(5–6 m) next to Ellesmere Island and the Greenland coast and progressively thins out toward the central Arctic and the coast of Siberia.

Consequences

Thinner ice at the start of a melt season leads to more open water at the end of it. The extra energy stored in the ocean during summer months is then given back to the atmosphere as heat in the fall. According to the National Oceanic and Atmospheric Administration's James Overland, air temperatures over those ice-free areas can be 5–6 °C warmer than over covered areas. Rising of the warm air into the troposphere can then "tilt" regional atmospheric pressure surfaces and modify wind patterns. Indeed, persistent southerly winds that formed in the summer of 2007 between high pressure over the Beaufort Sea north of Alaska and low pressure over eastern Siberia are thought to be responsible for the circulation of warm winds that led to excessive melt and the export of ice from the Siberian coast that year.

The influence of recent warm years and wind-driven sea ice, Overland argues, has thinned Arctic ice to the point that natural climate variability may kick the ice albedo feedback process into high gear. Based on models that couple ice, ocean, and atmosphere, he projects the loss of most summer ice within the next 30 years.[4] "Reversing recent trends would take several cold years in a row, which is probably not in the cards. We're on a one-way trip."

The Arctic is already transforming: Last summer was the second in a row in which the Northwest Passage was navigable through the Canadian archipelago; fisheries from northern Norway to the Bering Sea are expanding farther north; animals are losing their habitats; and the retreat of ice from coastlines is exacerbating erosion (see figure 1).

Perhaps most intriguing, and uncertain, is the role that ocean waters play in the melting of Arctic ice. Dense with salt and carrying enough heat to melt the entire cap, the Atlantic Ocean enters the Arctic some 250 m below the surface, separated only by a layer of colder, less saline water.

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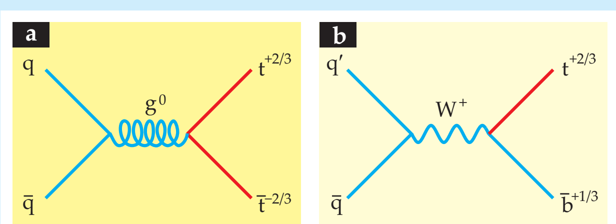
physics update

These items, with supplementary material, first appeared at http://www.physicstoday.org.

Making top quarks one at a time. Since its 1995 discovery in 2-TeV proton–antiproton collisions at Fermilab, the ultramassive top quark (t) has mostly been produced in top–antitop quark pairs via the strong interactions (diagram a, for example), which forbid the production of single top quarks. The standard model of particle theory also predicts single-top production via weak interactions like that in diagram b, with the weak boson $W^\pm$ replacing the gluon g^0 in the intermediate state and a bottom quark (b) emerging. But single-top production is much harder to detect than pair production amidst the overwhelming background of more pedestrian processes that can mimic either rare process. That's because a pair gives the experimenter two chances to see the telltale sig-



nals of t decay. So why bother? Yielding a direct measure of the coupling at the tbW vertex, the cross section for single-top production provides a particularly sensitive test of some aspects of the standard model, such as the presumed absence of a fourth generation of quarks beyond the t and b. Furthermore, the pattern-recognition techniques developed and tested in the search for single-top production are crucial to the quest for the Higgs boson. Now the DZero and CDF detector teams at Fermilab have reported robust observations of single-top production with a cross section of about 3 picobarns (3×10^{-36} cm^2), consistent with the standard-model prediction. That's almost half as big as the pair-production cross section, which is severely suppressed by the kinematic requirements for making two ultraheavy quarks. But that modest cross-section disparity also reflects the unifying tendency of the weak and strong interactions to approach each other with increasing energy. (V. M. Abazov et al., http://arxiv.org/abs/0903.0850; T. Aaltonen et al., http://arxiv.org/abs/0903.0885; both in press at *Phys. Rev. Lett.*) —BMS

The racehorse's debt to its jockey. The late 19th century saw a radical innovation in horse racing: Jockeys abandoned a comfortable, upright posture for the hunched-over, short-stirrup style seen today at racetracks (and in the figure). By 1910, when the style was universally adopted, race times had dropped by more than 5%; the improvement in the first decade of the 20th century was greater than in the hundred years since. One might think that the reduced aerodynamic drag of the new style led to the faster times, but Thilo Pfau and colleagues at the University of London's Royal Veterinary College suggest that the way the modern jockey moves in response to the horse's galloping makes the more significant contribution. The London group measured the motion of jockeys and horses and observed that jockeys do not suffer much vertical displacement as a horse races—a consequence of the way they absorb the horse's motion by strenuously pumping their legs while riding. So, though the horse supports the jockey's weight, it does not expend unnecessary energy lifting and lowering its cargo. Moreover, the horse's forward speed varies over the course of a gallop cycle. When the horse is moving faster than on