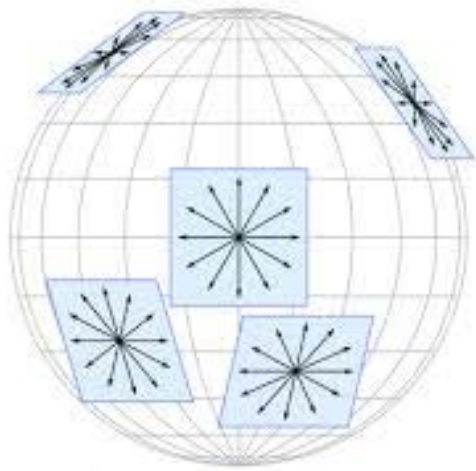
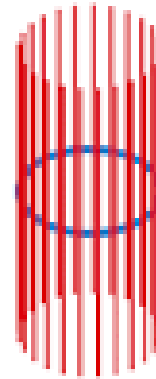
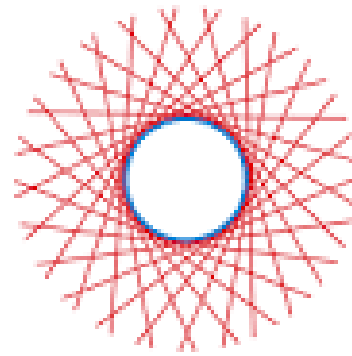


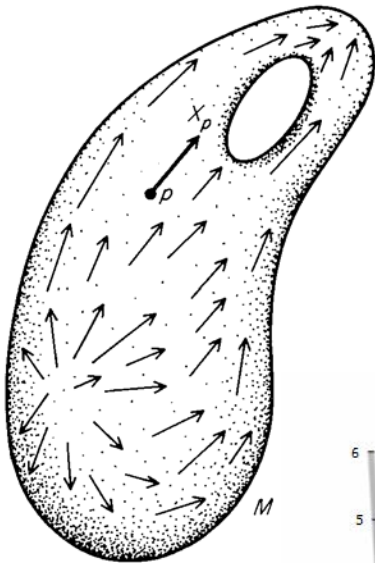
Some tangent bundles



Tangent bundle on a 2-sphere

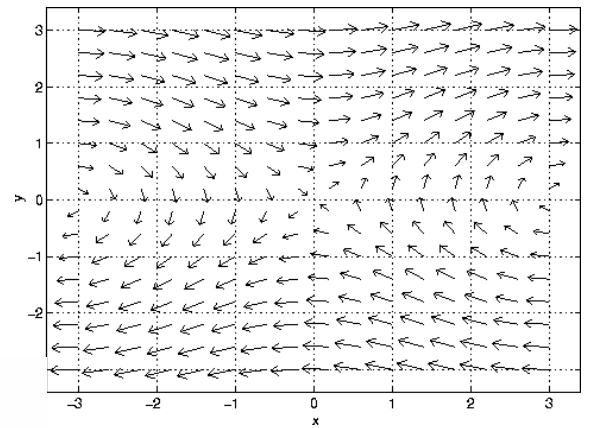
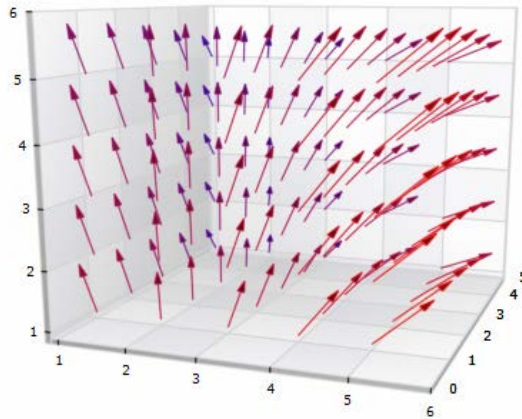


