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BUCKY Simulations of Tungsten RHEPP Experiments: Initial Temperature, Ion Type Effects and Stresses

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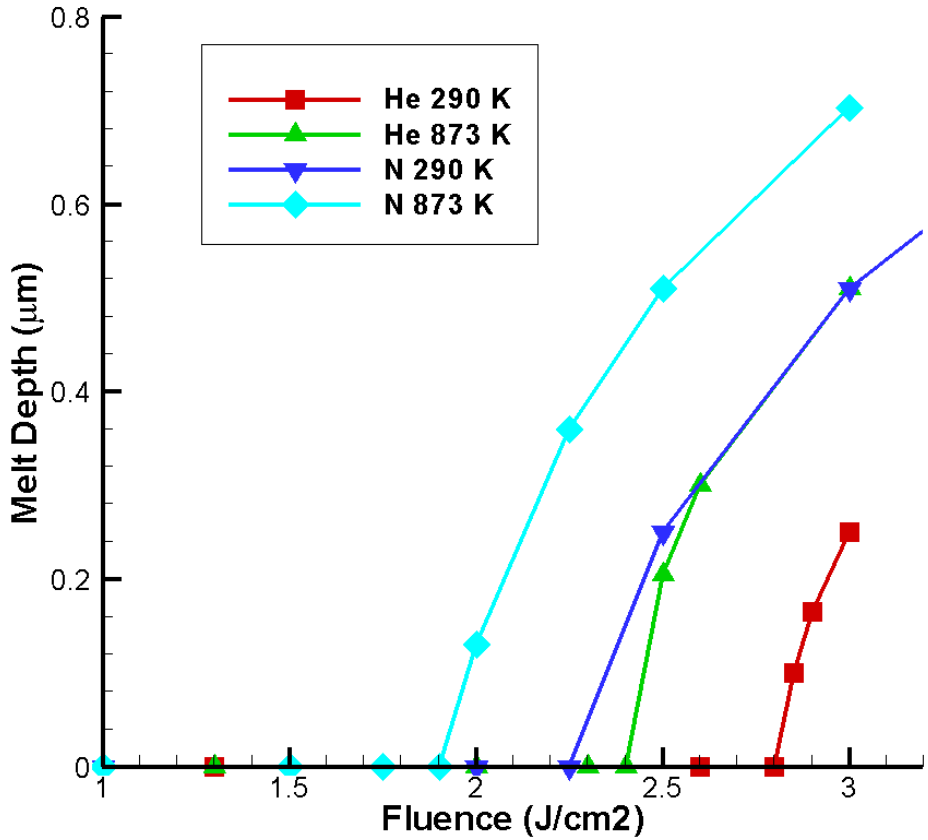
BUCKY Simulations Have Been Performed for RHEPP Experiments on Pure Tungsten at Different Initial Temperature and Ion Types

1. Melt threshold fluence and peak surface temperture depend on initial temperature and ion type (He or N).
2. Stress calculations performed for selected cases. All samples should exhibit yielding.
3. Plastic flow model is needed (discussed in poster session).

