KAVLI IPMU INSTITUTE FOR THE PHYSICS AND MATHEMATICS OF THE UNIVERSE

東京大学 THE UNIVERSITY OF TOKYO

SuMIRe/PFS Progress Report

Hitoshi Murayama (Kavli IPMU & Berkeley)

Subaru Users Meeting @ Tokyo, Feb 28, 2012

BERKELEY CENTER FOR THEORETICAL PHYSICS

BERKELEY LAB

IPMU INSTITUTE FOR THE PHYSICS AND MATHEMATICS OF THE UNIVERSE

東京大学 THE UNIVERSITY OF TOKYO

SuMIRe/PFS

村山斉 (IPMU & Berkeley)

Subaru Users Meeting @ 国立天文台 2011.1.19

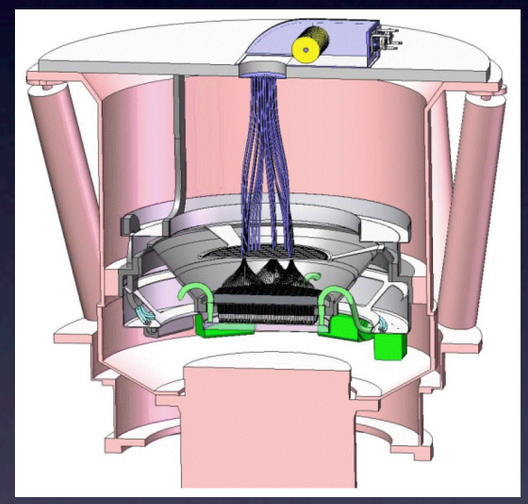
THE UNIVERSITY OF CALIFORNIA BERKELEY 1868 LET THERE BE LIGHT

BERKELEY CENTER FOR THEORETICAL PHYSICS

BERKELEY LAB

PFS提案

- 広視野・多天体・多目的・汎用の分光器を国際協力で製作、すばる望遠鏡を使ってサーベイ
- 装置はコミュニティーに提供
- 「日本人」は
  - サーベイ・デザインに参加歓迎
  - データも共有
- HSC 5年間の後すばる戦略枠を狙う



PFS

多目的・汎用

- 私の「最先端研究開発支援プログラム」(FIRST) の提案はHSCとPFSを組み合わせ、主にweak lensingとBAOでdark energyの研究
- しかし、PFSができるのなら他のサイエンスも当然やるべき cf. white paper
- コミュニティーの望む仕様を考えて来た

UMに期待

- リソースの確保は鶏と卵
- UMがPFSのサイエンスをexcitingと認定
- 天文台がすばるの次期計画として妥当と判断、台長が宣言
- 外国勢がリソース確保に乗り出せる

National Institutes of Natural Sciences (NINS)
National Astronomical Observatory of Japan
2-21-1 Osawa, Mitaka, Tokyo 181-8588, JAPAN

Jan 26, 2011

Director Hitoshi Murayama
Institute for the Physics and Mathematics of the Universe
The University of Tokyo
5-1-5 Kashiwa-no-Ha, Kashiwa City
Chiba, 277-8583, Japan

Re: Prime Focus Spectrograph (PFS)

Dear Director Murayama,

We, members of Subaru Advisory Committee (SAC) assigned for the Japanese fiscal year of 2010, have continuously had discussion on the Prime Focus Spectrograph (PFS) project. To hear more general comments and opinions on the PFS project from the Japanese community, we had the session intensively discussing the PFS project at the 2010 Subaru Users' meeting held at NAOJ on Jan 19, 2011. In particular, we SAC showed the users the following recommendation on the PFS project (see page 2) in order to stimulate discussion from the users.

There were slightly more than 100 Japanese users attending the PFS session on that day, and the attendees exchanged active, various discussions regarding advantages/disadvantages that PFS can bring for Subaru users.

At the end of the session, after having enough discussion, we had a vote by a show of hands on the proposal "Are you for or against moving ahead on the PFS project as one of the next-generation Subaru instruments?". As a result, the PFS project was endorsed by most of the attendees. Hence we SAC are reporting here that we received endorsement from Subaru users that the PFS project should be further promoted as a next-generation Subaru instrument project.

Sincerely yours,

Jan 26, 2011
Subaru Advisory Committee

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Sincerely yours,

SAC recommendation on PFS

At the 2010 Subaru Users' Meeting
Jan 19, 2011

Subaru can maintain its position as one of the top telescope facilities in the world by having both a wide-field imager and a wide-field spectrograph.

The PFS instrument concept was initially developed primarily for a BAO survey, but after consideration of the instrument specifications, it was realized that PFS could have much broader scientific impact, in areas such as galactic archaeology and galaxy/AGN evolution.

