

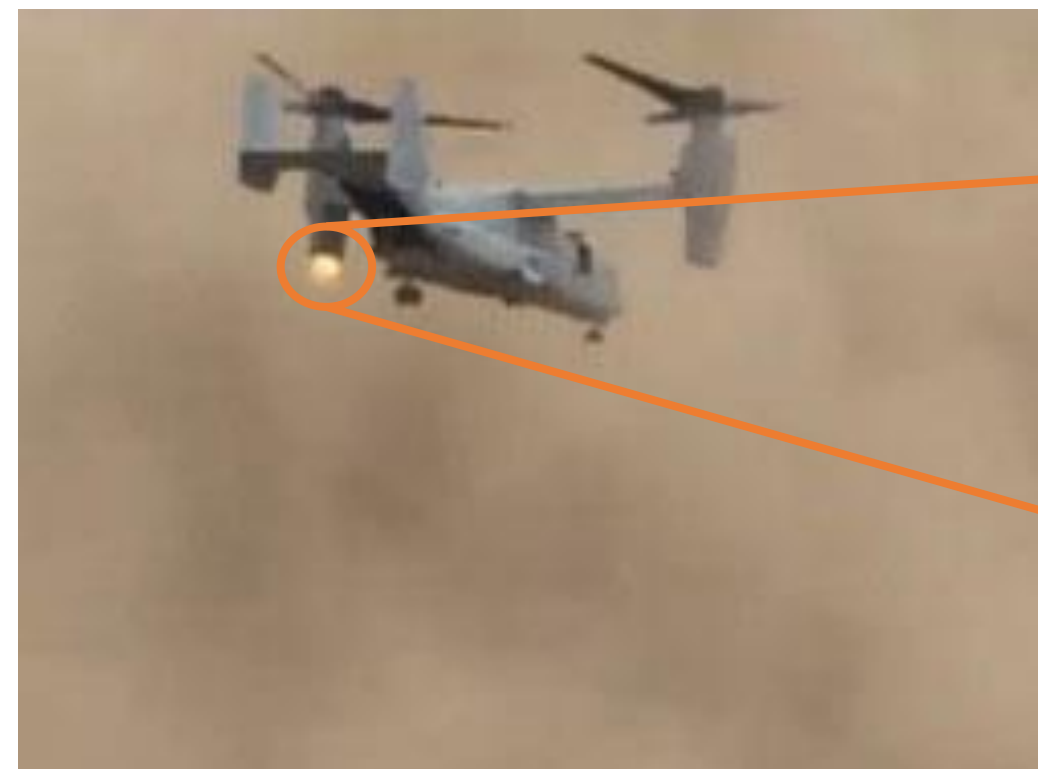
Experimental Investigation of the Onset of Sand Deposits on Hastelloy-X above 1000 °C

