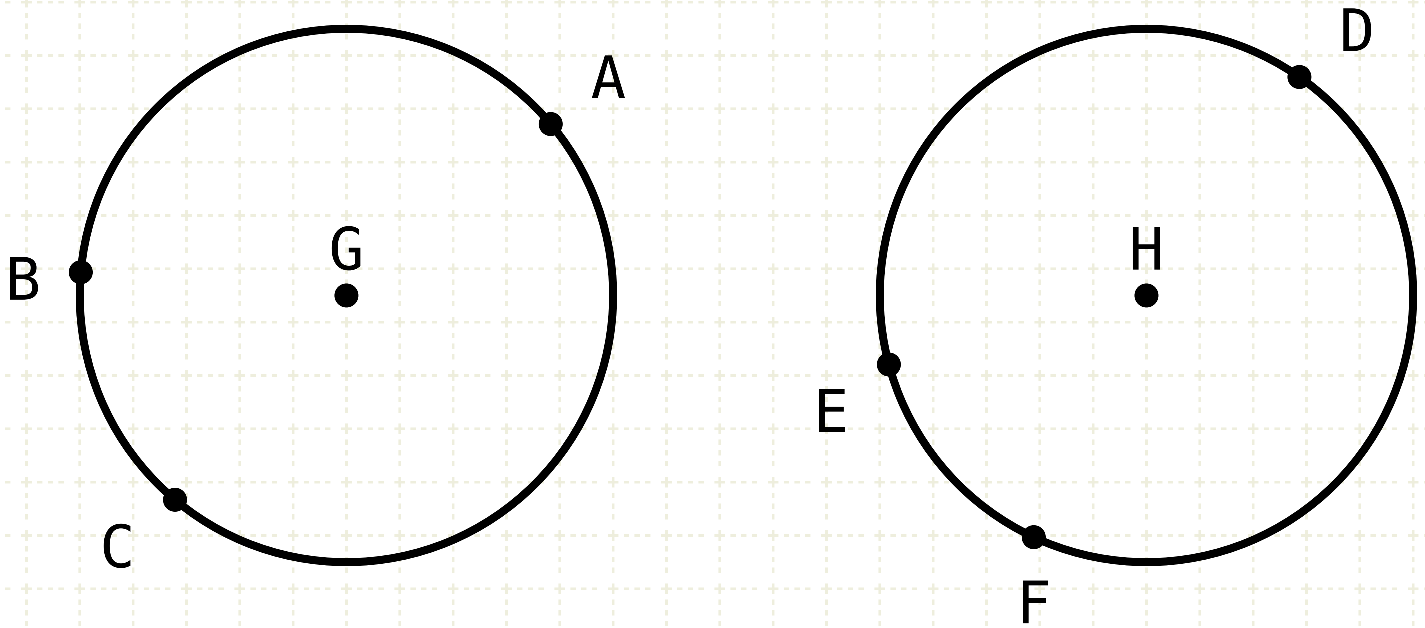
Proposition 33 of Book VI

In equal circles angles have the same ratio as the circumferences on which they stand, whether they stand at the centres or at the circumferences



In other words

Given two circles ABC,DEF with centres G and H respectively

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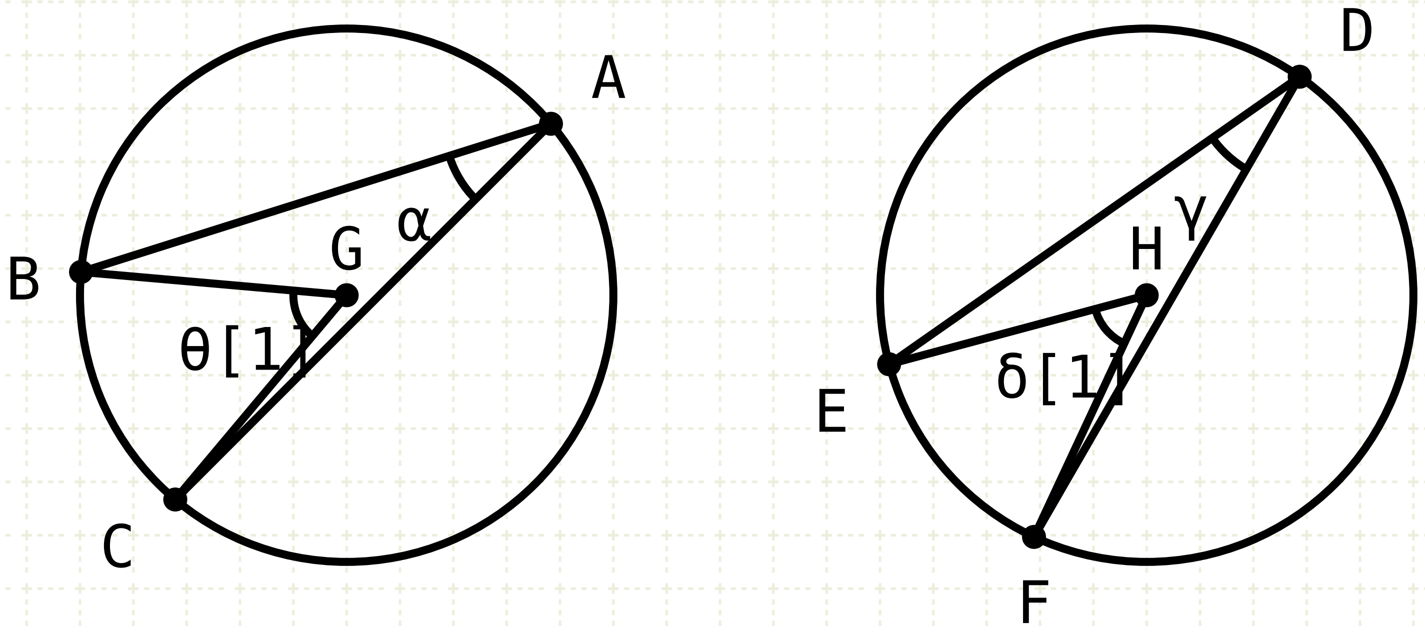

