

# Roman S. Ingarden and his passion for physics

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**Dariusz Chruściński**

Nicolaus Copernicus University, Toruń, POLAND

**IV. R.S. Ingarden Memorial Session, 29th November 2023**



# Toruń — 550th birthday of Copernicus

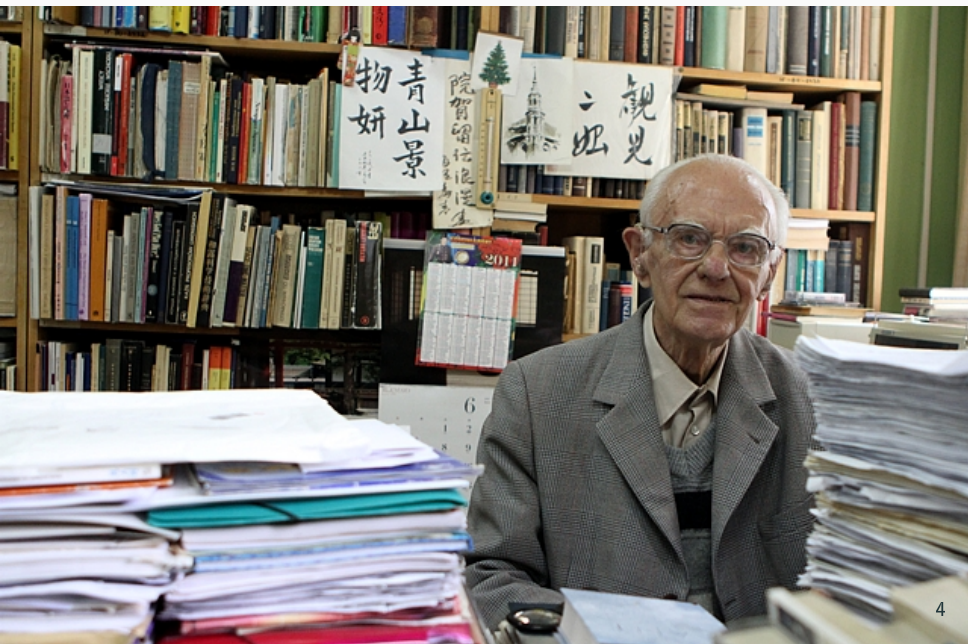


NICOLAUS COPERNICUS  
UNIVERSITY  
IN TORUŃ



 **THE YEAR OF NICOLAUS COPERNICUS - WORLD COPERNICAN CONGRESS**

Roman S. Ingarden 1.10.1920–12.07.2011





## Toruń years 1921-1926



*Rodzina Romana Witolda Ingardena (1893–1970), od lewej: Maria Pol-Ingardenowa (1889–1979), żona, Janusz Stefan (ur. 1923), najmłodszy syn, Roman Kajetan (1852–1926), ojciec, Roman Stanisław (ur. 1920), najstarszy syn, Roman Witold, Jerzy Kazimierz (1921–1949), średni syn, zdjęcie z III 1924 r., ul. Mickiewicza 115 (dziś 93), Toruń*

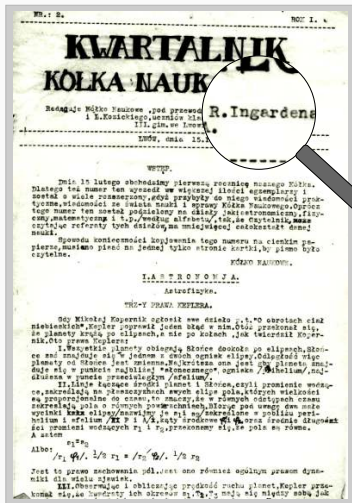
# Gimnasium years 1930-1938 in Lwów (Lviv)



