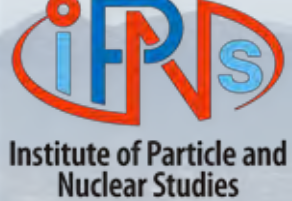




大学共同利用機関法人  
高エネルギー加速器研究機構



Institute of Particle and  
Nuclear Studies



IPNS = Institute of  
Particle  
and Nuclear Studies

IMSS = Institute for  
Materials Structure  
Studies

QUP = International Center for  
Quantum-field Measurement  
Systems for  
Studies of the Universe and  
Particles



つくばキャンパス  
Tsukuba Campus



with



東海キャンパス : J-PARC  
Tokai Campus : J-PARC

ATLAS実験  
(CERN) LHC

将来計画  
(Future Project) ILC/Higgs Factory

KISS実験  
(RIKEN)

エネルギー  
フロンティア  
Energy  
Frontier

KOTO実験  
(J-PARC)

ハドロン  
核物理  
Hadron  
Nuclear

理論物理  
Theoretical  
Physics

ハドロンホール  
(J-PARC) Hadron Hall

COMET実験  
(J-PARC)  
Institute of Particle and  
Nuclear Studies

フレーバー  
物理  
Flavor  
Physics

宇宙  
素粒子物理  
Astro-Particle  
Physics

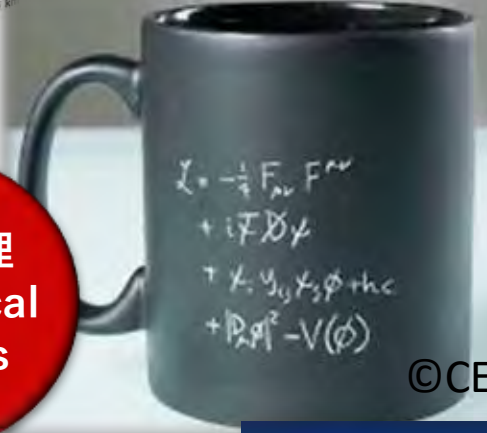
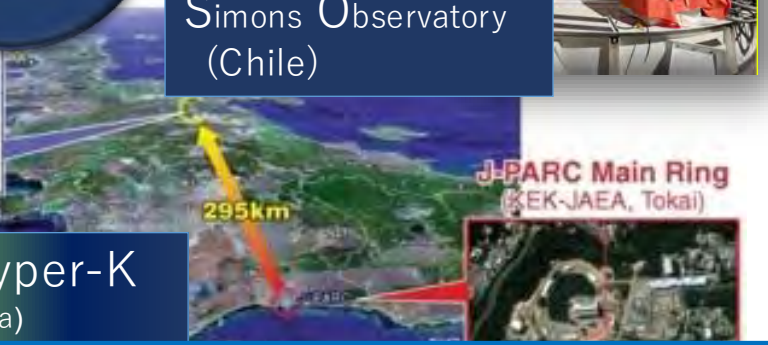
Simons Observatory  
(Chile)

Belle-II  
(SuperKEKB)

