



Result of a Correlation Study

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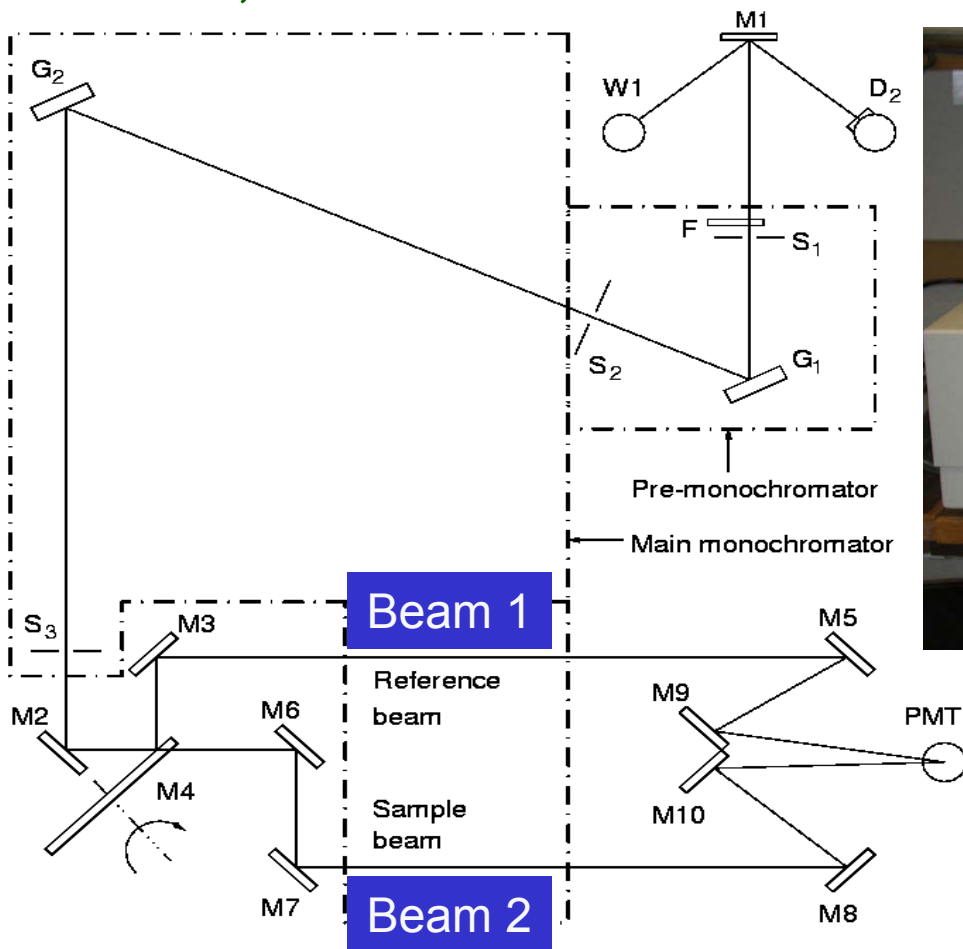
Introduction



- 54 PWO samples were studied at Caltech: 32 from SIC (20 of 2002 batches and 12 of 2004 batches) and 21 from BTCP (19 of 2001 batches and 2 of 2003 batches).
- Correlations between the slope of crystals' initial longitudinal transmittance around the band edge and its radiation damage, i.e. the relative light output loss under 15 rad/h irradiations and the emission weighted radiation induced absorption coefficient (EWRIAC), were investigated for all samples.

Transmittance Measurement

HITACHI U-3210 UV/VIS spectrophotometer with double beam, double monochromator & a large sample compartment



Precision: 0.3%

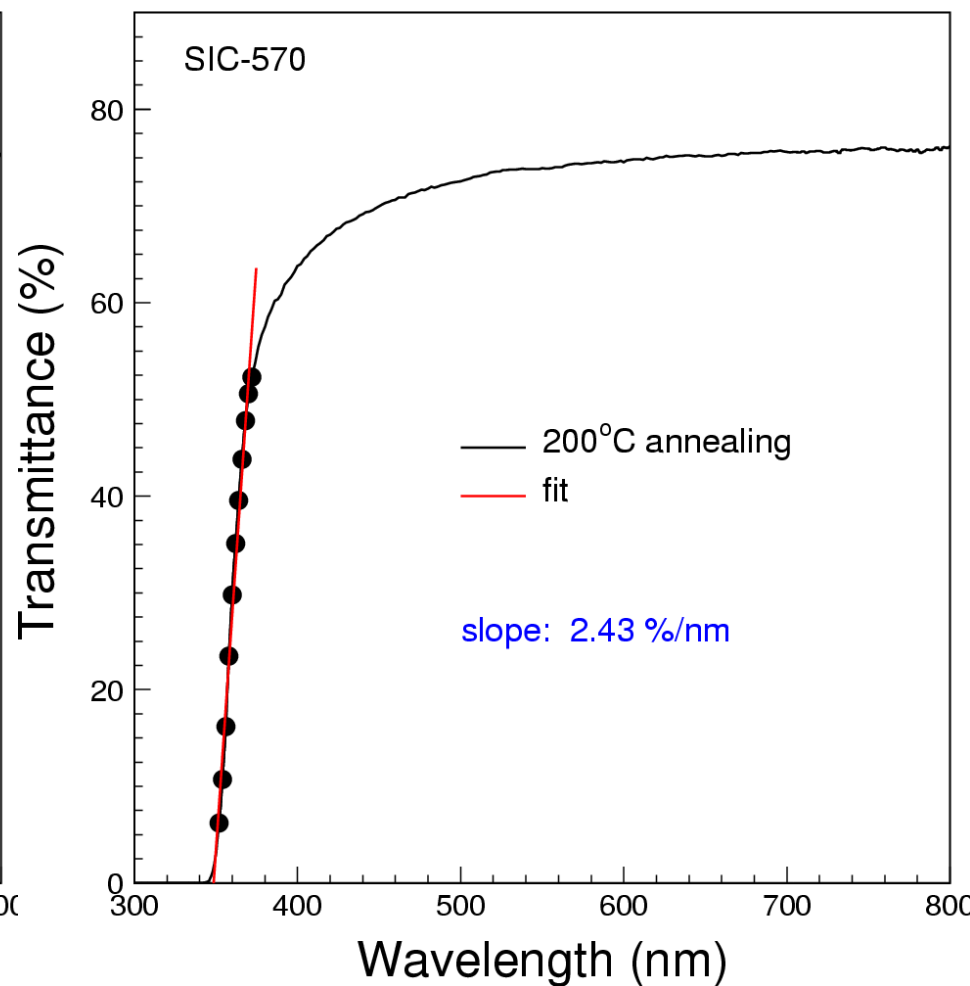
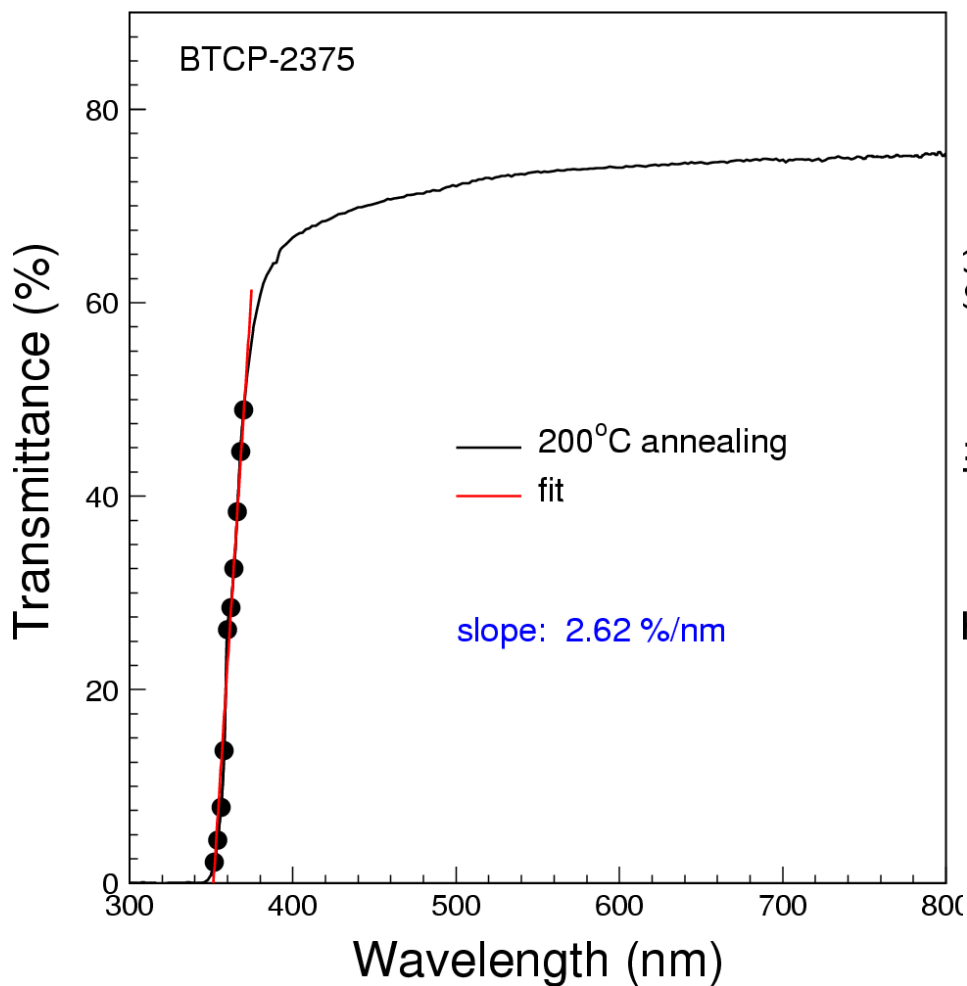
$$T_s = (1 - R)^2 + R^2(1 - R)^2 + \dots = (1 - R)/(1 + R), \text{ with}$$