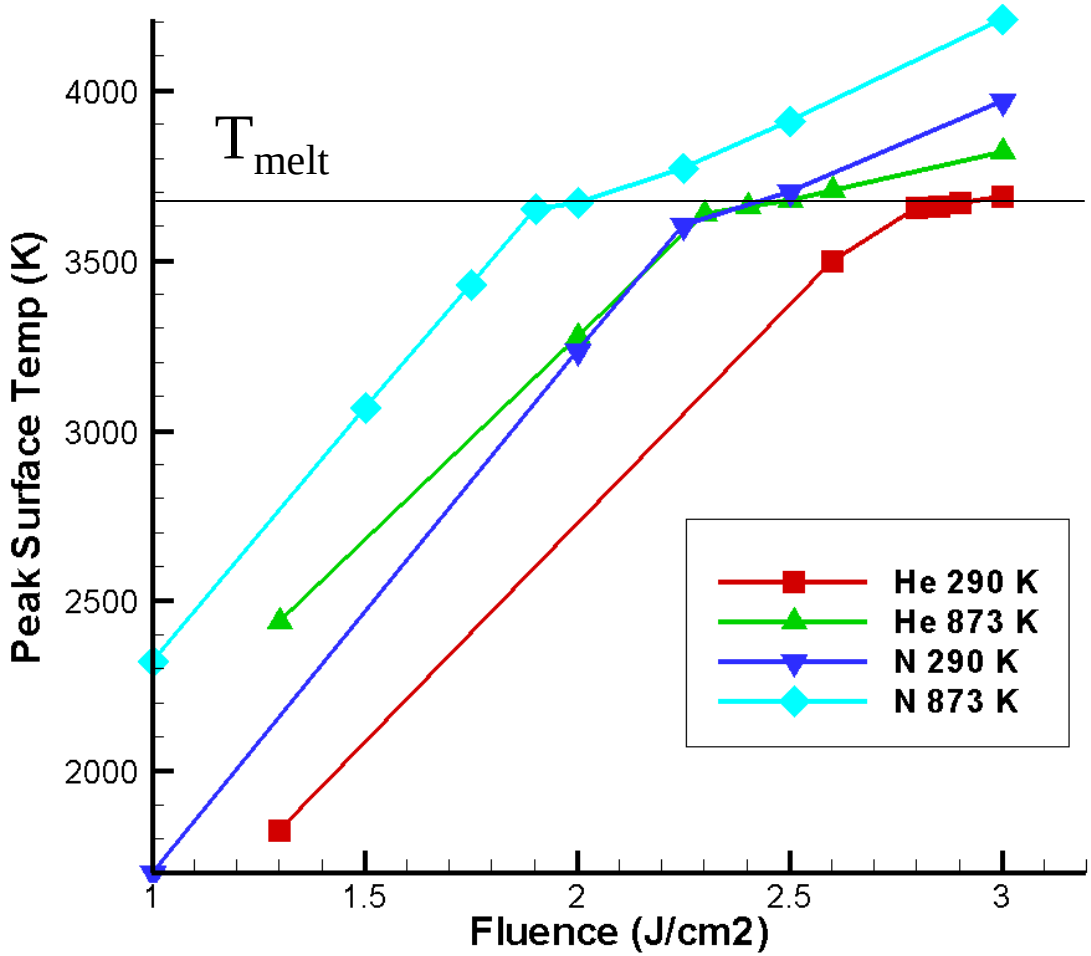
Melting Threshold Fluence is Sensitive to Ion Type and Initial Temperature

- Predicted RHEPP melting fluences vary between 1.9 and 2.8 J/cm^2.
- Tina Tanaka's thermal properties used for W.
- Pre-shot heating of the sample lowers melt threshold.
- A higher He fluence is required to melt W.

