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SDC
SOLENOIDAL DETECTOR NOTES

RADIATION DAMAGE STUDIES

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We have measured the effects of radiation damage on the optical response of scintillation tiles from Kurarary (SCSN81), Nuclear Enterprise (NE118 and DEV495) and Poly-Hi-Tech (PHT). The tiles tested were approximately 10 cm x 10 cm x 3.5 mm. They were exposed to gamma radiation from a ^{60}Co source at the LSU Nuclear Science Center. The optical response of the tiles to beta rays was measured using a collimated ^{106}Ru source on the LSU scanning table. Details of the setup and procedures are described in SDC note 92-172. The present setup differs from that described by having larger area trigger and veto counters to permit scanning of larger tiles. The changes are not important for this study. For these measurements the tiles were readout using Y7 wavelength shifter bars rather then by fibers. A Hammamatsu R878 photomultiplier tube collected light both from the tile being tested for radiation damage and from a reference tile.

Figs. 1a, 1b and 1c show the recovery curves of 3.52 mm thick SCSN81 tiles after exposure to 0.5, 1 and 2 MRAD respectively of gamma radiation. These curves show a flat response (within errors) for the first 12 days after exposure.

Figs. 2 and 3 show recovery curves after a 1 MRAD exposure for two 3.43 mm thick tiles made from NE118 from Nuclear Enterprise. These tiles show similar radiation damage effects as SCSN81. The absolute lightout before radiation is 82% of that measured with SCSN81 tiles. We also tested tiles of NE DEV495, a green scintillator. They were tested using our standard Y7 wavelength shifter for readout and thus they were not properly matched in wavelength. Figs. 4 and 5 show the response from two tiles 3.51 mm thick of NE DEV495 exposed to 1 MRAD of radiation. The absolute light yield before radiation of these tiles is 20% of that of SCSN81 tiles.

Fig. 6 shows the recovery curve of a 3.71 mm thick tile from Poly-Hi-Tech exposed to 1 MRAD. It shows about twice as much loss as for an SCSN81 tile exposed to 1 MRAD. The lightout before radiation is 40% of SCSN81 tiles. Fig. 7 shows results for a PHT fiber (W0050) exposed to 1 MRAD. The fiber was 2 m long and 1 mm in diameter. It was tested before and after radiation by installing one end in a U groove in a 10 cm x 10 cm x 3.6 mm RH1 Bicron tile. The other end was coupled to a PMT by a small

transition piece. It shows much more radiation damage than we have seen for Bicron BCF91-A fibers.

In conclusion none of the scintillation tiles tested are superior to SCSN81 or SCSN38 tiles.

ACKNOWLEDGEMENTS

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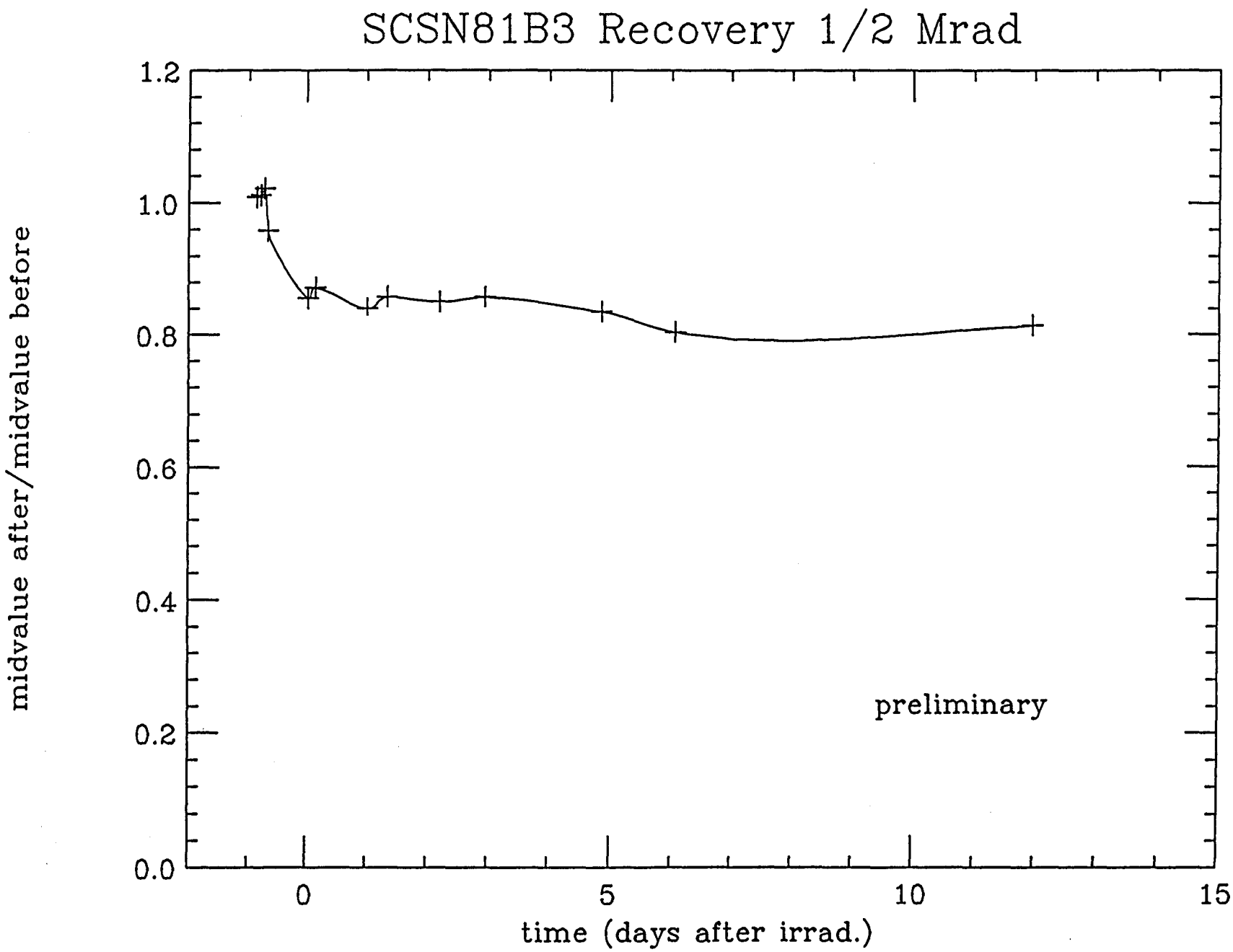
SCSN81B3 Recovery 1/2 Mrad
midvalue after/midvalue before
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
time (days after irrad.)
preliminary

