

The Quest for Rapid Cooling and Temperature Control

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SNS Sample Environment Team

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Motivation

- **New neutron source and instruments offer considerably faster data collection rates, therefore, new sample environments must keep pace**

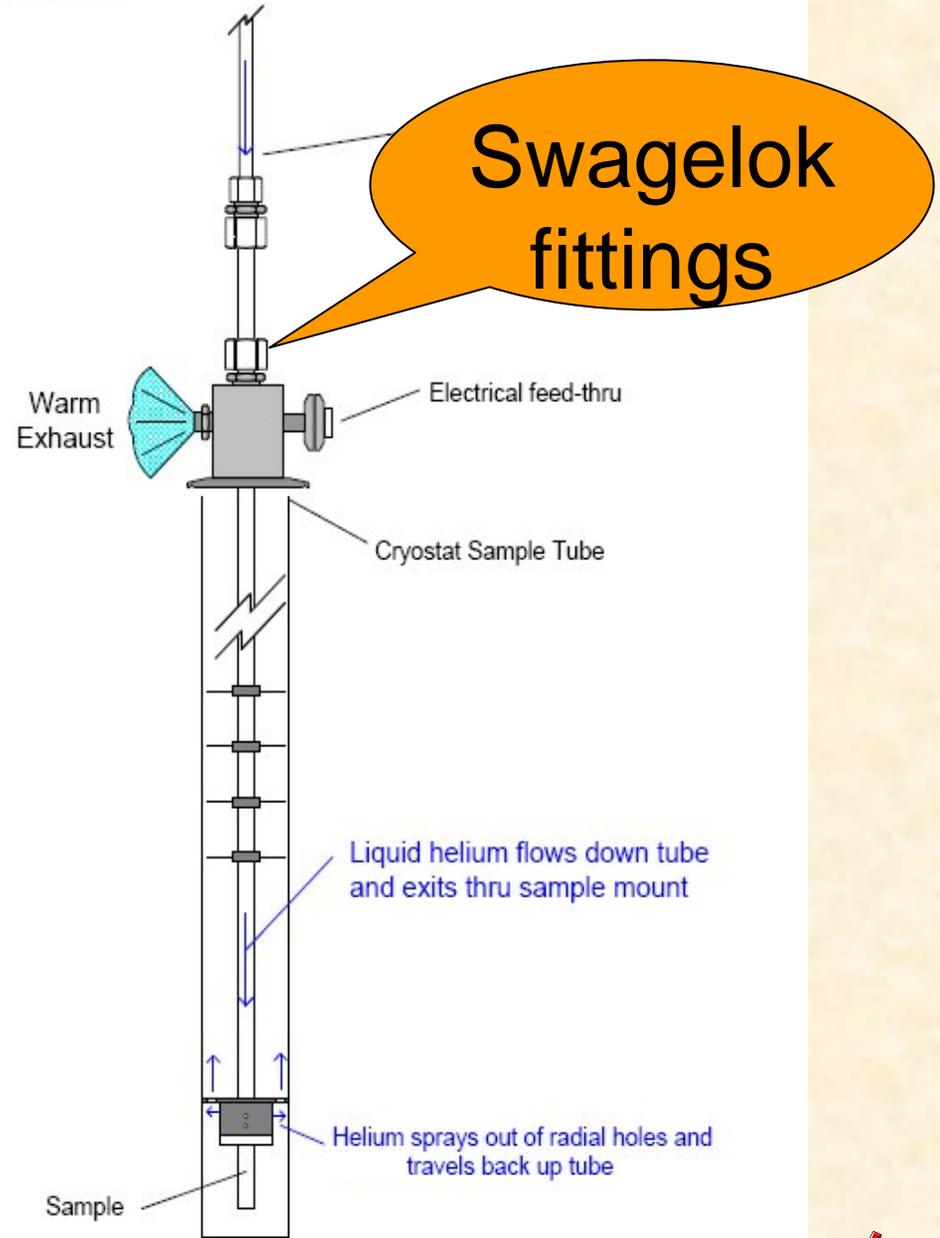
Rapid Strategies

- **Brute force**
 - Maximize your cooling capacity
- **Swift and light**
 - Minimize thermal mass
- **Balancing**
 - Ensure comparable heating and cooling rates

