

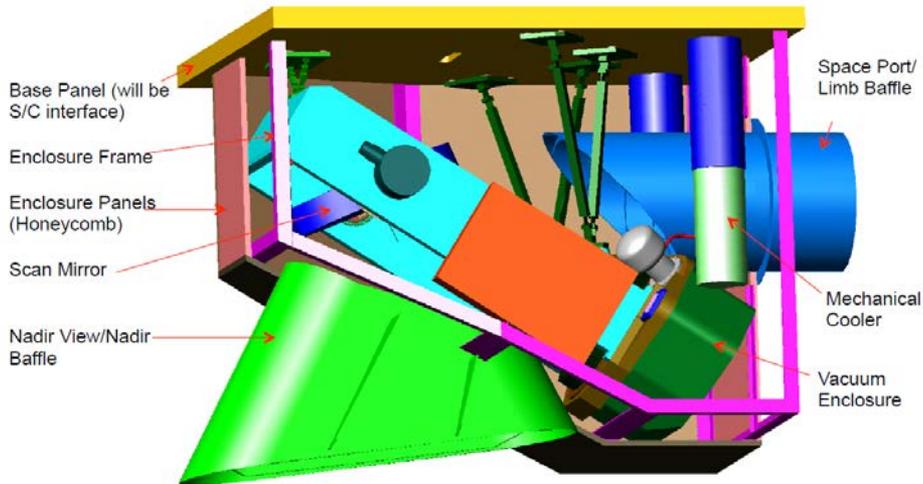


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California Institute of Technology  
Pasadena, California

- **Thermal Performance Testing of Two Thales 9310 Pulse-tube Cryocoolers for PHyTIR**

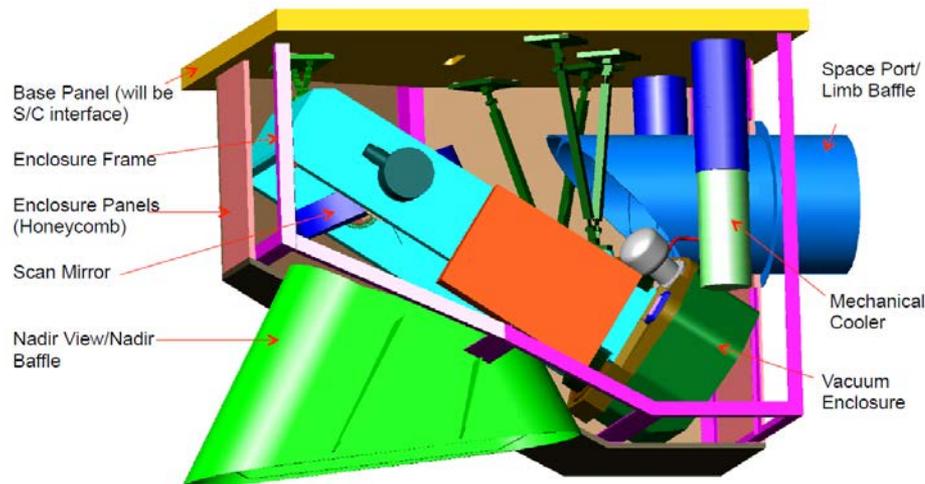
Christopher Paine  
Jet Propulsion Lab



- PHyTIR is a lab demonstrator for HypIRI technology in thermal infra-red
  - critical technologies and techniques
- One cryocooler for 60 K focal plane
- One cryocooler to simulate passive cryoradiator



- Selected Thales 9310 mid-size pulse tube cooler
  - Using Thales CDE7232 drive electronics with active vibration cancellation capability





