Genesis Science Team Meeting: Houston 2009

Fractionation processes in the SW revealed by He, Ne, and Ar

Presented as talk on Wednesday (Heber et al.)

The Genesis Concentrator Target Gold Cross

Presented as poster on Tuesday (Heber et al.)

Solar wind Kr and Xe

Presented as talk on Wednesday (Vogel et al.)

The Genesis Concentrator Target Gold Cross

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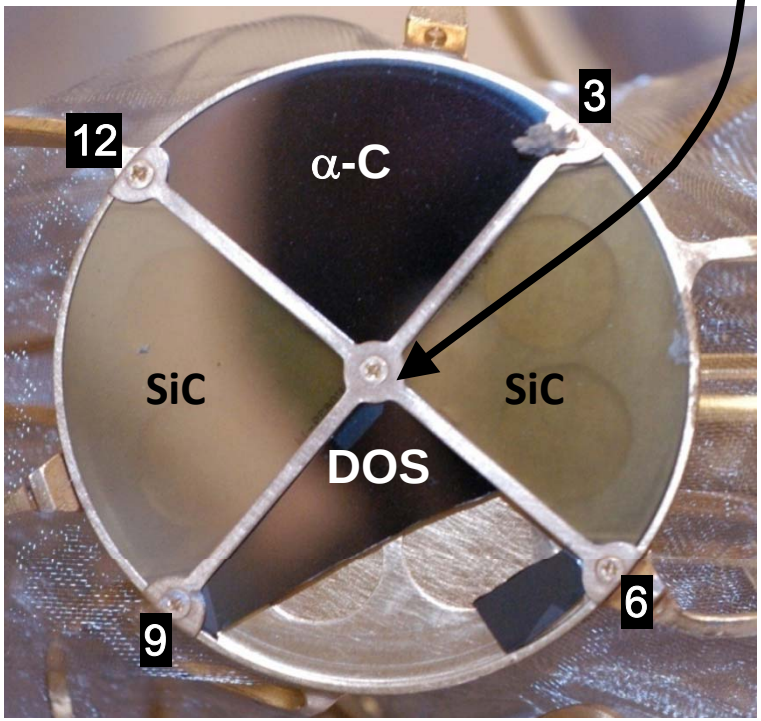
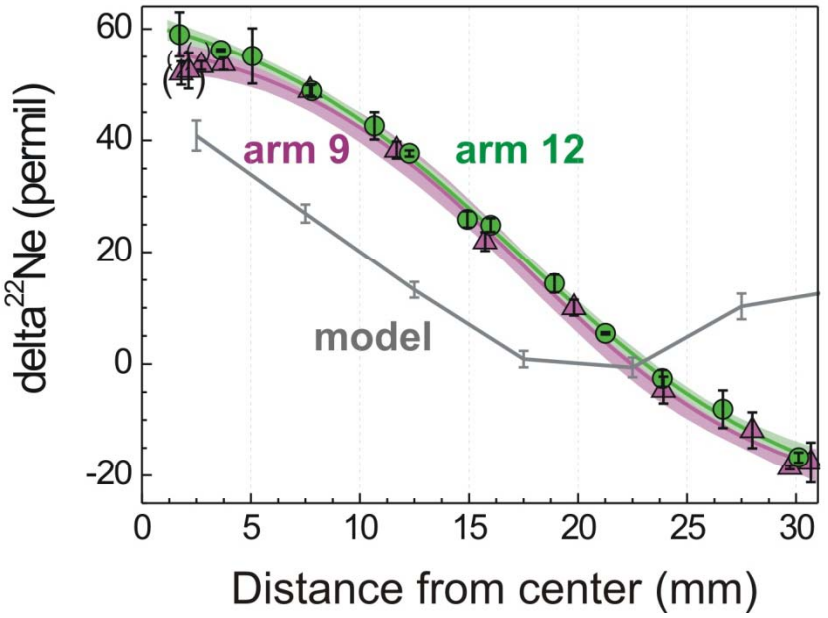
CD #1485

