

## Abstract

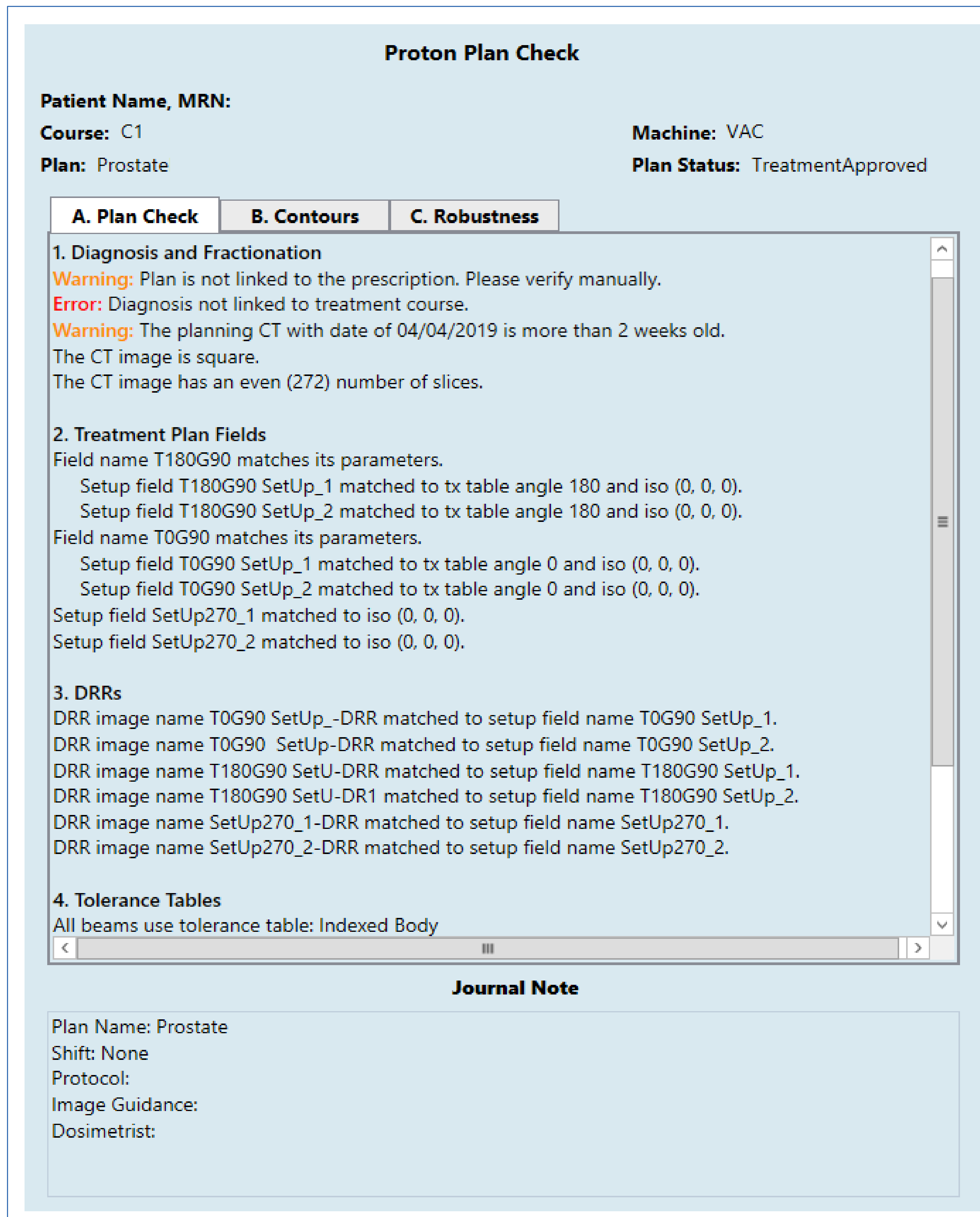
**Introduction:** For several treatment planning systems, scripting can be used as a complementary tool to automate components of treatment planning, plan check and patient-specific quality assurance. During treatment planning, several iterations of a plan are generated until the expected dosimetric and plan quality constraints are met. With increased iterations, errors can be made in the plan that could affect patient treatment. Using Varian's Eclipse treatment planning system, several routine tasks and checks can be scripted to assist with document completion, identify gross errors, improve consistency, and enforce professional recommendations such as TG-263.