Thus, with the conditions listed below, SAC recommends further development of the PFS project as a next-generation Subaru instrument.

Collateral Conditions

- PFS must satisfy instrument specifications agreed by the Japanese community.
- A firm management structure should be built in Japan to develop PFS, including the assignment of a Japanese project manager.
- SAC representative(s) should participate in important decision-making stages about international collaboration.
- There must be a framework for young Japanese students/researchers to get involved in the PFS instrumentation.

Please note the following premises for further discussion on the PFS project:

PFS Organization Structure

Principal Investigator
Hitoshi Murayama (IPMU)

Hiroshi Karoji (IPMU)

PFS Organization Structure

Steering Committee

Principal Investigator
Hitoshi Murayama (IPMU)

Subaru Telescope
Director

Science Team

Richard Ellis (Caltech)
Masahiro Takada (IPMU)

PFS Project Office

Project Management
Hiroshi Karoji (IPMU), Hajime Sugai (IPMU)
Naruhisa Takato (NAOJ, Subaru)

Naoyuki Tamura (IPMU)
Youichi Ohyama (ASIAA)
Akitoshi Ueda (NAOJ, Mitaka)

+ Masahiko Kimura

System Engineering
Atsushi Shimono (IPMU)
Hung Hsu Ling (ASIAA)

Subaru New Development office
Leader
Instrument Scientist for PFS

Telescope Engineerng
chief
System engineer
Mech. Tech.

Prime Focus Instrument & Fiber Positioner
Caltech / JPL

Fiber System
Brazil

System Software
IPMU

Metrology Cam
ASIAA

Spectrograph Optics
LAM

Detector & Dewar
Princeton / JHU

+ three experts on software

meetings

- Jan 2011: Subaru Users Meeting
- Apr 2011: project office launched
- July 2011: 1st PFS collaboration meeting @ IPMU
- Oct 2011: DENET @ Paris
- Nov 2011: pre-CoDR meeting @ Hilo
- Jan 2012: 2nd PFS collaboration meeting @ Marubiru & IPMU
- +many many telecons, video mtgs, trips
- Feb 2012: Subaru Users Meeting

2nd SuMIRe collaboration meeting 1/8, 9

PFS collaboration

Caltech

Jet Propulsion Laboratory
California Institute of Technology

ACADEMIA SINICA

PRINCETON UNIVERSITY

NAOJ

IPMU INSTITUTE FOR THE PHYSICS AND MATHEMATICS OF THE UNIVERSITY

LNA LABORATÓRIO NACIONAL DE ASTROFÍSICA

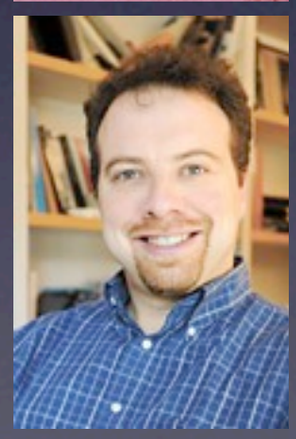
LAM LABORATOIRE D'ASTROPHYSIQUE DE MARSEILLE

JOHNS HOPKINS UNIVERSITY

Welcome, JHU!

