# FurC (PerR) from *Anabaena* sp. PCC7120: a versatile transcriptional regulator engaged in the regulatory network of heterocyst development and nitrogen fixation

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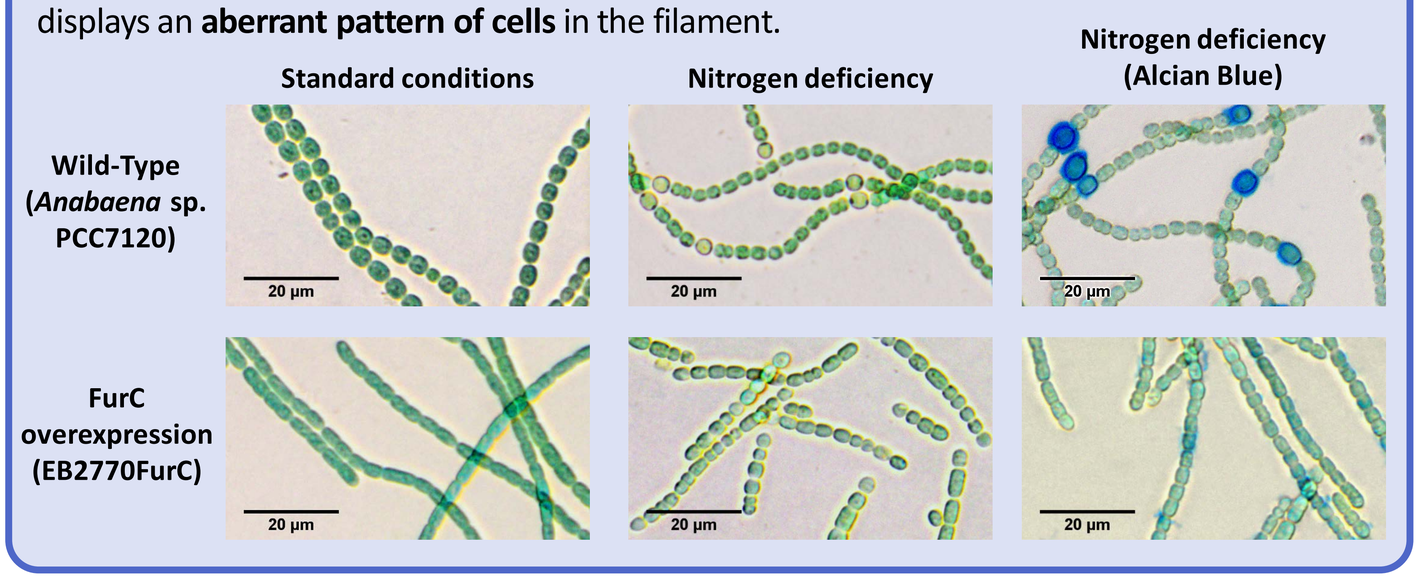
FurC (PerR) from *Anabaena* sp. PCC 7120 was initially described as a key transcriptional regulator involved in setting off the oxidative stress response. In this work, the transcriptome of a *furC*-overexpressing strain was compared with that of a wild-type strain both under standard and nitrogen-deficiency conditions. Results showed that the overexpression of *furC* deregulates genes involved in several categories such as photosynthesis, iron transport and nitrogen metabolism. The novel FurC-direct targets included regulatory elements that control heterocyst development, genes involved in the heterocyst envelope formation and genes involved in nitrogen fixation. The relevance of FurC in these processes is brought out by the fact that the overexpression of *furC* impairs heterocyst development under nitrogen step-down conditions. In summary, this work reveals a new player in the complex regulatory network of heterocyst formation and nitrogen fixation.

