astronomy," says Weiler, "and clearly identifies areas for NASA's and NSF's attention. Personally, I do not support yet another advisory group." Smith believes that such a committee will face a daunting challenge in matching the different agencies' priorities and cultures in a "scientifically productive" manner. In any case, the community must find a way to get past its differences and unite on the national level, says Giacconi. "We must develop a United States of Astronomy."

PAUL GUINNESSY

NSF Centers Stimulate Research at Physics Frontiers

Cosmology, gravitational wave physics, ultrafast physics, and particle physics are the topics that triumphed in NSF's first annual competition to form Physics Frontier Centers. Four inaugural centers will get up to $3 million a year each for five years, with home institutions chipping in at least 15% more. The money will be for research, conferences, visitors, postdoc and graduate student salaries, equipment, and outreach activities.

The new centers are intended to support physics on a scale bigger and costlier than an individual or small group can typically undertake, but smaller than in major collaborations. Unlike many of the private and public research centers that have cropped up in recent years, these step back from the trend to require interdisciplinarity and ties with industry or government, and physicists are free to dream up center organization for themselves. "These centers are targeted to get at physics frontiers," says Jack Lightbody, executive officer of NSF's physics division. "They are not designed to fill some scientific or political niche. They will have some outreach and educational activities. But the principal objective is cutting-edge science where there is potential for breakthroughs."

First frontiers

Like all the new centers, the Center for Cosmological Physics at the University of Chicago builds on existing research strengths. "The frontier that we're proposing to explore is, to my mind, the ultimate frontier because it delves into the laws of physics governing the entire universe," says director Bruce Winstein, a recent convert to cosmology from particle physics. The center's founding members meld particle physics and astrophysics, theory and experiment. Initial activities include spearheading a study of galaxy clustering to probe dark energy—which appears to be responsible for accelerating the universe's expansion; participating in Auger and Veritas, detectors of high-energy particles from space, with the goal of homing in on dark matter; building an instrument to measure polarization of the cosmic background microwave radiation; and setting up a data analysis hub for the Sloan Digital Sky Survey. NSF awarded this center $3 million a year.

A host of gravitational wave detectors is on the verge of collecting data—LIGO in the US, VIRGO and GEO in Europe, and TAMA in Japan are ground-based projects set to start next year, and an international space-based project, LISA, is slated for launch later this decade. The mission of the Center for Gravitational Wave Physics "is to help crystallize and develop the emerging field of gravitational wave phenomenology," says Sam Finn, director of the Pennsylvania State University-based center. "The science sits at the interface of the astrophysics and gravitational wave communities. Relativity theory has been developed in the absence of experiment. There is no experimental culture. That is a bridge that needs to be built," Finn says. The center has founding members at nine institutions, and will get $1 million a year from NSF. Its three main thrusts are astrophysical interpretation of observations, testing general relativity, and contributing to the design of source-specific gravitational wave detectors.

At the Center for the Study of Frontiers in Optical Coherent and Ultrafast Science (FOCUS), research will span a huge energy range, from creating relativistic plasmas with high-energy laser pulses, down to manipulating quantum states in optical lattices or Bose–Einstein condensates, says Philip Bucksbaum, director of the center, which is a partnership of scientists at the University of Michigan and the University of Texas, Austin. "Controlling decoherence is the recurring theme," says Bucksbaum. FOCUS won $3 million a year from NSF. Its biggest single undertaking will be to take Michigan's existing terawatt laser and, for about $2 million, power it up to petawatt capability.

Rounding out the first batch of NSF Physics Frontier Centers is the Center for the Origin and Structure of Matter, led by Hampton University in Hampton, Virginia. COSM physicists are involved in strangeness physics at Jefferson Lab, including leading PRIMEX, an experiment that will look at decay of π^0 mesons to explore quantum chromodynamics at low energies. And for the Large Hadron Collider at CERN, outside Geneva, they are building part of the ATLAS detector, which will hunt for, among other things, charged Higgs bosons. On top of the physics, COSM aims to create a network among particle and nuclear physicists at historically black colleges and universities. Three are on board so far—Hampton, Norfolk State University, and North Carolina A&T State University, says COSM director Keith Baker. "I have been doing physics for more than a decade," Baker says. "This is what I've been building toward." COSM's $1 million a year has been approved by NSF's physics division, but must still wind its way through the foundation's bureaucratic maze.

TONI FEDER

CHUCK LONG/HAMPTON UNIVERSITY

MICROCOSM: Hampton University student Don Arnold's research on a gas-handling system for CERN's ATLAS detector now falls under the umbrella of the Center for the Origin and Structure of Matter (COSM), one of NSF's four initial Physics Frontier Centers.

Secondary, Undergraduate Physics in Crisis in UK

The refrain is familiar, but the volume is up: UK secondary schools desperately need physics teachers, and university physics departments should broaden their reach in under-