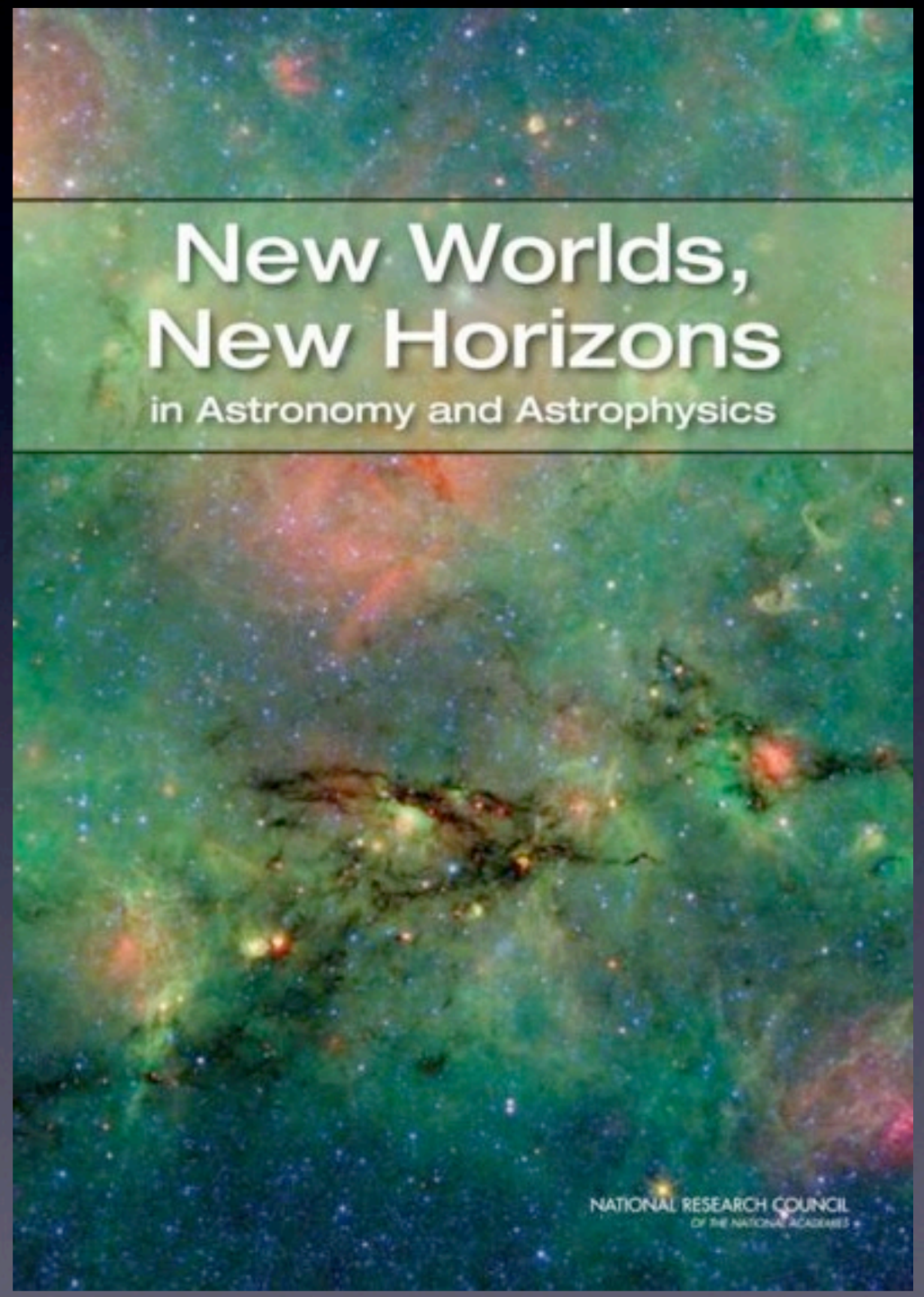
JOHNS HOPKINS UNIVERSITY

- Tim Heckman
- Chuck Bennett
- Brice Ménard
- Rosie Wyse
- Adam Riess
- Stephen Smee



Physics of the Universe

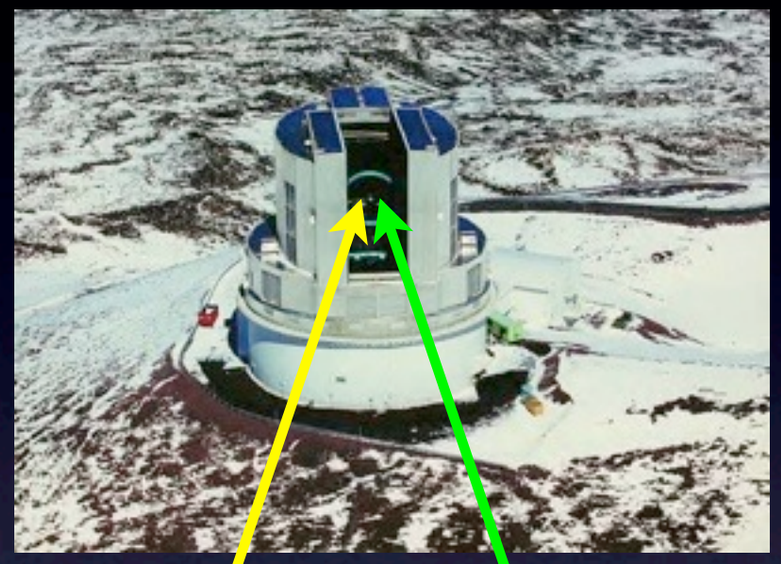
The properties of dark energy would be inferred from the measurement of both its effects on the expansion rate and its effects on the growth of structure (the pattern of galaxies and galaxy clusters in the universe). In doing so it should be possible to measure deviations from a cosmological constant larger than about a percent. Massively multiplexed spectrographs in intermediate-class and large-aperture ground-based telescopes would also play an important role.