**Methods:** Based on our planning guidelines, a script was developed using the Eclipse Application Programming Interface (ESAPI) to be used during treatment planning and physics plan check. A total of 15 checks were programmed pertaining to planned dose and fractionation, treatment and setup fields, contour naming, and plan robustness. For each plan evaluated, the easy to read interface automatically generated a list of the aforementioned categories and checks, and reported either a compliance or error status for each parameter of interest.

**Results:** The script reduced the time spent in plan finalization by explicitly indicating those items needing attention and assisting with plan documentation. During the physics plan check, the script reduced the number of manual tasks performed and simplified the process by automating routine checks, such as Hounsfield unit overrides and correct labeling of treatment fields.

**Conclusions:** The use of scripting to aide with routine tasks in treatment planning and plan check has been beneficial to our clinic by increasing plan consistency, department efficiency and diminishing the number of undetected errors.

## Proton Plan Check with ESAPI



**Proton Plan Check**

Patient Name, MRN: \_\_\_\_\_  
 Course: C1 Machine: VAC  
 Plan: Prostate Plan Status: TreatmentApproved

**A. Plan Check** **B. Contours** **C. Robustness**

**1. Diagnosis and Fractionation**  
**Warning:** Plan is not linked to the prescription. Please verify manually.  
**Error:** Diagnosis not linked to treatment course.  
**Warning:** The planning CT with date of 04/04/2019 is more than 2 weeks old.  
 The CT image is square.  
 The CT image has an even (272) number of slices.

**2. Treatment Plan Fields**  
 Field name T180G90 matches its parameters.  
 Setup field T180G90 Setup\_1 matched to tx table angle 180 and iso (0, 0, 0).  
 Setup field T180G90 Setup\_2 matched to tx table angle 180 and iso (0, 0, 0).  
 Field name T0G90 matches its parameters.  
 Setup field T0G90 Setup\_1 matched to tx table angle 0 and iso (0, 0, 0).  
 Setup field T0G90 Setup\_2 matched to tx table angle 0 and iso (0, 0, 0).  
 Setup field Setup270\_1 matched to iso (0, 0, 0).  
 Setup field Setup270\_2 matched to iso (0, 0, 0).

**3. DRRs**  
 DRR image name T0G90 Setup\_-DRR matched to setup field name T0G90 Setup\_1.  
 DRR image name T0G90 Setup\_-DRR matched to setup field name T0G90 Setup\_2.  
 DRR image name T180G90 Setup-DRR matched to setup field name T180G90 Setup\_1.  
 DRR image name T180G90 Setup-DR1 matched to setup field name T180G90 Setup\_2.  
 DRR image name Setup270\_1-DRR matched to setup field name Setup270\_1.  
 DRR image name Setup270\_2-DRR matched to setup field name Setup270\_2.