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Research Purpose and Scope

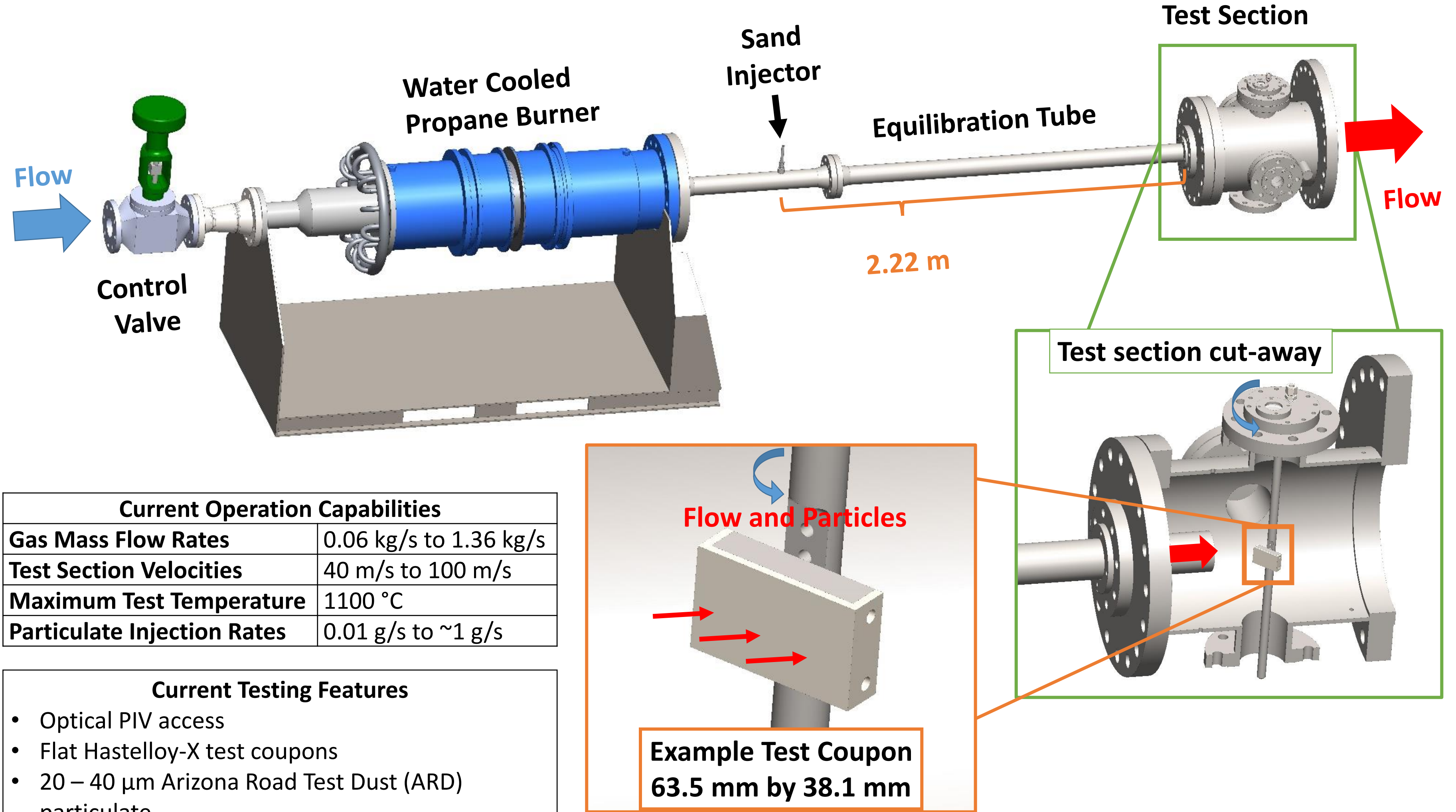
Gas turbine engine ingestion of particulates (sand and dust) in arid or austere environments can hinder performance and damage gas path components via erosive mechanisms and deposits. This project focuses on experimentally quantifying microparticle impacts, rebounds, and deposits onto nickel superalloy substrates.



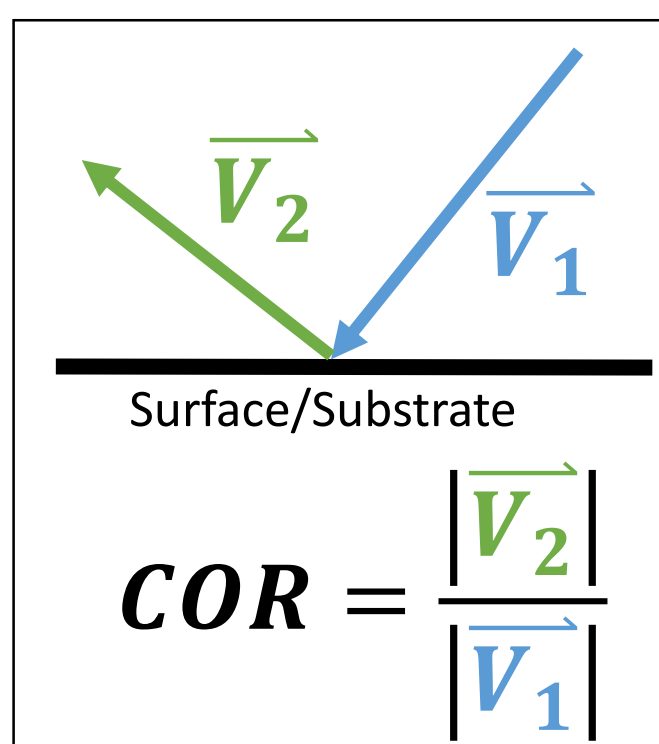
Fatal V-22 Osprey crash (May 2015), Engine flame out due to excessive dust ingestion leading to significant turbine section deposits