Brute
Force

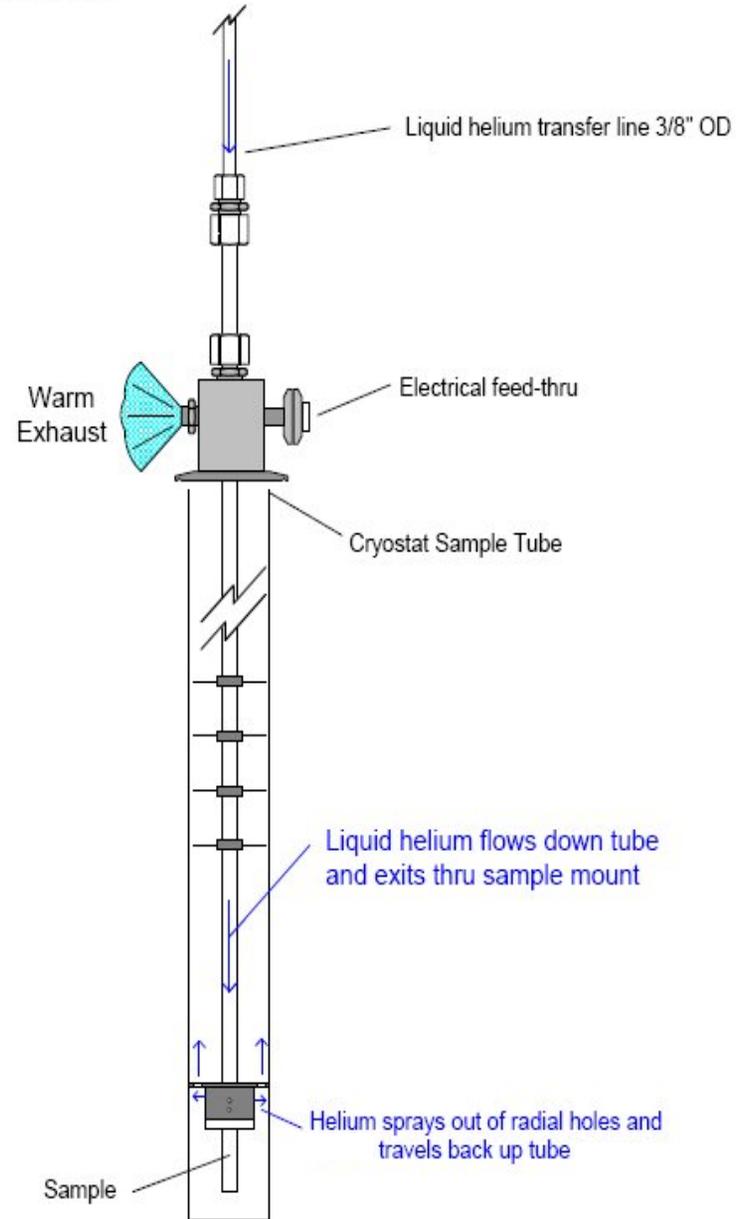
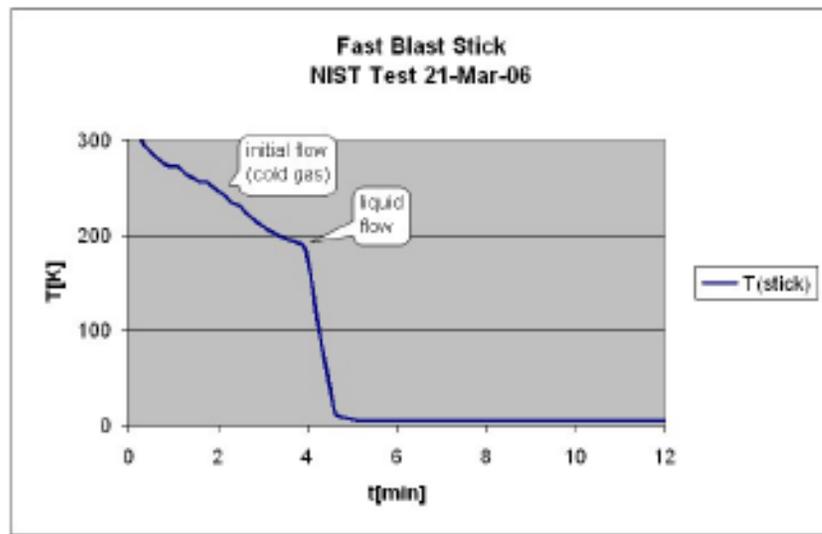
Fast Blast Sample Stick

- Use with standard off-the-shelf cryostats and CCRS
- Accepts LHe transfer line for quick cooling



Brute Force

5K in 5 minutes



Brute
Force



- Open flow liquid helium system
- Special, slow-flow transfer line connects dewar and SuperTran unit
- Flow rate can be regulated by liquid valve built into transfer line
- Can pump or allow to passively flow to atmosphere



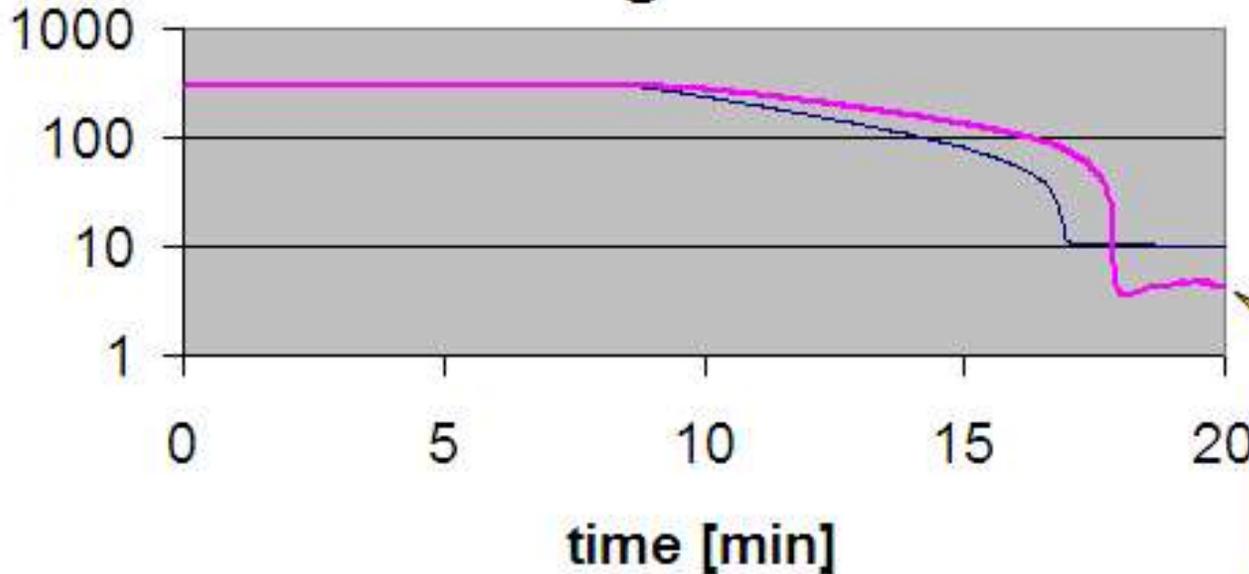
Brute
Force



SuperTran Cooling High Flow

9/13/05

T [K]