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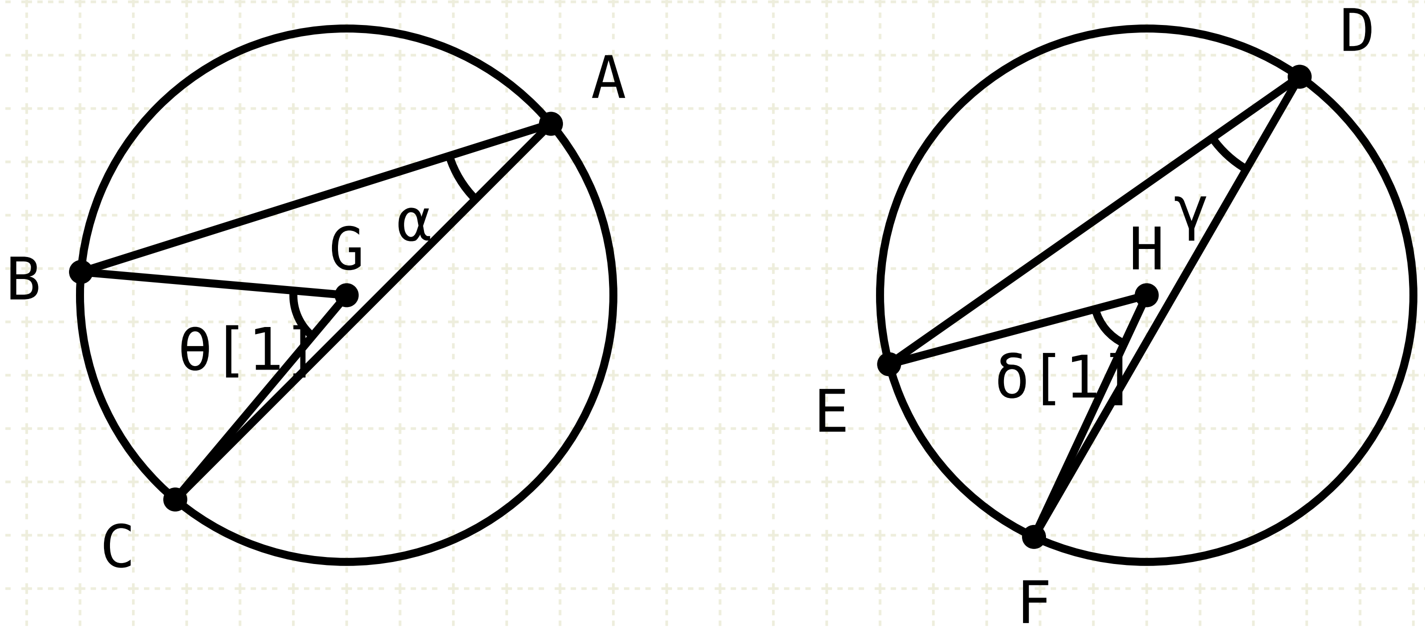

In other words

Given two circles ABC,DEF with centres G and H respectively

Let the angles BAC, BGC and EDF and EHF be drawn

Then the ratio of the circumferences BC to EF is equal to the ratios of BGC to EHF and BAC to EDF

