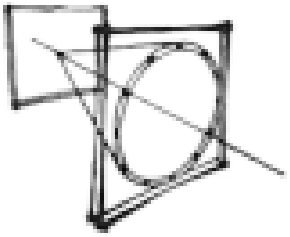

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From the speed of sound to the speed of light: ultrasonic Cherenkov refractometry.

Friday 9 September 2016 12:25 (25 minutes)

Despite its success in the SLD CRID at the SLAC Linear Collider, ultrasonic measurement of Cherenkov radiator refractive index has been less fully exploited in more recent Cherenkov detectors employing gaseous radiators. This is surprising, since it is ideally suited to monitoring hydrostatic variations in refractive index as well as its evolution during the replacement of a light radiator passivation gas (e.g. N2) with a heavier fluorocarbon (e.g. C4F10[CF4]; mol. Weight 188[88]). The technique exploits the dependence of sound velocity on the molar concentrations of the two components at known temperature and pressure. The SLD barrel CRID used an 87%C5F12/13%N2 blend, mixed before injection into the: blend control based on ultrasonic mixture analysis maintained the ⊠=1 Cherenkov ring angle to long term variation better than ± 0.3%, monitored ultrasonically at multiple points in the radiator vessel.
Recent advances using microcontroller-based electronics have led to ultrasonic instruments capable of simultaneously measuring gas flow and binary mixture composition in the fluorocarbon evaporative cooling systems of the ATLAS Inner Detector. Sound transit times are measured in opposite directions in flowing gas for simultaneous measurement of flow rate and sound velocity. Gas composition is evaluated in real-time by comparison with a sound velocity/composition database.
In the ATLAS application C3F8 fluorocarbon coolant leaks into the N2 anti-humidity envelopes of the silicon tracker are measured to a precision better than 5.10-5. Another instrument is configured as an angled path flowmeter to measure high returning C3F8 vapour flux (up to ˜1.2 kg.s-1) with a precision of < 2% F.S., and can also monitor C3F8/C2F6 blend composition to better than ±3.10-3.
These instruments, which could find their way back into new and upgraded gas Cherenkov detectors, have many other applications - including Xenon-based anaesthesia. These possibilities are discussed.

Registered

Yes

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