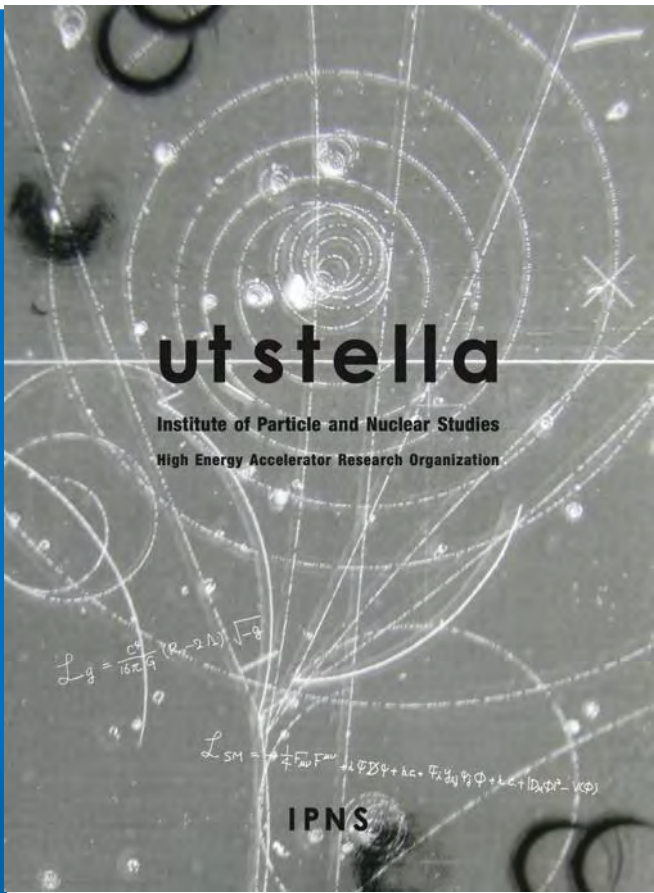
g-2/EDM  
(MLF, J-PARC)

UCN  
(TRIUMF)

T2K and Hyper-K  
(J-PARC & Kamioka)



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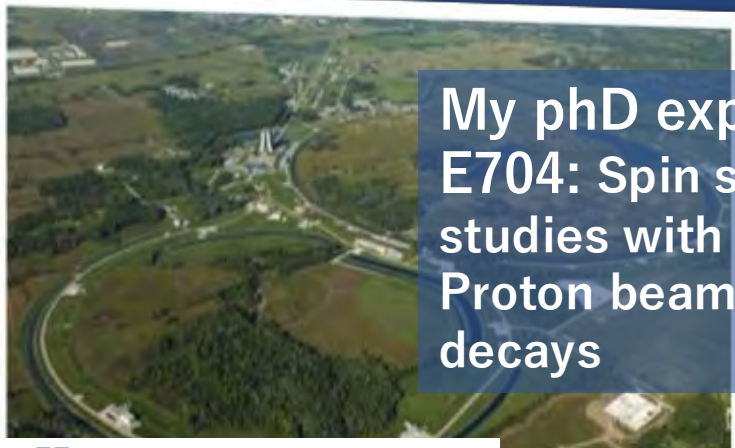


[https://www2.kek.jp/ipns/wp-content/uploads/2024/04/0313\\_stella16p\\_E.pdf](https://www2.kek.jp/ipns/wp-content/uploads/2024/04/0313_stella16p_E.pdf)



Brochure of IPNS Physics  
(9.6 MB)

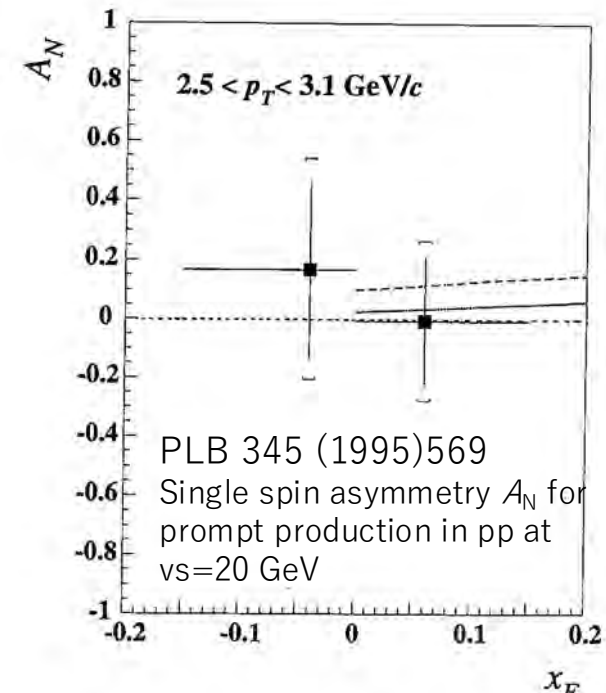
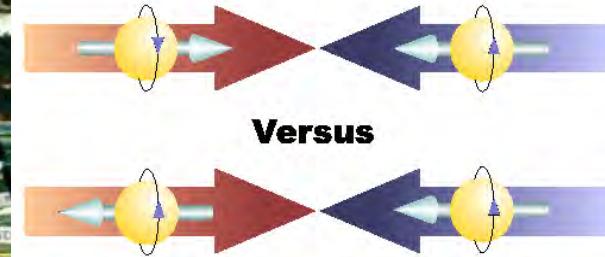
# From Fermilab to Brookhaven