Concentrator target

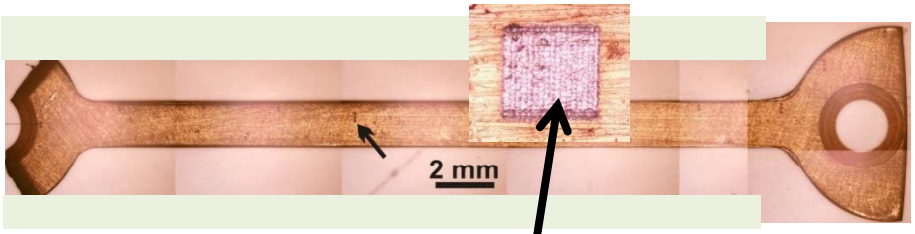
Gold cross



Isotope fractionation as function of the radius

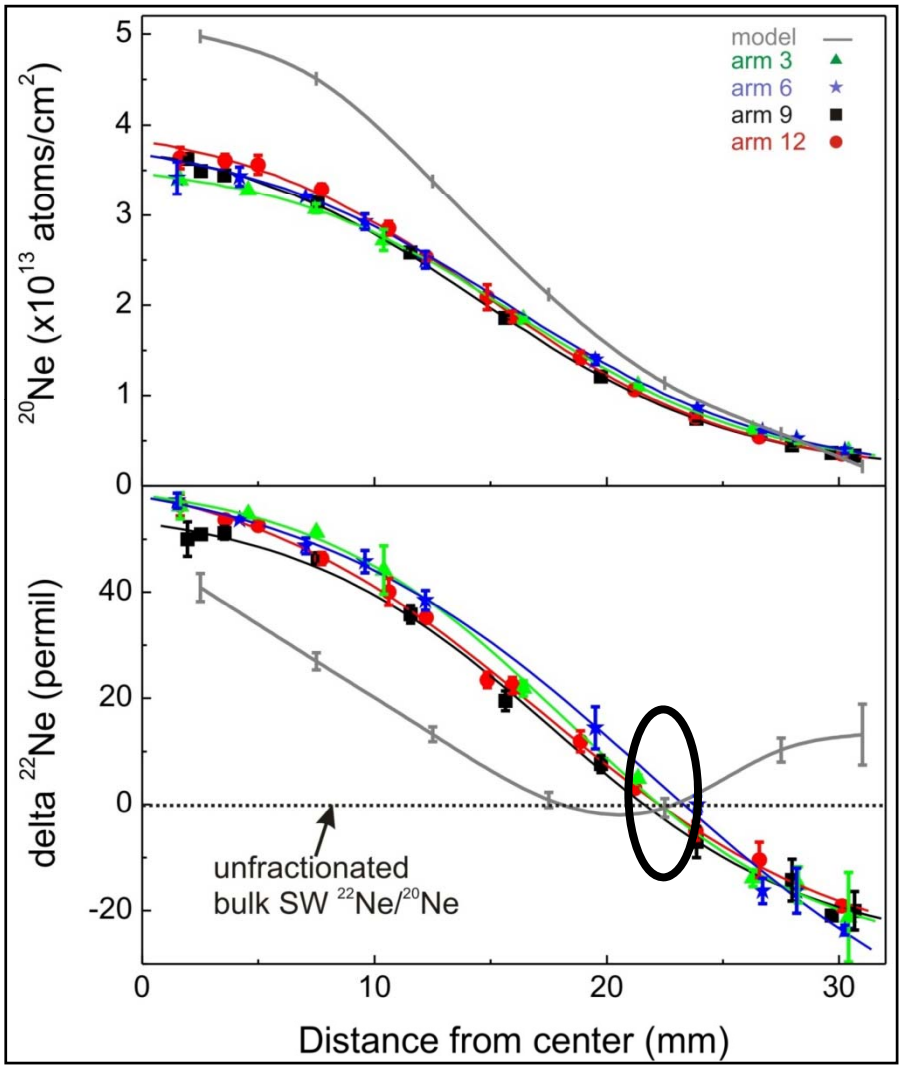


(Heber et al. 2007)