<http://www.military.com/daily-news/2016/01/29/follows-of-dust-a-sudden-pop-and-an-osprey-falls-from-the-sky.html>

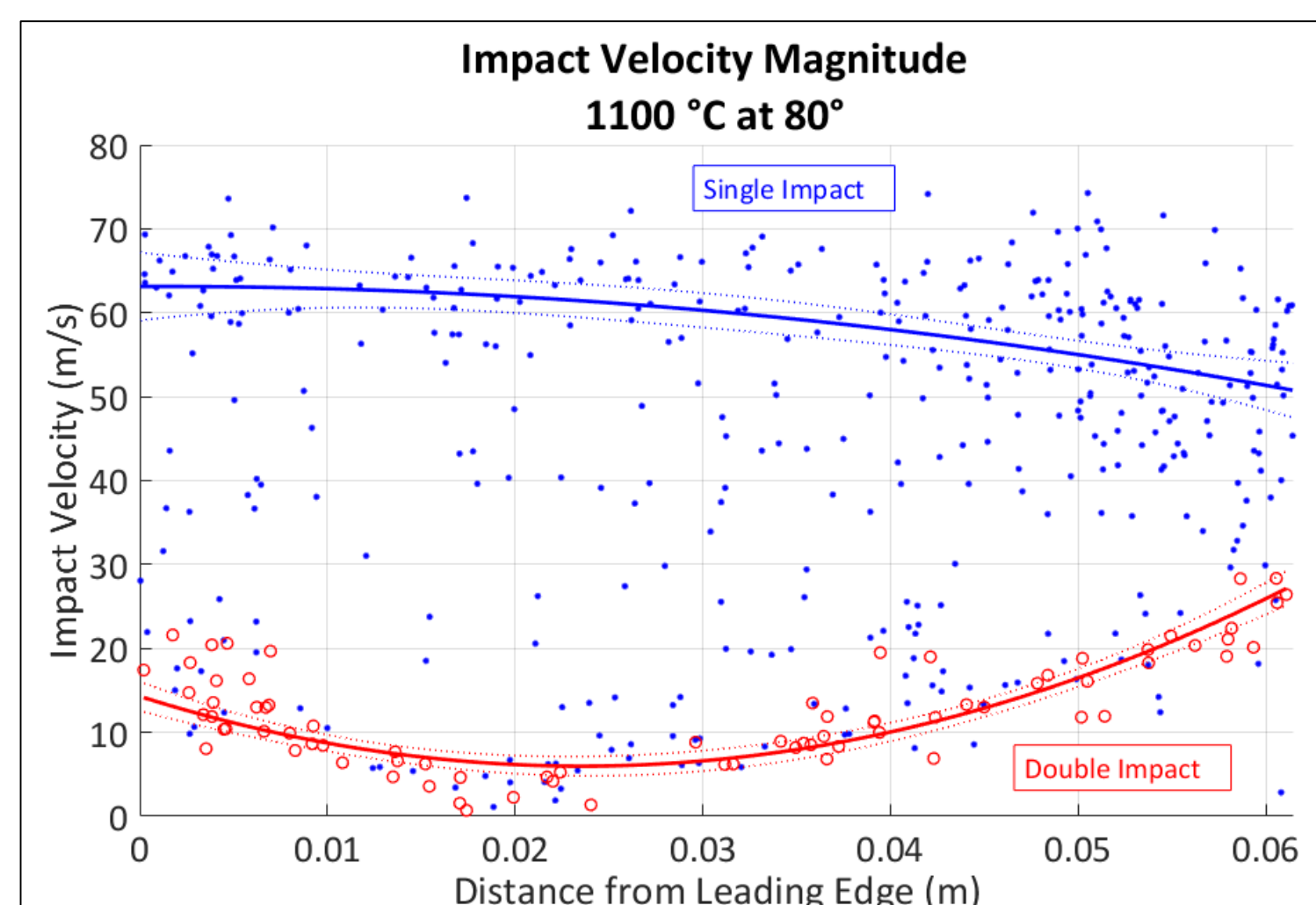