$$BC:EF = \theta_1:\delta_1 = \alpha:\gamma$$

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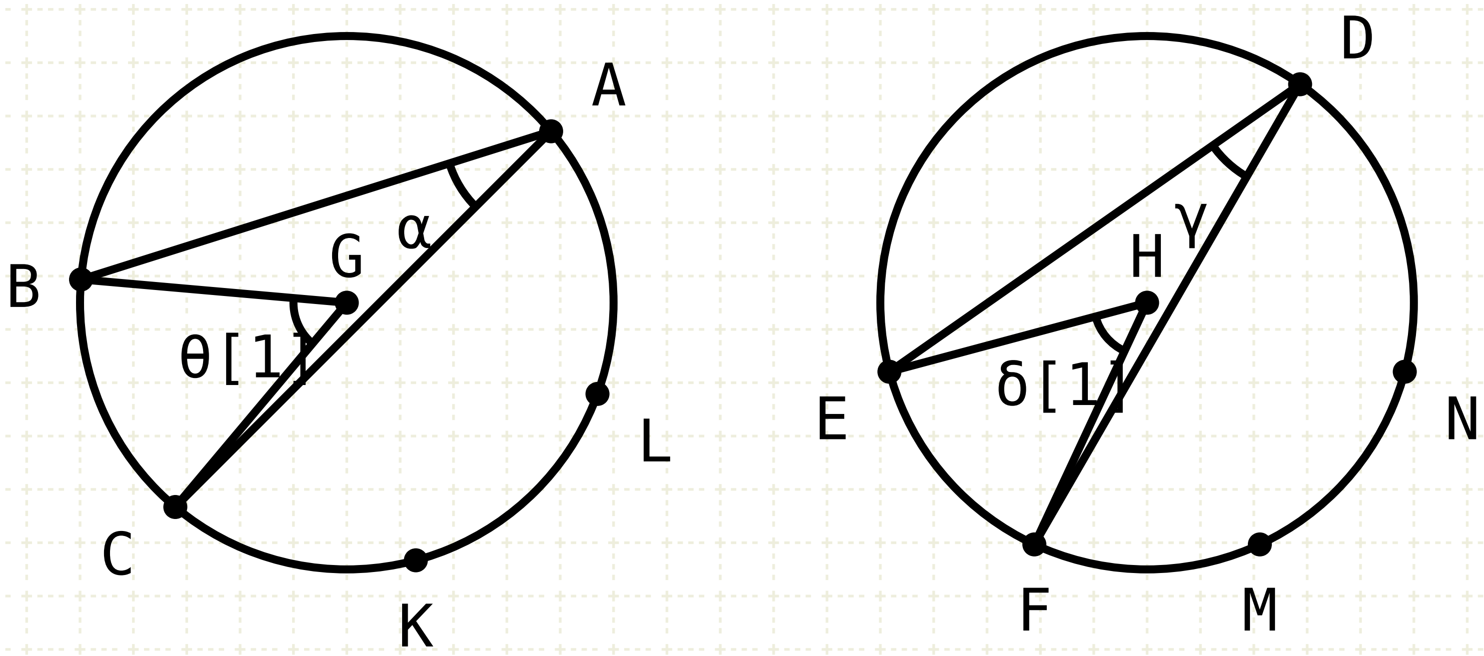

BC = CK = KL
EF = EM = MN

Proof

Create an number of consecutive circumferences CK, KL equal to BC

And create and number of consecutive circumferences FM, MN equal to EF

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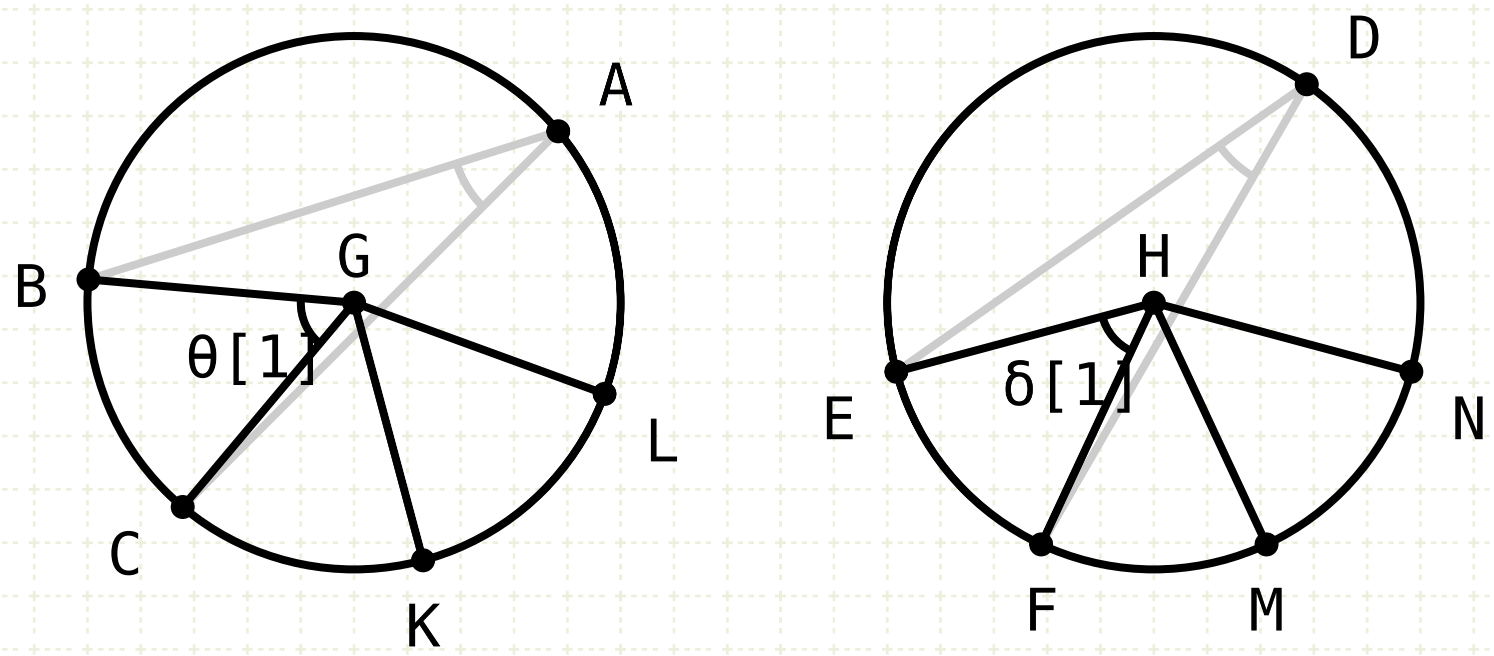