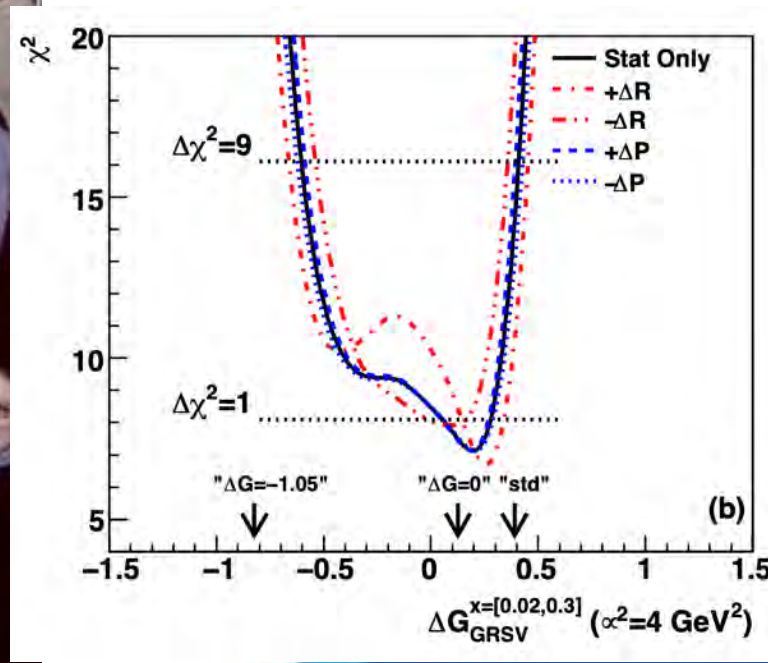
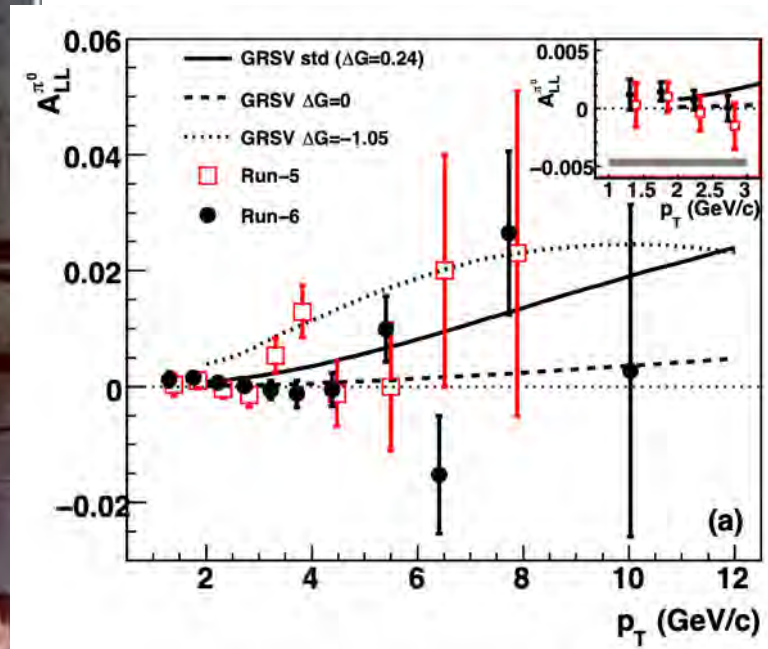
My PhD experiment =  
E704: Spin structure  
studies with Polarized  
Proton beam from Lambda  
decays



