

Dissolution DNP at High-Throughput

Transformational Gains for the Solution State

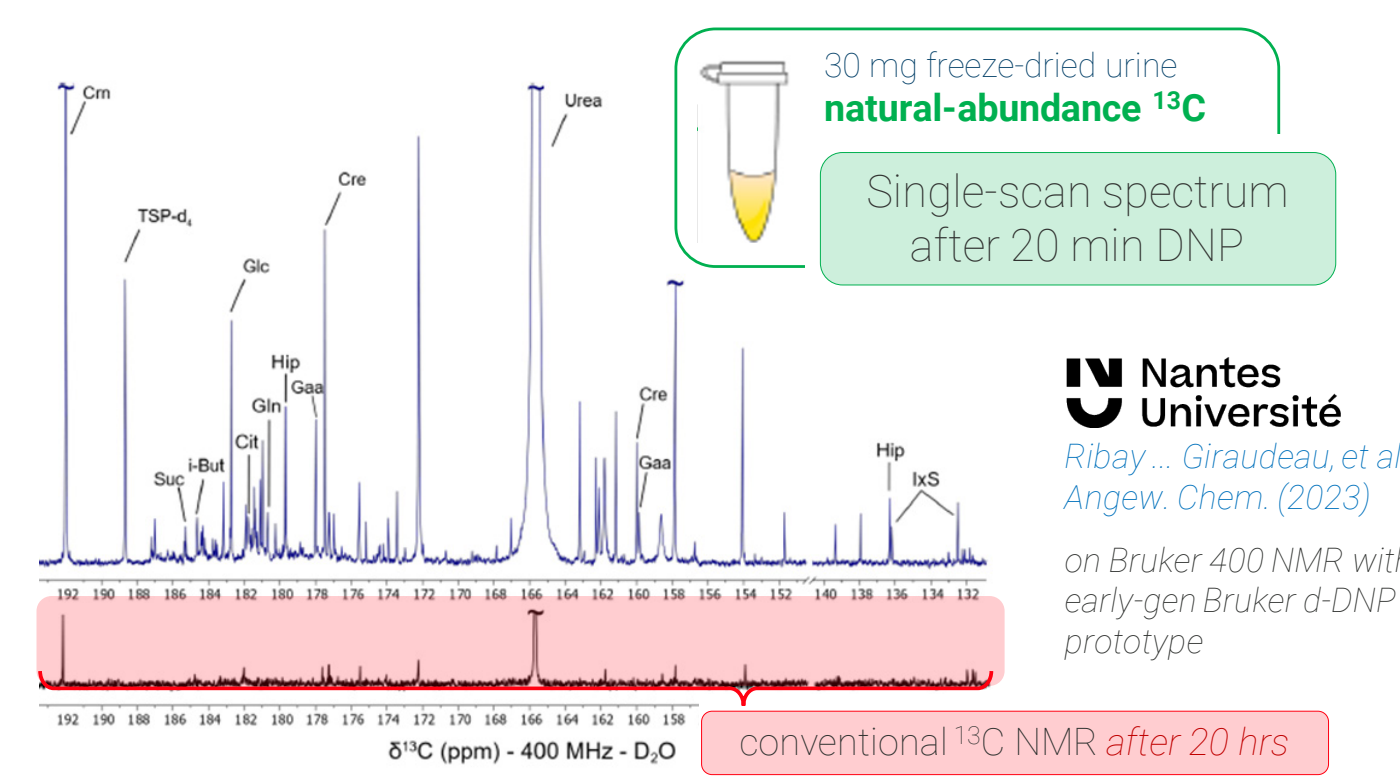
d-DNP can provide >10,000-fold SNR on ^{13}C and other nuclei.

- Uses solid-state DNP on a sample at high-field (e.g. 7 T) and near just 1 – 2 K to yield a hyperpolarized frozen solid.
- Rapid (<1 s) injection of a superheated solvent melts and dissolves, while pushing the sample from the ultracold environment.

Although the transition of sample conditions in d-DNP is extreme, the output is a sample near room or body temperature with record-setting sensitivity.