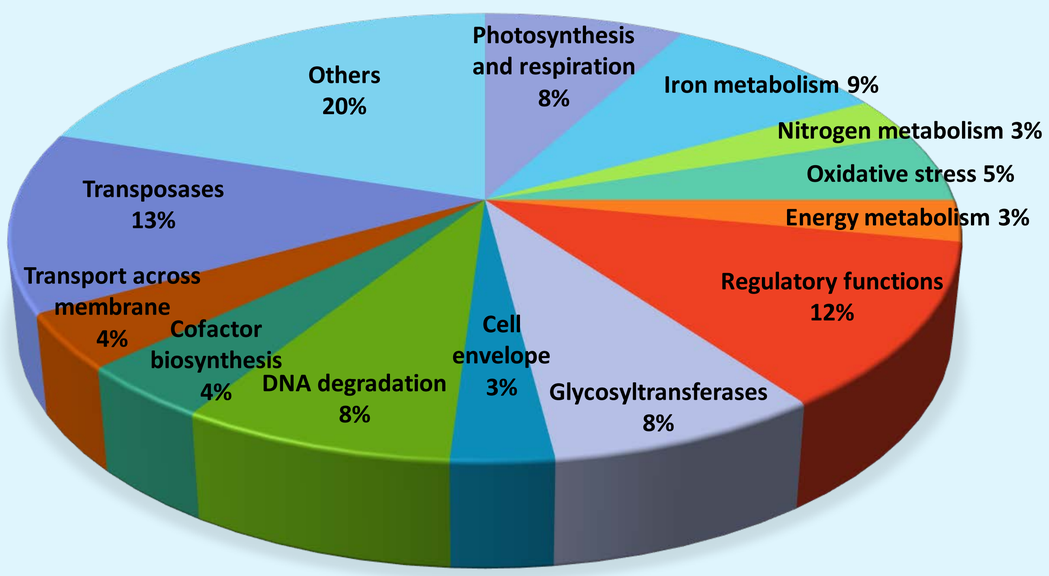
## FurC overexpression impairs heterocyst development

Under **nitrogen deficiency** the ***furC* overexpression** strain is not able to **form heterocysts** and displays an **aberrant pattern of cells** in the filament.

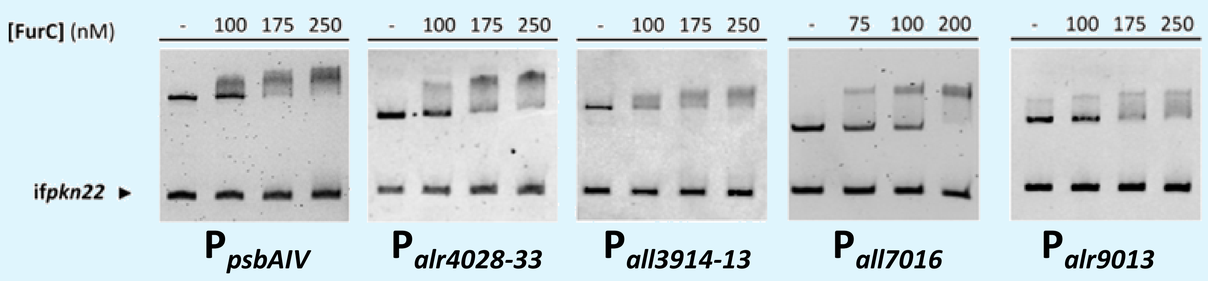



## Differential transcriptomics under standard culture conditions

Under **standard culture conditions**, there are **75 genes** with **differential expression** and **functional annotation** in the *furC* overexpression strain. These genes belong to a **wide variety** of functional categories




**EMSA assays** were used to **analyse the binding of FurC** to the **promoter regions** of genes with **differential expression** and **find direct targets of this regulator**