The tangent spaces have been reoriented

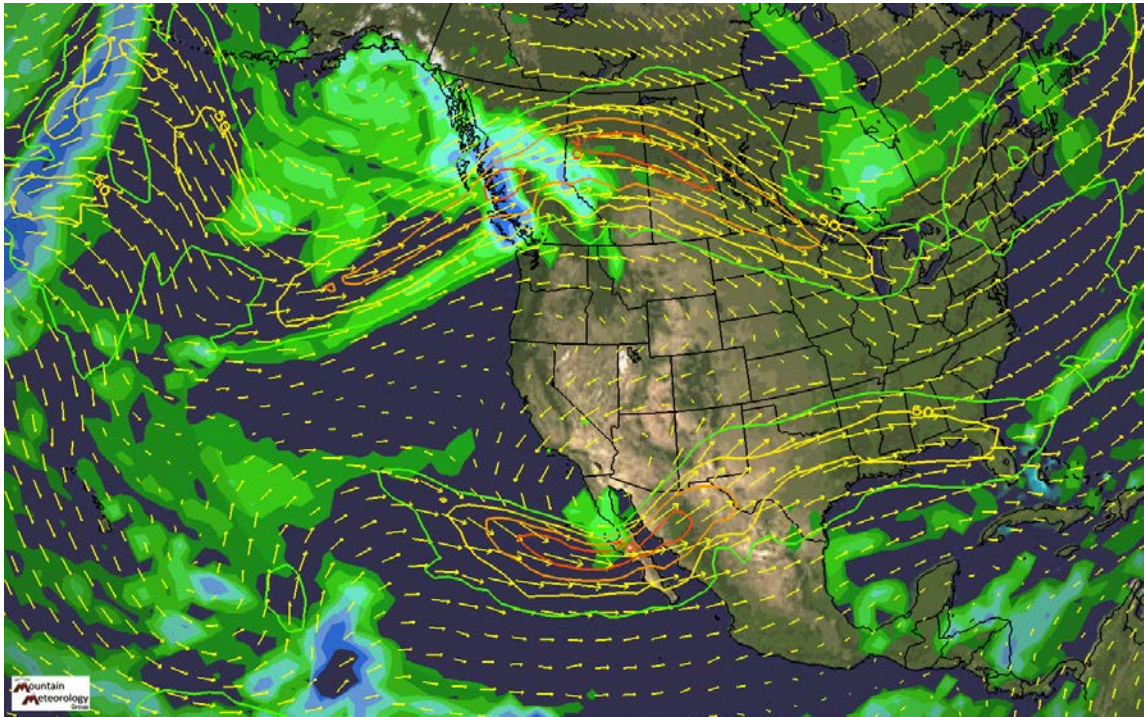


Some vector fields

3D Vector Field



A vector field in daily life



The so-called Hairy ball theorem (for $n = 2$) :

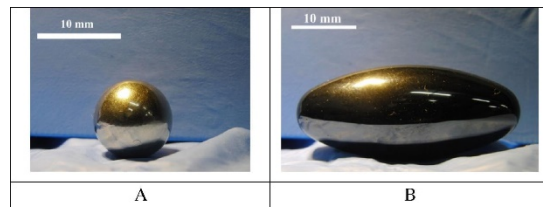
Theorem 1. *Suppose \mathbf{v} is a continuous vector field on S^2 . Then there is $\mathbf{p} \in S^2$ such that $\mathbf{v}(\mathbf{p}) = 0$.*

Two applications of this theorem:

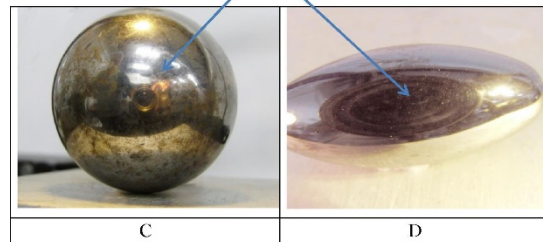
1) *No way to avoid reflection of light*