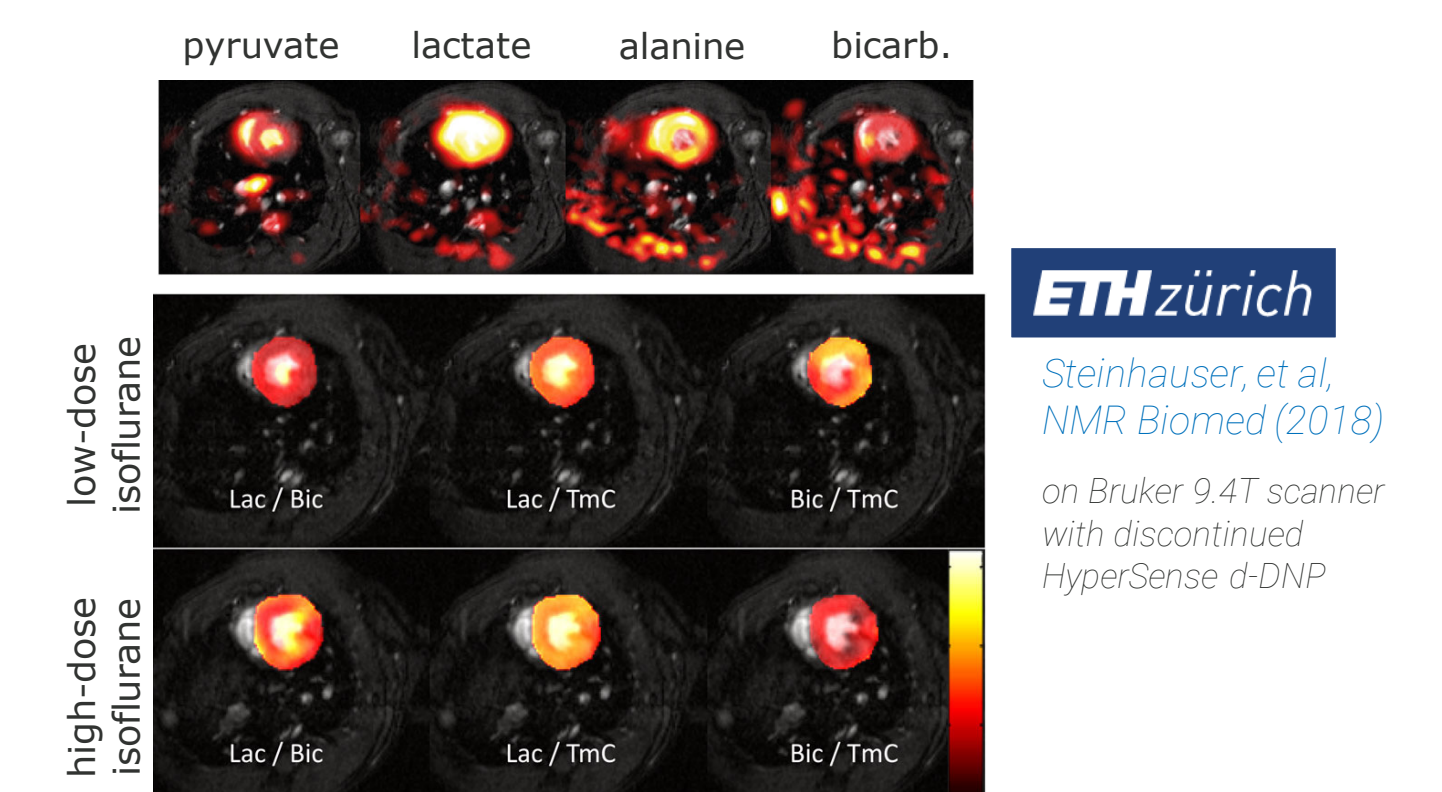
d-DNP enables a wide range of otherwise impossible Apps in chemical or metabolic analysis in solution-state NMR & preclinical MRI.

