Uniting fundamental forces in a new package

When physicists try to construct a mathematical model aimed at putting into a tidy, compact package all the different ways in which elementary particles interact, they generally start with the simplest possibility. But that strategy fails when applied to the development of a grand unified theory, which combines the present theory governing quark behavior with the electroweak theory describing the interactions of electrons, photons and related particles. In this case, the simplest model founders on its prediction that protons decay faster than indicated by observations of proton stability.

Theorist Paul H. Frampton of the University of North Carolina in Chapel Hill and his colleagues are now exploring an alternative, though more complicated, grand unified theory that seems to avoid some of the inherent problems of the original, simple model. "In this [new] theory, the proton is essentially stable," Frampton says. The model also predicts the existence of particles called leptoquarks, which, in principle, could be detected in a proton-electron collider nearing completion in Germany.

Frampton's prediction appears in a paper submitted to PHYSICAL REVIEW LETTERS, and the model itself was first described in the Feb. 5, 1990 PHYSICAL REVIEW LETTERS.

Like other grand unified theories, the new scheme goes by its mathematical designation, SU(15), which describes the mathematical "group" that acts as a framework for the model. The original grand unified theory was based on a group called SU(5). "It's a different approach to grand unification," says Thomas W. Kephart of Vanderbilt University in Nashville. "It's not a perfect model, but it has some very attractive points."

The idea behind grand unification is that at sufficiently high energies, the strong and electroweak forces lose their identities and merge into a more fundamental interaction. The new model suggests that this unification occurs in several stages rather than in a single step. Each stage necessitates the existence of additional force-transmitting particles. Those associated with the lowest step may exist at such a low energy that an accelerator such as the proposed Superconducting Super Collider (SSC) would find them.

In addition, the theory predicts that high-energy collisions between electrons and protons would produce leptoquarks. If leptoquarks are light enough, physicists should be able to detect them when experiments begin next year at the Hadron-Electron-Ring Accelerator in Hamburg, Germany.

"The discovery of leptoquarks would be evidence for grand unification as compelling as proton decay," Frampton says.

The SU(15) model, however, suffers the drawback of requiring each known quark and every member of the lepton family (which includes the electron, muon and neutrino) to have a closely related cousin. "It looks implausible that there would be so many [additional] particles—that there is another world sitting just around the corner," says Palash B. Pal of the University of Oregon in Eugene. Nonetheless, if such particles exist, they would probably have masses that put them within the SSC's detection range.

To avoid this hypothetical "particle glut," Frampton and others have begun looking for alternative grand unified theories that preserve the desirable features of SU(15) but don't require the existence of these so-called "mirror fermions."

Indeed, SU(15) doesn't have the grand unification stage all to itself, and not everyone takes it seriously. "It's a complicated story," says Paul Langacker of the University of Pennsylvania in Philadelphia. "I suspect that [Frampton's model] is just one out of a very large class of models that could be constructed."

"SU(15) is an interesting model, though it has problems," says Nilendra G. Deshpande of the University of Oregon. "It makes some new predictions, and one would like to see how they work out."

— I. Peterson

Home alone: Latchkey kids on good behavior

"Latchkey" children, who fend for themselves after school until their parents return from work, do about as well socially and emotionally as youngsters receiving adult supervision following classes, according to two new studies.

The findings, described in the July DEVELOPMENTAL PSYCHOLOGY, contrast with recent warnings by some researchers that latchkey children face an increased risk of a wide array of emotional problems. However, neither of the new studies showed that children left on their own after school gain any advantages over their classmates. Latchkey children represent about 7 percent of all U.S. youngsters between the ages of 5 and 13.

"[Our study] suggests that the type of after-school care *per se* is less important than the quality of children's experiences with their families," conclude Deborah L. Vandell of the University of Wisconsin-Madison and Janaki Ramanan of the University of Texas at Dallas.

The decision to leave a child unattended after school should depend on the parent's ability to monitor the child's activities during that time and to provide consistent support and discipline, maintain Nancy L. Galambos and Jennifer L. Maggs of the University of Victoria in British Columbia.

Vandell and Ramanan studied 199 girls and 191 boys in third, fourth or fifth grade during 1986. The group consisted of black, white and Hispanic youngsters, mainly in large cities. Nearly half came from poor households, and slightly more than half lived with the mother only.

Mothers reported more hyperactivity and misbehavior among the 28 latchkey children than among youngsters returning to a parent or another adult after school. However, when the psychologists statistically controlled for family emotional support, this discrepancy disappeared in families living above the poverty line. Below the poverty line, the behavior difference remained significant despite the level of family emotional support, which was measured with questionnaires completed by the mothers and home observations by the researchers. All behavioral differences disappeared when the team controlled for both income and emotional support.

The study also showed that children who returned home to single mothers after school experienced more anxiety, misbehavior and conflicts with other children than did youngsters receiving after-school supervision from other adults. Vandell and Ramanan suggest that some single mothers endure considerable stress and may have few psychological resources to offer a child after school. These families may benefit the most from after-school child care, they maintain.

The Canadian psychologists focused on sixth graders who received after-school care from adults or took care of themselves at home, at a friend's house or by "hanging out" with friends. In 1988, Galambos and Maggs administered extensive questionnaires to 112 suburban children and their parents. Six months later, follow-up questionnaires reached 100 of the original participants, all of whom lived with both parents.

Youngsters under adult supervision and those returning to an empty home after school showed no differences in involvement with peers, problem behaviors, self-control and self-confidence. But problems emerged among children left on their own outside the home. In particular, the researchers note, girls who spent unsupervised time "hanging out" reported more problem behavior — such as smoking, drinking alcohol and stealing — and more contact with trouble-prone peers than did the other girls and the overall sample of boys. But self-care outside the home may not cause the behavior problems uncovered in the study, say Galambos and Maggs, who note that children already inclined to rebel or take risks may seek out like-minded peers after school.

— B. Bower