$$R = \frac{(n_{crystal} - n_{air})^2}{(n_{crystal} + n_{air})^2}$$

Theoretical limit of transmittance: NIM A333 (1993) 422

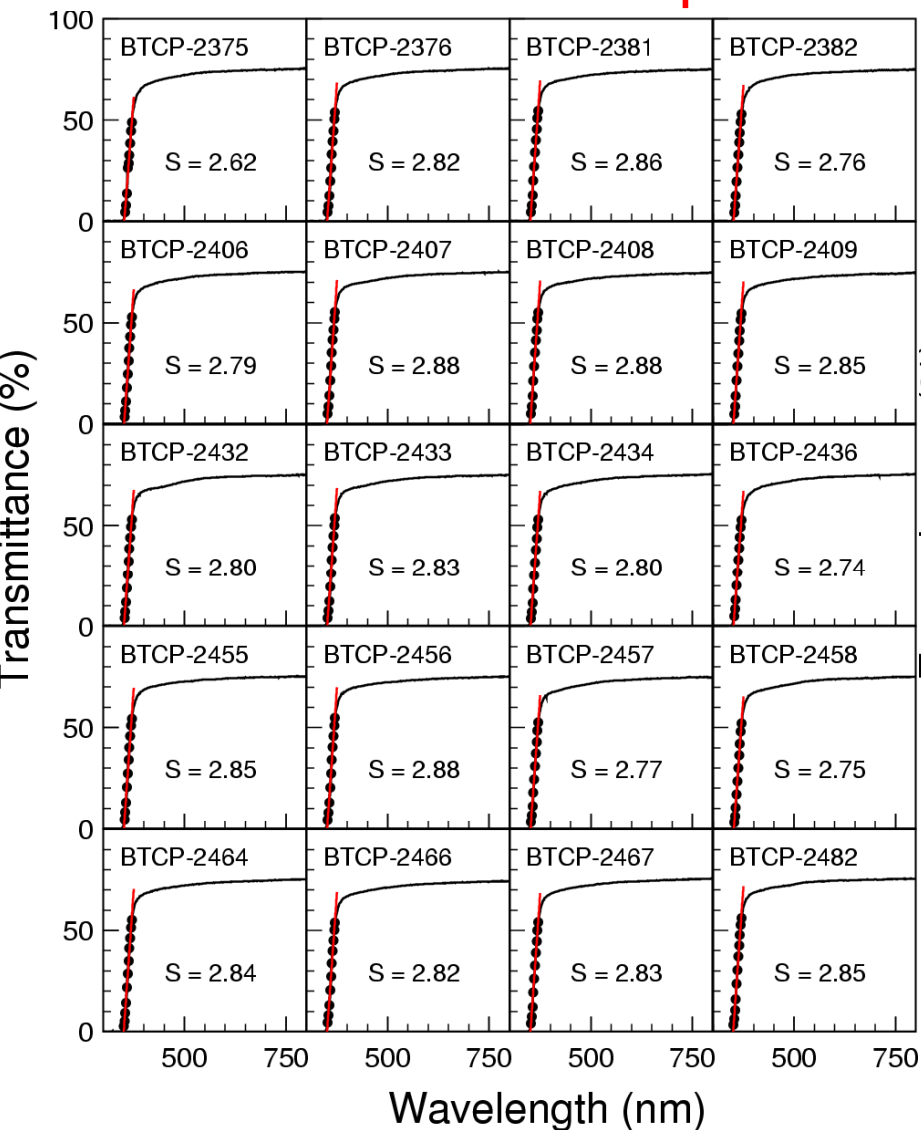
Fit Slope for the Initial LT Data

Fit region: 350 -- 370 nm for BTCP samples ("a" axis)
352 -- 372 nm for SIC samples ("c" axis)