Fig 1a

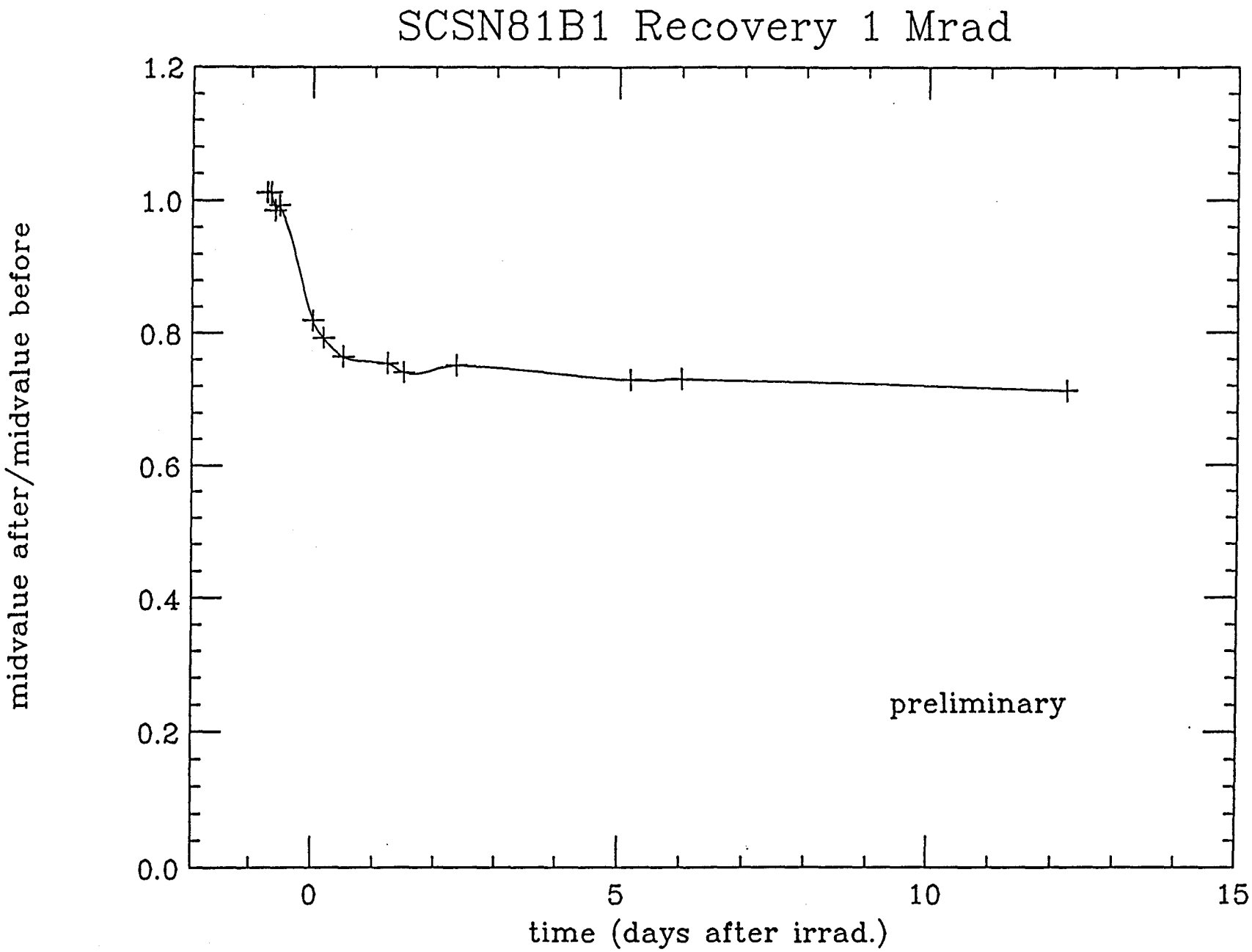
SCSN81B1 Recovery 1 Mrad
midvalue after/midvalue before
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
time (days after irrad.)
preliminary

