrystals found so far are binary or ternary alloys [1]. It has been known already in 1986, that is, 2 years after the discovery of the first quasicrystals, that such a structure is obtained from a periodic structure in a higher-dimensional space by taking a three-them. Noting this point, a higher-dimensional cluster model dimensional (3D) intersection passing through an arbitrary has been introduced [6]. In this model, we describe the crystals were obtained [3] and after that single crystals package for many quasicrystals have become obtainable [1]. Their extensive analyses have however been performed after 1997. (For detailed review before 1997, see [4].)

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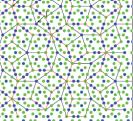
polygonal (dihedral) quasicrystals, which have one 8, 10 or nit volume) can be determined uniquely. We need to adjust Quasicrystals are special ordered structures which have 12-fold axis and is periodic along this axis. They are called the size and shape of the area (volume in icosahedral ones)

Soon after the discovery, they had been considered to consist of some kinds of atomic clusters. Direct observations of quasicrystals by high-resolution electron microscopy played an important role for this [5] If we employ this idea, it is easily conceivable that the structure description om the structure analysis of the approximants. In addition, becomes easy by considering the clusters and atoms linking

The contents of the paper can be classified into three 9 sections describe on the software package and several calculation techniques employed in the package. Finally,



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igure 2. ODs of the b-Ni phase in d-Al-Ni-Co quasic rystals. In ), the OD is located at (1, 1, 1, 1, 5z)/5, while in (b), it is at (2, 2, 2, 5z)/5 (z = 1/4)

e need to use the density and chemical composition of assicrystals as additional important information. The lattice onstant is not determined uniquely as mentioned above. There are two types in quasicrystals. One is called at the point density of atoms (the number of atoms in a mposition. In addition, in the case where the approximant vstals are formed, we use the information from them his is because we can frequently obtain the information dusters in quasicrystals. Furthermore, the density of the pproximants is almost the same as that of quasicrystals. We sume for simplicity that the cluster structure is obtained e suppose that the interpenetration of the clusters is not

these two by the inversion. We abbreviate the description is simple yout such ODs. In the following replace 'the OD 1 etc' categories. The sections 1-7 are devoted to a short review ith 'the OD 1 and the other OD related to it by the 6. Closeness conditions szersion etc' )

In this model, we assume that two kinds of clusters are It is difficult to conceive that large holes are included in





Topical Review

Figure 3. Structure model of the b-Ni phase in d-Al-Ni-Co quasicrystals projected along the 10-fold axis. A black circle represents the transition metal (Ni,Co) and gray, Al. The boots-shaped region located at the outermost part in figure 2(a part of icient use of similarity transformations in OD 3) and whole area of figure 2(b) are assumed to be occupied by is of quasicrystals was discussed. Detailed Al. On the other hand, the transition metal positions are generated by the large pentagonal region except for the boats in figure 2(a).

of the periodic structure. It is known that the vertices of the Penrose pattern are generated from the two small gray pentagons labeled by 1 and 5 in figures 2(a) and (b) [15] qestre is the program for calculating atom positions in 3D space for given ODs. The electron density in 3D space can be

space to given 0.05. The electron density in 3D space van be down by the program qemen.

There exist two kinds of vertices around which there are 5 to 7 atoms and 10 atoms (denoted by 1 and 2 in A and Massmoto T1987 Japan J. Appl. Phys. 10 and 10 atoms (denoted by 1 and 2 in A and Massmoto T1987 Japan J. Appl. Phys. 10 and M figure 3). The former and latter comes from the ODs 1 and  $\frac{M}{105-7}$ 5, respectively. We call clusters consisting of atoms around 99, and Crystallogr AS 2509-60 these cluster centers clusters: I and 2. In figure 2, the large 40th imaging and Bite. Phys. 122 2-88 ODs consist of the periagons similar to these but in some will line it. The property of the periagons similar to these but in some will line it. The property of the cases, they are partially overlapped. For example, the OD 6 observations of the control of the Co part except for the central pentagons (ODs 1 and 5) generates 'right DC and Mermin ND 1988 Phys. Rev B peripheral atoms around the cluster center. In addition, a part shared by two ODs generates an atom position which are emin ND, RokhsarDS and Wright DC 1991 shared by two clusters. We can prove that an ODs, which 35.636 generates an atom position for from the cluster center by a fixed distance in the external space, is obtained from the OD of the cluster center by shifting it by that distance along the external space. In the present case, such an OD is located at In a higher-dimensional cluster model, we assume the the peripheral of another large OD. As a result, depending on point [2]. Therefore, the role of the structure analysis is clusters distilluting in 3D space as a periodic structure rangement of clusters in quasicrystals. That is, we usually the kind of clusters, we may have a very complicated polygons to determine such a higher-dimensional periodic structure. in a higher-dimensional space. A software package based sume that the cluster center is located at vertices of some with concave parts consisting of the aggregates of small ODs. Single (quasi)crystals with enough size necessitated for the on this description has been written by the author and assignment assignment of the substance of quasicrystal structure models single crystal diffraction method had not been obtained for been released recently [7] (http://quasi.mim.sgo.jp/). In this gure 2 was employed (In this case, the inversion center is consisting of stom dusters. It is worth noting that even if the several years from the discovery but in 1987, the first such paper, we describe shortly an analysis based on this program summed, so that there are other two ODs which are related shape of the ODs is complicated, the principle leading to them

cated at the vertices of a quasiperiodic pattern known as quasicrystals, since they are alloys. Therefore, we need to e Penrose pattern. This consists of two rhombi joined by consider quasicrystals, which do not include such holes. It alid lines seen in figure 3. As the two clusters, we consider—is also unrealistic that the structure shows an interatomic those denoted by 1 and 2 in the same figure. After the distance shorter than a value determined by the atomic radii determination of the ODs, we build a periodic structure in the As a result, we need to consider a dense packing of atoms nD space. After that we can calculate all the corresponding without including such shorter interatomic distances. Such a atom positions in the 3D space by taking a 3D intersection model imposes restrictions for the ODs.

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n a model used. The input form at of such yed in the program package was described on the coordinate system for introducing positions in the external space was also as of quasicrystals was discussed. Detailed of quasicrystals performed so far are a [6]. The author hopes that this package ed and promote the structure analyses of

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