



263 GHz Klystron

- Top-Notch Enhancement at a Lower Cost

Solid-state DNP with 263 GHz Klystron

The 263 GHz klystron is a continuous-wave (CW) microwave source with high power and frequency stability designed and manufactured for extended DNP NMR at 400 MHz ¹H frequency and 100 K sample temperature.

The klystron provides a DNP option with lower purchase price, operating costs, footprint, and facility requirements versus the gyrotron product line while retaining high DNP sensitivity. At 5 W output power, it reaches 90-100% DNP efficiency on biological samples and small molecules in frozen solution while dense material samples perform at > 80% compared to the 263 GHz gyrotron.

The klystron is compatible with a 400 WB Ascend DNP solid-state NMR spectrometer and

Bruker low-temperature magic angle spinning (LT MAS) probes.

Your Key Benefits:

- DNP signal enhancements for applications at 400 MHz, ranging from materials to pharmaceutical science
- Ideal for insensitive, natural isotopic abundance samples
- Compact microwave source mounted just outside the NMR magnet 5 G line
- Low maintenance and infrastructure requirements
- Easy repositioning of klystron for probe exchanges and non-DNP NMR
- Low-temperature MAS DNP probes to cover a wide range of applications

Pharmaceuticals

The 263 GHz klystron provides excellent DNP signal enhancements on challenging samples, such as dense pharmaceutical preparations. For example, natural abundance posaconazole was prepared as an amorphous solid dispersion (ASD) containing the biradical AMUPol in deuterated vinyl acetate polymer, without altering the integrity of the formulation. Figure 1 shows enhancements of 25, allowing the collection of 2-dimensional ^1H - ^{13}C HETCOR spectra in approximately 7 hours; in conjunction with ^1H - ^{15}N HECTOR spectra, these enabled the full assignment of the posaconazole resonances as well as studies of atomic-level interactions in the sample such as API-excipient compatibility.

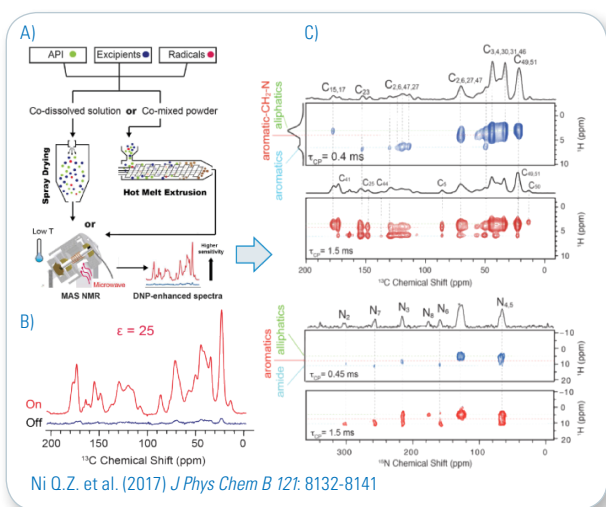


Figure 1: ASD formulations (A) of posaconazole with DNP biradical AMUPol yield excellent enhancements (B); ^1H - ^{13}C and ^1H - ^{15}N 2D HETCOR spectra of posaconazole ASD acquired with different CP contact times (C) reveal specific API-excipient contacts. All data were acquired using a 263 GHz klystron microwave source.

Key Features

- 263.6 GHz frequency matched for DNP NMR applications at 400 MHz
- 5 W output power, variable down to 1 W
- High frequency and power stability
- Fully integrated system with graphical user interface and safety interlocks
- Optimized microwave propagation to the sample
- Easy probe exchange
- Air-cooled water chiller for klystron circuit. No facility water cooling requirements
- Three phase, 400 VAC, 10 A electrical requirement
- Compatible with all 263 GHz/400 MHz Bruker DNP LTMAS probes
- Compatible with 400 WB Ascend DNP NMR magnet

Materials Science

One of the key challenges facing materials scientists interested in NMR involves preparing materials samples with isotopic enrichment in order to achieve acceptable signal levels. By providing large DNP signal enhancements in a small package, the 263 GHz klystron overcomes the need for isotopically labeling, making even challenging experiments such as 2-dimensional ^1H - ^{13}C - ^{15}N (double-CP) heteronuclear correlation accessible in record time at natural abundance. This approach enabled the structural characterization of several promising carbon nitride photocatalysts, with a view toward explaining their differences in function (Figure 2).

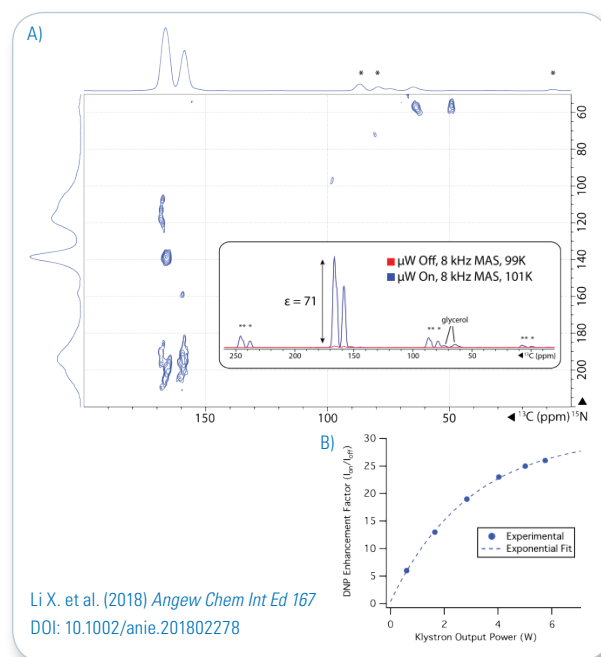


Figure 2: (A) Polymeric carbon nitride (PCN) materials doped with 15 mM AMUPol in aqueous solvent yield excellent DNP enhancements with ~5 W of microwave power, allowing ^{15}N - ^{13}C correlation spectra to be acquired at natural isotopic abundance in ~6 hours. (B) On another PCN sample, ~5 W klystron output is sufficient to virtually saturate the sample, providing high DNP gains.