Roman S. Ingarden jako harcerz, zdjęcie z 1934 r., Lwów



Zakopane, summer 1938



# Studies in Lwów: 1938-41 and 1944-45



Stanislaw Loria



Wojciech Rubinowicz



Juliusz Schauder



Stefan Banach



Hugo Steinhaus

**physics**



Roman S. Ingarden in 1938



Stanislaw Saks



Edward Marczewski

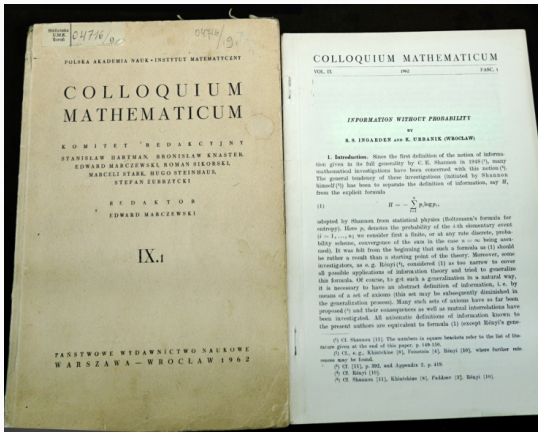
**mathematics**

**... and philosophy**

## Early carrier: 50s and 60s

- 1946 PhD in physics (Wojciech Rubinowicz)
- 50s, and 60s worked in Wrocław:
  - Head of the Department of Theoretical Physics (1949-1952)
  - Head of the Department of Solid State and Low Temperature Physics (1960-66)
  - created a Laboratory for Low Temperatures (1955)
  - a scholarship at the Courant Institute (NY, 1961)

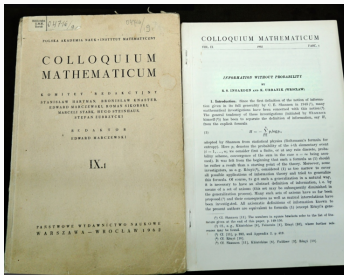
# Information theory



R.S. Ingarden, K. Urbanik, *Information without probability*, Colloquium Mathematicum IX (1962), 131-150.

# Information theory

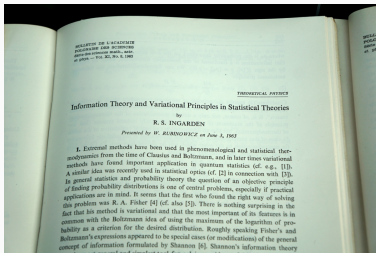
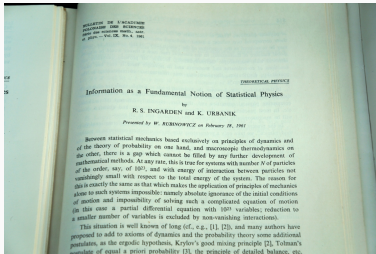
"I did not read Shannon papers until the end of the 1950s. His main work appeared in 1948. Having heard of information theory while developing that of optical instruments, which actually are nothing more than transmitters of information, I realised that it was my fate or maybe a curse that was going to haunt me, and sooner or later I would have to delve into the subject. And so I did one day."  
(R. S. Ingarden interview, 1993).



R.S. Ingarden, K. Urbanik, *Information without probability*, Colloquium Mathematicum IX (1962), 131-150.

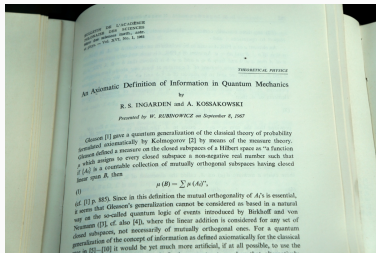
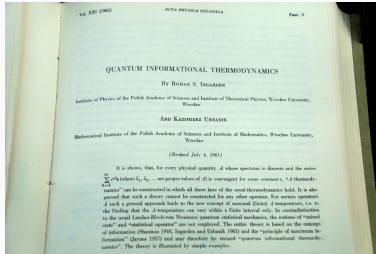
# Information theory

Information as a Fundamental Notion of Statistical Physics, Bull. Acad Pol. Sci, 1961



Information Theory and Variational Principles in Statistical Physics, Bull. Acad Pol. Sci, 1963

Quantum Informational Thermodynamics, Acta Phys. Polon. 1962



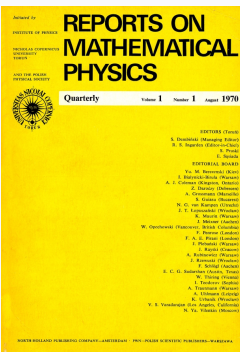
An Axiomatic Definition of Information in Quantum Mechanics, Bull. Acad Pol. Sci, 1967