100 x 100 μm Laser ablation raster

The Concentrator Target Gold Cross



Measured ^{20}Ne and isotopic composition agree in all 4 arms

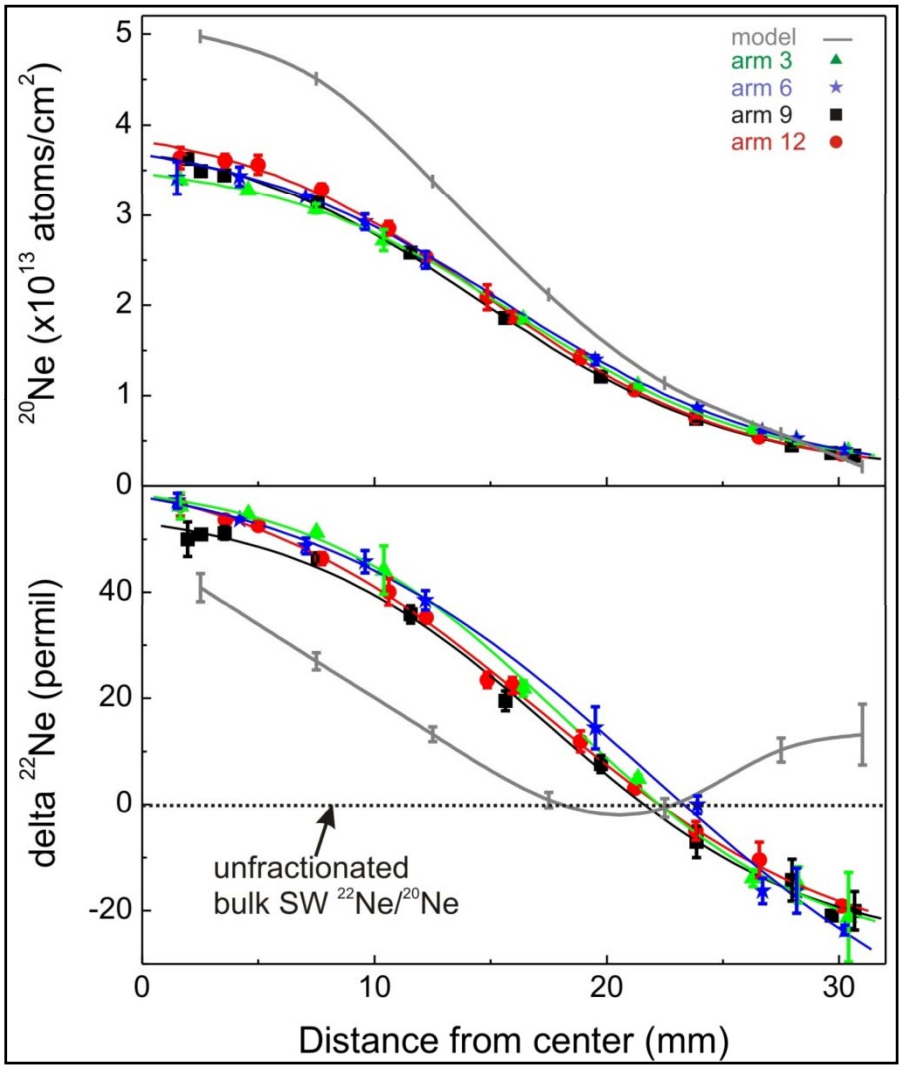
Entire concentrator target was radially symmetrically irradiated.