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# heat rejection

- Cooling via recirculated fluid, temperature-controlled chiller



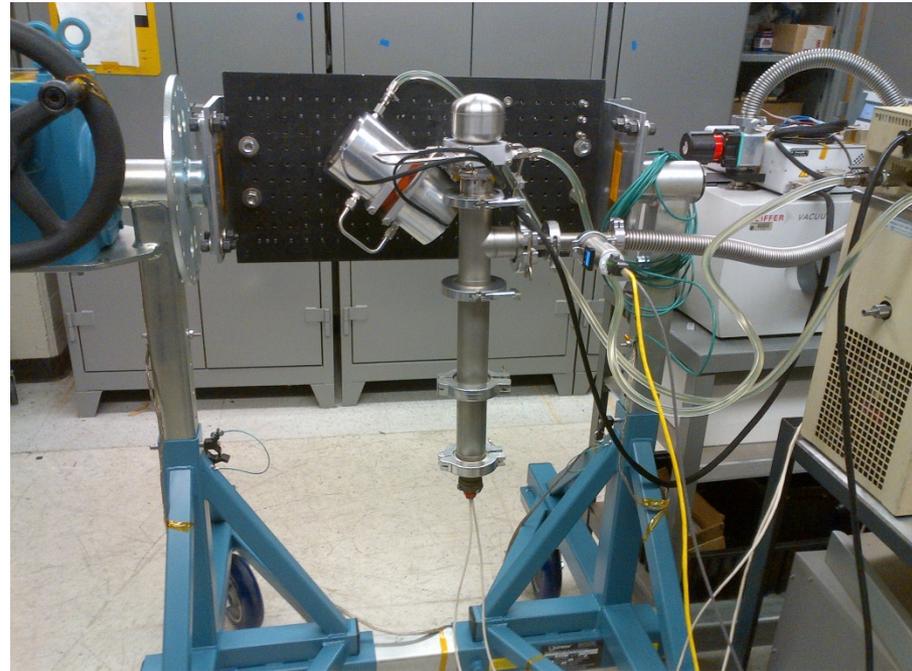
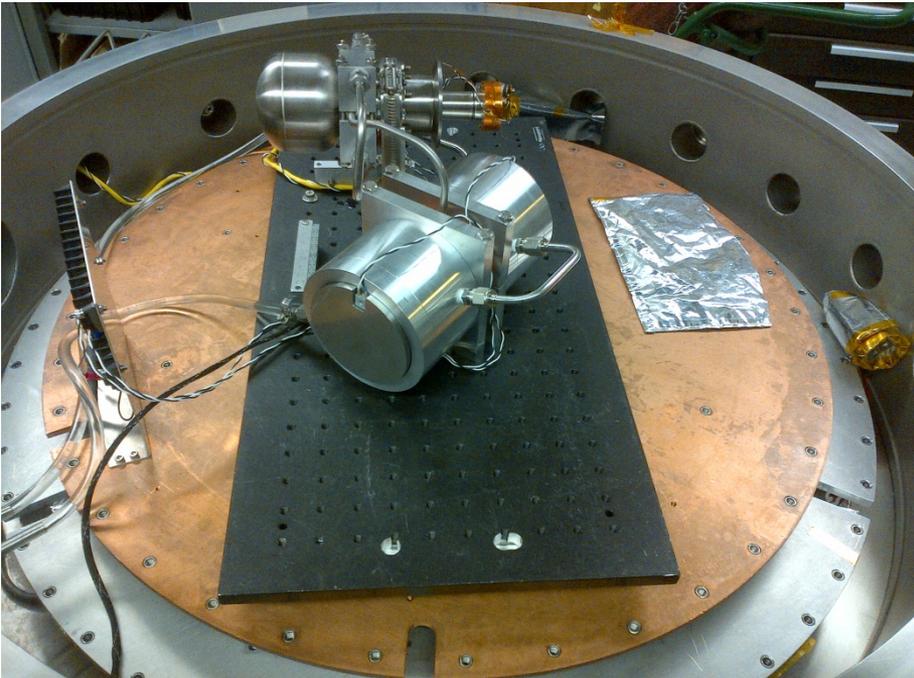


