**Text S1. Myelin Diffraction Analysis**

***Observed and calculated intensities***

Theory of myelin diffraction has been summarized previously [1], and is given in brief here. Assuming the apposition of like surfaces, the electron density  is centrosymmetric and given by**. The Fourier transform of the unit cell electron density  is

, where  is the reciprocal coordinate in the same direction as the real coordinate ** in the stacking direction of the membranes, and the length is , where  is the scattering angle and  is wavelength. The structure factor contains only the real term, as the phase is either *0* or *π*. When the one-dimensional lattice has a period , which corresponds to the myelin repeat distance of membrane pairs,  gives the values at , where  is an integer. The structure factor  is related to the observed intensity by a Lorentz correction  according to

.

For the point-focus beam, the correction factor is *h2* . Using the observed structure amplitudes the electron density is calculated according to

,

where *K* is a scale factor. The structure factor at the origin  is given by , where  is the structure factor at the origin for the 'minus fluid model' [2, 3],  is the average of  in the range , and  is the average of  in the range , where  is the exclusion distance, and  is the electron density of the fluid medium. The absolute scale was derived previously by using a scale factor of 2.0, exclusion length 136 Å, average membrane electron density within the exclusion length 0.343 e/Å3, and fluid electron density 0.335 e./Å3 for swollen myelin in a hypotonic solution of glycerol [1, 4].

The continuous Fourier transform *,* which is the Fourier transform of  in the unit cell, is given by .

The myelin swells and compacts under different condition which give rise to different periodicities. The observed structure amplitudes from the different data sets with different myelin periods were arbitrarily scaled according to .

***Phase determination by replacement method***

The electron density distribution of the unit cell is given by using the electron density of the asymmetric unit  and the intra-unit, cell membrane pair separation *u* according to

.

The Fourier transform of the asymmetric unit  consists of symmetric and asymmetric terms, ; and the Fourier transform of the unit cell is written as



When the lattice period is , the structure factor amplitudes are observed discretely only at , where  is an integer. The intensity is .

If the asymmetric structure, myelin period, and packing distance are known, the phase of the structure amplitude is determined [5]. To derive the phase combination of the unknown structure, we first choose the known native myelin structure to obtain . Then the packing distance  is derived by searching for the minimum R-factor between the observed and calculated structure amplitudes as a function of  [6].

***Diffracting power of myelinated fiber***

The diffracting power (or the total intensity) is defined by . The structure factor for the exposed volume  in the Cartesian coordinates is given by , where  is the electron density distribution. The equatorial reflection at  is

. This indicates that the  projection of the electron density distribution along the  axis is related to the equatorial intensity distribution. When the electron density is composed of two domains, one giving the periodical arrays along the  axis and the other giving along other axes normal to *x*, the first crystalline domain will give the Bragg peaks in the  direction. This diffracting power can be plotted as a function of the position of the incident x-ray beam. The relationship may be derived by using the size of the nerve fiber, the size of the axon, and the shape of the nerve’s cross-section (circle) (**Fig. S3**). For the circular shape a single myelinated nerve is assumed to consist of multi-concentric cylinders having outer radius  and inner radius . The axon is present within the region at , and the bathing fluid is located at . The incident x-ray beam size is  and this is directed along the vertical direction (**Fig.** S**3**). The angle  is assumed, so that the electron density distribution within the area ABCD gives the equatorial, lamellar Bragg reflections as a function of incident beam position .

***Concentric multilamellar cylinders***

The area  as a function of the incident beam position  for the concentric rings is considered. Different x-ray injection points are indicated by , where



The areas at different incident beam positions were then derived by

 at ,

 at ,

 at ,

 at ,

 at ,

 at ,

 at ,

 at , and

 at , where



***Surface structure and cylindrical averaged intensity calculation***

The intensity distribution as a function of radial component of cylindrical coordinates  was calculated using zero and first order of Bessel functions of the first kind ( and ). This is given by , where  is the structure factor of a solid cylinder of radius  and  is the interference where  is the distance between the subunit vectors in cylindrical coordinates [7, 8]. A solid cylinder of a radius of 16 Å was used to represent the P0 extracellular domain. Solid cylinders (2, 3, and 4 in number) were placed on a circle of a radius of 28 Å [4]. The model calculation gave an intensity maximum similar to the observed one **(Fig. S2)**.

The cylindrically averaged intensity , where  and  are radial and axial components of the cylindrical reciprocal coordinates, was calculated using the atomic coordinates according to , where  is the atomic factor. In the current study the equatorial intensity at  was calculated. The intensity distribution for 2, 3, and 4 molecules, using the reported atomic coordinates determined by protein crystallography [9], showed diffuse scattering in the range of 0.015– 0.04 1/Å (**Fig. S2**). The intensity maximum at 40 Å was smaller than the observed spacing, indicating that the separation between the glycosylated full sequence P0-molecules in the whole nerve was larger by about 10 Å than the non-glycosylated extracellular domain of P0 that was analyzed by protein crystallography [9].

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