Concentration factors from 5 (edge) to 50 (center) relative to bulk SW in AuoS

Ne isotopic fractionationation 3.8%/amu

At 22.4 mm radius unfractionated solar wind Ne isotopic composition

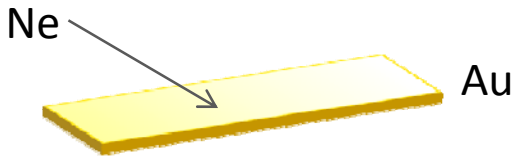
Disagreement of measured and modeled data



➔ **Due to difference between actual (measured data) and SRIM-predicted (modeled data) backscatter loss**

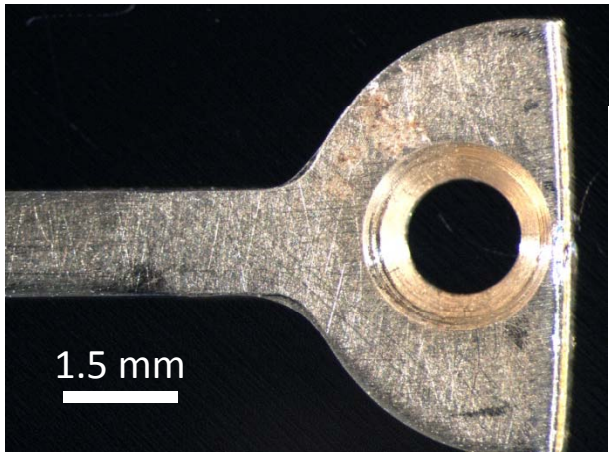
?

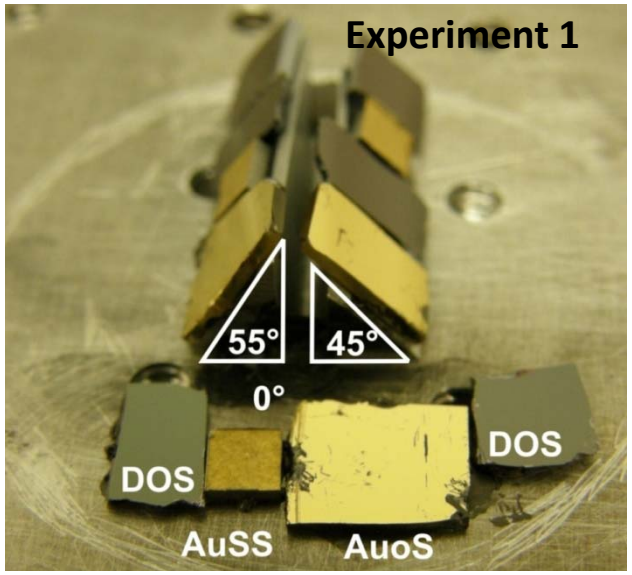
SRIM-predicted backscatter loss factors: for perfect surfaces



However

Gold cross (AuSS) has a very rough surface





Implantation experiments

^{20}Ne : 1E+14/cm^2 at 72keV
^{22}Ne : 1E+13/cm^2 at 74keV

Mean E of SW Ne before implantation

Angles of incidence:
0° ➔ as reference
45°,55° ➔ as 50°-55° = main SW ion angle of incidence into the concentrator target