# Toruń from 1966





# Reports on Mathematical Physics (ROMP) 1968



# SMP in 70. and 80.



## International guests of the SMP in the 1970-80s

A. Holevo  
G. Lindblad  
G. Sudarshan  
V. Gorini  
A. Wehrl  
O. Melsheimer  
H-D. Doebner  
Yu. Berezanski  
V. Belavkin  
A. Uhlmann  
R. Streater  
S. Pulmannova  
P. Lahti  
C. Piron  
.... and many others



## Ingarden with Gorini-Kossakowski-Sudarshan Trio (1975)



## QUANTUM INFORMATION THEORY

ROMAN S. INGARDEN

Institute of Physics, Nicholas Copernicus University, 87-100 Toruń, Poland

*(Received December 13, 1975)*

A conceptual analysis of the classical information theory of Shannon (1948) shows that this theory cannot be directly generalized to the usual quantum case. The reason is that in the usual quantum mechanics of closed systems there is no general concept of joint and conditional probability. Using, however, the generalized quantum mechanics of open systems (A. Kossakowski 1972) and the generalized concept of observable ("semiobservable", E. B. Davies and J. T. Lewis 1970) it is possible to construct a quantum information theory being then a straightforward generalization of Shannon's theory.

### 1. Introduction

Information theory, as it is understood in this paper and as it is usually understood by mathematicians and engineers following the pioneer paper of Shannon [57], is not only a theory of the entropy concept itself (in this aspect information theory is most in

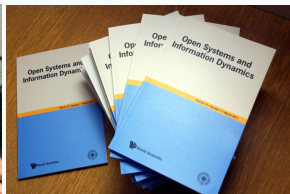
- V. Gorini, A. Kossakowski, E. C. G. Sudarshan, Completely positive dynamical semigroups of N-level systems, J. Math. Phys. **17**, 821 (1976).
- G. Lindblad, On the Generators of Quantum Dynamical Semigroups, Comm. Math. Phys. **48**, 119 (1976).
- S.L. Woronowicz, Positive maps of low dimensional matrix algebras, Rep. Math. Phys. **10**, 165 (1976).
- R.S. Ingarden, Quantum Information Theory, Rep. Math. Phys. **10**, 43 (1976).

# Japan: Information dynamics and Finsler Geometry



- 1975 first journey to Japan (Kyoto University)
- collaboration with prof. Makoto Matsumoto (Finsler Geometry)
- collaboration with prof. Masanori Ohya (Information dynamics)

with Luigi Accardi and Masanori Ohya (1992)



Open Systems and  
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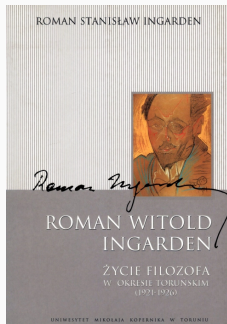
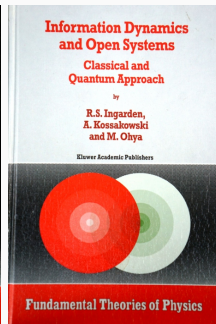
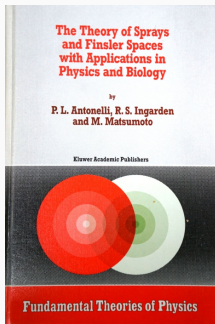
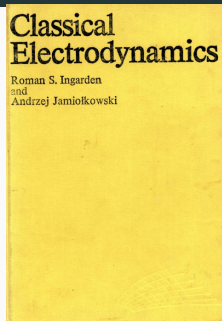


## R.S. Ingarden and his passion for books





# Textbooks and monographs





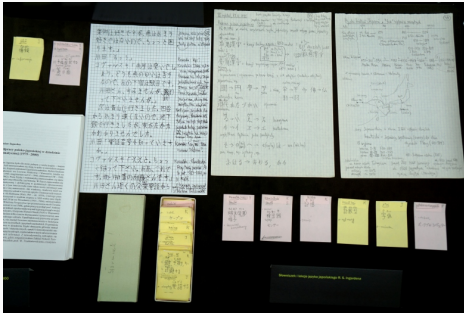




# R.S. Ingarden and his passion for Japanese language and culture

1. Miłosz Michalski, *Scientific legacy of Roman S. Ingarden* (2020)
2. Krzysztof Ingarden, *Roman S. Ingarden, Life: Photographs from the Family Archives* (2021)
3. Andrzej Jamiołkowski, *My memories of Roman Stanisław Ingarden* (2022)

# Center for Japanese Culture and Language





## R.S. Ingarden and his passion for science

