TECHNICAL REPORT N° 78 **Dec 2002**

SYNCHROTRON RADIATION VUV CD

W. Curtis Johnson wrote nearly 20 years ago[1]:

> *The extra information provided by extending CD spectra into the vacuum UV region provides extra sensitivity for investigating the secondary structure of all types of biological molecules. This extra information is mandatory if CD spectra of proteins are to be used to determine their component secondary structures. The noise of a CD spectrum depends on the amount of light collected during the measurement and conventional sources for the vacuum UV are weak enough that noise levels are high and the instruments always working at their limits of reliability. Synchrotron radiation provides the high light intensity for this wavelength region that it's necessary for the rapid scanning of accurate noise-free spectra.*

Despite the real progresses in conventional CD spectrometer design (see T.R. 22 for a comment) these statements have still a strong value.
The number of synchrotron radiation CD facilities has been increasing, today status is tentatively as follows:
-SRS, Daresbury; UK
-NSLS, Brookhaven National Laboratory, US
-ASTRID, Aarhus Denmark
-HiSOR, Hiroshima, Japan
-BSRF, Beijing, China
-ELSA, Bonn, Germany
but other places are now following, despite the required huge economic investment.

The different beamlines so far existing are following various approaches regarding the monochromator /entrance optics choice; furthermore some designs use a linear polarizer (a critical component here), while others rely on the natural linear polarization of synchrotron beam: all however find far UV absolute limit in the choice of PEM material (130nm for CaF_2 or 120nm for LiF).

Advantages using synchrotron radiation are evident and widely published[2] [3]: the high photon fluxes in the VUV region and the small beam size at sample point are outstanding compared to conventional lamp based VUV spectrometers.
Anyway technique is not easy to implement and while practical data starts to appear in the literature[a] [b] [c] [d], the number of spectra published is still quite low. This is partially due to the fact that original beamlines were designed *also* for CD, but usually shared with other techniques, such as fluorescence.
Newer installations are more specialized, so we can easily expect much more data in the nearby future.

---

[1] Curtis Johnson W. Jr., *in Application of Circularly Polarized Radiation Using Synchrotron and OrdinarySources*, Allen F., Bustamante C. ed., Plenum Press, New York, 1985, 121
[2] Wallace B.A., *J. Synchrotron Radiat.*, 7, 2000, 289
[3] Clarke D.T., Bowler M.A., Fell B.D., Flaherty J.V., Grant A.F., Jones G.R., Martin-Fernandez M.L., Shaw D.A., Wallace B.A., Towns-Andrews E., *Synchrotron Radiat. News*, 13, 2000, 21
[a] Clarke D.T., Jones G.R., *Biochemistry*, 38, 1999, 10457
[b] Ojima N., Sakai K., Matsuo K., Matsui T., Fukazawa T., Namatame H., Taniguchi M., Gekko K., *Chem. Lett.*, 2001, 522
[c] Matsuo K., Matsushima Y., Fukuyama T., Senba S., Gekko K., *Chem. Lett.*, 2002, 826
[d] Pulm F., Schramm J., Lagier H., Hormes J., *Enantiomer*, 3, 1998, 315