Targets of experiment 1

AuSS ➔ as the trouble-maker

AuoS ➔ smooth Au surface

DOS➔ as reference for the original implanted Ne

Targets of experiment 2

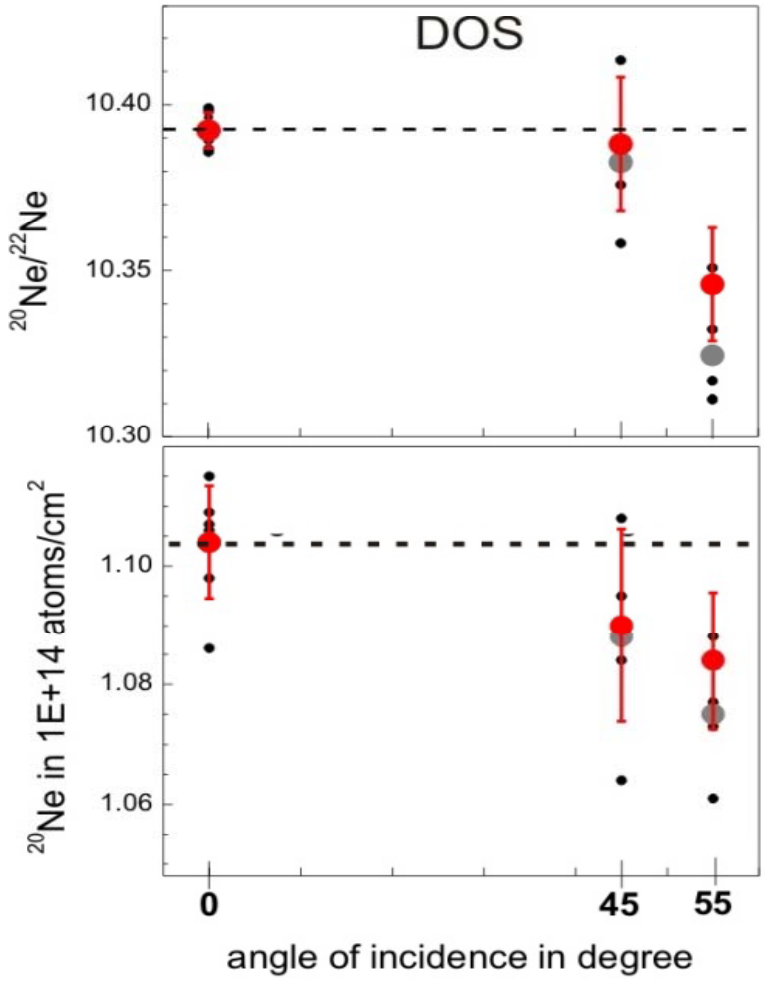
DOS➔ as reference

SiC ➔ as "real" concentrator target material

Analysis

Gas extraction by UV laser ablation (350 x 350 μm)
Backscatter loss determined by SRIM

Implantation experiment 1: Results for DOS



Dashed line

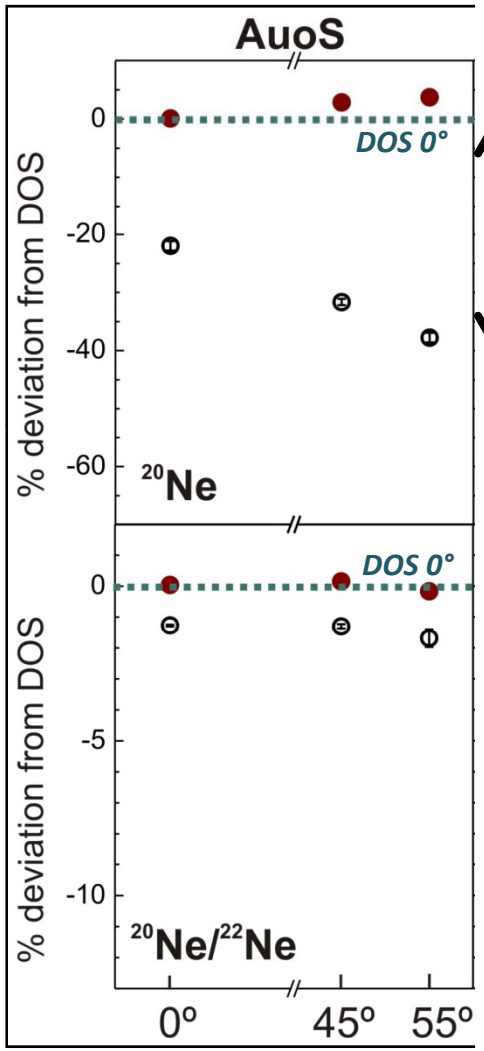
= mean ^{20}Ne and $^{20}Ne/^{22}Ne$ of the 0° sample

= the implanted Ne abundances and isotopic composition = reference

55°: SRIM-based correction for backscatter loss is slightly insufficient

Black: single measurements
Gray: measured data, average
Red : SRIM-based backscatter corrected average

Implantation experiment 1: Results for AuoS



% deviation from 0° DOS

AuoS: ^{20}Ne loss 22 - 37% at 0° to 55°

^{20}Ne/^{22}Ne fractionation is relatively small, **1.7%** (55°) at maximum

SRIM-predicted based backscatter correction successfully applied to:

^{20}Ne 0° implantation,

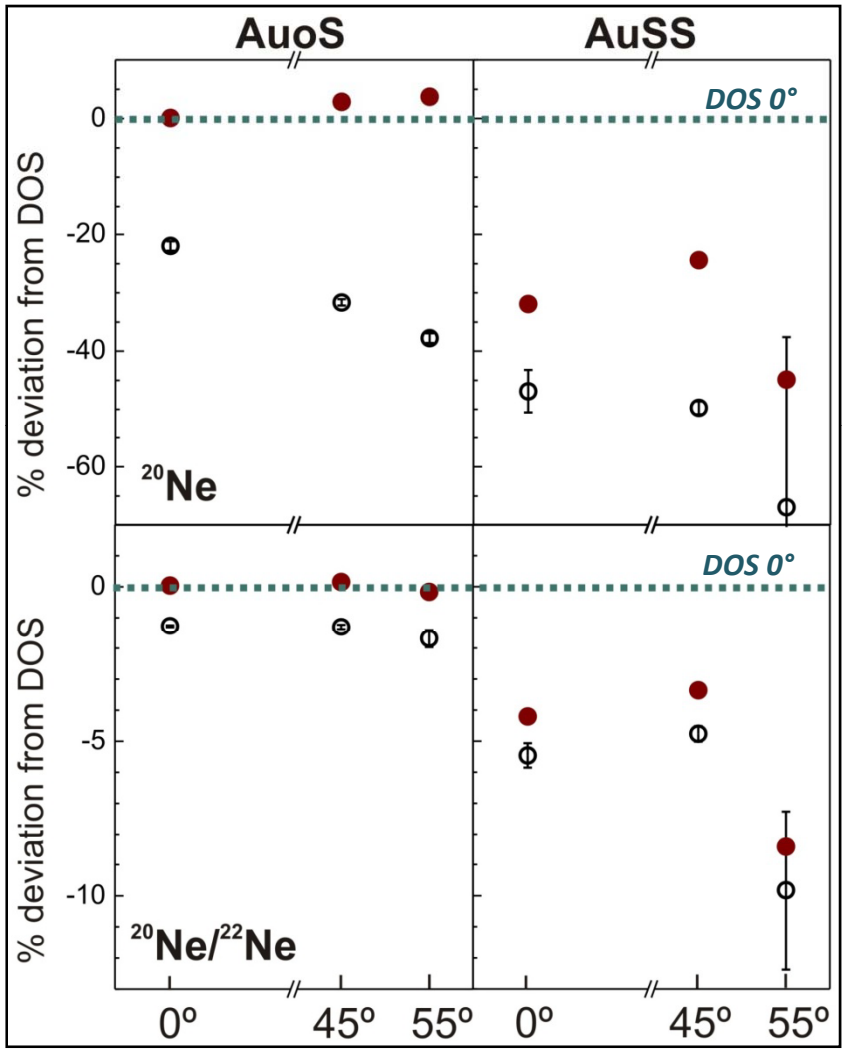
^{20}Ne/^{22}Ne 0° - 55° (0.2% difference to the DOS 0° value)

SRIM slightly overestimates abundances at higher angles

circles: measured data, average

Red : SRIM-based backscatter corrected average

Implantation experiment 1: Results for AuSS and AuoS



circles: measured data, average
Red : SRIM-based backscatter corrected average

AuSS: ^{20}Ne loss , 47-67%,
^{20}Ne/^{22}Ne fractionation is large: **5-10%**

SRIM ignores surface structures ➔ same correction factors for both Au targets applied