Fig 1b

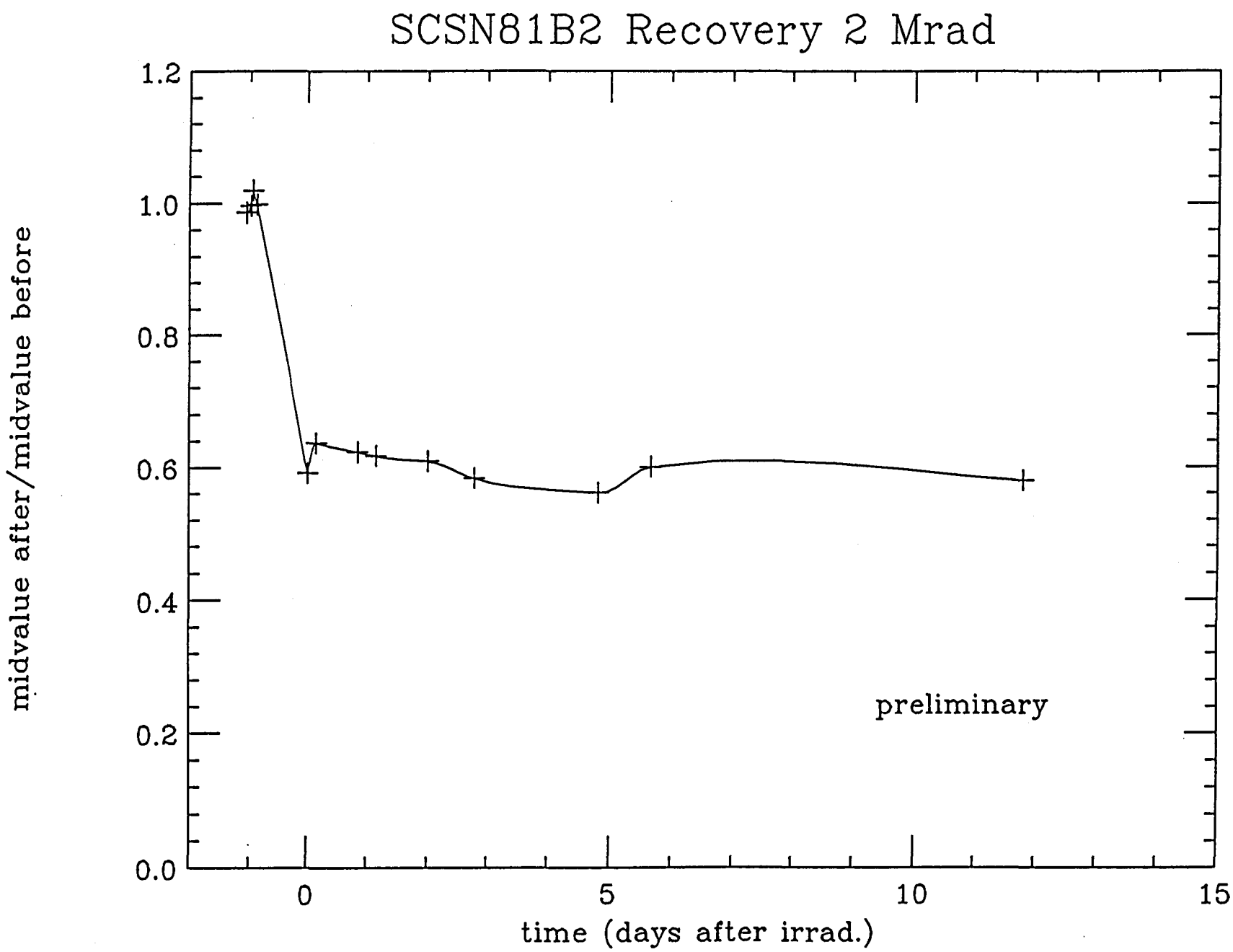
SCSN81B2 Recovery 2 Mrad
midvalue after/midvalue before
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
time (days after irrad.)
preliminary