**4. Tolerance Tables**  
 All beams use tolerance table: Indexed Body

**Journal Note**

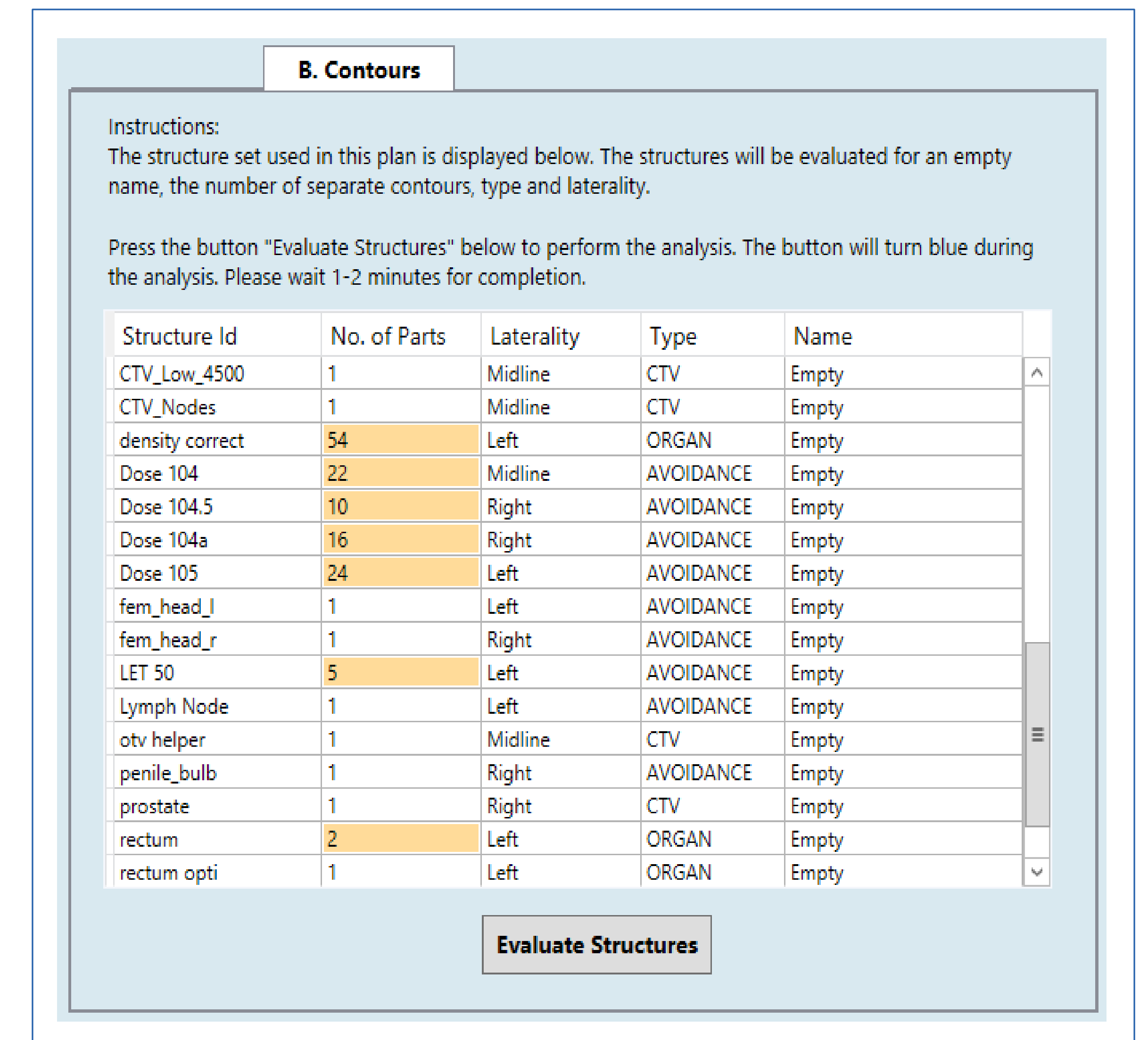
Plan Name: Prostate  
 Shift: None  
 Protocol:  
 Image Guidance:  
 Dosimetrist:

**Figure 1.** The main user interface displays a summary of the results for checks extending to the plan CT, treatment fields, DRRs, tolerance tables, target expansions and Hounsfield unit overrides. Identified warnings and errors are highlighted and presented to the user for evaluation and/or correction.

### Automated Plan Checks:

- Correct dose and fractionation
- DRRs exist and are named correctly
- Treatment field IDs match gantry and table parameters
- Correct setup fields exist
- Correct tolerance table is used
- CTV is included in STV expansion
- Field targets are inside body
- Correct HU overrides
- Plan robustness
- Contours check (laterality, number of parts, structure type and name)
- Editable journal note populated automatically

