



# Bubbles Behaving Badly

The bubbles in your beer are more interesting than you might think

by Andrea Tang

Sit down at a bar, order a pint of Guinness and ponder its effervescence. If you think all the bubbles in the beer move to the top—think again. By capturing the motion of these bubbles on film, Stanford's Chemistry professor Richard Zare and University of Edinburgh's research fellow Andy Alexander have observed them moving down the sides of the glass instead of up. But common knowledge says objects of lower density should float up. Why then, do these bubbles sink?

According to Professor Zare, the answer is fairly simple: the bubbles at the center are rising up more rapidly than those at the sides, which are hindered by the drag of the glass surface. The liquid is lifted in the center by the rising bubbles and then spills back downward along the edges bringing down other bubbles the same time. "Think of Niagara Falls," explains Professor Zare. "If you take a canoe in the Niagara River above the Falls, no matter in what directions you paddle, you will go over the Niagara Falls." This same phenomenon applies to the small bubbles near the sides of the beer glass. When they reach the bottom, they then move to the center, becoming the rising bubbles that lift up the liquid. This circulation does not stop until most of the bubbles have risen to the top and are gone from the liquid.

It was actually Md Nurul Hasan Khan, a chemical engineer from Australia, who first tried to explain the bubbles' behavior by computational modeling in 1999. Initially, his findings were met with skepticism. "Indeed, Andy and I first disbelieved this and wondered if [Khan] had had maybe too much Guinness to drink," recalled Professor Zare. To capture images of the downward motion made by the small bubbles, Professor Zare and Alexander used a high-speed camera that is capable of taking up to 4,500 frames per second. Interestingly, they found the bubbles to be 40 to 120 micrometers in diameter and travel about 2.11cm per second. But more importantly, they generated slow-motion movies to visually confirm that bubbles in Guinness beer actually do sink.

While most people don't buy Guinness to study the behavior of its bubbles, research on bubbles

allows industries to find ways of making beer stay fresh for a longer period of time. But for Professor Zare, the motivation behind his examination of bubbles is far simpler: "Have you ever wondered what makes bubbles rise in beer? Have you ever wondered why the shower curtains are drawn in when you take a hot shower?" Professor Zare wonders about such questions in life: "I find the world to be an awesome, fascinating, and indeed a wondrous place." **S**



Bubbles create circulation in beer by moving up at the center of glass and down at the edges.