Fig 1c

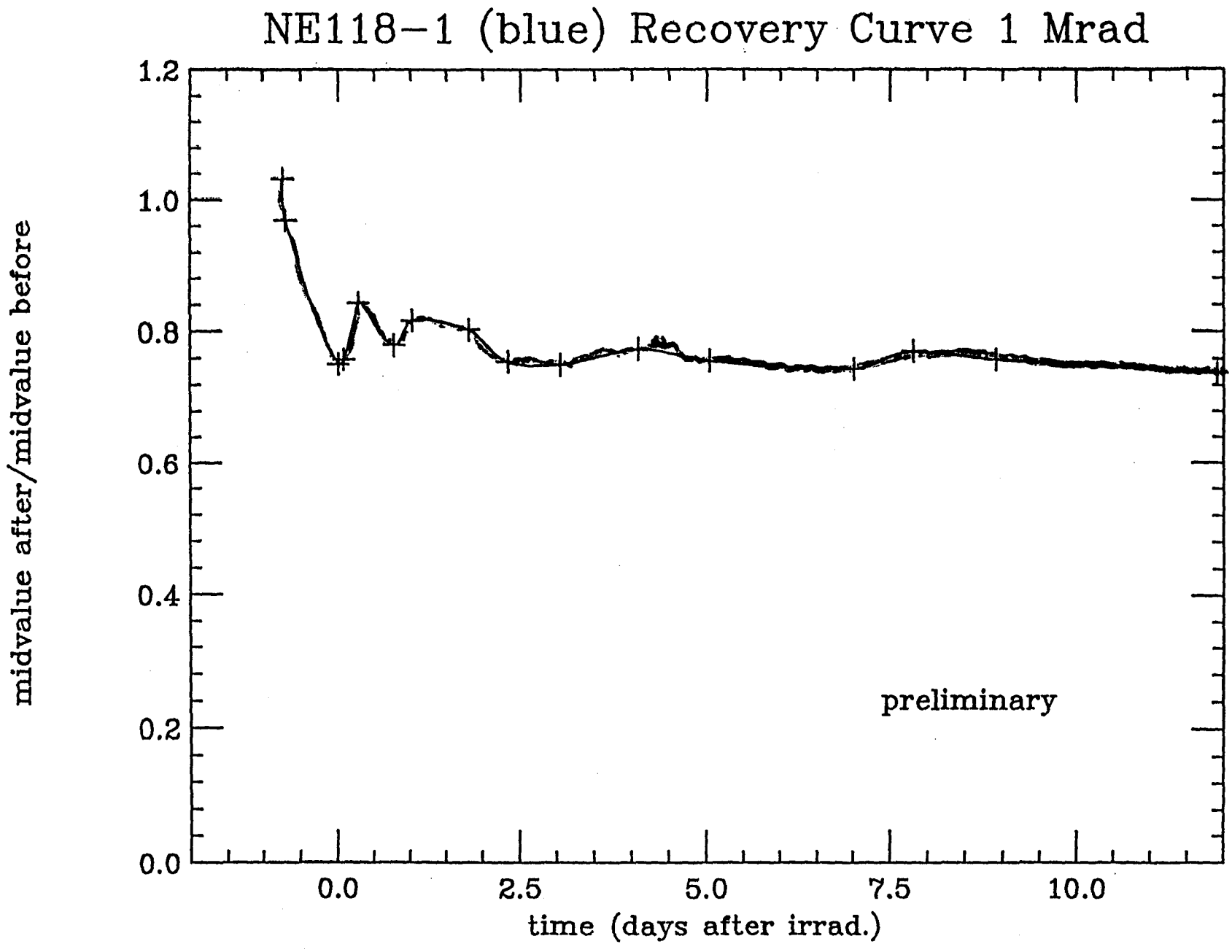
NE118-1 (blue) Recovery Curve 1 Mrad
midvalue after/midvalue before
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
2.5
5.0
7.5
10.0
time (days after irrad.)
preliminary