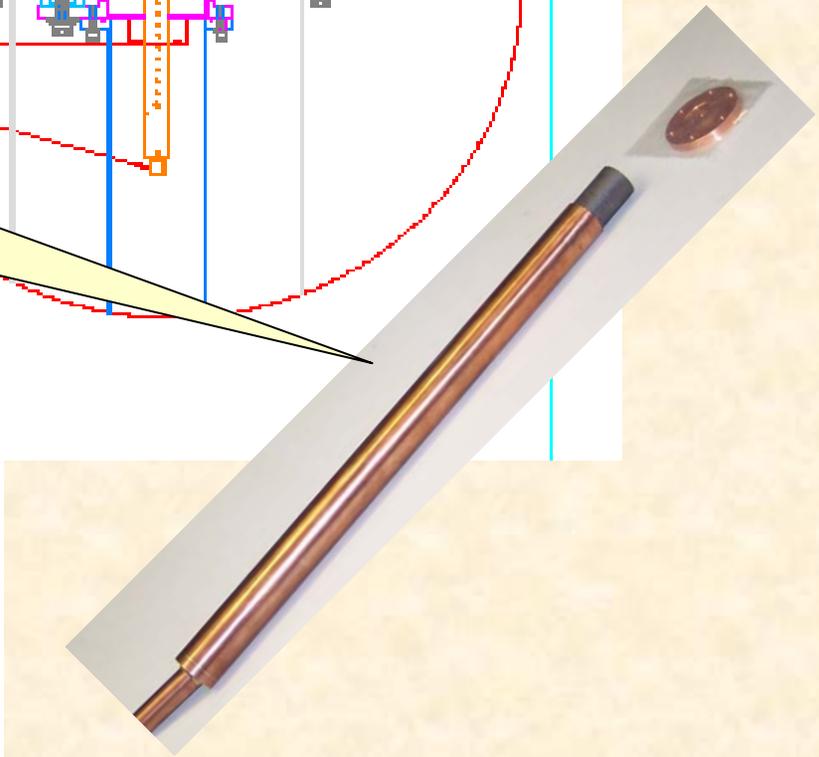
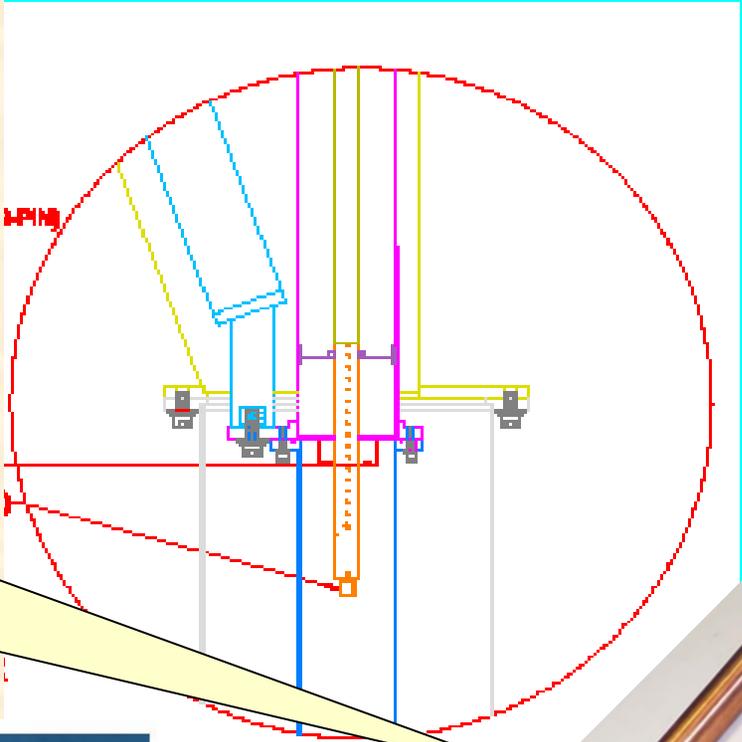


Tstick ~ 4 K
Tvti ~ 10 K
*heat shield may still be warm

Swift & Light

G-Foam Link

Vendor supplied thermal link replaced with low mass graphite foam filled Cu link



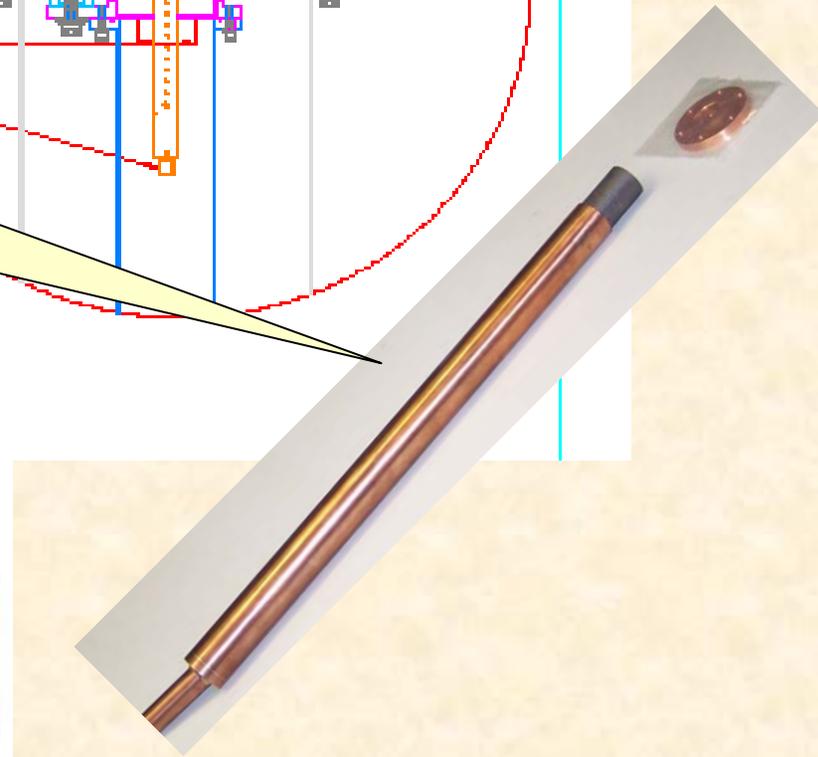
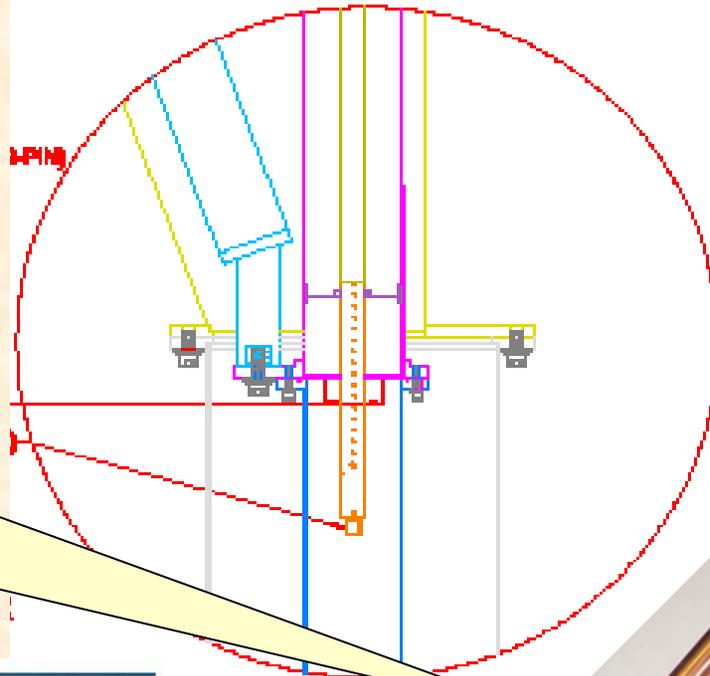
DE-210 is the heart of the system.