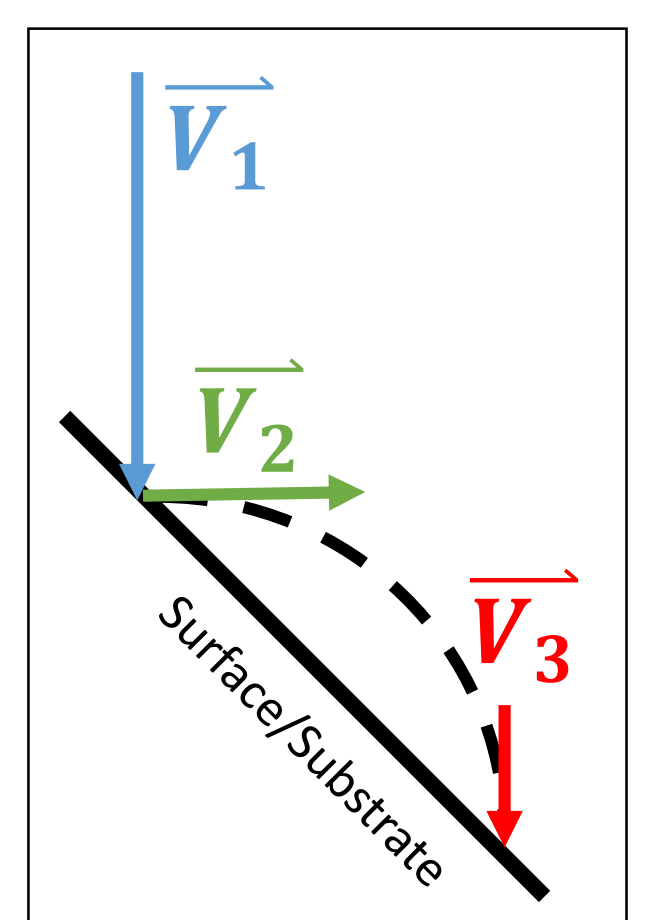
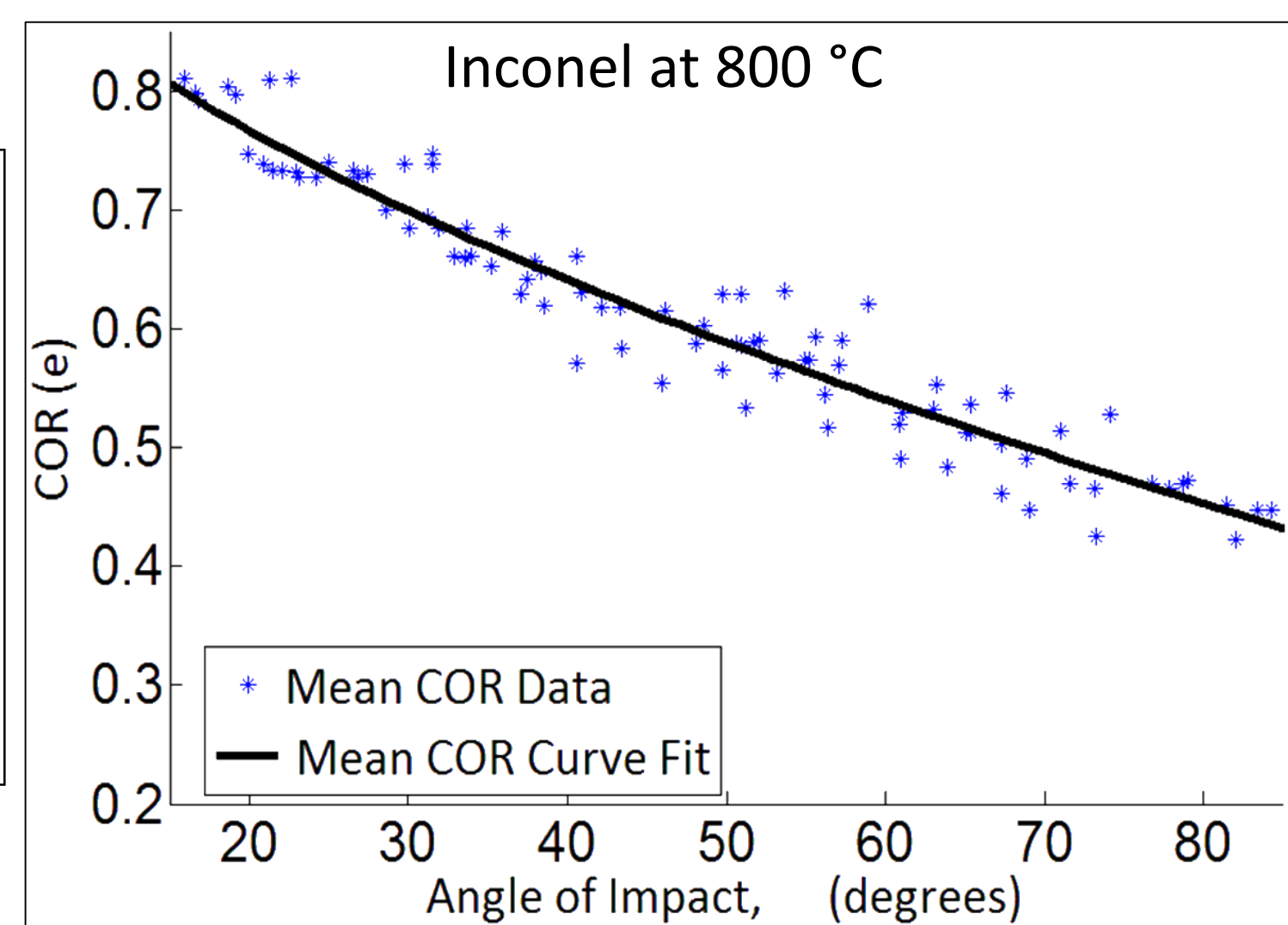
Virginia Tech Aerothermal Rig (VTAR)