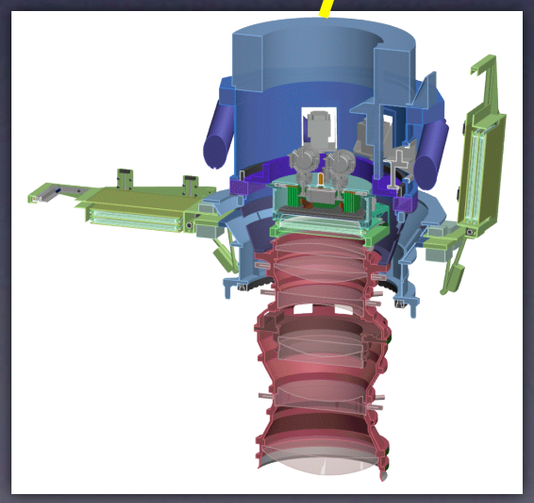
SuMIRe

Subaru Measurement of Images and Redshifts

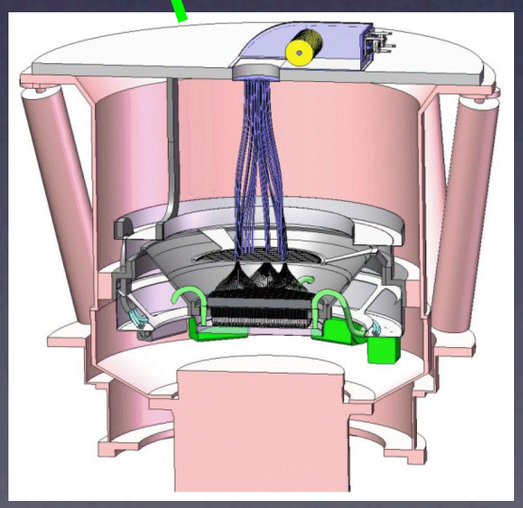
- 8.2 m, excellent seeing 0.6”
- FOV1.5° ~ 1000xHST, 100xKeck
- HyperSuprimeCam: weak lensing survey
  - 0.9 B pixels, 3 ton camera
  - billions of galaxies
- PrimeFocusSpectrograph: BAO
  - 2400 fibers, ~2000 sq. dg.
  - >1M redshifts
- imaging & spectroscopy on the same telescope: SDSS on powerful 8.2m!



