Global alignment update

Nils Breer

29. November 2023

TU Dortmund, AG Albrecht

Tested various configurations for aligning the VELO and the SciFi together

VELO halves always aligned in ”TxTyTzRy”; SciFi aligned in ”TxRz(Rx)”

Here: Reconstruction sequence from the SciFi is used

Joint constraints used everywhere and set a very small Rx survey uncertainty

constrain readout side to nominal position of the C-Frame

example called ’v1’ here

```python
def configureGlobalAlignment(halfdofs="TxTyTzRy"):
    setup = AlignmentScenario('GlobalAlignment')
    setup.SubDetectors += ['VP', 'FT']

    elements = Alignables()
    elements.VP("None")
    elements.VPRight(halfdofs)
    elements.VPLeft(halfdofs)
    elements.FTHalfModules("TxRxRz")

    setup.Elements += list(elements)

    surveyconstraints = SurveyConstraints()
    if UseDD4Hep:
        surveyconstraints.VP(ver='2023_dd4hep')
        surveyconstraints.FT(addHalfModuleJoints=True)
    else:
        surveyconstraints.VP(ver='latest')
    setup.SurveyConstraints = surveyconstraints

    constraints = []
    constraints.append("VPHalfAverage : .*?VP(Left|Right) : Tx Ty Tz Ry")
    constraints.append("FTBackFramesFixed : FT/T3/X2/HL.*/M. : Tx Rz")
    setup.LagrangeConstraints = constraints

    return setup
```

Alignment configurations

v1: SciFi (TxRxRz), no SciFi survey

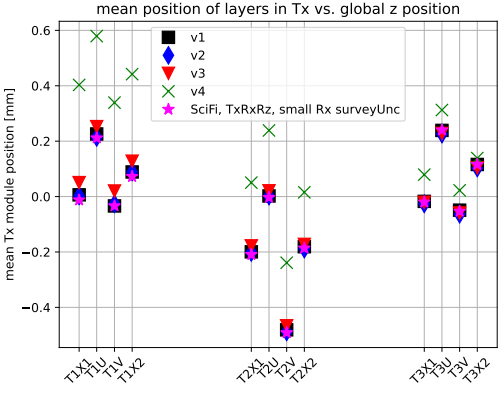
v2: SciFi (TxRz), no SciFi survey

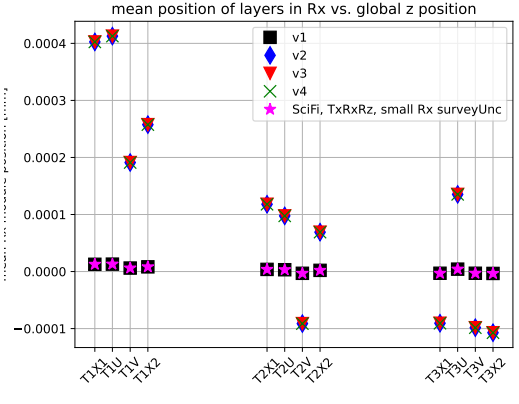
v3: SciFi (TxRz), SciFi C-Frames survey

v4: SciFi (TxRz), SciFi C-Frames survey, constrain (U|V) layer in T2 for Tx Rz

Global alignment: Tx, Rx vs global z position

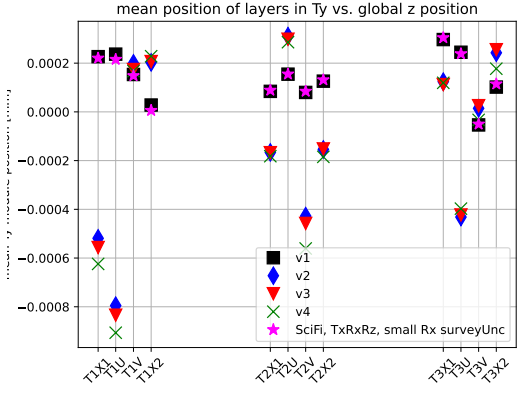
mean Tx in [mm], Rx in [rad] of each layer