Microparticle Impacts and Rebounds

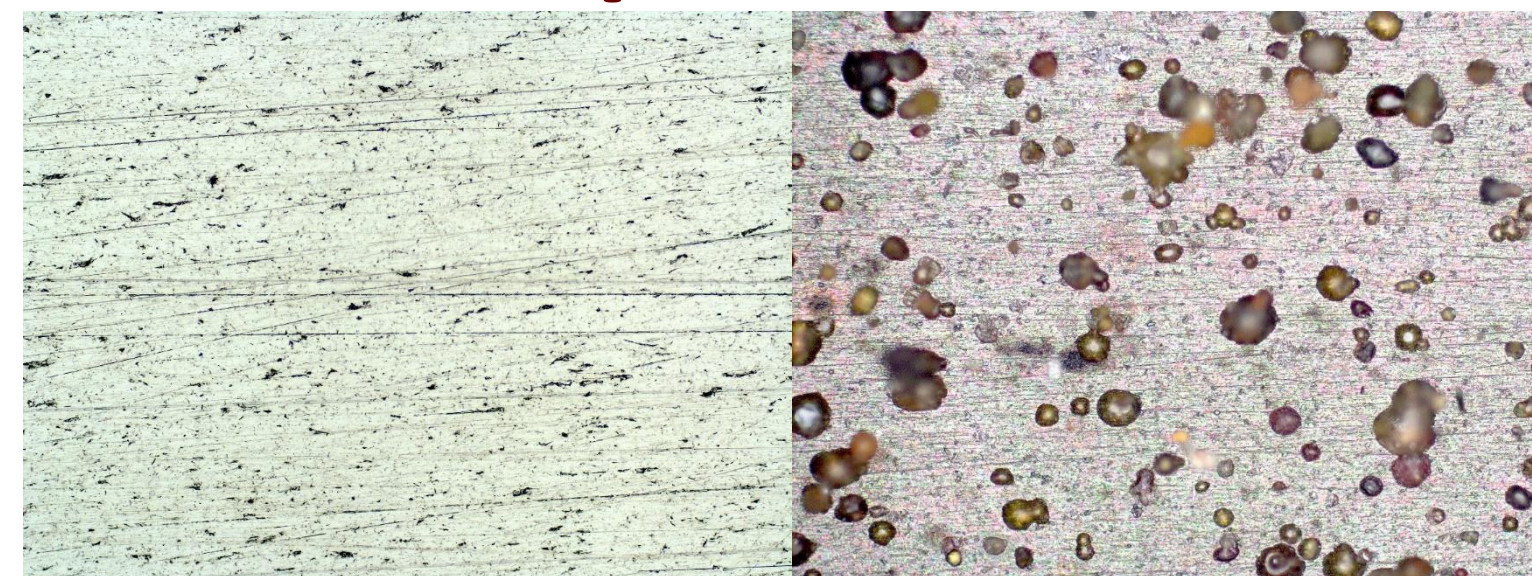


Coefficient of Restitution (COR)