In NMR: Metabonomics at Nat. Abundance ^{13}C



In MRI: Cardiac functional study with ^{13}C

- HP ^{13}C pyruvate, traced to downstream metabolites in spectral-spatial imaging



Bruker's New d-DNP Polarizer

(Technology development, final config may vary)

Zero-consumption cryomagnet

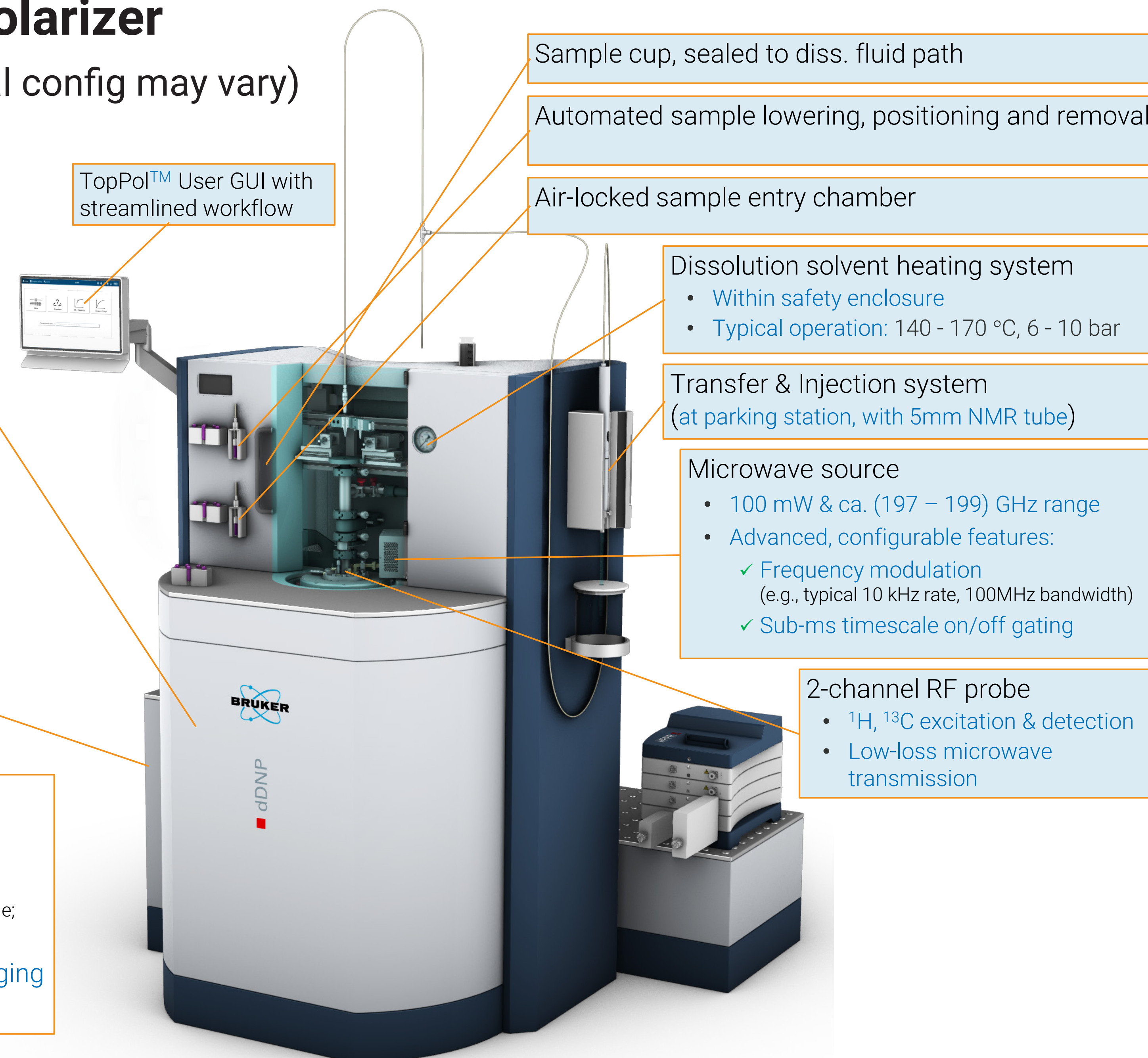
- ✓ 7.1T shielded, dry magnet
- ✓ max 3L liquid helium volume...
 - in recycling circuit, initial helium charge is condensed from He gas cylinder used as...
 - He source for ≤ 1.4 K sample space
 - quench buffer (4-hr min. autonomy)
- ✓ Auto-cooling, Auto-charging
 - full autonomy in event of facility failure
- ✓ Sealed central probe / sample tube
 - cooled by re-circulating He
- ✓ Suitable design for service
 - quick GM coldhead exchange
 - annual maintenance