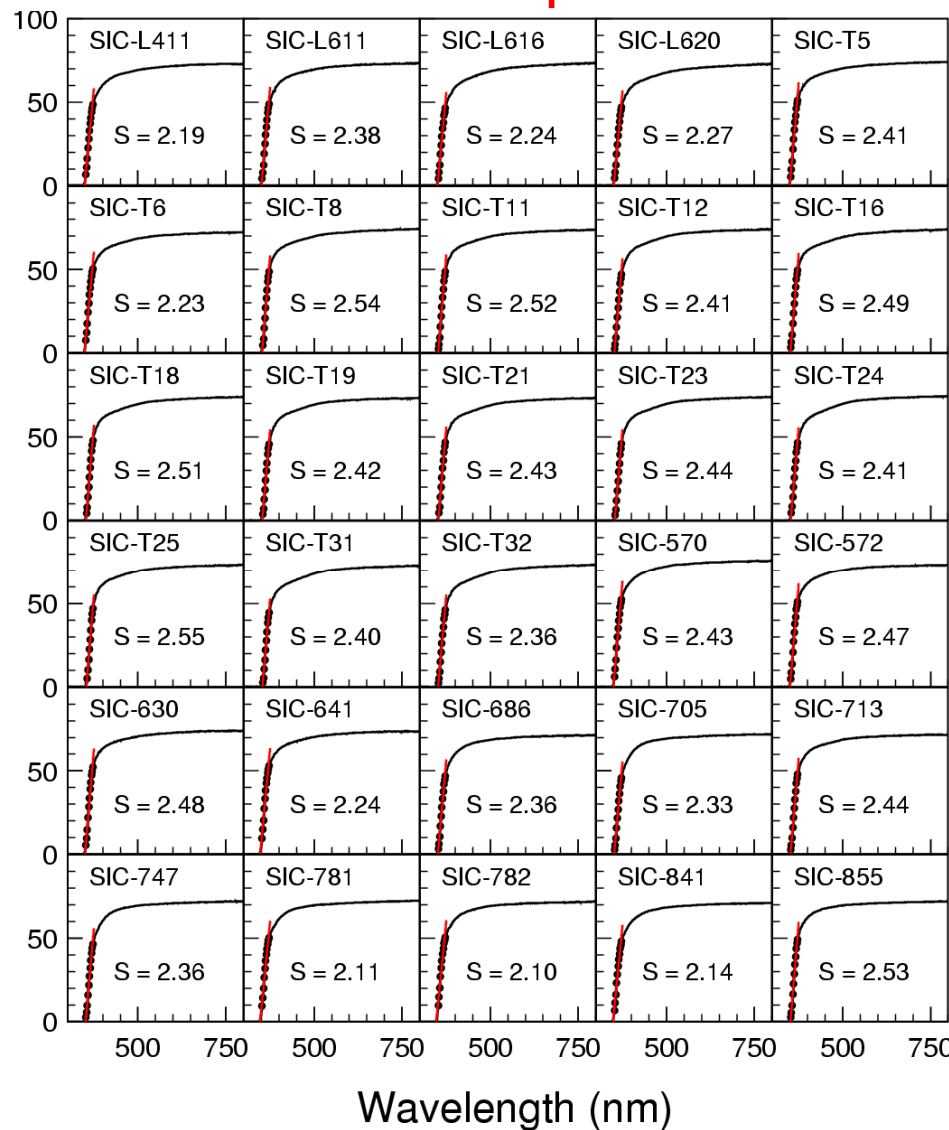


Slope Fits for BTCP and SIC Samples

20 BTCP Samples

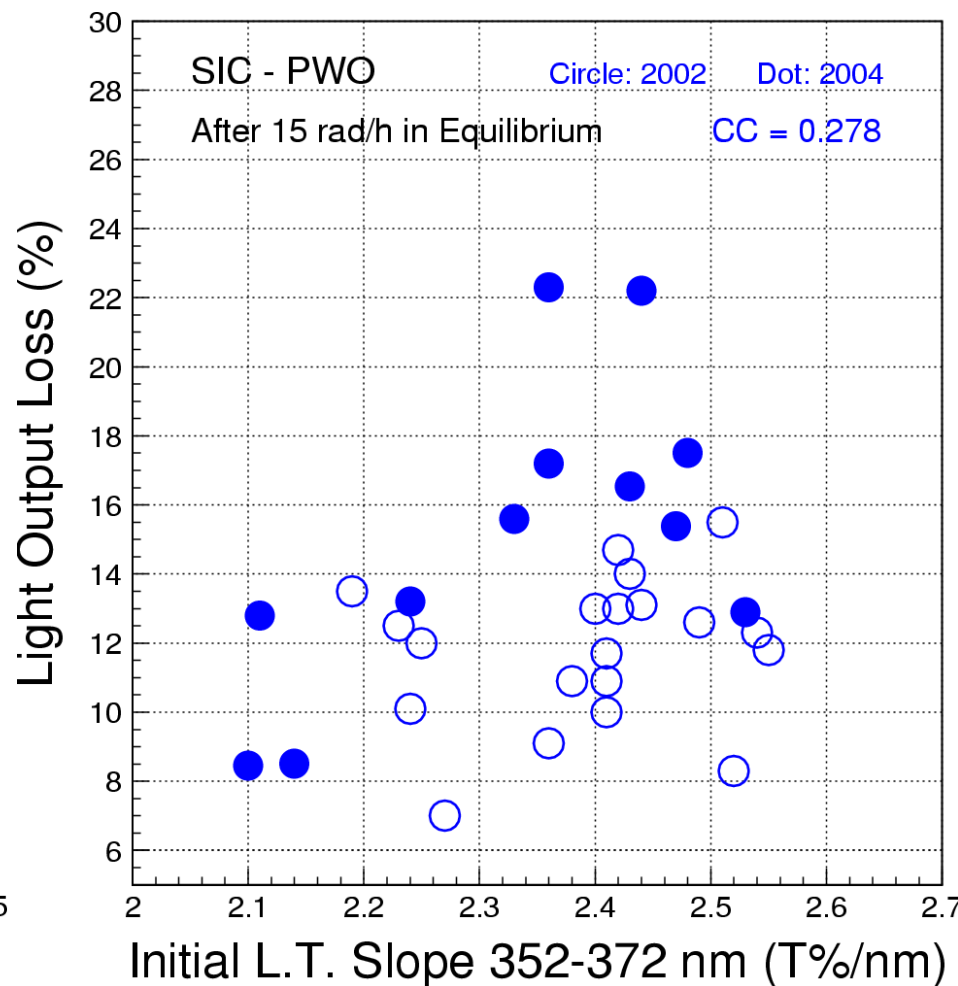
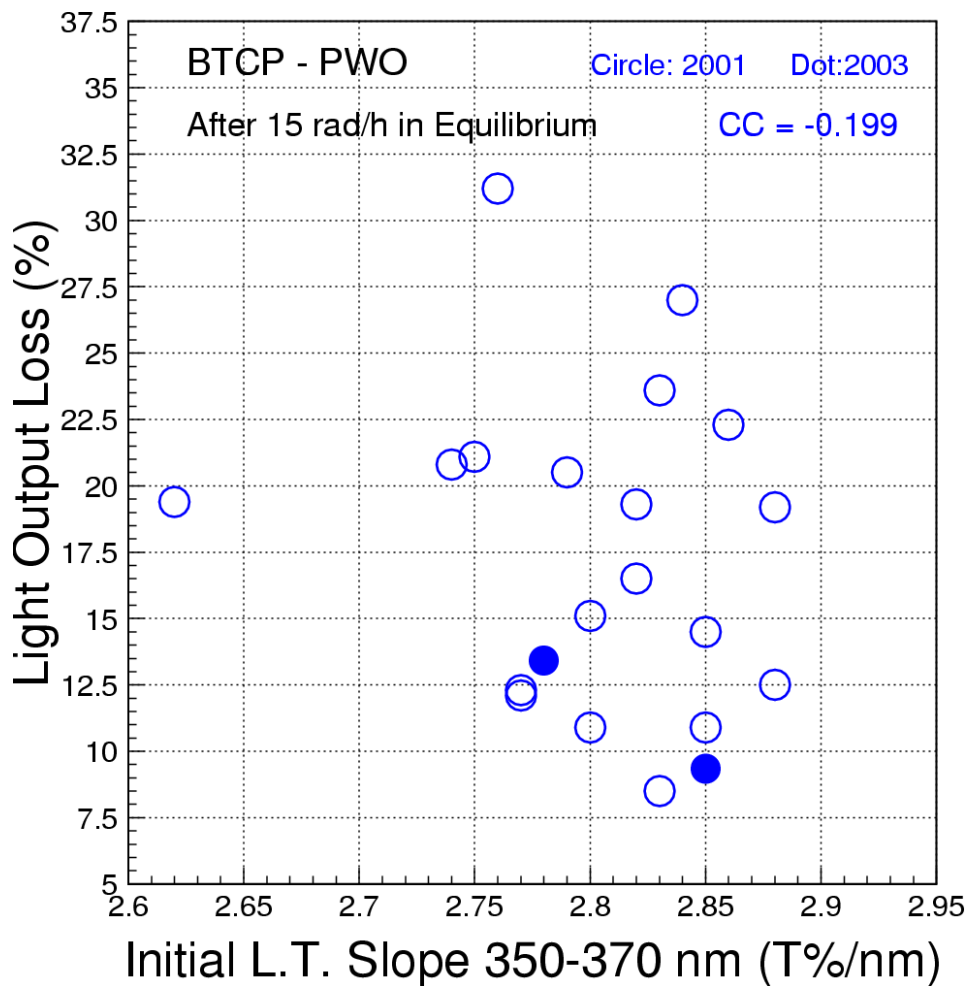