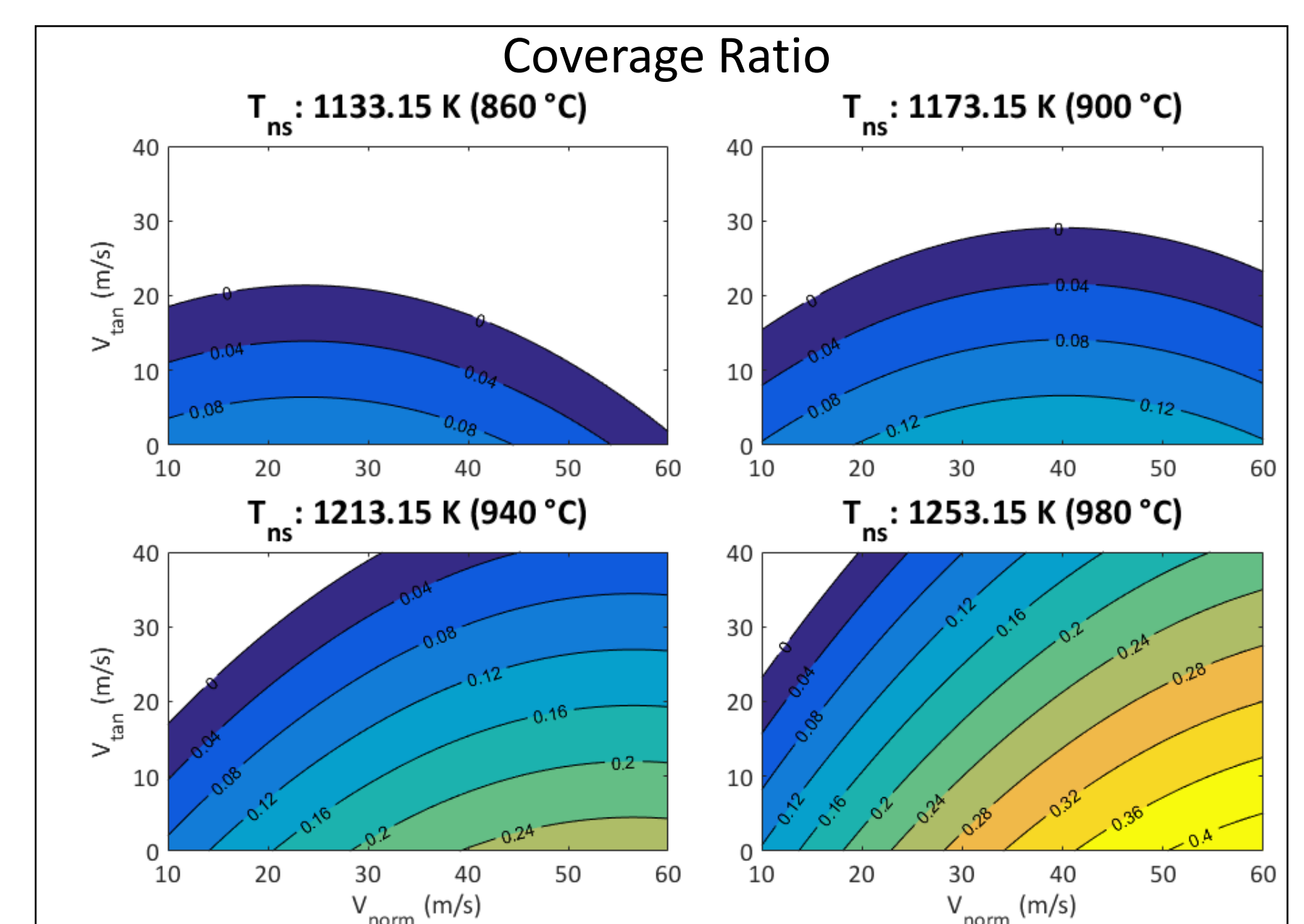