Main pump

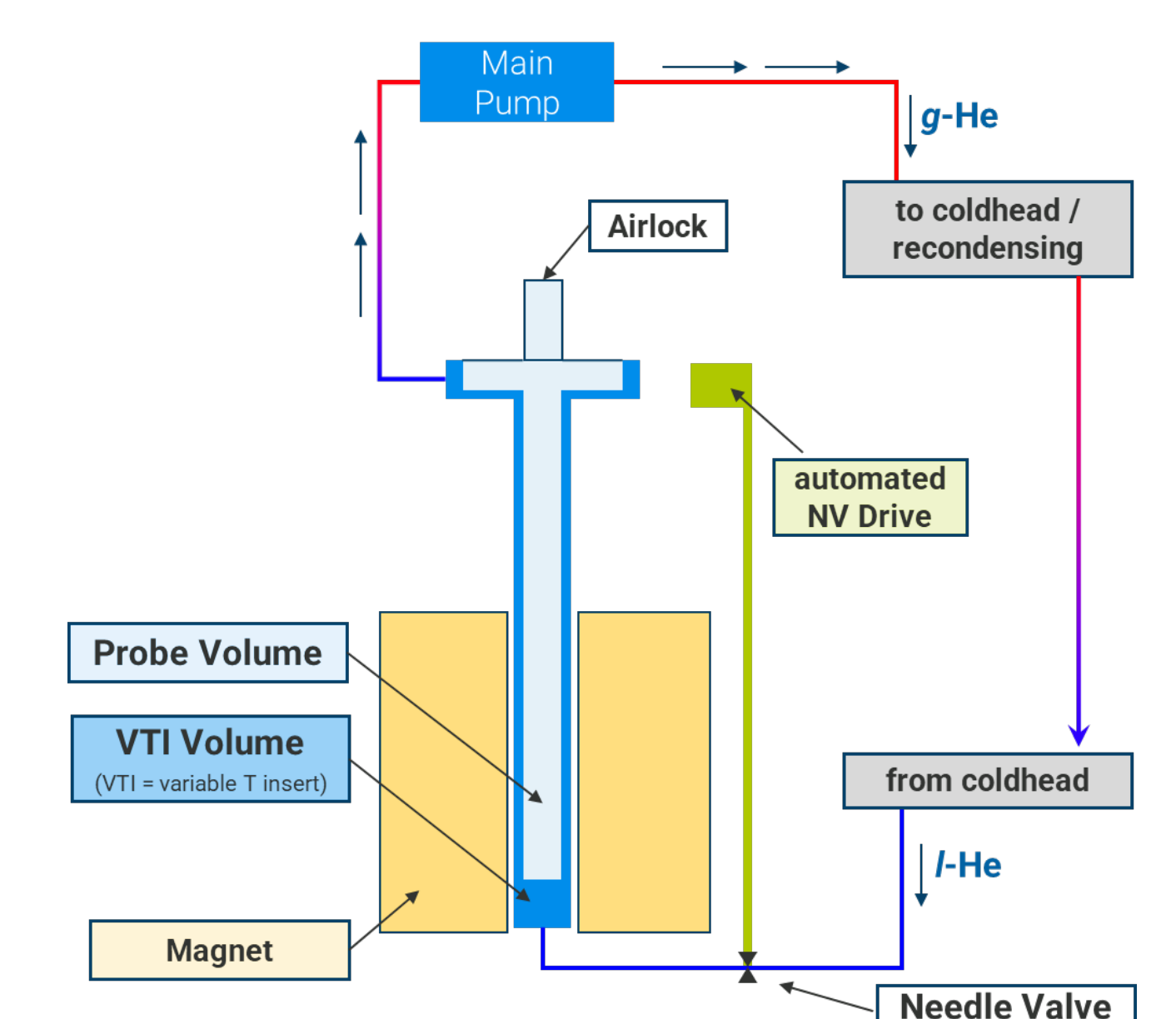
- Final cooling stage for LHe about the sealed probe/sample space in the helium recycling loop

Also includes: (not shown)