Fig 2

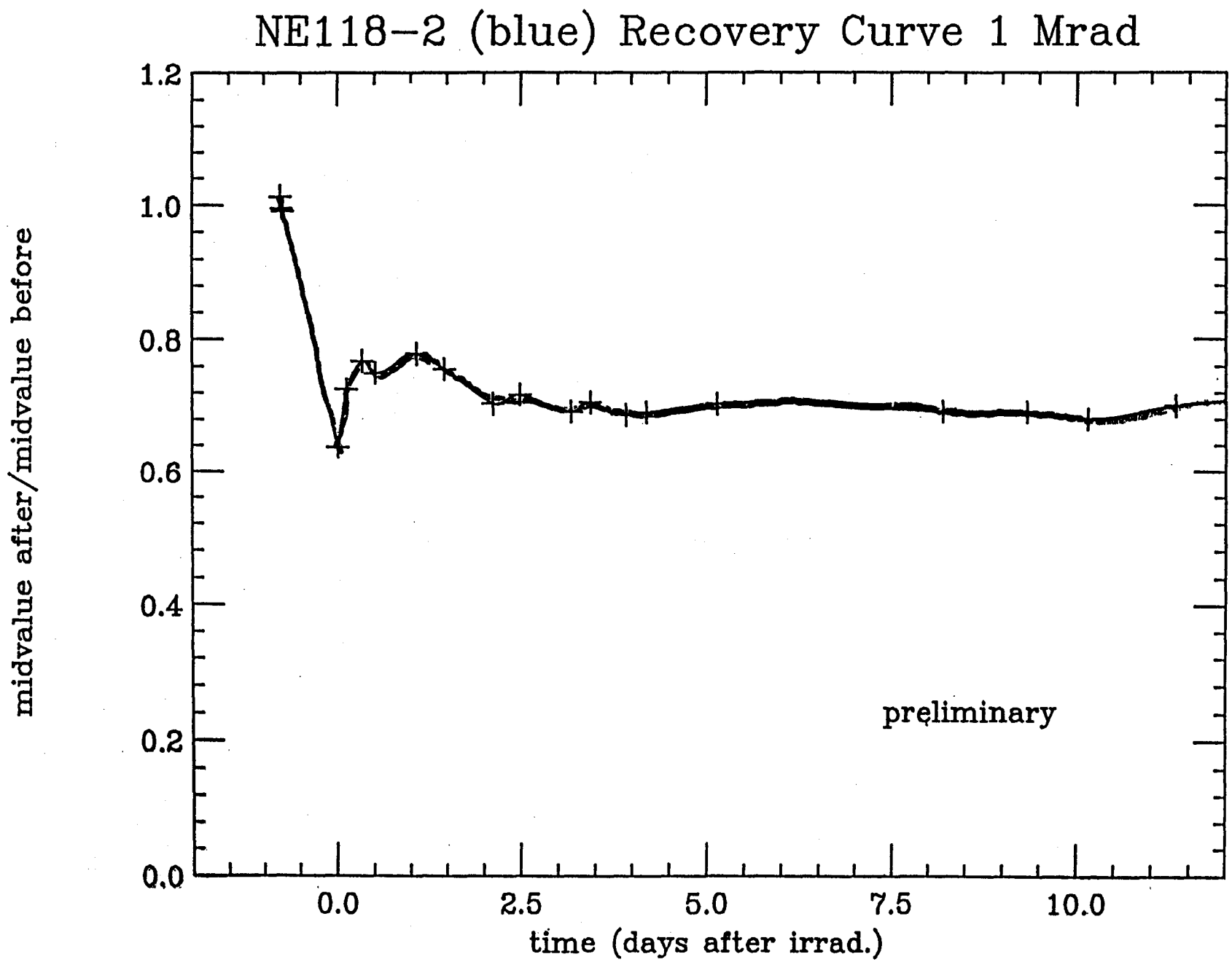
NE118-2 (blue) Recovery Curve 1 Mrad
midvalue after/midvalue before
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
2.5
5.0
7.5
10.0
time (days after irrad.)
preliminary