30 SIC Samples



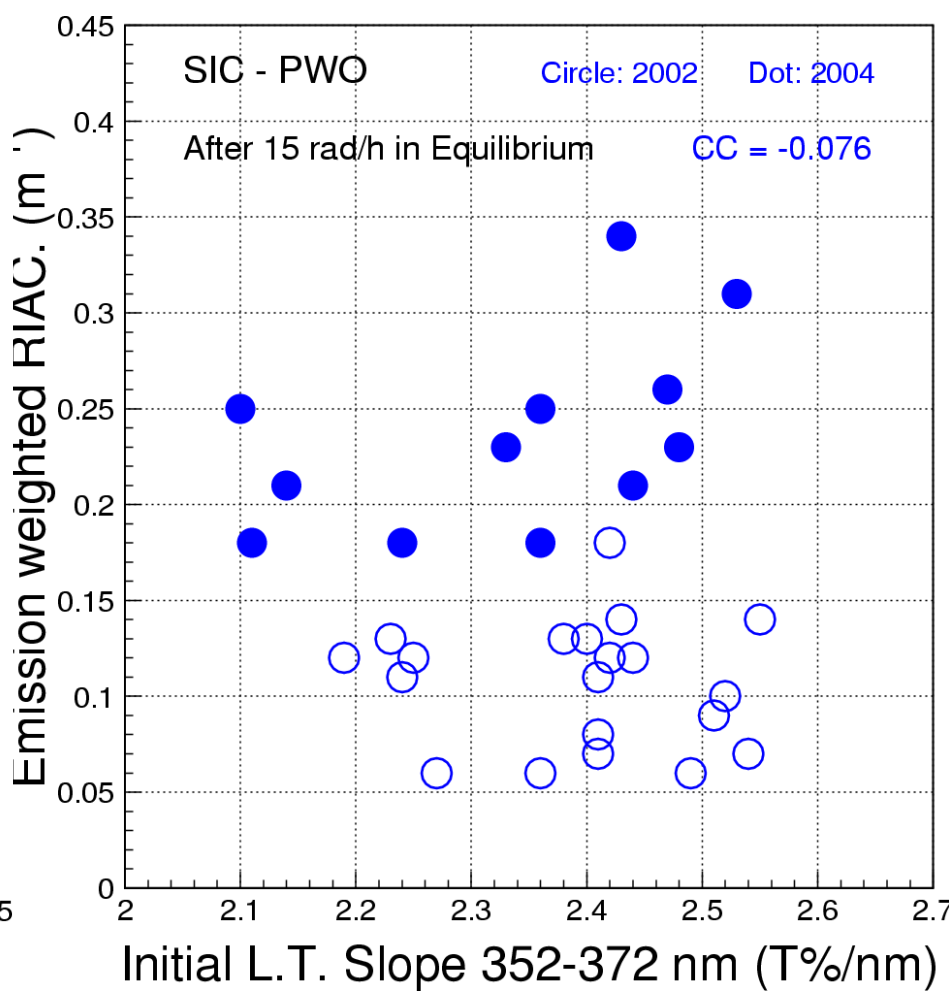
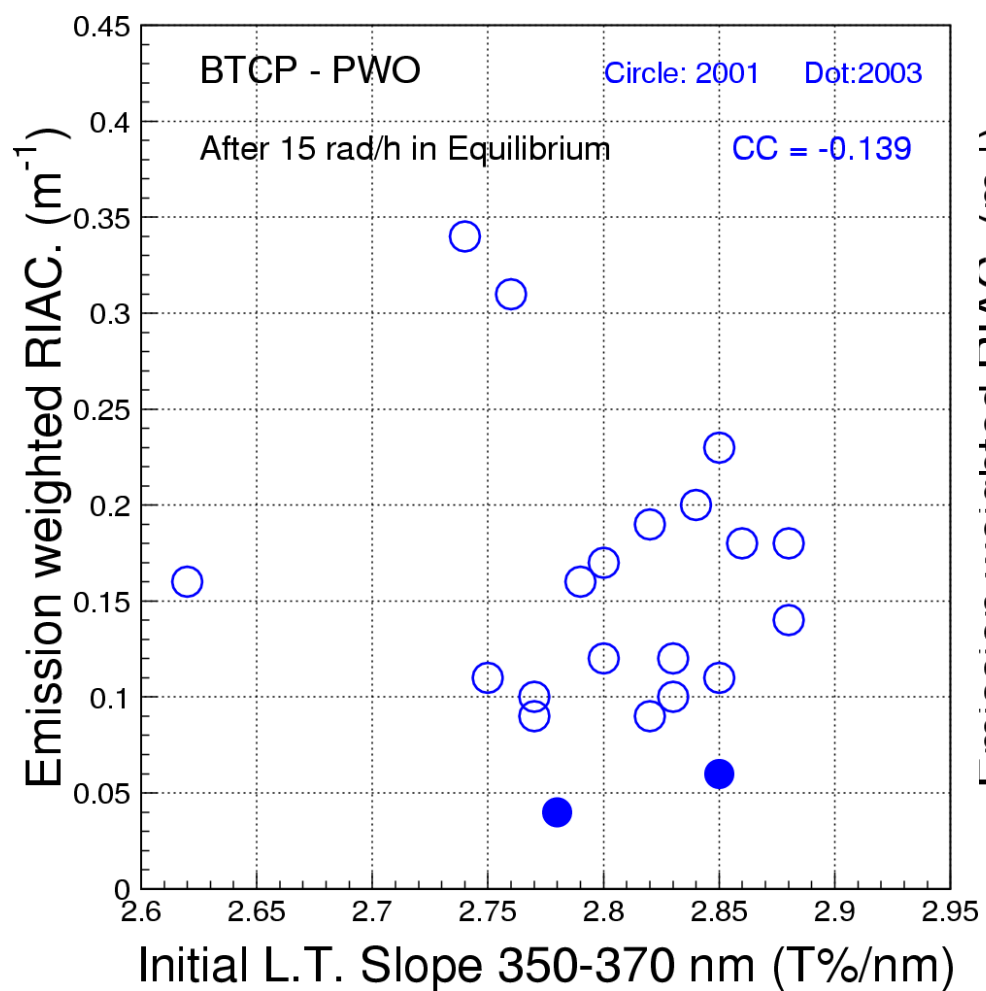
$\delta LO/LO$ @ 15 rad/h versus Slope