Spin polarization is  
preserved up to the  
highest energy of RHIC



# PHENIX



# Some of the work we did at RBRC

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## PROSPECTS FOR SPIN PHYSICS AT RHIC

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**Key Words** proton spin structure, spin asymmetries, quantum chromodynamics  
beyond the standard model

**Abstract** Colliding beams of 70% polarized protons at up to  $\sqrt{s}$   
high luminosity,  $L = 2 \times 10^{32} \text{ cm}^{-2} \text{ sec}^{-1}$ , will represent a new approach  
for studying the proton. RHIC-Spin will be the first polarized-hadron collider  
will be capable of copious production of jets, directly produced partons, and  
Z bosons. Features will include direct and precise measurements of the  
of the gluons and of  $\bar{u}$ ,  $\bar{d}$ ,  $u$ , and  $d$  quarks in a polarized proton. Spin  
searches for physics beyond the standard model will be competitive with  
searches at the Fermilab Tevatron. Transverse spin will explore spin physics  
first time, as well as quark-gluon correlations in the proton. Spin



ELSEVIER

1 August 1996

PHYSICS LETTERS B

Physics Letters B 382 (1996) 165–172

### QCD selection rules in polarized hadron collisions<sup>\*</sup>

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Cambridge, MA 02139, USA

and Lyman Physics Laboratory, Harvard University, Cambridge, MA 02138, USA

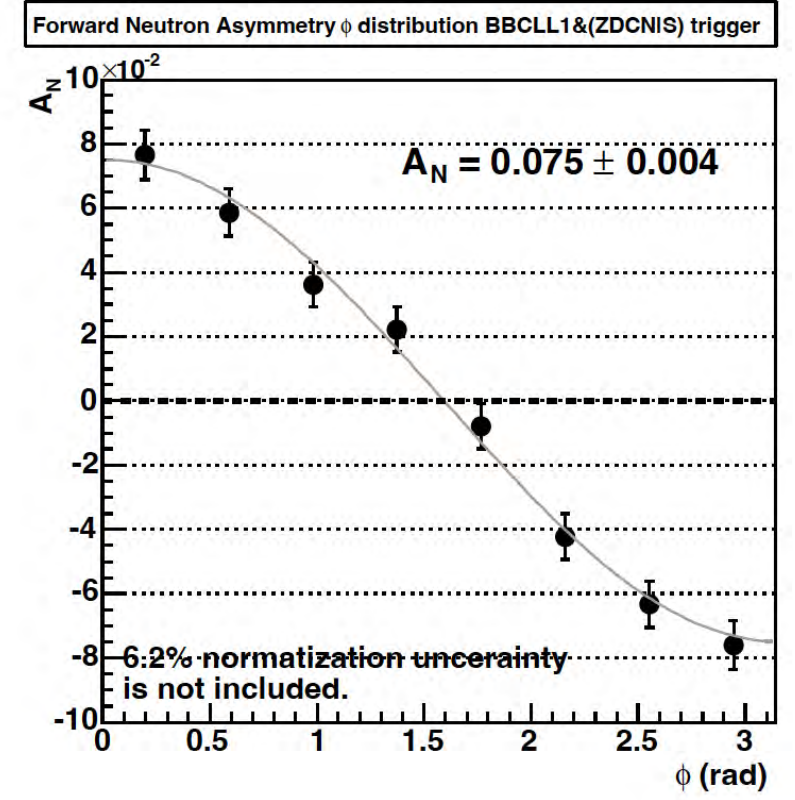
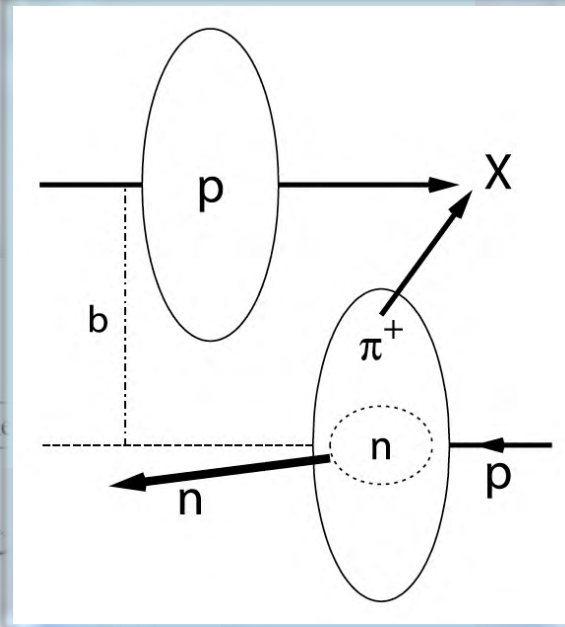
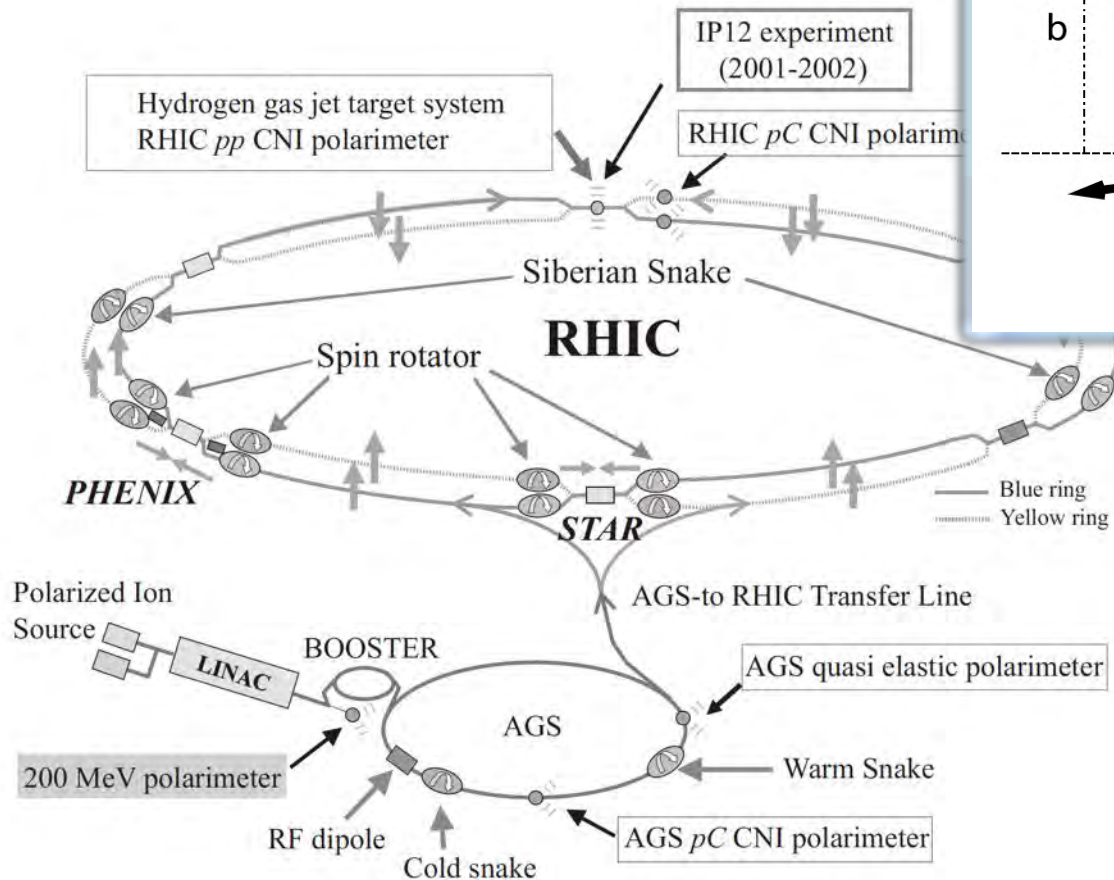
<sup>b</sup> Radiation Laboratory, RIKEN (The Institute of Physical and Chemical Research), Wako, Saitama, 351-01, Japan