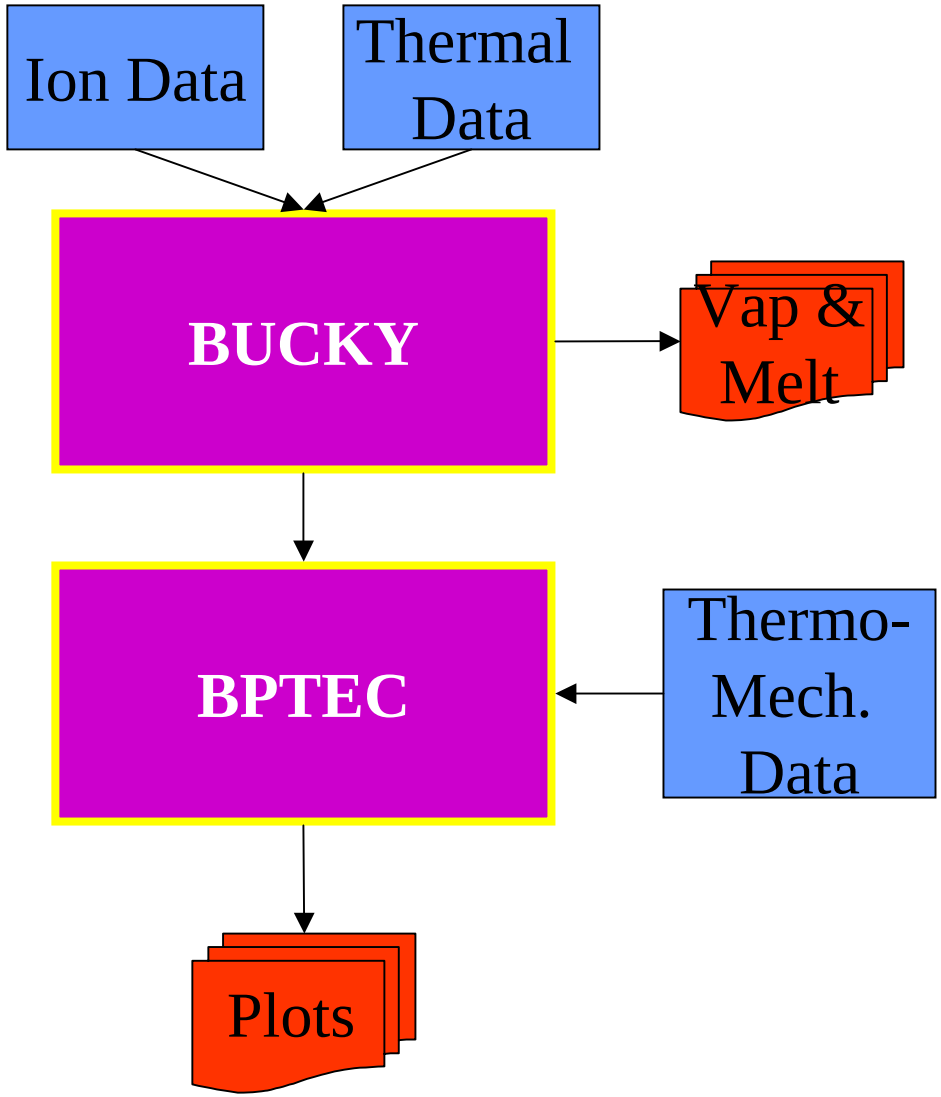


Peak Surface Temperature is Sensitive to Ion Type

- Predicted RHEPP Peak surface temperatures show change in slope at melting.
- Pre-shot heating of the sample is not just an additive effect because of temperature dependence of properties.
- Higher surface temperatures are seen for N irradiation.



Stress and Yield Post-Processing in BUCKY



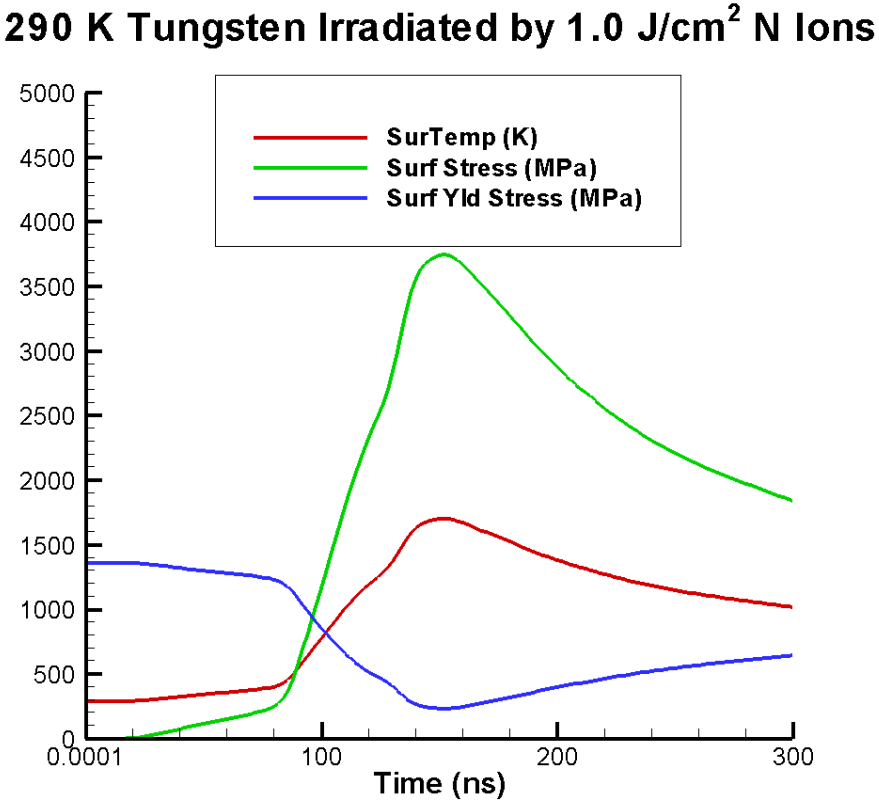
- Ion Data: from SNL
- Thermal Data: $\kappa(T)$, $C_p(T)$, ΔH_v, ΔH_m