No correlation: Slope of initial LT is not correlated to the light output loss



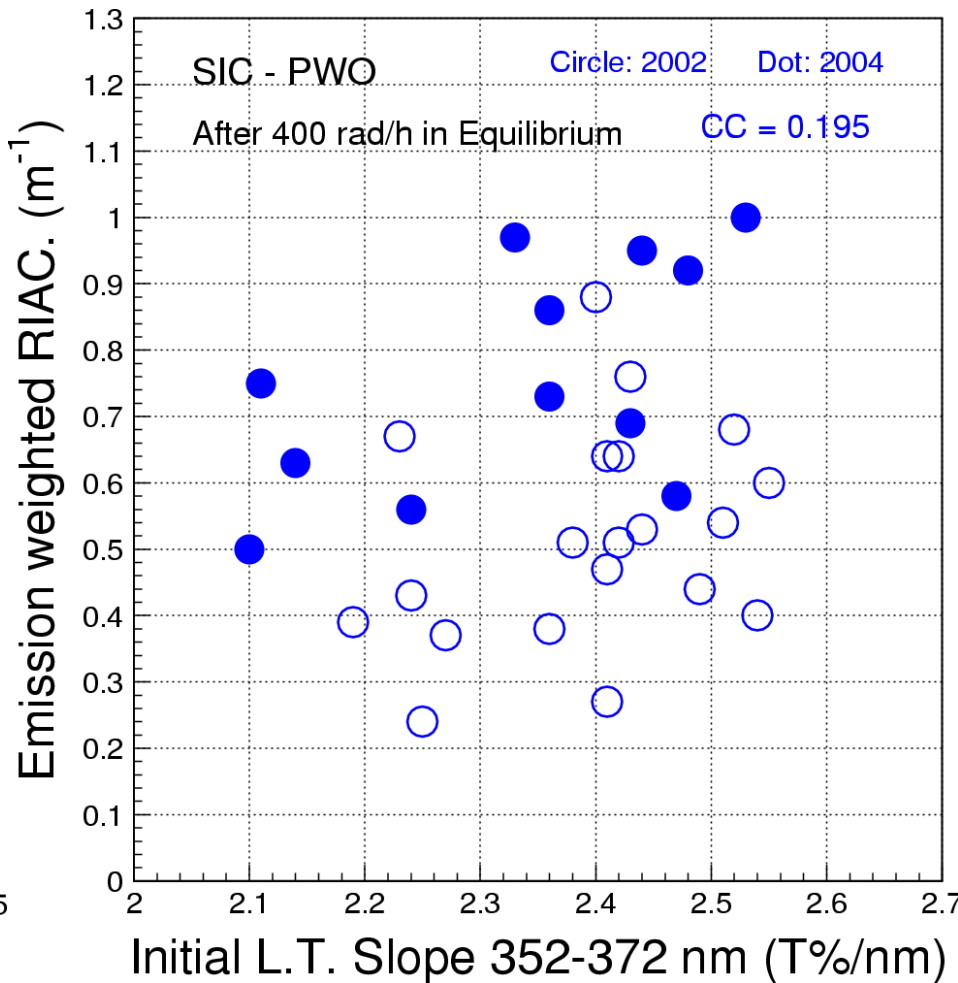
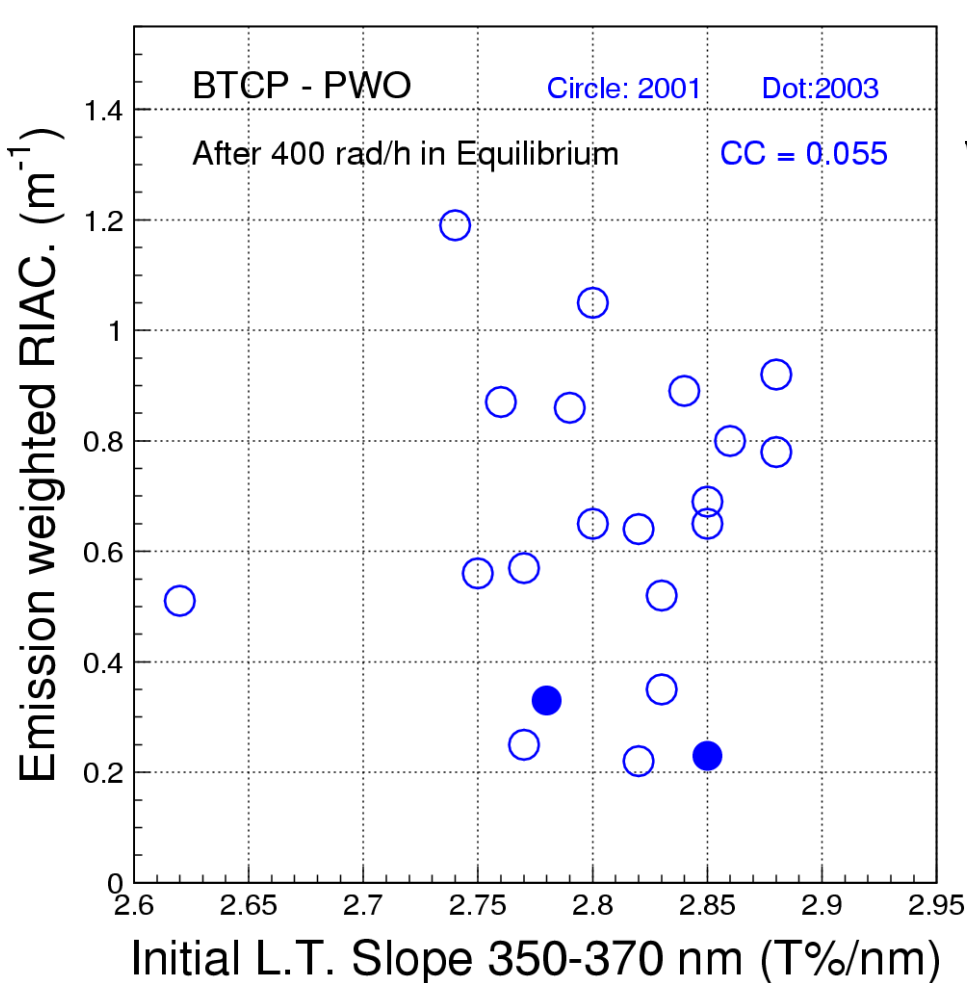
EWRIAC @ 15 rad/h versus Slope