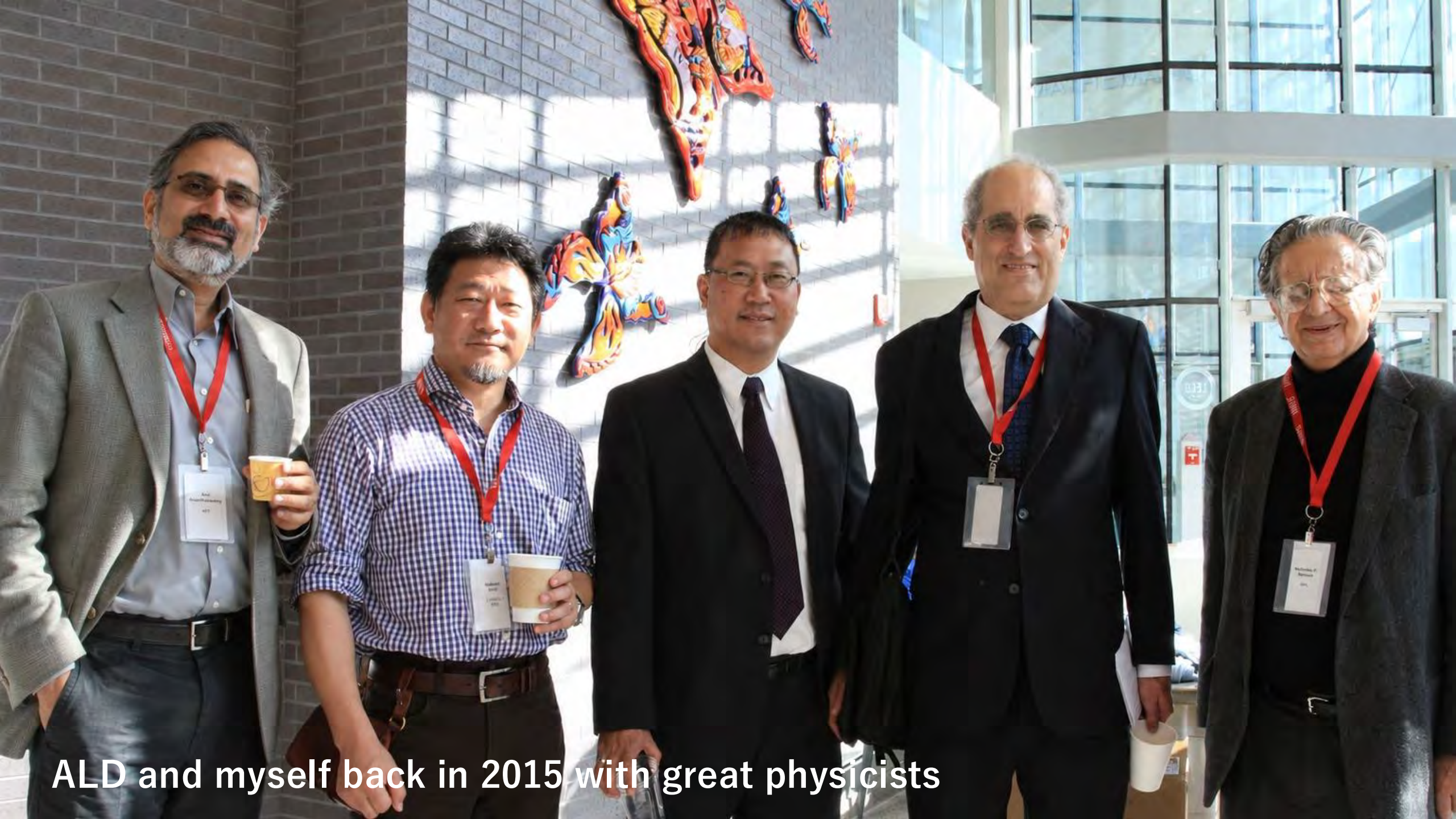
Received 3 April 1996

Editor: H. Georgi



# Crucial Polarimeters





ALD and myself back in 2015 with great physicists



Outpainted from the original photo

- backup

13.8B years  
Present

### Production

Production of life and new forms of matter

~8Byears

Accelerated expansion of the universe begins.