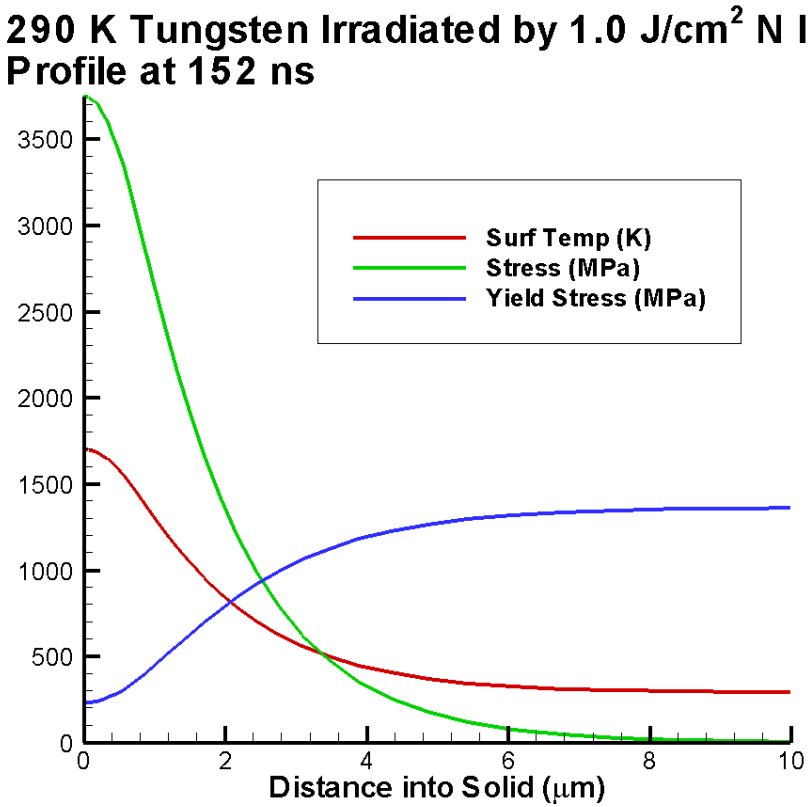
- Elastic Stress Model.
- Temperature-dependent Data for W from ITER manual.
- See Poster for details.

Least Damaged Case Still has Yielded Material

Yielding persists for more than 200 ns

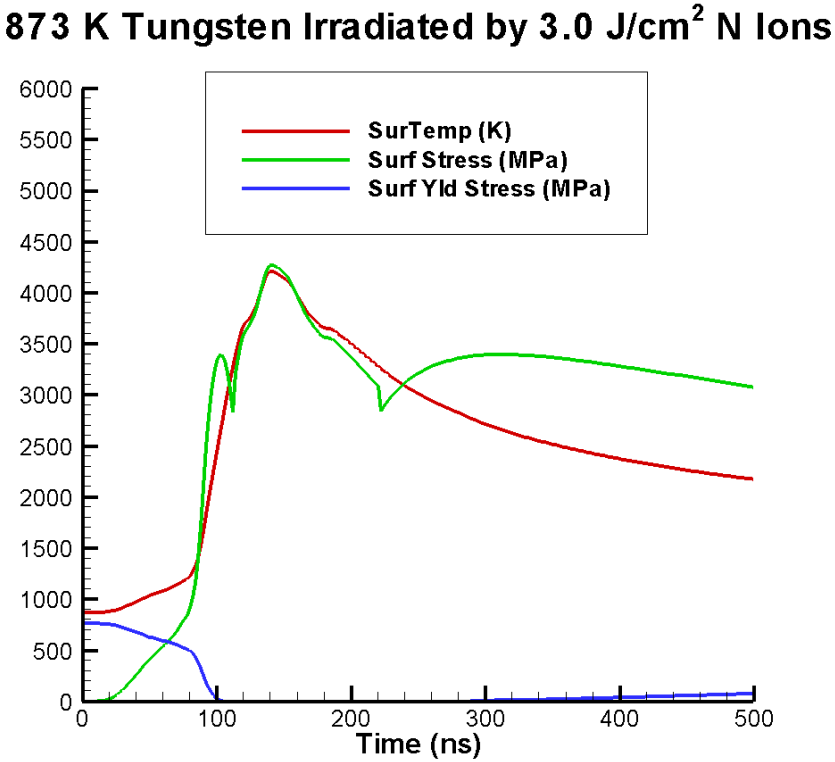
At peak surface temperature, 2.5 μm of material is yielding