No correlation: Slope of initial LT is not correlated to the radiation induced absorption



EWRIAC @ 400 rad/h versus Slope

No correlation: Slope of initial LT is not correlated to the radiation induced absorption

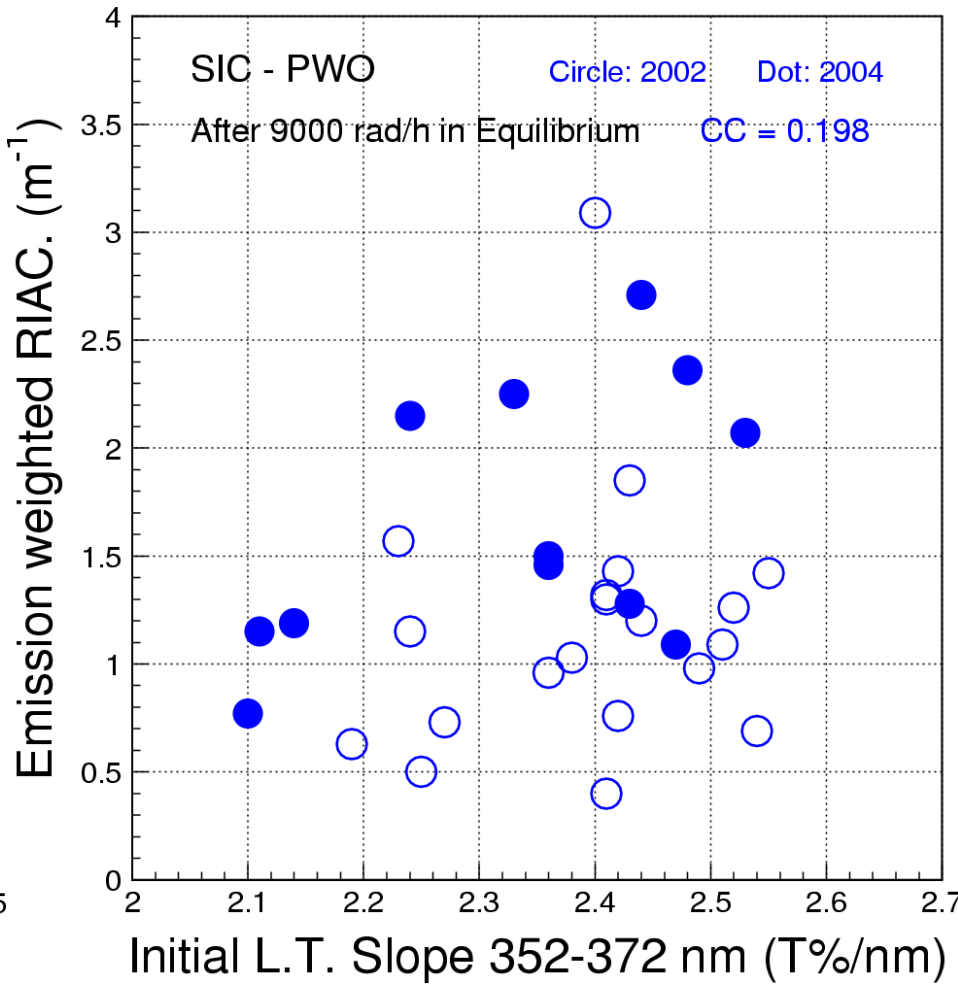
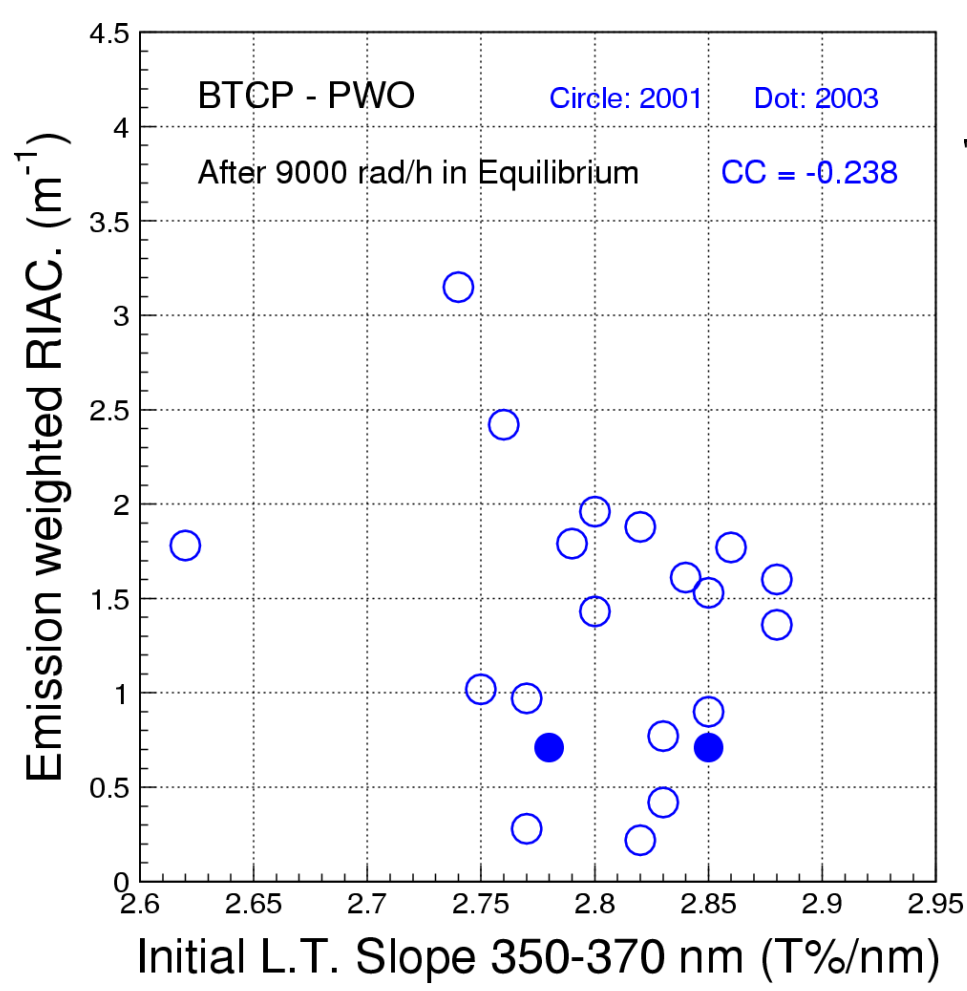