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# test conditions

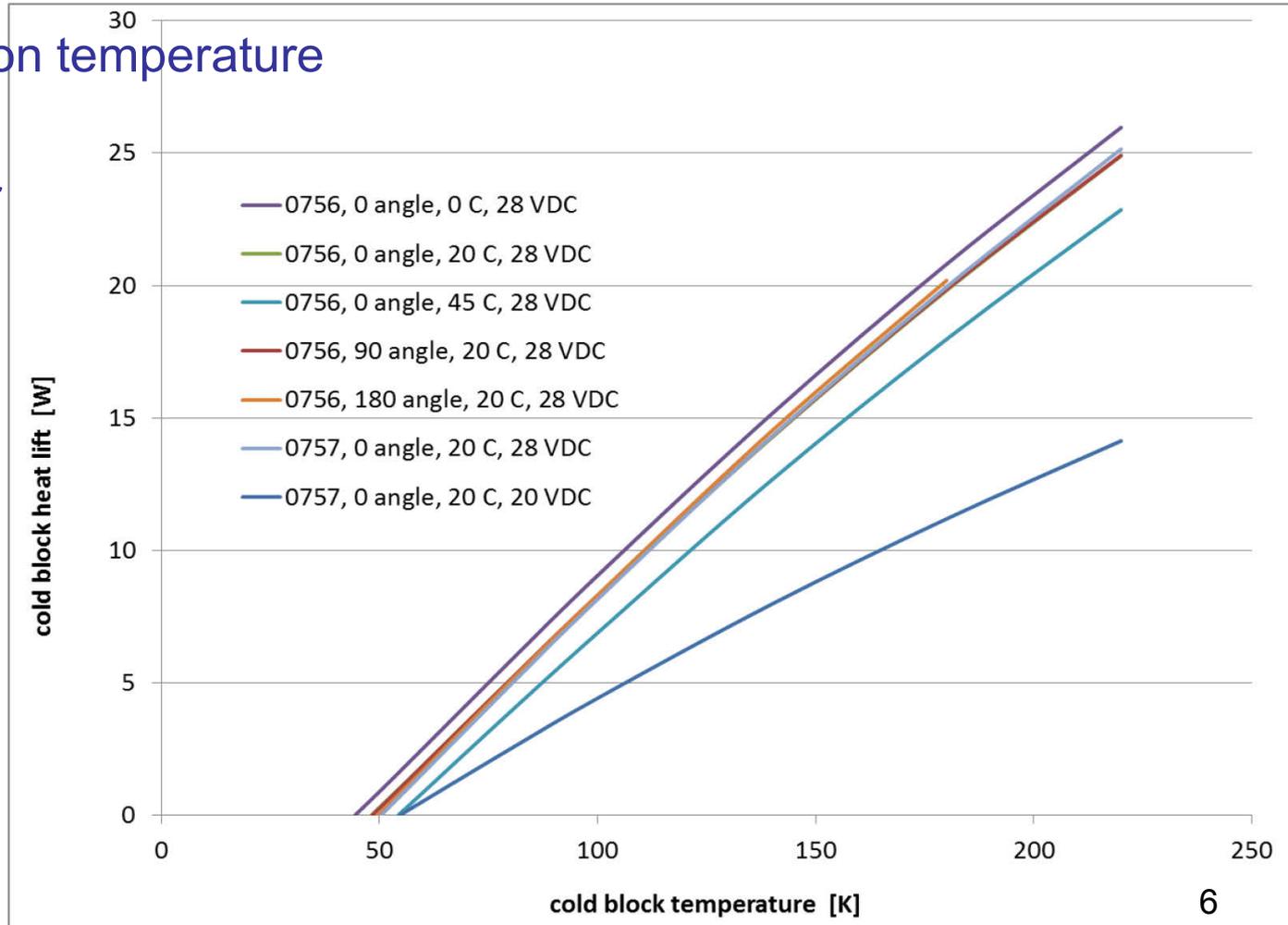
- Entire TMU in vacuum:
  - varied heat rejection temperature and orientation
  - relative heat rejection at motor and at cold head
- Only cold finger in vacuum:
  - varied cold finger orientation and drive power





# performance results

- heat lift as function of
  - heat rejection temperature
  - orientation
  - drive power





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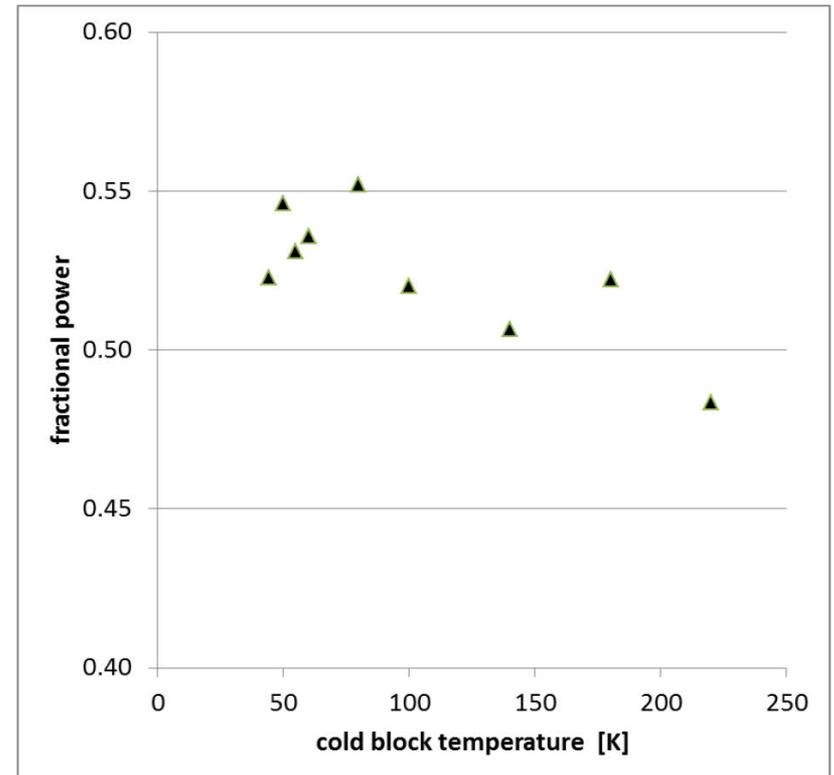
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# performance results