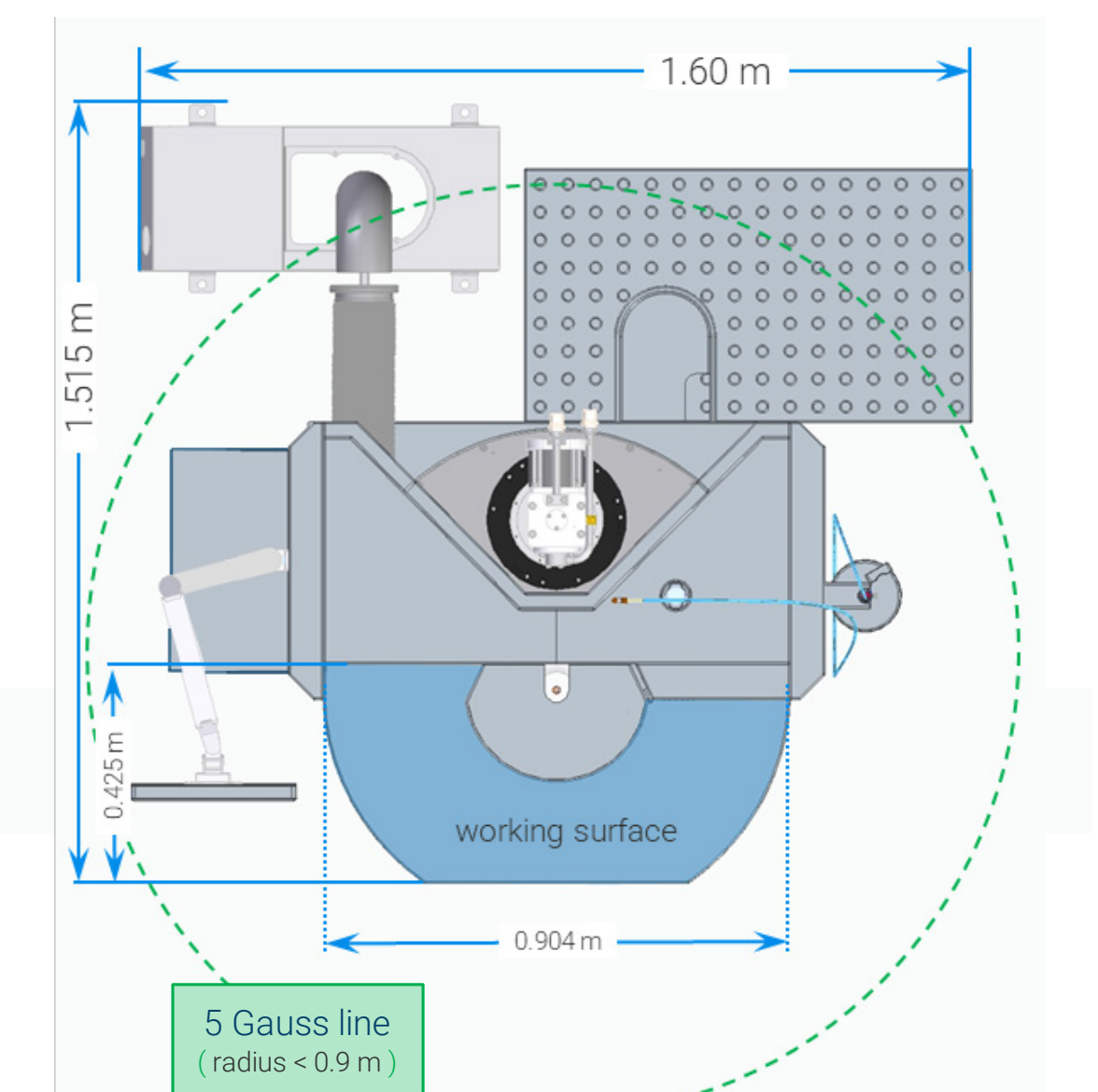
- AV NEO solids NMR console (^1H and broadband channels)
- d-DNP Control System (inside NMR console; cryogenic and diss. automation & monitoring)
- Cryomagnet Auto-cooling, Auto-charging (pumping station, power supply, He compressor)



Closed-cycle, automated cryogenics



Compact footprint, convenient workspace



Cross Polarization & High-Throughput

(5–10 min polarization, <40 min, full cycle)

- CP ($^1\text{H} \rightarrow ^{13}\text{C}$) d-DNP is fast: <10 min vs. 1–2 hours buildup by direct ^{13}C DNP.
- CP is a central advantage of our polarizer, yet, from expt-to-expt, many steps determine overall throughput. The new polarizer provides a well-automated & optimized full workflow.