## Contours Check



**B. Contours**

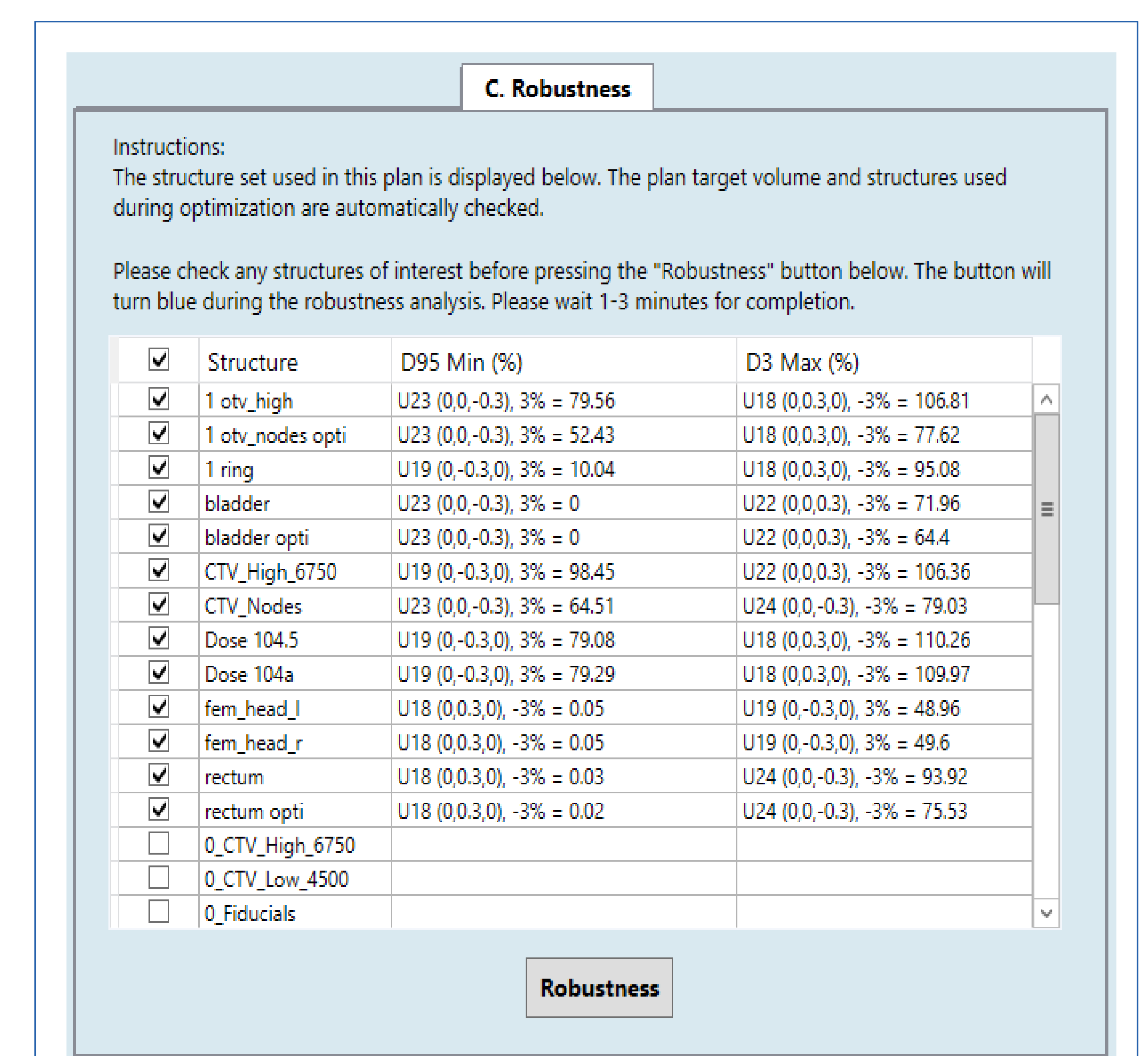
Instructions:  
 The structure set used in this plan is displayed below. The structures will be evaluated for an empty name, the number of separate contours, type and laterality.  
 Press the button "Evaluate Structures" below to perform the analysis. The button will turn blue during the analysis. Please wait 1-2 minutes for completion.