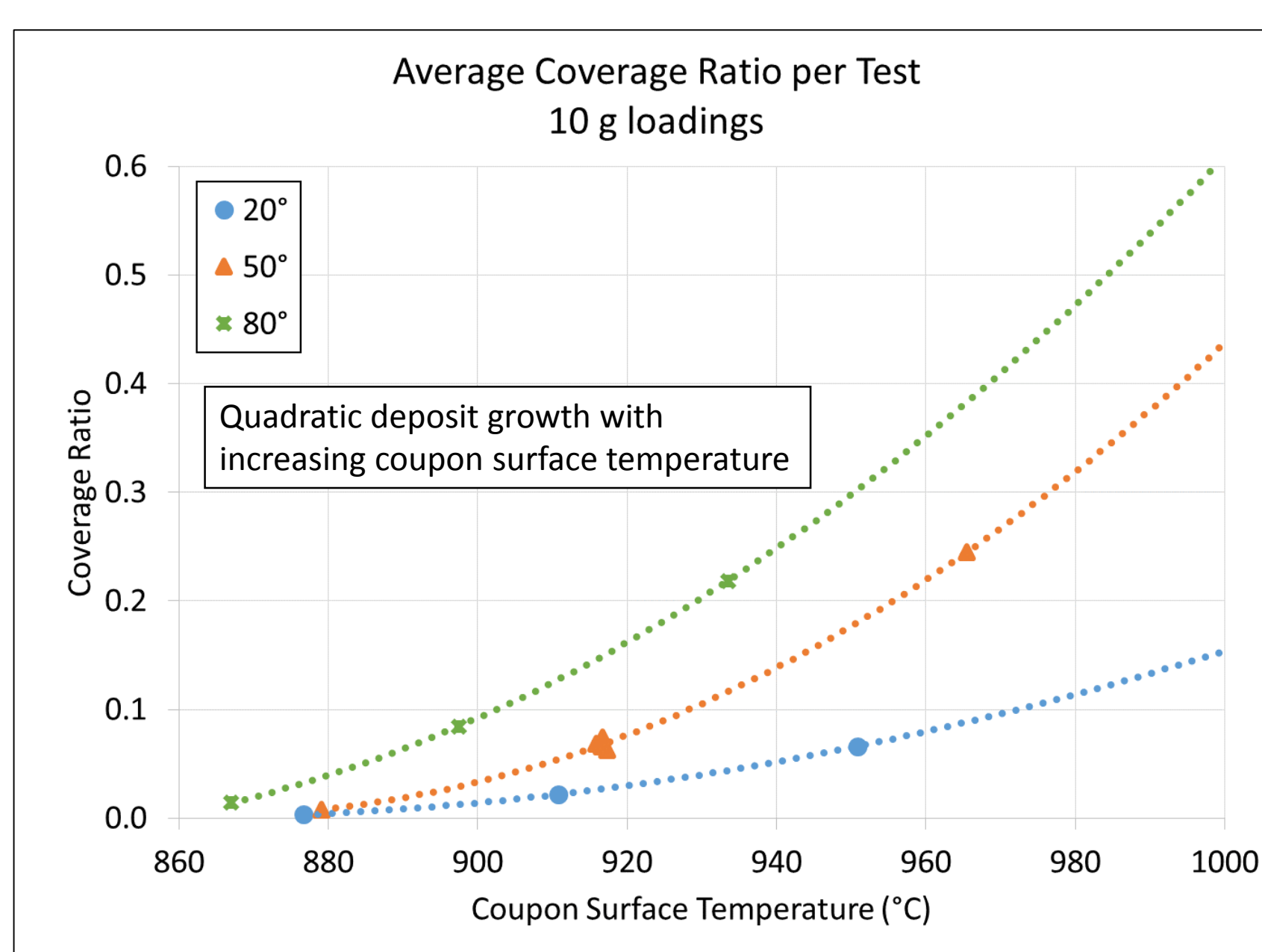