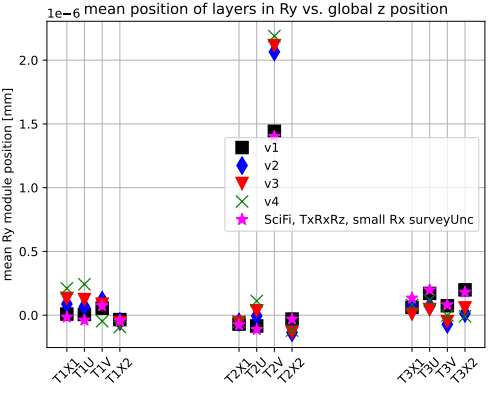




Global alignment: Ty, Ry vs global z position

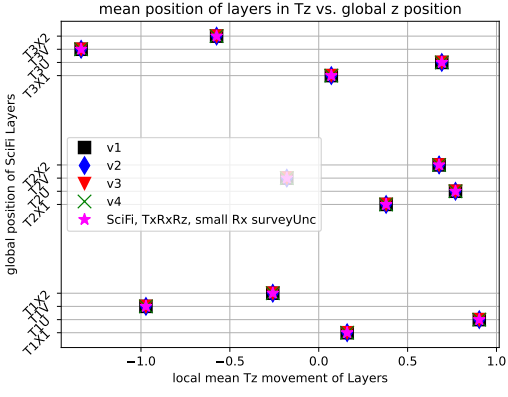
mean Ty in [mm], Ry in [rad] of each layer

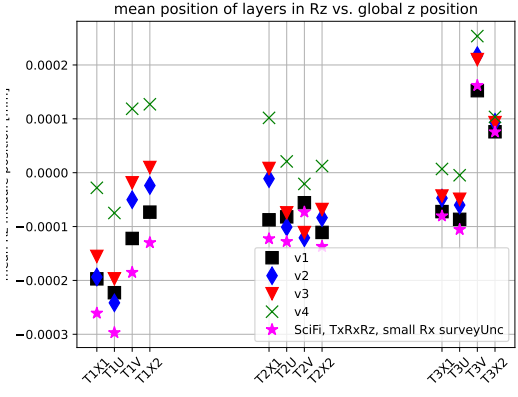




Global alignment: Tz, Rz vs global z position

mean Tz in [mm], Rz in [rad] of each layer





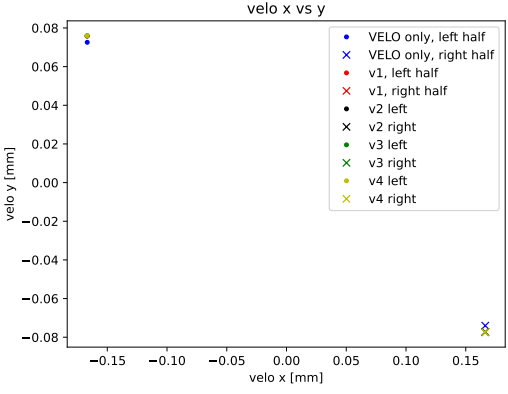
without aligning Rx there will be a non-zero Rx; maximum 0.4 mrad

visible but small z-rotation across stations

Tx constraint in v4 shifted everything closer to zero but didn't solve the problem for Tx behaviour

Ty worse when NOT aligning for Rx →joint constraint or C-Frame survey cannot correct for that

Comparison VELO only vs global constants



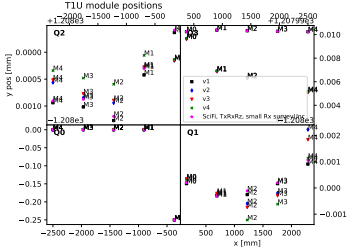
dots: left velo half; crosses: right velo half

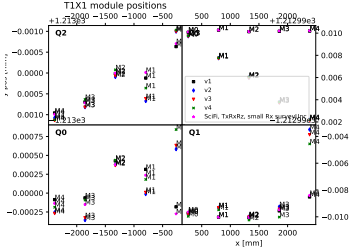
v1 →v4 nearly identical (on top of each other)