E. Bormashenko, A. Kazachkov
 Results in Physics
 Volume 6, 2016, Pages 76-77

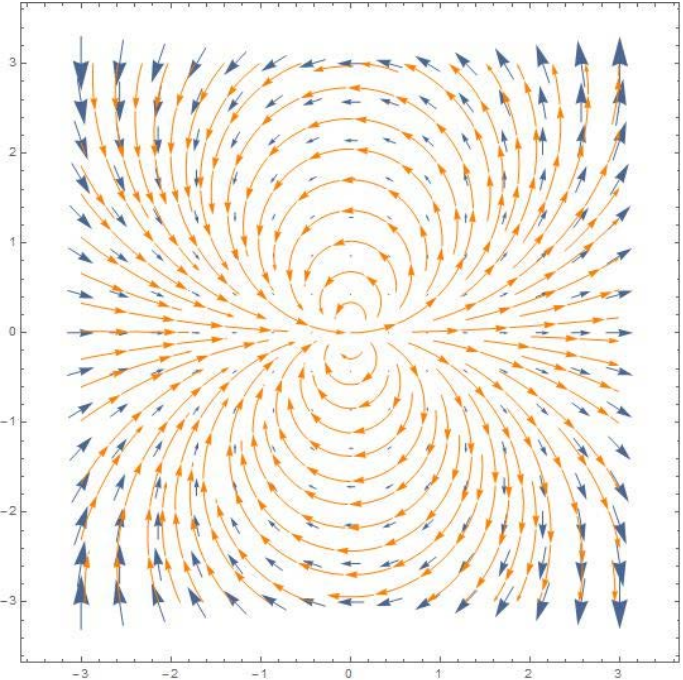
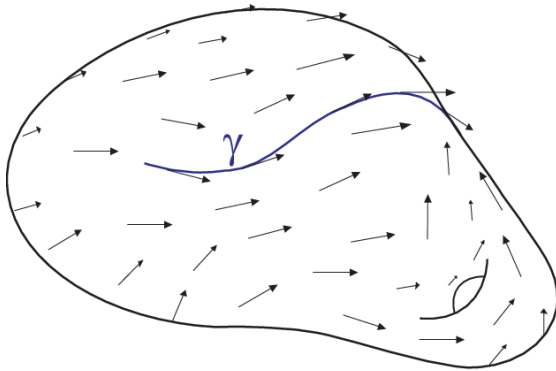
2) *At any time, there is at least one place on earth with no wind*



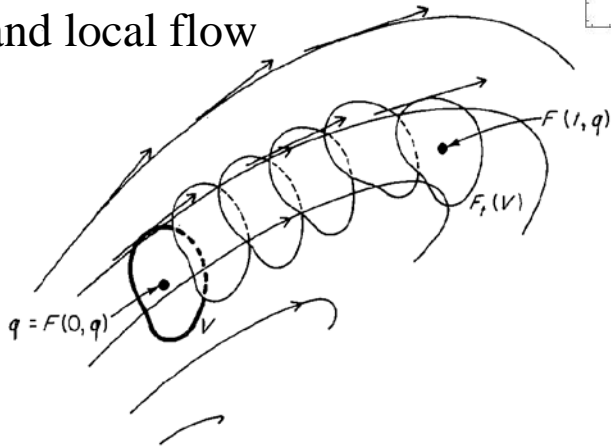
images of the camera



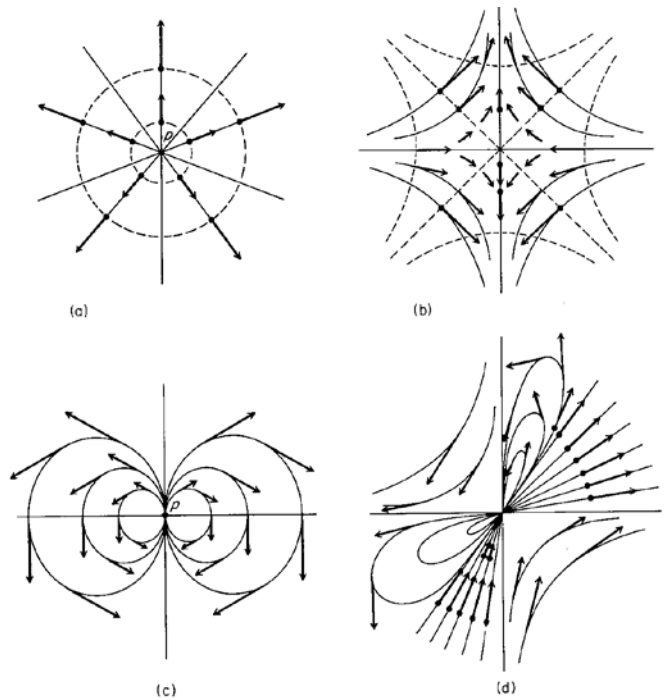
Integral curves



and local flow



Critical points and integral curves around them



Additional exercises: [GN] Ex. & 12 p. 33 9 (see also [Bo] Thm 7.9 p. 155 for 9)
 [Bo] Thm 3.6 p. 125, Thm 7.12 p. 156, Ex. 3 p. 157 & 11 p. 158