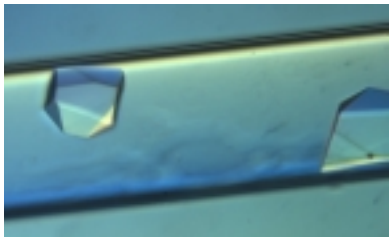
30-01-587. Comparison of the quality of protein crystals grown on earth and in the International Space Station (ISS)

The Triose Phosphate Isomerase protein (TIM) is a glycolytic enzyme that catalyses the interconversion of dihydroxyacetone phosphate and D-glyceraldehyde-3-phosphate. It is a dimeric protein consisting of two identical subunits, each about 250 residues long. Each TIM monomer is formed by an eightfold repeat of a (β-strand, loop, α-helix, loop) motif. The catalytic residues are located in the β-strands and in the loops connecting the β-strands to subsequent α-helices.

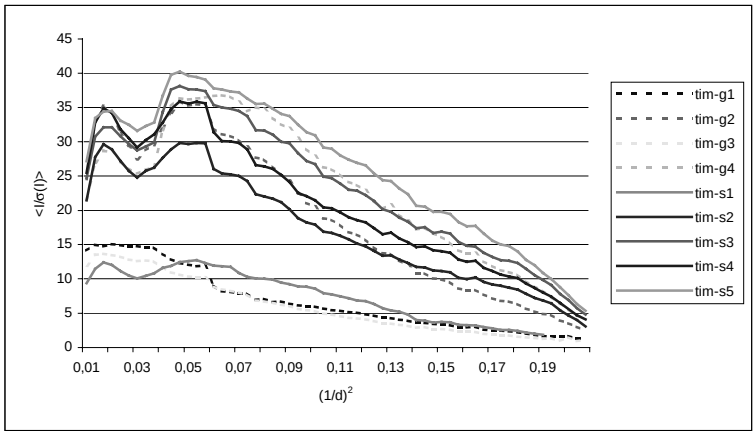
TIM from *Thermotoga maritima* (a hyperthermophilic bacterium) was chosen as a model protein for the **PromISS experiment** because it is a stable protein that is easily produced, purified and crystallized. The crystal structure of Tm TIM was solved by D. Maes in 1999 (PROTEINS: Structure, Function, and Genetics 37:441-453). The crystals diffracted to 2.8 A.

The **PROMISS experiment** is a part of the science research activities that has been performed aboard the ISS by Frank de Winne, ESA astronaut of Belgian nationality, in the frame of the ODISSEA Project. The European Space Agency and Belgian Federal Office for Scientific, Technical and Cultural Affairs (OSTC) are customers of the preparation and implementation of the scientific program. This experiment consists in using digital holography diagnostics for studing the protein crystal growth processes in microgravity conditions by the counterdiffusion crystallisation technique. One of the objectives of this experiment is to make a detailed analysis and a quantitative interpretation of the relationship between the quality of the obtained crystals (X-rays analysis) and the environment in which they are produced (digital holography data). The same counter diffusion crystallisation experiment was conducted on earth for comparison.



Tm TIM crystals harvested from space and ground experiments are trigonal, space group p312 with cell dimensions a = b = 215.22 Å, c = 102.16 Å, γ = 120°. X-rays data were collected on beamline BM30A (FIP) at ESRF. The best crystals grew at the top of the capillaries, where the supersaturation is the lowest.

A clear improvement of the mosaicity is observed for the space crystals. On the other hand, the plot of the mean intensity over sigma versus resolution only shows a slight improvement for the space grown crystals.



Plot of <I/σ(I)> versus resolution

Crystal	mosaicity
s1 = tim4a1c	0.42
s2 = tim4b1b	0.26
s3 = tim4b2b	0.29
s4 = tim4c1c	0.24
s5 = tim4c2b	0.27
g1 = timga3b	0.59
g2 = timga4b	0.33
g3 = timgb1b	0.77
g4 = timgc1b	0.34