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And draw the lines GK, GL, HM, HN

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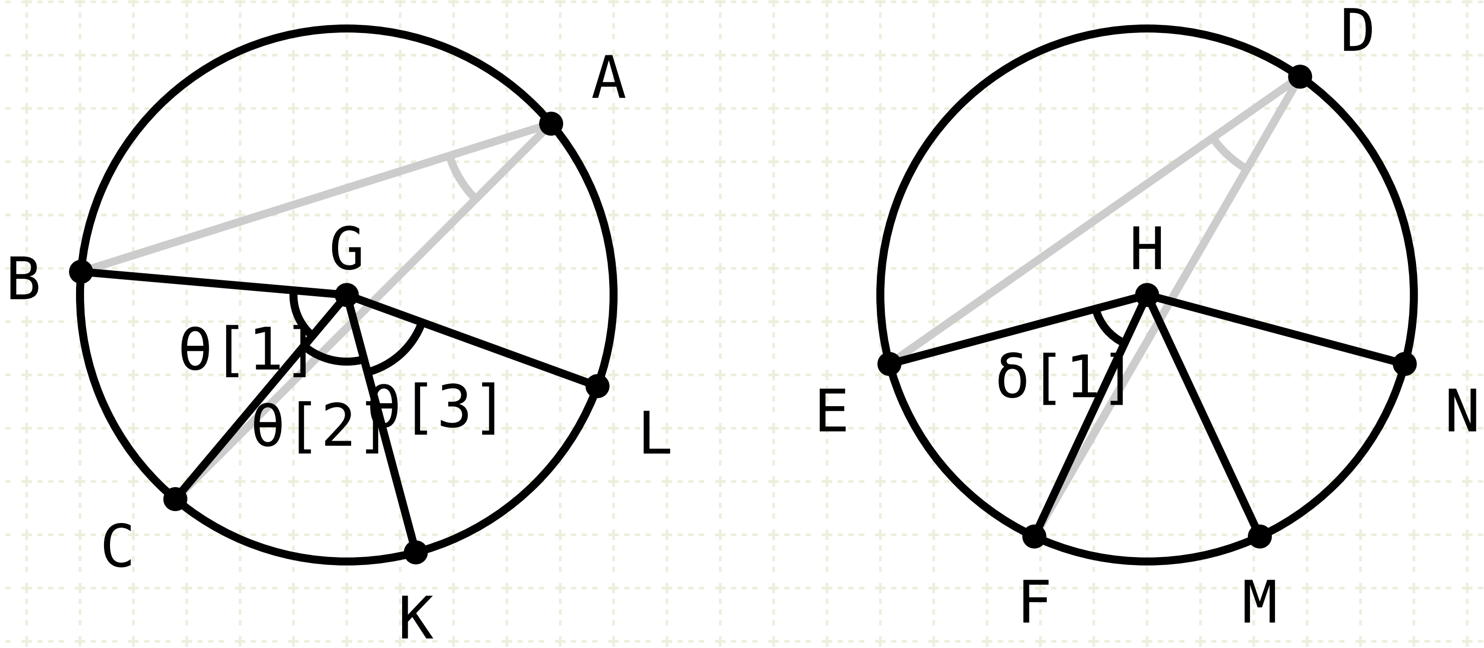

$$\theta_1 = \theta_2 = \theta_3$$

Proof

Create an number of consecutive circumferences CK, KL equal to BC

And create and number of consecutive circumferences FM, MN equal to EF

And draw the lines GK, GL, HM, HN

And since BC, CK, KL are equal, so are the angles BGC, CGK, KGL (III·27)