Fig. 3

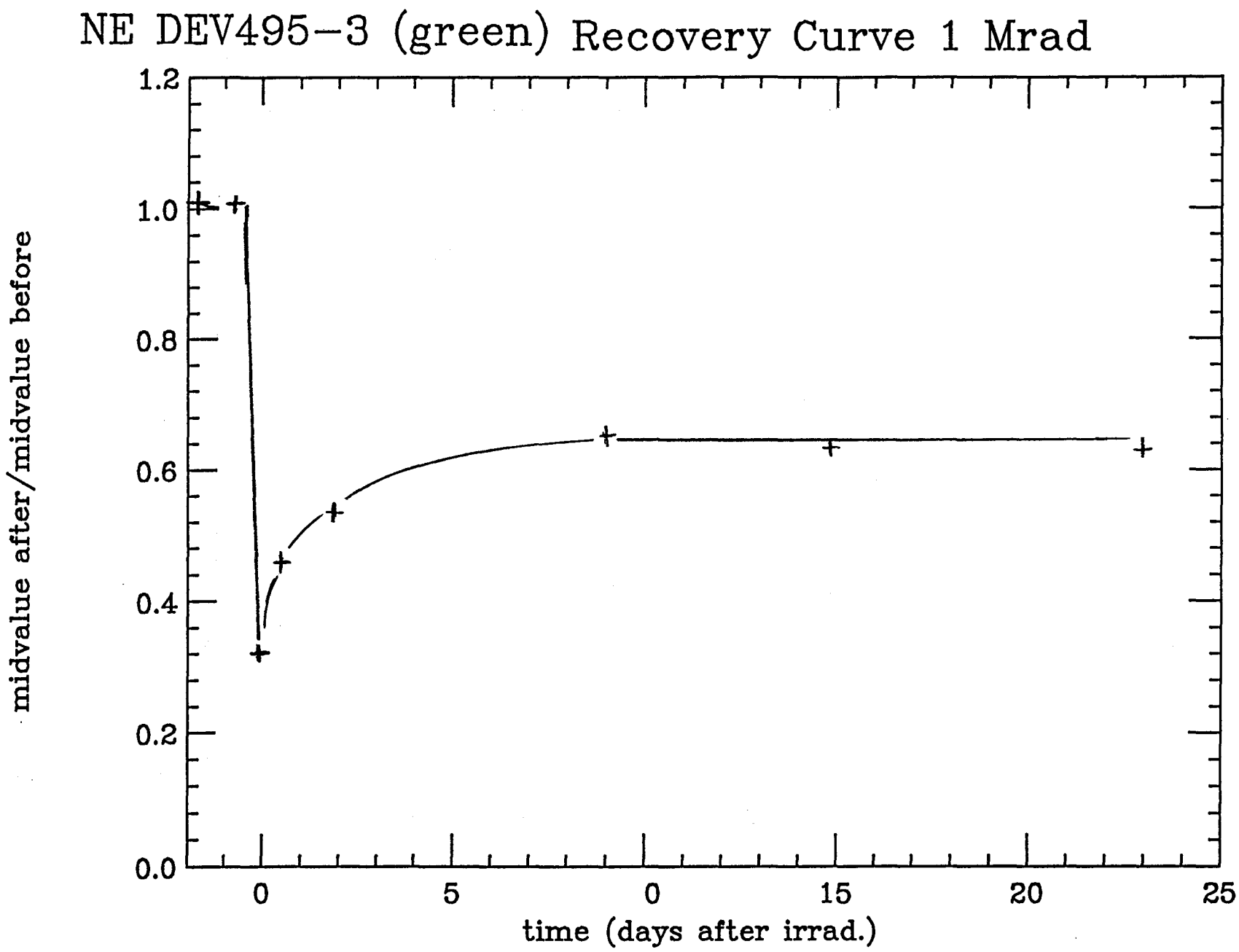
NE DEV495-3 (green) Recovery Curve 1 Mrad
midvalue after/midvalue before
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
5
0
15
20
25
time (days after irrad.)

Figure 4

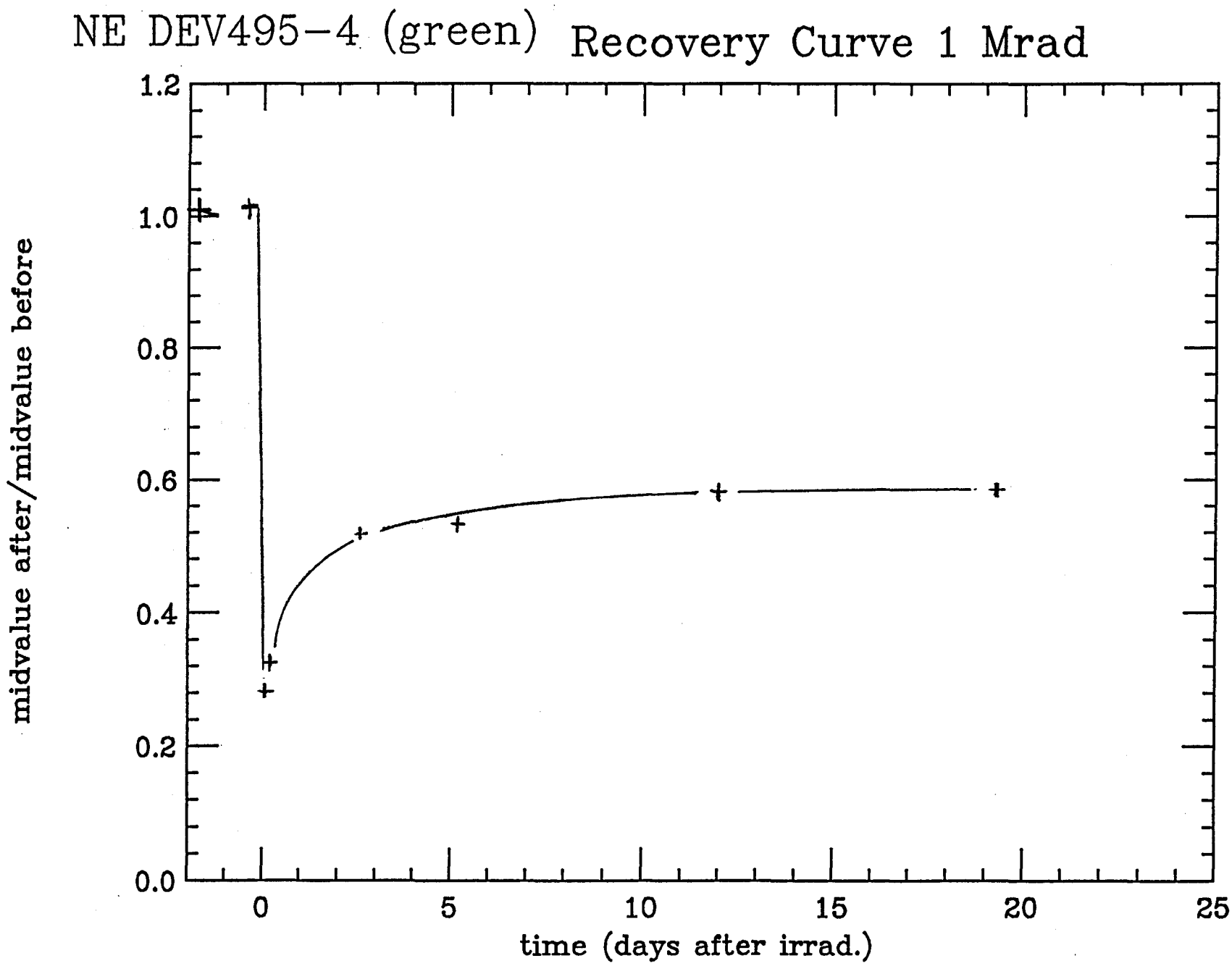
NE DEV495-4 (green) Recovery Curve 1 Mrad
1.2
1.0
0.8
0.6
0.4
0.2
0.0
midvalue after/midvalue before
0
5
10
15
20
25
time (days after irrad.)