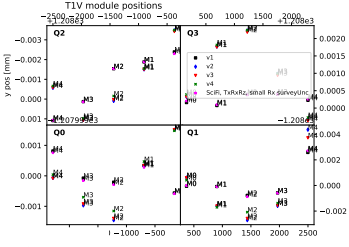
difference between VELO only and from the global alignment: 3.5 μm

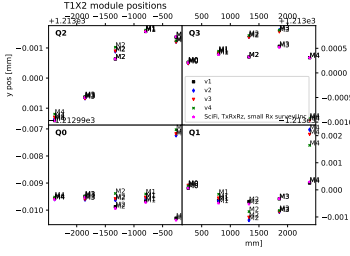
→is this withing the VELO acceptance or is 3.5 μm problematic?

T1 SciFi module constants in global: x vs y

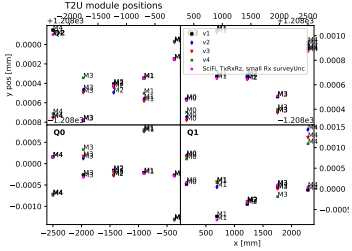


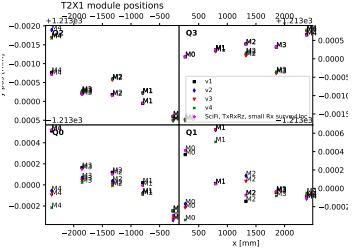


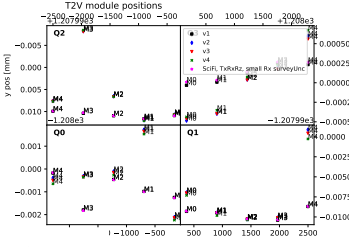


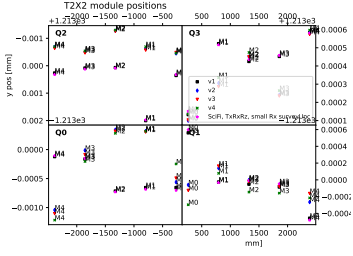


T2 SciFi module constants in global: x vs y

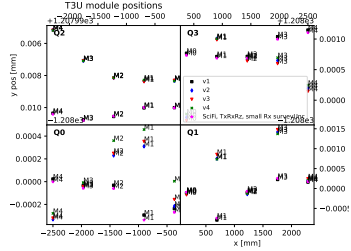


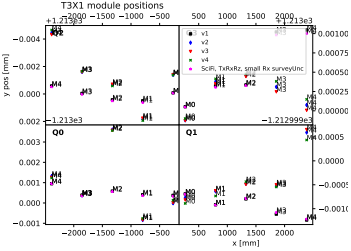


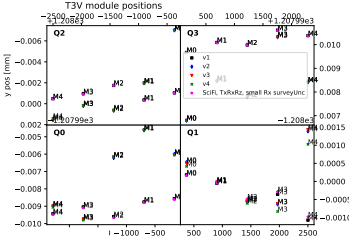


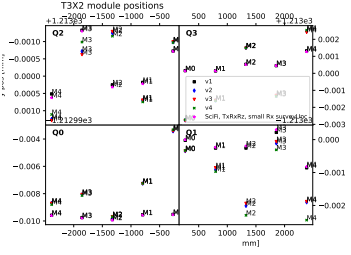


T3 SciFi module constants in global: x vs y

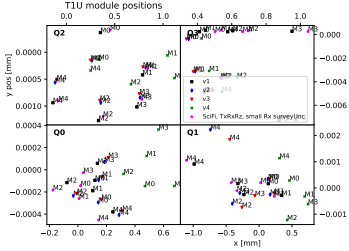


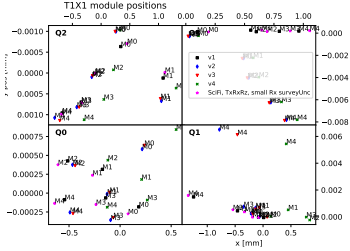


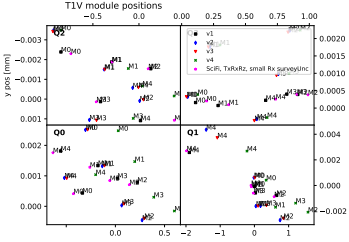


