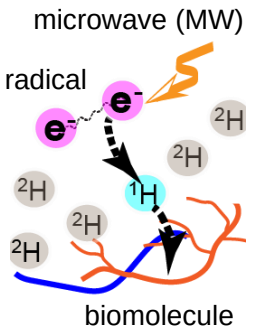
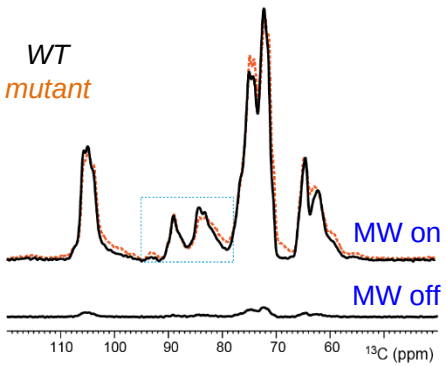
# High-Resolution Solid-State NMR Analysis of Unlabeled Plant Cell Walls

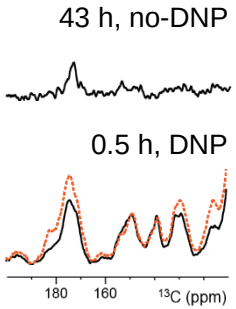
DNP mechanism



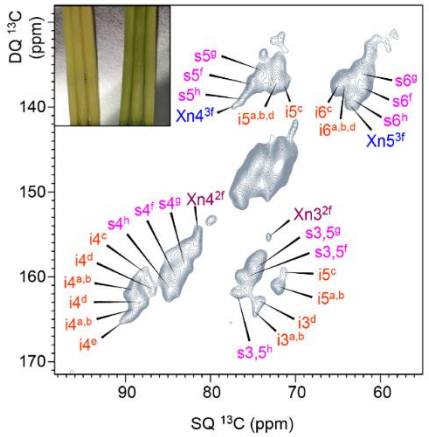

26-57-fold better sensitivity



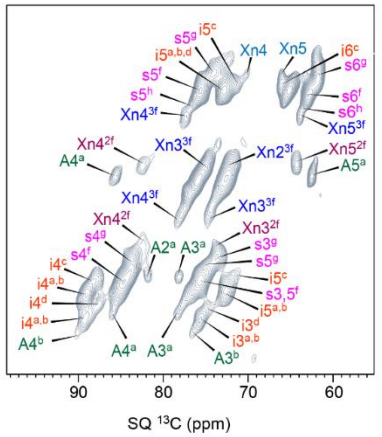

Lignin detection



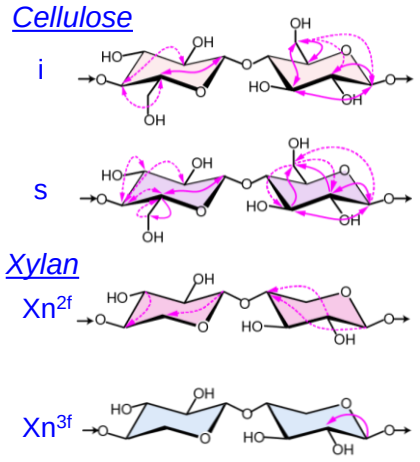

Unlabeled stem




¹³C-labeled stem




*Cellulose*





Zhao, W., Kirui, A., Deligey, F., Mentink-Vigier, F., Zhou, Y., Zhang, B., Wang, T. (2021) Solid-State NMR of Unlabeled Plant Cell Walls: High-Resolution Structural Analysis Without Isotopic Enrichment. Biotechnology for Biofuels, 14: 14. doi: 10.1186/s13068-020-01858-x


## Scientific Achievement

A biophysical method enables the atomic-level analysis of carbohydrate structure in unlabeled and intact plant tissues.

## Significance and Impact

2D/3D solid-state NMR analysis of cell wall structure requires isotope ($^{13}C$) enrichment, which is time-consuming and often impractical for many lignocellulose materials. We rely on the sensitivity enhancement of Dynamic Nuclear Polarization (DNP) to establish a toolbox for understanding polysaccharide and lignin structure in unlabeled plant species and tissues.

## Research Details

- Sensitivity was enhanced by 26-57 fold on rice stems, shortening the measurement time by 676-3249 fold.
- Using unlabeled rice stems, carbohydrate and lignin signals are efficiently detected within half an hour, which is impossible for conventional approaches.
- DNP-enabled 2D $^{13}C$-$^{13}C$ spectra of unlabeled rice stems have remarkable resolution, resolving sugar units in the interior (i) and surface (s) chains of cellulose, as well as the 2-fold ($Xn^{2f}$) and 3-fold ($Xn^{3f}$) conformers of xylan.
- The *ctl1 ctl2* rice mutant with a brittleness phenotype exhibited significantly higher polymer mobility.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