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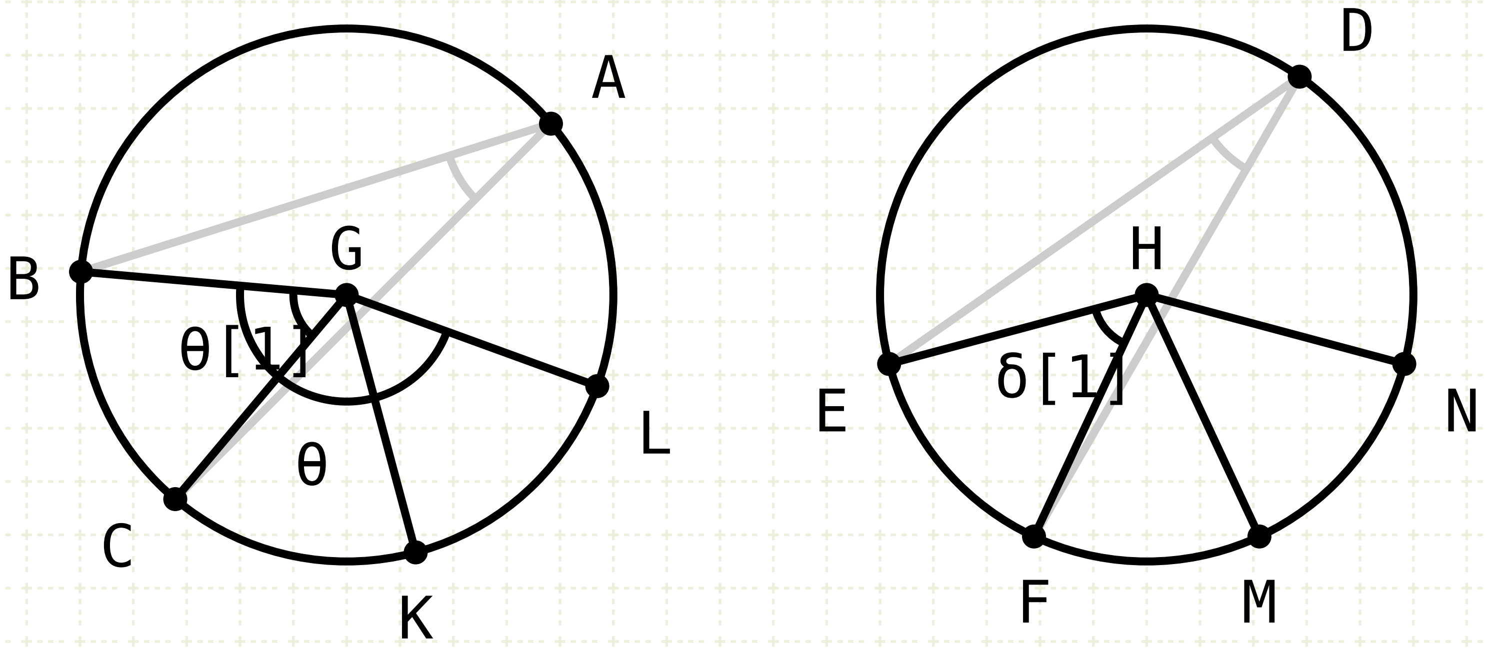

$\theta_1 = \theta_2 = \theta_3$
$BL = n \cdot BC$
$\theta \;\; = n \cdot \theta_1$

Proof

Create an number of consecutive circumferences CK, KL equal to BC

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And since BC, CK, KL are equal, so are the angles BGC, CGK, KGL (III·27)

Thus, whatever multiple BL is of BC, it is the same multiple that BGL is to BGC

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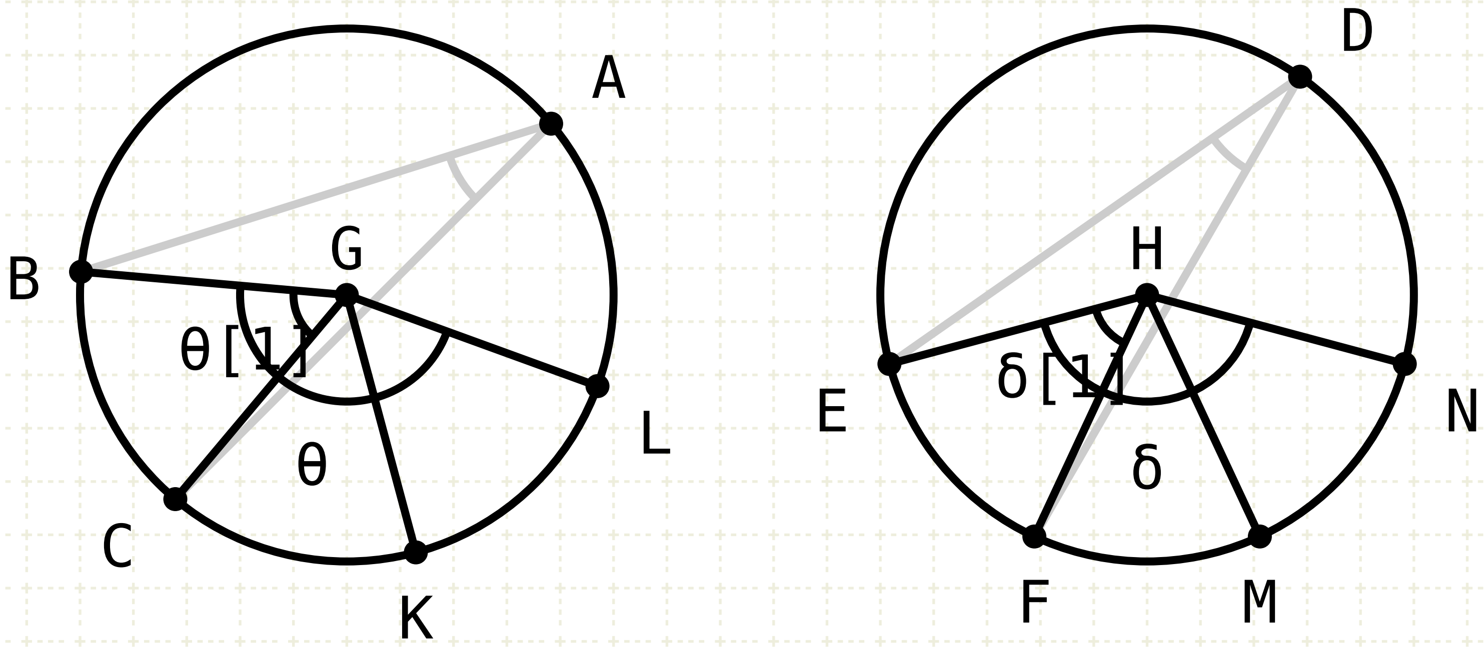

$$\theta_1 = \theta_2 = \theta_3$$
$$BL = n \cdot BC$$
$$\theta = n \cdot \theta_1$$
$$EN = m \cdot EF$$
$$\delta = m \cdot \delta_1$$

