INTRODUCTION

Everywhere You Turn

Wherever matter concentrates in the vast vacuum of space, chances are you will find a disk. Simple physics makes it so; all you need is a spinning sphere of matter collapsing under its own gravitational pull. As the core contracts, it rotates faster to conserve angular momentum. This spin causes the matter around the core to fall onto the equatorial plane, forming a flattened disk of gas and solids. Angular momentum creeps outward, keeping the core from breaking apart. Meanwhile, disk material moves inward along the equatorial plane, eventually either feeding the core or forming other orbiting objects around the core. That oft-repeated scenario makes disks essential building blocks of the universe. This special section covers the many different flavors of disks in space and what they can tell us about the formation of everything from giant gas planets to galaxies.

The solar system got its start when a molecular cloud collapsed to form the Sun and a circumstellar disk of gas and dust. As Connolly notes in his Viewpoint (p. 75), chondritic meteorites contain primordial dust from other nearby stars, evidence that the Sun formed within a cluster of stars. In his Review, Gladman (p. 71) takes us to the edge of the solar system, where remnants of the circumstellar disk are dispersed in the Kuiper belt. The belt is more extensive and more structured than previously thought, and its structure holds clues to planetary formation, planetary migration, possible rogue planets, and the close passage of other stars.

Over the past decade, as Greaves describes in her Review (p. 68), the search for circumstellar disks with possible planets around other stars has intensified. Planets around Sunlike stars are now considered to be ubiquitous. Current models of planet formation require a disk full of gas and dust to swirl and sway around the star long enough to accrete giant gas planets. Observations of the different stages of the evolution of circumstellar disks are helping to refine these models.

For decades, astrophysicists thought that disk-shaped spiral galaxies turn into featureless balls of stars when they collide with other galaxies. In the first of his two News stories (p. 64), however, Irion describes evidence that the spirals (which include our own Milky Way galaxy) can be surprisingly resilient. Meanwhile, other astronomers are probing how disks of matter pulled from a companion star trigger the nuclear explosions that turn white dwarf stars into type Ia supernovas (p. 66): cosmic flares that help gauge the expansion of the universe.

Narayan and Quataert (p. 77) end this special issue with a Review of the most illuminating evidence for black holes: the accretion disks that surround them. As a black hole accretes gas, the gas radiates and provides a thermal signature of the mass, rate of spin, and location of the event horizon of the black hole.

This quick tour of disks in space highlights their simplicity and ubiquity. As modeling and observations continue to provide more details of disk complexity, their utility for resolving fundamental mysteries of space, such as planet formation and black hole jets, will grow.

—LINDA ROWAN, DANIEL CLERY, ROBERT COONTZ

CONTENTS

NEWS

64 As the Galaxies Turn
R. Irion

66 Disks of Destruction
R. Irion

REVIEWS AND VIEWPOINT

68 Disks Around Stars and the Growth of Planetary Systems
J. S. Greaves

71 The Kuiper Belt and the Solar System’s Comet Disk
B. Gladman

75 From Stars to Dust: Looking into a Circumstellar Disk Through Chondritic Meteorites
H. C. Connolly Jr.

77 Black Hole Accretion
R. Narayan and E. Quataert
Everywhere You Turn
Linda Rowan, Daniel Clery and Robert Coontz

Science 307 (5706), 63.
DOI: 10.1126/science.307.5706.63

ARTICLE TOOLS
http://science.sciencemag.org/content/307/5706/63

RELATED CONTENT
http://science.sciencemag.org/content/sci/307/5706/71.full
http://science.sciencemag.org/content/sci/307/5706/64.full
http://science.sciencemag.org/content/sci/307/5706/75.full
http://science.sciencemag.org/content/sci/307/5706/66.full
http://science.sciencemag.org/content/sci/307/5706/77.full
http://science.sciencemag.org/content/sci/307/5706/68.full

PERMISSIONS
http://www.sciencemag.org/help/reprints-and-permissions