- Sample fill/seal (manual)

- ✓ ~5 uL up to >250 uL
- ✓ reusable, He-tight seal

- Purge (auto)

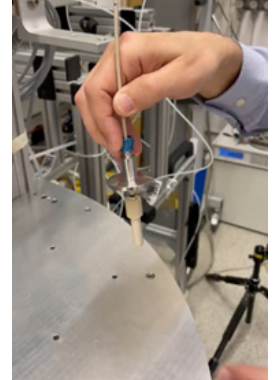
-- 3 min

- Sample loading

- ✓ Airlock entry
- ✓ Auto lowering

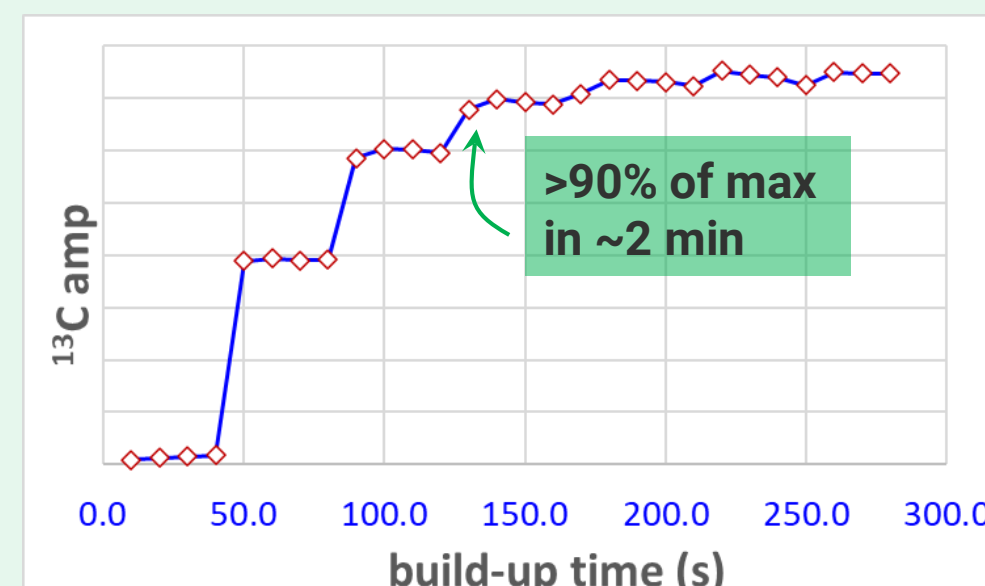
-- 2 min

-- 7 min



CP-based polarization

-- 5-10 min

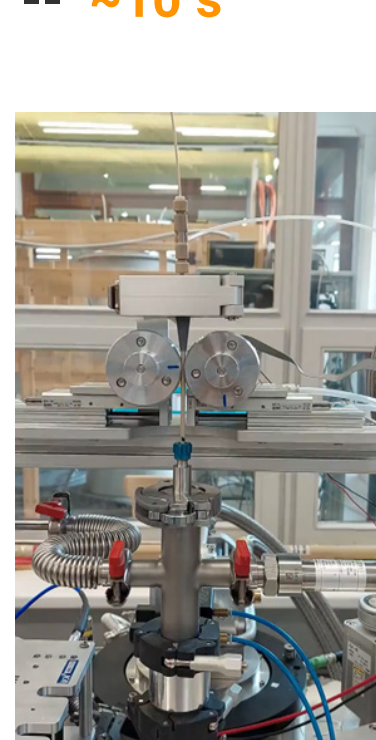


- ^{13}C acquisition / monitoring
- perform CP ($^1\text{H} \rightarrow ^{13}\text{C}$) every 4th point