Proof

Create an number of consecutive circumferences CK, KL equal to BC

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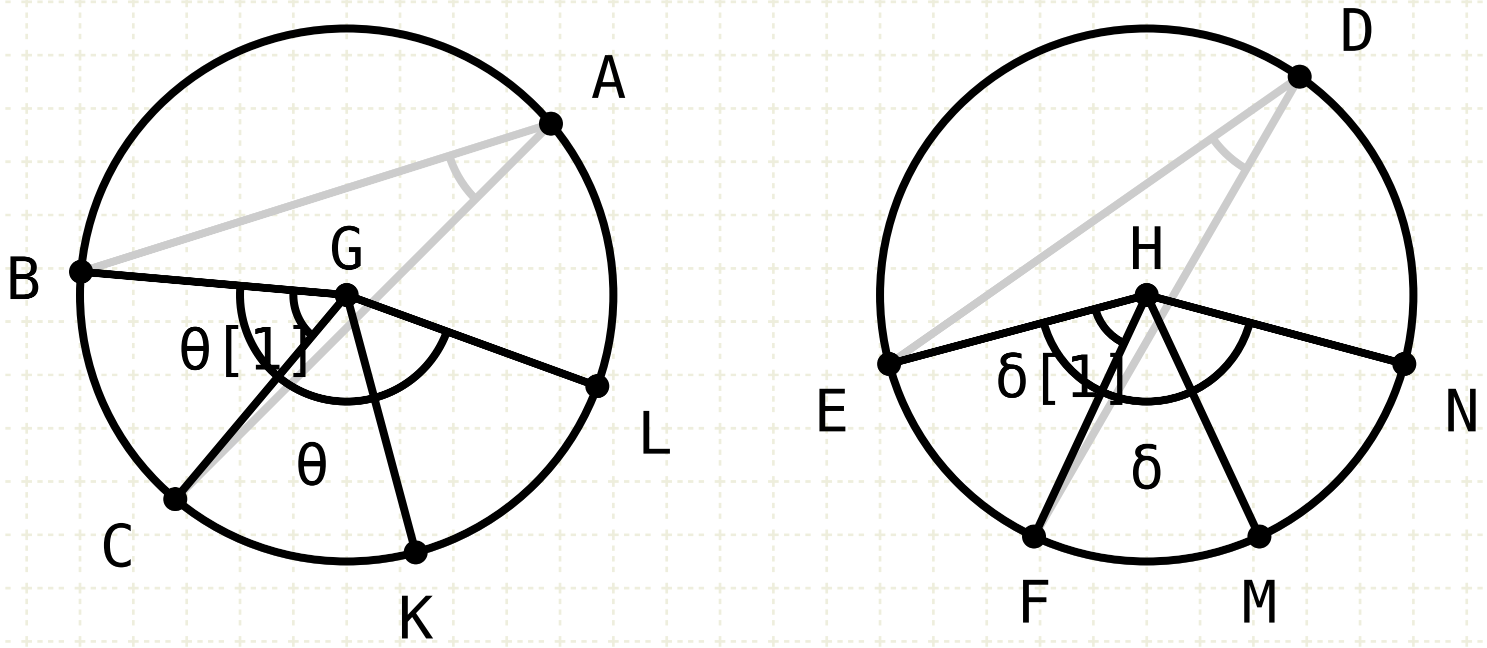

$$\theta_1 = \theta_2 = \theta_3$$
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$$BL <=> EN \rightarrow \theta <=> \delta$$

Proof

Create an number of consecutive circumferences CK, KL equal to BC

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And draw the lines GK, GL, HM, HN

And since BC, CK, KL are equal, so are the angles BGC, CGK, KGL (III·27)