Subaru



HSC



PFS

Science Team
Ellis, Takada

Cosmology
Takada, Kneib, Hirata

Galaxy
Bundy, Silverman, Ouchi, Greene

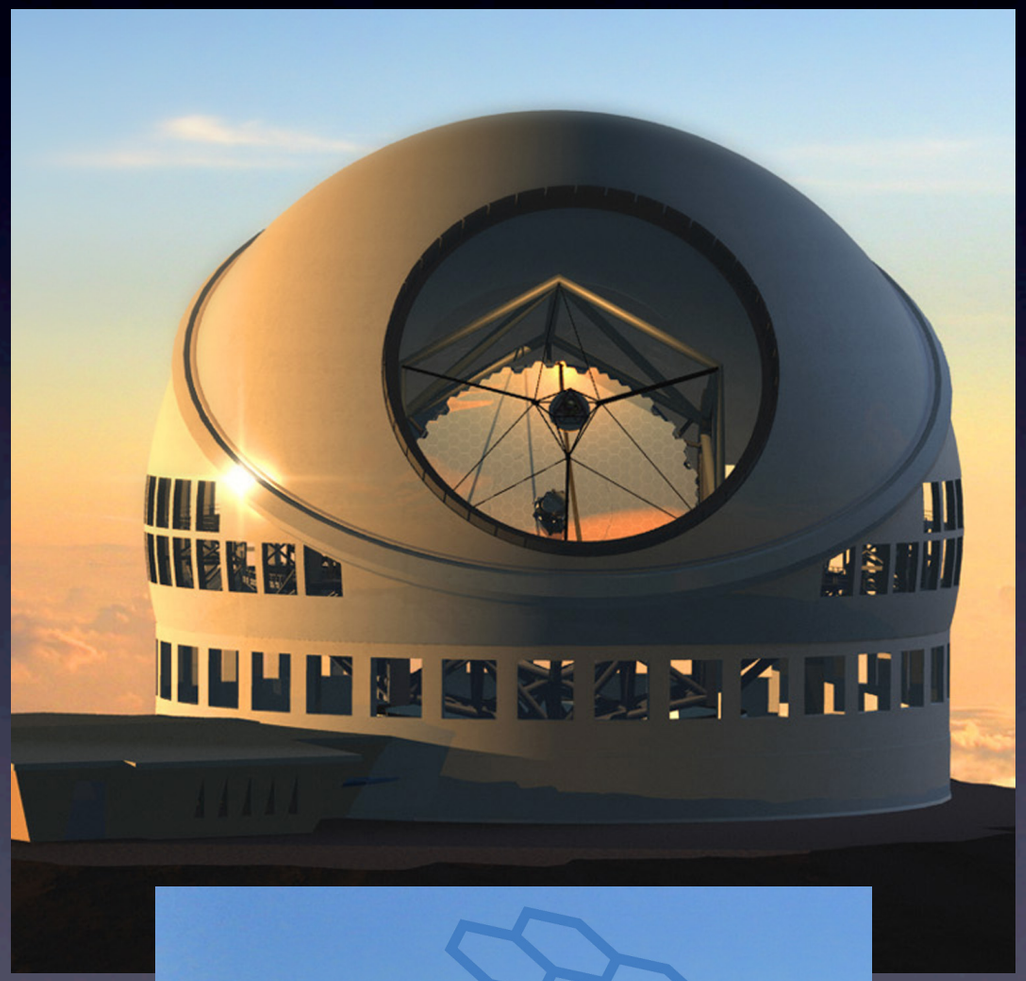
Archeology
Chiba, Cohen

AGN/QSO
Nagao, Strauss

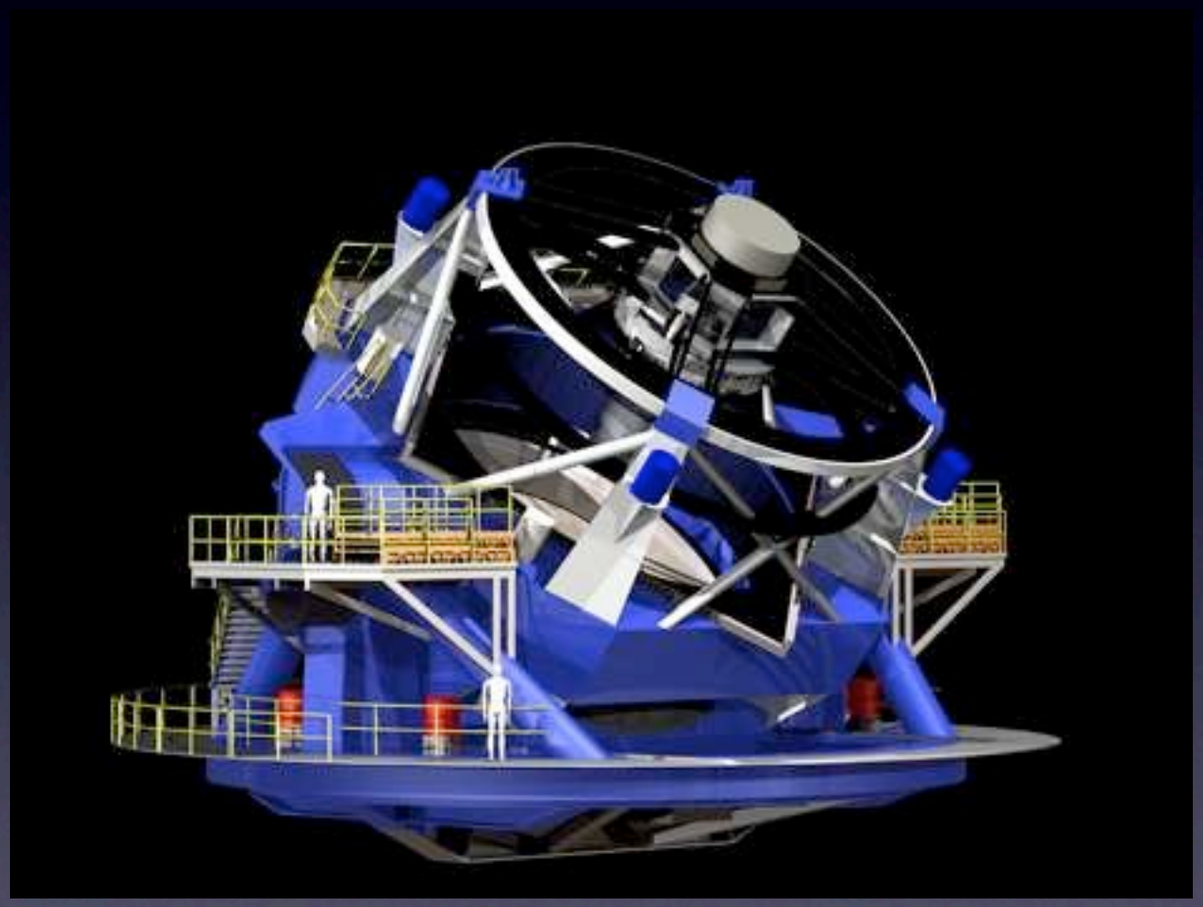
Masahiro Takada

KAVLI IPMU

SuMIRe
all the more important



TMT
THIRTY METER TELESCOPE



LSST

Timeline

imaging — DES, HSC — LSST

spectroscopy — SDSS/BOSS, PFS — Euclid? — WFIRST?