Sample in vapor for fast sample change.

Swift & Light

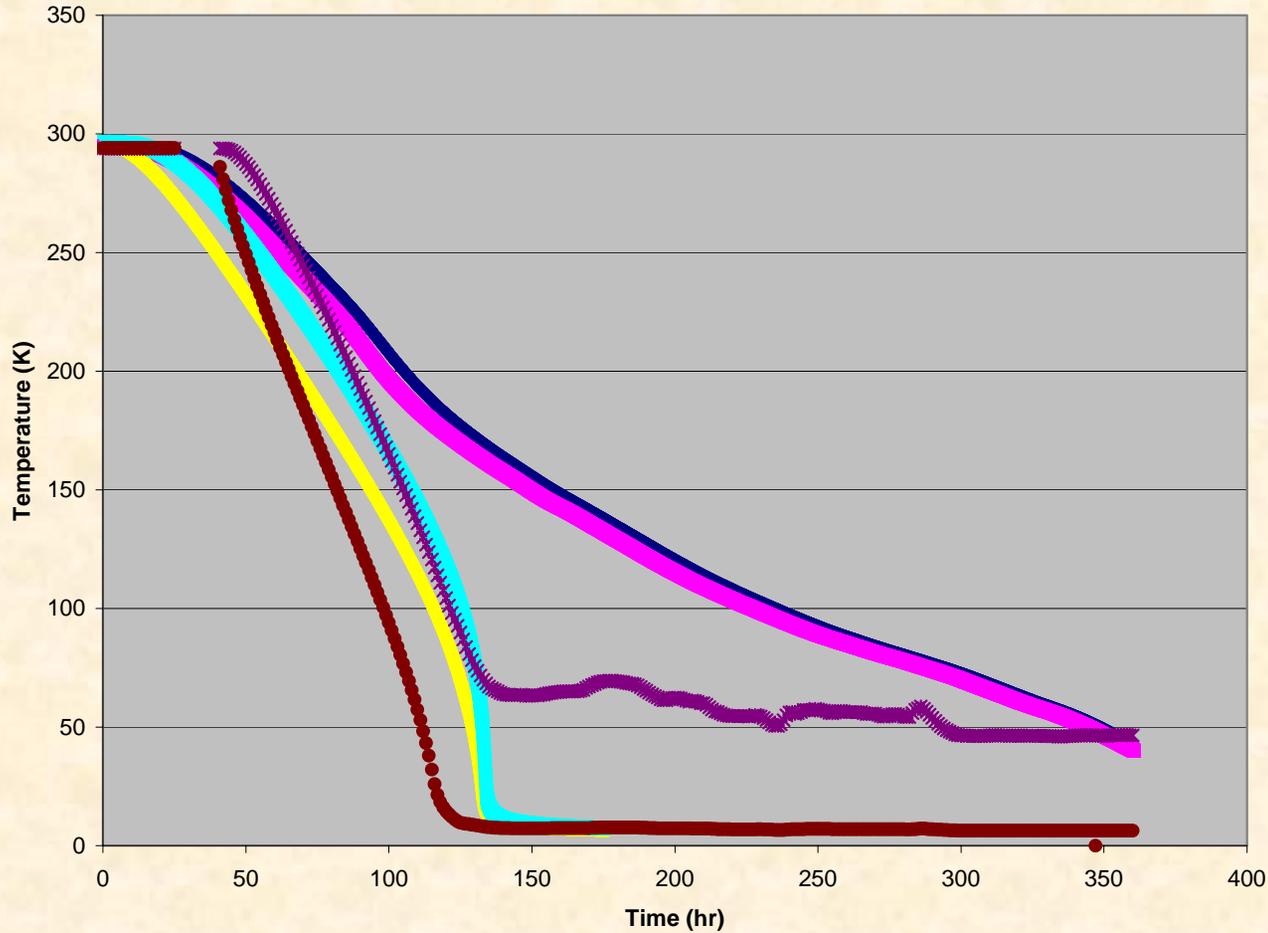
G-Foam Link

Helium charged and vacuum purged thermal link testing conditions



Swift & Light

Vendor Link vs. G-Foam Link



Preliminary Conclusion:
G-Foam Link
Too Light

FERNS

Background

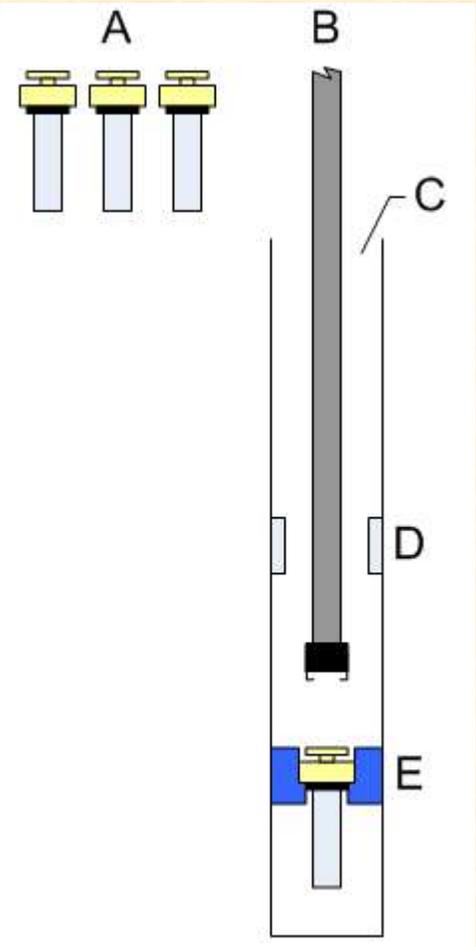
“Fast Exchange Refrigerator for Neutron Science”