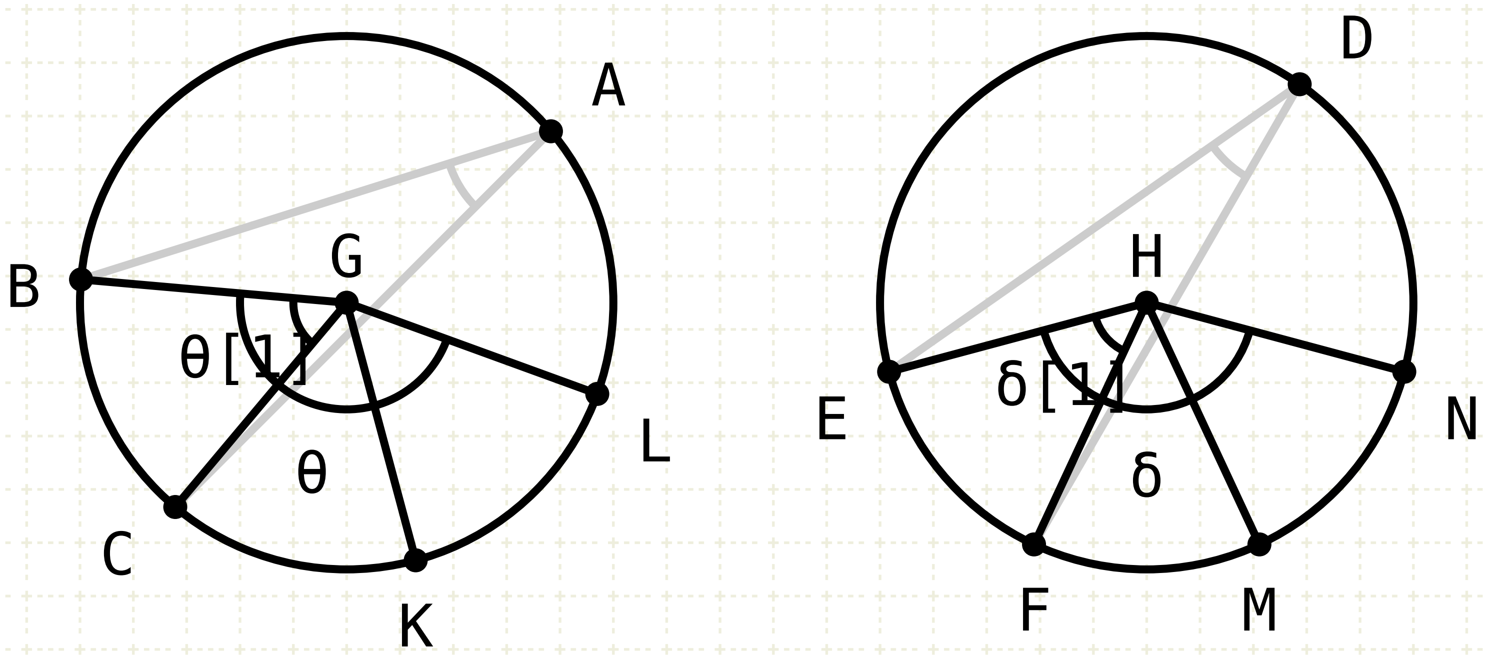
Thus, whatever multiple BL is of BC, it is the same multiple that BGL is to BGC

For the same reason, whatever multiple EN is of EF, it is the same multiple that EHN is to EHF

Equal circumferences on equal circles have equal angles (III·27), thus if BL is greater than EN, BGL will also be greater than EHN, if equal then equal, if less than, then less

Proposition 33 of Book VI

In equal circles angles have the same ratio as the circumferences on which they stand, whether they stand at the centres or at the circumferences



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$$BL = n \cdot BC$$
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$$EN = m \cdot EF$$
$$\delta = m \cdot \delta_1$$
$$BL \lessgtr EN \rightarrow \theta \lessgtr \delta$$
$$n \cdot BC \lessgtr m \cdot EF \rightarrow n \cdot \theta_1 \lessgtr m \cdot \delta_1$$

Proof

Create an number of consecutive circumferences CK, KL equal to BC

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But BL,EN are equimultiples of BGC, EHF, so substitute them in the previous equation

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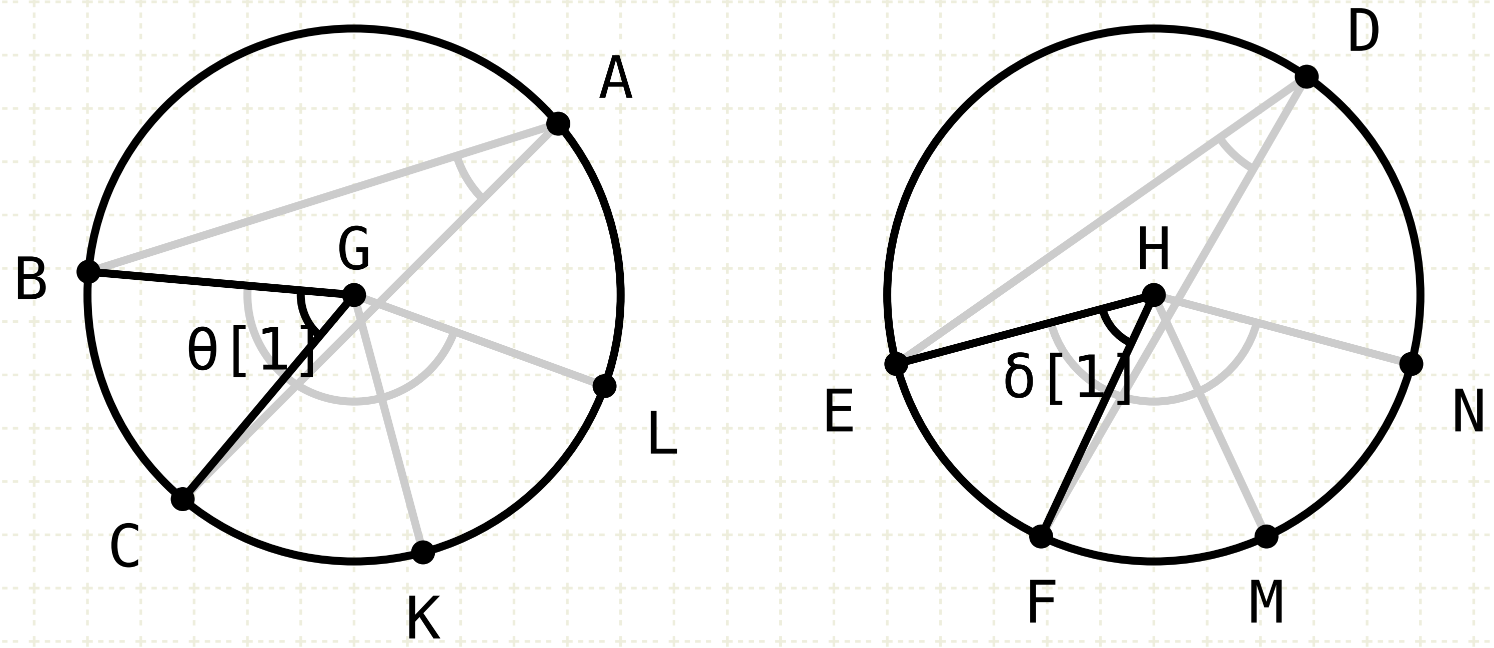