Figure 5

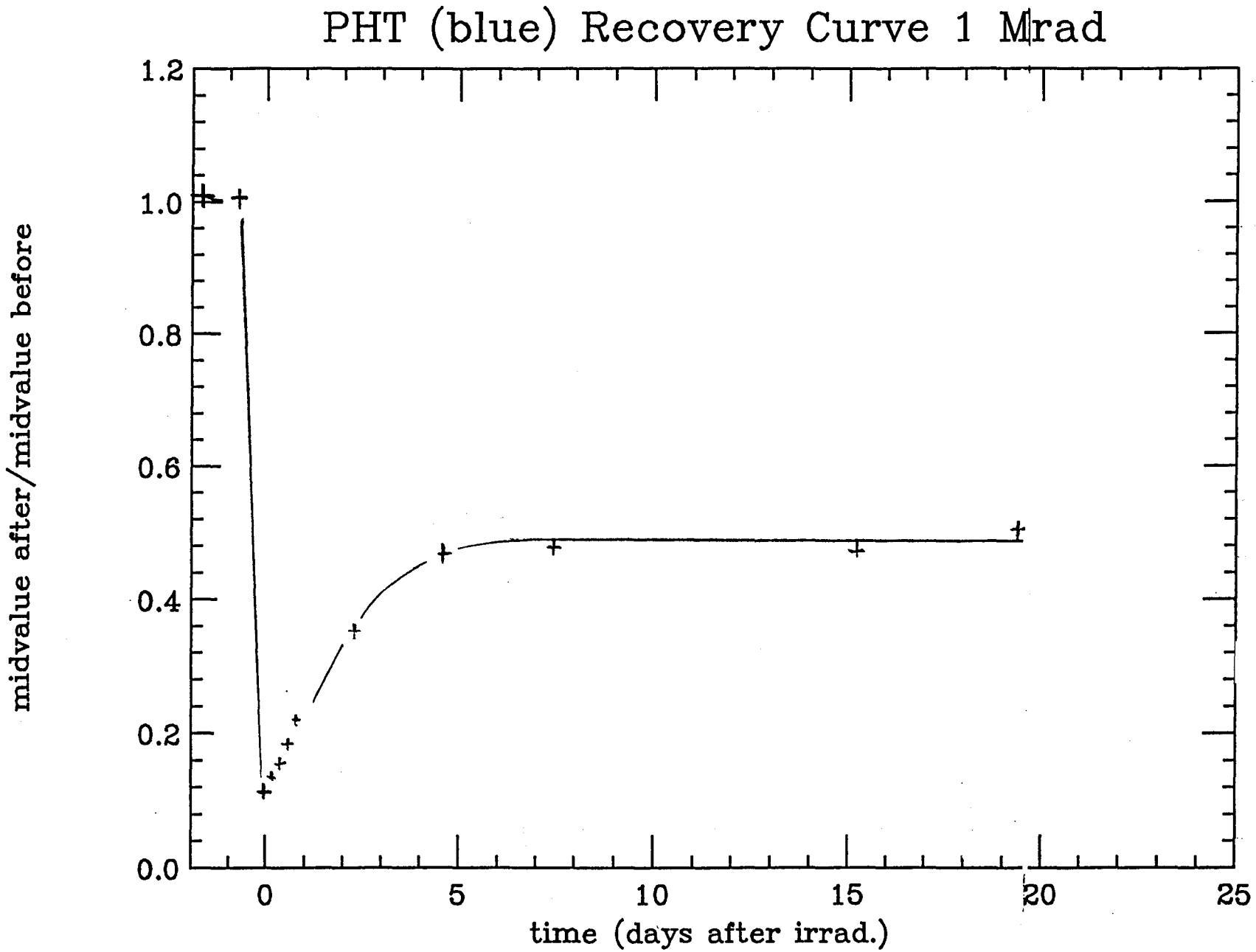
PHT (blue) Recovery Curve 1 Mrad
midvalue after/midvalue before
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
25
time (days after irrad.)