The expansion is driven by a repulsive gravitational effect known as dark energy.

~0.4 B years

Formation of celestial bodies.

Gravity gathers atoms together to form stars, which later assemble into galaxies.

0.38 Myears

Formation of atoms "Recombination"

Electrons become bound to atomic nuclei, allowing light to travel freely through space.

3 minutes

Formation of helium nuclei.

Light nuclei such as helium are produced from protons and neutrons.

10<sup>-4</sup> second

Confinement

Quarks combine to form protons and neutrons.

10<sup>-10</sup> second

Electroweak symmetry breaking

The universe is filled with a hot plasma of quarks, electrons, and other particles.

10<sup>-43</sup>-10<sup>-38</sup> second

Inflation

The universe expands explosively from subatomic scales to macroscopic size.

### Formation

Formation of nuclei and atoms

### Creation

Creation of elementary particles

### Dawn

Creation of Space and Time

## Cosmic Calendar

Today  
Life on earth  
Acceleration  
Dark energy dominates  
Solar system forms  
Star formation peak

365 days = 13.8 B yrs  
1 day = 37.8 M yrs  
1 minute = 26 thousand yrs

Galaxy formation era

Earliest visible galaxies

January 11

Jul. 26 Universe expansion accelerated

Sep. 2 am Formation of Solar system

Sep. 2 pm Formation of proto-Earth

Sep. 11 Formation of Earth's magnetic field

Sep. 17 Formation of oceans/Emergence of life

Nov. 1 Global glaciation #1

Dec. 13 Global glaciation #1 #2

Dec. 14 Global glaciation #1 #3

Dec. 18 Cambrian Explosion

Dec. 30 Dinosaur extinction

Dec. 31 Appearance of Australopithecus

23:48 Emergence of Homo Sapiens

23:58 Emergence of Language

January 1

Electroweak transition  
Electromagnetic and weak nuclear forces first differentiate

Grand unification transition  
Strong, electromagnetic and weak forces differentiate

Inflation  
Spacetime description breaks down

Quantum gravity wall

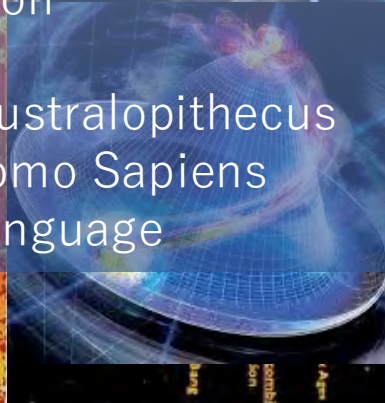
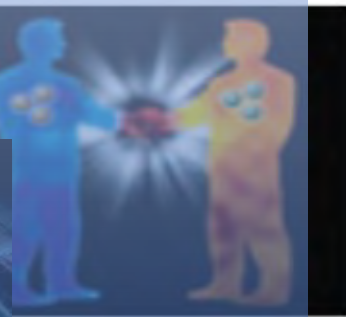
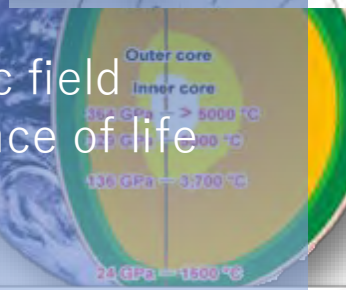
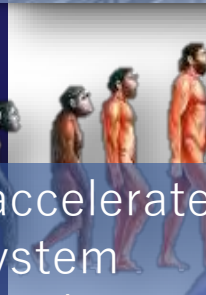
Electron

Helium atom

Helium nucleus

Proton

Electron



Cosmic age 10<sup>-43</sup>sec! 380000yr 13.8Gyr