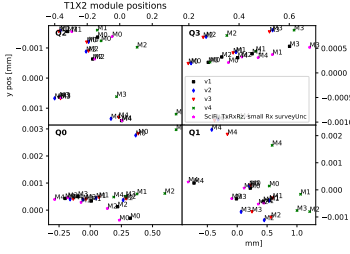


T1 SciFi module constants in local: x vs y

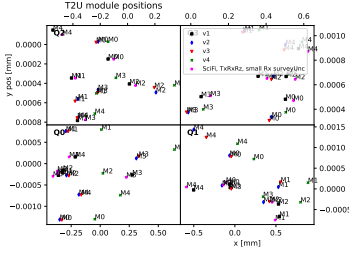


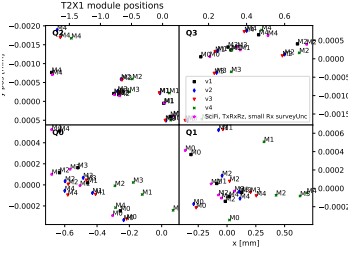


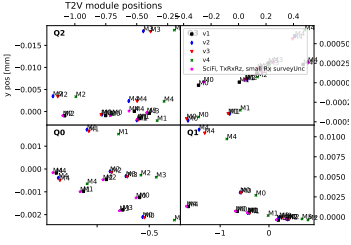


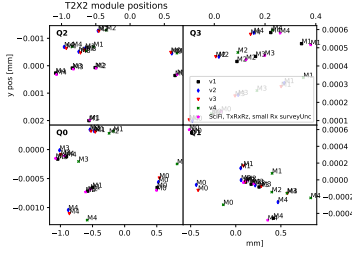


T2 SciFi module constants in local: x vs y

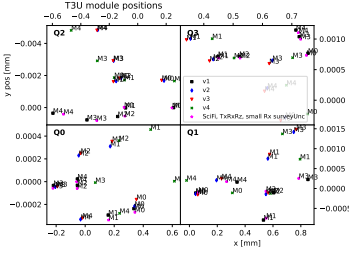


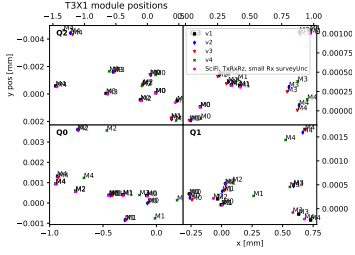


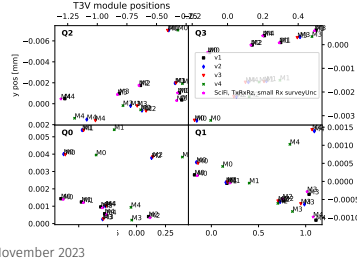


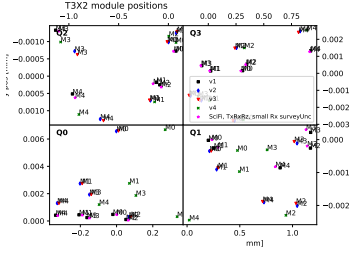


T3 SciFi module constants in local: x vs y

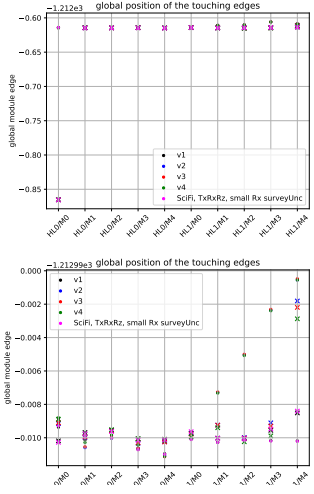








module edge difference in y direction



dots: middle edge of top half module, cross: middle edge of bottom half module

joints uncertainties: 0.01 0.0012 0.0019 0.0004 0.0002 0.00017

→half modules fairly close everywhere, but T1UQ0M0

T1X1: Q1 is drifting from Q3