- Funded by DOE/SBIR
- ***Containerless Research & SNS***
- **Modular, adaptable design**
- **Deliver sample to cryogenic “Landing Pad” from cartridge holding 24 samples**
- **De-couple sample from stick**
- **Fill with various materials (fixed volume comparison)**
- ***FERNS* sample cans equipped with internal sensor**



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Design Schematic

- A. Sample Carousel
- B. Motorized stick
- C. Sample Well
- D. 1st Stage / pre-cool zone
- E. Landing pad

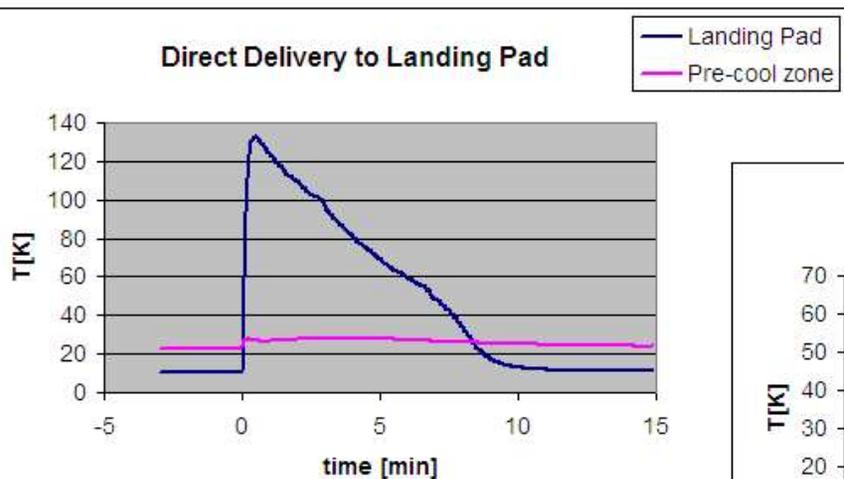
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2006 System Delivery

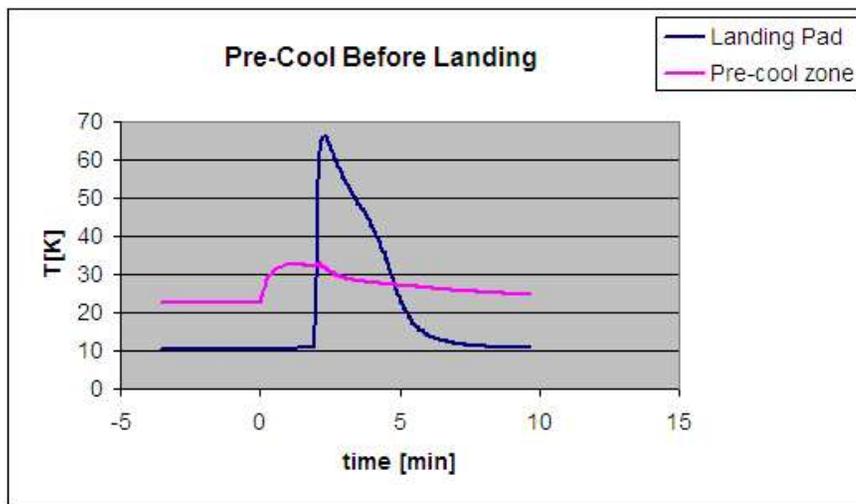
- Demonstrated thousands of ambient sample changes
- Cryogenic studies underway