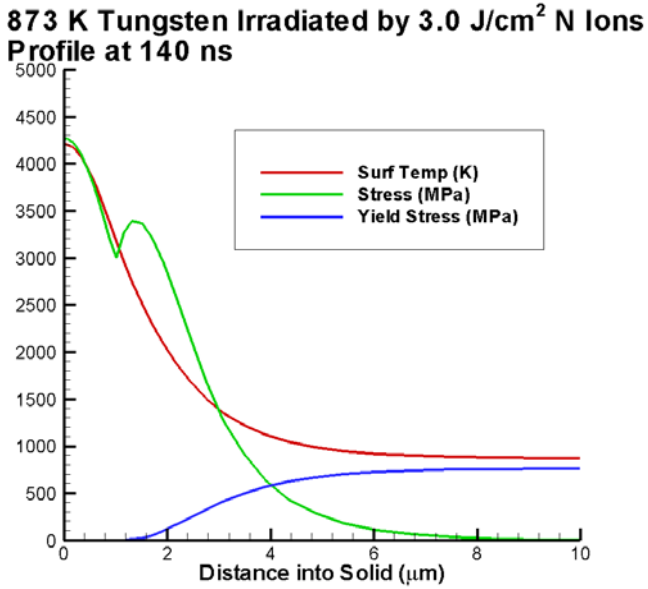


Melted Case Sees Substantial Yielded Material

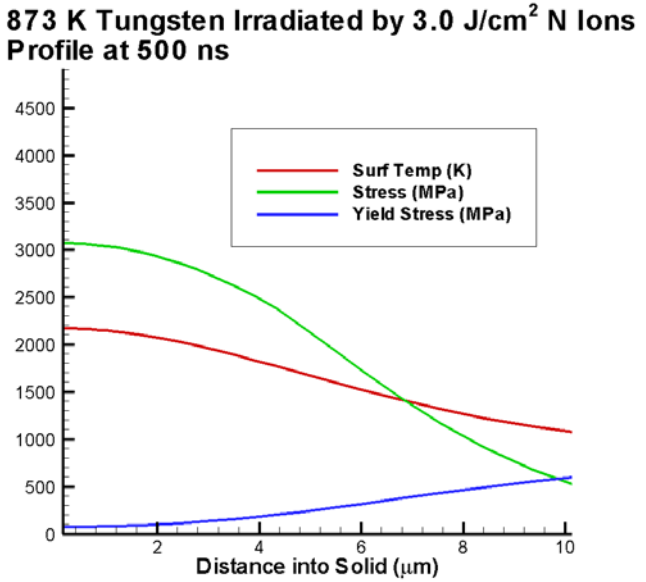
When temperature goes beyond melting, stress model and data is invalid and "stress" values are meaningless.



