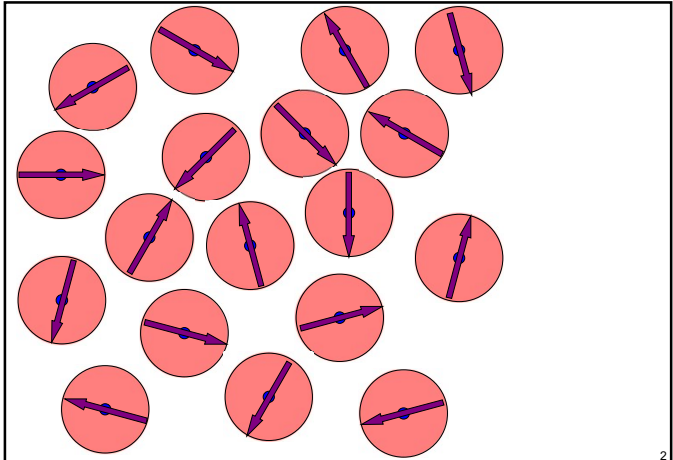


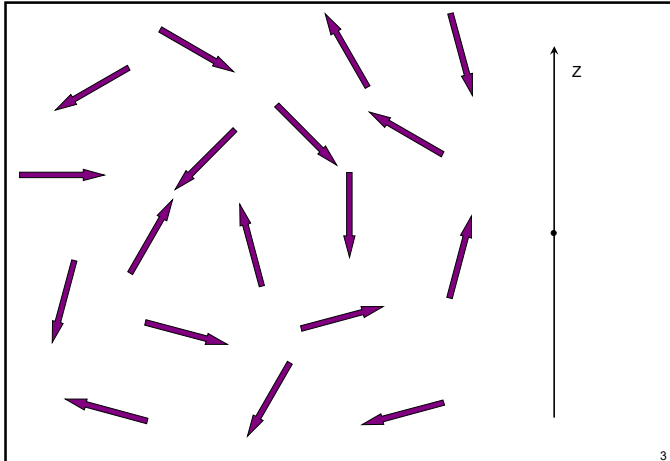
orientation of a nuclear ensemble

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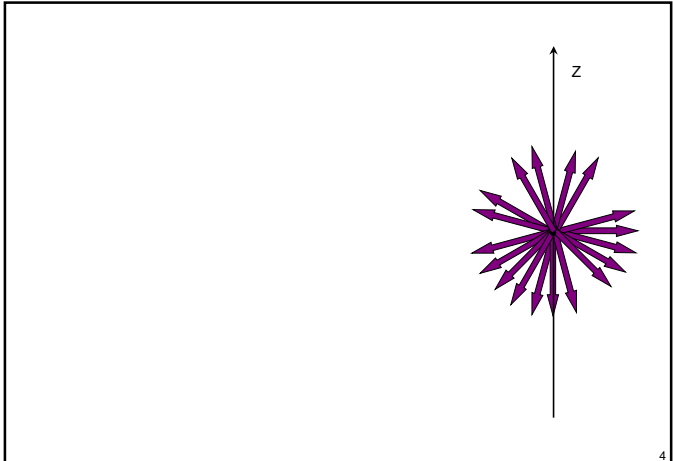
1



2



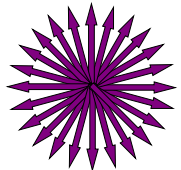


3



4

When space is not isotropic (due to e.g. the presence of an external magnetic field, or a crystal lattice), it becomes meaningful to ask for the average orientation of the nuclear spins I in a collection of nuclei.

random orientation for every nucleus:

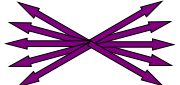






"soccer ball"

5

When space is not isotropic (due to e.g. the presence of an external magnetic field, or a crystal lattice), it becomes meaningful to ask for the average orientation of the nuclear spins I in a collection of nuclei.

most nuclei in the **horizontal plane** :

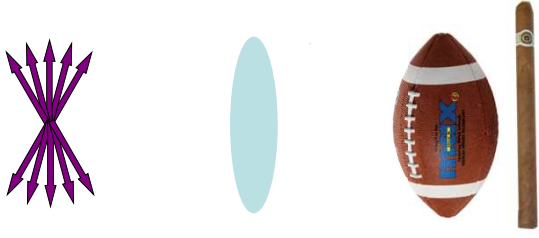




"pan-cake"

6

When space is not isotropic (due to e.g. the presence of an external magnetic field, or a crystal lattice), it becomes meaningful to ask for the average orientation of the nuclear spins I in a collection of nuclei.

most nuclei along the **vertical axis**
(horizontal plane is mirror plane) :




The diagram shows two objects: a rugby ball and a cigar. To the left of each is a set of purple arrows representing nuclear spins. For the rugby ball, the arrows are distributed symmetrically around a vertical axis. For the cigar, the arrows are also distributed symmetrically around a vertical axis. A light blue oval is positioned between the two sets of arrows.

"rugby ball" "cigar"

7

When space is not isotropic (due to e.g. the presence of an external magnetic field, or a crystal lattice), it becomes meaningful to ask for the average orientation of the nuclear spins I in a collection of nuclei.

most nuclei along the **vertical axis**
(horizontal plane is **not a** mirror plane) :




The diagram shows a pear. To its left is a set of purple arrows representing nuclear spins, all pointing towards the top of the pear. A light blue pear-shaped drop is positioned to the left of the actual pear.

"pear"

8

Orientation of a nuclear ensemble



The diagram shows four objects: a soccer ball, a flat round object, a pear, and a rugby ball with a cigar. Each object is labeled with its orientation: 'unoriented, random' for the soccer ball, 'aligned (axially symmetric)' for the flat round object, 'polarized (axially symmetric)' for the pear, and 'aligned (axially symmetric)' for the rugby ball and cigar.

unoriented, random

aligned (axially symmetric)

polarized (axially symmetric)

aligned (axially symmetric)

9