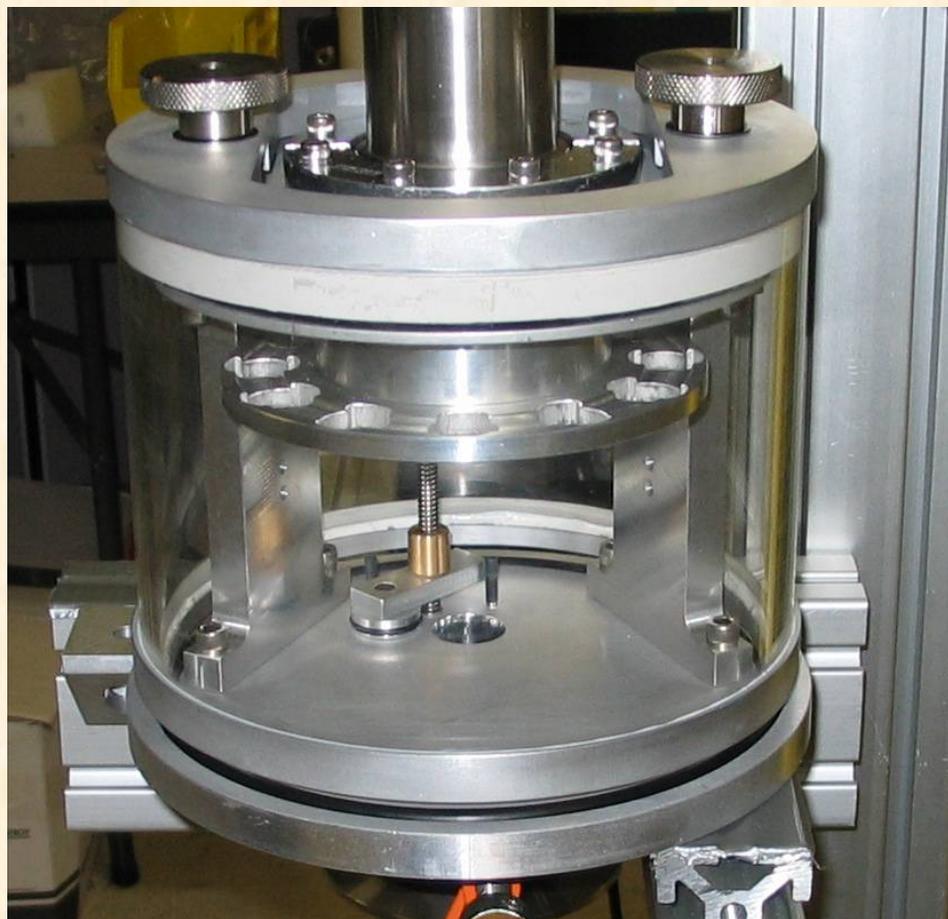
Direct Delivery to Landing Pad



Pre-Cool Before Landing



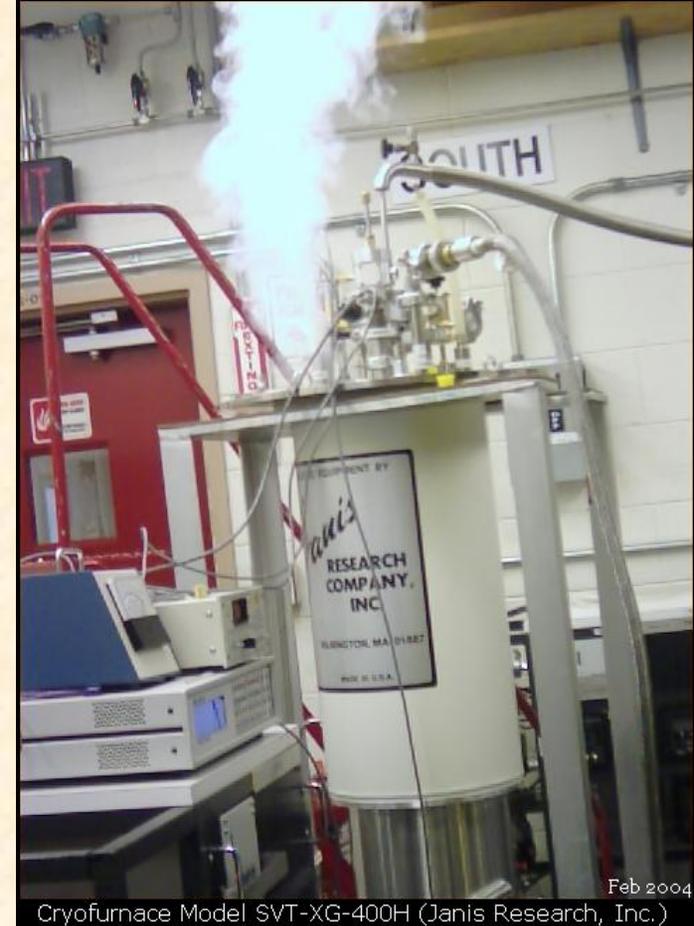
FERNS Innovation



Balance

Cryofurnace

- Testing and refinement of operating procedure
- Long and tedious trial-and-error process
- Speed and performance significantly improved



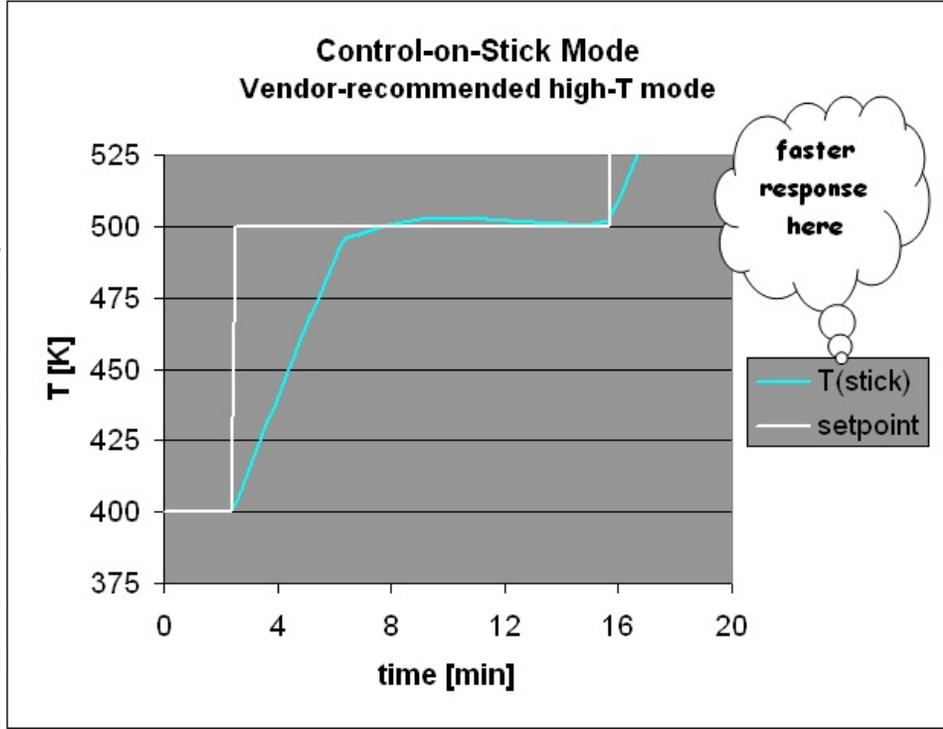
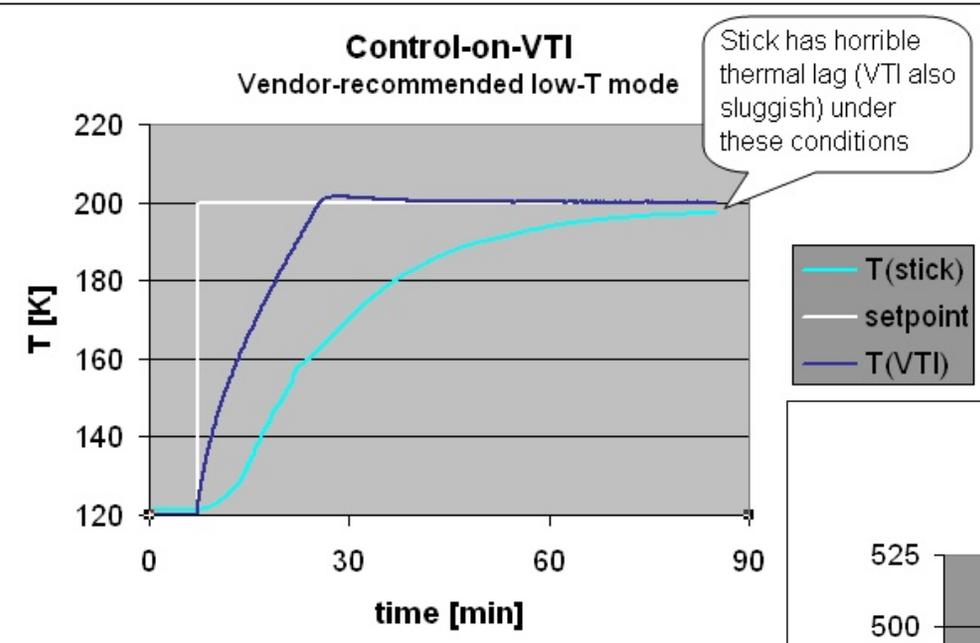
Cryofurnace Model SVT-XG-400H (Janis Research, Inc.)