Yielded region 4 μm thick at 140 ns

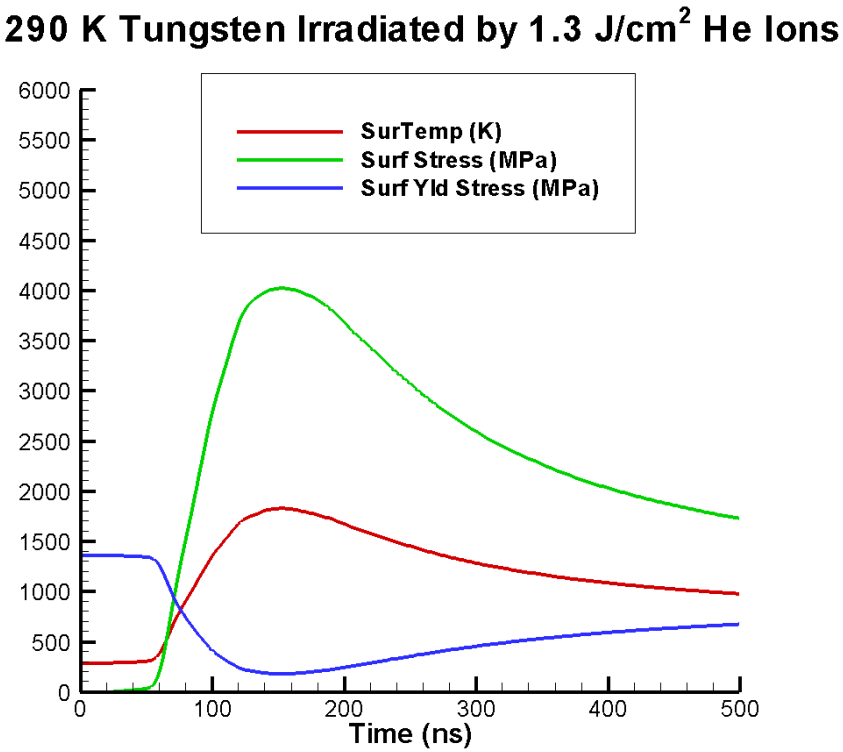


Yielded region 10 μm thick at 500 ns

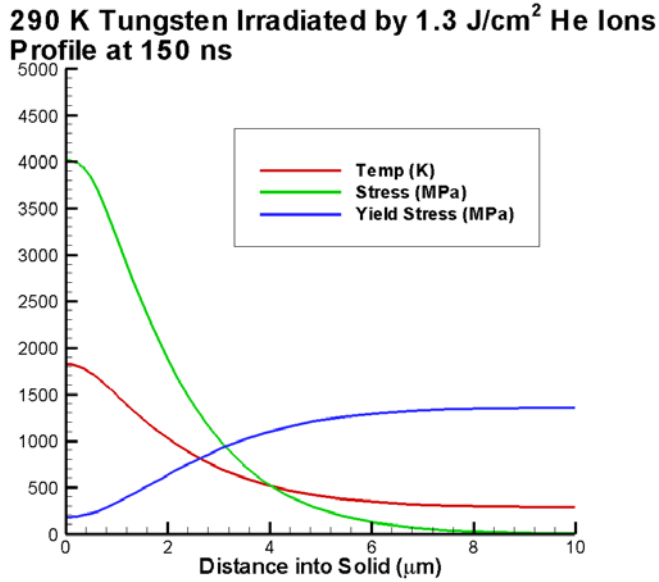


1.3 J/cm^2 Of He Irradiation on 290 K Tungsten

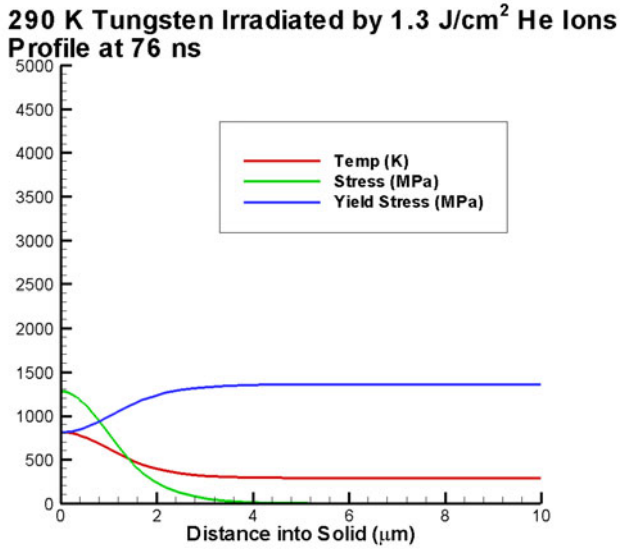
In a Yielding Condition for at least 100's of ns



Yielded region 3 μm thick at 150 ns



Yielded region 1 μm thick at 76 ns



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1. Melt threshold fluence and peak surface temperture depend on initial temperature and ion type (He or N).
2. Stress calculations performed for selected cases. All samples should exhibit yielding. *Experiments at lower fluences could examine onset of yield.*
3. Plastic flow model is needed (discussed in poster session). *There are known strain-rate and grain size effects that will come into play.*