Boundary Conditions

- match physical constraints @ Subaru
  - little assembly @ summit
  - no moving parts in spectrograph
- FIRST: ¥1.7B by March 31, 2014
  - = $21M (today's EX rates)
  - "a spectrograph" by that date
- CoDR March 19-21, 2011
- start spending real money mid-2012
- PDR ~Jan 2013

Boundary Conditions

- PFS survey after the HSC survey? (2017?)
- Subaru Strategic Program ≦ 300 nights in 5 years (current limit)
- PFS is a “Subaru facility instrument”
- Japanese community is a part of the collaboration “*at will*”
- Review by NAOJ around PDR
- approval by SAC < 1 year before the survey

Memorandum of Understanding
between
The National Astronomical Observatories of Japan
and
The Institute for the Physics and Mathematics of the Universe
on
the Prime Focus Spectrograph Project

Dec, 2011

The National Astronomical Observatory of Japan (NAOJ) constructed the Subaru Telescope on the Mauna Kea summit in Hawaii, U.S. and has been operating it for more than ten years. The Subaru Telescope has become one of the major contributors in advancing knowledge of humankind and understanding of the universe in many fields of astronomy. Notably, Subaru Prime Focus Camera “Suprime-Cam” has provided Subaru Telescope, among other large aperture telescopes, with its unique capability to image wide field of view, producing results such as survey observations of the deepest regions of the universe. NAOJ is currently engaging in an international collaboration with the Institute for the Physics and Mathematics of the Universe (IPMU) of the University of Tokyo, Princeton University, and the Academia Sinica Institute of Astronomy and Astrophysics to develop “Hyper Suprime-Cam” (HSC) that will expand the field of view of the Suprime-Cam tenfold for frontier researches such as mapping of the Dark Matter in the universe, and exploration of the evolution of galaxies.

IPMU of the University of Tokyo, along with a major contribution to the realization of HSC, has started the Prime Focus Spectrograph (PFS) project in order to explore properties of Dark Energy by measuring the distance to galaxies, thus the geometry of the deep universe, and applying the analysis of the acoustic oscillation of baryon in the early universe. PFS will be another Subaru prime focus instrument with the same 1.5 degree diameter field view as HSC. It provides multiple object spectroscopic function by using more than 2,000 optical fibers. PFS is expected to be a unique instrument not only in studying the new field of dark energy astronomy but also to be a versatile instrument in promoting other research areas of astronomy such as the evolution of galaxies and active galactic nuclei, and galactic archaeology. IPMU intends to develop and build PFS as another unique instrument on the Subaru Telescope in collaboration with international institutions.

The PFS project is to equip the Subaru Telescope with a new spectroscopic instrument taking advantage of and enhancing the telescope's strength in the wide field observations. This matches Subaru Telescope's long-range strategy. Both the Japanese community of optical and infrared astronomy and the Subaru Advisory Committee has expressed a strong interest and are enthusiastic to bring a support to the project under the condition that the Subaru community is involved in the project decision making process and that the project allows participation of junior researchers in Japan. Subaru Advisory Committee considers the project a good opportunity for the astronomical community of Japan, as the instrument's expected capability has much scientific potential and it also enables young researchers to be involved with the development of a state-of-the-art large instrument.

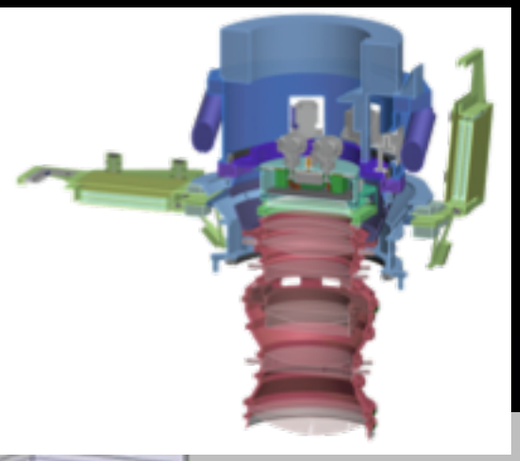
NAOJ and IPMU, therefore, agree to the followings.