Balance

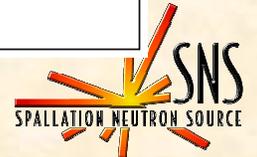
Cryofurnace

Round 1:

Using Vendor's Procedure



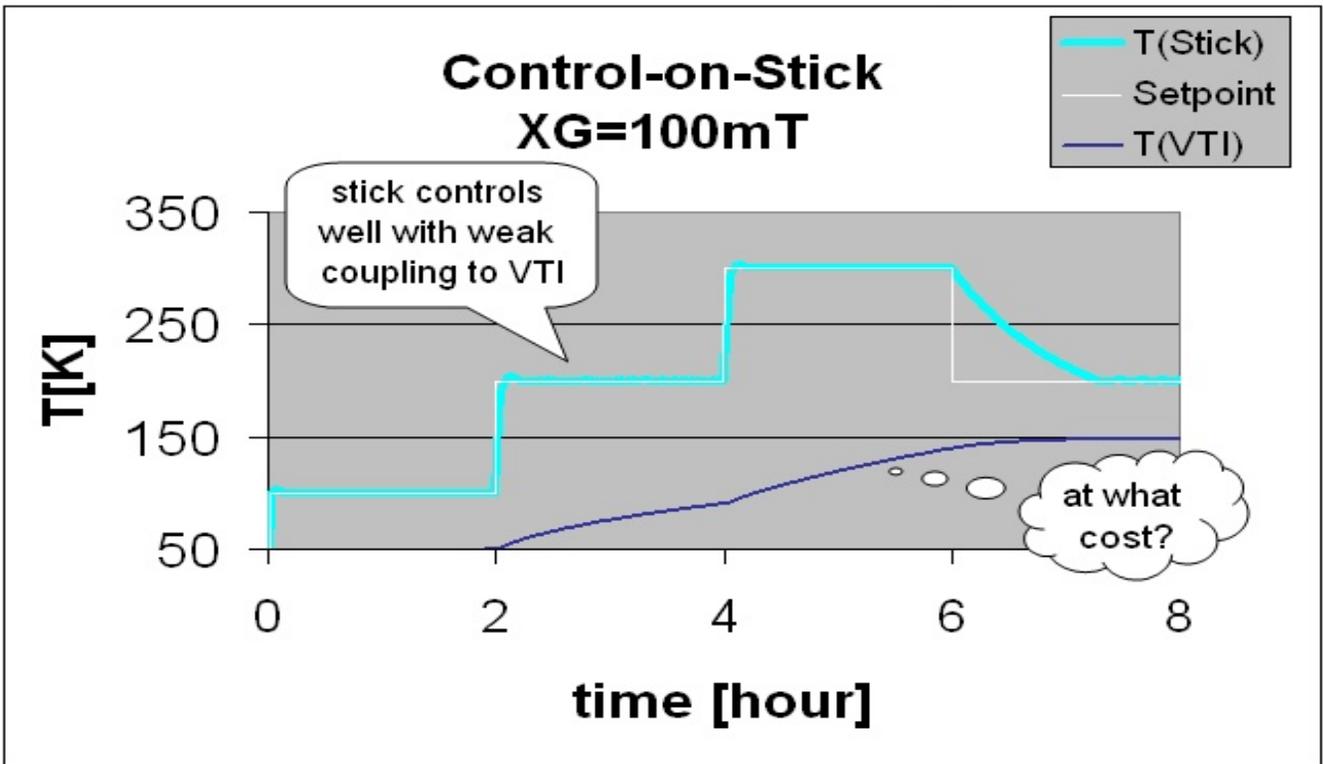
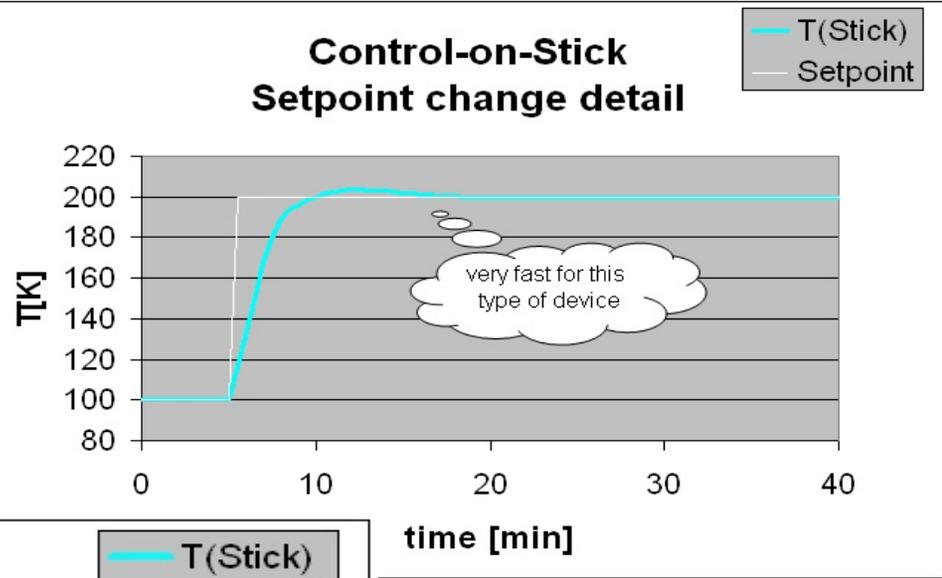
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Balance Cryofurnace