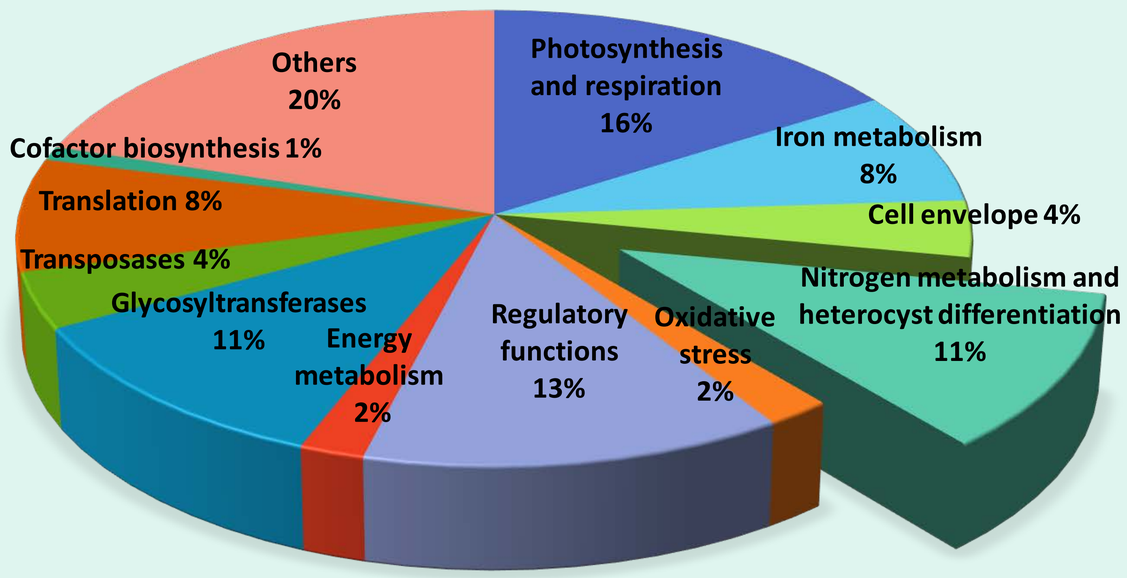



**FurC directly regulates** genes belonging to **different functional categories**

- **Photosynthesis**: Photosystem II P680 reaction center D1 protein (*psbAIV*)
- **Iron metabolism**: Fec system, uptake and transport of $Fe^{3+}$-citrate (*alr4028-33*)
- **Energy metabolism**: Succinyl-CoA synthetase (*all3914-13*)
- **Regulatory functions:** Transcriptional regulator (*all7016*)
  Response regulator (*alr9013*)

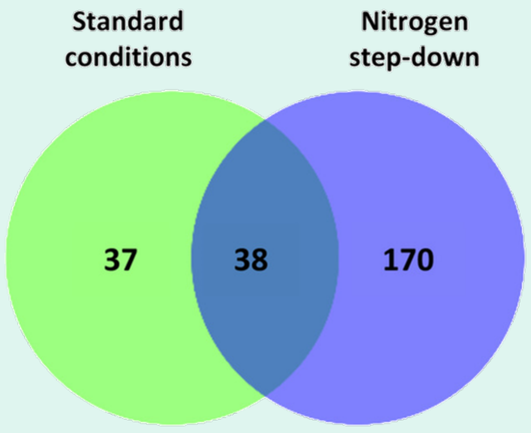
## Differential transcriptomics under nitrogen deficiency

Under **standard nitrogen deficiency**, there are **208 genes** with **differential expression** and **functional annotation** in the *furC* overexpression strain.