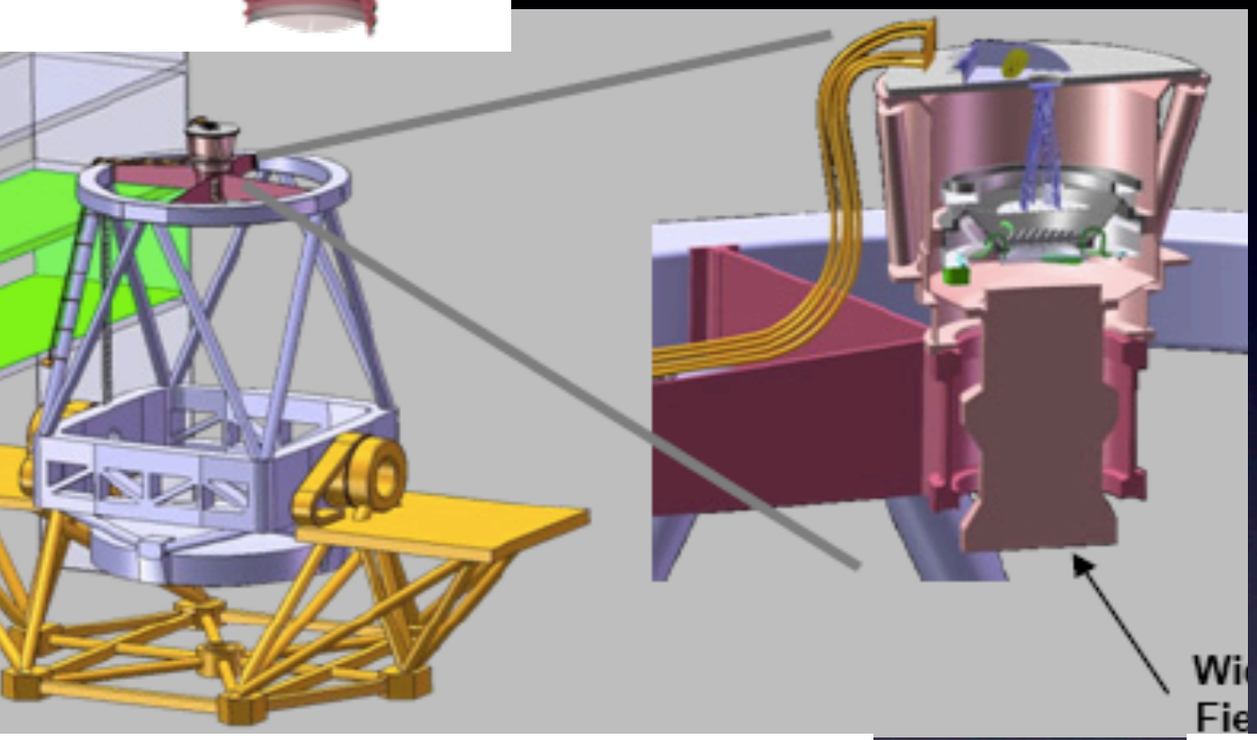
1) NAOJ supports the PFS project that IPMU is intending to develop and build through international collaboration. In particular, NAOJ provides personnel to help design the instrument.

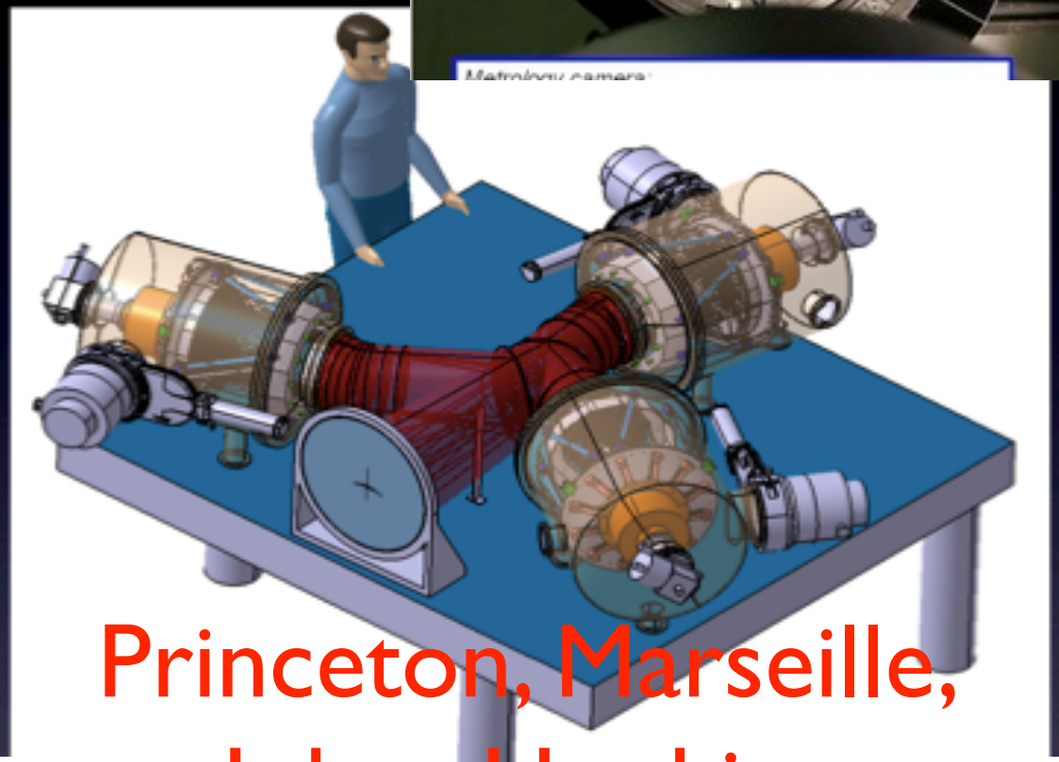
2) After its completion, NAOJ anticipates the PFS project in collaboration with the Japanese astronomical community to carry out a Subaru Strategic Science Program, which currently has a cap of 60 nights a year of the observing time up to about five years. NAOJ's Subaru Advisory Committee would review the Strategic Science Program with criteria including, the science justification, the number of nights, the memberships, their roles and how to share scientific benefits.