Structure Id	No. of Parts	Laterality	Type	Name
CTV_Low_4500	1	Midline	CTV	Empty
CTV_Nodes	1	Midline	CTV	Empty
density correct	54	Left	ORGAN	Empty
Dose 104	22	Midline	AVOIDANCE	Empty
Dose 104.5	10	Right	AVOIDANCE	Empty
Dose 104a	16	Right	AVOIDANCE	Empty
Dose 105	24	Left	AVOIDANCE	Empty
fem_head_l	1	Left	AVOIDANCE	Empty
fem_head_r	1	Right	AVOIDANCE	Empty
LET 50	5	Left	AVOIDANCE	Empty
Lymph Node	1	Left	AVOIDANCE	Empty
otv_helper	1	Midline	CTV	Empty
penile_bulb	1	Right	AVOIDANCE	Empty
prostate	1	Right	CTV	Empty
rectum	2	Left	ORGAN	Empty
rectum_opti	1	Left	ORGAN	Empty

**Evaluate Structures**

**Figure 2.** The contours tab evaluates each plan structure to identify the number of separate contours, laterality, DICOM type and name tag. Color highlights are used to identify warning and errors in each of the checks. Multiple separate contours are highlighted in yellow to indicate warnings, while issues in laterality, DICOM type and name tags are highlighted in red to indicate an error that requires correction.

## Plan Robustness



**C. Robustness**

Instructions:  
 The structure set used in this plan is displayed below. The plan target volume and structures used during optimization are automatically checked.  
 Please check any structures of interest before pressing the "Robustness" button below. The button will turn blue during the robustness analysis. Please wait 1-3 minutes for completion.

Structure	D95 Min (%)	D3 Max (%)
<input checked="" type="checkbox"/> 1_otv_high	U23 (0,0,-0.3), 3% = 79.56	U18 (0,0,3.0), -3% = 106.81
<input checked="" type="checkbox"/> 1_otv_nodes_opti	U23 (0,0,-0.3), 3% = 52.43	U18 (0,0,3.0), -3% = 77.62
<input checked="" type="checkbox"/> 1_ring	U19 (0,-0.3,0), 3% = 10.04	U18 (0,0,3.0), -3% = 95.08
<input checked="" type="checkbox"/> bladder	U23 (0,0,-0.3), 3% = 0	U22 (0,0,0.3), -3% = 71.96
<input checked="" type="checkbox"/> bladder_opti	U23 (0,0,-0.3), 3% = 0	U22 (0,0,0.3), -3% = 64.4
<input checked="" type="checkbox"/> CTV_High_6750	U19 (0,-0.3,0), 3% = 98.45	U22 (0,0,0.3), -3% = 106.36
<input checked="" type="checkbox"/> CTV_Nodes	U23 (0,0,-0.3), 3% = 64.51	U24 (0,0,-0.3), -3% = 79.03
<input checked="" type="checkbox"/> Dose 104.5	U19 (0,-0.3,0), 3% = 79.08	U18 (0,0,3.0), -3% = 110.26
<input checked="" type="checkbox"/> Dose 104a	U19 (0,-0.3,0), 3% = 79.29	U18 (0,0,3.0), -3% = 109.97
<input checked="" type="checkbox"/> fem_head_l	U18 (0,0,3.0), -3% = 0.05	U19 (0,-0.3,0), 3% = 48.96
<input checked="" type="checkbox"/> fem_head_r	U18 (0,0,3.0), -3% = 0.05	U19 (0,-0.3,0), 3% = 49.6
<input checked="" type="checkbox"/> rectum	U18 (0,0,3.0), -3% = 0.03	U24 (0,0,-0.3), -3% = 93.92
<input checked="" type="checkbox"/> rectum_opti	U18 (0,0,3.0), -3% = 0.02	U24 (0,0,-0.3), -3% = 75.53
<input type="checkbox"/> 0_CTV_High_6750		
<input type="checkbox"/> 0_CTV_Low_4500		
<input type="checkbox"/> 0_Fiducials		

**Robustness**

**Figure 3.** For the user selected structures, the robustness DVHs are evaluated to identify the minimum D95 and maximum D3. The results are presented to the user with a display of the resulting shift and dose variance.