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$\theta \;= n \cdot \theta_1$

$EN = m \cdot EF$

$\delta \;= m \cdot \delta_1$

$BL <=> EN \rightarrow \theta <=> \delta$

$n \cdot BC <=> m \cdot EF \rightarrow n \cdot \theta_1 <=> m \cdot \delta_1$

$BC:EF = \theta_1 : \delta_1$

Proof

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Which in turn is the definition for equal ratios

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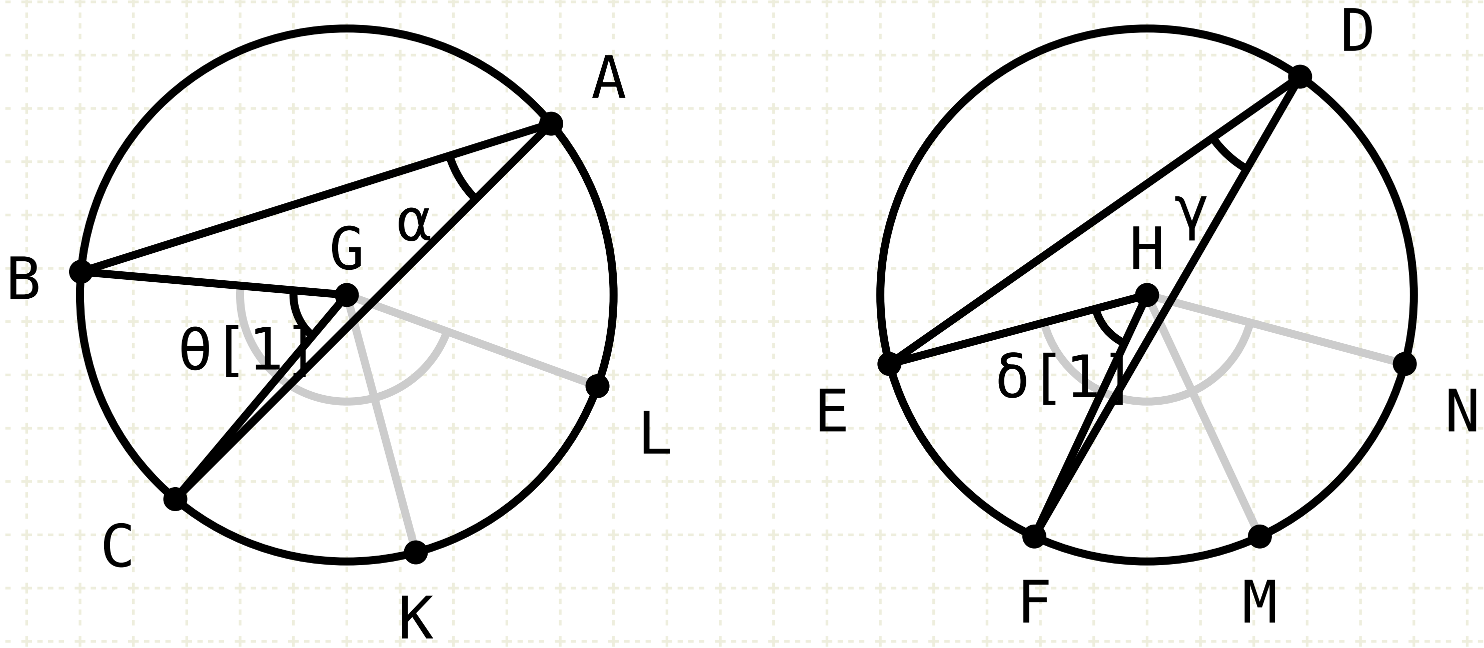

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$n \cdot BC \lessgtr m \cdot EF \rightarrow n \cdot \theta_1 \lessgtr m \cdot \delta_1$

$BC:EF = \theta_1:\delta_1$
$BC:EF = \alpha:\gamma$

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But BL,EN are equimultiples of BGC, EHF, so substitute them in the previous equation

Which in turn is the definition for equal ratios

And since BAC is half BGC, and EDF is half EHF, the ratio of BC,EF is also equal to the angles BAC,EHF

Youtube Videos

https://www.youtube.com/c/SandyBultena