3) NAOJ will conduct a review on the project to make a decision on its further commitment to the project in conjunction with the Preliminary Design Review by the PFS project.

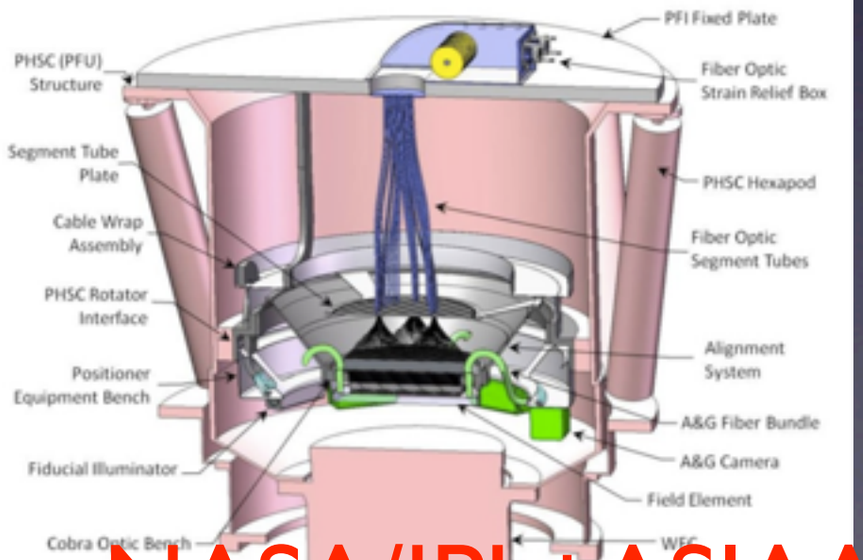
instrument team





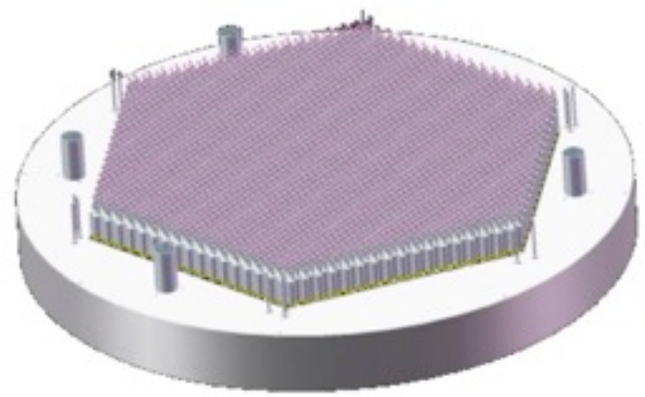


Princeton, Marseille, Johns Hopkins



NASA/JPL+ASIAA

Hajime Sugai



NASA/JPL+Caltech

Name?

- PFS = PrimeFocusSpectrograph is not fixed in stone
- Yasusi Suto proposed it to match HSC = HyperSuprimeCam
- too confusing with PSF?
- Something more cute and memorable?
- need logos for HSC, PFS, SuMIRe

PFS & HSC

- PFS collaborators outside HSC collaboration need to access HSC data
  - target selection
  - science analyses
- shouldn't publish any science papers based on the HSC data alone
- need authorization of the HSC executive board

Momentum is building!

dark energy

HSC
PFS