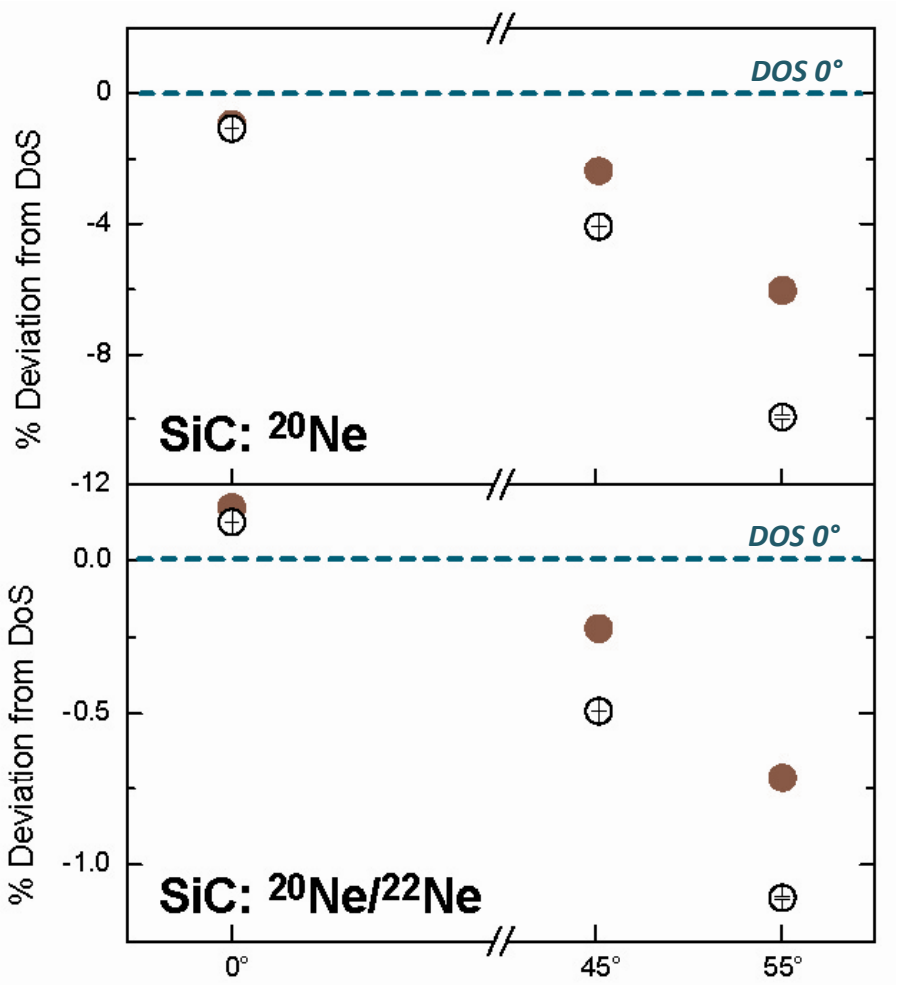
➔ AuSS:
Underestimation of backscatter loss and fractionation
Abundances + isotope fractionation of ions cannot be corrected by SRIM

➔ measured **fractionation factors** from the gold cross **are impossible to transfer** to other concentrator targets

➔ The ? / One ? Reason of the discrepancy between measured and modeled data from the gold cross

Implantation experiment 2: Results for SiC

(measured by Nadia Vogel)



SiC: ^{20}Ne loss 1 - 10% at 0° to 55°

^{20}Ne/^{22}Ne measured fractionation is small, **1%** (55°) at maximum

SRIM-based backscatter correction:
underestimates loss at high angles (by few %)

shifts ^{20}Ne/^{22}Ne close to DOS reference, but still 0.7% too low.

SRIM-based backscatter correction much better for SiC (compared to AuSS), however high angles of incidence are problematic for SRIM.

circles: measured data, average
Red : SRIM-based backscatter corrected average

Conclusion

Good News: Gold cross data: Concentrator target is homogenously irradiated

Bad News: Gold cross fractionation factors not transferable to the data measured in the real concentrator SiC or DOS targets

Concentrator instrumental mass fractionation must be determined on the real concentrator along with O and N measurements

Good News:

UV laser is applicable for SiC ablation

backscatter loss and related isotope fractionation is minor

Improvement of SRIM for high angle implantation