Figure 6

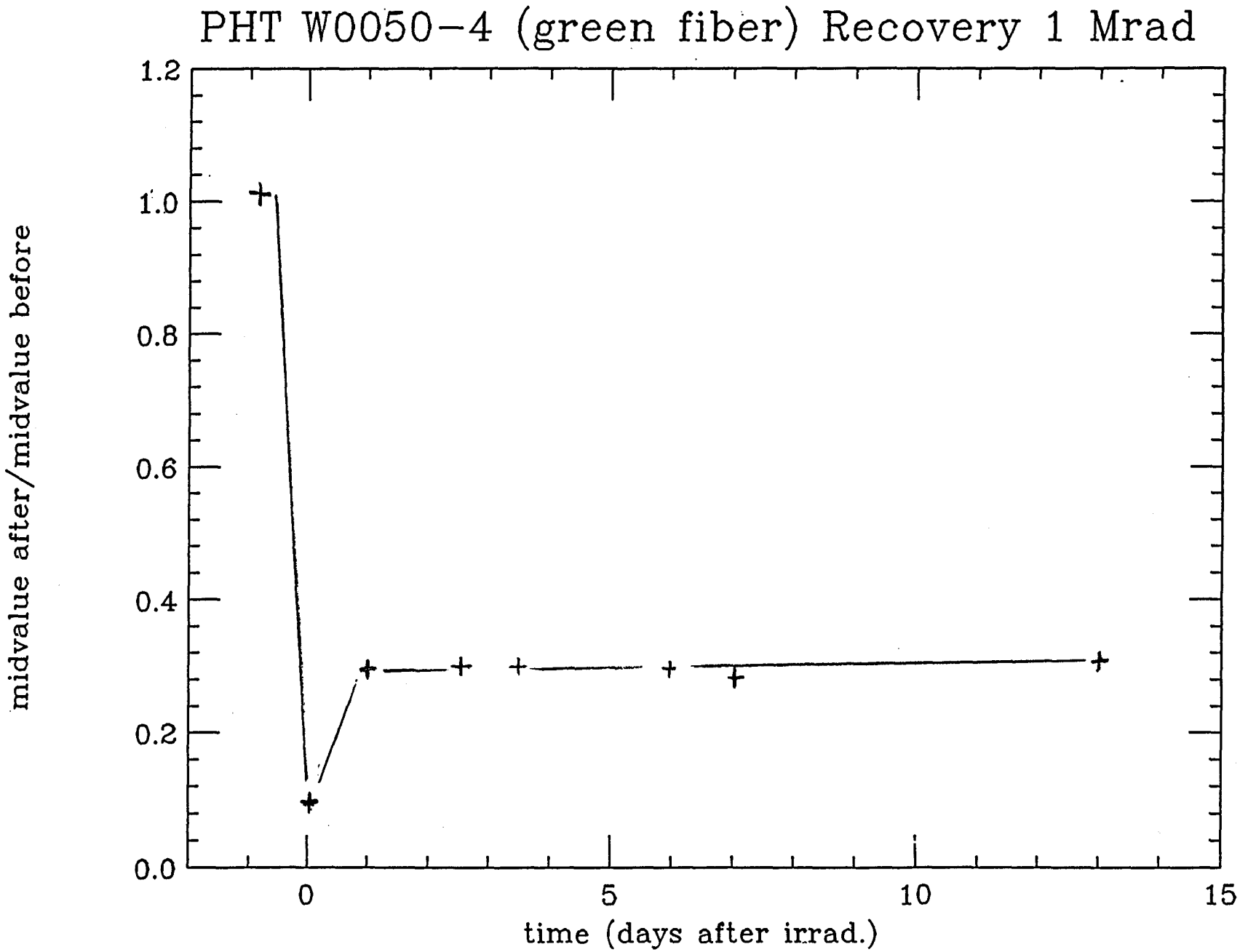
PHT W0050-4 (green fiber) Recovery 1 Mrad
midvalue after/midvalue before
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
time (days after irrad.)

Figure 7