- relative amount of heat rejected at motor and at cold head
- individual temperature probes in cooling flow

- $$F_{motor} = \frac{DT(motor)/DT(motor+cold\ head)}{P(compressor)/P(compressor\ maximum)}$$

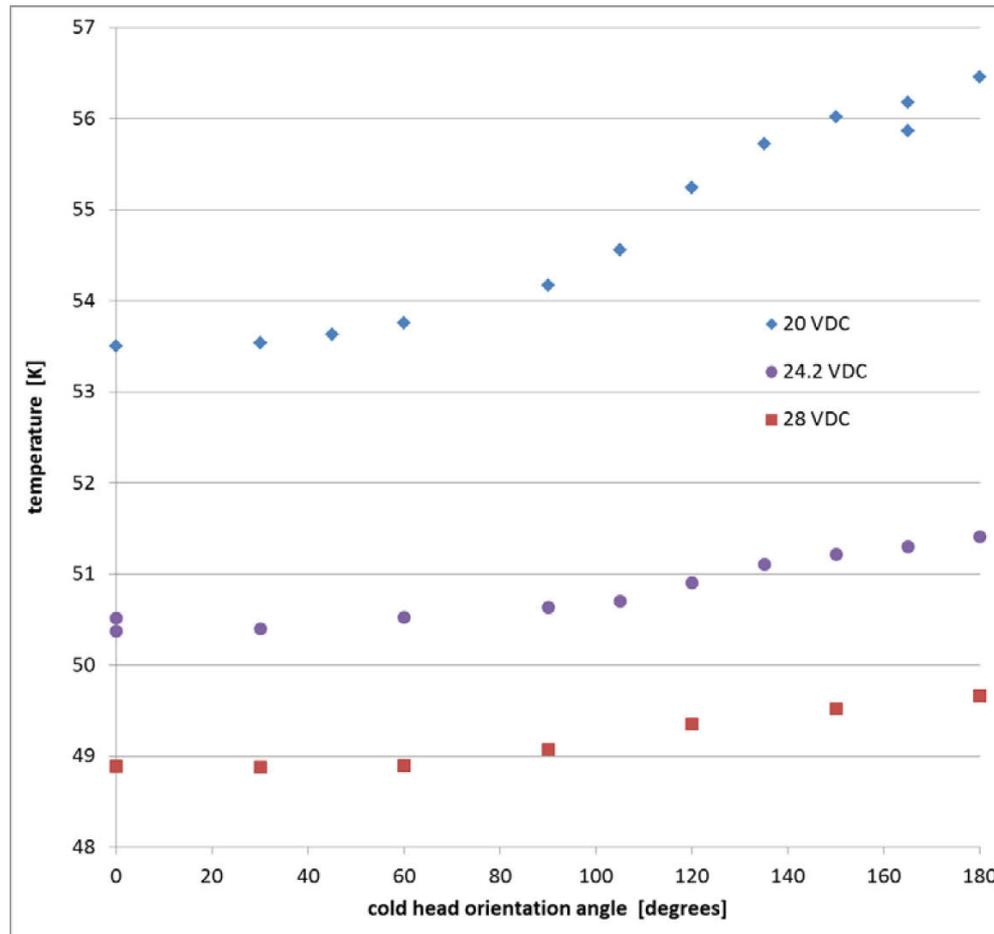
- ~50% of heat is rejected at motor





# performance results

- effect of cold finger orientation and drive power





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# in conclusion

- Two Thales 9310 cryocooler have been characterized for use in a laboratory-based technology-development instrument