Wrapping a sphere

A flat, two-dimensional map of the spherical Earth must introduce some sort of distortion; though Carl Friedrich Gauss proved it nearly two centuries ago, cartographers have confronted the matter for some two millennia. The converse—covering a curved substrate with a 2D sheet—is also of technological and practical relevance, be it in depositing thin films, measuring materials properties, covering knuckles with bandages, or wrapping a snow globe to give as a gift. (See PHYSICS TODAY, May 2012, page 15.) That problem is an active area of research, and Jérémy Hure (ESPCI ParisTech) and colleagues have recently approached it using a planar, elastic sheet on an adhesive, rigid sphere.

The image, 80 mm across, shows how a thin, 15-μm-thick sheet of polypropylene deforms on a sphere of radius 60 mm (the extent of the sphere is visible in the image's corners). Yellow dye outlines the regions where the sheet has stretched to adhere to the sphere. Between the twisting branches of that contact area, the sheet is unattached, bent, and buckled; various wrinkles in those regions appear here as white. Such branching is one of several adhesion patterns that the researchers observed. Experiments and theory show that the shape, size, and complexity of the contact area are governed by two dimensionless parameters that compare the relative strength of the adhesion energy, which promotes contact, to the sheet's bending and stretching energies, which measure the costs of geometric distortion. (J. Hure, B. Roman, J. Bico, *Phys. Rev. Lett.* **106**, 174301, 2011; J. Hure, B. Audoly, *J. Mech. Phys. Solids* **61**, 450, 2013. Image submitted by Jérémy Hure.)

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