Round 2:

Try "control-on-stick" method at low temperature



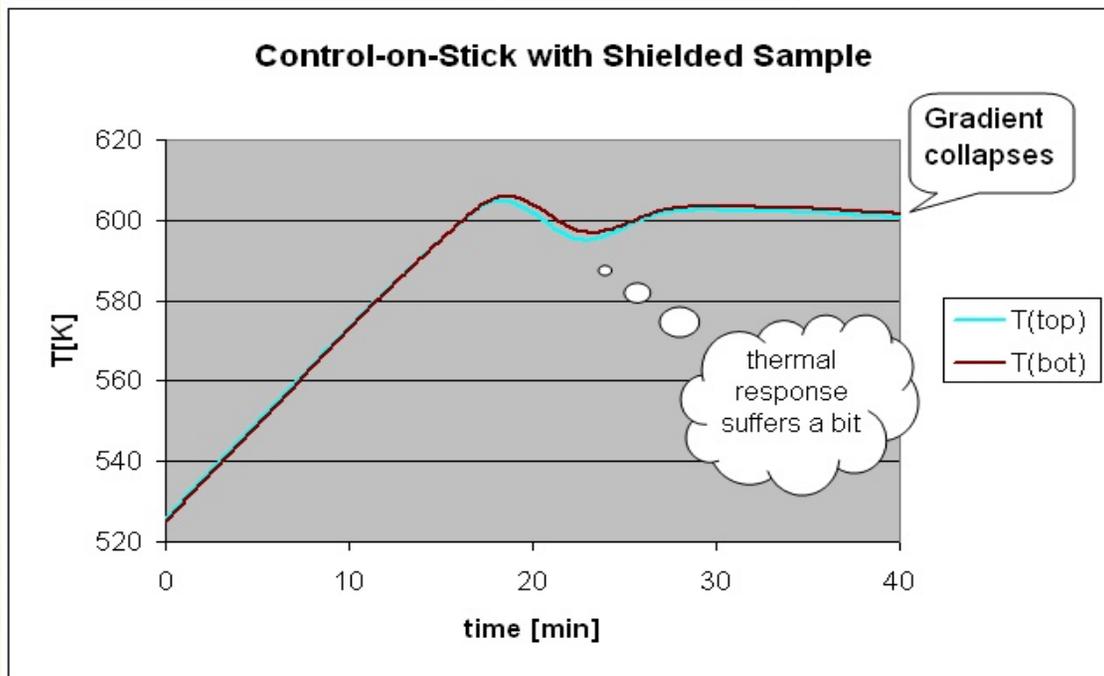
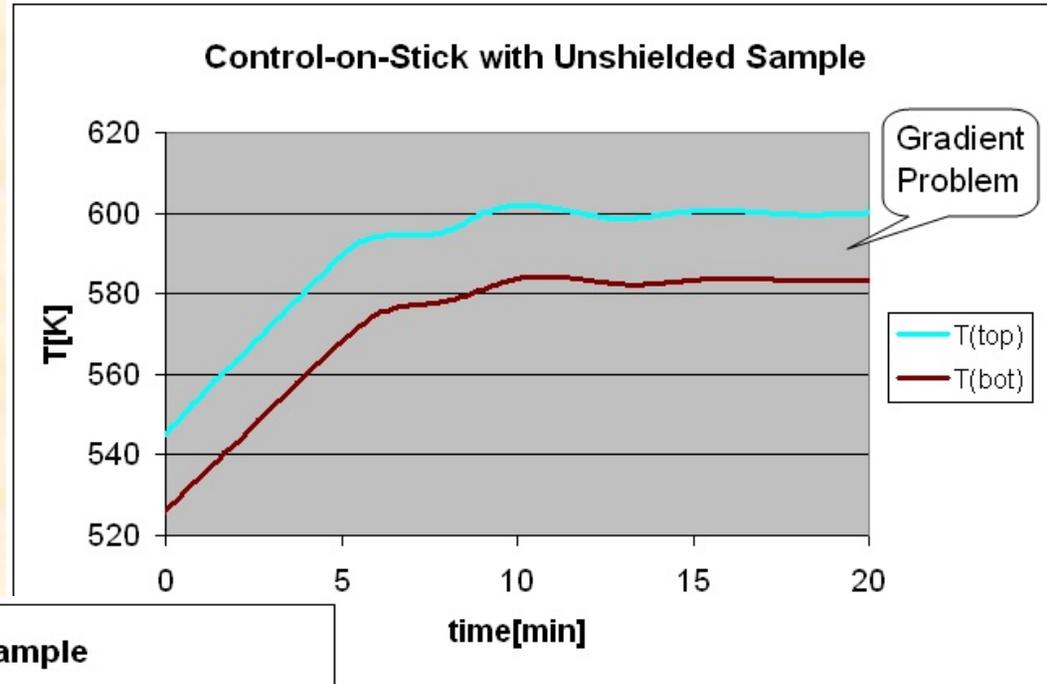
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Balance Cryofurnace

Round 3:

Get rid of gradient



Acknowledgements

- **SNS Sample Environment Team**
- **SNS Manufacturing & Design Engineers**
- **Rick Weber and Jim Rix (FERNS project)**

