- One WETLabs ac9 absorption and beam attenuation meter is used to measure $a(\lambda)$ and $c(\lambda)$. Short lengths of copper pipe added to the the intake and outflow ends of the flow-through tubing (Fig. 3.14). The copper pipe sections provide a toxic barrier on each end of the flow tube system to prevent biological organisms from entering the flow tube area when the pump is off between sampling periods. This system yields approximately 2-3 months protection before effects of biofouling begin to become apparent in the data record. Bromide, or bleach, leaching methods are not used, because these reactive materials may etch of the quartz window surfaces during a several month deployment.

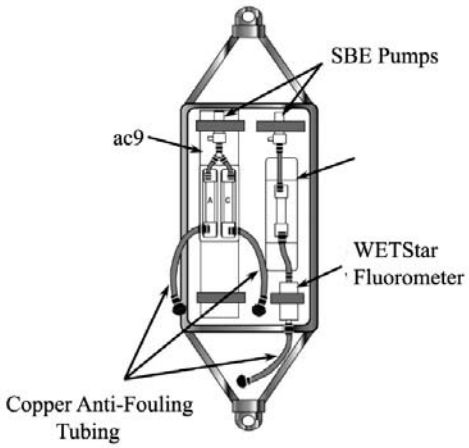

Fig. 3.14: Schematic diagram showing a bio-optical package with copper tubing used to protect the flow-through optical instruments from bio-fouling (after Manov 2003).

Methods for Other Measurements

The MBARI-ISUS (Johnson and Coletti, 2002) is a new system for the optical determination of nitrate concentrations *in situ* without the use of reagents. The system has been successfully deployed on a number of buoys (MOOS-M1, TAO, and SOFeX). ISUS uses UV spectroscopic techniques to provide a measure of nitrate in a 1 cm path length cell in approximately one second. ISUS provides a real time nitrate concentration (in analog and digital formats) and optionally, a full UV absorption spectrum from 200-400nm. Real time nitrate concentrations are accurate to 2mM with a precision of 0.05mM. For moored systems, a novel antifouling chamber has been developed by MBARI using a perforated copper tube and Nitex filter cloth over the probe.

Validation Using Shipboard Measurements

During any recovery, deployment, or servicing of optical moorings or drifters, it is strongly recommended that shipboard bio-optical and radiometric profiles of the water column be measured for comparison with the concurrent buoy measurements. The appropriate measurements are those listed in Vol. I, Chapter 3, Table 3.1, where the protocols covering each measurement are provided in the volumes and chapters indicated in Table 3.2, of Volume I, Chapter 3. Examples of data sets used for this purpose are described in Dickey *et al*. (2001). In the present context, the shipboard radiometric profile measurements made just after a drifting or moored buoy's radiometers are placed in the water, and just before they are recovered, provide invaluable information on the extent of biofouling during a deployment and the quality of water-leaving radiances and diffuse attenuation derived from the buoy measurements. A similar suite of samples are collected off the Oregon Coast when optical drifters are deployed. In addition, a calibrated Tethered Spectral Radiometer Buoy (Satlantic Inc.) is used to collect optical data in the vicinity of the drifters for comparative purposes.

It is also useful to acquire i*n situ* fluorometric chlorophyll *a* before or after radiometric profiles and optical mooring or drifter deployments. Samples to determine the chlorophyll-specific absorption coefficient (a^*) are also