Institut fur Metallforschung and The unit cell of one segment of these motives is conform with the either with pentagonal twins showing the point-group symmetry $y = 0.25$ and $y = 0.75$. Two TM atoms in form of puckered pentagons. The basal faces of the pentagonal clusters are formed by TM atoms. Two TM atoms are situated in the middle of the prisms at $y = 0.25$ and $y = 0.75$. Each of them is surrounded by five aluminum atoms in form of puckered pentagons. The basal faces of the prisms are alternate occupied by one aluminum atom or five aluminum atoms forming distorted pentagon.

A regular cyclical tilting of pentagonal clusters yields 2D motives either with pentagonal twins showing the point-group symmetry $C_3$ or with decagonal twins showing the point-group symmetry $C_{10}$. The unit cell of one segment of these motives is conform with the unit cell of the $m$-Co$_4$Al$_{13}$ structure, while the twin-interface arrangement corresponds to a partial unit cell of $o$-Co$_4$Al$_{13}$.

Pentagonal and rhombic clusters probably dominate the structure Co$_4$Al$_{13}$. The structure proposal for Co$_4$Al$_{13}$ agrees well with the experimental powder diffraction data.

Strategies for collecting and analyzing diffuse scattering data of quasicrystalline materials will be presented: Automatic indexing of rotation pictures from aperiodic materials [1], background analysis in the presence of diffuse scattering, reconstruction of arbitrary slices and volumes in diffraction space and data reduction.

Diffuse scattering effects can be observed in most materials with decagonal or icosahedral diffraction symmetry. These effects cannot be explained by strict quasiperiodic ordering, various kinds of disorder must be considered, such as random static disorder or orientationally ordered nanodomain structures. The knowledge of the real structure of decagonal and icosahedral phases is an important step towards understanding their physical properties which are strongly determined by defects and disorder.

Our primary aim is to proceed towards a quantitative analysis of the disorder effects; a number of models based on the known average structure of decagonal AlCoNi are currently being developed in our laboratory.

To record quantitatively large volumes of X-ray diffraction space we use the MarResearch imaging plate detector system which is an on-line imaging plate scanner in combination with simple rotation geometry. Small rotation ranges of $0.2^\circ$ or even still images result in 2D spherical sections which are small enough to allow a complete reconstruction of the diffraction space. After the usual corrections for resolution, absorption and Lp effects, the entire measurable reciprocal space is accessible for numerical calculations.