EWRIAC @ 9 krad/h versus Slope



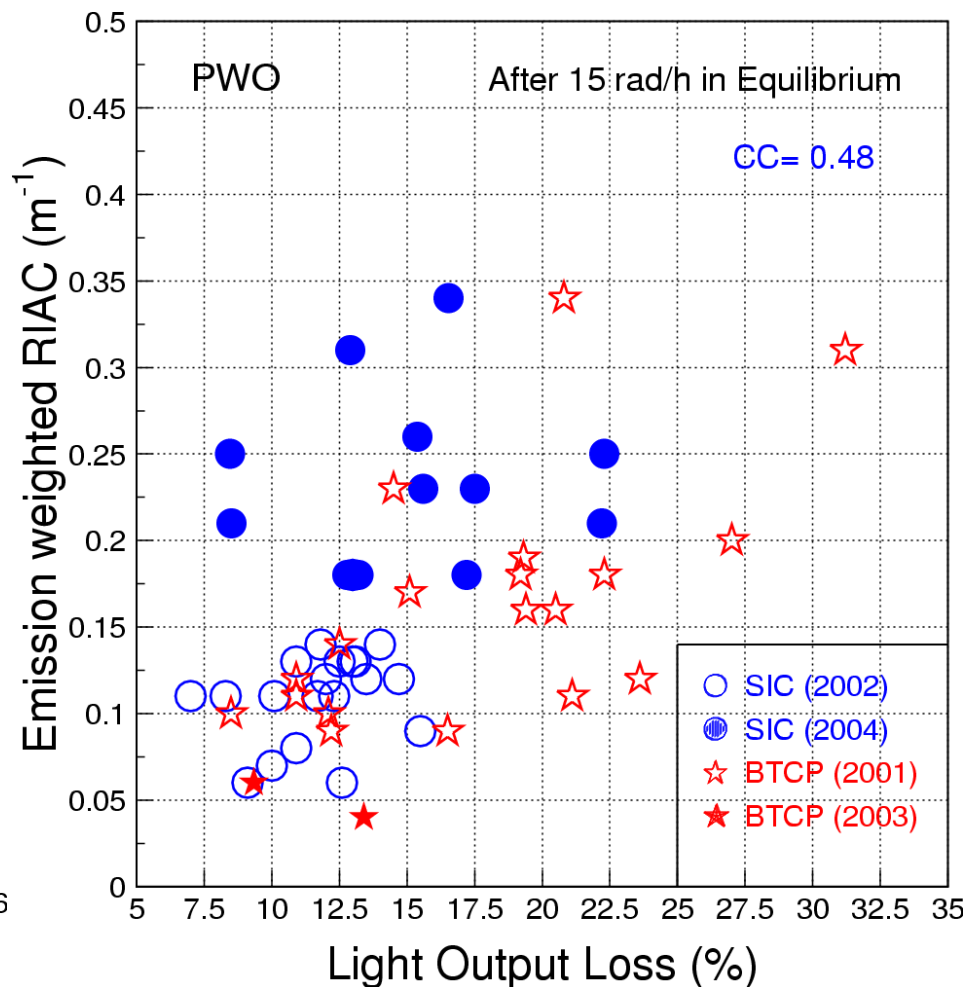
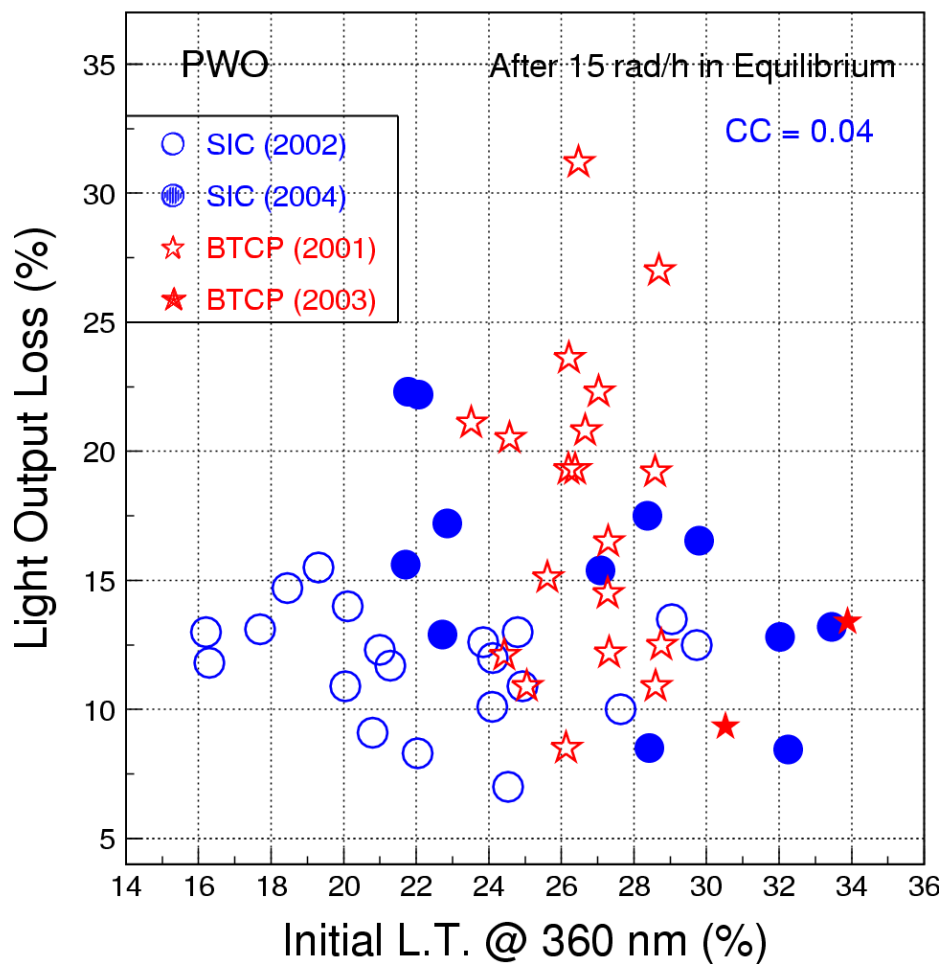
No correlation: Slope of initial LT is not correlated to the radiation induced absorption