1- ^{13}C pyruvate (up to 4.5 M)
50 mM TEMPOL, in 10/30/60 H₂O/D₂O/glycerol-d₃

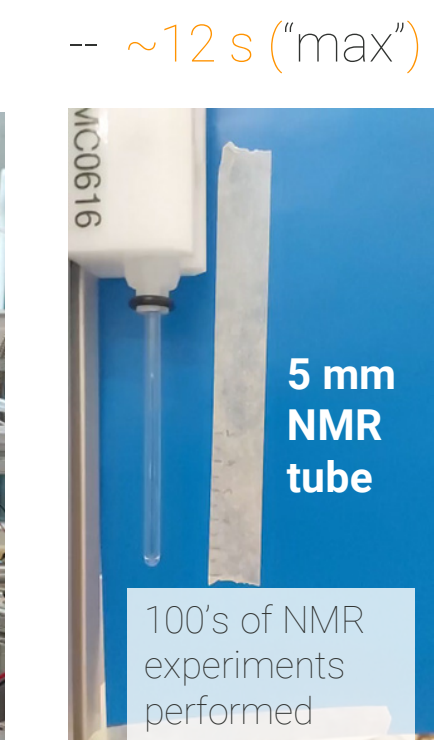
- Sample lift (above superfl. He)

-- ~10 s



- Solution-state Trans. & Inject (triggered NMR acq)

-- ~12 s (*max)

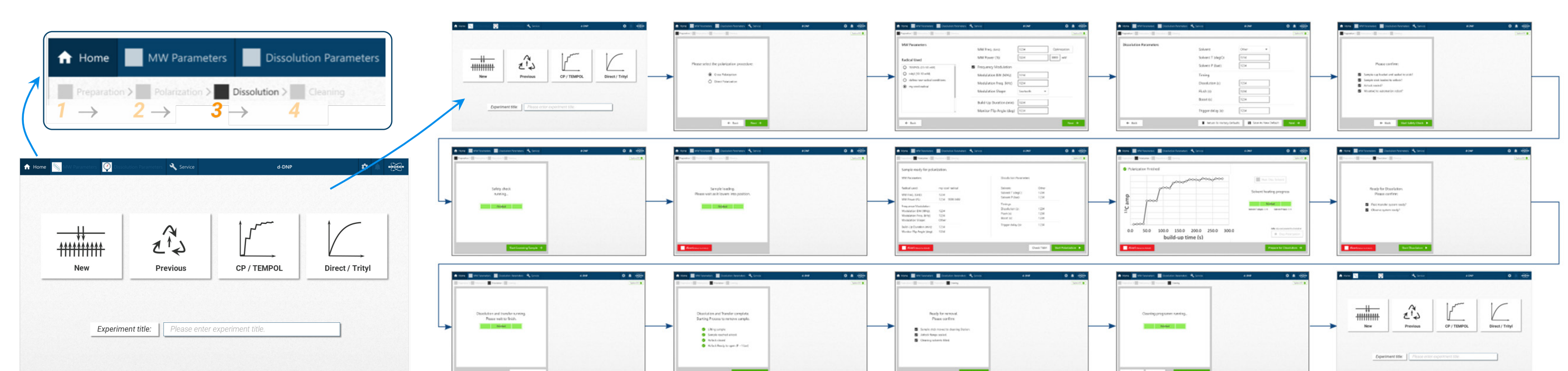


- Auto-Clean & Reload

-- < 15 min

TopPol™ GUI for Automated Workflow

An efficient d-DNP workflow is built into the software for quick setup, best results, & repeatability.



Conclusion

Bruker's d-DNP polarizer is loaded with state-of-the-art features and unique, breakthrough advantages.

- Efficient closed-cycle cryogenics: no source of l-He required; fully automated op. & standby modes; quench protection and auto-recovery protect you from facility outages
- Optimal conditions for high polarization: T < 1.2 K, B = 7.1 T
- High-throughput from: CP, automation & reliable, intuitive design
- Bruker's worldwide-best probe and spectrometer tech: Full AVNEO solids console & 2-channel (^1H , ^{13}C) RF probe
- Built for the future: planned for adaptability to other nuclear combinations (e.g., HX, for X = ^{15}N , ^{31}P , ^{29}Si , ^2H , etc...)