BETA STRAND

Prof. Alejandro Hochkoeppler
Department of Pharmaceutical Sciences and Biotechnology
University of Bologna
E-mail: a.hochkoeppler@unibo.it
BETA STRAND

NH and CO groups: right, left, right…
(plane of the slide)

R groups: Front, back, front...
(plane of the slide)
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Intra-strand hydrogen bonds are hampered by the extended conformation of beta strands.

Inter-strand hydrogen bonds are favoured.
By convention, the N-ter side of a beta strand is represented as the base of an arrow. The C-ter side is depicted as the head of an arrow.
Beta strands can mutually interact, forming a beta sheet. The orientation of strands can be parallel or anti-parallel.
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Antiparallel beta-sheet

Hydrogen bonds in beta-sheets

Parallel beta-sheet
Two beta strands can be connected via a type-one turn.

Hydrogen bond between $i$ and $i+3$ residues.

Any of the 20 amino acids can reside at $i$ and $i+2$ sites.

Carbon C’ of $i+1$ residues and R-group of $i+2$ amino acid are directed toward opposite directions (C’ of $i+1$ down, and R of $i+2$ up, respectively). Clash between $i+1$ carbonyl and $i+2$ R is avoided.
Two beta strands can be connected via a type-two turn.

Hydrogen bond between $i$ and $i+3$ residues.

Glycine must reside at $i+2$ site.

Carbon C’ of $i+1$ residue and R-group of $i+2$ amino acid are directed toward the same direction. Clash between $i+1$ carbonyl and $i+2$ R is avoided by the presence of glycine.
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**Helix 3.0\textsubscript{10}**
Periodicity: 3 residues/turn
The groove contains 10 atoms
Narrower than alpha helix
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Beta turn

Structural motif

- two contiguous antiparallel beta strands
- connection by a loop
- present in proteins also containing alpha helices (isolated beta turn)
- repetition of the beta turn yields a sheet
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Retinol-binding protein
Binding and transport of vitamin A

Antiparallel strands forming two sheets. 
$n$ strand connected to $n+1$, $n+1$ to $n+2$...
The two sheets form a barrel.
The barrel cavity binds retinol.
The beta strands are connected by:
• two small alpha helices
• turns

Turns can be of two types:
• type-1 beta-turns
• type-2 beta turns (contain glycine)
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Hydrophobic residues fill the cavity

Charged residues on the surface
Bovine gamma-crystallin

Antiparallel strands forming two sheets.
$n$ strand connected to $n+3$
The barrel is crossed by the connection between stands.

This structural motif is denoted as “greek key”.
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The connection between n and n+3 strand is not a beta-turn.

The cavity of the barrel is crossed by the connection between strands n and n+3.
**AraC protein of *Escherichia coli***

Barrel formed by antiparallel beta-sheets.

Transcriptional regulator

The N-terminal domain binds arabinose. The C-ter domain binds DNA. AraC is a dimer. Free AraC represses genes of *araBAD* operon. When AraC is bound to arabinose, *araBAD* genes are transcribed.
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Jelly Roll motif:
the barrel is crossed 4 times by connections between strands. The motif resembles a “jelly roll”, an English candy decorated in a typical way.

Greek key motif:
the barrel is crossed 1 time by connections between strands.
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Jelly Roll:
- 8 beta strands
- 2 antiparallel sheets
- the barrel is crossed by 2-3, 3-4, 6-7, and 7-8 loops

Greek key:
- 4 beta strands
- 1 antiparallel sheet
- the barrel is crossed by 3-4 loop
- two greek keys can form a barrel
Generation of a Greek-key motif from an extended conformation

β-strands 1-4:
• contiguous in the secondary structure
• non-contiguous in the tertiary structure
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Generation of a Jelly-Roll motif from an extended conformation

Connections 2-3 and 6-7: cross the bottom of the barrel
Connections 3-4 and 7-8: cross the top of the barrel
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