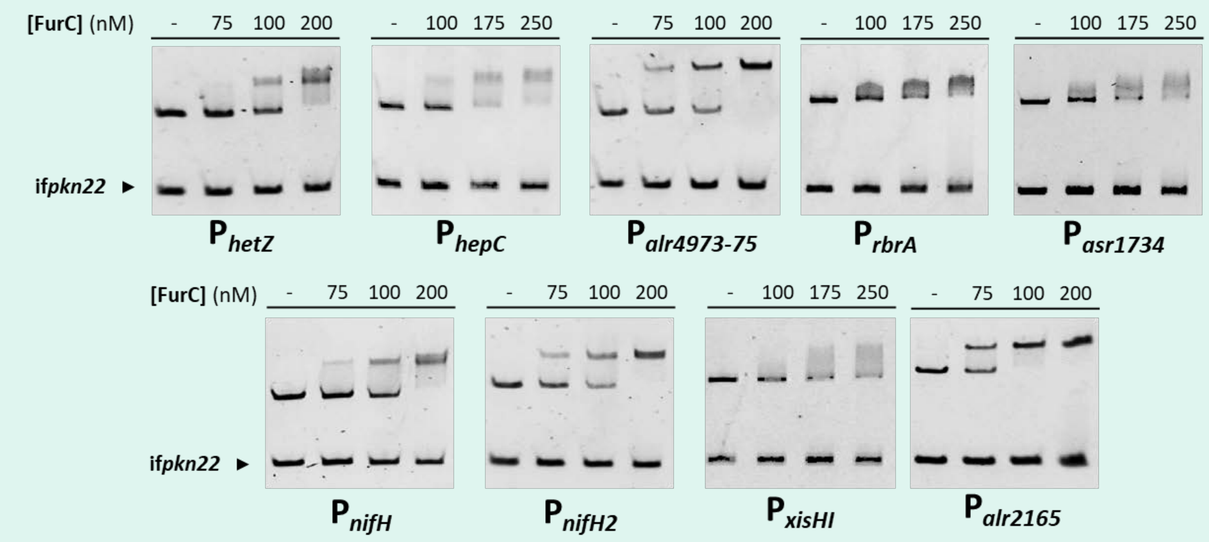

**Differential expression** of **more than 170 genes** that showed **no change under standard conditions**

**Key role of FurC in the response to nitrogen deficiency**

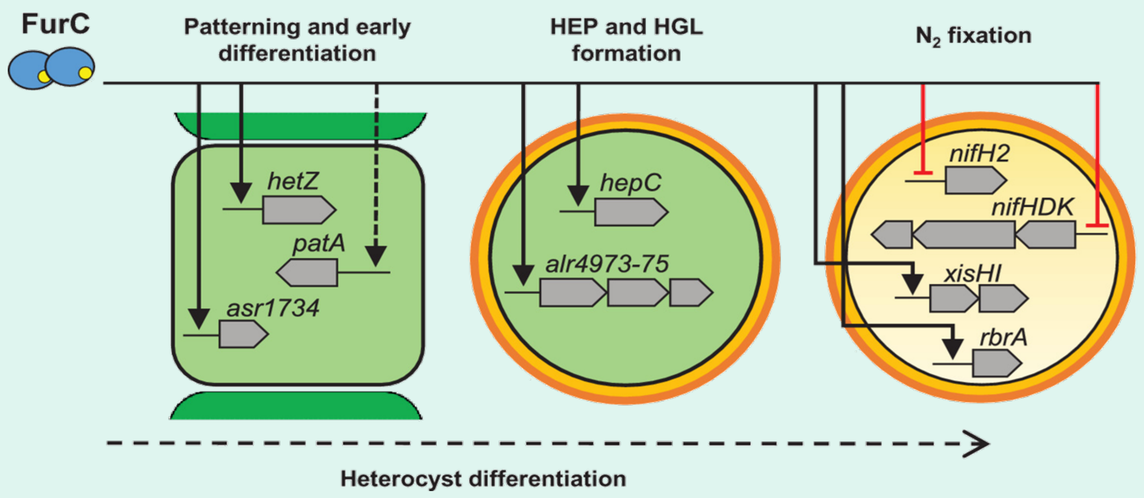



**Differential transcriptomics EB2770FurC vs WT**

**EMSA assays** were used to **analyse the binding of FurC** to the **promoter regions** of genes with **differential expression** and **find direct targets of this regulator**




**FurC directly regulates several genes involved in diffferent steps of heterocyst differentiation: early differentiation, synthesis of the envelopes** and **$N_2$ fixation**




## CONCLUSIONS

- **FurC is a global regulator in *Anabaena* sp. PCC 7120**
- The **transcriptomic profile** of the strain EB2770FurC vs WT **changes drastically under nitrogen deficiency**
- **FurC plays a key role in heterocyst development**

**This study is published in Environmental Microbiology. If you are interested, you can find it here:**

If you have any questions or are interested in our work please do not hesitate to contact me: jguio@unizar.es • Follow us on Twitter! @cyanofur

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