$\delta LO/LO$ versus Initial LT and EWRIAC

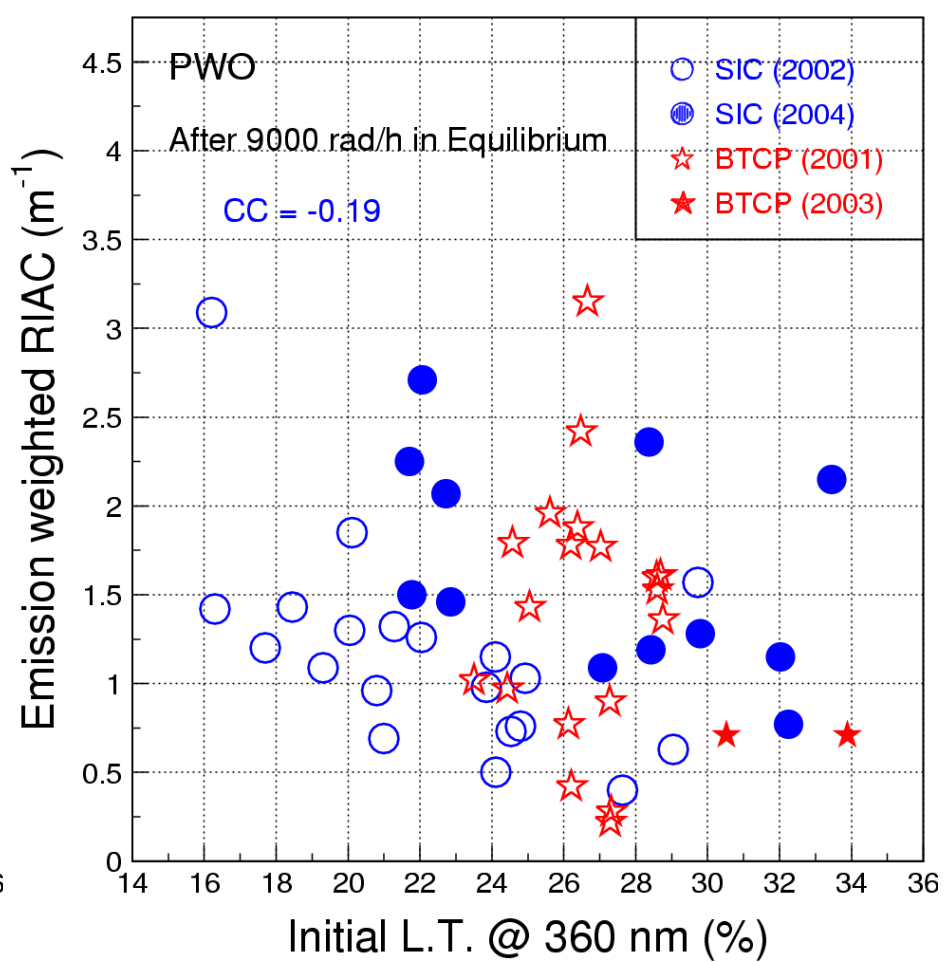
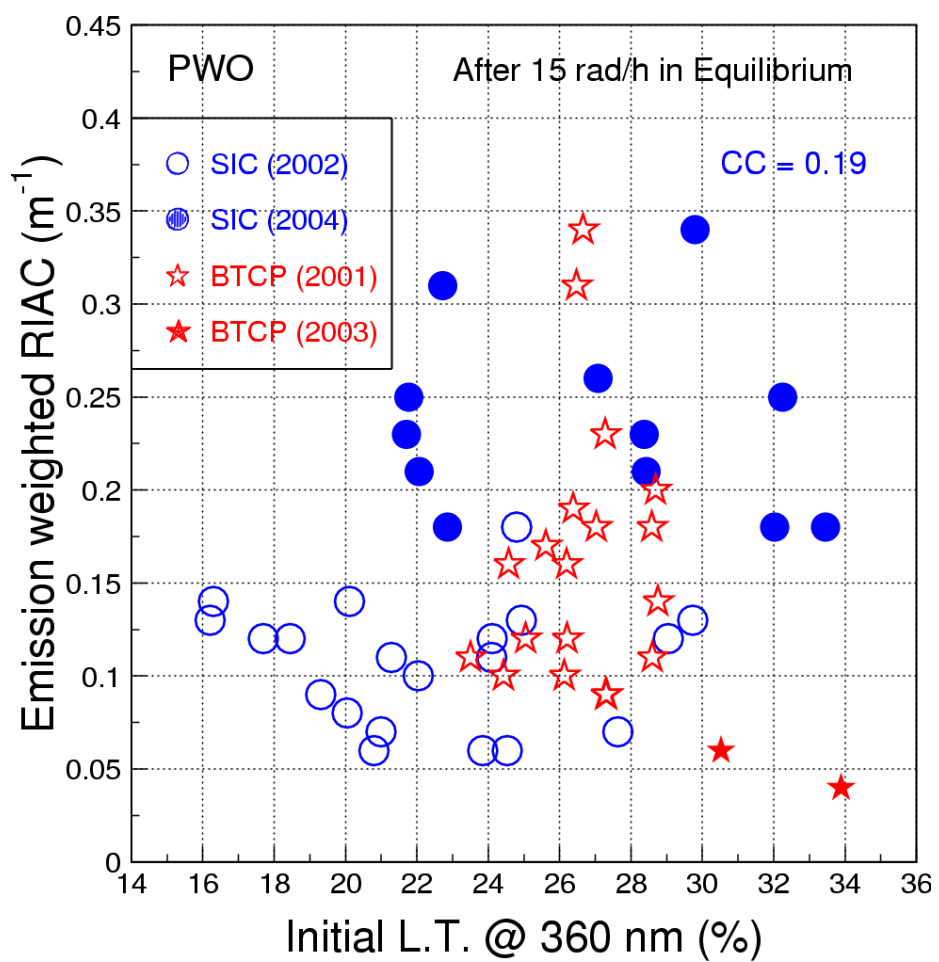
No correlation between $\delta LO/LO$ and Initial LT

Weak (0.48) correlation between $\delta LO/LO$ and EWRIAC



EWRIAC versus Initial LT

No correlation: preexisting absorption is not correlated with radiation induced absorption





Summary



- No correlations were found between the slope of crystals' initial longitudinal transmittance around the band edge and its radiation hardness for both BTCP and SIC samples.
- This result consists with the Rome group observation reported in the June 21, 2005, DPG meeting: 3/5 BAD Xtals with slope OK and 4/5 OK Xtals with slope BAD, indicating that slope at the band edge is not reliable.
- Recalling our previous result of no correlations between the initial LT and radiation hardness reported in the November 3, 2005, DPG meeting, it seems necessary to irradiate and sort endcap PWO crystals before installation.



Emission Weighted RIAC



All samples: EWRIAC < 1 m⁻¹ up to 400 rad/h

Rigorous QC required to qualify endcap crystals for SLHC