Unique hybrid PIV-CFD particle tracking technique with statistical processing techniques

Deposition Coverage Ratio Models for Prediction

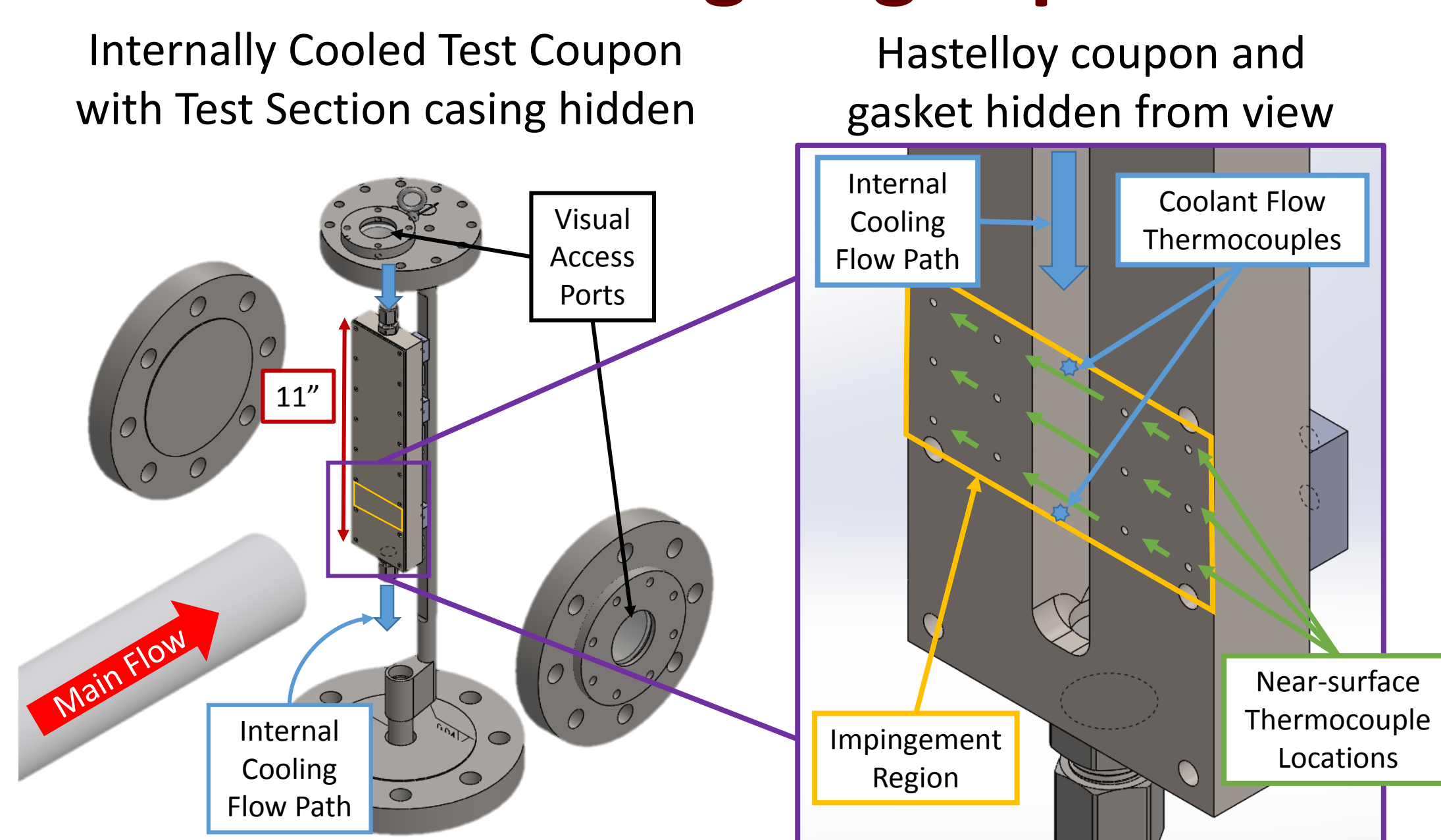


Surface deposits are quantified by a ratio of the amount of area covered by deposits per total surface area



Coverage ratio increases at a quadratic rate relative to surface temperature as well as normal and tangential impact velocities

Ongoing Experiments and Studies



- Cooled coupons decouple surface temperature from gas path flow temperature to mimic actively cooled turbine components
- Infrared coupon surface temperature measurements

Future Plans

- Increase main gas path temperature up to 1200 °C
- Utilize particulates of different composition and smaller than 10 μm
- External deposition responses with different cooling methods