time studies with hydrogen maser

Cycles are inextricably involved in the measurement of time. From primitive time measurements, involving the periodic rotation of the earth around the sun to the most sophisticated chronometers – hydrogen masers and caesium beam resonators with radiation frequencies of billions of cycles per second – man has striven to measure time by means of some regularly repeating process.

The perception of events one after another created the urge in man, in pondering the concept of succession, to assign a numerical estimate to the interval between these events. A glance back over the millenia of man's quest to better these estimates will reveal how cycles of greater and greater regularity were manufactured or discovered in widely differing phenomena, and how man ingeniously exploited them, only to be continually hampered by inherent inaccuracies in the cycles.

Early man was stimulated to timekeeping by the observation of certain periodicities in vital phenomena, such as recurring hunger and fatigue as well as similar rhythms in external nature such as the reappearance of day after night and the ebb and flow of the tides. To progress, man needed to standardize his estimates of time passing; he first arbitrarily based them on the recurrence of some simple phenomenon, evident to all and of convenient regularity – the passage of the sun or stars across the meridian. Over the last 4,000 years, the measurements of the "simple" phenomenon have grown in complexity through sun dials, hourglasses, water clocks, mechanical clocks, and pendulum clocks to electric clocks where a generator determines the frequency, quartz crystals (electromechanical oscillators) and the atomic timepieces of the twentieth century.



Dr. Mungall (left) and Dr. Morris remove maser storage bulb from resonating cavity. Collisions of hydrogen atoms with the walls of this bulb create one of the baffling problems of the maser.

Monsieur Mungall (à gauche) et M. Morris en train d'enlever le ballon de stockage de la cavité résonnante. La collision des atomes d'hydrogène contre les parois pose un problème des plus épineux.